

# SCAS

South Carolina Academy of Science



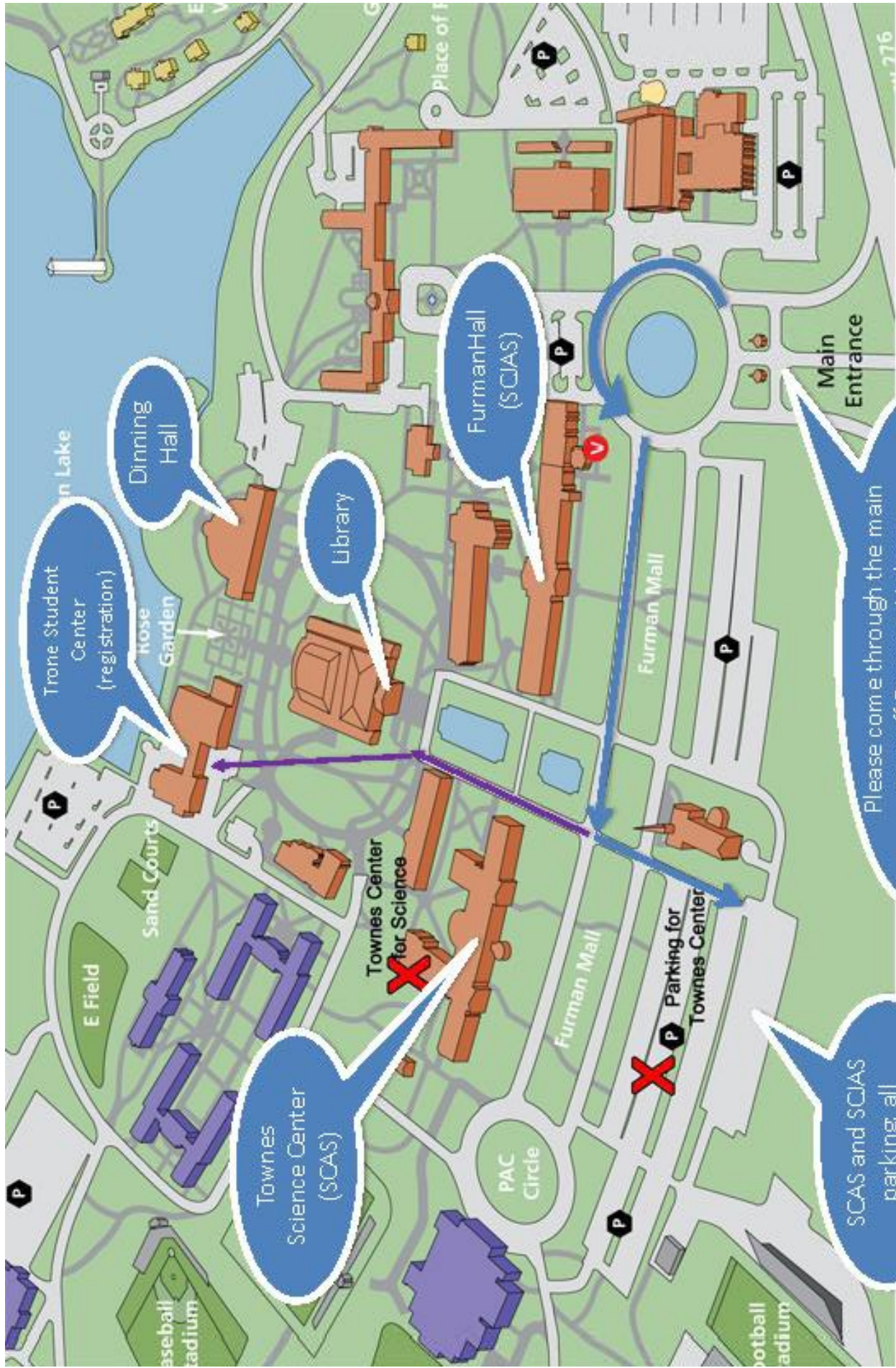
**BULLETIN**  
of the  
**South Carolina**  
**Academy of Science**  
Volume LXXXVIII  
2015

Including the Annual Meeting Program



FURMAN





Trone Student Center (registration)

Dining Hall

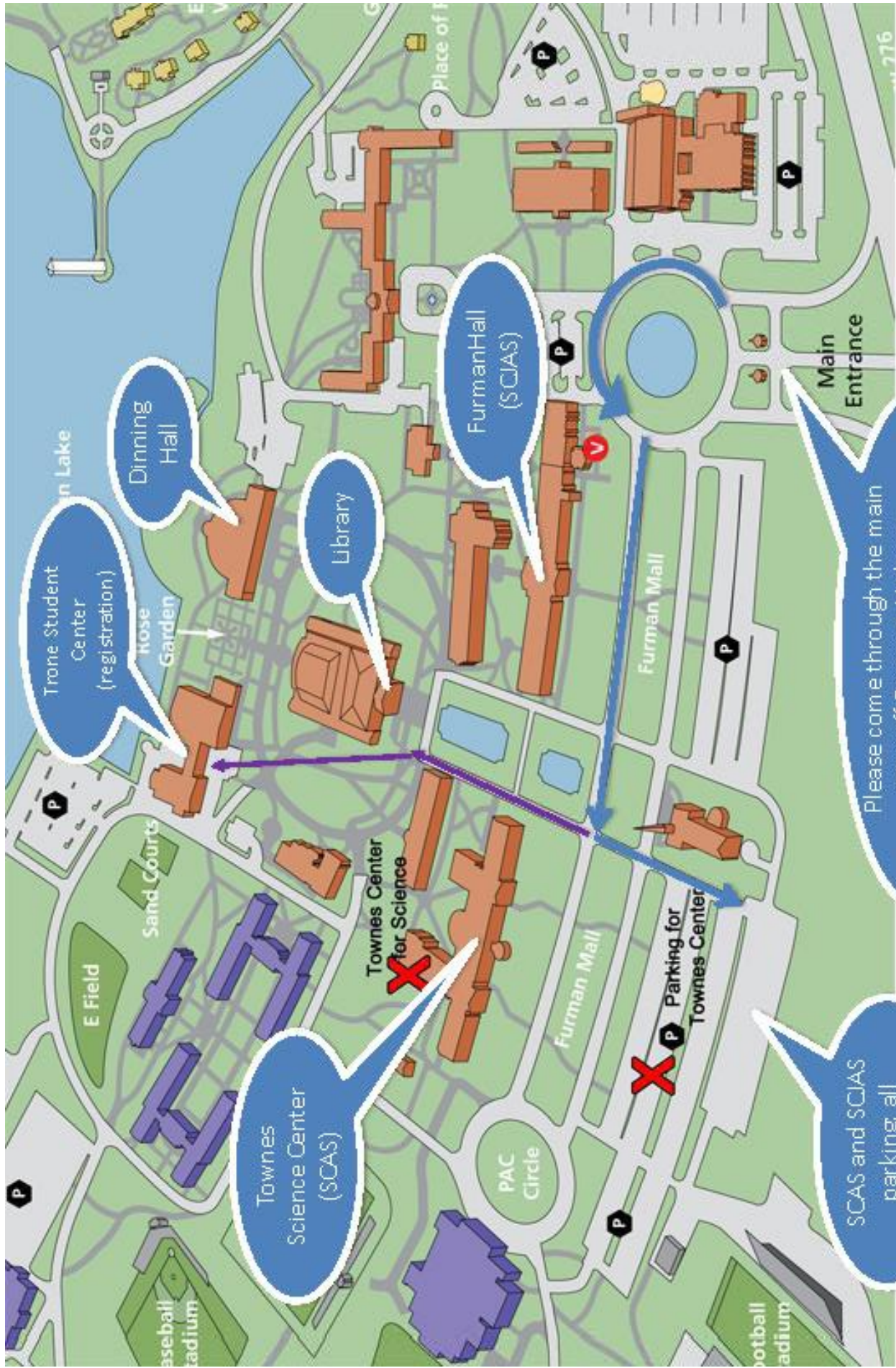
Library

Furman Hall (SCIAS)

Townes Science Center (SCAS)

SCAS and SCIAS parking: all buses and cars

Please come through the main gate off Poinsett Highway. There will be SCAS signs to guide you to the parking lot.



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## Welcome to the South Carolina Academy of Science 2015 Annual Meeting

Dear Students, Teachers, Scientists, and Colleagues,

Good morning and welcome to the South Carolina Academy of Science Annual Meeting. I am Dr. John Kaup, President-Elect of the South Carolina Academy of Sciences (SCAS). I am the Coordinator of Science Education here at Furman University. On behalf of the Academy it is my pleasure to welcome you to Furman University and I hope you will have the opportunity to spend sometime both on our campus as well as in downtown Greenville. For those of you who are new to the Academy, SCAS is a state-wide, interdisciplinary science organization established in 1924. Membership is open to anyone with an interest in science and includes students, faculty, administrators, and related professionals.



The Academy also sponsors the South Carolina Junior Academy of Science and in addition to my role with SCAS, I am also proud to serve as the Executive Director of the SC Junior Academy of Science (SCJAS). SCJAS provides an for HS students throughout the state to the excitement of the scientific community by giving them an opportunity to present original research. Our mission (SCAS and SCJAS combined) 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. Marek Urban from Clemson University. Dr Urban is a world renowned materials scientist and we look forward to learning about his most recent work in self-healing polymers.

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 Furman University and its faculty and students and especially for Dr. John Beckford'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. Thanks to our current and past presidents (Dr Laurie Fladd and Dr. Pearl Fernandez) for guiding me throughout the past year. For Dr. Bill Pirkle and Dr. James Privett for their outstanding service as judging

coordinators for the SCAS and SCJAS respectively. Dr. David Ferris for his annual delivery of an outstanding program and Dr. Edna Steele for her countless hours serving as Treasurer for the SCAS and SCJAS (and keeping us in line with our budgets).

A very special thank you to all of the students, their teachers, mentors, parents, scientists, and volunteers who have worked so hard to bring us their outstanding work today. I wish you an outstanding 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.

Enjoy your day,

*John G. Kaup*

John G. Kaup, PhD

President–Elect; South Carolina Academy of Science

Executive Director; South Carolina Junior Academy of science

**88<sup>th</sup> Annual Meeting of the South Carolina Academy of Science**  
**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>Trone Student Center</b>
<b>8:30 AM – 11:30 AM</b>	<b>SCAS Oral Sessions</b>	<b>Townes Science Center</b>
Cellular Biology		Room 026 (Basement of Townes)
Field Biology (before break)		Room 028 (Basement of Townes)
Earth Science (after break)		Room 028 (Basement of Townes)
Molecular Biology		Room 030 (Basement of Townes)
Medicine/Pharmacology/Health		Room 031 (Basement of Townes)
Chemistry / Biochemistry		Room 231 (2nd Floor of Townes)
Math / Computer Science / Physics / Astronomy		Room 222 (2nd Floor of Townes)
<b>10:30 AM – 12:30 PM</b>	<b>Poster Session (with SCBASM)</b>	<b>Townes Science Center</b>
	You can put your poster up anytime between 8 a.m. and 10 a.m. <i>(All posters must be on display by 10:00 a.m.)</i>	
<b>12:30 PM – 1:15 PM</b>	<b>Lunch</b> <i>Ticket is in your badge holder</i>	<b>Daniel Dining Hall</b>
<b>1:30 PM– 2:15 PM</b>	<b>Plenary Session</b>	<b>Burgiss Theatre; Trone Student Center</b>
<b>2:15 – 3:00</b>	<b>Governor’s Awards / Undergraduate Awards</b>	<b>Burgiss Theatre; Trone Student Center</b>

## Plenary Session

# Science of Self-Healing Materials; How Can Polymers Recover from Mechanical ‘Injuries’?

**Marek W. Urban**

*Department of Materials Science and Engineering  
and*

*Center for Optical Materials Science and Engineering (COMSET)  
Clemson University,*

Over the last decade, significant advances in chemistry of stimuli-responsive materials in general, and self-healing polymers in particular, have shown that materials can be self-repaired by chemical modifications. A wide range of monomers and synthetic approaches has been used to construct self-healing polymers that are capable of recover from damages. It turns out that localized events resulting in nano-, micro- and macrometer scale repairs are responsible for the formation of covalent and/or non-covalent bonds, including hydrogen bonding, metal–ligand coordination and ionic interactions. Perhaps one of the most attractive features of self-healing is achieved by light exposure that causes color changes in damaged area. Inspired by Nature, this presentation will focus on strategies developed by the Urban Research Group at Clemson University ([www.clemson.edu/ces/urbanresearch/](http://www.clemson.edu/ces/urbanresearch/)) to design and synthesize materials that can utilize Sun exposure as well as carbon dioxide and water to repair mechanical damage. Proper chemical design of polymer networks will lead to self-repair of damages upon exposure to carbon dioxide and water. (*Science*, 2009, 323(5920), 1458-1460; *Angew. Chemie Intern. Edition*, 2014, 53(45), 12142-12147)

### **Biography - Dr. Marek W. Urban**

Dr. Marek W. Urban is the Sirrine Foundation Endowed Chair and Professor of Materials Science and Engineering at Clemson University. He received MS in Chemistry from Marquette University, PhD in Chemistry and Chemical Engineering Department from Michigan Technological University, and postdoctoral training from Case Western Reserve University. Prior to joining Clemson University in 2013, he was a faculty member at NDSU and USM, where he directed the Materials Research Science and Engineering (MRSEC) as well as Industry/University Cooperative Research (I/U CRC) Centers funded by the National Science Foundation. He is an invited speaker of numerous national and international conferences, published over 300 publications, is the author three books, several patents, and edited seven American Chemical Society Advances in Chemistry Series books as well as Wiley Handbook on Stimuli-Responsive Materials. His research on antimicrobial polymers and self-repairing materials has been featured by numerous media, including New York Times, Forbes Magazine, BBC, NBC, Discovery Channel, USA Today, Yahoo, many TV and radio stations around the World. Current research interests include understanding physico-chemical processes governing responsiveness in materials, development of novel polymeric nanomaterials with living-like functions, and the design of self-repairing synthetic materials for a variety of applications.



The South Carolina Academy of Science gratefully recognizes the contribution of  
**MeadWestvaco**, and the **South Carolina Research Authority**  
for their support of the  
**Governor's Awards for Excellence in Science**  
1985-1988 Drug Science Foundation Award for Excellence in Science  
1989-Present Governor's 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, **MeadWestvaco** and the **South Carolina Research Authority** join 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.



## **2015 Governor's Award for Excellence in Scientific Research**

is awarded to

### **Dr. Asif Khan**

### **Carolina Distinguished Professor of Electrical Engineering and Founder/Director of the Photonics & Microelectronics Laboratory, University of South Carolina**

Dr. Asif Khan, Carolina Distinguished Professor and Founder/Director of the Photonics & Microelectronics Laboratory at USC, is author or co-author of more than 350 refereed publications, over 200 conference presentations, and has attracted research and development grants and contracts for an average funding level of over \$4 Million per year. Dr. Khan's pioneered the development of Gallium Nitride (GaN) Light-Emitting Diodes (LEDs) and Power Electronics Devices which are now used in every new traffic light, TV, or scoreboard across the globe. Dr. Khan's laboratory produced spinoff companies such as Sensor Electronic Technology, Inc. and Nitek Inc., which together employ over 120 people in Columbia, SC.

Dr. Khan's group was the first to demonstrate AlGaNbased deep ultraviolet light emitting diodes. His work in this area led to major research activity around the globe, and to new commercially available products. The deep UV LEDs can potentially revolutionize air/water purification, germicidal, power curing and bio-medical instrumentation applications. Solid-state deep uv lighting based on Dr. Khan's pioneered DUV LEDs has been forecasted to be a billion dollar market. The entire GaN power electronics industry is founded on Prof. Khan's pioneering research. Research activities following from this work currently involve many thousand researchers around the globe with major national research programs in US, Europe, Korea, Japan, Singapore and China.

## **2015 Governor's Award for Excellence in Scientific Awareness**

is awarded to

### **Dr. Perry Halushka**

### **Distinguished University Professor and Dean Emeritus, Medical University of South Carolina**

Dr. Halushka joined the Medical University of South Carolina faculty as an Assistant Professor of Pharmacology and Medicine in 1974, ultimately rising to the rank of full Professor and then Distinguished University Professor. The hallmarks of his career are outstanding research and a passion for mentoring and teaching. Throughout his career, he has always demonstrated a strong desire to act as an ambassador for the STEM disciplines by promoting an awareness of the excitement of discovery and research.

Dr. Halushka became Dean of the College of Graduate Studies in July, 2000. As Dean, he transformed the College of Graduate Studies, creating a common application and entry pathway into the graduate degree programs. This approach included an entirely new unified core curriculum for first-year students as well as courses in professional development, diversity awareness, grant-writing and new research training opportunities. As Dean, he created a series of programs to enrich the opportunities for students ranging from middle school through graduate school to gain awareness of the possible career paths available to them in the biomedical sciences. He helped start and foster with the graduate students the extraordinarily successful Graduate Students Reaching Out With Science (GROWS) program. The students created a series of modules representing major areas of science and used these in middle schools in the Charleston area to conduct science demonstrations for the students.

For 27 years, Dr. Halushka has also directed the Medical Scientist Training Program at MUSC. Of particular note, in a national survey conducted in 2013, the Medical Scientist Training Program ranked third per capita in the nation in the number of highly competitive NIH National Research Service Award fellowships.

**2015 Governor's Young Scientist Award for Excellence in  
Scientific Research**

(Dual Award)

is awarded to

**Dr. Matthew Carpenter**

**Department of Psychiatry and Behavioral Sciences and Hollings  
Cancer Center, Medical University of South Carolina**

Dr. Carpenter received his Ph.D. in Clinical Psychology from the University of Vermont in 2002, and relocated to Charleston for internship and postdoctoral training. He joined the MUSC faculty in 2006 and is currently an Associate Professor with a primary appointment within the Department of Psychiatry and Behavioral Sciences and a secondary appointment in the Department of Public Health Sciences. His principal affiliation is with the Hollings Cancer Center, Cancer Control Program.

His primary research interests relate to tobacco use across a broad methodological continuum: from lab-based studies of craving and nicotine dependence, to clinical trials for smoking cessation, to public health policy for effective tobacco control. He is principally funded through NIH, and is the prior/current recipient of a Career Development Award (K23) and three R01s (NCI & NIDA), and a R21, all as Principal Investigator. He serves as co-investigator or consultant on numerous other grants, all tobacco related. His research and expertise has been cited by local, state and national media.

He is credited with over 75 peer-reviewed publications, and has reviewed manuscripts for many journals, as well the 2008 Public Health Service Guidelines for Treating Tobacco Use and Dependence (published by the US Public Health Service). He serves on the editorial board of both CNS Drugs and the Journal of Behavioral Medicine.

As a Board Member of the Smokefree Lowcountry Coalition, he frequently advises on local and state efforts to promote smokefree ordinances. Dr. Carpenter is a frequent guest lecturer on smoking cessation to medical and dental students, as well to community groups, and provides practice implications from the current evidence base. Dr. Carpenter is a previous recipient of a New Investigator Award from the Society for Research on Nicotine and Tobacco.

**2015 Governor's Young Scientist Award for Excellence in  
Scientific Research**

(Dual Award)

is awarded to

**Dr. Brenda Garcia-Diaz  
Savannah River National Laboratory Aiken, South Carolina**

Dr. Garcia-Diaz received her Ph.D. in Chemical Engineering from the University of South Carolina in 2007. Subsequently, she joined the staff of the Savannah River National Laboratory (SRNL) as Senior Scientist in Materials Performance and Corrosion.

At SRNL, Dr. Garcia-Diaz successfully developed methods for the electrochemical synthesis of hydrogen storage materials for fuel cells. In addition, she conducted corrosion investigations to increase the safety envelope of the high level waste tanks at the Savannah River Site and developed an electrochemical fluorination method for processing spent nuclear fuel that greatly reduces the volume of the waste to be disposed. In 2012 she was named Principal Investigator for the U.S. Department of Energy's SunShot Initiative and currently leads a team of scientists and engineers from SRNL, University of South Carolina, and University of Alabama in this \$4M collaborative national effort that seeks to lower the cost of solar power to be cost-competitive with other energy sources by 2020.

Her work has led to 3 patents that are pending and 2 invention disclosures. She has published 10 articles in major scientific venues since 2007. She has received the SRNL Special Recognition Award 3 times, currently serves on the Industrial Research Advisory Board for the Chemical Engineering Department of the University of South Carolina, and is a member of the 2013 Leadership Energy Carolinas Class of 2013.

**2015 Governor's Award for Excellence in Scientific Research at  
a Predominately Undergraduate Institution**

is awarded to

**Dr. John Wheeler**

**Professor of Chemistry and Director, Office of Integrative  
Research in the Sciences, Furman University**

Over his 23 years at Furman University, John Wheeler has developed a research program that applies analytical techniques to a diverse group of chemical problems. Through this work, he has served as research mentor for over 160 undergraduate students resulting in more than 25 student co-authored peer reviewed publications and over 150 student presentations.

Since 2008, John has served as Director of the Office of Integrative Research in the Sciences (OIRS). Under his leadership, OIRS has been instrumental in acquiring nearly \$7M in funding through multiple NSF, NIH and HHMI awards. Wheeler's innovative management has helped strengthen the research programs of faculty across the sciences, supported the purchase of new instrumentation and provided research opportunities for Furman students as well as underserved college and high school students from around the State.

## 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 named in memory of the late Dr. Dwight Camper, Professor Emeritus in Plant Physiology at Clemson University. Dr. Camper was very active in the Academy serving in various capacities. He taught many graduate level plant physiology courses as well as a popular undergraduate class called Plant Medicine, Magic and Murder. This was the first exposure most students had to Plant Medicine and led many 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. His encouragement and can-do attitude enabled his students to become successful researchers. Dr. Camper felt deeply that research findings should be enthusiastically shared with others and encouraged his students to participate in the South Carolina Academy of Sciences as an avenue to share their discoveries. 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.

IN MEMORIAM  
**DR. WADE BATSON**  
1912 - 2015

Dr. Wade Batson passed away on February 14, 2015. Dr. Batson was a former South Carolina Academy of Science President, USC faculty member, and department head, member of the SC Hall of Science and Technology, and beloved biology professor and mentor to hundreds of practicing scientists and teachers.

Dr. Batson was the son of the late William Thomas and Mary Lenora Hendricks Batson of Marietta. He was educated at Mars Hill College, the University of Tennessee, and Furman University. Dr. Batson entered the U.S. Navy during World War II.

In 1948 he entered Duke University, receiving a M.S. and Ph.D. degrees in Botany. Dr. Batson taught botany and other biology courses at the University of South Carolina for thirty years and he was Chairman of the Biology Department from 1958-1959. He authored twelve books featuring flowering plant taxonomy to include *Wildflowers in South Carolina*, *Genera of Southeastern Plants*, *Genera of the Eastern Plants*, *Genera of the Western Plants*, *Landscape Plants for the Southeast*, and *Wildflowers in the Carolinas* and he wrote over forty articles in popular magazines and scientific journals.

Dr. Batson, known by his students as “Dr. B.,” received many awards and honors during his lifetime: 1966, voted one of three Outstanding Professors by University of South Carolina students; 1968, Meritorious Teaching Award by the Association of Southeastern Biologists; 1968, Michael J. Mungo Distinguished Professor of the Year Award; 1976, Education Conservationist of the Year by South Carolina Wildlife Federation; 1982, Order of the Palmetto Award presented by Governor Richard Riley who hosted his Retirement Party at the Governor's Mansion; 1994, Inducted into the South Carolina Hall of Fame; 1995, inducted into the South Carolina Hall of Science and Technology; 1995, Honorary Doctor of Science Award by the Medical University of South Carolina; 2004 Honorary Life Member of the University of South Carolina Alumni Association; 2011 Legends of Conservation Award by the South Carolina Wildlife Federation. Three endowments have been made in his honor at the University of South Carolina: 2000, The Wade T. Batson Professorship Endowment; 2000, W.T.B. Fellowship in Botany Endowment; and the W.T.B. Endowment for the A. C. Moore Herbarium.

At the celebration of his 100th birthday, Senator Mike Fair presented a Resolution from the South Carolina General Assembly to honor the distinguished career of this great South Carolinian. Furman University established a wildflower garden on the Swamp Rabbit Trail in his honor. The South Carolina Department of Parks, Recreation and Tourism presented him the State Park Award, one of three ever presented.

Dr. Batson is survived by his daughter, Marietta Lenora Moore, his son, Wade Thomas Batson, III, nine grandchildren and eleven great grandchildren.

*Excerpted from information prepared by John M. Herr, Jr. Department of Biological Sciences, University of South Carolina with additional information from South Carolina General Assembly resolution 2011-2012 Bill 1507; May 3, 2012.*



IN MEMORIAM  
**MIKE FARMER**  
1941 - 2015

Dr. Michael Houston Farmer, former president of the South Carolina Academy of Science, passed away in a car accident on February 10, 2015. Mike was born to the late Houston Martin Farmer and Edith Ballenger Farmer on November 8, 1941. He graduated from Greer High School in 1960, received an Associate's Degree in Chemical Technology from Greenville Technical College in 1970, a B.S. in Chemistry from Clemson University in 1972, a Masters Degree in Science Education from Clemson University in 1974, and a Doctorate in Secondary Education from the University of South Carolina in 1993.



Dr. Farmer taught Chemistry, Physics, and Astronomy for over 40 years at Riverside High School, Greenville Technical College, and the SC Governor's School for the Arts & Humanities. During his career, Dr. Farmer served as the President of the Greenville County Science Teachers Association, President of the South Carolina Science Council, President of the South Carolina Academy of Science, and Chairman of the High School Division of the National Science Teachers Association. Dr. Farmer's accolades include Discover Magazine Teacher of the Year (1984), South Carolina's candidate for NASA's Teacher in Space Program (1985), Order of the Palmetto from Governor Richard Riley (1985), the Presidential Award for Excellence in Science and Math Teaching (1987), the National Science Teacher's Association's Gustav Ohaus Science Teaching Award (1990), and the Governor's Award for Science Awareness for South Carolina (1999). Dr. Farmer's writings are numerous, including his book *Science Projects: A Modular Approach*, and he was working on a book of science and math geared for young artists.

Dr. Farmer was a passionate advocate for science and education. Memorial gifts may be contributed to two separate funds: the Dr. Farmer Scholarship Fund for students of Riverside High School (please contact [dontalley@gmail.com](mailto:dontalley@gmail.com) for more info) and/or the Dr. Mike Farmer fund for students at the Governor's School for the Arts Foundation, P.O. Box 8458, Greenville, SC 29604.

IN MEMORIAM  
**PEGGY CAIN**  
1925 - 2015

Margaret “Peggy” Cain, PhD, age 89, passed away on January 02, 2015.

Dr. Cain was a former Director of the South Carolina Junior Academy of Science, a former SCAS Council member, and served in leadership roles of many professional organizations including the American Association of Physics Teachers, and as board member of the South Carolina Science Council.



Peggy was born on September 7, 1925 in South Bend, Indiana. She and her family moved many times due to her father’s employment at Studebaker. They moved to Florida, Brussels, Detroit and finally Los Angeles, California where she attended junior high school and high school. She met her late husband, Francis “Frank” Marion Cain, Jr. when her mother invited him and another WWII soldier into their home for Sunday dinner. After marriage, she lived at home with her mother while Frank was away fighting in WWII. She worked in the fabric department of one the largest department stores of that time.

She and Frank returned to South Carolina after the war, settling in Frank’s hometown of Sumter, SC. She graduated with a Bachelor of Science from the University of South Carolina in 1949. Peggy started her science teaching career in 1963 at Mayewood High School and taught there until June 1970. For the next 8 ½ years she taught science at Sumter High School. Peggy received her Master’s Degree in Education from Clemson University in 1970. She was selected to serve as the South Carolina State Science Consultant in 1979. During this time, she authored two textbooks and co-authored two others on science teaching. In 1988, while working at the State Department, she received her doctorate degree from the University of South Carolina. Peggy served as an adjutant professor of Geology for Clemson University where she developed the acclaimed multi-disciplined SC Maps and Aerial Photographic Systems (SC MAPS) curriculum for teaching middle school. Her other professional accomplishments include: Developing the Elementary Science Leadership Program; Coordinator for the Presidential Award for Excellence in Science Teaching; Chairing the Textbook Evaluation Committee; Coordinating with the Governor on Science Camp awards; and Organizing the SC Science Supervisors Association.

In 1977 Dr. Cain was selected as the Cryovac Award for the South Carolina Science Teacher of the Year. She received the Helms Citation of Excellence Award in 1988. In 1998 she received the Charles H. Townes Award by the Governor’s School for Science and Mathematics for her long-standing service to science education in South Carolina.

Memorials may be made in memory of Peggy to Trinity United Methodist Church, 226 W. Liberty St., Sumter, SC 29150 or Delta Kappa Gamma-Alpha Kappa Chapter Educational Scholarship, c/o Margaret Hutchins, 2315 Primrose Ct., Sumter, SC 29150.

## TOPICAL SESSIONS SCAS

Saturday, April 11<sup>th</sup> 2015

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

### BIOLOGY: CELLULAR

8:30AM - 10:15AM

#### Room 026 (Basement of Townes)

- 8:30AM INVESTIGATION OF AHR ANTAGONISTIC EFFECTS OF GANODERMA LUCIDUM  
Erica Williams, Furman University
- 8:45AM SOYBEAN ISOFLAVONE EFFECTS AGAINST CERVICAL CARCINOMA  
Kristen Hawkins, Michael Hart, Diana Ivankovic, and Donna Weinbrenner, Anderson University
- 9:00AM THE ANTI-PROLIFERATIVE EFFECTS OF LAMIUM AMPLEXICAULE EXTRACTS ON HUMAN T-LYMPHOCYTES  
Braxton Noll, Anderson University
- 9:15AM AN INVESTIGATION OF THE ANTI-PROLIFERATIVE EFFECTS OF ELLAGIC ACID ON HUMAN MESOTHELIOMA  
Devan Fisher, Diana Ivankovic, and Donna Weinbrenner, Anderson University
- 9:30AM EXPRESSION OF HEART-SPECIFIC CONSTRUCT IN CIONA INTESTINALIS EMBRYOS  
Katlyn Brumley, Winthrop University
- 9:45AM BRAIN-PENETRATING HISTONE DEACETYLASE INHIBITOR RG2833 REDUCES THE GROWTH AND VIABILITY OF MALIGNANT MELANOMA CELLS IN VITRO  
Lauren Green, Winthrop University
- 10:00AM IDENTIFICATION OF THE CIONA INTESTINALIS FOXO DNA BINDING DOMAIN AND TARGET GENE SEQUENCES  
Lucas Boncorddo, Winthrop University
- 10:15AM ENZYMATIC COMPLEMENTATION TO IMAGE CELL SURFACE MARKERS  
Michelle Sutton, Morris College

### BIOLOGY: FIELD

8:30AM - 9:00AM

#### Room 028 (Basement of Townes)

- 8:30AM A PRELIMINARY STUDY OF THE VASCULAR FLORA OF STRAWBERRY SWAMP, GEORGETOWN COUNTY, SOUTH CAROLINA  
Richard Stalter, St. Johns University
- 8:45AM THE EFFECT OF DIETARY PHYTOESTROGEN ON THE ESTROUS CYCLE OF WISTAR RATS  
Reshma Thomas, Converse College

- 9:00AM SURVEY RESULTS AND COMPARISON OF BREEDING HABITATS FOR THE PINE BARRENS TREEFROG AT CAROLINA SANDHILLS NATIONAL WILDLIFE REFUGE  
Gregory T. Joye, University of South Carolina Salkehatchie

### **BIOLOGY: MOLECULAR**

**8:30AM - 9:45AM**

**Townes Science Center, Room 030 (Basement of Townes)**

- 8:30 AM IDENTIFICATION OF CHROMIUM RESISTANCE GENES  
Jessica A. Fuller, Claflin University
- 8:45AM UNDERSTANDING THE RELATION BETWEEN VACUOLAR PROTEIN SORTING GENES AND AFLATOXIN EXPORT IN ASPERGILLUS PARASITICUS  
Shaquille Jackson, Morris College
- 9:00AM SIRNA-MEDIATED DOWNREGULATION OF AN ESSENTIAL HIV REGULATORY PROTEIN  
Emily M. Webb, University of South Carolina Aiken
- 9:15AM OPTIMIZING GERMINAL TRANSPOSITION OF MPING IN ARABIDOPSIS THALIANA  
Courtney Burckhalter, University of South Carolina Aiken
- 9:30AM PRECISE REPAIR OF MPING EXCISION SITES IS FACILITATED BY TARGET SITE DUPLICATION DERIVED MICROHOMOLOGY  
David Gilbert, University of South Carolina Aiken
- 9:45AM TARGETED INSERTION OF THE TRANSPOSABLE ELEMENT, MPING  
Ashley Strother And C. Nathan Hancock, University of South Carolina Aiken

### **CHEMISTRY / BIOCHEMISTRY**

**8:30AM - 11:00AM**

**Townes Science Center, Room 231 (2nd Floor of Townes)**

- 8:30AM SEPARATION AND MASS ANALYSIS OF POLYCATIONIC BIOCIDES IN MULTIPURPOSE CONTACT LENS SOLUTIONS UTILIZING ULTRA PERFORMANCE  
Frederic David, Furman University
- 8:45AM UTILIZING CHIRAL CAPILLARY ELECTROPHORESIS IN THE SEPARATION AND ANALYSIS OF NOVEL CR(III) COMPLEXES EXHIBITING DNA PHOTOCLEAVAGE  
Christopher Stachurski, Furman University
- 9:00AM ASSESSING CR(III) COMPLEXES AS POTENTIAL ANTICANCER AGENTS USING PCR, CAPILLARY GEL ELECTROPHORESIS AND GEL ELECTROPHORESIS  
Yasmín Álvarez García, Furman University
- 9:15AM REVERSIBLE THERMOCHROMISM IN POLYDIACETYLENES  
Garret Gotthelf, Clemson University
- 9:30AM DETERMINATION OF BISPHENOL S LEACHED FROM PLASTIC BOTTLES

Quentin Lane, University of South Carolina Lancaster

9:45AM BIOPHYSICAL PARAMETERS THAT DETERMINE RNA-METAL COMPLEX  
FORMATION

Lance Mcdanel, Coastal Carolina University

10:00AM ZINC IS THE MOLECULAR "SWITCH" THAT CONTROLS THE CATALYTIC CYCLE  
OF BACTERIAL LEUCYL-TRNA SYNTHETASE

Layla Baykal, Coastal Carolina University

10:15AM - BREAK

10:30AM AN EXPERIMENTAL STUDY OF THE FORENSIC LUMINOL TEST FOR DETECTION  
OF BLOODSTAINS

Katherine A. Witherspoon, University of South Carolina Columbia

10:45AM STRUCTURAL CHARACTERIZATION OF 1-DEOXY-D-XYLULOSE-5-PHOSPHATE  
REDUCTOISOMERASE FROM VIBRIO VULNIFICUS

Makenzie Perdue, University of South Carolina Columbia

11:00AM NMR BASED METABOLOMICS STUDY OF CHROMIUM(VI) TREATED  
PSEUDOMONAS FLUORESCENS

Yugaanathy Thanaiah, Claflin University

## **EARTH SCIENCES**

**10:30AM - 11:15AM**

**Townes Science Center, Room 028 (Basement of Townes)**

10:30AM DESIGN AND TESTING OF A RAINDROP VELOCIMETER

Derek Tuck, College of Charleston

10:45AM USING VOLUME FRACTION AS A STATISTICAL MEASURE OF THE RAINDROP  
SIZE DISTRIBUTION

Joshua B. Teves, College of Charleston

11:00AM ERRONEOUS DROP SIZING IN IMPACT DISDROMETERS

Kate O'dell, College of Charleston

11:15AM DIURNAL RHYTHMS OF NEAR SURFACE WINDS' POWER SPECTRUM

Alexis Payne, College of Charleston

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

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

**Townes Science Center, Room 222 (2nd Floor of Townes)**

- 8:30AM RELATIONSHIPS BETWEEN LOCATION OF BRAIN INJURY OR CONCUSSION AND RECUPERATION TIME IN NFL FOOTBALL PLAYERS  
Brianna Dyar, Brandon Johnson, David Prager and Diana Ivankovic, Anderson University
- 8:45AM MATHEMATICAL MIND: INSIDE ARTIFICIAL INTELLIGENCE  
Wesley Alexander, Morris College
- 9:00AM SYSTEMATIC SYNTHESIS OF CORE-SHELL-SHELL NANOPARTICLES WITH MINIMAL DISSOLUTION  
Yvonne Wright, Morris College
- 9:15AM SUM OF SQUARES OF LUCAS NUMBERS  
Kaige Lindberg, The Citadel
- 9:30AM AUGMENTED HAPPY FUNCTIONS OF HIGHER POWER  
Marcus Harbol, The Citadel
- 9:45AM EXPLORING RAINDROP ARRIVAL TIME CORRELATIONS VIA A DROP SIZE DEPENDENT PAIR CORRELATION FUNCTION  
Robert Lemasters, College of Charleston
- 10:00AM TOWARDS A LOW-DIMENSIONAL MODEL OF THE NEURAL NETWORK RESPONSIBLE FOR GAMMA SYNCHRONIZATION USING OPTOGENETICS  
Patrick Lynn, College of Charleston
- 10:15AM DIRECT IMAGING OF CONCENTRATION-INDUCED FLUCTUATIONS IN NANOCOLLOIDS  
Lincoln Fraley, College of Charleston

**MEDICINE / PHARMACOLOGY / HEALTH**

**8:30AM - 10:00AM**

**Townes Science Center, Room 031 (Basement of Townes)**

- 8:30AM THE BODY PROJECT 4 ALL: A COMPARISON OF A FEMALE-ONLY TO A CO-ED BODY IMAGE PROMOTION PROGRAM  
Amanda Hock, Furman University
- 8:45AM SOCIOECONOMIC INEQUALITY IN ACCESS TO QUALITY, AFFORDABLE, VARIED HEALTHY FOOD: A MULTIVARIATE APPROACH TO MEASURING FOOD DESERT  
Will McCabe, Furman University
- 9:00AM THE DOSE DEPENDENT EFFECTS OF CAFFEINE ON COGNITIVE PERFORMANCE AND NEURONAL ACTIVATION  
Helen Morris, University of South Carolina Aiken

- 9:15AM SYNERGISTIC EFFECT BETWEEN CAFFEINE AND SUGAR ON COGNITIVE PERFORMANCE  
Sandra Urquiza, University of South Carolina Aiken
- 9:30AM THE EFFECTS OF STRESS, SUGAR AND EXERCISE ON DEPRESSION AND HIPPOCAMPAL NEUROGENESIS IN RATS  
Austin Kaiser, University of South Carolina Aiken
- 9:45AM THE EFFECTS OF CHRONIC STRESS, EXERCISE AND SUGAR CONSUMPTION ON BODY WEIGHT AND FAT PERCENTAGE IN RATS  
Christina Thomas, University of South Carolina Aiken
- 10:00AM THE SEARCH FOR LYTIC BACTERIOPHAGES WITHIN THE POPULATION OF COASTAL CAROLINA UNIVERSITY STUDENTS  
Derek Pride, Coastal Carolina University

**POSTER SESSION with SCBASM**

**Townes Science Center**

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

Poster set up is between 8 a.m. and 10 a.m.

*(All posters must be on display by 10:00 a.m.)*

**BIOLOGY: CELLULAR**

- POSTER #1 ENHANCING THE DEVELOPMENTAL POTENTIAL OF MURINE ADIPOSE-DERIVED MESENCHYMAL STEM CELLS  
Kathryn Steverson, Winthrop University
- POSTER #2 USING A SUITE OF ANTIBODIES TO EXAMINE THE HOST-PARASITE RELATIONSHIPS IN HEAD KIDNEYS OF FUNDULUS HETEROCLITUS FROM NORTH INLET ESTUARY (HOBCAW BARONY) IN GEORGETOWN, SOUTH CAROLINA  
Caitlin Brickley, Columbia College
- POSTER #3 DETERMINING THE PRESENCE OF THE ARYL HYDROCARBON RECEPTOR (AHR) IN FUNDULUS HETEROCLITUS LIVER TISSUES FROM THE BELLE BARUCH MARINE SANCTUARY A HOBCAW BARONY (GEORGETOWN, SOUTH CAROLINA)  
Jasmin Jones, Columbia College
- POSTER #4 USING MAB M24-2 (A FISH LYSOZYME) TO EXAMINE THE HOST-PARASITE RELATIONSHIPS IN LIVERS OF THE FISH FUNDULUS HETEROCLITUS FROM NORTH INLET ESTUARY (HOBCAW BARONY) IN GEORGETOWN, SOUTH CAROLINA  
Lillian Neal, Columbia College
- POSTER #5 PROBING THE ENTRYWAY FOR INFECTION: AN EXAMINATION OF THE GI TRACTS OF FUNDULUS HETEROCLITUS FOR IMMUNE RESPONSES TO METACESTODE  
Mara Reiss, Columbia College
- POSTER #6 ROS-MEDIATED NEURODEGENERATION IS INDEPENDENT OF THE RYANODINE RECEPTOR IN CAENORHABDITIS ELEGANS  
Lyndsay Young, Coastal Carolina University
- POSTER #7 CLONING AND EXPRESSION OF THE DNA BINDING DOMAIN OF FOXO FROM CIONA INTESTINALIS THAT CONTAINS AN N-TERMINAL NUCLEAR LOCALIZATION SIGNAL  
Mikala Smith, Winthrop University
- POSTER #8 EFFECTS OF GANDODERMA LUCIDUM EXTRACTS ON THE VIABILITY OF CANCEROUS VS. NON-CANCEROUS BREAST CANCER CELL LINES  
Brooke Harrison, Converse College
- POSTER #9 RESISTANCE AND REDUCTION POTENTIAL OF SERRATIA MARCESCENS IN HEXAVALENT CHROMIUM  
Ijeoma Ekpenuma, Claflin University



### **BIOLOGY: FIELD**

- POSTER #10 HEAVY METAL CONCENTRATION IN DONAX CLAMS FOUND IN MYRTLE BEACH ANALYZED USING ATOMIC ABSORPTION  
Harley Coates and Larissa Martin, Coastal Carolina University
- POSTER #11 MONITORING ACTIVITY PATTERNS OF THE AMERICAN CROW (CORVUS BRACHYRHYNCHOS) POPULATIONS ON THE CAMPUS  
Morgan Soulantikas, Francis Marion University
- POSTER #12 SPECIFICITY OF KLEPTOPLASTY IN SOUTH CAROLINA MARSH FORAMINIFERA  
Cobi Guilbeau, Coastal Carolina University
- POSTER #13 ACOUSTIC MONITORING OF BAT POPULATIONS IN FLORENCE, SC  
Ebony Brown, Francis Marion University
- POSTER #14 CR 6+ RESISTANCE OF BACTERIAL WASTEWATER ISOLATES  
Shatresa Bradley, Claflin University

### **BIOLOGY: MOLECULAR**

- POSTER #15 GENETIC MAPPING OF ARABIDOPSIS MUTANTS INVOLVED IN TRANSLATIONAL REGULATION OF MIRNAS  
Amber Bailey and Ingrid Bonilla, Charleston Southern University
- POSTER #16 OPTIMIZING IN VITRO FERTILIZATION PROCEDURES IN ZEBRAFISH  
Madelyn Wasden, University of South Carolina Aiken
- POSTER #17 USING THE CRISPR/CAS9 SYSTEM TO UNDERSTAND THE FUNCTION OF THE PHF21A COMPLEX IN DANIO RERIO CRANIOFACIAL DEVELOPMENT  
Khadijah Jihad, University of South Carolina Aiken
- POSTER #18 OPTIMIZATION OF THE RETROVIRAL VECTOR, PLGN, FOR DELIVERY OF ANTI-TAT SIRNAS FOR INHIBITION OF HIV REPLICATION  
Jennifer Deily, University of South Carolina Aiken
- POSTER #19 DEVELOPING MPING-BASED ACTIVATION TAGS  
Tiana Chandler, University of South Carolina Aiken
- POSTER #20 BUILDING CONSTRUCTS FOR CATHEPSIN K-MEDIATED EXPRESSION OF EGFP OR MCHERRY TO STUDY BONE RESORPTION IN THE DEVELOPING ZEBRAFISH  
Brianna Snelling ,University of South Carolina Aiken
- POSTER #21 EVALUATING MPING TRANSPOSITION IN MIMULUS LEWISII  
Autumn Busbee, University of South Carolina Aiken
- POSTER #22 DEVELOPING A DNA TRANSPOSON-BASED VECTOR TO EXPRESS ANTI-HIV GENES  
Brittney Adams, University of South Carolina Aiken

- POSTER #23 DEVELOPING A FUSION GENE UNDER THE CONTROL OF AN HIV-1 LTR PROMOTER  
Erin M. McLaughlin and Natalie M. Arthur, University of South Carolina Aiken
- POSTER #24 IDENTIFYING SEQUENCES RESPONSIBLE FOR THE HIGH TRANSPOSITION RATE OF A TOURIST MITE  
Daymond Parrilla, University of South Carolina Aiken
- POSTER #25 IDENTIFYING THE GENE UNDERLYING A JAW MUTATION IN ZEBRAFISH  
Kayce Vanpelt, University of South Carolina Aiken

### **CHEMISTRY / BIOCHEMISTRY**

- POSTER #26 MASS SPECTROMETRY ANALYSIS OF THE ANTIOXIDANT ACTIVITY OF SULFUR AND SELENIUM COMPOUNDS  
Emily Kurfman, Furman University
- POSTER #27 CHARACTERIZATION AND UPTAKE STUDIES FOR THE BIOCIDES POLYHEXAMETHYLENE BIGUANIDE AND ALEXIDINE WITH EMPHASIS ON CONTACT LENS SOLUTIONS  
Hazel Davis, Furman University
- POSTER #28 SURFACE MODIFICATION VIA DIACETYLENE ALCOHOL SAM FORMATION  
Maria S. Gonzalez, Furman University
- POSTER #29 CHARACTERIZATION OF IMMOBILIZED RUTHENIUM(II) EMITTERS  
intercalated diacetylene self-assembled layers  
NATHAN RIVERS, FURMAN UNIVERSITY
- POSTER #30 BIOPHYSICAL PARAMETERS THAT DETERMINE RNA-METAL COMPLEX FORMATION  
Mariah Harden, Coastal Carolina University
- POSTER #31 DETERMINATION OF BPA IN ENVIRONMENTAL SAMPLES  
Adrian Coates, Columbia College
- POSTER #32 APPLICATION OF THE VIBRATIONAL SPECTROSCOPY FOR MONITORING THE ENZYMATIC HYDROLYSIS OF SOY HULL  
Rashshana Blackwood, Claflin University
- POSTER #33 IMMOBILIZATION OF POLYDIACETYLENE SENSORS ONTO CELLULOSE  
Sara J. Garbowski and Salley A. Reamer, Clemson University

### **MATH/PHYSICS/ASTRONOMY**

- POSTER #34 A NEW HYBRID METHOD FOR SOLVING OSCILLATORY INITIAL VALUE PROBLEMS  
Jenny Beebe, USC Salkehatchie
- POSTER #35 PHASE RESETTING OF NEURAL OSCILLATORS SUBJECT TO MULTIPLE INPUTS  
Kelsey Vollmer, College of Charleston
- POSTER #36 A PHOTOMETRIC STUDY OF AH HERCULIS  
Christopher Sherman, Furman University
- POSTER #37 INVESTIGATING DARK MATTER COMPOSITION THROUGH DECAYS INTO FLAVOR CONSERVING TAU PAIRS  
William Hester, College of Charleston
- POSTER #38 SEARCHING FOR EMISSION EPISODE SELF CONSISTENCY IN GAMMA-RAY BURST LIGHT CURVES  
Thomas Cannon, College of Charleston
- POSTER #39 CONFORMATIONAL ISOMERIZATION AND CHEMICAL REACTIVITY INDICES OF BUT-2-ENEDIOLIC ACID: -A COMPUTATIONAL STUDY  
Britney Stewart and Dr. Johnson Agbo, Coastal Carolina University
- POSTER #40 CHARACTERIZING A NEW METHOD OF HARVESTING ENERGY FROM THE NATURAL ENVIRONMENT AND EXPLORING THE PHYSICS OF THE TRIBOELECTRIC EFFECT  
Ryan Michael Sullivan and Dr. Alem Abraha Teklu, College of Charleston

### **EARTH SCIENCES**

- POSTER #41 SUSTAINING THE SOUTH: THE MOVEMENT OF URBAN CENTERS TOWARDS SUSTAINABLE DEVELOPMENT  
W. Hayden Couvillion, Furman University

### **MEDICINE/PHARMACOLOGY/HEALTH**

- POSTER #42 THE SEARCH FOR LYTIC BACTERIOPHAGES WITHIN THE POPULATION OF COASTAL CAROLINA UNIVERSITY STUDENTS  
Amy Powers, Coastal Carolina University
- POSTER #43 INHIBITORY EFFECT OF PARTIAL DECOUPLING AGENTS AS AN ALTERNATIVE THERAPY FOR CANCER  
Kareem Heslop, Claflin University
- POSTER #44 SOUTH CAROLINA PLEISTOCENE TERRESTRIAL VERTEBRATE DIVERSITY  
Adam Kirtley, Dakota Pruitt, and Joseph Shillinglaw, Charleston Southern University

## SCAS ABSTRACTS

(Listed alphabetically by presenter's last name)

### DEVELOPING A DNA TRANSPOSON-BASED VECTOR TO EXPRESS ANTI-HIV GENES

Brittney Adams and William Jackson, PhD  
University of South Carolina Aiken

Human immunodeficiency virus (HIV) is a retrovirus that infects CD4+ T lymphocytes, and progressively degrades the immune system. Thus far, there are antiviral drugs being used to reduce viral replication; however, there are no treatments that are curative. Gene therapy studies are being conducted as a new possible treatment for HIV. Most of these studies use retroviral vectors to deliver anti-HIV reagents, but the combination of a transposon-based vector with anti-HIV reagents could provide a long-term transgene expression without compromising biosafety. The HIV genome expresses nine proteins, one of the regulatory proteins, Tat (trans-activator of transcription) is responsible for up regulation of viral transcription and is therefore vital for replication. In this project, Tat will be targeted for degradation using RNA interference. Transposons, or transposable elements, are DNA sequences that can change position within a genome via a transposase. For this project, Sleeping Beauty (SB) was selected as a DNA based-transposable system to deliver anti-HIV small-interfering RNAs (siRNAs). The SB transposon has been modified to express two selectable markers, neomycin phosphotransferase and enhanced Green Fluorescent protein from an internal CMV promoter. In addition, a siRNA targeted to HIV Tat at nucleotides 5892-5991 of the HIV-1LN4-3 subtype (Accession #M19921) was cloned under the control of the RNA Polymerase III H1 promoter. Currently a control siRNA plasmid is being designed and cloned. This design will allow for co-transfection of cells to measure the potential inhibition of HIV replication by using a DNA based vector containing a siRNA.

### MATHEMATICAL MIND: INSIDE ARTIFICIAL INTELLIGENCE

Wesley Alexander  
Morris College

This summer we have been working on coding a NAO robot in 'Python' to perform three different autonomous tasks: design of winning strategies to games, design on human-like behavior motion planning for obstacle avoidance, and vision recognition applied to music sheets to identify and play songs. These three tasks are a clear exponent on how basic mathematics helps achieve very complex feats in artificial intelligence. The design of strategies to win at games is done by generalizing root-finding techniques in Calculus. The analysis of the different strategies is performed with techniques of statistics. Motion planning is carried within the field of computational geometry, while the design of smooth paths is merely an application of interpolation. Finally, the project related to vision recognition is done under the scope of image processing and analysis, which is in a set of basic application of multivariate Calculus. This resulted in a game winning, music reading, and obstacle-avoiding body of artificial intelligence. The main focus of this research is the process of designing those strategies so that the NAO robot could efficiently beat its opponents.

### GENETIC MAPPING OF ARABIDOPSIS MUTANTS INVOLVED IN TRANSLATIONAL REGULATION OF MIRNAS

Amber Bailey, Ingrid Bonilla, and Charlotte Song  
Charleston Southern University

MicroRNAs (miRNAs) have been a fairly recent discovery in the scientific world. These small RNAs have been found to be important as post-transcriptional regulators of gene expression. Through either cleavage or translational repression, miRNAs regulate specific genes. In plants, these miRNAs play important roles in development, stress response, and protein degradation, to name a few. To test whether these miRNAs can act through translational regulation, we have engineered artificial miRNAs to Chalcone synthase (CHS) that act through translational repression in the plant *Arabidopsis thaliana*. Through the creation of loops, we can prevent cleavage and shift to translational regulation. We performed EMS mutagenesis and screened these mutants for suppression. These identified mutants will be further mapped and characterized.

### ZINC IS THE MOLECULAR "SWITCH" THAT CONTROLS THE CATALYTIC CYCLE OF BACTERIAL LEUCYL-TRNA SYNTHETASE

Layla Baykal and Dr. Rachel Whitaker  
Coastal Carolina University

The *Escherichia coli* (*E. coli*) leucyl-tRNA synthetase (LeuRS) enzyme is part of the aminoacyl-tRNA synthetase (aaRS) family. LeuRS is an essential enzyme that relies on specialized domains to facilitate the aminoacylation reaction. Herein, we have biochemically characterized a specialized zinc-binding domain (ZN-1). We demonstrate that the ZN-1 domain plays a central role in the catalytic cycle of *E. coli* LeuRS. The ZN-1 domain, when associated with Zn<sup>2+</sup>, assumes a rigid architecture that is stabilized by thiol groups from the residues C159, C176 and C179. When LeuRS is in the aminoacylation complex, these cysteine residues form an equilateral planar triangular configuration with Zn<sup>2+</sup>, but when LeuRS transitions to the editing conformation, this geometric configuration breaks down. By generating a homology model of LeuRS while in the editing conformation, we conclude that structural changes within the ZN-1 domain play a central role in LeuRS's catalytic

cycle. Additionally, we have biochemically shown that C159, C176 and C179 coordinate Zn<sup>2+</sup> and that this interaction is essential for leucylation to occur, but is not essential for deacylation. Furthermore, calculated K<sub>d</sub> values indicate that the wild-type enzyme binds Zn<sup>2+</sup> to a greater extent than any of the mutant LeuRSs. Lastly, we have shown through secondary structural analysis of our LeuRS enzymes that Zn<sup>2+</sup> is an architectural cornerstone of the ZN-1 domain and that without its geometric coordination the domain collapses. We believe that future research on the ZN-1 domain may reveal a possible Zn<sup>2+</sup> dependent translocation mechanism for charged tRNA<sup>Leu</sup>.

#### A NEW HYBRID METHOD FOR SOLVING OSCILLATORY INITIAL VALUE PROBLEMS.

Jenny Beebe and Dr. Fidele Ngwane  
USC Salkehatchie

A continuous hybrid method using trigonometric basis with an off-stop point is developed and used to construct a new method by using collocation and interpolation techniques. The new method is implemented in block form. Numerical examples are presented and the efficiency and accuracy of the new method are discussed.

#### APPLICATION OF THE VIBRATIONAL SPECTROSCOPY FOR MONITORING THE ENZYMATIC HYDROLYSIS OF SOY HULL.

Rashshana Blackwood and Dr. Uruthira Kalapathy  
Clafin University

Soy hull is a biodegradable waste that can be used to produce glucose which can be fermented to produce ethanol. An enzymatic treatment with suitable pre-treatments to disrupt the structure of the soy hull is examined. Raman spectroscopy was used to monitor the glucose production by enzymatic hydrolysis of the soy hull. Glucose, fructose and sucrose show very similar Raman spectra with characteristic vibration between 1000- 1200 cm<sup>-1</sup>. Raman spectral data showed significant changes in peak intensities for concentrations between 0.2 M and 2M of fructose and sucrose solutions. In the case of glucose, changes in peak intensities did not reflect the changes in concentrations, probability due to intermolecular interaction and hydrogen bonding that may play a significant role in the vibrational spectra of glucose. However, Raman spectral data clearly showed the progress of the enzymatic hydrolysis of soy hull. Cellulases from *Aspergillus niger* and *Trichoderma reesei* were used for the enzymatic hydrolysis of soy hull and the reactions were monitored for 5 days using peak intensity of characteristic vibration. At the experimental conditions used, there was no significant sugar production observed until 3rd day of hydrolysis. Maximum concentration of sugar observed on 4th day with a decrease in concentration thereafter. This decrease may be result of concomitant fermentation in the medium at later days of the experiment. This study shows that Raman Spectroscopy can be used to monitor cellulosic hydrolysis of waste products such as soy hull.

#### IDENTIFICATION OF THE CIONA INTESTINALIS FOXO DNA BINDING DOMAIN AND TARGET GENE SEQUENCES

Lucas Boncorddo and Dr. Heather Evans-Anderson  
Winthrop University

*Ciona intestinalis* is a useful model for studies examining heart development. The cardiac gene program is highly conserved across chordates, including *C. intestinalis*. FoxO1 is a highly conserved gene as well as an important transcription factor that regulates myocardial development. Previous in vitro experiments in our lab have characterized the interaction between the forkhead DNA binding domain of FoxO from *C. intestinalis* and target sequences of complementary Human and *Drosophila melanogaster* DNA. These studies confirmed that the *C. intestinalis* FoxO DNA Binding Domain (DBD) is able to bind to target sequences from other organisms. Our next step is to determine which regions of the genome FoxO binds to in *C. intestinalis*. This will help to identify which genes are targeted and regulated by FoxO in *C. intestinalis*, which will help us to understand the function of FoxO during heart development. We will utilize Chromatin Immunoprecipitation (ChIP)-Seq assay to identify sequences of the *Ciona intestinalis* genome that FoxO binds to as well as the potential target genes. A hexahistidine-tagged FoxO DBD sequence was inserted into a pCes vector containing a H2B-cherry fluorescent tag to produce an expression plasmid (FoxO DBD-H). Once confirmed by sequencing, the FoxO DBD-H expression plasmids were electroporated into *Ciona intestinalis* embryos prior to the first cell cleavage. The ultimate goal of this project is to generate transgenic *Ciona intestinalis* embryos that express the FoxO DBD-H sequence so that it will interact with chromatin in vivo. The resulting embryos will be collected and their chromatin isolated in order to perform a ChIP-Seq assay that will identify the FoxO1 target DNA sequences.

The project described was supported by NIH Grant Number P20 RR-16461 from the National Center for Research Resources for support of the program entitled "South Carolina IDeA Networks of Biomedical Research Excellence" (SC-INBRE); NIH Grant Number 1R15HL104587-01 (HJEA) from the National Heart, Lung, and Blood Institute and SC Experimental Program to Stimulate Competitive Research and Institutional Development Awards (EPSCoR/IDeA) Science Affiliate Network grant (HJEA and NG).

## IDENTIFICATION OF THE *CIONA* INTESTINALIS FOXO DNA BINDING DOMAIN AND TARGET GENE SEQUENCES

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## CR 6+ RESISTANCE OF BACTERIAL WASTEWATER ISOLATES

Shatresa Bradley and Dr. Randall Harris  
Claffin University

Bioremediation is the treatment of pollutants and waste by the use of microorganisms that break down the undesirable substances. Chromium is used in industries such as metallurgical (alloy, and steel), chemical (pigments and tanning) and refractory (chrome and chrome magnesite) industries. Chromium has two main oxidation states, Cr (III) and more carcinogenic Cr (VI). Cr (VI) is mainly used for its anti-corrosive properties. Influent is the raw material that enters the plant through the collection system. Sludge is the growth of microorganism to break down suspended solids. The purpose of this research is to isolate and characterize bacterial isolates from wastewater environmental samples and determine if the bacterial isolates are resistant to Cr (VI). Influent and sludge samples were collected from a local wastewater treatment facility, serially diluted and plated onto brain heart infusion agar. After two days of incubation, the unique bacterial colonies were re-streaked. Of the eight sludge isolates, S14 were resistant to at least 200 ppm of Cr (VI) using a plate assay. Of the six influent isolates I4 were resistant to at least 100 ppm of Cr (VI). Growth of three sludge isolates (S3, S11, and S14) in liquid culture reveal that S3, S11, and S14 grew in 50 ppm, 25 ppm, and 200 ppm of Cr (VI), respectively. Future experiments are to test the isolates for Cr (VI) reduction.

## USING A SUITE OF ANTIBODIES TO EXAMINE THE HOST-PARASITE RELATIONSHIPS IN HEAD KIDNEYS OF *FUNDULUS HETEROCLITUS* FROM NORTH INLET

Caitlin Brickley and Marlee B. Marsh  
Columbia College

Fish innate immune responses can be evaluated as indicators of immune function and status following exposure to pathogens, biological response modifiers, immunotoxicants, and nutritional regimes. We have developed several monoclonal antibodies used to recognize immune responses in several species of fish, including *Fundulus heteroclitus*. Immunohistochemistry was performed on head kidney tissue. Antibodies used included probes against lysozyme (neutrophils and macrophages), eosinophilic granular cells (possible mammalian eosinophil homolog), and Cox-2 (various cells during inflammation). We hope to discover direct role(s), if there are any, of innate immune cells in fish immune responses to parasites. Data collection is still in progress and will be completed by March.

ACOUSTIC MONITORING OF BAT POPULATIONS IN FLORENCE, SC  
Ebony Brown and Dr. Jeff Steinmetz  
Francis Marion University

In this study a bioacoustics monitoring system was used to collect data on the bat populations of Florence County. Wildlife Acoustics Echo Meter Touch provides spectrograms of bat calls and auto identification. Bat populations were monitored between the months of May to March. A route was selected that sampled a variety of areas including ponds, open fields, neighborhoods, and city streets. The route was driven every two weeks to record bat populations. For the Pee Dee region, the Echo Meter Touch auto identifies nine species of bats. Based on the bat calls recorded eight of the nine species were collected. The most commonly detected species were *Tadarida brasiliensis* (Mexican free-tailed) and *Nycticeius humeralis* (Evening bat). The numbers of recordings collected in the study were higher in the summer and fall compared to the winter. This data will provide a baseline for a long term bat monitoring project.

EXPRESSION OF HEART-SPECIFIC CONSTRUCTS IN *CIONA INTESTINALIS* EMBRYOS  
Katlyn Brumley and Dr. 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 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 *Ciona*. 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 *Ciona* embryos is altered if the PI3K/AKT signaling pathway is disrupted. *Ciona* 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 is currently underway.

The project described was supported by NIH Grant Number P20 RR-16461 from the National Center for Research Resources for support of the program entitled "South Carolina IDeA Networks of Biomedical Research Excellence" (SC-INBRE) and NIH Grant Number 1R15HL104587-01 from the National Heart, Lung, and Blood Institute.

OPTIMIZING GERMINAL TRANSPOSITION OF MPING IN *ARABIDOPSIS THALIANA*  
Courtney Burckhalter and C. Nathan Hancock  
University of South Carolina Aiken

Transposable elements (TE) are repetitive sequences that are able to move throughout the genome. Some types of TEs, including mPing from rice, are mobilized by a cut and paste mechanism catalyzed by transposase and ORF1 proteins. The overall goal of our research is to develop mPing into an efficient mutagen for gene discovery in plants. To be effective, mPing must produce heritable insertions that disrupt gene function. Previous studies have shown that mPing preferentially inserts near genes and can cause mutant phenotypes in plants. The objective of this project is to test novel mPing mutagenesis constructs to determine if they increase the germinal mPing transposition rate in plants.

A chimeric ORF1 (ORF1S-C1) made by combining the Pong and Ping ORF1 and adding a strong nuclear import signal was shown to drastically increase transposition of mPing in yeast. Our hypothesis is that using the ORF1S-C1 protein will increase the transposition rate and the number of germinal transposition events in *A. thaliana*. Constructs with the RPS5A promoter driving either Pong ORF1 or ORF1S-C1 and the GmUbi promoter driving Pong TPase LA were transformed into *Arabidopsis* using the floral dip method. mPing transposition in the T1 generation was monitored by the use of a GFP reporter construct. The ORF1S-C1 constructs produced a higher percentage of plants with sectors of GFP expression, indicating that this altered protein also has higher transposition in plants. The T2 generation of this population is being analyzed to determine the germinal transposition rate. When complete, this research should provide more information about how to optimize using mPing as a mutagenesis tool.

EVALUATING MPING TRANSPOSITION IN *MIMULUS LEWISII*  
Autumn Busbee and C. Nathan Hancock  
University of South Carolina Aiken

A variety of techniques are used to expand what is known about plant genomes and the genes that control important traits. Mutagenesis has historically been a useful technique used for the modification and identification of plant genes. Transposable elements, which are small pieces of DNA that are able to move within a genome, can be used for mutagenesis in a technique called transposon tagging. When a transposon is inserted in a gene, it can disrupt gene function, often resulting in a detectable phenotype. mPing is a transposable element that was discovered in rice and is mobilized by the Open Reading Frame 1 (ORF 1) and Transposase (TPase) proteins. mPing has been shown to transpose and induce mutations in rice and

soybean. Due to the success of mPing in rice and soybean, we sought to determine if mPing would mobilize within the genome of *Mimulus lewisii*, an up and coming model organism due to its phenotypic plasticity. *M. lewisii* plants were transformed with two separate constructs, one with an mPing-GFP reporter and the other encoding ORF 1 and TPase. These lines were then crossed and the F2 progeny was analyzed for the presence of ORF 1, TPase, and the mPing-GFP reporter using PCR. The inheritance of the two constructs and whether or not mPing was mobilized was analyzed.

#### SEARCHING FOR EMISSION EPISODE SELF CONSISTENCY IN GAMMA-RAY BURST LIGHT CURVES

Thomas Cannon and Jon Hakkila  
College of Charleston

Using light curves of gamma-ray bursts (GRBs) detected by the Burst And Transient Source Experiment on NASA's Compton Gamma Ray Observatory, we introduce a new method of self-consistent GRB categorization. We compile a table of 'similarity distances' measuring the degree of correlation between any two GRB light curves. We then apply automated data mining tools such as Self-Organizing Maps and decision trees to sort like-GRBs into groups according to their similarity distances. The results give us an additional method for classifying GRB light curves.

#### DEVELOPING MPING-BASED ACTIVATION TAGS

Tiana Chandler and Dr. C. Nathan Hancock  
University of South Carolina Aiken

Transposable elements (TEs), also known as "jumping genes," are DNA sequences that move from one location on the genome to another. A TE discovered in rice, mPing, has been shown to transpose at high rates, creating mutations and generating genome diversity. mPing is being used for plant genome mutagenesis and gene discovery. This element has been shown to jump into regions just upstream and downstream of genes. This insertion preference is optimal for activation tagging, where an insertional sequence that contains promoter elements can cause transcriptional activation of nearby genes. Activation tagging is a powerful gain-of-function approach to reveal the functions of genes because overexpression of genes can reveal their function. Our goal has been to modify mPing into an activation tag by adding enhancer elements from strong promoters. We made a number of mPing-based activation tags and tested their transposition rates in yeast transposition assays. These experiments showed that inserting various enhancer sequences into mPing causes a major decrease in the transposition rate. This is probably due to the increase in TE size and inhibition of transposition complex formation. This negative effect can be countered by using a hyperactive version of mPing recently discovered in the lab.

#### DETERMINATION OF BPA IN ENVIRONMENTAL SAMPLES

Adrian Coates and Adrienne Oxley  
Columbia College

Bisphenol A, commonly known as BPA, is a plasticizer that is used to manufacture common, everyday items, such as water bottles, canned food and drinks, and baby bottles. It is typically used as a monomer in order to produce polycarbonate plastics and epoxy resins which are used in the manufacturing of food storage containers. At increased temperatures, BPA has been found to leech into foods and drinks stored in these containers. There are also large amounts of BPA found in water sources and soils as the result of environmental pollution. This project will explore BPA in environmental samples, fish in particular, through the use of fluorescence spectroscopy.

#### SUSTAINING THE SOUTH: THE MOVEMENT OF URBAN CENTERS TOWARDS SUSTAINABLE DEVELOPMENT

W. Hayden Couvillion and Dr. Jessica Vogt  
Furman University

Abstract: By 2050, 85% of OECD populations will be living in cities. In the Southeastern U.S, urban areas are projected to grow 160% by 2060, forming a "megalopolis" that stretches 400 miles across Georgia and both Carolinas. Simultaneously urban cores in mid-small sized metropolitan areas are being 'regenerated.' A term of European origin, urban regeneration seeks to improve the economic, physical, social, and environmental form of an area. Once declining city centers now contribute to communities through increased services and tax revenues. The new urban core is the product of a movement to regenerate existing infrastructure through individual regeneration projects. Often, these regeneration projects, and more largely the urban centers in which they reside, are declared sustainable. However, there is little consensus on what 'sustainable urban development' (as exemplified by these regeneration projects) actually means. In this poster sustainability is defined as economic, ecological, and social systems that meet the needs of current generations without compromising the ability of future generation to meet their own needs. Using Greenville, SC, Chattanooga, TN, Wilmington, NC, and Birmingham, AL as case studies, this poster depicts both the successes and difficulties of urban regeneration projects and how they are moving their respective urban centers towards economic, ecological, and social sustainability.



## SEPARATION AND MASS ANALYSIS OF POLYCATIONIC BIOCIDES IN MULTIPURPOSE CONTACT LENS SOLUTIONS UTILIZING ULTRA PERFORMANCE

Frederic David and John Wheeler  
Furman University

Multiple cationic biocides are routinely incorporated into multipurpose contact lens solution (MPS) to inhibit microbial growth. The most widely used cationic additives are polydisperse, complicating their analysis using conventional HPLC with UV detection. This study provides a novel method by which to analyze the biocide polyhexamethylene biguanide (PHMB) using Ultra Performance Liquid Chromatography (UPLC) with UV detection and electrospray Quadrupole Time-of-Flight Mass Spectrometry (QTOF-MS). The resulting UPLC methods developed were found to provide sensitive and reproducible measurements at sub-ppm concentrations with UV detection when authentic MPS samples were prepared via weak cation-exchange solid phase extraction (> 92% recovery) and analyzed via the method of standard additions ( $R^2 > 0.95$ ). Further, mass analysis of the eluting UPLC peaks has provided mass identification of multiple structures from the PHMB polymer, with oligomers ranging in size from 1 – 6 units. Additionally, studies involving the uptake of PHMB and alexidine dihydrochloride have been performed with a range of lens materials. Contact lenses immersed in stock biocide solutions in conventional contact lens cases for varying amounts of time (i.e., up to 96 hours) were analyzed by UPLC to ascertain the remaining biocide concentration. The results demonstrate substantial uptake of these biocide materials by the contact lens, corresponding in a significantly reduced concentration of biocide in the lens cases. Elucidation of the molecular weight distribution of PHMB via dialysis is also explored.

## CHARACTERIZATION AND UPTAKE STUDIES FOR THE BIOCIDES POLYHEXAMETHYLENE BIGUANIDE AND ALEXIDINE WITH EMPHASIS ON CONTACT LENS SOLUTION

Hazel Davis and John Wheeler  
Furman University

Recent years have found an increasing growth in the number of antibiotic-resistant bacteria. A new avenue of study has developed to meet the need for the characterization and investigation of biocidal compounds with a broad range of use in personal care and medicinal applications. Among these substances are the polycationic biocides polyhexamethylene biguanide (PHMB) and alexidine dihydrochloride, which are often found in commercial multi-purpose solutions (MPS) for the care of contact lenses. Whereas alexidine displays a single cationic structure, PHMB has recently been characterized as a complex, polydisperse structure. Through ultra-performance liquid chromatography (UPLC) as well as the method of standard additions, techniques have been developed to analyze and quantitate both alexidine and PHMB, including partial resolution of PHMB's polydisperse mixture. ES(+) Spectrometry (MS) has also been used to characterize the elution components of PHMB, and we have additionally initiated uptake studies for both biocides in order to elucidate the adsorption and absorption isotherms associated with these compounds in contact lenses.

## OPTIMIZATION OF THE RETROVIRAL VECTOR, PLGN, FOR DELIVERY OF ANTI-TAT SIRNAS FOR INHIBITION OF HIV REPLICATION

Jennifer Deily and Dr. William H. Jackson  
University of South Carolina Aiken

Human Immunodeficiency Virus (HIV) is a retrovirus characterized by the infection and loss of CD4+ T lymphocytes, which are normally responsible for mounting effective immune responses. A significant loss of CD4+ T lymphocytes, combined with one or more defined opportunistic infections, leads to the Acquired Immunodeficiency Syndrome (AIDS). The aim of our lab is to inhibit HIV replication by taking advantage of the post transcriptional gene silencing pathway, RNA interference (RNAi). To target HIV mRNAs for degradation, we have designed a number of anti-HIV siRNAs to specific genes in the HIV genome that are essential for HIV replication, in particular the trans-activator of transcription (Tat), which is crucial for transcription. We hypothesize that by targeting Tat using RNAi, HIV transcription, and subsequently HIV replication will be inhibited. In order to test these siRNAs for their effectiveness at inhibiting Tat, each was endogenously expressed in cells using a retroviral vector. The siRNAs were initially tested using the retroviral vector, pSuper.Retro.neo+GFP, and siRNA5892 was shown to be promising at inhibiting Tat; however, because this retroviral vector is inefficient at generating recombinant retroviral particles, the goal of this project is to investigate the use of new retroviruses to deliver siRNAs. p1744 is a self-inactivating retroviral vector that has been shown to efficiently generate recombinant retroviral particles; however, p1744 lacks some important features such as the H1 promoter and Green Fluorescent Protein (eGFP), which we find useful as an indicator of retroviral gene delivery. p1744 will be optimized by replacing the  $\beta$ -galactosidase reporter with eGFP and inserting the RNA Pol III H1 promoter creating vector pLGN. This optimization will result in the ability to observe live cells that express this vector using eGFP, and to express our siRNAs from the H1 promoter.

## RELATIONSHIPS BETWEEN LOCATION OF BRAIN INJURY OR CONCUSSION AND RECUPERATION TIME IN NFL FOOTBALL PLAYERS

Brianna Dyar, Brandon Johnson, David Prager and Diana Ivankovic  
Anderson University

Concussions have recently become a hot topic in media concerning collision sports like professional football: where a single concussion can end a healthy career. However the lack of information surrounding sports concussions makes it difficult for athletes to know how soon they can expect to return to a competition after a concussive incident. In order to construct a reasonable model for recovery, we analyzed data from the PBS series Frontline that has catalogued the number of weeks missed by players after sustaining a concussion during the National Football League's 2013-2014 seasons. After analyzing each hit to the head, we constructed a statistical model using the One-Way Anova method to show how concussing specific regions of the brain directly influences the length of the recovery period. We analyzed the variance between brain injuries and recuperation time to show how damage to certain regions of the brain are more likely to carry lengthy recovery periods in terms of a player's overall missed games after a concussive incident.

## RESISTANCE AND REDUCTION POTENTIAL OF SERRATIA MARCESCENS IN HEXAVALENT CHROMIUM

Ijeoma Ekpenuma  
Clafin University

Heavy metal pollution due to legacy waste from the Cold War nuclear proliferation remains a huge problem at federal and industrial sites. Microbial bioremediation is a cost effective method for removing heavy metals from soil and groundwater. The purpose of this study was to characterize the growth pattern of a *Serratia marcescens* strain 93-1399-1 in the presence of the heavy metal hexavalent chromium (Cr [VI]) and its ability to convert Cr (VI) to the less toxic Cr (III). When *S. marcescens* was grown on LB agar with increasing concentrations of Cr (VI) as potassium dichromate, the bacteria survived at all concentrations tested up to 200 ppm. Growth curves of *S. marcescens* in Cr (VI) showed that the bacteria exposed to 25 ppm grew in similarly to bacteria without Cr (VI), had reduced exponential growth at 50 and 100 ppm and poor growth in 200 ppm after 24 hours. Plate count assays showed that the 65% of the bacteria survived in 25 ppm of Cr (VI) but only 5% survived at 50 ppm. In preliminary chromium reduction assays, *S. marcescens* was grown for 24 hours in 25 ppm of Cr (VI). *S. marcescens* reduced 60% of the Cr (VI) to Cr (III) as compared to 4% reduction in broth alone. These data suggest that the *S. marcescens* strain may be useful in bioremediating Cr (VI) at contaminated sites. Future studies will focus on identifying the genes responsible for Cr (VI) reduction

## AN INVESTIGATION OF THE ANTI-PROLIFERATIVE EFFECTS OF ELLAGIC ACID ON HUMAN MESOTHELIOMA CELLS

Devan Fisher, Diana Ivankovic, and Donna Weinbrenner  
Anderson University

*Punica granatum*, better known as pomegranate, contains several interesting phytochemicals that have shown anti-proliferative effects in various cancer cell lines. This particular fruit contains a multitude of constituents including ellagic acid, ellagitannins, punicic acid, flavonoids, anthocyanins, estrogenic flavanols, and flavones. In this experiment, the ellagic acid derived from pomegranate was applied in different concentrations ranging from 0.25mg/mL to 10mg/mL to the mesothelioma cancer cell line and tested for effects via MTS assay, Trypan Blue exclusion, and Live/Dead count.

## DIRECT IMAGING OF CONCENTRATION-INDUCED FLUCTUATIONS IN NANOCOLLOIDS

Lincoln Fraley and Dr. Ana Oprisan  
College of Charleston

Nanocolloids are ideal systems for investigating both spatial and temporal processes using optical methods since they have particle sizes larger than the characteristic size of atomic or molecular systems. We performed direct imaging experiments in order to investigate the concentration-driven non-equilibrium fluctuations. Our direct imaging experimental setup involved a glass cell filled with colloidal suspension and water with the concentration gradient oriented against the gravitational field and a superluminescent diode (SLD) as the light source. Nonequilibrium concentration-driven fluctuations in silver nanocolloidal suspensions with a range of particle sizes and at different concentrations were recorded using direct imaging technique. We used a dynamic structure factor algorithm for image processing in order to compute the structure factor and to find the power law exponents and the correlation time of these fluctuations. The investigation of time evolution of concentration induced fluctuations allowed us to evaluate the dynamics of critical wave number.

## IDENTIFICATION OF CHROMIUM RESISTANCE GENES

Jessica A. Fuller and Randall Harris, PhD  
Clafin University

Hexavalent chromium pollution is steadily increasing with continuing industrial practices. Consequently, Chromium (VI) has been considered as one of the major environmental contaminants of soil and groundwater at industrial waste sites. Because of the toxic effects of hexavalent chromium to human health and the environment, remediation strategies are imperative in order to reduce chromium (VI) into a less harmful form. *Pseudomonas* species have been recognized as an efficient chromate

reducer under both aerobic and anaerobic conditions. The goal of this research was to generate chromium sensitive mutants in *P. fluorescens* Pf-5, examine them for chromium reduction capabilities, and identify the genes that are responsible for reducing Cr (VI) to Cr (III). Initial growth curve studies showed the optimal working concentration of K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> was 50 ppm. Pf-5 was conjugated with *Escherichia coli* BW20767 (pMiniHimarRB1) and mutants were generated using transposon mutagenesis. Ex-conjugates were plated on Luria Bertani medium with kanamycin and mutants were replica plated to identify chromium sensitive bacteria. Approximately 50,000 mutants were screened and three potential chromium sensitive mutants were identified. Possible methods to enhance mutant generation of chromium sensitive bacteria are currently being explored. Further analysis is being done to identify the genes responsible for chromium reduction.

#### IMMOBILIZATION OF POLYDIACETYLENE SENSORS ONTO CELLULOSE

Sara J. Garbowski, Salley A. Reamer, Sarah C. Hill, and William T. Pennington  
Department of Chemistry, Clemson University

Polydiacetylenes (PDAs) are conjugated polymers with interesting optical properties. PDAs exhibit a chromatic response to a variety of chemical, biological and environmental stimuli. In order to develop cheap and effective sensors for food safety applications, we have coated cellulose-based media (cotton fibers and paper) with 10,12-pentacosadiynoic acid (PCDA) and derivatives. The characterization, properties, and potential applications of these sensors will be reported and discussed.

#### ASSESSING CR(III) COMPLEXES AS POTENTIAL ANTICANCER AGENTS USING PCR, CAPILLARY GEL ELECTROPHORESIS AND GEL ELECTROPHORESIS

Yasmín Álvarez García and John Wheeler  
Furman University

Transition metal complexes that establish interactions with DNA are being extensively studied for their potential as photodynamic therapy photosensitizers with increased selectivity over traditional chemotherapeutics. For years, our lab has been focused on Cr(III) diimine complexes as alternatives to current anticancer therapeutic drugs (e.g., cisplatin) that are highly toxic and unselective. [Cr(diimine)]<sup>3+</sup> complexes were chosen because of their high excited state oxidizing power and their long excited state lifetimes. Previous research in our lab has demonstrated that excitation of Cr complexes in the presence of DNA results in emission quenching accompanied by DNA cleavage. Polyacrylamide gel electrophoresis (PAGE) and Capillary Gel Electrophoresis (CGE) is used to analyze the movement of DNA after treatment with Cr compounds in order to understand the binding mechanisms that ultimately achieve DNA damage. Polymerase chain reaction (PCR) and subsequent analysis by Agarose gel electrophoresis and Microcapillary Gel Electrophoresis (CGE) is utilized in order to study the effects that Cr(III) compounds have on the systematic replication of DNA.

#### PRECISE REPAIR OF Mping EXCISION SITES IS FACILITATED BY TARGET SITE DUPLICATION DERIVED MICROHOMOLOGY

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

DNA transposons are sequences that excise and re-insert into the genome, facilitated by transposase proteins. Some transposons, including miniature inverted transposable elements (MITEs), do not encode transposase proteins, but are mobilized in trans. In plants, these MITEs reach very high copy number and influence genome evolution. MITE insertion produces identical target site duplications (TSDs) flanking the element. Stowaway and Tourist MITE families differ in their alteration of the genome following excision. Stowaway-like MITEs (Mariner elements) leave short sequences from the end of the element at the excision site, while Tourist-like MITEs (PIF/Pong/Harbinger elements) usually excise precisely. Our goal is to determine what differences in the transposition mechanisms of these two classes of elements lead to this difference in genome alteration. We tested this by altering the TSDs of the Stowaway-like MITE 14T32-T7, and the Tourist-like MITE mPing in two different yeast strains, one of which is unable to perform non-homologous end joining. From these experiments, we conclude that mPing excises precisely due to microhomology created as a result of staggered cleavage of the TSDs. In contrast, 14T32-T7 transposase cleaves within the terminal inverted repeat sequences, leaving no microhomology.

#### SURFACE MODIFICATION VIA DIACETYLENE ALCOHOL SAM FORMATION

Maria S. Gonzalez and Laura Wright  
Furman University

This research investigated the use of long chain alcohols in altering specific surfaces. High grade muscovite mica sheets were modified using various concentrations of 10,12-octadecadiyn-1-ol to form self-assembled monolayers. Due to the diacetylene linkage, molecules on the surface has improved layer formation and could be photo-cross linked via short wave UV exposure. These SAMs were monitored and imaged via Atomic Force Microscopy. Optimal concentrations and UV exposure times were determined. Changes in contact angle between plain mica, surface modified mica, and photo-cross linked mica samples were observed. A luminescent ruthenium(II) complex was synthesized and intercalated into the samples. Photo-polymerization promoted molecular immobilization. These samples were then imaged via fluorescence microscopy to ensure ruthenium intercalation and immobilization.

## REVERSIBLE THERMOCHROMISM IN POLYDIACETYLENES

Garret I. Gotthelf, Sarah C. Hill, and William T. Pennington

Department of Chemistry, Clemson University

Polydiacetylenes (PDA) in the form of ordered assemblies such as single crystals, coatings, or liposomes exhibit a chromatic response to a variety of chemical, biological and environmental stimuli. A dramatic blue to red color change is accompanied by an on/off quenching mechanism and dramatic changes in Raman spectroscopic signature peaks, making PDAs a unique and effective sensing system. In most cases the change in color and other associated properties is irreversible. During the course of optimizing the adherence of 10,12-pentacosadiynoic acid (PCDA) onto cellulose-based media, we discovered a new reversible form of PCDA. The preparation and properties of this new material will be discussed.

## BRAIN-PENETRATING HISTONE DEACETYLASE INHIBITOR RG2833 REDUCES THE GROWTH AND VIABILITY OF MALIGNANT MELANOMA CELLS IN VITRO

Lauren Green and Dr. 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 brain-penetrating 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. Thus, 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 SKMEL-28 cells to increasing concentrations of RG2833. We found that concentrations of RG2833 that effectively inhibited HDAC activity also resulted in reduced melanoma cell growth and viability. These results demonstrate the effectiveness of RG2833 in 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.

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## SPECIFICITY OF KLEPTOPLASTY IN SOUTH CAROLINA MARSH FORAMINIFERA

Cobi Guilbeau and Megan Cevasco

Coastal Carolina University

The phenomenon of kleptoplasty in which the plastids of algal prey are sequestered by predators/hosts and are kept functional (photosynthetically active) for an extended period of time (weeks/months), is examined in foraminiferal taxa collected from tidal lagoons habitats along the SC coast. The identities of both hosts and the sequestered plastids are determined using both sequence and microscopic data to address the overall specificity of the kleptoplastic condition in foraminifera of coastal South Carolina.

## AUGMENTED HAPPY FUNCTIONS OF HIGHER POWER

Marcus Harbol and Dr. Breeanne Swart  
The Citadel

The presentation investigates Augmented Happy Functions of Higher Powers, defined as

$$T_{[c,q]} \left( \sum_{i=0}^n 10^i a_i \right) = c + \sum_{i=0}^n a_i q^i$$

with  $0 \leq a_i \leq 9$  and  $c, q \in \mathbb{Z}^+$ . This function takes the digits of a positive integer, raises each digit to the power  $q$ , sums the results, and adds a constant,  $c$ , to the sum. In particular, the iterative properties of this function are investigated for a range of values of  $c$  and  $q$ .

## BIOPHYSICAL PARAMETERS THAT DETERMINE RNA-METAL COMPLEX FORMATION

Mariah Harden and Dr. Rachel Whitaker  
Coastal Carolina University

Ribonucleic acids (RNA) are known to primarily interact with  $Mg^{2+}$  when assuming higher-ordered tertiary configurations. Structurally, when tRNA molecules interact with  $Mg^{2+}$ , they consistently form a tRNA isotype-specific "L-shape" conformation each time they are synthesized. The tRNA's L-shape conformation is assumed only in the presence of  $Mg^{2+}$ . Therefore, we hypothesized that if  $Mg^{2+}$  can induce tertiary structure formation, then binding to alternative cations could potentially produce alternative tertiary structural conformations. By utilizing circular dichroism and mobility gel-shift assays we have observed that tRNA structure can be dramatically altered when in the presence of different cationic species. We further validated the formation of these aberrant structural configurations by aminoacylating these tRNA structural anomalies with their native enzyme. From these biochemical tests, we found that the aminoacyl-tRNA synthetase could not recognize numerous altered tRNA structures. Thus, we have confirmed that severe structural changes do occur when tRNA forms complexes with different cations. Lastly, we have observed through the determination of  $k_{on}$  and  $k_{off}$  rates that tRNA can associate/dissociate from different cations to varying degrees, thus forming cation-specific complexes at unique rates. From the data that has been gathered thus far, we conclude that the tRNA molecule can chelate numerous cations in solution and that it could possibly be used to remove heavy metals from aqueous solution when tethered to a solid support system.

## EFFECTS OF GANODERMA LUCIDUM EXTRACTS ON THE VIABILITY OF CANCEROUS VS. NON-CANCEROUS BREAST CANCER CELL LINES

Brooke Harrison and Neval Erturk  
Converse College

*Ganoderma lucidum* (reishi) is a fungal supplement known for its therapeutic properties. In this project, we investigated the effects of ethanol and water extracts of reishi on the viability of cancerous and non-cancerous breast epithelial cell lines. We report that water and ethanol crude extracts of reishi reduce cell viability in breast epithelial cells in a dose dependent manner. The reduction on the viability of reishi treated non-cancerous cells is significantly lower than the reduction observed on cancerous cells. Therefore we conclude that reishi might have a specific effect on the viability of cancerous cells. In our laboratory we use the freshly prepared reishi extracts for each treatment. Recent reports that use refrigerated reishi extracts have been published. Using refrigerated reishi will reduce the experiment time for two hours per treatment day. In this project we also compared the effects of fresh versus refrigerated reishi on cell viability. We observed that both water and ethanol extracts of refrigerated reishi lose their effect on cell viability after a week of storing for the water extracts and after two weeks storing for the ethanol extracts. This shows the reishi compound that causes reduction on viability is not stable in solution even when refrigerated. The compound in the ethanol extracts seemed to be stable for a longer period of time since the effect on viability stayed similar to fresh extracts for 2 weeks. We recommend the use of fresh reishi extracts. Further research investigating mechanisms of reishi on cancerous cells is underway.

Acknowledgements: This research was funded by South Carolina IdEA Networks of Biomedical Research Excellence (SC-INBRE). National Institutes of Health 2P20 RR016461, 2010-2015.

## SOYBEAN ISOFLAVONE EFFECTS AGAINST CERVICAL CARCINOMA

Kristen Hawkins, Michael Hart, Diana Ivankovic, and Donna Weinbrenner  
Anderson University

Current treatments of cervical cancer include surgery, radiation, and chemotherapy and can be deleterious to the patient. Cervical cancer prevention is warranted. Soybeans have low methionine and high arginine content, which is known to inhibit tumor development. Effects of the phytochemical isoflavone from soybeans were tested on cervical carcinoma cells using the MTS, Trypan Blue exclusion, and Live/Dead analysis. Extract concentrations of 1 mg/mL to 100mg/mL extract were tested. The minimum inhibitory concentration was determined using an alpha of 0.05 ( $p=0.517$ ) comparing, 10mg/mL of extract in medium to 10mg/mL extract in medium with  $1 \times 10^5$  cells/mL killed the cervical cancer cells at 48 hours of exposure. Ellagic

acid from pomegranate was also tested from 0.25mg/mL to 20 mg/mL against the cervical carcinoma cell line. Using an alpha of 0.05, 18mg/mL killed the cervical carcinoma ( $p=0.438$ ) comparing to the 10mg/mL extract in medium alone. Thus, soybean isoflavone and pomegranate ellagic acid may serve as cancer treatments with less deleterious effects to the patient.

#### INHIBITORY EFFECT OF PARTIAL DECOUPLING AGENTS AS AN ALTERNATIVE THERAPY FOR CANCER

Kareem Heslop and Dr. Omar Bagasra  
Claffin University

Cancer therapies are generally non-specific for cancer cells and affect cells in the body, resulting in severe side effects. We are working on an alternate method to prevent and treat cancer. Hypothesis: All replicating cells require energy in the forms of ATP and raw material to reproduce. Cancer in a human body generally is the most energy consuming foci; therefore, it will be logical to down regulate the highest energy output pathways that do not harm the human being treated for a cancer. Two of the most prevalent cancers are adenocarcinomas of prostate and breast. We hypothesized that if we treat cancer cells to a partial electron transport inhibitor that results in reduction in total ATP output it may significantly reduce cancer cell proliferation without interfering with normal functioning of other physiologic and immune functions. We chose Amygdalin (D-mandelonitrile- $\beta$ -gentiobioside) which is found in seeds of prunasin family, plants such as peaches, apricots, almonds, apples, and other rosaceous plants and have been used as a traditional alternative medicine for treating terminal cancers and other illnesses. We evaluated the optimal dose that can inhibit various breast and prostate cancer cell lines as well two stem cell lines derived from neuroblastomas. We determined that cancer cell line and stem cell line proliferation rates were significantly inhibited by 0.9  $\mu$ L concentration of amygdalin. This level of Amygdalin can be achieved by consuming 4-6 bitter almond and 2-3 apricot seeds daily. In addition, we observed that Amygdalin induced apoptosis in prostate and breast cancer cell lines.

#### INVESTIGATING DARK MATTER COMPOSITION THROUGH DECAYS INTO FLAVOR CONSERVING TAU PAIRS

William Hester and Dr. Gardner Marshall  
College of Charleston

In this project the program Pythia is used to simulate the decay of scalar, weakly-interacting, massive, dark matter particles into flavor conserved tau pairs. Data on the neutrino energy distribution from these decays is taken and compared to data gathered from the IceCube experiment in Antarctica. This information is used to place bounds on what the lifetime of a dark matter particle can be, narrowing our scope for future investigations.

#### THE BODY PROJECT 4 ALL: A COMPARISON OF A FEMALE-ONLY TO A CO-ED BODY IMAGE PROMOTION PROGRAM

Amanda Hock and Dr. Kerstin Blomquist  
Furman University

#### UNDERSTANDING THE RELATION BETWEEN VACUOLAR PROTEIN SORTING GENES AND AFLATOXIN EXPORT IN *ASPERGILLUS PARASITICUS*

Shaquille Jackson  
Morris College

Filamentous fungi in the genus *Aspergillus* produce a variety of natural products, including aflatoxin, the most potent naturally occurring carcinogen known. Aflatoxin biosynthesis, one of the most highly characterized secondary metabolic pathways, offers a model system to study secondary metabolism in eukaryotes. This study focused on the molecular mechanisms responsible for secondary metabolite export and fate. Thirty-Eight (38) vacuolar protein-sorting (VPS) genes were acquired from the fully characterized genome of *Aspergillus flavus*, a close relative to *Aspergillus parasiticus*, with a high genetic homology. This study was designed to understand the genetic regulation of vacuolar protein-sorting genes associated with aflatoxin export. In this work, we were able to see trends of expressed genes in each of the three variables tested: time period (24hr, 48hr, and 72hr), media (Yeast Extract Sucrose and Yeast Extract Peptone), and genetic composition (Afs10).

#### USING THE CRISPR/CAS9 SYSTEM TO UNDERSTAND THE FUNCTION OF THE PHF21A COMPLEX IN DANIO RERIO CRANIOFACIAL DEVELOPMENT

Khadijah Jihad and Dr. April DeLaurier  
University of South Carolina Aiken

The purpose of this study is to understand the basis of craniofacial defects associated with Potocki-Shaffer, a genetic disorder that also results in mental retardation and delayed development. The goal is to make novel zebrafish mutants for the *kdm1a*, *zmym2* and *zmym3* genes to understand their function singularly and working together with PHF21A during craniofacial development. Previous research has indicated that defects in these genes underlie Potocki-Shaffer syndrome and craniofacial abnormalities. PHF21A encodes for a plant finger protein and its expression seems consistent with the function of craniofacial

and neurofacial development. Constructs for targeted mutagenesis of *kdm1a*, *zmym2* and *zmym3* will be generated using the CRISPR-Cas system. CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) is a system that first evolved in bacteria as a defense mechanism to silence foreign viruses and plasmids, and can now be used as a tool for targeted mutagenesis in vertebrates. The CRISPR system involves making guide RNA (gRNA) to target specific genes and co-injecting gRNA constructs along with Caspase (Cas9) mRNA into 1-cell stage embryos, where gRNA binds to the gene, recruiting Cas9, which induces permanent double-strand breaks in DNA. gRNA constructs targeting zebrafish *kdm1a*, *zmym2*, and *zmym3* genes have been generated, and will be injected into 1-cell stage embryos. Prospective mutants will be raised to adulthood, outcrossed, and F2 mutant larvae will be screened for phenotypes. Ultimately, the goal is to understand the singular and combined requirements for these proteins in regulating downstream expression of genes required for craniofacial development.

#### DETERMINING THE PRESENCE OF THE ARYL HYDROCARBON RECEPTOR (AHR) IN *FUNDULUS HETEROCLITUS* LIVER TISSUES FROM THE BELLE BARUCH MAR

Jasmin Jones and Marlee B. Marsh  
Columbia College

Fish innate immune responses are routinely evaluated as indicators of immune function and immunotoxicants. *Fundulus heteroclitus*, an estuarine fish commonly used as a model in immunotoxicological studies, were collected from the North Inlet of Belle Baruch Marine Sanctuary in Georgetown, SC. In order to analyze the fish, an antibody specific for the Aryl hydrocarbon receptor (AhR) will be used as a biomarker. Biomarkers of exposure reflect the presence of toxic compounds in the environment and the value of each biomarker depends on its specificity, sensitivity, simplicity, and stability (Arrellano-Aguilar et al., 2009). In this leg of a longer scientific project, I will be examining Ah receptors (AhRs) and their presence in fish who are found in a marine sanctuary to provide baseline data. Ah receptors are cytoplasmic proteins that bind certain aryl hydrocarbons, translocate to the nucleus, and activate transcription of particular DNA segments. AhRs are identified by their high-affinity for binding to several carcinogenic or teratogenic environmental chemicals. It has been suggested in a previous experiment that AhRs, and especially AhR2, may be recurring targets for selection during local adaptation of fish to dioxin-like aromatic hydrocarbon contaminants, although the specific molecular changes may vary among independently adapting populations or species (Reitzel et al., 2014). Later studies in the project will examine fish from contaminated sites and compare to our data. The samples of the *Fundulus heteroclitus* are currently being processed with all experimentation expected to be completed by early March.

#### A COMPREHENSIVE SURVEY AND COMPARISON OF BREEDING HABITATS FOR THE PINE BARRENS TREEFROG (*HYLA ANDERSONII*) AT CAROLINA SANDHILLS NATIONAL WILDLIFE REFUGE

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<sup>1</sup>University of South Carolina Columbia, Department of Civil and Environmental Engineering; <sup>2</sup>University of South Carolina Salkehatchie, Division of Mathematics and Science; <sup>3</sup>Carolina Sandhills National Wildlife Refuge; <sup>4</sup>South Carolina Department of Natural Resources

*Hyla andersonii* (Pine Barrens Treefrog), a state-listed species with significant conservation status, was first surveyed at Carolina Sandhills National Wildlife Refuge from 1975 to 1982. A span of thirty years passed before the next comprehensive survey, which detected fewer *H. andersonii* in actively managed habitats compared to habitats within a gas line right-of-way. Monitoring continued in 2014 to further explore *H. andersonii* occurrence at right-of-way sites and to document the associated anuran community. From May 30 - August 15, 2014 two gas line right-of-way sites, two non right-of-way sites, and two sites where *H. andersonii* occurred historically were surveyed using Song Meter digital recorders. *H. andersonii* was detected 347 times with the majority of detections (69%) occurring at right-of-way sites and 27% of detections occurring at non right-of-way sites. *Acris gryllus* (Southern Cricket Frog), *Hyla femoralis* (Pinewoods Treefrog), *Lithobates catesbeianus* (Bullfrog), *Lithobates clamitans* (Green Frog), and *Lithobates virgatipes* (Carpenter Frog) were detected most often with *H. andersonii*. The trend for *H. andersonii* to be detected more frequently, and produce more active choruses in right-of-way sites could be attributed to vegetation structure, associated anuran assemblage, and watershed properties. The gas line right-of-ways, which are not actively managed for *H. andersonii*, are serving as productive surrogate habitats and source populations for this species on the refuge. Habitat measurements will take place in 2015 and an analysis of these variables, in combination with *H. andersonii* call data, will help guide future management decisions for this important species in South Carolina.

#### THE EFFECTS OF STRESS, SUGAR AND EXERCISE ON DEPRESSION AND HIPPOCAMPAL NEUROGENESIS IN RATS

Austin Kaiser and Michelle Vieyra  
University of South Carolina Aiken

Major Depressive Disorder (MDD) is one of the most common mental illnesses in the United States, having a lifetime risk of approximately 17%. Only 1/5 of Americans perform an adequate amount of exercise and they eat a diet that has 400% of daily sugar requirements, on average. This study sought to test the efficacy of exercise as a treatment for depressive symptomatology in the context of a high-sugar diet and chronic stress, which mimics the average Western lifestyle, using Sprague-Dawley rats as an animal model. Twenty-one rats were subjected to the chronic-mild stress (CMS) model of animal depression, and placed into four groups that were treated with different combinations of exercise and high-sugar diet for a period of eight weeks. The rats were subjected to behavioral testing of depression before the CMS model, after the CMS model,

and after the eight week trial period to measure depressive symptomatology. The rats were then sacrificed and blood and brain samples were taken. Total brain weight was measured and the hippocampus was removed from each subject for neural density histology. Raw data appear to suggest that exercise groups performed better on behavioral testing, regardless of diet treatment. This would suggest that exercise can be used as a treatment for depression without requiring the patient to undergo a complete lifestyle change, and that this could be a safe, low-cost alternative to therapies and pharmaceuticals currently used to combat MDD.

#### SOUTH CAROLINA PLEISTOCENE TERRESTRIAL VERTEBRATE DIVERSITY

Adam Kirtley, Dakota Pruitt, and Joseph Shillinglaw  
Charleston Southern University

The published Pleistocene terrestrial vertebrate fauna of South Carolina includes mammals, reptiles, and birds. A faunal list based on Sanders (2002), Roth and Laerm (1980), Bentley and Knight (1998), Chandler and Bentley (2007), and Chandler and Knight (2009) was compiled and compared with published faunas from Virginia (Eshelman and Grady, 1986; Holman, 1986) and Florida (Hurlbert, 2001). The faunas were compared for general body size and biogeography. The South Carolina fauna has fewer localities, a lower taxonomic diversity, and fewer taxa with a small body size than the faunas of Virginia and Florida.

#### MASS SPECTROMETRY ANALYSIS OF THE ANTIOXIDANT ACTIVITY OF SULFUR AND SELENIUM COMPOUNDS

Emily Kurfman and John Wheeler  
Furman University

Sulfur and selenium compounds can prevent oxidative damage to DNA, proteins, and lipids; however, their mechanisms of action are not fully understood. Previous studies suggest thione- and selone-containing compounds utilize the antioxidant mechanisms of radical scavenging and metal chelation. To understand thione and selone antioxidant mechanisms when bound to hydroxyl-radical-generating iron, two Fe(II)-thione and -selone complexes have been synthesized: Fe(L)2Cl2 (L = N,N'-dimethylimidazole thione or selone). Analysis of the products of the oxidation of these complexes is currently being investigated using electrospray ionization (ESI) mass spectrometry. Preliminary results suggest formation of iron tetrachloride structures. Future research will focus on elucidating mechanisms for the oxidation reactions of these sulfur and selenium antioxidants.

#### DETERMINATION OF BISPHENOL S LEACHED FROM PLASTIC BOTTLES

Quentin Lane, Bettie Obi Johnson and Jill Castiglia  
University of South Carolina Lancaster

Bisphenol A (BPA) has been replaced by bisphenol S (BPS) in some plastics, but both compounds have similar estrogen activity (EA). These compounds have been found to have negative health effects on vertebrates. Currently, methods such as Liquid Chromatography Mass Spectrometry (LC-MS) are used to detect low concentrations of BPS. However, LC-MS is expensive and not widely available in labs. Due to rising concerns of BPS in our food supply, a readily accessible and economical method is needed to determine low levels of BPS in solutions. In this study, Ultraviolet-Visible Spectrophotometry (UV-Vis), High Performance Liquid Chromatography (HPLC), and pre-concentration by Solid Phase Extraction (SPE) were evaluated with standard solutions and plastic leachate samples. The limit of detection of BPS using UV-Vis was found to be 500 nmole/L (125ug/L). BPS levels from water microwaved in polysulfone plastic bottles for five minutes measured between 700 and 9,200 nmole/L (175-2300 ug/L). A variety of plastics have been tested using the same method, and detectable amounts of aromatic compounds with potential EA have leached from them. The compounds are currently being identified by HPLC. Future work will involve applying these test methods to a broader range of plastics.

#### EXPLORING RAINDROP ARRIVAL TIME CORRELATIONS VIA A DROP SIZE DEPENDENT PAIR CORRELATION FUNCTION

Robert Lemasters and Dr. Michael L. Larsen  
College of Charleston

There is empirical evidence that large raindrop arrival times are not perfectly random. Additionally, it has been observed that a substantial portion of smaller drops tend to be falling at superterminal velocities. The exact mechanism for these phenomena is not clear and it is uncertain whether they are related. In an effort to identify any correlation, the authors use a generalized notion of the temporal cross-correlation function for use with discrete data. This tool, which will be called the "size dependent pair correlation function" (SDPCF), is applied to data provided by a 2-dimensional video disdrometer.



### SUM OF SQUARES OF LUCAS NUMBERS

Kaige Lindberg, Dr. Rigoberto Florez, and Dr. Antara Mukherjee  
The Citadel

In this talk I will be talking about how I found the closed form for a finite sum of the square of two consecutive Lucas numbers. I will discuss the identities and techniques I used. I will additionally talk about the potential generalizations of this result to generalized Fibonacci numbers. The summation was an open problem in the Fibonacci Quarterly.

### TOWARDS A LOW-DIMENSIONAL MODEL OF THE NEURAL NETWORK RESPONSIBLE FOR GAMMA SYNCHRONIZATION USING OPTOGENETICS

Patrick Lynn and Dr. Sorinel Oprisan  
College of Charleston

Optogenetics allows optical control of neuronal activity by using genetically altered neural cells and optical tools. Briefly, optogenetics uses a photosensitive element that, upon absorption of light, produces some change in the activity of the cells. By precise spatial and temporal delivery of light pulses we can identify the local interconnections among neurons and investigate their dynamical response under different conditions.

In this study, we investigated the response of prefrontal cortical cells under a 40 Hz intermittent stimulus. We found that there are significant differences between response of neural cells in mice under systemic cocaine injection compared to control. We recorded the spiking responses of interneurons and analyzed them using nonlinear dynamics tools.

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

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

The coquina clam, *Donax variabilis*, is a ubiquitous invertebrate along the eastern seaboard that, due to its placement in the food chain and intertidal habitat, makes it an ideal indicator for the health of the surrounding ecosystem. The clams, along with water and sand samples, were collected from three separate locations in Myrtle Beach, SC and analyzed for heavy metals using an atomic absorption (AA) instrument. This is a temporal study to see how the concentration changes with time. It is hypothesized that the concentrations will increase during the summer months due to increased foot and vehicle traffic from tourists.

### A MULTIVARIATE APPROACH TO MEASURING ACCESSIBILITY TO HEALTHY AND AFFORDABLE FOOD IN GREENVILLE COUNTY, SC

Will McCabe, Dr. Suresh Muthukrishnan, and Dr. Alicia Powers  
Furman University

Food deserts, or disadvantaged areas with low access to a variety of healthy and affordable food options, represent issues related to public health and social justice. Studies suggest that residents in deprived communities are exposed to the lowest quality in-store food options, which in turn contributes to spatial inequalities in chronic diseases. The purpose of this study is to identify areas with poor geographic access to healthy food and high social deprivation in Greenville County. Four population-weighted measures of physical accessibility to supermarkets were calculated for county block groups using road network distances. A social deprivation index was calculated using variables from the 2008-2012 American Community Survey. The Nutrition Environment Measures Survey (NEMS-S) measured the availability, price, and quality of healthy food options in 23 supermarkets. Lastly, a hierarchical cluster analysis uncovered seven classes of accessibility to supermarkets that were constructed using a k means classification procedure, mapped, and superimposed over high deprivation areas. Supermarket accessibility decreases towards the peripheral county areas where population density is the lowest. The most socially deprived populations are found in Greenville's urban areas with an average population density of 990.4. The four measures of access reveal no systematic socioeconomic inequality in access to supermarkets, as the most socially deprived people have the highest access to supermarkets. The in-store NEMS-S measure shows that supermarkets in areas of high social deprivation carry a significantly less variety in affordable, quality healthy food options than those areas of low social deprivation. Thus, there is no injustice in access to supermarkets in Greenville County, however there is injustice in the overall class of those supermarkets. The results of this study expose the importance in evaluating multiple measures within the consumer and community nutrition environments in order to sufficiently describe the complexity of a population's access to healthy food.

## BIOPHYSICAL PARAMETERS THAT DETERMINE RNA-METAL COMPLEX FORMATION

Lance McDanel and Dr. Rachel Whitaker  
Coastal Carolina University

Ribonucleic acids (RNA) are known to primarily interact with Mg<sup>2+</sup> when assuming higher-ordered tertiary configurations. Structurally, when tRNA molecules interact with Mg<sup>2+</sup>, they consistently form a tRNA isotype-specific “L-shape” conformation each time they are synthesized. The tRNA’s L-shape conformation is assumed only in the presence of Mg<sup>2+</sup>. Therefore, we hypothesized that if Mg<sup>2+</sup> can induce tertiary structure formation, then binding to alternative cations could potentially produce alternative tertiary structural conformations. By utilizing circular dichroism and mobility gel-shift assays we have observed that tRNA structure can be dramatically altered when in the presence of different cationic species. We further validated the formation of these aberrant structural configurations by aminoacylating these tRNA structural anomalies with their native enzyme. From these biochemical tests, we found that the aminoacyl-tRNA synthetase could not recognize numerous altered tRNA structures. Thus, we have confirmed that severe structural changes do occur when tRNA forms complexes with different cations. Lastly, we have observed through the determination of kon and koff rates that tRNA can associate/dissociate from different cations to varying degrees, thus forming cation-specific complexes at unique rates. From the data that has been gathered thus far, we conclude that the tRNA molecule can chelate numerous cations in solution and that it could possibly be used to remove heavy metals from aqueous solution when tethered to a solid support system.

## DEVELOPING A FUSION GENE UNDER THE CONTROL OF AN HIV-1 LTR PROMOTER

Erin M. McLaughlin, Natalie M. Arthur and William H. Jackson, PhD.  
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 subset of immune cells. The loss of these cells results in a gradual decrease in the ability to mount an immune response to pathogens and ultimately complete failure of the immune system. Although current HIV treatments may reduce viral load, they are not curative. A potential treatment method may be the artificial induction of apoptosis in cells infected with HIV-1. One of the goals of our lab is to study the use of pro-apoptotic genes to induce cell death only in the presence of the HIV regulatory genes, tat (trans-activator of transcription) and rev. In this regard, Tat functions to increase expression of viral genes through the HIV promoter, while Rev functions in exporting viral mRNAs from the nucleus to the cytoplasm. This project will use the HIV-based retroviral vector, pLRed(INS)2R, to express pro-apoptotic genes, along with a suitable reporter gene to easily detect expression. To determine proof of this concept, the enhanced Green Fluorescent Protein (eGFP) and the Renilla Luciferase (LucR) genes will be expressed from the HIV-1 promoter by creating a fusion gene between the two. Expression of these genes will then be tested in the presence of HIV-1 Tat and Rev. Two different fusion genes will be generated by PCR: one will contain a nuclear localized eGFP that is designed to monitor apoptotic change in the nucleus, the other will express eGFP in the cytoplasm. If this system works as hypothesized, LucR will be replaced with a pro-apoptotic gene that should induce apoptosis only in HIV-infected cells.

## THE DOSE DEPENDENT EFFECTS OF CAFFEINE ON COGNITIVE PERFORMANCE AND NEURONAL ACTIVATION

Helen Morris and Michelle Vieyra  
University of South Carolina Aiken

People often assume that the more caffeine you drink, the more focused you can become, and students are drinking caffeinated beverages more than ever. Over-consumption of caffeine has many negative effects including bouts of nausea, gastrointestinal upset and cardiovascular issues. If there are no dose related cognitive benefits to caffeine consumption people should limit their intake and look to healthier alternatives, such as improved diet, exercise or sleep patterns. This study compared cognitive performance after consumption of 0mg, 100mg or 200mg caffeine. It also looked at the whether there would be a correlation between cognitive performance and neuronal activation at these different doses. Sixty-six participants were tested in three separate trials after receiving either 0mg (placebo), 100mg or 200mg caffeine tablets. In each trial, participants performed the N-back memory test while an fNIR (functional Near-Infrared) recorded neuronal activity. Preliminary results show that scores on the N-back task improved with the consumption of 100mg of caffeine as compared to the placebo; however improvements decreased in the 200mg trial. This suggests that cognitive performance is highest with low doses of caffeine. Neuronal activation decreased over baseline in the 0mg trial on all cognitive tasks. There was an increase in neuronal activation in both caffeine trials which was greatest in the 100mg trial while performing easier tasks and the 200mg trial while performing the harder task. The results suggest that there is not a correlation between increases in neuronal activation and cognitive performance.

## USING MAB M24-2 (A FISH LYSOZYME) TO EXAMINE THE HOST-PARASITE RELATIONSHIPS IN LIVERS OF THE FISH FUNDULUS HETEROCLITUS FROM NO

Lillian Neal and Marlee B. Marsh  
Columbia College

Fish innate immune responses are routinely evaluated as indicators of immune function and status following exposure to pathogens, biological response modifiers, immunotoxicants, and nutritional regimes. Recently, we developed monoclonal antibody (mAb) M24-2 that recognizes lysozyme in several species of fish (E.g. Fundulus heteroclitus) used in comparative immunological studies. Lysozyme is found in macrophages and neutrophils and is one of several humoral and cellular factors

associated with innate immunity in all vertebrates. The purpose of this study was to use mAb M24-2 to examine cellular profiles of immune cells in livers of parasite-infected and uninfected livers of 50 fish from Belle Baruch Marine Sanctuary in Hobcaw Barony (Georgetown, SC.) There are only a paucity of reagents available to examine the cellular mechanism of fish immune response and mAb M24-2 has been successful tool thus far. Furthermore, we hope to elucidate any direct role(s) of neutrophils and macrophages in fish immune responses to parasites. Data collection is still in progress and will be completed by March. In this study, we probe paraffin-embedded livers of *F. heteroclitus* and compare the lysozyme profiles of parasite-infected vs. uninfected individuals.

#### THE ANTI-PROLIFERATIVE EFFECTS OF LAMIUM AMPLEXICAULE EXTRACTS ON HUMAN T-LYMPHOCYTES

Braxton Noll and Diana Ivankovic, Frank Norris, Donna Weinbrenner  
Anderson University

In this experiment I tested various concentrations of *Lamium amplexicaule*, (commonly known as henbit dead-nettle) extract on human Jurket (T-Cell leukemia) cells. The main goal was to determine an effective extract dose that induces an apoptotic death within the cells, with the main focus on one chemical constituent of the extract, Caffeic acid Phenyl-ethyl Ester. Caffeic acid phenyl-ethyl ester has been shown to induce an apoptotic death through mitochondrial membrane potential disruption by interrupting the proton motive force, that in turn halts ATP synthase, and without any energy to the mitochondria the cytochrome c is released and signals for whole cell apoptotic death. With various concentrations of the extract the LD50 was determined to be 3 mg/mL, which half the cells in culture were killed when exposed to the extract. The main methods of determination of these numbers were through various dye exclusion assays, MTS assays, and fluorescent staining.

#### ERRONEOUS DROP SIZING IN IMPACT DISDROMETERS

Kate O'Dell and Dr. Michael L. Larsen  
College of Charleston

Recent studies have found small raindrops to fall at velocities exceeding their expected terminal velocity. The Joss-Waldvogel disdrometer, which utilizes pressure sensors and the terminal velocity of raindrops to determine their size, would thus produce an erroneous inferred raindrop size. The magnitude of this effect was investigated using two dimensional video disdrometer data for several storms in South Carolina to infer Joss-Waldvogel-like disdrometer data. Z and R relationships were found using both the two dimensional video disdrometer data and the inferred pressure sensor disdrometer data. Differences between the resulting Z-R scatter plots and statistical fits were explored.

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

Daymond Parrilla and C. Nathan Hancock  
University of South Carolina Aiken

Transposable elements are DNA sequences that have the ability to move from one location to another in the genome. These elements can be used as tools to for mutagenesis and gene discovery. The focus of this study is the transposable element mPing, a 430-bp deletion derivative of the natural occurring Ping element that exhibits high transposition activity and can reach a high copy number in rice. In comparison, mPong, an artificial deletion derivative of the natural occurring Pong element exhibits low transposition activity. The question we are trying to address is which regions of the mPing element control its transposition and allow it to be so much more active than other elements. By comparing chimeric constructs of mPing with mPong we were able to identify a region in the first half of the element (90-215bp) that could potentially promote transposition in mPing. Similarly, by screening a library of mutagenized mPing elements, we identified high and low activity mutants, each having approximately 7 base changes from the original mPing. Analysis of one of mutants that has high activity (mmPing20) suggests that the region between 260-360bp may inhibit mPing's transposition. To analyze these regions further, we performed assays on elements in which these regions have been deleted. These constructs also provide a platform to help answer the question of what role these regions play in the transposition success of MITEs.

#### DIURNAL RHYTHMS OF NEAR SURFACE WINDS' POWER SPECTRUM

Alexis Payne and Dr. Michael L. Larsen  
College of Charleston

Our project studied near surface winds' power spectrum and its shift through a diurnal cycle. Data was gathered using three sonic anemometers located within the atmospheric surface layer (less than 2 meters above the surface). The 1D fast Fourier transform was calculated for the data, and the data was analyzed using traditional tools, i.e. the power spectrum. Subdividing the data into pieces, the shift in wind's statistical structure is explored. A diurnal signal is anticipated due to the total power of wind coupled to daylight. The way the structure shifts through the day is presented.

## THE SEARCH FOR LYTIC BACTERIOPHAGES WITHIN THE POPULATION OF COASTAL CAROLINA UNIVERSITY STUDENTS

Amy Powers and Paul E. Richardson  
Coastal Carolina University

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

The rise in antibiotic resistant bacteria has resuscitated 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.

## BACTERIOPHAGES FOR *ESCHERICHIA COLI* AND *STAPHYLOCOCCUS AUREUS* PRESENT WITHIN THE STUDENT POPULATION

Derek Pride and Paul E. Richardson  
Coastal Carolina University

There is a growing medical concern regarding bacterial resistance to antibiotics. Therefore, the quest to find an alternative treatment for bacterial infections through the use of bacteriophages was undertaken. A bacteriophage (phage) is a virus that solely infects bacteria, and they are commonly found behind the ear and inside the nostrils. Coastal Carolina University students volunteered to be swabbed in these locations in attempts to sequester phages for additional study. The samples were filtered and plating techniques were performed to identify the potential presence of phages; capable of lysing *Escherichia coli* (*E. coli*) or *Staphylococcus aureus* (*S. aureus*). Once found, the phages were confirmed and classified using polymerase chain reaction (PCR) and gel electrophoresis.

## PROBING THE ENTRYWAY FOR INFECTION: AN EXAMINATION OF THE GI TRACTS OF FUNDULUS HETEROCLITUS FOR IMMUNE RESPONSES TO METACESTODE

Mara Reiss and Marlee B. Marsh  
Columbia College

Fifty *Fundulus heteroclitus* from the North Inlet Estuary at Hobcaw Barony in Georgetown, South Carolina, were collected and examined for parasites. The predominant parasite found were metacestodes located in abdominal mesenteries and in the livers. *F. heteroclitus* acquire this parasite through their diet, and parasites must penetrate the gastrointestinal tract to establish infection. Fish innate immune responses are routinely evaluated as indicators of immune function and status following exposure to pathogens, biological response modifiers, immunotoxicants, and nutritional regimes. Recently, we developed two monoclonal antibodies (mAb) that are useful in identifying fish innate immune cells. mAb M24-2 recognizes lysozyme in several species of fish and has been used in comparative immunological studies. Lysozyme is found in macrophages and neutrophils and is one of several humoral and cellular factors associated with innate immunity in all vertebrates. mAb 2C11 recognizes eosinophilic granular cells in fish- a cell whose presumed function is similar to that of the mammalian eosinophil (anti-parasite). The purpose of this study is to use these antibodies to examine cellular profiles of immune cells in the gastrointestinal tract of parasite-infected and uninfected gastrointestinal tracts. The data collection is currently in progress and will conclude in early March.

## CHARACTERIZATION OF IMMOBILIZED RUTHENIUM(II) EMITTERS INTERCALATED DIACETYLENE SELF-ASSEMBLED LAYERS

Nathan Rivers and Laura Wright  
Furman University

Diacetylene (DA) self-assembled monolayers (SAMs) have the ability to allow intercalation of other compounds and become immobilized by irradiation. Because of these unique characteristics, it has a wide variety of potential uses such as biological sensors, microelectronics, or adhesives. Herein we report the synthesis and characterization of PDA self-assembled mono- and multilayers on high grade ultraflat mica using ethanol as a solvent. Characterization was done by atomic force microscopy (AFM), fluorescent microscopy, and contact angle. Optimal conditions for the formation of SAMs of 10,12-octadecadiynoic acid

(DA) were found to be a soak time of 45 seconds in 1mM solutions. 10,12-octadecadiynamide,N-1,10phenanthrolin-5-yl (DAphen) was synthesized to use as a ligand on a ruthenium (II) complex. Using this ligand, bis(2,21-bipyridyl)(10,12-octadecadiynamide-N-1,10phenanthrolin-5-yl)ruthenium (II) hexafluorophosphate (RuDAphen) was then synthesized. RuDAphen was intercalated into the DA SAMs on mica, photopolymerized, and characterized through AFM, fluorescent microscopy, and contact angle.

A PHOTOMETRIC STUDY OF AH HERCULIS  
Christopher Sherman and William Baker, David Moffet  
Furman University

The objective of this study is to make an analysis of the Z-Cam type, cataclysmic variable AH Herculis (AH Her). Specifically, to add any information about the current state of the star that is lacking and to look for changes in the star system over the past fifty years with archival data from the American Association of Variable Star Observers (AAVSO). With this information we can better predict the dynamical evolution of cataclysmic variables.

CLONING AND EXPRESSION OF THE DNA BINDING DOMAIN OF FOXO FROM CIONA INTESTINALIS THAT  
CONTAINS AN N-TERMINAL NUCLEAR LOCALIZATI  
Mikala Smith and Dr. Heather Evans-Anderson  
Winthrop University

FoxO proteins are a subgroup of the Forkhead family of transcription factors. FoxO proteins are highly conserved and regulate expression of genes that control a wide variety of cellular processes including: apoptosis, cell differentiation and proliferation, and atrophy. *Ciona intestinalis* is a useful model system to study developmental biology, particularly heart development since all chordates share a conserved cardiac gene program as well as similar cellular processes during development. *Ciona* FoxO (ciFoxO) protein is very similar to the FoxO1 protein in humans. In order for ciFoxO to transcriptionally regulate gene expression, it must localize to the nucleus. The major goal of this project is to add a nuclear localization signal (NLS) to an expression vector containing ciFoxO sequence that will be electroporated into *Ciona* embryos where it will be expressed. The N-terminal NLS will direct the exogenous ciFoxO sequence to the nucleus of cells where it will be able to bind to target DNA sequences in the *Ciona* genome. The ultimate goal is to express ciFoxO constructs containing a NLS in vivo and then isolate chromatin in order to perform a ChIP-Seq assay to determine ciFoxO target genes. The ciFoxO target genes will be compared to vertebrate FoxO1 target genes to determine the level of conserved function of FoxO family members in chordates during heart development. To date, we have successfully inserted the NLS into the vector and produced dechorinated embryos; electroporation optimization is under way.

The project described was supported by NIH Grant Number P20 RR-16461 from the National Center for Research Resources for support of the program entitled "South Carolina IDeA Networks of Biomedical Research Excellence" (SC-INBRE); NIH Grant Number 1R15HL104587-01(HJEA) from the National Heart, Lung, and Blood Institute and SC Experimental Program to Stimulate Competitive Research and Institutional Development Awards (EPSCoR/IDeA) Science Affiliate Network grant (HJEA and NG).

BUILDING CONSTRUCTS FOR CATHEPSIN K-MEDIATED EXPRESSION OF EGFP OR MCHERRY TO STUDY BONE  
RESORPTION IN THE DEVELOPING ZEBRAFISH  
Brianna Snelling and April DeLaurier  
University of South Carolina - Aiken

The goal of this project is to use transgenic reporter lines to study osteoclast activity in the developing zebrafish so as to better understand how the processes of bone formation (by osteoblasts) and resorption (by osteoclasts) shape the skeleton. Fluorescent reporter lines that label specific cell populations allow the study of the role of cells in tissue patterning during development. This project aims to use eGFP and mCherry as reporter genes under the control elements of cathepsin K to study osteoclast activity in the developing embryo. A construct containing regulatory elements of cathepsin K driving eGFP, along with a transposon element iTol2 has been constructed (ctsk:EGFP-iTol2), and generation of a construct containing mCherry (ctsk:mCherry-iTol2) in the place of eGFP is in progress. Once both constructs are completed, they will be microinjected into separate 1-cell stage zebrafish embryos to generate germ lines expressing EGFP or mCherry in osteoclasts. Using these osteoclast reporter lines along with lines created previously that label osteoblasts (sp7:EGFP), we will observe how osteoclasts and osteoblasts work together to shape bones during development and maintain homeostasis of bone matrix in the adult fish. Understanding how the skeleton is formed in development and maintained throughout life in zebrafish has implications for studying developmental diseases and osteoporosis in humans.

MONITORING ACTIVITY PATTERNS OF THE AMERICAN CROW (*CORVUS BRACHYRHYNCHOS*) POPULATION ON  
THE CAMPUS OF FRANCIS MARION UNIVERSITY  
Morgan Soulantikas, Jeff Steinmetz, and Paul Zwiery  
Biology Department, Francis Marion University

The American Crow (*Corvus brachyrhynchos*) also known as the “Common Crow”, is a medium-sized, stocky, black, perching bird of the Corvidae family. American Crows mainly reside in woodland, farmland, and also suburban areas. They require open spaces for ground feeding, but scattered trees, woodlots, and forest edges must be present in order for the birds to have a safe place to nest and roost. The campus of Francis Marion University provides a sufficient habitat in which American Crows can thrive.

In this study, bioacoustic monitoring equipment was used to collect data on the population of American Crows living in the campus area from August 2013 to March 2015. A double-microphone recording unit was placed in several wooded regions across FMU's campus for the span of three to five days at a time. Recorded files were then analyzed by using Song Scope Software where aural activity was displayed as a sound spectrogram. From this format, the distinctive “caw-caw” call of the American Crow could be easily identified and used to determine the exact hours throughout the day when the birds are most vocally active. American Crows residing in the area were most active and produced the highest number of vocalizations between the hours of 7:00am and 12:00pm. Also, seasonal changes and weather factors were discovered to have significant effects on the overall activity of this population. Furthermore, the specific types of crow calls were identified by recognizing various patterns in frequency levels and call length. Seasonal changes can account for the variation in different types of calls throughout the year.

UTILIZING CHIRAL CAPILLARY ELECTROPHORESIS IN THE SEPARATION AND ANALYSIS OF NOVEL Cr(III)  
COMPLEXES EXHIBITING DNA PHOTOCLEAVAGE  
Christopher Stachurski and John Wheeler  
Furman University

Over the past decade there has been increased interest in identifying biologically active transition metal complexes that exhibit efficient yet selective chemotherapeutic properties. Traditional therapeutics including cisplatin ( $\text{PtNH}_2\text{Cl}_2$ ) have shown to be effective DNA double strand cleavers yet fail to show any form of selectivity in determining the affected cells. Recently our labs have synthesized and characterized a variety of homoleptic, bis- and tris-heteroleptic Cr(III) complexes in the form of  $[\text{Cr}(\text{diimine})_3]^{3+}$  or  $[\text{Cr}(\text{diimine})_2\text{X}_2]^{3+}$  exhibiting photoactive DNA cleaving properties. In support of this effort, the use of chiral capillary electrophoresis (CCE) has allowed for simultaneous assessment of product purity and as precise enantioseparation. Despite similar structures our Cr(III) complexes exhibit vast chemical diversity between compounds and as such numerous commercially available chiral additives including antimonyl-d-tartrate, dibenzoyl-L-tartrate, and b-sulfated cyclodextrin have been employed in the search for ideal separation conditions. In general, compounds containing smaller diimine ligands (e.g., 1,10-phenanthroline) demonstrate superior resolution with antimonyl-d-tartrate. Consequentially larger, hydrophobic ligands (e.g., dipyrrophenazine) have shown complete resolution using dibenzoyl-L-tartrate. Results obtained from tartrate salts and cyclodextrins will be presented.

A PRELIMINARY STUDY OF THE VASCULAR FLORA OF STRAWBERRY SWAMP, GEORGETOWN COUNTY, SOUTH  
CAROLINA

R. Stalter, K. Arjune, R. Kerns, E. Mieses, and M. Singh  
Department of Biology, Saint John's University  
W. Conner, S. Hutcheson  
School of Forestry, Clemson University  
J. Baden  
Former Researcher, Belle W. Baruch, South Carolina

The objective of this preliminary study is to investigate the vascular flora at Strawberry Swamp at Hobcaw Barony. Vouchers of vascular plant species collected at this site will be housed at the A. C. Moore herbarium at the University of South Carolina. The study was initiated in October 2014 and will be terminated around October 2016. A preliminary list of the flora includes 82 species in 70 genera within 54 families. Only two non-native taxa have been identified to date, *Sapum sebiferum* and *Phragmites australis*. Salinity, conductivity and pH of the water and soil at the site will be provided by Clemson University scientists at several sites within the swamp. Salinity at the swamp may vary according to rainfall as some years may be drier or wetter than others. We will also monitor and map the spread of *Phragmites australis* as this non-native taxon generally can out compete other vascular plant species. We have observed monocultures of *Phragmites* in portions of three of our abandoned rice field study sites and expect *Phragmites* may have the same impact here where it becomes established. As sea level rises this century swamp vegetation may be replaced by marsh taxa. Ultimately, salt tolerant taxa such as *Spartina alterniflora* may eventually colonize the site.

## 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.

## CONFORMATIONAL ISOMERIZATION AND CHEMICAL REACTIVITY INDICES OF BUT-2-ENEDIOIC ACID: - A COMPUTATIONAL STUDY

Britney Stewart and Dr. Johnson Agbo  
Coastal Carolina University

The gas phase conformational isomerization of trans-butenedioic acid is studied computationally. The potential energy surface is explored using ab initio methods and the reaction pathway is studied using density functional theory (DFT) at B3LYP level of theory. The kinetic and thermodynamic properties of this reaction are calculated at the B3LYP level using the augmented correlation-consistent polarized Valence-only Double Zeta (aug-cc-pVDZ) basis set. The isomerization rate constants are determined using the Rice-Ramsperger-Kassel (RRK) theory and the transition state (TST) theory at 298 K and 1.00 atm. The HOMO – LUMO energies are used to compute the chemical reactivity indices.

## TARGETED INSERTION OF THE TRANSPOSABLE ELEMENT, MPING

Ashley Strother and C. Nathan Hancock  
University of South Carolina Aiken

Transposable elements, including mPing from rice, are mobile pieces of DNA that move throughout the genome through a cut-and-paste mechanism. mPing, is mobilized by two proteins, ORF1 and Transposase, encoded by the autonomous transposons, Ping and Pong. This element preferentially inserts in gene-rich regions and has high transposition activity, making it a great tool for disrupting genes to determine gene function. Our overall goal is to design a mechanism that would allow mPing insertion to be directed to a specific location within an organism's genome. If mPing insertion can be targeted to specific sequences, specialized mutagenesis applications, including disruption of gene function and alteration of promoters, could be performed. The resulting mutant phenotypes could then be compared to control plants, allowing researchers a better understanding of the targeted gene's function. Our strategy is to fuse the Transposase protein with the Cas9 D10A protein from the CRISPER/Cas9 system. Cas9 D10A is a partially disabled version of the Cas9 protein, which has a targeted endonuclease activity. The Cas9 D10A protein is guided by a gRNA that can be synthesized to correspond to any target site within the genome. To determine if targeted insertion of mPing is possible, we fused the Cas9 D10A protein to the N-terminus of the Transposase protein. The targeted sequence was the CAN1 gene that when mutated will allow yeast to grow on plates containing the toxin canavanine. We tested if expressing the Cas9 D10A Transposase fusion protein along with the ORF1 protein in the presence of mPing and the gRNA would impact the transposition rate and location of mPing insertions.

## CHARACTERIZING A NEW METHOD OF HARVESTING ENERGY FROM THE NATURAL ENVIRONMENT AND EXPLORING THE PHYSICS OF THE TRIBOELECTRIC EFF

Ryan Michael Sullivan and Dr. Alem Abraha Teklu  
College of Charleston

A prototype DC triboelectric generator (DC-TEG) is presently undergoing a proof of concept investigation to determine its feasibility as a new system for harvesting energy from the natural environment. The DC-TEG converts rotational motion into electrical energy through the utilization of the triboelectric effect between Nylon and PTFE in its design. Preliminary results show that the DC-TEG generates several open-circuit DC voltages. Also, the output current is measured to be directly proportional to the tangential velocity of the rotating triboelectric-wheels (TWs) and it remains constant with changes in the contact force associated with the triboelectric interface (TI). Future work will determine the time it takes to charge a capacitor, the quantitative relationships between the contact force at the TI and the tangential velocity of the TWs with the output current, and also to place constraints on the minimum distance between the triboelectric materials that yield measurable charge separation.

## ENZYMATIC COMPLEMENTATION TO IMAGE CELL SURFACE MARKERS

Michelle Sutton  
Morris College

Molecular imaging provides unique biological information that cannot be revealed by conventional imaging. Since malignancies overexpress certain membrane receptors, probing changes in gene expression that lead to phenotypic alterations will make it possible to detect cancers earlier and with more specificity. The ultimate goal of this project was to design and develop a molecular imaging system capable of detecting the presence of multiple markers. In order to achieve this goal, a construct must be designed with an imageable probe conjugated to antibodies. This construct will bind to specific cell surface proteins (via the antibodies) and will be visualized through molecular imaging modalities. The probe of choice is the enzyme  $\beta$ -galactosidase ( $\beta$ -gal), which can be broken into discrete subunits, allowing imaging of multiple cell surface markers simultaneously. Our current studies demonstrate that we can target the  $\beta$ -gal to specific cells overexpressing a biomarker and that it is internalized within the cells.

## USING VOLUME FRACTION AS A STATISTICAL MEASURE OF THE RAINDROP SIZE DISTRIBUTION

Joshua B. Teves and Professor Michael L. Larsen  
College of Charleston

Using a dense optical rain gauge array near Charleston, SC, a novel measure of rain is used to categorize and analyze storm behavior. Using 14 non-overlapping raindrop size categories, the fractional contribution of each size category to overall accumulation is determined. This "accumulation contribution fraction,"  $f_a$ , is calculated for a range of time-averages from one minute to one hour for each instrument in the array. Relationships between these accumulation contribution fractions are investigated.

## NMR BASED METABOLOMICS STUDY OF CHROMIUM(VI) TREATED PSEUDOMONAS FLUORESCENS

Yugaananthy Thanaiiah and Dr. Randall H Harris  
Claffin University

Soil and groundwater contamination by heavy metals from nuclear waste and industrial waste is one of the major problems found at sites within the United States. Out of the 1699 sites on the National Priorities List from the Superfund Program administered by the Environmental Protection Agency, 1127 sites were reported to be highly contaminated with the heavy metal chromium. Even though chromium(VI) has been discovered as a strong carcinogen, chromium(III) is reported to be less toxic. Bioremediation uses microorganisms to transform hazardous contaminants into forms that are less toxic than the parent materials and is considered to be a cheap and environmental friendly method. *Pseudomonas fluorescens* species were reported to reduce highly toxic chromium(VI) to a less toxic chromium(III).

In this study, we use NMR based metabolomics to study the changes in metabolic pathways due to chromium stress on *P. fluorescens* Pf-5. *P. fluorescens* Pf-5 over night cultures containing 50 ppm  $K_2Cr_2O_7$  were incubated at 25C with shaking (200 rpm) for 6h and 24h. At each time point, samples were collected and processed to obtain bacterial pellets. The polar metabolites were extracted from the pellets through a methanol/water two phase solvent extraction process. The polar phase was dried and dissolved in NMR buffer. The NMR samples were analyzed using Bruker 700 MHz NMR. The results were statistically analyzed using Principal Component Analysis (PCA). Distinct metabolic profile separation was observed between each sample group (6h control versus 6h chromium stressed, 24h control versus 24h chromium stressed). Among all combinations, the metabolic profile separation observed between control samples at 24 h and chromium stressed samples at 24 h was most prominent. The metabolic profile separation observed in PCA suggests that the chromium stress could have induced a change in the metabolic pathway of *P. fluorescens* Pf-5. Currently, further research is being conducted to analyze and identify potential critical metabolic pathways responsible for chromium resistance in *P. fluorescens* Pf-5 that can serve as a possible biomarker of chromium resistance.

## THE EFFECTS OF CHRONIC STRESS, EXERCISE AND SUGAR CONSUMPTION ON BODY WEIGHT AND FAT PERCENTAGE IN RATS

Christina Thomas and Michelle Vieyra  
University of South Carolina Aiken

The objective of this study was to examine body weight and fat percentage in rats depending on three variables: exercise, sugar intake, and chronic stress. Previous studies have shown a relationship between obesity and each of these variables but not in combination. Twenty one female Sprague-Dawley rats were exposed to a four week period of chronic stress prior to a six week period of sugar/ exercise treatments. Stressors included alterations to light cycles, moist bedding, predator sounds, and cage switching. At the initiation of the study baseline data was collected including results of behavioral tests of stress and urinary cortisol levels. Baseline tests were completed again at the end of the chronic stress period and at the conclusion of the study. The rats were divided into four groups receiving either 1) 10% sugar solution and exercise 2) 10% sugar solution and no exercise 3) exercise without sugar 4) no sugar or exercise (control). At the conclusion of the study, the rats were sacrificed and fat was collected from the body wall and genitals. The average body weight and fat percentage was calculated for each group. Results of this study suggest that even when allowed to exercise, rats that consumed sugar had approximately four times higher body fat percentage than those that did not. In previous work by this lab, rats that consumed sugar and



exercised had significantly less fat than those that ate sugar alone. The chronic stress may have overridden some of the benefits of exercise in this study.

#### THE EFFECT OF DIETARY PHYTOESTROGEN ON THE ESTROUS CYCLE OF WISTAR RATS

Reshma Thomas, Nichole Tackett, and Edna Steele

Department of Biology, Chemistry and Physics, Converse College

Over the past few decades, there has been a steady decline in the age of menarche. This decline can be correlated with an increase in obesity and other health issues. There is a belief that this shift parallels with an increased consumption of high levels of dietary phytoestrogen, a common endocrine disrupting chemical present in the environment. Phytoestrogens are plant-derived chemicals that mimic the action of estrogen and could have an effect in the physiology and development of animals and humans. To study the effect of dietary phytoestrogen on the onset and characteristic of estrous cycle, vaginal secretions of 30 prepubescent (21-day old) Wistar rats were examined over the course of 3 months. The rats were randomly assigned into one of three groups: experimental, negative control, and positive control. The experimental group was fed a soy-based isoflavone-enriched diet while both control groups were fed an isoflavone-free diet. The positive control group received estradiol injections and the rest received placebo injections. All three groups started their estrous cycles within a few days of one another illustrating menarche was not linked to a change in the estrogen levels in the body. No definite inconsistencies within the cycles were visible throughout the course of the experiment. The level of phytoestrogen in the rat diet may not be high enough to produce an estrogenic effect on the rats. However, the weight was noticeably higher in rats with increased levels of estrogen.

#### DESIGN AND TESTING OF A RAINDROP VELOCIMETER

Derek Tuck and Dr. Michael L. Larsen

College of Charleston

Using affordable laser diodes and photodetecting transducers, a simple instrument was constructed. This instrument is designed to be capable of measuring raindrop arrival times at two locations with known vertical offset. Acquired data includes the fall speeds of large raindrops with the ultimate goal of identifying and analyzing drops falling slower than their terminal velocities. Here we present results from the early calibration and testing phases of the instrument prototyping process.

#### SYNERGISTIC EFFECT BETWEEN CAFFEINE AND SUGAR ON COGNITIVE PERFORMANCE

Sandra Urquiza and Michelle Vieyra

University of South Carolina Aiken

Many studies confirm that, working independently, both caffeine and sugar provide benefits to attention and memory. However, there is sparse literature on the synergistic effects of caffeine and sugar on improved cognitive performance when taken together. In this study, we explored the dynamics between caffeine and sugar when consumed under ordinary conditions – as a cup of coffee. 25 undergraduate students (16 women, 9 men) were asked to refrain from consuming caffeinated products for 12 hours and to fast 4 hours prior to the study. At the start of the session, participants completed a baseline cognitive test and one of the three variables was given at random in the form of a cup of coffee: decaffeinated with sugar (to assess performance after consuming only sugar), caffeinated with no sugar (to assess performance after consuming only caffeine), and caffeinated with sugar (to assess synergistic effects on cognitive performance between caffeine and sugar). The remaining two variables were administered over the next two sessions. After each variable, participants completed the same cognitive test, and results were compared within subjects and between subjects to assess effects on short-term memory and cognitive performance. Our hypothesis was that there would be a significant improvement on short-term memory by way of correct responses and shorter response times in the sessions where caffeine and sugar were consumed simultaneously vis-à-vis the caffeine or sugar independently. With the results of this study, we hope to elucidate the most effective way to consume this ubiquitous drink.

#### IDENTIFYING THE GENE UNDERLYING A JAW MUTATION IN ZEBRAFISH

Kayce Vanpelt and April DeLaurier

University of South Carolina Aiken

A line of mutant zebrafish discovered in a forward genetics screen was determined to have defects of jaw cartilage including fusions, and abnormal shaping of 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 the aforementioned frame have already been sequenced, but none of the gene sequences have shown significant differences from the wild type (non mutant) zebrafish sequences. Further sequencing has been performed by designing primers to amplify candidate genes, and those results are being analyzed for possible mutations. If data analysis shows nearly identical sequences between mutant and wild type zebrafish, a reverse genetics approach will be taken by employing the CRISPR/Cas9 system as a mutagenesis tool. This study has the potential to reveal an entirely new gene or gene pathway involved in skeletal joint formation that could be applied to human disease research.

## PHASE RESETTING OF NEURAL OSCILLATORS SUBJECT TO MULTIPLE INPUTS

Kelsey Vollmer and Sorinel Oprisan  
College of Charleston

External stimuli, such as presynaptic inputs, reset the phase of neural oscillators. The phase resetting curve (PRC) determines the advance or delay of an action potential based on the strength and timing of the presynaptic stimulus. Since neural oscillators are nonlinear systems, the neural response to a set of external stimuli is not the sum of responses to an individual stimulus. We developed a systematic and consistent mathematical approach to predicting the phase resetting induced by multiple stimuli that arrive during the same activity cycle of a neural oscillator. Our approach is independent of oscillator's biophysical details and generalizes the single-stimulus PRC.

## OPTIMIZING IN VITRO FERTILIZATION PROCEDURES IN ZEBRAFISH

Madelyn Wasden  
University of South Carolina Aiken

There are currently over 20,000 mutant and transgenic zebrafish lines used to study genetics, toxicology, human medicine, and so much more. 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 yields consistently successful fertilization, many of these lines are at risk. I aim to increase the success and consistency of the in vitro protocol, specifically the sperm freezing and thawing process, for our lab so that we may be able to continue Dr. DeLaurier's invaluable work and research with zebrafish. I will begin by applying principles of cryobiology to the protocol as well as errors in gamete handling and pooling. After identifying problem areas in the protocol that are affecting fertilization, I will begin isolating each method and testing it for success. By process and elimination I hope to narrow down the various elements and steps of the sperm freezing and thawing process that are crucial to egg fertilization. Once I have established a protocol that has proved successful, Dr. DeLaurier and future lab members will have a standardized system by which to further these mutant and transgenic lines.

## SIRNA-MEDIATED DOWNREGULATION OF AN ESSENTIAL HIV REGULATORY PROTEIN

Emily M. Webb and William H. Jackson, PhD.  
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. Eight to ten years after initial infection, if treatment is not available, HIV infection 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 small double-stranded RNA molecules, particularly 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 a HIV gene that encodes an essential regulatory protein known as 'tat'. The presence of tat is not only required to up-regulate viral transcription, but is also crucial for successful HIV replication. Our lab has designed four siRNAs that each targets a specific site within the HIV tat gene. These anti-HIV tat siRNAs were subsequently converted to double-stranded DNA and cloned into a vector under the control of the RNA polymerase III H1 promoter. Preliminary results suggest these anti-HIV tat siRNAs are successfully downregulating the target gene. Currently, our research is focusing on optimizing the delivery of the anti-HIV tat siRNAs and measuring their activities through multiple assays.

## INVESTIGATION OF AHR ANTAGONISTIC EFFECTS OF GANODERMA LUCIDUM

Erica Williams<sup>1</sup> and Neval Erturk<sup>2</sup>  
<sup>1</sup>Furman University    <sup>2</sup>Converse College

The aryl hydrocarbon receptor (AhR) is a ligand-activated transcription factor. It regulates the responses of the cell to a variety of polyaromatic hydrocarbons (PAH). AhR mediated toxicity to these chemicals is associated with a variety of pathological conditions, including cancer. Therefore AhR modulation currently is studied as an important physiological process. Ganoderma lucidum (reishi) is a popular fungal supplement used to prevent and treat a variety of illnesses including cancer. Here we report antagonist effects of the reishi water extract on AhR activation. Real-time RT-PCR was used to measure CYP1A1 gene expression in MCF-7 cells treated with the supplements and 2,3,7,8-Tetrachlorodibenzodioxin (TCDD). Cells treated with TCDD alone showed an increase in expression of CYP1A1. This suggests that Ganoderma contains compounds that are AhR antagonists. Further research by using fractionated reishi extract will be conducted in order to isolate and identify the compound (s) that acts as an AhR antagonist.

Acknowledgements: This research was funded by South Carolina IdEA Networks of Biomedical Research Excellence (SC-INBRE). National Institutes of Health 2P20 RR016461, 2010-2015.

## SYSTEMATIC SYNTHESIS OF CORE-SHELL-SHELL NANOPARTICLES WITH MINIMAL DISSOLUTION

Yvonne Wright  
Morris College

Nanoparticles (NPs) are being rapidly incorporated into a wide variety of commercial products (Alvarez *et al.*, 2009), which increases their potential for environmental release. Silver (Ag) NPs are widely used for their antibacterial properties causing an increased risk and hazard to the environment, thus, causing toxicity to biota (Fabrega *et al.*, 2011). There is debate over whether toxicity is due to dissolution of the Ag NPs or to the injection/uptake of the NPs. Here, we report a systematic method of creating tri-layered NPs with an Ag core, Au inner-shell and Ag outer-shell. A thick Au inner shell was used to prevent the Ag core from dissolving. We exposed the AgAuAg NPs to moderately hard OECD water for a 24 hour period and found that the Ag outer shell is rapidly removed. It was observed that the UV-visible spectra red had shifted from 492.5 nm to 510 nm within 24 hours with the spectra being characteristic of a Au NP. The dissolution was measured with ICP-OES and showed Ag dissolution but no Au dissolution. Eventually this synthesis method will be used to create NPs with the core made out of the isotopes, Ag 107 and Ag 109. We will then be able to definitively pinpoint the location of the two isotopes of silver and so the fate and transport of these NPs.

## ROS-MEDIATED NEURODEGENERATION IS INDEPENDENT OF THE RYANODINE RECEPTOR IN CAENORHABDITIS ELEGANS

Lyndsay Young and Daniel Williams  
Coastal Carolina University

Despite the significant impacts on human health caused by neurodegeneration, our understanding of the degeneration process is incomplete. Two factors that contribute to neurodegeneration are excessive neuronal excitability (excitotoxicity) and stress due to reactive oxygen species (ROS). The nematode *Caenorhabditis elegans* is an emerging genetic model organism used to identify cellular mechanisms and molecular pathways of neurodegeneration. Disruption of the gene *unc-68*, which encodes the ryanodine receptor, abolishes excitotoxic cell death, indicating a role for Ca<sup>2+</sup> signaling in neurodegeneration. We tested the requirement for *unc-68* in ROS-mediated neurodegeneration using the genetically encoded photosensitizer KillerRed. Upon illumination of KillerRed expressing worms to produce ROS, we observed similar levels of degeneration in wild-type and *unc-68* mutant worms. Our results indicate that ROS-mediated cell death is independent of *unc-68* and suggest multiple molecular pathways of 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 – 9:30 AM</i>	<b>SCJAS Registration</b> <i>Continental Breakfast</i>	<b>Trone Student Center</b>
<b>8:30 AM – 12:00 PM</b>	<b>SCJAS Oral Sessions</b> <i>See SCJAS oral session listing for details &amp; room numbers</i>	<b>Furman Hall</b>
<b>10:15 AM – 10:30 PM</b>	<b>Break</b>	
<b>10:30 AM – 12:30 PM</b>	<b>Poster Session (with SCBASM)</b>	<b>Townes Science Center</b>
<i>You can put your poster up anytime between 8 a.m. and 10 a.m. (All posters must be on display by 10:00 a.m.)</i>		
<b>12:00 PM – 1:15 PM</b>	<b>Lunch</b> <i>Ticket is in your badge holder</i>	<b>Daniel Dining Hall</b>
<b>1:30 PM– 2:15 PM</b>	<b>Plenary Session</b>	<b>Burgiss Theatre; Trone Student Center</b>
<b>2:15 – 3:00</b>	<b>Governor’s Awards / Undergraduate Awards</b>	<b>Burgiss Theatre; Trone Student Center</b>
<b>1:30 PM – 4:00 PM</b>	<b>SCJAS Oral Sessions</b> <i>See SCJAS oral session listing for details &amp; room numbers</i>	<b>Furman Hall</b>
<b>2:30 PM – 4:00 PM</b>	<b>Afternoon SCJAS Activities</b>	
	Journey to the Center of the Atom	Meet at Trone Student Center
	Tour of Campus/Science Departments	Meet at Trone Student Center
	Planetarium Show	Meet at Trone Student Center
	Shi Center for Sustainability	Meet at Trone Student Center
<b>4:00 PM</b>	<b>SCJAS Pizza and drinks</b>	<b>Trone Student Center Watkins Room</b>
<b>4:00 PM - ???</b>	<b>SCJAS Awards Ceremony</b>	<b>Trone Student Center Watkins Room</b>

**SCJAS 2015 ANNUAL MEETING ORAL PRESENTATIONS  
FURMAN UNIVERSITY, APRIL 11, 2015**

**Biochemistry / Non-Mentored**

**Furman Hall 106**

- 8:30 a.m. Jane Lindberg and Vaibhav Bafna, Southside High School  
COMPARISON OF THE DIFFUSION OF ACETAMINOPHEN BY ITS FORMS
- 8:45 a.m. Farris Sabir, Southside High School  
EXAMINATION OF THE FLOW OF ACETAMINOPHEN
- 9:00 a.m. Dillon Harper, The Center for Advanced Technical Studies  
DEVELOPING AN OPTIMAL BIO-PETROL DIESEL BLEND TO MAXIMIZE ENGINE PERFORMANCE

**Biochemistry / Mentored**

**Furman Hall 106**

- 9:15 a.m. Sean Conway, South Carolina Governor's School for Science and Mathematics  
THE EFFECT OF HEPATOCYTE-SPECIFIC GLUCOCORTICOID RECEPTOR LOSS-OF-FUNCTION ON ARGINASE I EXPRESSION IN THE MOUSE LIVER UREA CYCLE
- 9:30 a.m. Elizabeth Grant, South Carolina Governor's School for Science and Mathematics  
INCREASING THE EFFICACY OF ANTITUMOR THERAPY: A LYSINE SPECIFIC DEMETHYLASE 1 INHIBITOR IN COMBINATION WITH 5-DEOXYAZACYTIDINE
- 9:45 a.m. Mitchell Mills, South Carolina Governor's School for Science and Mathematics  
GLYCOL CHITOSAN BASED NANOPARTICLES DELIVERING CISPLATIN FOR THE TREATMENT OF CANCER
- 10:00 a.m. Mayank Patel, South Carolina Governor's School for Science and Mathematics  
EFFECT OF INTERLEUKIN-6 ON TRANSLATIONAL CAPACITY IN C57BL/6 AND APCMIN/+ MICE

**BREAK**

- 10:30 a.m. Jamison Hite, South Carolina Governor's School for Science and Mathematics  
DETERMINING TBPEX13.2'S POTENTIAL FOR GLUCOSE-DEPENDENT LOCALIZATION IN TRYPANOSOMA BRUCEI
- 10:45 a.m. Ronit Kulkarni, Spring Valley High School  
DETERMINING EXPRESSION OF WILD-TYPE PLK1 AND DRUG-RESISTANT MUTANT C67V PLK1 IN CERVICAL CANCER CELLS
- 11:00 a.m. Thomas Stanton, South Carolina Governor's School for Science and Mathematics  
DYNAMIC REGULATION OF BIODIESEL PRODUCING ESCHERICHIA COLI BIOSYNTHETIC PATHWAYS

- 11:15 a.m. Joshua Pope, South Carolina Governor's School for Science and Mathematics  
ARTICULAR CARTILAGE AND ITS POTENTIAL FOR REGENERATION WHEN GROWN USING A NOVEL TECHNIQUE FOR CULTURING
- 11:30 a.m. Brooks Digh, South Carolina Governor's School for Science and Mathematics  
DETERMINATION OF THE PHOSPHORYLATION SITE OF THE REGULATOR OF IRON TRANSPORT IN STREPTOCOCCUS PNEUMONIA BY MASS SPECTROMETRY / LIQUID CHROMATOGRAPHY
- 11:45 a.m. Carlan May, South Carolina Governor's School for Science and Mathematics  
IMPACT OF TERT-BUTYL HYDROPEROXIDE CONCENTRATIONS IN RETINAL PIGMENT EPITHELIAL CELL MODELS IN VITRO

**Botany / Mentored**  
**Furman Hall 107**

- 8:30 a.m. David Strickland, South Carolina Governor's School for Science and Mathematics  
BUDGETING THE DEFENSE EFFICIENTLY: EFFECT OF NUTRIENT DEFICIENCY AND INSECT HERBIVORY ON TANNIN CONCENTRATIONS IN JAPANESE KNOTWEED
- 8:45 a.m. Trina Dinh, South Carolina Governor's School for Science and Mathematics  
GENETIC MAPPING OF ADVENTITIOUS ROOTING IN PEACH: CORRELATION OF GENETIC MARKERS AND ROOT SYSTEMS
- 9:00 a.m. Olivia Smithson, South Carolina Governor's School for Science and Mathematics  
LONG-TERM MONITORING OF HURRICANE HUGO'S EFFECTS ON SANTEE EXPERIMENTAL FOREST, NEAR CHARLESTON, SC
- 9:15 a.m. Angel Lopez-Akiyama, South Carolina Governor's School for Science and Mathematics  
MOLECULAR CHARACTERIZATION OF A BASAL ANGIOSPERM CINNAMYL ALCOHOL DEHYDROGENASE (CAD) HOMOLOG
- 9:30 a.m. TK Cornish, South Carolina Governor's School for Science and Mathematics  
UTILIZING ADVENTITIOUS ROOT VARIATION TO IDENTIFY THE CORRELATION BETWEEN ROOT FORMATION AND LEAVES IN PEACHES
- 9:45 a.m. Kendall Koon, South Carolina Governor's School for Science and Mathematics  
WARMING AND ELEVATED CARBON DIOXIDE INCREASES SUBERIN CONTENT IN THE ROOTS OF A C4 GRASS SPECIES
- 10:00 a.m. Rose Dellinger, South Carolina Governor's School for Science and Mathematics  
THE EFFECTS OF WARMING AND ELEVATED CARBON DIOXIDE ON THE SUBERIN COMPOSITION OF ROOTS: A CASE STUDY WITH A C3 PLANT SPECIES

**BREAK**

- 10:30 a.m. Charles Ison, South Carolina Governor's School for Science and Mathematics  
LONG-TERM MONITORING OF THE DECREASING UNDERSTORY AT HOBCAW BARONY'S CYPRESS FORESTS POST-HURRICANE HUGO

- 10:45 a.m. Kayla Owens, South Carolina Governor's School for Science and Mathematics  
LIRIODENDRON TULIPIFERA L. EST-SSR MARKER DEVELOPMENT FOR  
GENETIC LINKAGE MAP CONSTRUCTION
- 11:00 a.m. Adam Herbert, South Carolina Governor's School for Science and Mathematics  
FUNCTIONAL CHARACTERIZATION OF A NEWLY IDENTIFIED NICOTIANA  
TABACUM SULFATE TRANSPORTER GENE NTASULTR2 INVOLVED IN SULFATE  
TRANSPORT AND DISTRIBUTION

**Botany / Non-Mentored**  
**Furman Hall 107**

- 11:15 a.m. Rohan Brebion, Southside High School  
IRON UPTAKE IN DUCKWEED
- 11:30 a.m. Ruth Dibble and Kate Nassab, Heathwood Hall Episcopal School  
THE EFFECT OF HYDROPONIC GROWING TECHNIQUES ON THE AMOUNT OF  
VITAMIN C PRODUCED ON BRASSICA RAPA NIPPOSCIA
- 11:45 a.m. Jacob Brock, Spring Valley High School  
THE EFFECT OF PUERARIA MONTANA ON THE GERMINATION OF  
CHAMAECHRISTA FASCICULATA

**LUNCH**

- 1:30 p.m. Khanh Fleshman, Spring Valley High School  
ALLELOPATHIC EFFECT OF ACER PALMATUM, PINUS TAEDA, AND LONICERA  
JAPONICA ON ZEA MAYS AND GLYCINE MAX
- 1:45 p.m. Isabelle Robinson and Carter Smith, Heathwood Hall Episcopal School  
THE EFFECT OF DIFFERENT NUTRIENTS LEVELS IN SOIL ON THE OXYGEN  
PRODUCTION RATE OF WISCONSIN FAST PLANTS (BRASSICA RAPA)
- 2:00 p.m. Annie Heath, Heathwood Hall Episcopal School  
THE EFFECT OF ORGANIC AND INORGANIC FERTILIZERS ON THE AMOUNT OF  
CHLOROPHYLL IN A BRASSICA RAPA PLANT.
- 2:15 p.m. Paris Tomlin and Lydia Comer, Heathwood Hall Episcopal School  
THE EFFECT OF RUNOFF ON PLANT GROWTH
- 2:30 p.m. Aidan Powers, Heathwood Hall Episcopal School  
THE EFFECT OF PLANT SPECIES ON ZINC ABSORPTION
- 3:00 p.m. Matt Watford, Heathwood Hall Episcopal School  
THE EFFECT OF THREE DIFFERENT COMMERCIAL FERTILIZERS ON THREE  
VARIOUS GRASS TYPES
- 3:15 p.m. Sirila Padi, Spring Valley High School  
THE EFFECT OF TARAXACUM OFFICINALE AND MYCORRHIZAL FUNGI IN  
CLAY, SILT, AND SANDY ON THE GROWTH AND DRYMASS OF GLYCINE MAX

3:30 p.m. Seungmee Kim, Spring Valley High School  
THE EFFECT OF TWO ALOE VERA EXTRACTS AGAINST CHENOPODIUM ALBUM  
WITH TRITICUM AESTIVUM AS A CONTROL PLANT

**Cell & Molecular Biology/ Mentored**  
**Furman Hall 108**

8:30 a.m. Shawn Patel, South Carolina Governor's School for Science and Mathematics  
A GENETIC MAP INVESTIGATION OF ADVENTITIOUS ROOTING AND THE  
CORRELATION BETWEEN GENETIC MARKERS AND ROOTING TYPES OF  
PEACHES

8:45 a.m. Sydney Hart, South Carolina Governor's School for Science and Mathematics  
BIOCHEMICAL CHARACTERIZATION OF ALPHA-SYNUCLEIN CONTAINING  
PROTEIN AGGREGATES IN A YEAST MODEL FOR PARKINSON'S DISEASE

9:00 a.m. Zachary Berry, South Carolina Governor's School for Science and Mathematics  
EFFECT OF TATA-BOX-BINDING-PROTEIN ASSOCIATED FACTOR 1 (TAF1) AND  
P0071 (AN ADHERENS JUNCTION PROTEIN) ON CELL POLARITY OF CACO-2, A  
HUMAN COLON CARCINOMA CELL LINE

9:15 a.m. Messer, South Carolina Governor's School for Science and Mathematics  
EFFECTS OF TLR4 AND UCP2 ON NON-ALCOHOLIC STEATOHEPATIS OF THE  
LIVER

9:30 a.m. JaLisa Decker, South Carolina Governor's School for Science and Mathematics  
IDENTIFICATION OF TOXIN-ANTITOXIN SYSTEMS IN PSEUDOMAS  
AERUGINOSA

9:45 a.m. Mackenzie Foster, South Carolina Governor's School for Science and Mathematics  
DNA METHYLATION CHANGES RESULTING IN ENHANCER AND NON-  
ENHANCER REGIONS OF THE SIX3B GENE

10:00 a.m. Carla Jane Pax, South Carolina Governor's School for Science and Mathematics  
ANALYSIS OF SPACE-TIME RECEPTIVE FIELDS OF SILICON-BASED GANGLION  
AND CORTICAL CELLS IN THE PHYSIOLOGIST'S FRIEND CHIP USING MATLAB  
SOFTWARE

**BREAK**

10:30 a.m. Katherine Bishara, South Carolina Governor's School for Science and Mathematics  
MOLECULAR MECHANISMS CONTROLLING PHOSPHODIESTERASE 11A4  
(PDE11A4) PROTEIN EXPRESSION AND SUBCELLULAR LOCALIZATION IN  
BALB/CJ VS. C57BL/6J MICE

10:45 a.m. Tyler Brown, South Carolina Governor's School for Science and Mathematics  
MULTIPLE PDZ DOMAIN PROTEIN INHIBITS ANGIOGENIC SPROUTING IN  
HUMAN UMBILICAL ARTERIAL ENDOTHELIAL CELLS (HUAEC)

11:00 a.m. Taylor Buckner, South Carolina Governor's School for Science and Mathematics  
INTRACELLULAR LOCALIZATION OF HGF RECEPTOR FRAGMENTS IN LUNG  
FIBROBLASTS



- 11:15 a.m. Faith Mitchell, South Carolina Governor's School for Science and Mathematics  
OPTICAL PROBES FOR NONINVASIVE MOLECULAR IMAGING OF CANCER BIOMARKERS IN GLIOBLASTOMA CELL LINES
- 11:30 a.m. Madeline Grant, South Carolina Governor's School for Science and Mathematics  
OPTIMIZING T CELL ACTIVATION CONDITIONS FOR ADOPTIVE CELL THERAPY OF CANCER
- 11:45 a.m. Sean Cosh, South Carolina Governor's School for Science and Mathematics  
SEMAPHORIN 3F RESPONSES TO NEUROFILIN 2 ISOFORM KNOCKDOWNS IN H157 LUNG CANCER CELLS

### **LUNCH**

- 1:30 p.m. Zachary Walsh, South Carolina Governor's School for Science and Mathematics  
SITE-SPECIFIC MUTAGENESIS OF RAD51 IN ESCHERICHIA COLI
- 1:45 p.m. Phuong Huynh, The Center for Advanced Technical Studies  
THE EFFECT OF MULTIPLE FLAVONOIDS ON AMYLOID-BETA AND NEUROFIBRILLARY TANGLES IN ALZHEIMER'S DISEASE
- 2:00 p.m. Nathan Pignone, South Carolina Governor's School for Science and Mathematics  
THE EFFECTS OF HIGH FAT DIET INDUCED OBESITY ON THE TRANSLATIONAL CAPACITY AND EFFICIENCY IN THE SKELETAL MUSCLE OF MICE
- 2:15 p.m. Olivia Reszczyński, Dutch Fork High School  
THE GENDER GAP: THE EFFECT OF OVARIAN FUNCTION IN THE CACHECTIC RESPONSE AND IL-6 DURING CACHEXIA PROGRESSION
- 2:30 p.m. Aon Ali, South Carolina Governor's School for Science and Mathematics  
TREATMENT OF PATIENTS WITH A NONSENSE MUTATION IN THE X-LINKED INTELLECTUAL DISABILITY CUL4B GENE WITH G418

### **Cell & Molecular Biology / Non-Mentored** **Furman Hall 118**

- 10:30 a.m. Roann Abdeladl, Greenville Technical Charter High School  
DIFFERENTIATING BETWEEN THE ABILITIES OF SYNTHETIC VERSUS PHARMACEUTICAL ANTIBIOTICS TO PREVENT ANTIBIOTIC RESISTANCE
- 10:45 a.m. Emily Morton, The Center for Advanced Technical Studies  
T CELL VACCINES AS AN IMMUNOTHERAPY FOR TYPE 1 DIABETES

### **Chemistry / Mentored** **Furman Hall 109**

- 8:30 a.m. Kelby Beam, South Carolina Governor's School for Science and Mathematics  
BLOCK COPOLYMER SYNTHESIS THROUGH ATOM TRANSFER RADICAL POLYMERIZATION AND RING OPENING POLYMERIZATION

- 8:45 a.m. Albert Wang, Dutch Fork High School  
POLYMERS CONTAINING HIGHLY POLARIZABLE CONJUGATED SIDE CHAINS AS HIGH-PERFORMANCE ALL-ORGANIC NANODIELECTRIC CAPACITORS
- 9:00 a.m. Brooke Christensen, South Carolina Governor's School for Science and Mathematics  
THE STUDY OF HUMAN SPHINGOSINE KINASE AND ITS POTENTIAL INHIBITORS
- 9:15 a.m. William Rivers, South Carolina Governor's School for Science and Mathematics  
OXIDATIONS FACILITATED BY BIS-UREA BENZOPHENONE MACROCYCLES
- 9:30 a.m. Hansen Mou, South Carolina Governor's School for Science and Mathematics  
OPTIMIZING NOBLE METALS ADSORPTION FOR CATALYST SYNTHESIS USING STRONG ELECTROSTATIC ADSORPTION (SEA)
- 9:45 a.m. Mattie Piness, South Carolina Governor's School for Science and Mathematics  
IDENTIFICATION OF POST-TRANSLATIONALLY MODIFIED (O-GLCNAc) HEPATIC PROTEINS IN FASTED AND RE-FED MICE
- 10:00 a.m. Jack Runge, South Carolina Governor's School for Science and Mathematics  
HETEROAGGREGATION OF CITRATE-COATED SILVER NANOPARTICLES WITH POLYSTYRENE AND SILICA PARTICLES

**BREAK**

- 10:30 a.m. Zachary Scott, South Carolina Governor's School for Science and Mathematics  
FACET ENGINEERING ON THE TIP OF GOLD NANORODS
- 10:45 a.m. Will Carpenter, South Carolina Governor's School for Science and Mathematics  
CONTROLLING THE DISSOLUTION OF AG IN AG-AU CORE SHELL NANOPARTICLES OF VARYING SHELL THICKNESS
- 11:00 a.m. Anya Bali, South Carolina Governor's School for Science and Mathematics  
CONTROLLING ENERGY TRANSFER IN METAL-ORGANIC FRAMEWORKS BY COORDINATIVE IMMOBILIZATION OF PHOTOCHROMIC LIGANDS

**Chemistry / Non-Mentored**  
**Furman Hall 109**

- 11:15 a.m. Samira Nematollahi, Shonte Clement, and Nathaniel Boen , Southside High School  
TEST FOR CORROSION OF IRON IN YEAST AND YOGURT
- 11:30 a.m. Hannah Wilder and Rebecca Wu, Southside High School  
ANALYSIS OF ELECTRONIC CIGARETTE VAPORS FOR CARBONYLS
- 11:45 a.m. Isabelle Doan, Southside High School  
AN ANALYSIS OF ELECTRICAL CONDUCTIVITY AND PH IN ACETOUS FERMENTATION

**LUNCH**

- 1:30 p.m. Caroline Bunch and Emmye Mullins, Heathwood Hall Episcopal School  
THE EFFECT OF THE CONCENTRATION OF STRONTIUM NITRATE IN A BLACK POWDER BASE ON THE INTENSITY OF THE 600 NANOMETER WAVELENGTH OF THE EMISSION SPECTRUM
- 1:45 p.m. Anthony Frederick, Spring Valley High School  
THE EFFECT OF MULTIPLE PUNCTURE SITES ON THE HEALING RATE OF HINDERED UREA BOND SELF-HEALING POLYMER
- 2:00 p.m. Jacob Cooney, Spring Valley High School  
THE EFFECT OF FIRE RETARDANT SPRAY, CPVC CEMENT AND STARCH AND AMORPHOUS SODIUM POLYBORATE ON INCREASING THE FIREPROOF ABILITY OF CLOTHING IN SEARCHING FOR A CHEAPER SUBSTITUTE FOR NOMEX/KEVLAR
- 2:15 p.m. Patrick Van Hook, Greenville Technical Charter High School  
THE FACTORS INFLUENCING THE DEFLAGRATIVE RATE OF GUNPOWDER AND THE INFLUENCES OF THE AFOREMENTIONED FACTORS ON THE EFFICACY OF THE MIXTURE
- 2:30 p.m. Revanth Kanumuri, Spring Valley High School  
THE EFFECT OF L-HISTIDINE AND PLANT EXTRACTS ON THE CORROSION OF STEEL
- 3:00 p.m. Pranathi Meda, Spring Valley High School  
THE EFFECT OF ADDING  $\text{NaHCO}_3$ ,  $\text{NH}_4\text{H}_2\text{PO}_4$ , AND  $\text{KHCO}_3$  AND DNA FROM FRAGARIA ANANASSA IN WATER TO EVALUATE ITS FIRE-EXTINGUISHING CHARACTERISTICS ON COTTON FIBERS BY TESTING ITS FLAMMABILITY RATE
- 3:15 p.m. Nigam Sheth, Spring Valley High School  
THE EFFECT OF SACRIFICIAL ANODE CATHODIC PROTECTION ON INHIBITING GALVANIC, CREVICE, AND FLAT CORROSION IN AL-MG-SI ALLOYS
- 3:30 p.m. Paige Mewborn, Dutch Fork High School  
THE EFFECT OF THE FERMENTATION OF POTATOES ON THE PRODUCTION OF ETHANOL

**Consumer Affairs / Mentored**  
**Furman Hall 110**

- 8:30 a.m. Chanon Amphan, South Carolina Governor's School for Science and Mathematics  
AN ANALYSIS OF SBIR FUNDING ACROSS THE NATION
- 8:45 a.m. Tommy Berrigan, South Carolina Governor's School for Science and Mathematics  
COMPARATIVE ANALYSIS OF RECYCLING PROGRAMS IN THE SOUTHEASTERN UNITED STATES
- 9:00 a.m. Logan Robinson, South Carolina Governor's School for Science and Mathematics  
ECONOMICS OF THE EYE: DEVELOPING AN ALTERNATIVE TO TRADITIONAL PACKAGING EYE TRACKING STUDIES
- 9:15 a.m. Daniel Beasley, South Carolina Governor's School for Science and Mathematics  
REBRANDING THE PEE DEE: A CASE STUDY

- 9:30 a.m. Jay Gohil, South Carolina Governor's School for Science and Mathematics  
THE BENEFITS OF ECONOMIC DEVELOPMENT STRATEGIES FOCUSED ON HIGH TECH, EARLY-STAGE BUSINESSES VERSUS THOSE FOCUESED ON TRADITIOAL, LATER-STAGE BUSINESSES
- 9:45 a.m. Jeff Rubillo, South Carolina Governor's School for Science and Mathematics  
USING A DATA WAREHOUSE TO ANALYZE INFORMATION ABOUT INSURANCE CLAIMS AND POLICIES
- 10:00 a.m. Shuler Black, South Carolina Governor's School for Science and Mathematics  
THE BID: AN EXPLORATION OF THE BUSINESS IMPROVEMENT DISTRICT AND HOW IT RELATES TO THE CITY OF BEAUFORT

**BREAK**

- 10:30 a.m. Joel Fonseca, South Carolina Governor's School for Science and Mathematics  
SUCCEEDING IN THE HIGH-GROWTH TECHNOLOGY INDUSTRY
- 10:45 a.m. Joshua Bingham, South Carolina Governor's School for Science and Mathematics  
EFFECT OF CULTURE ON A COMPANY'S SUCCESS
- 11:00 a.m. Gavin Roser, South Carolina Governor's School for Science and Mathematics  
COMPARING STATE TAX INCENTIVES FOR AEROSPACE MANUFACTURING CLUSTER GROWTH
- 11:15 a.m. Sydney White, South Carolina Governor's School for Science and Mathematics  
ANALYSIS AND RECOMMENDATIONS OF ONLINE LEARNING RESOURCES FOR TEACHERS WHO LEAD ECONOMICS AND FINANCIAL LITERARY COURSES IN K-12 SCHOOLS

**Consumer Affairs / Non-Mentored**  
**Furman Hall 110**

- 11:30 a.m. Brandon Hill, Heathwood Hall Episcopal School  
THE EFFECTS OF ANTIOXIDANT VITAMINS A, C, & E ON THE PREVENTION OF BACTERIAL GROWTH IN GRANNY SMITH APPLES
- 11:45 a.m. Matthew Breivik, Spring Valley High School  
THE EFFECT OF CORPORATE FINANCIAL DATA ON STOCK VALUE FLUCTUATION

**LUNCH**

- 1:30 p.m. Jason Lee, The Center for Advanced Technical Studies  
GENETIC ANALYSIS OF CAFETERIA FOOD FOR THE ROUND-UP READY GENE
- 1:45 p.m. Sonali Patel and Emma Shealy, Heathwood Hall Episcopal School  
THE EFFECT OF VARIOUS TYPES OF PACKAGING ON THE CARBONATION IN COCA-COLA

**Engineering / Mentored**  
**Furman Hall 201**

- 8:30 a.m. Cameron Maes, South Carolina Governor's School for Science and Mathematics  
A 3D MICROSCOPE FOR VISUALIZATION OF THICK SAMPLES
- 8:45 a.m. Mike Bhoi, South Carolina Governor's School for Science and Mathematics  
AN ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY STUDY OF EPITAXIAL GRAPHENE FOR USE IN A BREATH ALCOHOL ANALYZER
- 9:00 a.m. Jones Jenkins, South Carolina Governor's School for Science and Mathematics  
AN EXPERIMENTAL STUDY OF THE ELECTROOSMOTIC BEHAVIOR OF VARIOUS GLYCEROL SOLUTIONS, UNDER VARYING POTENTIAL DIFFERENCE IN A T-SHAPED MICROCHANNEL ENVIRONMENT
- 9:15 a.m. Alex Mau, South Carolina Governor's School for Science and Mathematics  
AN EXPLORATION OF THE USE OF ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY OF EPITAXIAL
- 9:30 a.m. Gordon Zhang, South Carolina Governor's School for Science and Mathematics  
BIO-COMPATIBLE HYDROGELS FOR CONTINUOUS GLUCOSE MONITORS
- 9:45 a.m. Mehrzad Namiranian, South Carolina Governor's School for Science and Mathematics  
CONSTRUCTION OF A WHITE LIGHT SOURCED COMPUTED TOMOGRAPHY SCANNER PROTOTYPE
- 10:00 a.m. Madison Maddox, South Carolina Governor's School for Science and Mathematics  
DESIGN OF A VACUUM THERMOFORMING DEVICE AND EXPERIMENTS ON PIN-TOOL TYPE RECONFIGURABLE SURFACES

**BREAK**

- 10:30 a.m. Zach Bills, South Carolina Governor's School for Science and Mathematics  
EFFECTS OF AL<sub>2</sub>O<sub>3</sub> AND LI<sub>2</sub>O MODIFIERS ON MOCC MEMBRANE PERFORMANCE
- 10:45 a.m. Julia Daniels, South Carolina Governor's School for Science and Mathematics  
DEVELOPING A TEST METHOD TO PRECISELY INDUCE AND MAINTAIN DIFFERENT CRACK WIDTHS IN REINFORCED CONCRETE
- 11:00 a.m. Aspen Golden, South Carolina Governor's School for Science and Mathematics  
ESTIMATION OF GREENSHIELDS MODEL PARAMETERS USING PYTHON
- 11:15 a.m. John Mathai, South Carolina Governor's School for Science and Mathematics  
ELECTROSPINNING PVDF NANOPOROUS MEMBRANES FOR USE IN AIR GAP MEMBRANE DISTILLATION TO DESALINATE DIRTY WATER
- 11:30 a.m. Deidra Ward, Academic Magnet High School  
DEVELOPING A COMPUTER MODEL THAT PREDICTS THE OUTCOME OF CORNEAL COLLAGEN CROSSLINKING

11:45 a.m. Andrew Re, South Carolina Governor's School for Science and Mathematics  
EVALUATION OF CARBON BASED CATALYSTS FOR WATER ELECTROLYSIS AND  
CO<sub>2</sub> ELECTRO-REDUCTION

**LUNCH**

1:30 p.m. Mimi Foster, South Carolina Governor's School for Science and Mathematics  
HUMAN FALL DETECTION: VIBRATION FREQUENCY DIFFERENTIATION

1:45 p.m. Bethany Spencer, South Carolina Governor's School for Science and Mathematics  
SAFE AND SIMPLE: DESIGNING MINIATURE COMPUTERIZED TOMOGRAPHY  
SCANNERS FOR MULTIPURPOSE SCIENTIFIC TESTING WITHIN RESEARCH  
LABORATORIES AND CLASSROOMS

2:00 p.m. Dimitri Amiridis, Heathwood Hall Episcopal School  
THE EFFECT OF MASS ON THE VIBRATION OF A HELICOPTER DRIVESHAFT

2:15 p.m. **BREAK**

2:30 p.m. Katherine Duchinski, South Carolina Governor's School for Science and Mathematics  
THE EFFECT OF SALINE IRRIGATION ON TEMPERATURE PROFILE DURING  
RADIOFREQUENCY (RF) ABLATION

3:00 p.m. Adam Blocker, South Carolina Governor's School for Science and Mathematics  
THE PROPAGATION OF LAMB WAVES IN HONEYCOMB STRUCTURES

3:15 p.m. Coby Jeffcoat, South Carolina Governor's School for Science and Mathematics  
VALIDATION OF HIGH THROUGHPUT ELECTROCHEMICAL GAS SCREENING  
SYSTEM

**Engineering / Non-Mentored**  
**Furman Hall 204**

8:30 a.m. Elyse Gandy, Greenville Technical Charter High School  
FLAT VS. VERTICAL

8:45 a.m. Akim Koutsioukis, Greenville Technical Charter High School  
SAFER SEATBELTS

9:00 a.m. Connor Walpole and Jason W. Shaffer, The Center for Advanced Technical Studies  
THE DEVELOPMENT OF A LID FOR A NOSEY CUP TO IMPROVE EFFICIENCY

9:15 a.m. Matthew Quan, Heathwood Hall Episcopal School  
A SONAR DEVICE TO AID THE VISUALLY IMPAIRED

9:30 a.m. Chandler Abrams, The Center For Advanced Technical Studies  
AN INCONSPICUOUS BRACE THAT WILL CORRECT POSTURE TO RELIEVE  
SCIATICA

9:45 a.m. William Sullivan, Spring Valley High School  
BUILDING A NOVEL PHOTOVOLTAIC THERMOELECTRIC DEVICE

10:00 a.m. Jenning Chen, Spring Valley High School  
DEVELOPMENT AND PERFORMANCE EVALUATION OF A PHOTOVOLTAIC  
TREKKING POLE

**BREAK**

10:30 a.m. Tyler Wrenn, The Center for Advanced Technical Studies  
OPTIMIZING UNDERWATER TURBINES TO IMPROVE THE EFFICIENCY OF  
OCEAN ENERGY GENERATION

10:45 a.m. Prithvi Tippabhatla, Spring Valley High School  
THE ABILITY OF SENSORS PLACED ON AN ARDUINO ROBOT TO DETECT  
OBJECTS FROM DIFFERENT DISTANCES

11:00 a.m. Edoardo Tremolada, Spring Valley High School  
THE AMOUNT OF ENERGY OUTPUT FROM A FUNGI-BASED MICROBIAL FUEL  
CELL (MFC) UTILIZING GRAPHENE ELECTRODES

11:15 a.m. Nicholas Junker, Spring Valley High School  
THE EFFECT OF A PD VS PID CONTROLLER ON THEIR ABILITY TO CONTROL  
AN UNSTABLE SYSTEM

11:30 a.m. Athreya Murali, Heathwood Hall Episcopal School  
THE EFFECT OF BLADE PITCH ON THE ELECTRICAL OUTPUT OF A WIND  
GENERATOR

11:45 a.m. Parker Henderson, Greenville Technical Charter High School  
THE EFFECT OF GASOLINE ADDITIVES ON ENGINE PERFORMANCE/RUN TIME

**LUNCH**

1:30 p.m. Frederick Drescher, Spring Valley High School  
THE EFFECT OF ORGANIC SUBSTRATE ON THE ENERGY OUTPUT IN  
MICROBIAL FUEL CELLS

1:45 p.m. Nikitha Sashi , Nikhila Cheepurupalli and Mitchell England, Spring Valley High School  
THE EFFECT OF PLACING A WIND TURBINE ON VARIOUS LOCATIONS ON THE  
BACKS OF A HONDA ACCORD HYBRID IN ORDER TO CAPTURE WIND ENERGY

2:00 p.m. John Weiss, Heathwood Hall Episcopal School  
THE EFFECT OF PLATINUM CATALYST (MEA) LOADING (.4/.4 G/CM<sup>2</sup>) (.4/.1  
G/CM<sup>2</sup>) (.1/.4 G/CM<sup>2</sup>) AT TEMPERATURES OF (70OC, 80OC, 90OC), AND RELATIVE  
HUMIDITIES OF (50%, 75%, 100%), ON THE POWER OF A POLYMER  
ELECTROLYTE MEMBRANE FUEL CELL

2:15 p.m. August Cole, Spring Valley High School  
THE EFFECT OF THE POINT DENSITY OF THE IONIZING ELECTRODE ON THE  
THRUST PRODUCED BY AN ASYMMETRICAL CAPACITOR

2:30 p.m. Landon Louthian, Heathwood Hall Episcopal School  
THE EFFECT OF UV RADIATION ON DIFFERENT TYPES OF SAIL CLOTH

- 3:00 p.m. Breanna Murrin, Spring Valley High School  
THE EFFECT OF VARIOUS HEATING AND COOLING METHODS ON THE OUTPUT VOLTAGE OF A PELTIER TILE
- 3:15 p.m. Cam Ashcraft and Lamar Dawkins, Heathwood Hall Episcopal School  
THE EFFECT THAT "CORKING" A WOODEN BASEBALL BAT HAS ON THE DISTANCE TRAVELED IN THE AIR BY A STRUCK BASEBALL
- 3:30 p.m. Albert Huang, Spring Valley High School  
THE EFFECT OF INCREASED HYDROPHOBICITY ON WATER FLUX AND SALT REJECTION IN A SOLAR MEMBRANE DISTILLATION MODULE

**Environmental Science / Mentored**  
**Furman Hall 126**

- 8:30 a.m. Patrick McKenzie, South Carolina Governor's School for Science and Mathematics  
EFFECTS OF LIGHT COLOR ON POPULATION GROWTH IN RHODOMONAS SALINA
- 8:45 a.m. Lindsey Richardson, South Carolina Governor's School for Science and Mathematics  
LAND USE AND SURROUNDING STREAMS: COMPARING FORESTED, PASTORAL, AND AGRICULTURAL LAND COVERS TO DETERMINE POSSIBLE HUMAN IMPACT IN THE SAVANNAH, SALUDE, AND ENOREE RIVER BASINS
- 9:00 a.m. Katelyn Kraichely, South Carolina Governor's School for Science and Mathematics  
POPULATION ESTIMATE OF DIAMONDBACK TERRAPINS (MALACLEMYS TERRAPIN) IN GRICE COVE, SC
- 9:15 a.m. Brandi Windham, South Carolina Governor's School for Science and Mathematics  
THE EFFECT OF RAINFALL VARIATIONS ON WATER CHEMISTRY, FISH ABUNDANCE AND DIVERSITY, AND CHANNEL GEOMORPHOLOGY IN AGRICULTURAL STREAMS WITHIN THE SALUDA AND UPPER SAVANNAH RIVER BASINS
- 9:30 a.m. Jo Jahn, South Carolina Governor's School for Science and Mathematics  
THE EFFECTS OF A ONE METER SEA LEVEL RISE AND INCREASE IN STORMINESS ON THE PEOPLE AND PROPERTY IN THE GWENT LEVELS ON THE SEVERN ESTUARY
- 9:45 a.m. Olivia O'Connor, South Carolina Governor's School for Science and Mathematics  
THE POTENTIAL IMPACTS OF A 1 METER SEA LEVEL RISE AND INCREASED STORMINESS ON THE LANDSCAPE AND WILDLIFE OF THE SOMERSET LEVELS IN THE SEVERN ESTUARY
- 10:00 a.m. Emily Navin, South Carolina Governor's School for Science and Mathematics  
THE RELATIONSHIPS BETWEEN RURAL LAND COVERS AND WATER CHEMISTRY UNDER BASE FLOW CONDITIONS IN THE SOUTH CAROLINA PIEDMONT

**BREAK**



- 10:30 a.m. Rhea Mathew, South Carolina Governor's School for Science and Mathematics  
USING DIAGNOSTIC PCR TO ANALYZE TROPHIC RELATIONSHIPS BETWEEN  
MACROFAUNA AND MEIOFAUNA
- 10:45 a.m. Jessica Collins, South Carolina Governor's School for Science and Mathematics  
USING HYDROTHERMAL CARBONIZATION REACTORS TO REMOVE E. COLI  
FROM LIVESTOCK PRODUCTS
- 11:00 a.m. Kristy Waterlander, South Carolina Governor's School for Science and Mathematics  
VARIOUS FISH SPECIES ABUNDANCES AND DIVERSITY IN RELATION TO  
PERCENT COVERAGE OF MACROALGAL GROWTH

**Environmental Science / Non-Mentored**  
**Furman Hall 127**

- 8:30 a.m. Sahil Garg and Elise Volden, Southside High School  
THE EFFECTS OF NITRATE LEVELS ON ALGAL GROWTH
- 8:45 a.m. Lillian Meng, Southside High School  
THE EFFECTS OF VARYING LIGHT WAVES ON ALGAL GROWTH
- 9:00 a.m. Jarett Cantey, The Center for Advanced Technical Studies  
TARGETED WASTE SEPARATION TO IMPROVE THE ECONOMIC VIABILITY OF  
METHANE HARVESTING
- 9:15 a.m. Gage Burkhalter, The Center for Advanced Technical Studies  
COULD SCALING FRESNEL LENS TECHNOLOGY RESULT IN A GREATER  
CAPACITY FOR SOLAR HEATING AND COOKING APPLICATIONS?
- 9:30 a.m. Rakib Siddique, Spring Valley High School  
DEVELOPMENT OF NOVEL AND COST-EFFECTIVE ADSORBENTS FOR  
WASTEWATER TREATMENT USING THE COMMON DANDELION
- 9:45 a.m. Casey Brayton, Dutch Fork High School  
DISRUPTIONS IN PHOTORESPIRATION OF GENUS MILLEPORA CORAL  
SYMBIODINIUM IN RESPONSE TO OCEAN ACIDIFICATION
- 10:00 a.m. Yufei Wang, Heathwood Hall Episcopal School  
THE EFFECT OF ALKALINE BATTERIES ON BRASSICA RAPA PLANTS GROWING  
HEIGHT

**BREAK**

- 10:30 a.m. Anvith Deeconda, Spring Valley High School  
THE EFFECT OF DIFFERENT PHOTOCATALYTIC SEMICONDUCTORS ON THE  
EFFECT OF PET SOLAR DISINFECTION OF E.COLI-CONTAMINATED WATER  
SOURCES
- 10:45 a.m. Jordan Withycombe, Heathwood Hall Episcopal School  
THE EFFECT OF GENETICALLY MODIFIED AND ORGANIC CORN ON THE  
AMOUNT OF CORN CONSUMED BY WILDLIFE

- 11:00 a.m. Azalfa Lateef, Spring Valley High School  
THE EFFECT OF GYMNOSPERM, PINUS TAEDA, AND ANGIOSPERM, LAGERSTROEMIA, ON RED FOOD COLORING PARTICLES.
- 11:15 a.m. Almeera Lateef, Spring Valley High School  
THE EFFECT OF DIFFERENT CONCENTRATIONS OF CITRUS SINENSIS ON THE PRODUCTION OF BIO-PLASTICS
- 11:30 a.m. Micah Nerielle Legaspi, Spring Valley High School  
THE EFFECT OF ACESULFAME POTASSIUM ON THE PHOTOSYNTHESIS OF SPIROGYRA GREVILLEANA WHEN PRESENT AT THE CONCENTRATIONS OF 5, 10, 20, AND 30 MICROGRAMS PER LITER
- 11:45 a.m. Tylar Watson, Spring Valley High School  
THE EFFECT OF A QUERCUS LAURIFOLIA FILTER ON THE BACTERIAL COLONY COUNT IN LAKE WATER

### LUNCH

- 1:30 p.m. Shashwat Ravi, Spring Valley High School  
THE CORRELATION BETWEEN REPORTED NUTRIENT LEVELS AND QUANTIFICATIONS OF MICROCYSTINS IN LAKE MURRAY, LAKE WATEREE, LAKE KEOWEE, AND SALUDA LAKE
- 1:45 p.m. Mohammad Arammash, Spring Valley High School  
DESIGNING A COST-EFFECTIVE, ENVIRONMENTALLY-FRIENDLY, AND SUSTAINABLE WATER TREATMENT SYSTEM
- 2:00 p.m. Sarah Buchanan, Heathwood Hall Episcopal School  
THE EFFECT OF MICROBEADS ON THE MORTALITY PERCENTAGE OF DAPHNIA MAGNA
- 2:15 p.m. Arya Soman, Spring Valley High School  
THE EFFECT OF NITRATE ENRICHMENT ON LEMNA MINOR ON THE PHYTOREMEDIATION OF COPPER
- 2:30 p.m. Christopher Juhn, Spring Valley High School  
THE EFFECT OF PERFLUOROOCCTANOIC ACID ON THE GROWTH AND DEVELOPMENT OF DROSOPHILA MELANOGASTER
- 3:00 p.m. Alekhya Mitta, Spring Valley High School  
THE EFFECT OF THE MICROALGAE, CHLORELLA VULGARIS VS. THE COCCOLITHOPHORID ALGAE, EMILIANIA HUXLEYI FERTILIZED WITH DIFFERENT CONCENTRATIONS OF AN IRON NITRATE SOLUTION ON THE BIO SEQUESTRATION OF CARBON DIOXIDE
- 3:15 p.m. Jenna Seubarran, Greenville Technical Charter High School  
THE EFFECT OF XYLEM FILTERS ON REDUCING WATER CONTAMINATION
- 3:30 p.m. Muhammad Fayyaz, Spring Valley High School  
COMPARING THE EFFICIENCY OF CARBON CLOTH, GRAPHITE FELT, AND STAINLESS STEEL MESH AS ANODES FOR LOW-COST, SINGLE-CHAMBERED MICROBIAL FUEL CELLS

3:45 p.m. Paige Mewborn, Dutch Fork High School  
THE EFFECT OF THE FERMENTATION OF POTATOES ON THE PRODUCTION OF ETHANOL

**Math & Computer Science / Mentored**  
**Furman Hall 128**

8:30 a.m. Zachary Wyman, South Carolina Governor's School for Science and Mathematics  
AUGMENTING A VIRTUAL PROTOTYPING ENVIRONMENT WITH A DOMAIN-SPECIFIC VISUALIZATION FRONTEND

8:45 a.m. William Blanchett, South Carolina Governor's School for Science and Mathematics  
CREATING AN ADAPTING SMART VIRTUAL CAMERA HEIGHT CONSTRAINT ALGORITHM

9:00 a.m. John McElvenny, South Carolina Governor's School for Science and Mathematics  
DEVELOPMENT OF A SOCIAL MEDIA APPLICATION FOR GOOGLE GLASS

9:15 a.m. Aida Kouri, South Carolina Governor's School for Science and Mathematics  
MOTORS AND MATLAB: PROGRAMMING WHITE LIGHT COMPUTERIZED TOMOGRAPHY RESEARCH SCANNERS USING ARDUINOS, MOTOR DRIVERS IN CONJUNCTION WITH MATLAB TOOLBOXES

9:30 a.m. Crystel Sylvester, South Carolina Governor's School for Science and Mathematics  
CREATING A MOBILE APPLICATION FOR COLLEGE STUDENTS VIA GAMIFICATION

9:45 a.m. Elaine Patterson, Spring Valley High School  
CHARACTERISTICS OF ACCELEROMETER SIGNALS TO CLASSIFY EVENTS AS FALLS OR ACTIVITIES OF DAILY LIVING

10:00 a.m. Stone Holt, South Carolina Governor's School for Science and Mathematics  
PREDICTING SECONDARY STRUCTURES OF PROTEINS USING DEEP LEARNING AND SVM

**BREAK**

10:30 a.m. Alex Hoover, South Carolina Governor's School for Science and Mathematics  
THE EVALUTATION OF THE K-MEANS CLUSTERING ALGORITHM USING DIFFERENT DISTANCING METHODS

10:45 a.m. Vijay Tripathi, Spring Valley High School  
THE EFFECTS OF FORENSIC DNA TYPING ON THE FRR AND FAR OF A BIOMETRIC SYSTEM

11:00 a.m. Bertrand Zhang, Academic Magnet High School  
OBJECTIVE ASSESSMENT CRITERIA FOR MEDIAN BASED FILTERING OF IMPULSE NOISE CORRUPTED IMAGES

**Math & Computer Science / Non-Mentored**  
**Furman Hall 128**

- 1:30 p.m. Rishi Suresh, Spring Valley High School  
A COMPARISON OF THE PERFORMANCE OF PELTIER HYBRID COOLERS TO STANDARD AIR AND WATER COOLERS AT COOLING AN OVERTCLOCKED COMPUTER PROCESSOR.
- 1:45 p.m. Luke Marazzo, Spring Valley High School  
THE EFFECT OF AUTHENTICITY OF RESEARCH DATA ON COMPLIANCE WITH BENFORD'S LAW
- 2:00 p.m. Lisa Qu, Spring Valley High School  
THE EFFECT OF USING FFT AND BANDSTOP FILTER ON VOICE RECORDINGS WITH DIFFERENT AMOUNTS OF BACKGROUND NOISE ON THE ACCURACY OF A SPEAKER VERIFICATION SYSTEM
- 2:15 p.m. Eli Horner, Chapin High School  
CAN BUS ROUTING BE IMPROVED THROUGH TRAFFIC STUDY
- 2:30 p.m. Emily Beach, Chapin High School  
DO MATH- AND SCIENCE-ORIENTED STUDENTS PERFORM BEST ON THE ACT OR SAT?

**Microbiology / Mentored**  
**Furman Hall 118**

- 8:45 a.m. Nathan Leaphart, South Carolina Governor's School for Science and Mathematics  
APOPTOTIC AND AUTOPHAGIC CELL DEATH IN GANODERIC ACID DM TREATED PROSTATE CANCER CELLS
- 9:00 a.m. Annah Nieman, South Carolina Governor's School for Science and Mathematics  
DETERMINING THE EXTENT OF TRYPANOSOMA BRUCEI PEROXIN 13.2 (TBPEX13.2)'S GLUCOSE-DEPENDENT LOCALIZATION OF THE GLYCOSOMES IN THIS ORGANISM
- 9:15 a.m. Sara Watson, South Carolina Governor's School for Science and Mathematics  
EUKARYOTIC MICROBIAL DIVERSITY OF THE ICEMOLE; A REVOLUTIONARY EXPLORATORY ICE PROBE COMBINING MELTING AND DRILLING
- 9:30 a.m. Victoria McCarthy, South Carolina Governor's School for Science and Mathematics  
INDUCTION OF APOPTOSIS IN ESCHERICHIA COLI CELLS
- 9:45 a.m. Taylor DeHart, South Carolina Governor's School for Science and Mathematics  
MAGNETIC HYPERTHERMIA INACTIVATION OF ENTEROTOXIGENIC ESCHERICHIA COLI USING BIO-FUNCTIONALIZED IRON-OXIDE NANOPARTICLES
- 10:00 a.m. Noa Camp, South Carolina Governor's School for Science and Mathematics  
THE EFFECTS OF PROTEASE ACTIVATED RECEPTOR-1 (PAR-1) ACTIVATION ON MOTOR NEURON AXON EXTENSION IN A 3-D COLLAGEN MATRIX MODEL

**Microbiology / Non-Mentored**  
**Furman Hall 209**

- 8:30 a.m. Katie Krouglicof and Emily Chen, Southside High School  
INVESTIGATING THE EFFICIENCY OF DIFFERENT PRESERVATION METHODS  
ON BACTERIAL GROWTH
- 8:45 a.m. Vaibhav Bafna and Jane Lindberg, Southside High School  
INVESTIGATION OF E. COLI AND ACETOMINOPHEN
- 9:00 a.m. Mary-Frances Behnke, Greenville Technical Charter High School  
THE EFFECT OF UV-C IRRADIATION ON RAW FRUIT JUICE
- 9:15 a.m. Karen Ni, The Center for Advanced Technical Studies  
THE EFFECTS OF SUGAR ALCOHOLS ON STREPTOCOCCUS MUTANS IN THE  
PRESENCE OF SUCROSE
- 9:30 a.m. Flinn Christian and Kristin Clemmons, Heathwood Hall Episcopal School  
BACTERIAL GROWTH ON PROCESSED EGGSHELLS(US) VS UNPROCESSED  
EGGSHELLS(UK)
- 9:45 a.m. Lauren Groseclose, Spring Valley High School  
THE EFFECT OF CERAMICS INFUSED WITH SILVER NANOPARTICLES ON  
ESCHERICHIA COLI FOR SMALL SCALE DRINKING WATER SYSTEMS
- 10:00 a.m. Noah Fechter, Spring Valley High School  
THE EFFECT OF FEED COMPOSITION ON BIOLOGICAL HYDROGEN  
PRODUCTION IN SACCHAROMYCES CEREVISIAE
- BREAK**
- 10:30 a.m. Veronica McLean, Spring Valley High School  
THE EFFECT OF LATHERIN ON THE GROWTH AND DEVELOPMENT OF  
CANDIDA ALBICANS FUNGUS
- 10:45 a.m. Brenna Connor, Heathwood Hall Episcopal School  
THE EFFECT OF SALINITY ON THE FUNCTIONS OF A MICROBIAL MAT.
- 11:00 a.m. Zahida Ashroff, Spring Valley High School  
THE EFFECT OF SHRIMP SHELL AND FISH SCALE EXTRACTS ON THE  
PATHOGENIC BACTERIAL STRAINS OF KLEBSIELLA
- 11:15 a.m. Marie Demetriades, Heathwood Hall Episcopal School  
THE EFFECT OF TEMPERATURE ON BACTERIA GROWTH
- 11:30 a.m. Grayson Byrd, Heathwood Hall Episcopal School  
THE EFFECT OF TEMPERATURE ON THE GROWTH OF PSEUDOMONAS SP. AND  
PENICILLIUM SP. WHEN GROWN USING MOTOR OIL AS A SOURCE OF  
NUTRIENTS

11:45 a.m. Priyanka Rao, Spring Valley High School  
THE EFFECT OF VARIOUS KINDS OF SWEETENERS ON THE CALCIUM  
DEGRADATION OF THE TOOTH ENAMEL CAUSED BY STREPTOCOCCUS  
MUTANS IN DENTAL CARIES

**LUNCH**

1:30 p.m. Dylan McCormick, Spring Valley High School  
THE EFFECT OF WATER FILTERS AND WATER TREATMENT TABLETS ON THE  
AMOUNT OF BACTERIA THAT GROWS ON A NUTRIENT AGAR PLATE

1:45 p.m. Catherine Johnson and Lawson Leidinger, Heathwood Hall Episcopal School  
WILL SLIME MOLDS BE ABLE TO PREFERENTIALLY MAINTAIN THE SHORTEST  
ROUTE OF A MAZE?

2:00 p.m. Noah Fechter, Spring Valley High School  
THE EFFECT OF FEED COMPOSITION ON BIOLOGICAL HYDROGEN  
PRODUCTION IN SACCHAROMYCES CEREVISIAE

2:15 p.m. Taylor Motlong, Spring Valley High School  
THE EFFECT OF VARYING CONCENTRATIONS OF CANDIDA ALBICANS ON  
ALOE VERA

**Physics / Mentored**  
**Furman Hall 111**

10:00 a.m. Jay Sridharan, South Carolina Governor's School for Science and Mathematics  
DYNAMICS OF A SINGLE PARTICLE FALLING THROUGH A FUNNEL: AN  
ANALYSIS OF THE EFFECTS OF FRICTION ON AVERAGE TRAJECTORY  
DURATION

**Physics / Non-Mentored**  
**Furman Hall 111**

8:30 a.m. Tryston Crawford, Greenville Technical Charter High School  
INSULATIVE PROPERTIES AND HEAT TRANSFER

8:45 a.m. Romello Reed, Greenville Technical Charter High School  
NOTHING BUT NET: THE SCIENCE OF SHOOTING HOOPS

9:00 a.m. Caitlin Kunchur, Dutch Fork Middle School  
A WINDY DAY: THE EFFECT OF WIND PATH AND DIRECTION ON ITS FORCE ON  
OBJECTS

9:15 a.m. Theodore Myers, Spring Valley High School  
A COMPARITIVE ANALYSIS OF A CYCLOIDAL ROTOR AND A STANDARD  
HELICOTER ROTOR

9:30 a.m. Austin Wiesehahn, Spring Valley High School  
COMPARING THE SPLATTER RATES OF LOW GRADE, MID GRADE, AND HIGH  
GRADE PAINTBALLS WHILE BEING SHOT FROM A PAINTBALL MARKER

9:45 a.m. Krishna Gorrepati, Spring Valley High School  
THE EFFECT OF A P-N TiO<sub>2</sub>/Cu<sub>2</sub>O/ITO COMPOSITE JUNCTION USING E-BEAM  
EVAPORATION ON A SHEWANELLA ONIEDENSIS MR-1 MICROBIAL COUPLED  
PHOTOELECTROCHEMICAL CELL

**BREAK**

10:30 a.m. John Davis, Heathwood Hall Episcopal School  
HAS THE ADDITION OF WIRELESS HOUSEHOLD ELECTRONICS EFFECTED THE  
LEVELS OF EMF IN HOUSEHOLDS?

10:45 a.m. Coleman Couick and Spencer Hann, Heathwood Hall Episcopal School  
THE EFFECT OF ARROW MASS ON BOTH THE ARROW VELOCITY AND THE  
EFFECIENCY OF THE BOW

11:00 a.m. Andrew Shroyer, Spring Valley High School  
THE EFFECT OF BULLET AERODYNAMICS MODELED AFTER FALCO  
PERIGRINUS AND ISTIOPHORUS ON DRAG FORCE

11:15 a.m. Dandavikranth Reddy, Spring Valley High School  
THE EFFECT OF MULTIPLE OPTICAL FILTERS ON THE REDUCTION OF  
INTENSITY FROM DIFFERENT COLORED 100MW LASER BEAMS

11:30 a.m. Shuai Wang, Heathwood Hall Episcopal School  
THE IMPACT OF TEMPERATURE ON THE EFFICIENCY OF A NEWTON'S CRADLE

11:45 a.m. Alexis Lopez, Greenville Technical Charter High School  
ULTRAVIOLET RADIATION

**Physiology & Health / Mentored**  
**Furman Hall 207**

8:30 a.m. Anne-Marie Coble, South Carolina Governor's School for Science and Mathematics  
AUDITORY NERVE INJURY INDUCES MACROPHAGE ACTIVATION

8:45 a.m. Troy Hodge, South Carolina Governor's School for Science and Mathematics  
BODY COMPOSITION IN RELATION TO VO<sub>2</sub>MAX AND RUNNING PERFORMANCE

9:00 a.m. Ramsey Coyle, South Carolina Governor's School for Science and Mathematics  
EFFECT OF BOLUS VISCOSITY ON EPIGLOTTIC INVERSION DURING  
SWALLOWING

9:15 a.m. Allie Young, South Carolina Governor's School for Science and Mathematics  
LACTATE THRESHOLD AND VO<sub>2</sub>MAX AS PREDICTORS OF RUNNING  
PERFORMANCE

9:30 a.m. Maya Rush, South Carolina Governor's School for Science and Mathematics  
MEXICANIN I INHIBITS FIBROCYTE GENERATION FROM MOUSE  
SPLENOCYTES ACCOMPANIED BY DOWN REGULATION OF KLF4

9:45 a.m. Elizabeth Mugo, South Carolina Governor's School for Science and Mathematics  
PROGRESSION TOWARDS A 3-DIMENSIONAL INNERVATION MODEL OF THE  
HUMAN BLADDER

10:00 a.m. Sayaka Reed, South Carolina Governor's School for Science and Mathematics  
THE EFFECT OF MEDIA SUPPLEMENTS ON DIFFERENTIATION OF HUMAN  
ADIPOSE DERIVED STEM CELLS INTO UROEPITHELIAL CELLS

### **BREAK**

10:30 a.m. Dae Bigach, South Carolina Governor's School for Science and Mathematics  
THE EFFECT OF PACLITAXEL AND CISPLATIN ON A VARIETY OF METASTATIC  
MAMMARY HETEROGENEOUS NUCLEAR RIBONUCLEOPROTEIN – E1 (HNRNP-  
E1) KNOCK DOWN CELL LINES

10:45 a.m. Mary Lyn Mitchell, South Carolina Governor's School for Science and Mathematics  
THE EFFECT OF PAR-1 ACTIVATION ON SCHWANN CELL MOPHOLOGY IN A 3-D  
COLLAGEN MATRIX MODEL

11:00 a.m. Meredith Hammer, South Carolina Governor's School for Science and Mathematics  
VERSICAN PLAYS AN IMPORTANT ROLE IN NEURAL DEVELOPMENT AND  
DAMAGE REPAIR IN THE COCHLEA

11:15 a.m. Wenxin Fan, Spring Valley High School  
THE EFFECTS OF LIPOPOLYSACCHARIDES, IMIQUIMOD, AND EMODIN ON  
ADHERENCE OF MACROPHAGES TO BREAST CANCER CELLS AND THE  
PRODUCTION OF TUMOR NECROSIS FACTOR ALPHA (TNF-A) BY  
MACROPHAGES

11:30 a.m. Dixie McCollum, South Carolina Governor's School for Science and Mathematics  
THE RELATIONSHIP BETWEEN LIPOPROTEINS AND CORONARY HEART  
DISEASE IN AFRICAN AMERICANS: THE SEA ISLANDS GENETIC AFRICAN  
AMERICAN REGISTRY

11:45 a.m. Sloan Nietert, Academic Magnet High School  
DEVELOPMENT AND IMPLEMENTATION OF AN EXERCISE PRESCRIPTION  
PROTOCOL FOR LUNG CANCER PATIENTS USING INTERNET-CONNECTED  
FITNESS TRACKERS

### **LUNCH**

#### **Physiology & Health / Non-Mentored** **Furman Hall 208**

8:30 a.m. Omar Abdeladl, Greenville Technical Charter High School  
EXAMINING THE EFFECTS OF DIFFERENT KNEE FLEXION ANGLES AND  
DIFFERENT QUADRICEPS MUSCLE STRENGTHS ON THE PATELLAR TENDON

8:45 a.m. Cameron Shull, Chapin High School  
ALCOHOLISM SKIPPING GENERATIONS

9:00 a.m. Natalie Reszczyński, Dutch Fork High School  
JUST KEEP SWIMMING: AN APPROACH TO ALZHEIMER'S VIA COMMON-  
SUBSTANCE INGESTION



- 9:15 a.m. Cherilyn Heintz, Chapin High School  
EFFECTS OF YOGA ASANAS ON STUDENT STRESS
- 9:30 a.m. Alyssia Mitchell, Spring Valley High School  
THE EFFECT OF CHITOSAN SOLUTIONS ON THE REPRODUCTION OF  
EVOLVING PATHOGEN AND NOSOCOMIAL INFECTION STAPHYLOCOCCUS  
EPIDERMIDIS
- 9:45 a.m. Amelia Robinson-Brown and Alyce Petit, Heathwood Hall Episcopal School  
THE EFFECT OF DIFFERING CONTACT METHODS ON THE SPREAD OF GERMS  
IN CLASSROOM ENVIRONMENTS
- 10:00 a.m. Tanvi Mehta, Spring Valley High School  
THE EFFECT OF EXOGENOUS MELATONIN ON MATRICIDAL HATCHING IN  
CAENORHABDITIS ELEGANS
- BREAK**
- 10:30 a.m. Matthew Reupke, Spring Valley High School  
THE EFFECT OF INAUDIBLE HIGH FREQUENCY SOUNDS RANGING FROM 20-22  
KILOHERTZ ON THE VISUAL ACCURACY OF HOMO SAPIENS
- 10:45 a.m. Savannah Hillmeyer, Heathwood Hall Episcopal School  
THE EFFECT OF DIFFERENT STYLES OF UNDERWATER KICKING ON VELOCITY  
IN SWIMMING
- 11:00 a.m. Jackson Hall, Spring Valley High School  
THE EFFECT OF THE AMOUNT OF CELECOXIB ADMINISTERED ON THE  
NUMBER OF CASES OF ATRIAL FIBRILLATION IN FOUR POPULATIONS OF  
DAPHNIA MAGNA
- 11:15 a.m. Jordan Lester, Chapin High School  
DIFFERENCES IN FLUID INTAKE POST-WORKOUT BETWEEN GATORADE AND  
WATER
- 11:30 a.m. Carl Lobitz, Spring Valley High School  
THE EFFECT OF CINNAMOMUM CASSIA ON THE HEART RATE OF DAPHNIA  
MAGNA

**Psychology / Mentored**  
**Furman Hall 227**

- 8:30 a.m. Daniel Newsome, South Carolina Governor's School for Science and Mathematics  
AFFECTIVE CIRCUMPLEX IN MUSIC
- 8:45 a.m. Alexia Junker, South Carolina Governor's School for Science and Mathematics  
CREATING DYNAMIC VISUAL STIMULI FOR USE IN FMRI AND EEG STUDIES ON  
THE INTERNAL REPRESENTATION OF AFFECTIVE STATES
- 9:00 a.m. Austin Gibbs, South Carolina Governor's School for Science and Mathematics  
EXAMINING DIFFERENCES IN FACE SPECIALIZATION IN SUBJECTS WITH  
ALZHEIMER'S DISEASE USING FUNCTIONAL MAGNETIC RESONANCE IMAGING

**Psychology / Non-Mentored**  
**Furman Hall 227**

9:15 a.m. Isabella Antonetti and Leila Barwick, Heathwood Hall Episcopal School  
DETERMINING THE RELATIONSHIP BETWEEN SPORTS AND ATHLETES  
PERSONALITY TYPES BASED ON THE BIG FIVE PERSONALITY TEST

9:30 a.m. Sonali Parmar, Heathwood Hall Episcopal School  
ANALYSIS OF THE STEREOTYPE THREAT IN SIXTH GRADE STUDENTS'  
PERFORMANCE ON A MATH TEST

9:45 a.m. Julia Long, The Center for Advanced Technical Studies  
ARE ANTI-ANXIETY MEDICATIONS WORTH THEIR BENEFITS?

10:00 a.m. Madison Owen, Chapin High School  
BAND SIZE AND PERFORMANCE

**BREAK**

10:30 a.m. Reid Creswell, Chapin High School  
COMMUNITY SERVICE AWARENESS THROUGH THE USE OF MEDIA

10:45 a.m. Sanjay Ravindra, Spring Valley High School  
THE EFFECT OF COLOR SCHEME AND TYPEFACE ON THE CONVERSION RATE  
OF A PRODUCT SOLD ON AN ECOMMERCE WEBSITE

11:00 a.m. Christian Fultz, Chapin High School  
EXAMINING CORRELATION BETWEEN MUSIC AND COGNITIVE FUNCTION

11:15 a.m. Alexander Siegfried, Chapin High School  
DOES HIGH SCHOOL STRESS PROGRESS

11:30 a.m. Sarah Sharpton, Chapin High School  
EDITING FOR A BRIGHTER FUTURE

11:45 a.m. Madison Lynch, Spring Valley High School  
THE EFFECT OF COGNITIVE DISTRACTIONS FROM MOBILE PHONES ON  
DIFFERENT REACTION TIMES IN VARIED AGE GROUPS OF DRIVERS

**LUNCH**

1:30 p.m. Lorraine Haselden, Chapin High School  
SEVERITY OF ASD SYMPTOMS IN RELATION TO CHILDREN'S GENDER

1:45 p.m. Donzelle Benton, Westwood High School  
THE CORRELATION BETWEEN AGE AND FRUSTRATION

2:00 p.m. Olivia Price, Heathwood Hall Episcopal School  
THE CORRELATION BETWEEN IMPLICIT AND EXPLICIT RACIAL ATTITUDES

2:15 p.m. Amy Loy, Chapin High School  
THE CORRELATION BETWEEN VISUAL ARTS AND MATH AND SCIENCE

2:30 p.m. Rachel Shroyer, Spring Valley High School  
THE EFFECT OF BRAIN HEMISPHERE DOMINANCE ON 15-WORD  
MEMORIZATION USING THE METHOD OF LOCI

**Psychology / Non-Mentored**  
**Furman Hall 228**

8:30 a.m. Gracie Daughtry, Greenville Technical Charter High School  
EFFECTS OF DIFFERENT TYPES OF MUSIC ON VARIOUS LEARNERS AND THE  
AFOREMENTIONED'S COGNITIVE ABILITIES

8:45 a.m. Samantha McCall and Abigail Tempel, Chapin High School  
COOKING CLASS FOR CHILDREN WITH AUTISM TO IMPROVE FRACTION  
RELATED PERFORMANCE

9:00 a.m. Abhiraj Gupta, Spring Valley High School  
THE EFFECT OF DECIBEL VOLUME ON THE PERCENTAGE OF WORDS  
ACCURATELY RECALLED DURING AND AUDITORY RECALL TEST

9:15 a.m. Linnea Bacon, Spring Valley High School  
THE EFFECT OF JUNG TYPOLOGY TEST PERSONALITY TYPES ON PERCEIVED  
ACNE VULAGRIS SEVERITY IN HIGH SCHOOL STUDENTS

9:30 a.m. Michael Spicer, Spring Valley High School  
THE EFFECT OF NATIONALITY AND MEDIA ON KNOWLEDGE, EVALUATION,  
AND FRAMING OF THE RUSSIAN CRIMEAN ANNEXATION

9:45 a.m. Matthew Frierson, Spring Valley High School  
THE EFFECT OF OCULAR DOMINANCE ON A HIGH SCHOOL PLAYERS ABILITY  
TO QUICKLY AND ACCURATELY DETERMINE A FOUL

10:00 a.m. Vinay Penmetsa, Spring Valley High School  
THE EFFECT OF SHAPE ON THE PERCEIVED TASTE OF BROWNIES BY TEST  
SUBJECTS

**BREAK**

10:30 a.m. Lindsey Miller, Spring Valley High School  
THE EFFECT OF SOCIAL MEDIA USE ON INTERPERSONAL COMMUNICATION  
SKILLS AND SELF-ESTEEM IN HIGH SCHOOL STUDENTS

10:45 a.m. Brandon Lacey, Spring Valley High School  
THE EFFECT OF THE MODALITY OF MUSIC ON A PERSON'S JUDGEMENT  
USING THE AFFECT HEURISTIC

11:00 a.m. Caroline Nassab, Heathwood Hall Episcopal School  
THE EFFECT OF VERBAL AND TANGIBLE REINFORCEMENT ON TASK  
ACCURACY OF YOUNG BOYS VS. GIRLS

11:15 a.m. Ali El-Ali, Spring Valley High School  
THE EFFECTIVENESS OF BOTH THE CENTRAL AND PERIPHERAL PATHS OF  
PERSUASION IN PERSUADING HIGH SCHOOL STUDENTS TO PARTICIPATE IN  
BLOOD DRIVES.

11:30 a.m. Jamie Milliff, Chapin High School  
THE EVOLUTION OF VILLAINS

11:45 a.m. Jayanth Vemula, Spring Valley High School  
THE USE OF NEUROLINGUISTIC PROGRAMMING ON THE INFLUENCE OF  
CHOICE IN HUMANS BY THE USE OF ANCHORING

### **LUNCH**

1:30 p.m. Anson Bidwell, Spring Valley High School  
A MESO-LEVEL ANALYSIS OF THE EFFECT OF PERCEIVED ECONOMIC  
CONDITIONS OF A VOTER ON VOTE CHOICE IN A LOCAL ELECTION IN  
RICHLAND COUNTY

### **Zoology / Non-Mentored** **Furman Hall 230**

9:45 a.m. Melina Manos and Olivia Moran, Heathwood Hall Episcopal School  
FISH GROWTH VS. TANK SIZE

10:00 a.m. Teebro Rahman, Spring Valley High School  
THE COMPARISON OF ECOTOXIC EFFECTS OF BORIC ACID BASED AND  
ACEPHATE BASED PESTICIDES

### **BREAK**

10:30 a.m. Andres Pineda, Spring Valley High School  
THE EFFECT OF DIFFERENT PROTEIN RATIOS ON THE WEIGHT GAIN OF BOS  
TAURUS

10:45 a.m. Katie Beaudoin, Vineeth Sama, and Anna Hardison, Southside High School  
ANALYSIS OF CHEMOTAXIS AND PHOTOTAXIS IN PLANARIA

11:00 a.m. Taylor Ferguson, Spring Valley High School  
THE EFFECT OF PAIRING BORIC ACID WITH XYLOSE AND SUCROSE AT  
VARIOUS CONCENTRATIONS ON THE FORAGING BEHAVIOR OF  
POGONOMYRMEX BARBATUS

### **Zoology / Mentored** **Furman Hall 230**

11:15 a.m. Vaibhav Mohanty, Academic Magnet High School  
NONSTEROIDAL ANTI-INFLAMMATORY DRUGS DECREASE VIABILITY AND  
PRODUCE MORPHOLOGICAL ABERRATIONS IN EARLY CHICKEN  
DEVELOPMENT

11:30 a.m. Leslie Galvez, South Carolina Governor's School for Science and Mathematics  
POLLUTION-SENSITIVE LARVAE OF WORMALDIA SPP. (TRICHOPTERA:  
PHILOPOTAMIDAE) AND NEURECLIPSIS MELCO ROSS, 1947 (TRICHOPTERA:  
POLYCENTROPODIDAE)

## SCJAS ABSTRACTS (Listed alphabetically by presenter's last name)

### EXAMINING THE EFFECTS OF DIFFERENT KNEE FLEXION ANGLES AND DIFFERENT QUADRICEPS MUSCLE STRENGTHS ON THE PATELLAR TENDON

Omar Abdeladl  
Greenville Tech Charter High School

In the Knee, there is a strong, flat ligament commonly known as the Patellar Ligament or the Patellar Tendon. The Patellar Tendon originates apex of the patella distally, surrounds the patella, and inserts below the knee joint at the tibial tuberosity. When it undergoes high tensions or strong pressures, it can be injured. In sports and orthopedics, people will sometimes refer to this as a "Jumper's Knee". While a very strong force is required to tear a healthy patellar tendon, a weakened tendon is more likely to become injured with minimal force. In sports, heavy squats and deep knee bends are assumed to strengthen the leg, but this stress may in fact weaken the patellar tendon if performed incorrectly. The project aims to provide an extensive understanding of the effect of certain knee angles and different quadriceps muscle strengths at the inflection point of the Patellar Tendon. A functioning model of the human knee will be built utilizing different sized springs for the quadriceps muscle sizes, and a guitar tuner mechanism as the patellar tendon. Hooke's law will be used to determine the force inflicted on the patellar tendon. This will demonstrate which angles on flexion at the knee joint are the most dangerous. Next, different strength springs will be used to simulate different muscle strengths. Again, Hooke's Law will be applied to determine the force inflicted on the Patellar Tendon. The overall objective is to provide further understanding of the effects of different knee flexion angles and quadriceps muscle sizes on the patellar tendon. The results will help doctors and athletic trainers in setting flexion restrictions on patients' knee braces and determining which exercises will better help the patients in the healing process. Furthermore, the results will also help athletes and coaches by demonstrating the harms of strenuous activities such as deep knee bends and heavy squats.

### DIFFERENTIATING BETWEEN THE ABILITIES OF SYNTHETIC VERSUS PHARMACEUTICAL ANTIBIOTICS TO PREVENT ANTIBIOTIC RESISTANCE

Roann A. Abdeladl  
Greenville Technical Charter High School

In 1928, biologist Alexander Fleming invented the first antibiotic Penicillin. Just 4 years after Penicillin was continually being mass produced, Staphylococcus Aureus was the first pathogen proven to be resistant to Penicillin. Bacteria can become resistant by genetic mutation or by exchanging genes with other bacteria in order to develop resistant "bodies" and survive; bacteria can also use plasmid exchange to become resistant, which consists of DNA that replicates itself. These bacteria then reproduce, creating an entire generation of resistant bacteria, and the antibiotic no longer works. To prevent this, consumers must stop overusing antibiotics and make sure to utilize the correct antibiotic that properly treats the illness he or she has. This project proves which type of antibiotic more effectively prevents antibiotic resistance. Both synthetic or natural antibiotics, which are found in nature and in our bodies, and pharmaceutical or manufactured antibiotics will be applied to bacteria samples, and the percent decrease will then be found. This will determine which antibiotic is more effective. The results proved that the pharmaceutical antibiotics more efficiently prevented antibiotic resistance because they had a greater percent decrease than the natural antibiotics. The overall objective is to inform society about which antibiotic is more beneficial to use and begin the battle against what is considered one of the most serious global health issues: bacterial resistance to antibiotics.

### AN INCONSPICUOUS BRACE THAT WILL CORRECT POSTURE TO RELIEVE SCIATICA

Chandler Abrams  
The Center For Advanced Technical Studies

Sciatica is a set of symptoms that arise when the sciatic nerve is compressed or inflamed which causes pain, numbness or tingling and muscle soreness and stiffness in the affected leg of the compressed sciatic nerve. It usually occurs in older adults between 25 and 50. Sciatica is mainly caused by a herniated lumbar disc, which can often be traced back to incorrect posture. People don't always take note of the way they sit, and posture is commonly overlooked. And while braces and other interventions created to correct posture exist, they are extremely bulky and far too visible for comfort. Creating an inconspicuous product that will correct ones posture without the user having to make a conscious effort to do so will greatly help to relieve sciatica and help to solve the problem at the source as well as make their problem less obvious to others. An unobtrusive innovation would be the creation of a Tank-Brace, a slim, but firm back brace that is embedded into a tank top. The initial designs feature a back brace component lined with slim nylon webbing for support, spacer mesh for padding, and spandex for comfort and elasticity. The brace will be secured by conjoining elastic straps with thin velcro attachments on each end for adjustability. The user will be able to adjust and fasten the velcro straps under the tank top by way of slits on either side of the front of the tank top, similar to a front pocket on a hoodie. After designs are sketched and appropriate materials are gathered, the adjustable prototype will be created and tested on 6 different people of varying body types who have, or have experienced, sciatica. They will rank the Tank-Brace on a scale of 1-10, on the effectiveness of the brace. It is expected that comfort level and particularly efficacy level will reach a level of 9 or above, and that the brace will not be extremely obvious on the user.

TREATMENT OF PATIENTS WITH A NONSENSE MUTATION IN THE X-LINKED INTELLECTUAL DISABILITY  
CUL4B GENE WITH G418

Aon Ali

Governor's School for Science and Mathematics

Patients affected by a nonsense mutation of the CUL4b gene suffer from X-Linked Intellectual Disability. Lymphoblast samples of affected people were grown and treated with G418. The G418 treatments were done at various concentrations to force the cells to produce the full length Cullin-4b protein. The samples did show production of CUL4b. However, if they are functional could not be determined. Further trials need to be done to see if the treatment is worth the side effects. The samples were able to produce the protein, and any presence of Cullin-4b could be beneficial

THE EFFECT OF MASS ON THE VIBRATION OF A HELICOPTER DRIVESHAFT

Dimitri Amiridis

Heathwood Hall Episcopal School

The purpose of this experiment was to determine the relationship between weight and vibration on the drive shaft of a helicopter. This can be useful in fields that specialize in helicopter maintenance, such as mechanical engineering or mecatronics. The procedure for the experiment was as follows. First, different weights were placed on a scale, and then applied on a helicopter drive shaft. The driveshaft was then spun at a high speed and the vibration was recorded in ips. Finally, the data was recorded on a graph to determine the relationship. The result of the ips of an single factor ANOVA test of the data had an F value that was higher than the F critical, meaning the data supported the hypothesis. The weight and vibration have no correlation. In conclusion, the data suggests that vibration is not affected by weight. This could have been due to mismeasuring the weights or perhaps the weight did not have a great enough effect to affect the vibration. The information gathered from this experiment can be used in other fields that pertain to helicopter maintenance.

AN ANALYSIS OF SBIR FUNDING ACROSS THE NATION

Chanon Amphan

Governor's School for Science and Mathematics

Small Business Innovation Research (SBIR) funds are highly sought after methods of gaining capital aimed at stimulating technological innovation. These government funds are targeted for small business technology research and development products with strong market potential. The program can easily offer over a million dollars of funding per project for award recipients and spans across eleven participant government agencies. Naturally such a resource is highly competitive. Consequently, many state institutions and universities seek to provide resources for the small tech businesses and startups of their state to take full advantage of the SBIR program by helping them through the proposal process. This research is an analysis of the methods and results of various institution's different methods to secure more proposals, including assistance in proposal writing, initial capital, fund matching incentives, and others. Mathematical analysis to determine any correlation to venture capital funding is also included. When adjusting for population differences, venture capital funding did not seem to be correlated with SBIR funding.

DETERMINING THE RELATIONSHIP BETWEEN SPORTS AND ATHLETES PERSONALITY TYPES BASED ON THE  
BIG FIVE PERSONALITY TEST

Isabella Antonetti and Leila Barwick

Heathwood Hall Episcopal School

This experiment was based off of multiple prior studies done to determine a relationship between personality type and the sport each athlete plays. This study focussed on teenagers who played football, volleyball, or soccer. This study differentiates from the prior studies because it was specific sports rather than sport type, previous studies observed the relationship between extreme and traditional sports, and the athletes' personality types. After reviewing these studies and their data, the hypothesis for this experiment was formed: If athletes are tested using the Big Five Personality Test, then the results will suggest a defined relationship between the athletes' personality type and the sport they play. The null hypothesis formed is as follows: If athletes are tested using the Big Five Personality Test, then the results will suggest there will be no clear relationship between the athletes' personality type and the sport they play. The independent variable is the sport each athlete plays. The gender, sport, day, and school are the constants/ controlled factors in the experiment. Each test was taken on practice days rather than game days to insure they were taken in the most relaxed manner possible. After completing the test and analyzing the results, the hypothesis was accepted.

## THE EFFECT THAT "CORKING" A WOODEN BASEBALL BAT HAS ON THE DISTANCE TRAVELED IN THE AIR BY A STRUCK BASEBALL

Cam Ashcraft and 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. Two identical baseball bats of same length that were made by the same company took twenty-five swings on a modified skeet shooter. Each distance the ball traveled away from the tee was recorded and rounded to the nearest inch. 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 and rounded to the nearest tenth of an inch. The data then showed that the cork did affect the ball by hitting it 7.3% farther than the uncorked bats.

## INVESTIGATION OF E. COLI AND ACETAMINOPHEN

Vaibhav Bafna and Jane Lindberg  
Southside High School

Acetaminophen, the pain-reliever found in virtually every household, has many forms and brands, with each claiming fast relief. More information is required to validate these claims of fast-acting medicine. This experiment aims to examine Acetaminophen and its three forms: liquid, tablet, and capsule and their subsequent effectiveness. The biology portion of this experiment is demonstrated by a prominent area impacted by Acetaminophen: the gut. The gut is necessary for the medicine to be effective and this experiment will utilize E-coli to stimulate the gastrointestinal area. The E-coli were grown over the period of a week and then exposed to various forms of medicine. Next, they were left with the medicine and after that, we recorded the data. The observable effects on the E-coli will demonstrate which form is the fastest acting. E-coli flourish in the gut and quickly metabolize semi-solids. Therefore, the liquid Acetaminophen is expected to be the most effective as it resides in a form that is most convenient for the E-coli to absorb and then "digest". The experiment will be especially important as it could potentially alter the course of medical diagnosis, leading to different and specialized forms of medicine for each unique part of the body.

## CONTROLLING ENERGY TRANSFER IN METAL-ORGANIC FRAMEWORKS BY COORDINATIVE IMMOBILIZATION OF PHOTOCHROMIC LIGANDS

Anya Bali  
Governor's School for Science and Mathematics

In recent years, the international demand for energy has increased rapidly. As a result, the exploration of novel renewable energy materials has widened greatly. Metal-organic frameworks (MOFs), or highly porous, crystalline hybrid structures made of organic ligands and metal nodes, have been researched for their energy applications. This research aimed to mimic photosynthesis through the implementation of photochromic ligands, or photoswitches, within efficient metal-organic frameworks to create a controllable energy transfer system. These photochromic organic molecules transfer energy by changing their structure when irradiated with ultraviolet or visible light. Previous research immobilized the bis(5-pyridyl-2-methyl-3-thienyl)cyclopentene (BPMTc) photoswitch within porphyrin-based (PPF-1) MOFs. This research replaced the PPF-1 layers with tetraphenylethylene-carboxylate (TPE-COOH), a ligand with an efficiency approximately ten times that of porphyrin. The photoswitch was produced and immobilized within these MOFs through ligand syntheses, standard purification processes, and heat-assisted MOF synthesis. Powder X-ray diffraction revealed photochromic properties within the resulting crystalline frameworks. Future trials will vary synthesis conditions and utilize solvent-assisted ligand exchange to produce larger crystals for use in renewable energy materials.

## DO MATH- AND SCIENCE-ORIENTED STUDENTS PERFORM BEST ON THE ACT OR SAT?

Emily Beach  
Chapin High School

While many studies use high school students' standardized testing scores to predict areas of success after graduation and performance on exams administered in college, and some studies detail personality traits that could predict students' level of performance on standardized tests, there are no studies that use high school students' areas of academic success to predict performance on the ACT vs. SAT.

This study attempts to illustrate a relationship between Chapin High School seniors' scholastic success in sciences and mathematics and performance on the ACT and SAT tests. Its results will assist parents and guidance counselors in recommending which standardized test a student should take.

It is hypothesized that math- and science-oriented students will perform best on the ACT, as the ACT requires planning skills most seen in math- and science-oriented students.

The following data about 139 Chapin High School seniors have been collected from the District 5 Testing Database: SAT score, ACT score, weighted math GPA, weighted science GPA, and weighted Humanities GPA. Researcher executes a multiple regression test designed to provide levels of influence of math GPA, science GPA, and humanities GPA on the difference between ACT score and SAT score on the data. The multiple regression test provides a function with coefficients whose values

predict the influences of math GPA, science GPA, and humanities GPA upon the difference between ACT and SAT scores. A T-test is performed upon the influence levels yielded by the multiple regression to determine respective levels of statistical significance. Researcher analyzes the results of the T-test to conclude how scholastic success in sciences and mathematics can predict success on the ACT.

#### BLOCK COPOLYMER SYNTHESIS THROUGH ATOM TRANSFER RADICAL POLYMERIZATION AND RING OPENING POLYMERIZATION

Kelby Beam

Governor's School for Science and Mathematics

There is a great need for environmentally friendly efficient energy sources with environmentally unfriendly energy sources, which are primarily used, are diminishing. A major method of producing this energy is through electrochemistry and maximizing the efficiency with increasing the reacting rates. By producing a polymer template with a gyroid morphology, metal oxide networks can be made with maximized surface area. In order to produce this gyroid morphology, a series of polymer based reactions can be used. These reactions include atom transfer radical polymerization and ring opening polymerization. Through a determined rate of degree of polymerization and pore size, required amounts of reagents and reaction times were calculated. Living polymerizations are good tools for the preparation of block copolymers as indicated by Proton Nuclear Magnetic Resonance Spectroscopy and Gel Permeation Chromatography. Estimated pore sizes of 12, 18, and 27 nanometers were produced. In the future, by using Transmission Electron Microscopy, these pore sizes will be confirmed. The minor block of the template will also be removed allowing for the deposition of a metal oxide.

#### REBRANDING THE PEE DEE: A CASE STUDY

Daniel Beasley

Governor's School for Science and Mathematics

Branding is the process by which a consumer product differentiates itself from other, similar entities. Everything from t-shirts to bottled water has a unique brand that consumers recognize, remember, and prefer. However, within this field exists the process of destination branding: creating a unique brand, based on core values and aspects of an area, that can be marketed to tourists to motivate them to visit. Some areas let their existing attractions speak for themselves, and simply create a name to be remembered by (think Charleston, the "Heart of the Lowcountry"). Other areas, such as the Pee Dee region, must create a brand that will help differentiate it from all of the other rural areas of South Carolina, and convince tourists that there is a unique and enjoyable experience to be had. The first step to creating this brand is finding a suitable set of core values and important aspects of the area, and this research focuses on that element of the branding process. Interviews were conducted with key individuals in the Pee Dee to determine what personality they thought existed, what actions needed to be taken to increase tourism in the area, as well as concerns for its future. Interview responses, which focused around potential for agritourism and economic development, were then used to create surveys, which were distributed en masse to both residents and visitors of the area. The results of these surveys will be the largest factor in creating a destination brand for the Pee Dee.

#### ANALYSIS OF CHEMOTAXIS AND PHOTOTAXIS IN PLANARIA

Katie Beaudoin, Vineeth Sama, and Anna Hardison

Southside High School

Planaria are simple flatworms, but they possess primitive eyespots that can detect certain chemicals. In this work, we describe their response to both positive and negative chemical stimuli. Planaria were isolated and placed in a container of water. Then, either a piece of chicken liver or a salt water solution was introduced to the planaria's environment. The planaria were then observed over time to allow for the chemicals to diffuse and create a concentration gradient. Previous studies have indicated that planaria display positive chemotaxis in response to chemicals found in chicken liver, and negative chemotaxis in response to salts such as the NaCl solution. The planaria's changes in speed and direction of motion were recorded and compared to a baseline average obtained in the absence of chemical stimuli. This was analyzed by using a coordinate system in the planaria's environment to establish a frame of reference and videotaping the planaria. A decrease in rate of movement typically indicates distress from the planaria, while increased speed typically indicates a positive response to the environment. Previous studies have indicated that planaria display negative phototaxis in response to light, but their ability to detect the light varies based on the wavelength. Eyespots tend to be more sensitive to light of shorter wavelengths. Filters were used to isolate wavelengths of light of around 450-500 nm and of around 750-720 nm, and a concentrated beam of light was shone in the planarian's environment. The planaria's changes in speed and direction of motion were recorded and compared to a baseline average obtained in the absence of the stimulus of bright light. This was analyzed by using a coordinate system in the planaria's environment to establish a frame of reference and videotaping the planaria. A decrease in rate of movement typically indicates distress from the planaria.



## THE EFFECT OF UV-C IRRADIATION ON RAW FRUIT JUICE

Mary-Frances Behnke  
Greenville Technical Charter High School

A potential alternative to heat pasteurization is UV-C light treatment, both of which are used to reduce microorganisms, thus extending shelf life. This method mostly preserves the natural taste and nutritional properties of the milk or juice, unlike heat pasteurization which chemically alters those same properties. However, UV-C treatment is still uncommon because many processing facilities question the safety and effectiveness of using UV-C and fear the expenses. To support the aspect of effectiveness of irradiation, approximately 250 mL of fresh, raw (untreated and unprocessed) apple juice was set out to reach room temperature. Samples were swabbed into a petri dish of nutrient agar. Then 15 mL of the juice was exposed to UV-C light for 5 minutes. A sample from the treated juice was taken and swabbed into another plate. The fruit juice treated with UV-C showed decreased bacteria growth compared to untreated juice.

## THE CORRELATION BETWEEN AGE AND FRUSTRATION

Donzelle Benton  
Westwood High School

The purpose of my experiment was to determine the relationship between age and the ability to deal with frustration. Participants were asked to complete a survey about their current level of frustration, copy a pattern by placing paper clips on the magnetic heads of nails, and then complete a second survey to determine a change in their current level of frustration. As the participants are completing the pattern, a polarity switch, wired to two of the nails, is flipped to cancel the electromagnetic field surrounding those two nails. This cancellation will prevent the paper clips from sticking to the nail and is meant to introduce frustration to the participants. Participants are instructed to forfeit when they began to feel frustrated. I will be collecting data regarding the time it takes before participants forfeit, as well as participants' perceived levels of frustration and the change in these levels. I hypothesize that increased age will correlate with an increased time allowed for frustration before any type of catharsis. I expect that age is a significant factor in the ability to deal with frustration.

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## COMPARATIVE ANALYSIS OF RECYCLING PROGRAMS IN THE SOUTHEASTERN UNITED STATES

Tommy Berrigan  
Governor's School for Science and Mathematics

In South Carolina there is an established recycling cluster, and research has shown that an increase in the recycling rate in South Carolina will lead to a direct boost in the overall economy of South Carolina. In order to increase the amount of recycling in the state, more information on tactics for accomplishing such a task were needed. EngenuitySC, an economic development firm which works on boosting the economy in South Carolina, currently has a focus on the South Carolina recycling industry. This research of recycling economies in other southeastern states was conducted and the information was gathered to benchmark recycling. Then the steps that would be most economically advantageous if implemented were selected to be advised. While South Carolina has better recycling statistics than many other southeastern states, with a current rate of 31.8%, a much better percentage is desired. The research conducted was for the purpose of looking outside of South Carolina to see what other states have done in the area of both laws and regulations in attempts to increase their own recycling. Then all the data on other states' recycling were taken and the different strategies that showed the most success once employed were pulled out. In conclusion it was found that South Carolina can improve its recycling the most through a few different tactics: a pay-as-you-throw program, bans on certain materials from landfills, and expansions of current incentive programs for individuals and companies.

## EFFECT OF TATA-BOX-BINDING-PROTEIN ASSOCIATED FACTOR 1 (TAF1) AND P0071 (AN ADHERENS JUNCTION PROTEIN) ON CELL POLARITY OF CACO-2, A HUMAN COLON CARCINOMA CELL LINE

Zachary Berry

Governor's School for Science and Mathematics

Cell polarity plays a vital role in cell functionality. In human carcinomas, epithelial cell polarity is destroyed, causing cells to divide and migrate rapidly. From a genome-wide siRNA scan in *Drosophila* ovaries, the downregulation of the transcription factor TATA-box-binding-protein associated factor 1 (TAF1) showed a major decrease in the polarity of the very clear apical-basal markings of the lining of the *Drosophila* ovaries. The aim of this research was to explore the effects of TAF1 along with p0071, an adherens junction protein, on the polarity of Caco-2 cells, a human colon carcinoma cell line. The TAF1 and p0071 proteins were then downregulated through reverse siRNA transfection to see the effects on the cell junctions: adherens junctions, tight junctions, and desmosomes. Adherens junctions hold epithelial cells together while assisting in contact inhibition. Tight junctions make small, impermeable channels between cells and desmosomes help to connect cells, but they also assist in attaching to the basal lamina. The knockdowns of the two proteins were checked by Western Blot analysis. The immunofluorescence technique was then used along with microscopy to view the co-localization of TAF1 and p0071 with E-cadherin (adherens junction protein), Cingulin (tight junction protein), and Desmoplakin (desmosome protein). The 2D culture of immunofluorescence showed that there was no effect of the TAF1 and p0071 downregulation on cell junctions. However, since colon cells normally form tubes that attach to the basal lamina, the downregulation of TAF1 in a 3D set-up might disrupt the polarity of the colon cell line.

## AN ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY STUDY OF EPITAXIAL GRAPHENE FOR USE IN A BREATH ALCOHOL ANALYZER

Mike Bhoi

Governor's School for Science and Mathematics

Breath alcohol analyzers are commonly used by law enforcement officers to estimate blood alcohol concentration with the goal of identifying drunk drivers. Such tests are quick and efficient. However, results can be inaccurate, sometimes leading to unfair arrests and wasted law enforcement resources. Improvement in the accuracy and reliability of breath alcohol analyzers would benefit the criminal justice system. Graphene, a two-dimensional carbon molecule, shows promise for use as an electrochemical sensor due to its large surface area, excellent electrical conductivity, and sensitivity to changes in local environment. Graphene can be grown epitaxially, which involves the desorption Si atoms from the surface of a SiC wafer, leaving behind a layer of graphene on a SiC substrate. Electrochemical impedance spectroscopy is a process in which the impedance across a conductor is measured over a range of electrical frequencies. In this study, electrochemical impedance spectroscopy was used to analyze epitaxial graphene exposed to various substances. The objectives of this research were to detect and differentiate changes in graphene in response to the presence of ethanol, water, and acetone. Experimentation revealed that contact with these substances changes the way the impedance of graphene responds to changes in the frequency of AC current. The resistance across graphene at any electrical frequency in the 0.1 Hz-1000 Hz range was significantly different during exposure to each substance. It was shown that the resistance was lowest for acetone, highest for water while ethanol produced intermediate values.

## THE EFFECT OF PACLITAXEL AND CISPLATIN ON A VARIETY OF METASTATIC MAMMARY HETEROGENEOUS NUCLEAR RIBONUCLEOPROTEIN – E1 (HNRNP-E1) KNOCK DOWN CELL LINES

Dae Bigach

Governor's School for Science and Mathematics

Breast cancer is the most commonly diagnosed cancer in women (9). One protein Heterogeneous nuclear ribonucleoprotein E1 (hnRNP E1) when absent allows epithelial mesenchymal transition to occur in primary tumors. This protein was knocked down in a variety of Normal Murine Mammary Gland (NMuMG) cells so they would metastasize. The cells then underwent in vivo passage in mice to mimic a metastatic tumor returning in a patient. The resulting cell lines were named NMuMG, hnRNP E1 Knock Down (E1KD), mammary 1 passage (M1P), lung 1 passage (L1P), and lung 2 passage (L2P). The aim of this research was to test the drug resistance of these five cell lines. These cell lines were treated for four hours with two chemotherapeutic drugs at concentration gradients of 0uM to 1uM for Paclitaxel and 0uM to 20uM for Cisplatin. An MTT assay was performed to determine the viability of the cells. The results showed that the L2P cells had the highest rate of survival followed by the L1Ps, the E1KDs, the M1Ps, and lastly the NMuMGs, showing that the more metastatic cell lines were better able to overcome the drugs. To further characterize the cell lines, the five lines were then subjected to growth curves, RT-PCRs to look at mesenchymal markers, immunofluorescence microscopy to look at spindle growth, and flow cytometry to look at cell cycle patterns. Results indicate that the L2Ps lost contact inhibition and were able to overcome the G2/M checkpoint better than others in the cell line.

## EFFECTS OF AL<sub>2</sub>O<sub>3</sub> AND LI<sub>2</sub>O MODIFIERS ON MOCC MEMBRANE PERFORMANCE

Zach Bills

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Currently anthropogenic climate change is a major threat to our society. A primary cause of this change is CO<sub>2</sub> emitted from coal burning power plants. The first step to mitigate CO<sub>2</sub> emissions is a cost-effective method to capture them at point sources. A proposed system for cleaner power generation from coal necessitates a semi-permeable membrane which allows for the transport of CO<sub>2</sub> while restricting the flow of other gases. This new class of membranes are called mixed oxide-ion and carbonate-ion conducting (MOCC) membranes. These membranes currently are not stable at high temperatures due to loss of molten carbonate, a liquid trapped within that generates the necessary semi-permeability. This research focuses on improving the stability of the MOCC membranes via the utilization of Al<sub>2</sub>O<sub>3</sub> and Li<sub>2</sub>O as additives. The addition of these additives to the base ceramic which comprises the main structure of the membrane is intended to reduce the size of the pores in which the molten carbonate is trapped as well as making the ceramic itself stronger. Gas permeation analysis of the membranes which simulates operational conditions indicates that membranes composed of a base ceramic incorporating the Al<sub>2</sub>O<sub>3</sub> additive demonstrated substantial performance increases. Structural analysis of the membranes using scanning electron microscopy indicate that both additives significantly reduced pore size of the ceramic.

## EFFECT OF CULTURE ON A COMPANY'S SUCCESS

Joshua Bingham

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What leads a software company in Charleston, SC, to be the fastest growing software company in the United States? In 2013, the Inc. 5000 list of fastest growing companies in the US labeled one such company, SPARC, number fourteen on their list, making them the single fastest growing software company in America. The biggest difference between SPARC and other companies may be that SPARC places a large emphasis on culture. This research into SPARC attempted to discover if this emphasis on culture made them successful, and, if so, what makes the culture so special. In order to answer these questions, time was spent at SPARC observing how the employees and executives interacted with each other, as well as interviewing a number of employees and executives. After being sifted through, these data were then compared to examples of culture from other companies, in an attempt to discover what made SPARC different. While further research is required, the data collected appear to suggest that SPARC's culture is a key driver to SPARC's success.

## MOLECULAR MECHANISMS CONTROLLING PHOSPHODIESTERASE 11A4 (PDE11A4) PROTEIN EXPRESSION AND SUBCELLULAR LOCALIZATION IN BALB/CJ VS. C57BL/6J MICE

Katherine Bishara

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Phosphodiesterases (PDE) are enzymes responsible for terminating cyclic nucleotide signaling. Neuropsychiatric patients such as those with Alzheimer's disease show a dysregulation of cyclic nucleotides as well as a dysfunction in the ventral hippocampus (VHIPP) region of the brain which is responsible for social behavior and memory. Phosphodiesterase 11A4 (PDE11A4) occurs primarily in the VHIPP. Previous research has shown that BALB/cJ mice show higher levels of PDE11A4 protein expression in both dorsal hippocampus (DHIPP) and VHIPP as well as more expression in the membrane relative to C57BL/6J mice. The aim of this research is to a) determine the mRNA expression of PDE11A4 in these two mice strains by in situ hybridization of the hippocampus using a PDE11A4 probe. Results indicate greater PDE11A4 mRNA expression levels in BALB/cJ mice compared to C57BL/6J only in the DHIPP unlike previous research that found differences in both the DHIPP and VHIPP; b) to determine the effects of a coding difference at Residue 499 on subcellular localization by microscopy of HEK293T cells and protein quantification of COS 1 cells. Microscopy analysis and Western Blot results show that BALB/cJ mice have a higher membrane fraction of PDE11A4 relative to C57BL/6J mice, similar to previous research that showed a higher membrane fraction in BALB/cJ mice.

## THE BID: AN EXPLORATION OF THE BUSINESS IMPROVEMENT DISTRICT AND HOW IT RELATES TO THE CITY OF BEAUFORT

Shuler Black

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The formation of Business, Community, and Municipal Improvement Districts has become a common practice in the modern United States. What is the difference between the BID, CID, and MID and which, if any, could be beneficial to Beaufort, SC? After researching the three, it became evident that these terms are synonymous. A business improvement district, commonly referred to as a BID, is a region with specific geographic boundaries, including residential and commercial property. This specified district taxes itself an ad valorem millage rate, which is a tax based on the assessed value of the property, in order to accrue money. With this money, various improvements are made in the sectors of marketing, maintenance, security, and housing, exclusively for the businesses paying the tax. These changes provide the groundwork for economic progress and stimulate local business by promoting a business-friendly environment, and are governed by a board of business owners. In this research, tax information was collected on a set of parcels covering a large portion of the Beaufort municipality. After gathering the market values for over 500 parcels, the information was transferred to an Excel spreadsheet. Then, through sensitivity analyses, various millage rates were studied in order to analyze revenue. Finally, the increase in revenue

generated by the various millage rates was examined to propose an appropriate rate of 3-5 additional mills for the Beaufort area. If the proposed BID is put in place, this research suggests it could generate significant economic growth, as it has in many other cities across the US.

#### CREATING AN ADAPTING SMART VIRTUAL CAMERA HEIGHT CONSTRAINT ALGORITHM

William Blanchett

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Virtual cinematography is a growing field with multiple applications, such as in movie production and gaming replays. To build upon previously conducted research and create a user based virtual camera position sharing tool, the basis of an algorithm was developed that would automatically adjust the camera to proportionally vertically fill a screen. The adjustment is based on the source object and the target object that is being adapted.

#### THE PROPAGATION OF LAMB WAVES IN HONEYCOMB STRUCTURES

Adam Blocker

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A common approach to structural health monitoring is to mount a network of PWAS (piezoelectric-wafer active sensors) in which one sensor sends out a pulse of Lamb waves that the others receive. Any difference between the initial wave form and the received wave form indicates potential damage between the actuator and receiving sensor. This hybrid sensing method requires extensive access to the structure, which cannot always be granted. An alternative approach to this problem utilizes a single mounted PWAS and a laser vibrometer, which measures out-of-plane displacements from the specimen. The PWAS emits pulses of Lamb waves that can be received by the laser vibrometer at any point on the specimen, not just the points where sensors are mounted. This method also requires much less access to the structure, as only one sensor needs to be mounted. In this paper preliminary research on the interaction between Lamb waves and honeycomb "sandwich" structures using the hybrid sensing method will be presented. In an anisotropic honeycomb structure, the Lamb waves propagated in an anisotropic manner at a frequency of around 15 kHz. Damage simulating delamination can be detected using the hybrid sensing method at this frequency. At higher frequencies, such as 100 kHz, the outlines of the individual honeycomb cores can be seen on the videos produced by the laser vibrometer.

#### DISRUPTIONS IN PHOTORESPIRATION OF GENUS MILLEPORA CORAL SYMBIODINIUM IN RESPONSE TO OCEAN ACIDIFICATION

Casey Brayton

Dutch Fork High School

Coral bleaching poses an imminent threat to the health and longevity of the world's coral reef systems. The recent increase of ambient CO<sub>2</sub> in sea water endangers the photoprotective process of photorespiration, which may overwhelmingly contribute to these bleaching events. While it has been established in numerous studies that ocean acidification negatively impacts calcification rates in corals, ocean acidification's potential effect on other physiological processes has been largely overlooked, and the link between photoprotection disruption and bleaching events has been highly suggested, but has yet to be definitively established within a controlled environment. This study will investigate the effect of increasing CO<sub>2</sub> levels on photorespiratory processes and their effect on coral bleaching patterns. When thirty specimen of genus *Millepora* are placed in ocean water with lower-than-average pH ("business-as-usual" projections ranging from normal levels to 1000 ppm), it is hypothesized that there will be a marked increase in surface area of bleached coral, measured in mm<sup>2</sup>. The surface area of bleached coral will be measured by a laser grid in mm<sup>2</sup>, while oxygen levels will also be monitored to observe the adjustment in photosynthesis after photorespiration declines. It will be analyzed whether the area of surface bleached in the high acidity group deviates from the control specimen where all conditions are at an optimal level.

#### IRON UPTAKE IN DUCKWEED

Rohan Brebion

Southside High School

The objectives of this study are to investigate the amount of iron uptake of floating *Spirodela polyrhiza* L. (Duckweed) and assess the effects of the uptake on growth dynamics in an isolated, aquarium environment. Two iron solutions of .36 mM were used to investigate the uptake of iron; one solution was made with Iron (II) Sulfate, Heptahydrate and the other solution with Iron (III) Chloride Anhydrous. These iron chemicals were used because they are present in common hydroponic solutions such as in Hoagland's medium. Each solution was placed in two separate trials. All samples of the *Spirodela polyrhiza* L. were germinated in the control conditions then moved into separate containers specific for each trial and variable. The study is analyzing if the iron uptake of the *Spirodela polyrhiza* L. provides any benefit to growth through root length, mass of the samples, plant height, and plant color. The impact of iron uptake in plants such as *Spirodela polyrhiza* L. (Duckweed) is important in the healthy development of root systems and development of new biotechnologies, such as more effective hydroponics solutions and supplements. Moreover, the rate of iron uptake is an important in understanding how to treat iron chlorosis, a typical iron deficiency that causes the yellowing and even browning of plants.

## MULTIPLE PDZ DOMAIN PROTEIN INHIBITS ANGIOGENIC SPROUTING IN HUMAN UMBILICAL ARTERIAL ENDOTHELIAL CELLS (HUAEC)

Tyler Brown

Governor's School for Science and Mathematics

Like any human tissue, cancerous tissues in tumors require a constant source of oxygen, which is provided by blood vessels. To allow for tumor growth, angiogenesis, or the development of new blood vessel lumen from pre-existing lumen, must occur. A major component of angiogenesis is cell differentiation, and current scientific understanding suggests that Delta-Notch signaling plays an important role in this process. It also suggests that Multiple PDZ domain protein (MPDZ), a scaffolding protein found in endothelial cells, may influence this pathway. Previous research has found that in Human Umbilical Venous Endothelial Cells (HUVEC cells), knockdown of MPDZ results in lower angiogenic activity due to an increase in Delta-Notch signaling. The aim of this research is to determine whether lower levels of angiogenesis occurs in Human Umbilical Arterial Endothelial Cells (HUAEC cells) as well. It was tested through measuring the expression of several Notch target genes (Hey1, Hey2, NRARP, and EphrinB2) using RT:PCRs and through the production of spheroids of HUAEC cells which were induced to sprout under the presence/absence of VEGF and MPDZ control/knockdown. We found that MPDZ knockdown resulted in lower expression of the genes and lower levels of angiogenic sprouting compared to control groups, confirming that MPDZ inhibits angiogenesis in HUAEC cells.

## THE EFFECT OF MICROBEADS ON THE MORTALITY PERCENTAGE OF DAPHNIA MAGNA

Sarah Buchanan

Heathwood Hall Episcopal School

Microbeads, primarily made up of polypropylene that are smaller than 1mm, are most commonly found in face washes and toothpastes. These microbeads, when poured down the drain, end up polluting many marine habitats causing contamination. The effect that these micro plastics have on the habitats on marine species was studied using Daphnia magna. The purpose of this experiment is to determine the effect that microbeads found in Neutrogena Deep Clean Gentle Scrub have on the mortality percentage of Daphnia magna. This was tested by isolating the microbeads from the product, adding different specified masses to each experimental group that contain ten Daphnia magna each. Then the percent of mortality and the percent of survival was measured after 24 hours and 48 hours. This experiment is still on going and result are still being collected.

## INTRACELLULAR LOCALIZATION OF HGF RECEPTOR FRAGMENTS IN LUNG FIBROBLASTS

Taylor Buckner

Governor's School for Science and Mathematics

Systemic sclerosis (SSc) is an irreversible fibrotic disorder with interstitial lung disease (ILD) being a major complication and leading cause of mortality. African American SSc patients exhibit higher prevalence of ILD and worse outcomes than those of other races. We previously reported that a cell-protective and antifibrotic factor, hepatocyte growth factor (HGF), is downregulated in bronchoalveolar lavage fluid and plasma from African American SSc-ILD patients compared with white SSc-ILD patients. It has also been reported that the HGF receptor, c-MET, can be cleaved by Caspase-3 and divided into 3 fragments: extracellular domain (100 kDa, designated as p100), kinase domain (40 kDa, designated as p40), and carboxy-terminal tail (1.1kDa, designated as M10). However, the role of these fragments inside of fibroblasts remains unknown. We hypothesize that intracellular localization of c-MET fragments depends on their specific functions within the cell. The purpose of this study is to observe the intracellular localization of the three protein fragments. Human lung fibroblasts were transfected with p100 and p40, cloned into pcDNA3.1 or treated with custom synthesized M10. Immunofluorescence study was performed using V5 antibody to detect p40 and p100 and C12 antibody to detect M10. We observed cytoplasmic and nuclear staining of p40 and M10 fragments. Our study indicates intracellular localization of HGF receptor fragments and suggests their role in the transmission of antifibrotic signaling to the nucleus.

## THE EFFECT OF THE CONCENTRATION OF STRONTIUM NITRATE IN A BLACK POWDER BASE ON THE INTENSITY OF THE 600 NANOMETER WAVELENGTH OF THE EMISSION SPECTRUM

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The purpose of this project was to determine whether or not the amount of strontium nitrate in a chemical mixture (with potassium chlorate, charcoal, and sulfur) affected the intensity of the color of the flame when it was ignited. The independent variable of the project was the percentage of strontium nitrate and the dependent variable was the intensity of the 600 nanometer emission line produced by the flame. In order to determine this, a device (with software included) called RSpec Explorer was used that had a special camera to collect the wavelength intensity and the flame intensity. After burning mixtures with different variations of strontium nitrate, and using the RSpec Explorer camera and software, the intensity of the 600 nanometer emission line was compared to the intensity of the overall spectrum to collect the data. For each trial, those two intensities were divided to get a percentage for accuracy. After comparing the intensity percentages, it was determined that the null hypothesis could not be rejected at the 0.05 level because there was no clear variation in the intensity compared to the different mixtures.

## COULD SCALING FRESNEL LENS TECHNOLOGY RESULT IN A GREATER CAPACITY FOR SOLAR HEATING AND COOKING APPLICATIONS?

Gage Burkhalter  
Center for Advanced Technical Studies

Fresnel lens devices are a type of solar concentrator technology that can be utilized to heat and cook very effectively due to the extremely high temperatures that are reached. The goal of this research study is to determine if scaling a Fresnel lens to a much larger size can result in a greater output efficiency that would allow for underdeveloped areas of the world to use the devices for heating and cooking applications. Specifically, larger Fresnel lens devices could potentially be used for heating & boiling large quantities of water in order to provide drinking water for areas of the globe where clean, safe drinking water does not currently exist. As long as extended periods of sunny weather are consistently available, Fresnel lens concentrators could reliably supply safe drinking water and cooking solutions.

## THE EFFECT OF TEMPERATURE ON THE GROWTH OF PSEUDOMONAS SP. AND PENICILLIUM SP. WHEN GROWN USING MOTOR OIL AS A SOURCE OF NUTRIENTS

Grayson Byrd  
Heathwood Hall Episcopal School

The purpose of this experiment is to determine the effect of temperature on the growth of *Pseudomonas* sp. and *Penicillium* sp. when grown using motor oil as a source of nutrients. First all of the materials needed were gathered. The bacteria and fungus were grown in an incubator at the recommended temperature while in a test tube of nutrient broth. After they grew for two weeks, thirty six test tubes were filled with two milliliters of oil and seven milliliters of water. A pipet was used to transfer one milliliter of nutrient broth/bacteria mixture to eighteen of the test tubes. One milliliter of nutrient broth/fungus mixture was added to the rest of the test tubes using a different pipet. Three sets of twelve containing six bacteria and six fungus test tubes were separated and put into three different climates: cold, room temperature, and hot. They were left to grow using the oil as a source of nutrients for two weeks. After these two weeks bacteria and fungus had grown directly underneath the layer of oil at the top of the water. The amount of growth was measured in millimeters for each test tube. The results of the experiment showed that in each of the climates the average growth of the two microorganisms were different than the microorganisms in the other climates. In conclusion, the results supported the null hypothesis, stating there will be no difference in growth in any of the climates, to be rejected.

## THE EFFECTS OF PROTEASE ACTIVATED RECEPTOR-1 (PAR-1) ACTIVATION ON MOTOR NEURON AXON EXTENSION IN A 3-D COLLAGEN MATRIX MODEL

Noa Camp  
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Motor neurons are nerve cells that originate in the spinal cord and are responsible for muscular control. Axons extending into the periphery from these motor neurons are very prone to damage. This kind of damage often also results in breakdown of nearby blood vessels, releasing thrombin, an activator of protease-activated receptor-1 (PAR-1). Thrombin activates PAR-1 by cleaving off a receptor cap, exposing the 7-amino acid sequence SFLLRNP, which then binds to a site on its own receptor. Previous studies have shown that PAR-1 activation on motor neurons grown in 2D culture causes less overall branching off the neurons and shorter axons. This project examines how PAR-1 activation affects axon growth in a 3D collagen matrix. To ensure that the axons grow in the proper direction, a collagen matrix containing nerve growth factor was placed at the bottom of the chamber and then topped with a matrix seeded with chick embryo motor neurons. Test groups were treated with 100 $\mu$ M SFLLRNP; whereas controls received an equal volume of medium. Collagen matrices were collected at 24, 48, 72, and 96 hour time periods after treatment and processed for immunocytochemistry. Cells were stained with anti-vinculin for focal adhesion points, TRITC-phalloidin for the processes and DAPI for the nuclei. Stained cells were photographed and axon lengths were measured. Preliminary results suggest that motor neuron axon growth rate is hindered by PAR-1 activation in the presence of SFLLRNP.

## TARGETED WASTE SEPARATION TO IMPROVE THE ECONOMIC VIABILITY OF METHANE HARVESTING

Jarrett Cantey  
Center for Advanced Technical Studies

Landfill methane harvesting is the process through which methane released through anaerobic digestion is collected and put to use in energy production. The viability of this method is historically unpopular due to the low energy output. In order to improve the economic viability of methane harvesting, this study seeks to improve the energy output of landfill gas harvesting through separation of waste components into common groups. The waste group which is found experimentally to have the greatest potential for methane production which then be further sub-divided to determine which components specifically lead to increased efficiency.

## CONTROLLING THE DISSOLUTION OF AG IN AG-AU CORE SHELL NANOPARTICLES OF VARYING SHELL THICKNESS

Will Carpenter

Governor's School for Science and Mathematics

Silver nanoparticles have recently come into use in multiple industrial and consumer products. Silver nanoparticles have been shown to be toxic in aquatic environments, but it is not known whether the toxicity is from the dissolution of the nanoparticle or the presence of the nanoparticle. The experiment was performed by creating differing thicknesses in the silver-gold core-shell nanoparticles. These nanoparticles were then dissolved in moderately hard water for 24 hours. The concentrations of silver in each of its forms at zero and twenty-four hours was measured. It was found that as the thickness of the outer gold layer was thickened, the dissolution decreased. Future work will deal with pinpointing the exact range in which there is the least dissolution with the thinnest gold layer.

## THE STUDY OF HUMAN SPHINGOSINE KINASE AND ITS POTENTIAL INHIBITORS

Brooke Christensen

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Stress towards cancer cells have the potential to cause the Sphingomyelin to branch off the cell membrane and enter the cell, triggering a metabolic reaction. During this reaction, the Sphingomyelin is a precursor for the proapoptotic compound, Ceramide, as well as the Sphingosine 1-Phosphate (S1P), which is known for its role in promoting cell proliferation. Sphingosine Kinase (SK) catalyzes the reaction by phosphorylating Sphingosine to produce S1P. Sphingosine, converted from Ceramide, maintains a minor role in cancerous cells and is therefore overlooked in the anticancer research. SK has recently been targeted for anticancer activity and research includes synthesizing potential SK inhibitors (SKI). An inhibitor was found to successfully inhibit SK in vitro; however, its high Log P value disallowed it to be successful in vivo. The SKI's Log P value, a ratio that inversely corresponds to the compounds solubility, is around six. The desired range for drugs for the human body is below five. It was hypothesized that a modification to the functional group of a carbonyl group and hydroxyl group of the SKI would increase the solubility of the inhibitor compound, therefore decrease the Log P value to the desired range. Future work includes modifications for all the functional groups of the SKI and testing the inhibitor's solubility.

## BACTERIAL GROWTH ON PROCESSED EGGSHELLS(US) VS UNPROCESSED EGGSHELLS(UK)

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The purpose of this project was to determine if there is a difference between the bacterial growth on processed egg-shells and unprocessed egg-shells that haven't been through any type of disinfection process. This is important because people, everyday, eat eggs. The hypothesis was that the processed egg-shells would show more bacterial growth compared to the unprocessed egg-shells because they have been stripped of their cuticle. The egg-shells were tested by dipping them in a bacterial broth which was a mixture of tryptic soy broth and micrococcus luteus. They dried for twenty-five to thirty minutes and then were swabbed. The eggs were swabbed using sterile cotton swabs dipped in sterile water. The swabs were then used to streak petri dishes in a zigzag motion and were set on the top of an incubator (set to 25°C), to be incubated at room temperature. After about 128 hours, the petri dishes were taken off of the incubator and pictures were taken of each. Imagej software was used to count the colonies of micrococcus luteus on each petri dish. The data was analyzed in Google Sheets where a t-Test was run (using the XLMiner add-on) to tell if there was a significant difference in the amount of bacteria on the unprocessed versus processed egg-shells. These results concluded that our hypothesis was true; the processed egg-shells showed more micrococcus luteus. However, the unprocessed eggshells showed more mold and different bacteria. Future research could be done to test what types of potentially harmful bacteria are found on unprocessed egg-shells, and other ways to disinfect eggshells without stripping them of their cuticle.

## AUDITORY NERVE INJURY INDUCES MACROPHAGE ACTIVATION

Anne-Marie Coble

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Macrophages are a special type of immune cell that engulfs dead or damaged cells. They are found everywhere in the body and become more active after damage to cells. Their role in healing acute injury in the mature mouse cochlea has not been fully determined. We used Ouabain surgery, a chemical that kills neurons, to investigate the behavior of macrophages after injury. We hypothesized that macrophages would become more active after direct injury to the cochlea. Using immunofluorescence, we were able to observe the behavior of macrophages stained with anti ionized calcium binding adapter molecule 1 antibody (IBA1), which is found on the surface of macrophages. We found that after the model of acute injury, the number of macrophages in the cochlea increased and appeared more active based on their morphology. This information can lead to future studies about the types of macrophages and the specific healing role in acute injury.

## USING HYDROTHERMAL CARBONIZATION REACTORS TO REMOVE E. COLI FROM LIVESTOCK PRODUCTS

Jessica Collins

Governor's School for Science and Mathematics

Scientists have been researching new methods that are eco-friendly and least costly when debating the topic of eliminating the spread of pathogen and antibiotic resistance in the environment. Prior research of this field has been rarely studied until the introduction of Hydrothermal Carbonization (HTC) Reactions which emit carbon-rich hydrochar. These reactors were used to test the elimination of the E. coli O157:H7 from infected cow bone and muscle tissue at different temperatures and time. Kanamycin, an antibiotic resistance drug containing the E. coli plasmid, has been known to have an increased resistance with bacteria used agriculturally. Because of this, Kanamycin was used in the agar plates in order to track the growth or lack of growth with the experimental E. coli. The leftover liquid from the reactor was serially diluted to test for growth in bacterial colonies. DNA extractions were taken on the different samples and ran on electrophoresis gels after undergoing PCR reactions. Detection of the E. coli plasmid was negative for 200° bone and muscle tissue samples and 150° meat samples but was positive in the first well of the 150° meat sample. Essentially, the HTC Reactors were essential in eliminating the bacteria which now lead into investigating which HTC reactor would be ideal for farmers to use in the future for livestock disposal.

## THE EFFECT OF SALINITY ON THE FUNCTIONS OF A MICROBIAL MAT.

Brenna Connor

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The purpose of this research was to discover how salinity affects the functions of a microbial mat specifically nitrate, dissolved oxygen, and pH levels. Ten mats in four weeks were grown, and then experimentation began. These tests measured the water quality parameters at three levels: low salinity, average salinity, and high salinity. The average salinity of water is 3.5%. During the experiment, there was a conduction with a couple trials on each mat based on salinity levels. Testing was done on each of the nine mats three times. The results obtained from experimentation varied. The pH was affected as concluded by my experiment. The nitrate did not change. The dissolved oxygen was affected as well. The conclusion is that salinity does affect microbial mats depending on the water quality parameter. This brief description isn't elaborated, but the trials weren't all conclusive. What is meant by conclusive is that it was not agreeable with my hypothesis. The null hypothesis of the experiment was that the salinity might not affect the microbial mat. This was compliant with the nitrate. The overall experiment was successful with the written statement of the hypothesis.

## THE EFFECT OF HEPATOCYTE-SPECIFIC GLUCOCORTICOID RECEPTOR LOSS-OF-FUNCTION ON ARGINASE I EXPRESSION IN THE MOUSE LIVER UREA CYCLE

Sean Conway

Governor's School for Science and Mathematics

The glucocorticoid receptor (GR) is known to play a role in gene transcription in nearly every animal cell. However, it is unknown how this relates to the body's overall function. This research examined two hepatocyte specific GR loss-of-function mice models, one knockout model and one microRNA model, for urea concentration using a urea assay. In both loss-of-function models the concentration was lower than in the controls. With this in mind, the loss-of-function models were examined for gene expression in six urea cycle associated genes using qPCR with cDNA synthesis from RNA samples, and the arginase gene (Arg1) was shown to be most affected. Arginase protein levels were also examined to examine whether it was also a translational problem using the western blot technique. Arginase protein levels were found to be lowered in both loss-of-function models. While these results were obtained from mice models, an understanding of the GR system in humans will also be beneficial. Human Addison's disease patients, who naturally show a lower GR count, had their serum tested for urea concentration with a urea assay and, like the mice models, showed a significant drop compared to the healthy individuals.

## UTILIZING ADVENTITIOUS ROOT VARIATION TO IDENTIFY THE CORRELATION BETWEEN ROOT FORMATION AND LEAVES IN PEACHES

T'Kayhlia Cornish

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Adventitious rooting of plants is beneficial to the cloning of desired plants; no matter the use. However, many desired species of plants do not produce adventitious roots, so the characteristics of adventitious roots are studied to see if these desired species of plant can get the genome needed to do so. In this research, the ultimate goal is to identify the different that leaves make when growing adventitious roots. Two populations, A and C, are phenotyped for their production of adventitious roots. Approximately ten, twenty-centimeter cuttings of current year wood were taken from 378 trees in the A population and 57 trees in the C population. The leaves were stripped and the stems were dipped in IBA, indole-3-butyric acid, and placed in a soilless media, which consisted of vermiculite and perlite. They were then put in the greenhouse and kept misted for four weeks. The cuttings were scored for various properties such as: number dead, callus, rooting, and budding. DNA from the dried leaf tissues of the same populations were extracted, quantified, and quality checked in order to produce a more detailed genetic map. A second experiment was done after this with the same populations leaving the leaves on the cuttings to see if they make a difference. The success of the growing stems, with or without leaves, will tell us whether the rooting of the plants can be controlled so that maybe in the future the genome of adventitious rooting can be modified and placed in other plants.



## SEMAPHORIN 3F RESPONSES TO NEUROPILIN 2 ISOFORM KNOCKDOWNS IN H157 LUNG CANCER CELLS

Sean Cosh

Governor's School for Science and Mathematics

Semaphorin 3F is a well-known tumor suppressor that is able to inhibit tumor metastasis. Neuropilin 2 is its high affinity receptor, but it has two isoforms, "a" and "b". SEMA3F is predicted to bind to the "a" isoform in order to function as a tumor suppressor, but it is unclear whether semaphorin 3F binds specifically to one isoform or the other to function as a tumor suppressor. Western Blots tested to see if isoform knockdowns in H157 lung cancer cells affected signaling associated with tumor metastasis. To test for SEMA3F effects on adhesion, we ran an adhesion assay to see how the cells attached to an ECM substrate. However, the adhesion that we observed could be static or dynamic, so we set up a pacman migration assay to assess the adhesive properties of the cells. The results gathered from each of these tests showed that SEMA3F utilizes both isoforms to function as a tumor suppressor. The "a" and "b" isoform knockdowns expressed metastatic signaling, transforming SEMA3F into a tumor promoter rather than an inhibitor. Therefore we can assess that semaphorin 3F needs both isoforms to function. A possible model for this is that a heterodimer between both of the isoforms is needed for SEMA3F to bind and send a tumor suppressing signal. It is also possible that a certain ration of NRP2a to NRP2b needs to be maintained in the cell for SEMA3F to function properly.

## THE EFFECT OF ARROW MASS ON BOTH THE ARROW VELOCITY AND THE EFFECIENCY OF THE BOW

Coleman Couick and Spencer Hann

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The topic of the experiment is the effect of mass of an arrow on bow efficiency. The research question is, "will the efficiency of a bow be affected by mass of an arrow?" Previous work has failed to address accurately the relationship between mass and efficiency. The research was conducted at a local indoor archery range with the help of the staff. The research was conducted by running experiments using one bow and multiple arrows of different masses. The key impact of this research is to help archers decide what mass arrows to use for shooting.

## EFFECT OF BOLUS VISCOSITY ON EPIGLOTTIC INVERSION DURING SWALLOWING

Ramsey Coyle

Governor's School for Science and Mathematics

Swallowing is an important and complex bodily function. One important structure involved in swallowing function is the epiglottis, which covers the airway during the swallow to help prevent food or liquid from getting into the trachea. This study aimed to examine if a more viscous bolus would induce greater inversion of the epiglottis, giving better protection to the airway during the swallow. This was tested by examining Modified Barium Swallow Study videos using the Modified Barium Swallow Impairment Profile ©™. This study looked specifically at component 10; epiglottic movement, which is scored on a 0-2 scale. It was hypothesized that more scores of 0 (complete inversion) would be seen in pudding trials when compared with thin liquid trials. The two swallows included a 5-mL (teaspoon) thin liquid trial and a 5-mL pudding trial. For purpose of this descriptive analysis, the scores were dichotomized into unimpaired (score = 0) and impaired (scores = 1 or 2). Fischer's exact test was used to analyze the data to indicate a statistical difference between the swallows of the different viscosities in this small sample. The rates of scores were entered into a 2x2 contingency table. The statistical significance was set at an alpha level of 0.05. There were significantly less impaired scores with the pudding than with the thin (P value = 0.0004).

## INSULATIVE PROPERTIES AND HEAT TRANSFER

Tryston Crawford

Greenville Technical Charter High School

Heat flow can occur through conduction, convection, and radiation. In an attempt to control heat flow, thermal insulators can be applied. Thermal insulators conduct heat poorly because they are working against heat transfer. The most common insulating materials work by slowing conductive heat flow. For this experiment, the plan is to test the insulating properties of different materials by comparing the time it takes to melt ice cubes in an aluminum can. Conduction will be the method of heat transfer that is utilized for this experiment. This experiment will also use multiple different insulators to slow the melting process and determine which insulator is most effective. This experiment will help identify the most effective type of insulator for slowing the heat transfer process and protecting the ice cube. The goal of this project is to demonstrate how good insulating materials can be used to control heat flow and slow down the heat transfer process.

## COMMUNITY SERVICE AWARENESS THROUGH THE USE OF MEDIA

Reid Creswell

Chapin High School

The purpose of this research project is to investigate how high school students go about finding community service opportunities. Service project involvement can have a major impact on college admissions and is required for many high school clubs. I hypothesised that there would be a 25% decrease in word of mouth communications and then inturn a 25%

increase in online communications. Research was done through online surveys conducted with random students in the high school. Data was collected from the preliminary survey; 25 participants took the survey and their responses to the questions were recorded. The survey contains questions ranging from frequency of community service to how participants find out about community service. It looked at patterns in attendance and other factors dealing with community service. A second survey, with the same questions, was conducted after the websites creation. Then the data from both surveys was compared to test the hypothesis. The conclusion from the preliminary data was that community service has fallen behind in a modern world in terms of online communication and lacking the necessary media to promote its message effectively in the community. After the creation of the website, secondary data was collected. It was concluded that the hypothesis was rejected and there was infact no decrease from word of mouth communication and an insignificant increase in online media. The reason for this is found in the lurking variables, the time frame that the website was displayed and the lack of community service events during this time.

#### DEVELOPING A TEST METHOD TO PRECISELY INDUCE AND MAINTAIN DIFFERENT CRACK WIDTHS IN REINFORCED CONCRETE

Julia Daniels

Governor's School for Science and Mathematics

Corrosion causes over \$8.3 billion worth of damage to highway bridges each year. In reinforced concrete bridges, steel rebar is reinforced inside of concrete to give the bridge additional strength and safety. Cracks in the concrete, however, provide a path for corrosive material such as chlorides of salt water to access the rebar and cause corrosion. The relationship between corrosion rates due to chloride access and the crack widths of reinforced concrete remains unclear. The objective of this project was to experimentally develop a standard method for testing corrosion rates in cracked concrete. Small concrete blocks with reinforcement bars were built, and a crack was induced through applied forces. A replicable test method to consistently induce cracks of specified widths in reinforced concrete was devised. The most effective design proved to be the beveled inverted rectangular prism of the third generation of reinforced concrete specimens. Future research at Clemson University will apply the test method to evaluate corrosion rates and crack repair strategies.

#### EFFECTS OF DIFFERENT TYPES OF MUSIC ON VARIOUS LEARNERS AND THE AFOREMENTIONED'S COGNITIVE ABILITIES

Gracie Daughtry

Greenville Technical Charter High School

There have been several experiments in the past that test the correlation between music, usually Mozart, and cognitive abilities. These experiments have shown mixed results. Most of the experiments are not thorough, and there is not a way to tell if their results are accurate. It was decided for this experiment to test classical music, pop music, and silence on children's cognitive abilities. Fifteen year olds will be the test subjects. First, they will take a test that determines if they are an auditory learner. Being able to tell if the subjects are auditory learners will help me find a connection between the test scores and music. After that, they will take a two part test. Part one will be consisted of the subjects to listen to a document and then they will have to answer 5 questions about the document. Part two will be 5 age appropriate math questions. While the children take the test the first time, they will listen to nothing. While the children take the test the second time, they will listen to pop music. And when children take the test the last time, they will listen to classical music. Silence is the control, music is the independent variables, and the dependent variable will be the average of the test scores for each test, for each age group. It is predicted that there will be negative correlation between the pop music and the test, and a positive correlation between the classical music and the test. (Note: I have changed this, however, I do not have my abstract saved to this device. I have mailed in 3 copies)

#### HAS THE ADDITION OF WIRELESS HOUSEHOLD ELECTRONICS EFFECTED THE LEVELS OF EMF IN HOUSEHOLDS?

John Davis

Heathwood Hall Episcopal

The purpose of this project was to determine the affect that the increase of wireless electronics has on the average electromagnetic radiation in a household. In this experiment, there were three measurements from twenty different points in a household that were taken using a jig that consisted of a tripod and a 3-axis rf meter. The twenty different points were chosen randomly throughout the household in different rooms. The three measurements were (1) all power off and the wifi off, (2) all power on with the wifi on, and (3) all power on with wifi on. All power off and the wifi off was a control group to find the background radiation. At each point three measurements were taken of the three different variables so that an average of electromagnetic radiation could be taken from the experiment group. From the results it can be concluded that wifi routers increase the average electromagnetic radiation in a household by 179% on average. This shows that the increasing use of wifi electronics has a definite affect on the amount of electromagnetic radiation we are exposed to in an average household.

## IDENTIFICATION OF TOXIN-ANTITOXIN SYSTEMS IN PSEUDOMAS AERUGINOSA

JaLisa Decker

Governor's School for Science and Mathematics

Toxin-antitoxin (TA) systems allow free-living bacteria to respond to environmental stresses by regulating toxin activity at the levels of transcription and translation. The toxin and the antitoxin form stable complexes. When disrupted, the toxin is free to target key processes within the cell, resulting in growth inhibition or death. TA systems have been extensively studied in the model organism *Escherichia coli*. However, current research has not elucidated any TA systems in the nosocomial pathogen *Pseudomonas aeruginosa*. The *P. aeruginosa* genome was screened and gene pair PA0124/0125 was predicted to be a TA system by the identification of two open reading frames in an operon. The predicted toxin gene, PA0124, was isolated, inserted into a shuttle vector, and overexpressed in *E. coli* and *P. aeruginosa*. The effect of the toxin gene on the growth of *P. aeruginosa* was observed as the transformed bacteria were grown on agar plates. There appeared to be little or no difference between the bacterial growth with or without the gene insertion. Future research will focus on isolating and expressing other predicted toxins in *P. aeruginosa*.

## MAGNETIC HYPERTHERMIA INACTIVATION OF ENTEROTOXIGENIC ESCHERICHIA COLI USING BIO-FUNCTIONALIZED IRON-OXIDE NANOPARTICLES

Taylor DeHart

Governor's School for Science and Mathematics

Rapid emergence of new multi-drug resistant bacterial strains warrants new therapy options for treating bacterial infections caused by these strains. The purpose of this project was to use magnetic hyperthermia, in the presence of bio-functionalized iron-oxide nanoparticles (IONPs), as a non-antibiotic technique that effectively kills bacterial infections caused by enterotoxigenic *Escherichia coli* (ETEC), specifically *E. coli* ATCC 13762 (EC K99). EC K99 is known to cause bloody diarrhea in newborn pigs and calves and foodborne illnesses. The IONPs were coated with polyethylene oxide (PEO-IONPs) and bio-functionalized with specific sialic-acid glycoconjugate Neu5ac( $\alpha$ 2-3)-Gal-( $\beta$ 1-4)GlcB-sp (GM3-IONPs) that mimic the receptors of EC K99 adhesins. Magnetic hyperthermia treatment of a mixture of EC K99 and GM3-IONPs resulted in a 2-log reduction of colony-forming units (CFUs) of EC K99 after 60 minutes. There also was a significant decrease in the ATP activity of EC K99 seen from luminescence assays after the hyperthermia treatment. These results suggest that magnetic hyperthermia can potentially be used as a novel non-antibiotic therapy option for treating bacterial infections.

## THE EFFECTS OF WARMING AND ELEVATED CARBON DIOXIDE ON THE SUBERIN COMPOSITION OF ROOTS: A CASE STUDY WITH A C3 PLANT SPECIES

Rose Dellinger

Governor's School for Science and Mathematics

Warming temperature and increasing CO<sub>2</sub> have a positive feedback loop known as the greenhouse effect. To estimate the changes that will present themselves in future years, the Prairie Heating and CO<sub>2</sub> Enrichment (PHACE) experiment in Wyoming set up twenty plots to see how the greenhouse effect will affect mixed-grass prairie. The amount of suberin, a compound found in the radial and transverse cell walls of the endodermal plant roots cells can help determine the rate of decomposition which affects the amount of carbon in the soil. The storage of carbon in soil is particularly important because soil is the largest reservoir of organic carbon in the terrestrial ecosystems (Rasse, Rumpel, & Dignac, 2005). We took C3 roots from the PHACE experiment, ground them in a mill until powdered, completed a solvent extraction, conducted base hydrolysis with and without heat, and a phase separation to try to determine the amount of suberin in the plant roots from each plot. The solvent extract and the methyl chloride from the phase separation were analyzed using gas chromatography mass spectrometry. Using the area of the peaks as references, it was determined that warming and CO<sub>2</sub> had a  $p = .07$  effect on the C3 species suberin production.

## THE EFFECT OF TEMPERATURE ON BACTERIA GROWTH

Marie Charlotte Demetriades

Heathwood Hall Episcopal School

Bacteria is grown under many different conditions. The bacteria *E. coli* and *Streptococci* were used to determine the effect that temperature has on the growth of bacteria. Previous work has failed to address if the temperature effects all bacteria in the same way. The research was conducted by germinating the bacteria in a lab in different temperatures. The experiment is relevant to the conditions of bacteria growth. The hypothesis is that if bacteria are cultured in a warm environment, then the bacteria will grow at a more rapid pace. The *Streptococci* bacteria supported the hypothesis, while the *E. coli* supported the null hypothesis.

THE EFFECT OF HYDROPONIC GROWING TECHNIQUES ON THE AMOUNT OF VITAMIN C PRODUCED ON  
BRASSICA RAPA NIPPONOSICA  
Ruth Dibble and Kate Nassab  
Heathwood Hall Episcopal School

Hydroponics is a relatively new technology, evolving rapidly since its inception 70 years ago. Hydroponics is the process of growing plants without soil but with added nutrients. The purpose of this experiment was to investigate the effect of growing techniques on the amount of vitamin C produced by *Brassica rapa nipponosica*, also known as mizuna lettuce. This study was conducted by assembling an NFT hydroponic system and growing twenty-eight mizuna plants using each technique: hydroponics and soil grown. Once the system was built, sixty mizuna plants were grown and tested for vitamin C levels. The hydroponic mizuna received nutrients in two parts, A and B, while the soil grown mizuna received only water and the bagged soil. The mean for the amount of vitamin C produced in the hydroponically grown plants was 0.0321 mg. The mean for the amount of vitamin C produced in the conventionally (soil) grown plants is 0.0082. The null hypothesis is able to be rejected because the t stat, 4.9478, is bigger than the t-critical one tail 1.6736 and the t-critical two tail 2.0049. The results were obtained by using a T- test (two- sample assuming equal variances) and indicate that the hydroponic growing technique helped to increase the amount of vitamin C found in the mizuna lettuce. Aside from nutrient levels, the hydroponically grown mizuna had a much greater mean height; 8.6 cm. as compared to the soil grown mizuna having a 5.8 cm. average height.

DETERMINATION OF THE PHOSPHORYLATION SITE OF THE REGULATOR OF IRON TRANSPORT IN  
STREPTOCOCCUS PNEUMONIA BY MASS SPECTROMETRY / LIQUID CHROMATOGRAPHY

Brooks Digh  
Governor's School for Science and Mathematics

Pneumonia is an infection of the lungs that is most commonly caused by the bacteria *Streptococcus Pneumonia*. Pneumonia kills over one million children under the age of five in the world annually, which is more than any other infectious disease. Pneumonia greatly affects adults over the age of 65, diabetics, heart related illness, smokers and asthmatics. The purpose of this investigation was to determine a secondary cure for Pneumonia that would allow for the better treatment of those who were unable to receive a vaccine. It was hypothesized that the Regulator of Iron Transport (RitR) would be phosphorylated by Serine Threonine Kinase (StkP) somewhere along the DNA binding domain. The two main questions that our research served to answer were: (1) does StkP Phosphorylate RitR, where would the phosphate bonding occur (2) does StkP auto-phosphorylate before phosphorylating RitR? Once the RitR reacted with StkP and was cut into smaller pieces with trypsin digest, mass spectrum analysis was used to determine where RitR was phosphorylated. Through mass spectrometric analysis it was determined that RitR was phosphorylated in a reaction with StkP and ATP. It was also determined that RitR was phosphorylated on the DNA binding domain on the Amino Acid sequence EYDLLATLMGSK. While investigating the reaction of RitR and StkP, it was also discovered that StkP did phosphorylate itself before phosphorylating RitR. Further work will attempt to confirm these results and to test the phosphatase that removes the phosphate from RitR. Then a drug can be developed to take advantage of this weakness and coming ones step closer to finding a cure for this illness.

GENETIC MAPPING OF ADVENTITIOUS ROOTING IN PEACH: CORRELATION OF GENETIC MARKERS AND ROOT  
SYSTEMS

Trina Dinh  
Governor's School for Science and Mathematics

Adventitious rooting is the characteristic in plants that allows them to regenerate a root system from an excised shoot and enables a mass cloning of elite germplasm. However, some plant species root very poorly and the genetic basis of this deficiency is not known. The goal of this research is to identify the genetic factors behind the rooting of peaches. Two populations, A and C, are being phenotyped for their ability to produce adventitious roots. Approximately ten, twenty-centimeter long cuttings of current year wood were taken from each of the 378 trees in the A population and 57 trees in the C population. The leaves were stripped and the stems were dipped in IBA (indole-3-butyric acid) and placed in a soilless media, which consisted of vermiculite and perlite. They were then placed in the greenhouse and kept misted for four weeks. The cuttings were then scored for mortality, callus formation, root formation, and bud break. DNA from the dried leaf tissues of the same populations were extracted quantified, and quality checked in order to produce a more detailed genetic map.

AN ANALYSIS OF ELECTRICAL CONDUCTIVITY AND PH IN ACETOUS FERMENTATION

Isabelle Doan  
Southside High School

The measurement of electrical conductivity, a solution's ability to conduct an electric current, is becoming widely used in ethanol and lactic acid fermentation, as an indirect way of testing the parameters of fermentation. In this work, we analyze how the measure of electrical conductivity can be used in acetous fermentation. Acetous fermentation is the oxidation of ethanol to acetic acid, typically by *Acetobacter*. During this process, the molecules of the solution tend to dissociate, allowing for greater electrical conductivity. We demonstrate the relationship between electrical conductivity and the fermentation of ethanol at different concentrations. *Acetobacter* cultures were placed in three different alcohols of varying ethanol content: red wine at 13.5% by volume, vodka at 40% by volume, and rum at 75.5% at volume, as well as a control group of water with no alcohol content. These samples were allowed to ferment for several weeks. Their conductivity was checked weekly, using a

conductivity probe. From the data, we found there was a steady increase in conductivity in all three alcohols. In addition, their pH was checked weekly using a pH probe.

#### THE EFFECT OF SALINE IRRIGATION ON TEMPERATURE PROFILE DURING RADIOFREQUENCY (RF) ABLATION

Katherine Duchinski

Governor's School for Science and Mathematics

Radiofrequency (RF) ablation can be a permanent solution to certain types of cardiac arrhythmia, including many supraventricular tachycardias (SVTs). Irrigation of saline through the RF catheter may increase the success rate of ablation procedures by enabling larger lesions. In order to test the effectiveness of irrigated catheters, we created an in vitro model with agarose gel, a saline pump system to simulate blood flow, and a heating coil to keep the saline temperature at 37°C. The tissue temperature profile was recorded via infrared (IR) imaging at a rate of 1 Hz and with a 320 x 240 resolution. We assessed the performance of a prototype catheter by Advanced Cardiac Technologies in trials with irrigation and without irrigation. In these trials, we varied the velocity of simulated blood flow as well as the applied power. We quantified the success of the ablations by measuring the area of tissue that reached temperatures of at least 50°C, which represents the region of ablated cells. In addition, we quantitatively compared maximum tissue temperature and temperature profile between the irrigated and non-irrigated trials.

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#### SUCCEEDING IN THE HIGH-GROWTH TECHNOLOGY INDUSTRY

Joel Fonseca

Governor's School for Science and Mathematics

The technology sector is a booming industry that has become crucial to the global economy. However, the business is becoming increasingly competitive, with new startup companies being created every day. Unfortunately, 1 in 3 of these new ventures fail. SPARC is one of the successful startups. It is a software development company in Charleston, SC that is doing exceptionally well in the tech arena. It was the fastest growing American software company in 2013 and 9th fastest growing company overall. A market analysis of the global tech industry and an internal analysis of SPARC was performed to create a model of succeeding in the industry, using SPARC as a template for success. The analyses determined that SPARC's continued success is driven by its dedication to maximizing user friendliness, creating an extremely fun and productive work environment that attracts incredible talent, and a being a business run by people with industry experience. This combination ensures high employee happiness and equally high productivity levels, which are both crucial to the future of a startup.

#### DNA METHYLATION CHANGES RESULTING IN ENHANCER AND NON-ENHANCER REGIONS OF THE SIX3B GENE

Mackenzie Foster

Governor's School for Science and Mathematics

Several regions upstream of genes affect whether transcription and translation occur. Two of these regions are the enhancer and the promoter, previously it was thought that promoters are the driving force for transcription, but now we are looking into the effects of enhancers. We isolated possible enhancer sequences, which we identified from where transcription factors bound, upstream of the six3b gene. These regions were cloned into entry and destination vectors for microinjection into zebrafish embryos. These regions were cloned so that expression of the GFP gene, which was located downstream of our possible enhancer regions, had the possibility to be expressed. If there was expression the region could be determined as an enhancer and if no expression was seen then the region could be looked at as a non-enhancer. After microinjection, we looked for patterned expression in the head and eyes of developing zebrafish, because the six3b gene has previously been shown to be expressed in the head and eyes region of the body. We identified the six3b-e1 region as a possible enhancer and the six3b-ne1 region as a possible non-enhancer, both by the fact that they were bound by transcription factors. The results provided evidence to support that these assumptions were correct because the six3b-e1 plasmid drove patterned expression in the head and eyes and the six3b-ne1 drove no patterned expression. We conclude that regions that experience DNA methylation, the

addition of methyl groups to a cytosine, throughout development can be considered enhancer regions. Six3b-e1 experienced DNA methylation, but six3b-ne1 did not.

#### HUMAN FALL DETECTION: VIBRATION FREQUENCY DIFFERENTIATION

Mimi Foster

Governor's School for Science and Mathematics

The overall goal of the Human Fall Detection project is to be able to place accelerometers under floors to detect when someone falls. These systems will allow nursing homes to have alert systems that will sound when a fall occurs. Many questions have been asked about the differences between floors. This section of the project deals with collecting data from different floor material so that we can demonstrate the differences between systems. Using MatLab we collected data from different types of flooring. The ultimate goal for my section of the project is to use the accelerometer data to create a transfer function for the system. The work done in the lab will determine the vibration frequencies upon impact on different materials. The results contributed from the data will enable the lab to determine what actions need to be taken when working with accelerometers for different areas, such as carpet, tile, or wood. The accelerometers are activated under specified vibrations and the vibration signature changes by flooring type. My part in the project views the differences in the vibrations of different flooring material. Others in the lab monitor the vibrations of falling objects or other actions. This process will enable the sensors to tell the difference between when someone falls on carpet, when someone is walking on linoleum or when someone drops a phone on tile.

#### POLLUTION-SENSITIVE LARVAE OF WORMALDIA SPP. (TRICHOPTERA: PHILOPOTAMIDAE) AND NEURECLIPSIS MELCO ROSS, 1947 (TRICHOPTERA: POLYCENTROPODIDAE)

Leslie Galvez

Governor's School for Science and Mathematics

Freshwater invertebrates are important organisms for monitoring water quality because the presence or absence of variously pollution-sensitive taxa indicates the severity of pollution. Wormaldia and Neureclipsis are common North American genera, but whereas the adult males of all species in these genera are readily identifiable, most larvae of their species are still unknown to science. To refine the usefulness of these insects for monitoring pollution, it is necessary to associate identifiable adults with their yet-unidentifiable larvae and then to describe the diagnostic features of the larvae. For this research, specimens of Wormaldia and Neureclipsis were collected from freshwater habitats in locations where adults have been observed. The larvae collected were preserved in 95% ethanol and were compared with each other and with previous descriptions. Their species-level identity was determined by reference to DNA sequences of identified adults in the Barcode of Life Database (BOLD). New diagnostic characters were hypothesized and tested by their consistency and co-occurrence, including characters such as the size of the tarsal claws, chaetotaxy, head color pattern, and shape of the foretrochantins. Illustrations and descriptions of these distinguishing features were prepared to facilitate recognition of the species.

#### FLAT VS. VERTICAL

Elyse Hope Gandy

Greenville Technical Charter High School

In most buildings trusses are used to construct the roof. The typical residential roof is made of wood 2x's. Those wood trusses are usually built vertically, where the surface area is the smallest, instead of flat. The purpose of the experiment is to see the effect on bridge models once the individual cord members' orientation was changed. To determine the effect of the orientation changes, two trapezoid truss bridges models were made. Each bridge was built exactly the same with the only difference being the orientation of the cord members. The models were constructed from 24" long Bass wood pieces that were cut into the needed sizes then hot glued together to create the truss (one side of a truss bridge). The 2 trusses were then attached to form a bridge. Once both bridges were made they were inserted in to a Testing Apparatus, at the Greenville Tech. College, one at a time. The Testing Apparatus is a machine used by the college to tell how much weight a bridge or other structure could handle before breaking. A white rectangular rod with a depression in the center was placed on the road way of the bridge and a metal rod was placed in the depression. The metal rod continued to add pressure until the bridge broke. The hypothesis for the experiment, based on the evidence, was that the vertical orientation model would work the best. No conclusion has yet been reached due to additional testing being needed.

#### THE EFFECTS OF NITRATE LEVELS ON ALGAL GROWTH

Sahil Garg and Elise Volden

Southside High School

Run-off continues to pollute water systems with nitrates, yielding large amounts of algal growth. This growth can be harmful to the remaining aquatic ecosystem, since the algae decreases the amount of oxygen present in the environment for other organisms. With these consequences of unregulated algae growth, it is evident that in some situations, it would be beneficial to have the ability to better control the growth and spread of algae. Information about the optimum nitrate levels for algal growth may be used to harness the growth of algae and better prevent against unwanted algal growth that may cause harm to other organisms in aquatic environments. This experiment demonstrates the relationship between nitrate levels in algae-

containing, aquatic environments and the resulting amounts of algal growth. Nitrates have been obtained from sodium nitrate compounds. Through manipulating the concentration levels of these nitrates in the aquatic environments of algae samples, effects on algal growth have been revealed. These effects on algal growth have been observed through spectrophotometry, in which chlorophyll concentration levels have been measured in each of the algae samples subjected to a certain nitrate level.

#### EXAMINING DIFFERENCES IN FACE SPECIALIZATION IN SUBJECTS WITH ALZHEIMER'S DISEASE USING FUNCTIONAL MAGNETIC RESONANCE IMAGING

Austin Gibbs

Governor's School for Science and Mathematics

Alzheimer's disease (AD), a devastating neurodegenerative disease, profoundly affects an individual's ability to socialize, stay motivated, and recognize faces. Grasping an understanding of the neural basis of this disease may lead to future behavioral or pharmacological interventions. The overall goal of the study was to identify group differences in neural activation of AD subjects and healthy controls (HC) while viewing face and non-face stimuli. The main hypothesis of this study is that AD subjects would show decreased activation in the fusiform face area (FFA) and increased primary visual cortex activation. To test this hypothesis, 5 AD and 55 HC subjects underwent a functional magnetic resonance imaging (fMRI) session, in which they viewed blocks of faces, objects, and textures. The fMRI images were preprocessed to correct for any head motion or geometric distortions using FSL (the interface for looking at brain images), FEAT (for skull-stripping and creating a model), and FEATQUERY (to extract the signals) software programs. Once the signals were extracted, ANOVAs were conducted for each region of interest. The results did not reveal significant group differences in face specialization in the FFA and the primary visual areas, but additional exploratory analyses revealed group differences in the face specialization of the amygdala, an area linked to emotional processing and detecting salience. Unlike the healthy control group, the amygdala activation in AD subjects was not face specific. This activation pattern may reflect diminishing salience of faces vs. objects in Alzheimer's disease.

#### THE BENEFITS OF ECONOMIC DEVELOPMENT STRATEGIES FOCUSED ON HIGH TECH, EARLY-STAGE BUSINESSES VERSUS THOSE FOCUSED ON TRADITIONAL, LATER-STAGE BUSINESSES

Jay Gohil

Governor's School for Science and Mathematics

The Charleston Digital Corridor has been fostering economic development in the Charleston, South Carolina region since 2001. Ernest Andrade, the founder and executive director of both the Charleston Digital Corridor and the City of Charleston's Office of Business Development, has developed new methods and processes of conducting economic development. Along with these prestigious titles, Mr. Andrade is also the principle of Andrade Economics, a business economic development consulting firm focused on the elements of high wage job creation including business incubation, talent development and capital formation. This research aimed to confirm Mr. Andrade's methods for economic development were proven by comparing the benefits of economic development strategies focused on high tech, early-stage businesses versus those focused on traditional, later-stage businesses. The data gathered were able to quantitatively and qualitatively explain Charleston's successful economy. It has been more effective to focus high growth, high tech industries in Charleston and such maybe applicable to other cities with similar demographics.

#### ESTIMATION OF GREENSHIELDS MODEL PARAMETERS USING PYTHON

Aspen Golden

Governor's School for Science and Mathematics

Greenshields model is a two-regime equation to describe the flow of traffic before and after the break point density (the point when cars are no longer able to move at the free flow speed). This research developed Python code to estimate the four parameters of the model ( $V_0$ , the minimum speed;  $V_i$ , the free flow speed;  $K_b$ , the break point density; and  $\alpha$ , the shape term) to be used in computer simulations of traffic. The estimated values obtained were  $V_0 = 59.76$ ,  $V_i = 3.000$ ,  $K_b = 17.21$ , and  $\alpha = 10.49$ , and they show similarity to the round data.

#### INCREASING THE EFFICACY OF ANTITUMOR THERAPY: A LYSINE SPECIFIC DEMETHYLASE 1 INHIBITOR IN COMBINATION WITH 5-DEOXYAZACYTIDINE

Elizabeth Grant

Governor's School for Science and Mathematics

Lysine-specific demethylase 1 (LSD1) is a chromatin remodeling oxidase enzyme that is over expressed in a number of human cancers. It has been targeted for the development of specific inhibitors with therapeutic potential. LSD1 has been shown that the interactions between histones and chromatin remodeling are very important for selective control of gene expression. Because of this, chromatin remodeling enzymes are very quickly becoming attractive therapeutic targets for multiple diseases with an epigenetic basis. Through histone and DNA marker changes such as: acetylation, methylation, and sumoylation, certain genes can be turned "on" or "off." LSD1 acts as a demethylase enzyme and removes methyl groups from the mono- and dimethylated forms of histone 3 lysine 4 (H3K4). Demethylation of mono- and dimethylated H3K4 results in gene silencing. Because H3K4 is over expressed in cancer, important tumor suppressor proteins are not formed. The drug 5-

deoxyazacytidine is a standard therapy for lung cancer, but has serious side effects that limit its use. We hypothesized that combining a specific LSD1 inhibitor with 5-deoxyazacytidine would allow the use of a lower dose, reducing side effects. To test this hypothesis, we treated CALU-6 human lung adenocarcinoma cells with novel LSD1 inhibitors combined with various concentrations of 5-deoxyazacytidine. It was discovered that these LSD1 inhibitors had minimal effect on the IC50 of 5-deoxyazacytidine. We concluded that there was no significant difference between the CALU 6 cells that were only dosed with 5-deoxyazacytidine and the ones that were dosed with both a novel LSD1 inhibitor and 5-deoxyazacytidine.

#### OPTIMIZING T CELL ACTIVATION CONDITIONS FOR ADOPTIVE CELL THERAPY OF CANCER

Madeline Grant  
Governor's School for Science and Mathematics

Adoptive T cell therapy (ACT) is a cancer treatment that involves using a patient's own T cells to fight their cancer. This can be done by isolating T cells from a cancer patient's blood, expanding them in culture, and genetically modifying them to make them better at destroying tumor cells. IL12 is a cytokine that may perform this modifying function. Once the T cells have been modified to target tumor cells, they are infused into the patient. This project's purpose was to determine the optimal culture conditions for activating T cells prior to adoptive cell therapy. The T cells used in this project were obtained from the spleen of a melanoma transgenic mouse. The T cells were cultured with either hGp 100 or plate bound anti-CD3 and/or anti-CD28. Each of these conditions was tested with and without IL-12. Activation of the T cells was assessed by measuring proliferation with cell counts and evaluating the extracellular phenotypic markers CD25 with flow cytometry. The results showed the activation conditions that contained IL12 had higher levels of CD25. Based on the results, activation by peptide was most effective due to the cells' high expression of CD25. The addition of IL12 increased activation. Future experiments could test Peptide activation with the addition of different cytokines. This could test whether other cytokines increase T cell proliferation thus improving the effectiveness of T cells to kill cancerous cells. Results from this project provide the conditions for most effective T cells to be used in cancer patients.

#### VERSICAN PLAYS AN IMPORTANT ROLE IN NEURAL DEVELOPMENT AND DAMAGE REPAIR IN THE COCHLEA

Meredith Hammer  
Governor's School for Science and Mathematics

The efficiency of signal transduction in the auditory pathway is vital to hearing function. Hearing loss can be caused by degeneration of neurons as a result of aging, noise damage, decrease in myelination or autoimmune response. Versican, a chondroitin-sulfate proteoglycan of the extracellular matrix, has proven to influence ECM organization in the central nervous system, and has appeared in the cochlea after damage and during postnatal development. V0/V2 Versican knockout (KO) mice were compared with wild type (WT) mice to determine differences in morphology and hearing function. Morphological changes within the Versican KO mice were seen with transmission electron microscopy. The recovery of hearing function after damage was compared between Versican KO and WT mice over 30 days using ABR (Auditory Brainstem Response) testing. Versican KO mice exhibited irregularity of myelin on neuron cell bodies, nodes of Ranvier and axons, as well as axonal changes at the nodes and within the axon. The WT mice exhibited recovery of original pre-damage hearing thresholds while KO mice showed a lack of recovery. These morphological changes in the Versican KO mice can be correlated with the differences in recovery between the two mice. These results suggest that Versican is important in maintaining structural integrity of the auditory nerve neurons, affecting the axon and proper myelination, and is important in damage repair. These results also suggest that the extracellular matrix could influence proper damage recovery or affect other factors like myelination and axonal structure.

#### DEVELOPING AN OPTIMAL BIO-PETROL DIESEL BLEND TO MAXIMIZE ENGINE PERFORMANCE

Dillon Harper  
Center for Advanced Technical Studies

Biodiesel fuel is commonly and easily produced from waste vegetable oil (WVO) and can be utilized in most commercially available diesel engines. The objective of this study is to find the optimal blend of biodiesel/petrol-diesel and then use this optimal blend to record data on engine performance under load. In this project, a go-kart or lawn tractor will be converted to use a small diesel engine. Performance tests can then be conducted using the predetermined optimal blend of biodiesel/petrol-diesel. Tests will be conducted using a dynamometer and will include torque, horsepower, and fuel efficiency. The goal is for a biodiesel blend to perform as well if not better than available petroleum diesel fuel.

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

Sydney Hart  
Governor's School for Science and Mathematics

Parkinson's disease (PD) is a disorder where the brain's motor neurons are affected, resulting in tremors, impaired balance, and muscle spasms. Aggregates and oligomers of the  $\alpha$ -synuclein protein were discovered in the dopaminergic neurons of post-mortem PD patients. It is unknown as to why these aggregates and oligomers form or how they cause the symptoms of PD. This study used the budding yeast, *Saccharomyces cerevisiae*, as a model for the examination of these  $\alpha$ -synuclein proteins by overexpressing the protein, leading to its aggregation. The results of this study showed that the human alpha-synuclein gene,



tagged with His6 and GFP, can be successfully integrated into the yeast genome. These  $\alpha$ -synuclein-containing aggregates and oligomers were purified using affinity chromatography and detergents. The next step will be analysis using mass spectrometry to identify any other proteins or particles aggregated along with  $\alpha$ -synuclein. Once the components of these aggregates and oligomers are identified, greater insight will be gained on their formation in the neurons, thus leading to pharmaceuticals that could inhibit the formation of these multi-protein complexes.

#### SEVERITY OF ASD SYMPTOMS IN RELATION TO CHILDREN'S GENDER

Lorraine Haselden  
Chapin High School

The purpose of this project was to determine whether or not the symptoms of Autism spectrum disorder (ASD) are more severe based on gender. If the severity of symptoms of both male and females with ASD are studied using the Childhood Autism Rating Scale (CARS), then males will be found to demonstrate the most severe symptoms. The data was collected through video analysis of children with ASD and then rated on the childhood autism rating scale (CARS). The data was analyzed using a 2 t-test to compare the mean scores of males and females. Through the analysis it was determined that males have significantly higher ratings on the CAR scale than females. These findings were statistically significant because the p value was 0.0000000000172 meaning that my hypothesis was supported by the data. In conclusion, the hypothesis that males will present more severe symptoms of ASD was proven correct by the analysis of the data. This project could be expanded to include publishing these findings in order to share the information and provide more specialized programs for males with ASD. These programs could be used to help elevate some symptoms to help make them higher functioning members of society.

#### THE EFFECT OF ORGANIC AND INORGANIC FERTILIZERS ON THE AMOUNT OF CHLOROPHYLL IN A BRASSICA RAPA PLANT.

Annie Heath  
Heathwood Hall Episcopal School

In this experiment the effect of different fertilizers on the amount of chlorophyll was determined. The question addressed is which fertilizer will increase the amount of chlorophyll the most. Previous research has failed to test how two different fertilizers affects the amount of chlorophyll. It will be hypothesized that organic and inorganic fertilizer mixed will have the greatest effect on the fertilizer. The experiment was conducted by cutting off the leaves of the plant in each fertilizer and crushing them into acetone, then running them through a SpectroVis. This project will help people to know which fertilizers will create the healthiest looking plants.

#### EFFECTS OF YOGA ASANAS ON STUDENT STRESS

Cherilyn Heintz  
Chapin High School

Student stress has been studied immensely and can be a detriment to many aspects of their lives. Yoga is system of exercise that involves meditation, breathing, and specific poses called Asanas. Hypothesis: By implementing an 8 week program of 20 minutes of yoga a week the participants (ages 13-18) will have a temporary decrease in stress those days that they participated. This was an observational study. A voluntary response was evaluated. Participants could either choose to be in the control or experimental group. For 8 weeks on Tuesdays during the homeroom period (11:39am- 12:03 pm) the experimental group participated in a 20 minute yoga class led by a certified instructor. Surveys were issued before and after the 8 week program and on Tuesdays when the yoga was done. Stress levels were evaluated on a Likert scale of 1 to 10 (1 being the least stress possible and 10 being the most). Data was collected using the surveys issued in which other variables were accounted for. The voluntary response may have altered the data and created a bias. The difficulty was in attaining the participants especially in the control group. The results showed, using a match paired t-test, that students who participated in yoga had a lower stress level compared to the control group. However the p values were greater than .05 which means the hypothesis cannot be supported. Using these results, awareness of the implication of yoga in a school setting should be broadened and to create a more statistically sound result, a greater sample size could be obtained. A permanent and possibly student led yoga group could be established. Students can use yoga as a beneficial outlet to decrease stress.

#### THE EFFECT OF GASOLINE ADDITIVES ON ENGINE PERFORMANCE/RUN TIME

Parker S. Henderson  
Greenville Technical Charter High School

Gasoline additives have often made headlines in the last ten years. As scientists search for reliable sources of alternative fuel, additives have taken the role of temporary measures or as performance boosters. Some like ethanol did not live up to expectations as they reduced performance as well as emissions, which "balanced out" each other. Some like lead were banned in the US because of their devastating environmental impact. Still others like octane boosters can be bought at a nearby auto parts store. In this experiment an old lawnmower engine was fixed and was used it to measure several different effects of gasoline additives. The additives involved lead, ethanol, and two store bought additives, all in various amounts. Pure gasoline was ran first as a control, then each additive was ran in constant amounts. Performance of the engine was measured

in RPM (measured every 30 seconds) and total run time was recorded. In the end, it was determined that the control of pure gasoline ran the best, with lead and ethanol tied for second. It is believe the generally poor performance of the additives had to do with the fact that our engine was a two stroke, not a four-stroke engine like the additives were designed for.

#### FUNCTIONAL CHARACTERIZATION OF A NEWLY IDENTIFIED NICOTIANA TABACUM SULFATE TRANSPORTER GENE NTASULTR2 INVOLVED IN SULFATE TRANSPORT AND DISTRIBUTION

Adam Herbert

Governor's School for Science and Mathematics

Sulfur, one of six macronutrients required by plants, is the rudimental component of cysteine, methionine and sulfolipid. It also serves as the active center of many enzymes. In soil, inorganic sulfate (SO<sub>4</sub><sup>2-</sup>) is the most common sulfur source for plants. Over the past twenty years, sulfate transporters involved in sulfate uptake and distribution have been well studied in plants. Fourteen sulfate transporter genes, classified into five groups, were identified in Arabidopsis thaliana. To date, twelve sulfate transporter genes have been identified in rice, Oryza sativa. However, only one sulfate transporter gene, NtaSULTR2 has been identified and cloned in tobacco, Nicotiana tabacum. NtaSULTR2 is regulated by a sulfate responding micro-RNA, with repression of NtaSULTR2 expression in transgenic tobacco leading to impaired sulfate homeostasis. The purpose of this study is to functionally characterize the gene NtaSULTR2. A micro-RNA resistant NtaSULTR2 cDNA, rNtaSULTR2 was created using a site-directed mutagenesis method. rNtaSULTR2 was ligated into the plasmid pHL721 in order to overexpress the cDNA. rNtaSULTR2 was also ligated into the plasmid pHL722 for RNA-interference, repressing NtaSULTR2. These two vectors were then transformed into Agrobacterium tumefaciens LBA4404 by electroporation. They will be transformed into tobacco using the leaf disc transformation method. This experiment could help solve issues with soil having decreasing sulfur levels by allowing the tobacco to have a higher uptake of sulfur.

#### THE EFFECTS OF ANTIOXIDANT VITAMINS A, C, & E ON THE PREVENTION OF BACTERIAL GROWTH IN GRANNY SMITH APPLES

Brandon Hill

Heathwood Hall Episcopal School

The purpose of this experiment is to test the effectiveness of certain antioxidants, vitamin A, vitamin C, and vitamin E, in the prevention of oxidation and the formation of free radicals as opposed to natural decomposition. My hypothesis states that the use of all included antioxidants, vitamin A, vitamin C, and vitamin E, will prove to be beneficial to the prevention of oxidation and the formation of free radicals as compared to natural decomposition. My null hypothesis states that the use of all included antioxidants compared to the process of natural decomposition will provide no differences in effectiveness. Each vitamin antioxidant will be tested in groups of 3 for both bacteria variables, the E.coli and nutrient broth. The results of the vitamins affecting and inhibiting the growth of the bacteria were measured and recorded.

#### THE EFFECT OF DIFFERENT STYLES OF UNDERWATER KICKING ON VELOCITY IN SWIMMING

Savannah Hillmeyer

Heathwood Hall Episcopal School

The purpose of this experiment was to compare different styles of underwater kicking with respect to velocity of a swimmer. Four underwater kicking styles were compared; underwater dolphins, underwater freestyle, on the surface dolphins, and on the surface freestyle. 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. 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 was that if the swimmer uses underwater dolphin kicking or underwater freestyle kicking, then the swimmer will have a greater velocity than if they use on the surface dolphin kicking or on the surface freestyle kicking. The results of this experiment supported the null hypothesis. In conclusion, this experiment will benefit the swimming community by displaying which type of underwater kick has the greatest velocity.

#### DETERMINING TBPEX13.2'S POTENTIAL FOR GLUCOSE-DEPENDENT LOCALIZATION IN TRYPANOSOMA BRUCEI

Jamison Hite

Governor's School for Science and Mathematics

Human African sleeping sickness, scientifically known as trypanosomiasis, is a disease that is native to Sub-Saharan Africa, affecting roughly 50,000 to 70,000 people. This fatal disease is transmitted by tsetse flies. The tsetse flies infect the host human with a parasite called Trypanosoma brucei, causing the illness. Researchers have found that T. brucei has two different Peroxisomal Membrane Protein 13 (PEX 13) isoforms. This research focused on a peroxin found in the trypanosomes called PEX 13.2. This organism is the only one known to have both types of PEX 13. Both PEX 13s are involved in the processes of protein import, biogenesis, and organelle division, and are thus very important to trypanosomes' cell lives. PEX 13.1 travels to another unidentified region of the cells (changes localization) depending on its carbon source. It has been postulated that PEX 13.2 is then taking PEX 13.1's place. In order to prove this theory, this research attempts to

discern whether or not PEX 13.2 exhibits glucose-dependent localization. Overall, the goal was to be able to transfect PEX 13.2 into trypanosomes to see if the results show glucose-dependent localization of PEX 13.2.

#### BODY COMPOSITION IN RELATION TO VO<sub>2</sub>MAX AND RUNNING PERFORMANCE

Troy Hodge

Governor's School for Science and Mathematics

Previous research on body composition and aerobic fitness has indicated that a lower percentage of body fat results in better endurance performance. Previous studies have also shown a high correlation between maximal oxygen uptake (VO<sub>2</sub>Max) and running performance. This study examines the correlation between body composition and aerobic performance. Body composition was measured using a Bodpod air plethysmography system. VO<sub>2</sub>Max was measured using a progressive treadmill test and Cosmed CPET breath analyzer. A significant correlation was found between body composition and absolute VO<sub>2</sub>Max, relative VO<sub>2</sub>Max, VO<sub>2</sub>Max relative to fat free mass, 1609-meter race time and 5000-meter race time. It was concluded that a lower body composition results in more efficient oxygen consumption and better running performance. This data can be used to determine one's own physiological data with the goal of improved training and performance.

#### PREDICTING SECONDARY STRUCTURES OF PROTEINS USING DEEP LEARNING AND SVM

Stone Holt

Governor's School for Science and Mathematics

Proteins are biological macromolecules that perform the most functions in living cells. In order for the proteins to have the correct function, they need to be folded to secondary structure and then the three-dimensional structure. The most common second structures in proteins are alpha-helices and beta-sheets. Computational prediction of protein secondary structure is important for understanding the protein functionalities. Many different algorithms have attempted to predict the secondary structure of proteins; however, current algorithms have not been able to achieve high accuracy yet due to the complexity of this problem. In this study, we used Deep Learning and Support Vector Machine (SVM) to predict the secondary structures of proteins. We created models from a training set and applied to be a testing set. We evaluated the accuracy and run time of both algorithms. The training set had a size of 10000 amino acids, and the testing set of size 3400 amino acids. Several trials (six for Deep Learning and eighty-eight for SVM) of different parameters were run to get the best results for both Deep Learning and SVM. In our results, SVM proved to be faster and more accurate with the best parameters. The highest accuracy with SVM was 71.44% with a run time of about six minutes while the highest accuracy with Deep Learning was only 65.15% with a run time of a little under nine minutes. With these results, it is easy to see the advantage that SVM has over Deep Learning in this setting.

#### THE FACTORS INFLUENCING THE DEFLAGRATIVE RATE OF GUNPOWDER AND THE INFLUENCES OF THE AFOREMENTIONED FACTORS ON THE EFFICACY OF THE MIXTURE

Patrick Van Hook

Greenville Technical Charter High School

Prior to now, the standard 15%, 10%, 75% mixture of gunpowder has been considered perfect for optimal combustion. The ratio has been the universal solution since the mid-late 1800's. This experiment is designed to reanalyze the natural deflagrative rate of standard powder and home-made powder with altered ingredients. The experiment will utilize charcoal of different types and alter the chemical ingredients of the gunpowder. By altering the ingredients in the powder, the rate of detonation and/or deflagration. Optimally, the experiment will show whether or not different compositions will alter any traits of the powder.

#### THE EVALUTATION OF THE K-MEANS CLUSTERING ALGORITHM USING DIFFERENT DISTANCING METHODS

Alex Hoover

Governor's School for Science and Mathematics

This research primarily focused on finding differences in various distancing methods used in the k-means clustering algorithm. The distancing methods used throughout the experiment are the Euclidean, Manhattan, and Earth Movers Distance. To accomplish this task, code in Python, wrapped around some C and Fortran code, was used to process images and determine the quality of the clusters made in the algorithm. The tests executed were performed on a ground truth to determine the quality of the measurements. For this experiment, Kylberg's Texture Set was used as that primary ground truth. After initial results were determined, with an assumed cluster count of 28 (1 cluster per texture), further testing was required to search for significant differences in the data. So, the cluster count was optimized using a Q-test and the Anderson-Darling Statistic. All the optimization data was used to find more accurate results of the primary experiment, and the cluster count, for Kylberg's Texture set, was actually optimized around 400 or 500. Results for the k-means clustering run on Kylberg's Texture set clusters, using the optimized cluster count, are not included in this paper.

## CAN BUS ROUTING BE IMPROVED THROUGH TRAFFIC STUDY

Eli Horner  
Chapin High School

This project examined how traffic study can be used to reduce the amount of time that school buses must spend on the road. The purpose of the project is to reduce the amount of time that students at Chapin schools spend riding the bus. This could also reduce the cost of transportation for the school district. Major intersections near Chapin High School were examined in order to determine the number of vehicles passing through them and the times at which the amount of vehicles was the highest. The hypothesis was that there would be significant variations in the traffic density over the time period studied. The data was analyzed and compared with current routes. New routes will be drawn from the results that will adjust the timing of the buses so that they arrive at the high traffic locations at ideal times. Data collection from the intersection of Amick's Ferry Road and Chapin Road, shows that the amount of vehicles traveling through the intersection peaks twice, around 7:30am and 8:00am. In between those peaks, there is a pronounced decrease in the amount of traffic. From this data, preliminary conclusions can be made that show that there are variations in the volume of vehicles in the intersections within the two hours preceding the start time of the school, therefore supporting the hypothesis. These results can be used to help to improve the efficiency of the Chapin bus system, by allowing the buses to be routed through these intersections at lower traffic times.

## THE EFFECT OF MULTIPLE FLAVONOIDS ON AMYLOID-BETA AND NEUROFIBRILLARY TANGLES IN ALZHEIMER'S DISEASE

Phuong Huynh  
The Center for Advanced Technical Studies

Alzheimer's disease stands as the largest threat to adults over 65 years old. Two factors present in the brain is use to diagnose whether or not an adult has Alzheimer's: amyloid-Beta plaques and neurofibrillary tangles. Both are caused by the accumulation of proteins within the brain and are independent of each other. Amyloid-Beta proteins accumulate outside the cells while neurofibrillary tangles accumulate within the cells. Current treatments are available to slow down the symptoms of this disease; however, those treatments could only lower each of the factors separately. This research is aimed to reduce the amount of both amyloid-Beta plaques and neurofibrillary tangles simultaneously, looking specifically at the effects of multiple flavonoids that will decrease the amount of both proteins. Two specific flavonoids will be inserted into neuroblastoma cells and – using microscopy – the cells will be analyzed intracellular and extracellular in order to determine the intensity of protein expression. It is expected that with the combination use of two flavonoids, the amount of plaques and tangles will significantly decrease due to the induction of two different pathways that will degrade the proteins both inside and outside the cells. Furthermore, the flavonoids will be synergistic to each other and promote further protein degradation at a higher level than each [flavonoid] individually would.

## LONG-TERM MONITORING OF THE DECREASING UNDERSTORY AT HOBCAW BARONY'S CYPRESS FORESTS POST-HURRICANE HUGO

Charles Ison  
Governor's School for Science and Mathematics

When Hurricane Hugo struck the South Carolina coast on September 21, 1989, it damaged over a million hectares of coastal forests. Because of the wide-ranging damage, the Hurricane Hugo Recovery Study was launched in 1994 at four separate study sites to monitor the long-term effects of the storm on coastal forests. Hobcaw Barony, a 7,100 ha forest preserved used for research in Georgetown, SC, was the closest of these four sites to the eye of the Hurricane Hugo. Cypress forests are one of four forest types at Hobcaw Barony and play a prominent role in the coastal ecosystem. In order to understand the long-term regeneration trends following Hurricane Hugo, the Cypress forests of Hobcaw Barony were examined. Every three years the understory seedling and sapling distribution were recorded. The data revealed that the total number of seedlings and saplings in the cypress understory at Hobcaw Barony has steadily decreased over the course of the study. To understand this trend, the fluctuations in small, medium, and large seedlings and saplings were analyzed, the dominant understory species were independently examined, overstory data was studied, and drought records were considered. The data suggests that increased competition from overstory regeneration post-Hurricane Hugo in combination with drought and flooding could be responsible for the decreasing cypress understory at Hobcaw Barony.

## THE EFFECTS OF A ONE METER SEA LEVEL RISE AND INCREASE IN STORMINESS ON THE PEOPLE AND PROPERTY IN THE GWENT LEVELS ON THE SEVERN ESTUARY

Jo Jahn  
Governor's School for Science and Mathematics

The Severn Estuary has one of the highest tidal ranges in the world, and the land around it is prone to flooding. The Gwent levels, in particular, are a Site of Special Scientific Interest to the scientific community because of environmental factors. The area also houses a lot of industry and real estate. By 2100 the sea will have risen to 1 meter and the storminess in the area will have increased as well. Given the environmental and economic importance of the Gwent levels, this area needed to be investigated further to compute the exact danger that the area is under. Surveying and mapping was done in the area, and many surveys were sent out to companies with property on the Gwent levels and government agencies that are responsible for the area. It was found that the Gwent levels would be flooded to a great degree and that the companies plan to rely on government aid to protect them.

## VALIDATION OF HIGH THROUGHPUT ELECTROCHEMICAL GAS SCREENING SYSTEM

Coby Jeffcoat

Governor's School for Science and Mathematics

New restrictions by the Environmental Protection Agency (EPA) are limiting the amount of certain gases released into the atmosphere by industries. These restrictions will have the greatest effect on the automobile and power industry, especially in fossil fuel burning power plants. These industries rely on powerful gas sensors to monitor and control emissions. But in order to meet the demand set by the new standards a new sensor is needed. This new sensor must be capable of withstanding harsh temperatures (In excess of 600°C) and providing a quick response to change in gas environment. We have developed a high throughput cell capable of exposing multiple new sensors to the same gas environment simultaneously. By using a physical deposition chamber we were able to quickly manufacture new sensors to be tested in the cell. Currently we are in the process of validating this high throughput system by testing it using previously studied sensors.

## AN EXPERIMENTAL STUDY OF THE ELECTROSMOTIC BEHAVIOR OF VARIOUS GLYCEROL SOLUTIONS, UNDER VARYING POTENTIAL DIFFERENCE IN A T-SHAPED MICROCHANNEL ENVIRONMENT

Jones Jenkins

Governor's School for Science and Mathematics

Microfluidics data for various fluid solutions (such as different concentrations of glycerol, Ferro fluid, Ph buffers, and MnBr<sub>2</sub>) is important for the invention and manufacture of mechanical microfluidic devices created for a variety of applications (mostly "lab on a chip" applications, the goal of which is the miniaturization of biological and chemical tests to the size of microscope slides). The goal of these experiments is to determine the electroosmotic behavior of different concentrations of glycerol solution (0%, 5%, 10%, 20%, and 30% by mass) under various electric field strengths (Between 500 - 1300 Volts dc), in a T-shaped microchannel. The behavior of the solutions is observed under a microscope, with a selective frequency light source, and a fluorescent Rhodamine B dye as the secondary solution. Recordings are taken of the solution's behavior for later analysis. Criteria of this behavioral analysis include the threshold voltage range at which instability at the barrier between the glycerol and dye solutions became apparent, the correlations between voltage, instability wave frequency and amplitude, and the different instability behaviors as you look further away from the beginning of the barrier between the glycerol and dye solutions. It was determined that as the strength of the electric field increases, the frequency of the instability increases until a certain point, where the wave form becomes more jagged and the frequency drops, then increases gradually with the electric field strength. It was also determined that the relationship between glycerol concentration and threshold voltage at which instability first occurs is linear.

## WILL SLIME MOLDS BE ABLE TO PREFERENTIALLY MAINTAIN THE SHORTEST ROUTE OF A MAZE?

Catherine Johnson and Lawson Leidinger

Heathwood Hall Episcopal School

The purpose of this experiment is to test the ability of the slime mold to find and maintain the shortest route in a maze. It was hypothesized that the slime molds are given multiple paths with food at the end of each correct path, then the slime molds will find and maintain the shortest route of the maze. The null hypothesis states the slime mold will find no difference between paths, and will have no distinction on the one it chooses to take. A pea-sized piece of slime mold was transferred into each of the mazes, in petri dishes with oats at the end, and placed in an incubator set at 22.2 degrees celsius (room temperature) for 4 to 5 days. The slime molds were checked on after that period of time to record their growth. The recorded data includes the molds that took the shorter path, an alternate path (longer or grew over entire maze), or did not display any growth towards the food source. The results were analyzed using a two-proportion z-test. The results show no significant difference in which path the slime molds choose to take

## CREATING DYNAMIC VISUAL STIMULI FOR USE IN FMRI AND EEG STUDIES ON THE INTERNAL REPRESENTATION OF AFFECTIVE STATES

Alexia Junker

Governor's School for Science and Mathematics

Affective states are central to how the world is experienced. An affective reaction to presented stimuli is included in the perception of the stimuli, becoming a property of it. According to the circumplex model of affect, affective states are represented along the dimensions of valence and arousal. These results have been shown for word, picture, and face stimuli. The use of dynamic visual stimuli is important because they are naturalistic. This study focused on the examination of the internal representation of dynamic visual stimuli. First, visual stimuli were created to vary on valence (positive, neutral, negative) while balancing across semantic features (human, animals, inanimate) and arousal across valence categories. The stimuli were found online and edited into five second clips. Second, in a behavioural experiment, 9 participants rated the video clips on six rating scales (e.g., how sad, how calm, how anxious, etc.). The similarity on video ratings was analyzed with multidimensional scaling. The results showed that most of the variability in the ratings was accounted for by dimensions of valence and arousal, consistent with the circumplex model of affect. This study was instrumental in the dynamic visual stimuli creation for fMRI and EEG studies of the internal representation of affective states.

## WARMING AND ELEVATED CARBON DIOXIDE INCREASES SUBERIN CONTENT IN THE ROOTS OF A C4 GRASS SPECIES

Kendall Koon

Governor's School for Science and Mathematics

Because of the global increase in greenhouse gases, carbon dioxide levels are rising and causing a change in the root chemistry of many plant species. Through the PHACE experiment, which tested the effects of increased Carbon Dioxide and temperature on two species of grasses, we gathered the root samples that were later tested for several suberin monomers. Because of their adaptability to environments with low carbon dioxide and temperature level, we assumed that the *Bouteloua gracilis* species that we studied would only have a small increase in its suberin content. C4 species can intake carbon dioxide at a higher rate than C3 species so having an increase in carbon dioxide would have a relatively small effect on these plants. To test this hypothesis we completed a base hydrolysis of the root samples and then analyzed them using Gas Chromatography/ Mass Spectrometry. Using Two Way ANOVA statistical analysis we found that carbon dioxide and warming played a significant role in the overall increase of suberin, aromatics, and  $\omega$ -hydroxy acid concentrations in the C4 species. This increase may be related to morphological changes causing roots to become longer and thinner. As the increase in temperature and carbon dioxide levels continue plants are likely to store more carbon in the soil.

## MOTORS AND MATLAB: PROGRAMMING WHITE LIGHT COMPUTERIZED TOMOGRAPHY RESEARCH SCANNERS USING ARDUINOS, MOTOR DRIVERS IN CONJUNCTION WITH MATLAB TOOLBOXES

Aida El Kouri

Governor's School for Science and Mathematics

Medical imaging is an exponentially growing field with clear beneficence for early diagnoses in patients. Yet, with scanners costing upwards of two hundred thousand dollars and emitting harmful radiation, medicine today is facing a dilemma in how to train young physicians to use these immensely intricate machines. The end goal of this research project was to create a low-cost and portable alternative, utilizing white light instead of X-rays, which could be used in research as well as classroom settings. Tomography is a method, which takes multiple 2D images from different perspectives and combines them to create one all-encompassing 3D image. The end goal of this aim was to create the software responsible for operating our prototype CT scanner. The technique implemented was unique because as opposed to a rotating light source and stationary object, we used a turntable system to create a rotating object and a stationary light source. The programming for operating our scanner was an important part in making it work, and was split into two parts; image acquisition and image reconstruction. The first part used Arduino software and hardware to use MATLAB to control a stepper motor as well as programming the camera to take and store images at intervals of one degree. The second part was involved in collecting all captured images and using tomography to create a 3D rendering of the object. At the end of this goal, we had a functional code capable of controlling the working prototype scanner.

## SAFER SEATBELTS

Akim Koutsioukis

Greenville Technical Charter High School

I have created a safer design for car seat belts. My design is a six point. It is similar to the three-point, but is overlapping and doubled. It provides extra support on the lap and an "X" across the chest to keep the body in the seat in the event of a crash. This sacrifices some comfort for safety. This system, if used properly, will do multiple things. It will decrease the number of casualties and serious injuries from car crashes. It will make it easier for officers to give tickets for not wearing seatbelts. If this new design were to be implemented, it could save hundreds, thousands, maybe even millions of lives if used properly. It holds the body more rigidly in the seat. In the states wear not wearing seatbelts is illegal, which is many, it will be easier to make convictions. The driver/passengers will not be able to pull the seatbelt on as quickly, as many people do while they are being pulled over. If this invention is paired with the law, it can be a useful tool for saving lives.

## POPULATION ESTIMATE OF DIAMONDBACK TERRAPINS (MALACLEMYS TERRAPIN) IN GRICE COVE, SC

Katelyn Kraichely

Governor's School for Science and Mathematics

Diamondback terrapin populations have been threatened since the 19th century, and new and serious threats have emerged in recent times. Declines have been noted in New Jersey and the Chesapeake areas. Monitoring a population is a key tool to preventing declines. In this study, we collected mark-recapture data from a small population in Grice Cove, SC, a small cove in Charleston Harbor. The population size was found to be 189.931 with a standard error of 19.1122, which was much less than the expected value. Other data collected on size and sex distribution showed little evidence of anthropogenic mortality in this population.

## INVESTIGATING THE EFFICIENCY OF DIFFERENT PRESERVATION METHODS ON BACTERIAL GROWTH

Katie Krouglicof and Emily Chen  
Southside High School

One of the leading preservation methods in the food industry is the use of chemical preservatives. Sodium benzoate and sodium nitrite are commonly used antioxidants, inhibiting oxidation in stored food products. Sodium nitrite, mainly used in the preservation of meats, inhibits iron-sulfur clusters essential to energy metabolism for bacteria such as *Clostridium botulinum*. There are mixed opinions on its effectiveness against others like *Salmonella* and *E. coli*; we hope to test its effectiveness in combination with other preservatives and temperature conditions. Sodium benzoate causes the pH within cells to decrease resulting in the anaerobic fermentation of glucose to decrease sharply. This inhibits the growth and survival of microorganisms that may cause food spoilage. Along with the salts, we are testing the effects of a basic, salt solution as well as an acidic solution to resemble the preservation methods of curing and pickling to inhibit oxidation and bacterial growth. Included also are the effects of temperature and UV radiation.

### ABSTRACT #: 370

#### A WINDY DAY: THE EFFECT OF WIND PATH AND DIRECTION ON ITS FORCE ON OBJECTS

Caitlin Kunchur  
Dutch Fork Middle School

**Purpose:** When wind hits an object like a sail, it exerts both pushing and pulling forces, which are parallel and perpendicular to the wind direction respectively. For airplanes, these forces are called drag and lift. To learn about these forces, I developed a new controllable way to evaluate these forces for various wind directions. (Originally I tested with a model sailboat in water, which proved difficult to control.)

**Procedure:** A table fan represented the wind source, which exerted a force on a flat piece of cardboard attached to a stiff wire. This wire was clamped to a stand. The force was measured by the distance the cardboard moved from the starting point. In one experiment, I positioned the cardboard perpendicular to the wind. In the second experiment, I positioned the cardboard parallel to the wind. The location of the fan was varied in both experiments.

**Results and conclusions:** When the cardboard's face was perpendicular to the wind, it was pushed directly downwind, thereby measuring the fan's wind profile. When the cardboard's face was parallel to the wind, it was always pulled to the side of the wind due to the Bernoulli's principle, therefore measuring the difference in air flow on its two sides. Indeed, the second graph resembles the slope of the first graph. This new information about a fan's wind profile can be useful to manufacturers and consumers. This method is also useful for designing and testing sails without the need of building an actual boat and testing in water.

#### APOPTOTIC AND AUTOPHAGIC CELL DEATH IN GANODERIC ACID DM TREATED PROSTATE CANCER CELLS

Nathan Leaphart  
Governor's School for Science and Mathematics

Traditional treatments of prostate cancer have difficulty handling the metastatic form of the cancer. Immense research has been done on discovering a more "user-friendly" chemoimmunotherapeutic. One potential chemoimmunotherapeutic is Ganoderic Acid DM (GA-DM). To understand the effects of GA-DM on advanced prostate cancer, two human prostate cancer cell lines, LnCaP and PC-3, were used in running and analyzing MTS assays, Western blots, and Annexin V and PI staining tests. To understand autophagy in GA-DM treated prostate cancer cells, a MTS assay was run with the autophagy inhibitor 3-MA. Results showed that GA-DM induced differential autophagy in the two different prostate cancer cell lines. With autophagy inhibited, GA-DM treated LnCaP expressed a decrease in cytotoxicity, while GA-DM treated PC-3 expressed an increase in cytotoxicity. To analyze Bax protein expression in the cells, a Western blot was conducted. This Western blot proved that Bax expression did not change between GA-DM treated and untreated LnCaP; however, the Bax expression for GA-DM treated and untreated PC-3 was unable to be interpreted. To quantify the amount of apoptotic cell death occurring in GA-DM treated PC-3, an Annexin V and PI staining test was organized. The staining showed that a 40  $\mu$ M GA-DM treatment increased the amount of cells in early apoptosis by 16.75% and the amount of cells in late apoptosis by 56.03%. Conclusively, these experiments showed that differential autophagy occurs in GA-DM treated prostate cancer cells, and that GA-DM induces apoptosis in prostate cancer cells.

#### GENETIC ANALYSIS OF CAFETERIA FOOD FOR THE ROUND-UP READY GENE

Jason Lee  
Center for Advanced Technical Studies

This study's objective is to analyze school foods for the Round-Up Ready gene. The study is conducted to prove that Round-Up Ready is in school foods and how reliant society is on Genetically Modified Organisms. The use of Gel Electrophoresis is used to find if the school foods have the Round-Up Ready gene. Results indicate that on the stained gel the Round-Up ready gene will be expressed. The Round-Up Ready Gene being expressed will indicate how society leans towards the use of Genetically Modified Organisms and how far this field has advanced.

## DIFFERENCES IN FLUID INTAKE POST-WORKOUT BETWEEN GATORADE AND WATER

Jordan Lester  
Chapin High School

The purpose of this experiment is to test the question, "How does fluid intake differ in teens post-workout when they consume Gatorade versus water?" Most teens do not take in a sufficient amount of water post-workout based on fluid lost. Because of this, it was predicted that teens would consume more Gatorade than water post-workout in comparison to their fluid lost during exercise. Sodium and sugars within Gatorade make it more appealing to the palate, persuading teens to drink more Gatorade post-workout than water. To conduct this experiment, isolated workouts were required and measurements of each athlete's weight before and after the workout were monitored. Every pound lost should be replaced with 16 to 20 ounces of fluid. With each test, an excess number of 8 ounce cups filled with water or Gatorade were present, depending on the experiment, and how many cups each athlete consumes of each liquid were monitored. Each athlete's data was kept anonymous to avoid any insecurity over weight and keep the experiment controlled. The data collected supports this prediction, showing a rise in average fluid consumed per pound lost when hydrating with Gatorade rather than water. These measurements suggest that drinking Gatorade post-workout may keep teens at a lower risk of dehydration. Furthermore, the gap between water and Gatorade consumed post-workout is much more significant in the male test subjects than the females. This may be because teenage boys consume more sodium than any other demographic, nearly three times the recommended amount. Further research is planned on being conducted to verify this new hypothesis.

## COMPARISON OF THE DIFFUSION OF ACETAMINOPHEN BY ITS FORMS

Jane Lindberg and Vaibhav Bafna  
Southside High School

In the human body, the manner in which a substance flows through the body hinge on the properties of both the substance in motion and the material through which it travels. For example, in the ingestion of certain pharmaceutical ones, peristalsis can be either propelled or hindered by the form in which the drug is ingested. This experiment accordingly measures the diffusion of acetaminophen across its constituent forms—capsules, tablets, and liquids. To most accurately emulate the pharmacokinetics present in the human body, we used dialysis tubing to serve as the medium for the flow, and change in the measure of the acetaminophen's concentration will reflect the rate of diffusion. We hypothesize that the liquid form will diffuse at the fastest rate while the capsule form will disperse most slowly.

## ARE ANTI-ANXIETY MEDICATIONS WORTH THEIR BENEFITS?

Julia Long  
Center for Advanced Technical Studies

The research dealt with anti-anxiety medication and whether or not they are worth taking based off of typical side effects experienced by the average patient. It was hypothesized that the medication is not worth taking. Data was compiled by sifting through redacted medical records of patients with anxiety disorders from 1960 to present day. It was expected that the medications are not worth taking and that the majority of patients with an anxiety disorder experience at least three side effects, no matter which medication they take. Data was analyzed by categorizing the patients based off of individual factors, compiled through percentages within those groups and then compared. It was hoped that, should the medication be found unworthy of prescription, psychiatrists will only prescribe the medication in more extreme cases of anxiety in his or her patients. Hopefully the project will serve as a foundation for future work on alternative solutions to anxiety relief for people with true disorders. As a second component, the experimenter used mice to study the side effects of the anti-anxiety medications versus the effects of powdered chamomile, which has been shown to alleviate symptoms of Generalized Anxiety Disorder. It was hoped that the chamomile would provide a safer alternative to the medication while also remaining effective.

## ULTRAVIOLET RADIATION

Alexis N. Lopez  
Greenville Technical Charter High School

Excessive exposure to ultraviolet radiation remains the leading cause of skin cancer and premature aging. There are a number of skin care experts who firmly believe that clothing color and material play a huge role in determining its ability to block the transmission of ultraviolet radiation. Throughout the duration of this project, a series of two experiments were conducted in order to test both variables by changing the material color and fabric type of cloth. During the experimentation process, the fabric was exposed to the sun for a select period of time. Then, a UV Meter obtained an accurate reading of the amount of ultraviolet radiation that was able to be transmitted through the cloth. Upon the completion of this experiment, the results were analyzed and compared to a UV Index Scale, which categorizes ultraviolet radiation readings based upon the potential risks it can cause to one's health. After reviewing the results, the fabric type and color that best prevents the transmission of ultraviolet radiation was determined. Due to the fact that darker colors tend to absorb the most amount of ultraviolet radiation, the color black was initially hypothesized to yield the best results.



## MOLECULAR CHARACTERIZATION OF A BASAL ANGIOSPERM CINNAMYL ALCOHOL DEHYDROGENASE (CAD) HOMOLOG

Angel Lopez-Akiyama  
Governor's School for Science and Mathematics

*Liriodendron tulipifera* L., commonly known as yellow-poplar, is a member of the Magnoliaceae family. It is a fast-growing hardwood tree species with great ecological and economic value. *Liriodendron* also occupies an important phylogenetic position as a basal angiosperm and has been used in studies of the evolution of flowering plants. Genomic resources, such as EST databases and BAC libraries, have been developed for this species. In this project, we mined available EST databases for CAD markers with the goal of developing informative EST CAD markers that would help us discover a link between lignin biosynthesis and CAD genes. These markers will be used to construct the first framework genetic linkage map of *L. tulipifera* with 380 full-sib seedlings. Such a linkage map is essential for future molecular breeding and quantitative trait locus (QTL) mapping, and as a framework for sequencing the *Liriodendron* genome in the future. When analyzed with polymerase chain reaction (PCR), informative markers were obtained from screening of EST-CAD markers. These markers are being utilized to tell us where certain CAD genes are located that will allow us to increase the biomass in the yellow poplar, leading to greater profit from each tree.

## THE EFFECT OF UV RADIATION ON DIFFERENT TYPES OF SAIL CLOTH

Landon Louthian  
Heathwood Hall

The purpose of this project was to determine how different types of popular sailcloth reacted under pressure after being exposed to ultraviolet radiation for one week. The experiment could help sailors decide what their sails should be made of. The types of sail cloth used were: dacron, kevlar laminate, and polyester laminate. Seven samples of each were cut out with one of each acting as the control group. After exposure, the samples were tested with a Mullen Burst Tester at Clemson University. The hypothesis was that if the sail cloths were exposed to UVR for a week, then they would react and weaken under UVR with polyester being the strongest and dacron being the weakest. The null hypothesis was that if the samples were exposed to UVR for a week, the samples would not react and would not weaken due to the radiation. The results favored the null hypothesis with each variable weakening insignificantly, and dacron being the strongest, and kevlar laminate being the weakest. In conclusion, the sail cloth was not exposed to the radiation long enough to inflict any serious damage.

## THE CORRELATION BETWEEN VISUAL ARTS AND MATH AND SCIENCE

Amy Loy  
Chapin High School

This project is in response to the lack of funding and awareness of visual arts in education. The purpose of this project is to determine the correlation in student GPAs between visual arts and the math and science subjects to raise awareness of the importance for visual arts in education. It is hypothesized that there is a higher than 50% correlation between visual art success and math and science success. This study utilized the individual GPAs of all Chapin High School students from the subjects of visual arts, math, and science. The GPAs were put into a spreadsheet and analyzed in a regression plot to find the r-squared value (correlation percentage). Some outliers were excluded because failing or AP students produce atypical data. However, the actual lurking variable is the lack of passion in lower level art students who are only taking the class to graduate. The correlation of the regression plot was found to be 13.73% with an r value of .372, which is lower than hypothesized, but still shows an upward trend. In summary, math, science, and visual arts are slightly correlate according to student GPAs and the regression plot. This shows that visual arts success is tied to science and math in education.

## DESIGN OF A VACUUM THERMOFORMING DEVICE AND EXPERIMENTS ON PIN-TOOL TYPE RECONFIGURABLE SURFACES

Madison Maddox  
Governor's School for Science and Mathematics

Thermoforming is a manufacturing process in which a thermoplastic material is heated and pulled over a mold to form a product. Examples of thermoformed articles include clamshells, refrigerator door panels, and automobile components. While thermoforming is a versatile and useful procedure itself, the tooling is not easily adaptable. The creation of molds is expensive and time consuming, and each one can only generate a specific shape. A reconfigurable mold would reduce expenses while increasing functionality (and leveraging the advantages of vacuum thermoforming). Specifically, in this research project, a self-inclusive thermoforming device was designed and constructed with a pin-type tool reconfigurable mold fitted in. The pin-tooling consists of a ten by ten matrix of height-adjustable pins with hemispherical tips. Though pin-tooling is less costly and more variable, there are other challenges, found in attaining a high quality surface finish and accurately producing a desired surface shape. To explore and address these challenges, experiments were devised with various configurations of the pin-tooling, including variable sheet materials and material thicknesses, different surface shapes, changes in plastic temperature, heating time of plastic, orientation of the pin-tool, and variation of interpolators. Initial results indicate the importance of the distance from the heating element to the plastic, that the materials' stretch limits act as a minor interpolator, that the taller drops the plastic has to mold over require higher heated and/or more flexible material, and the orientation of the pins relative to the vacuum mouth is significant.

## A 3D MICROSCOPE FOR VISUALIZATION OF THICK SAMPLES

Cameron Maes

Governor's School for Science and Mathematics

Three dimensional images of cells can be produced by multiphoton excitation and confocal laser scanning microscopy, in which a laser scans the cell point-by-point and layer-by-layer. Though the lateral scan is executed rapidly (several kHz), scanning through the entire depth of thick samples hinders the speed of real-time visualization of the volume. Here we use a different type of laser known as a Bessel beam, which does not diffract based on its unique properties. The beam's extended focus eliminates the need to scan the depth, allowing the entire volume of the cell to be recorded by a lateral scan of the sample. Recording the volume from two different angles, known as a parallax view, provides the sample's depth information. This pair of images can be combined using computer code to create a red-cyan stereoscopic image of the volume. These stereo images can be viewed in as a real-time three dimensional scan of a sample.

## FISH GROWTH VS. TANK SIZE

Melina Manos and Olivia Moran

Heathwood Hall Episcopal School

The purpose of this research is to investigate the final size of a guppy with respect to the size of its environment. The independent variable was the tank size, and adult size of the guppies were the dependent variables. Pregnant guppies were purchased, and then gave birth to twenty-nine guppy fry. Newly hatched guppy fry were placed into three different sized sections of a thirty gallon tank. The smallest section was five gallons, medium was ten gallons, and large section was fifteen gallons. The fish are a good measure of response to the independent variable because their exact age is known, and their lives have been controlled since the day they were born.

This project will help the science community understand the effect of limited growing space versus open growing space on guppy's final size. The null hypothesis is the size of the tank will have no effect on the final size of the guppy. The hypothesis is the fish in the large tank will achieve a larger size than the fish in the smaller tank. Previous studies have various results: some people believe the tank size affects growth, while others think fish growth is based entirely on genetics, diet, and water quality.

In conclusion, we found that there was no statistically significant difference between the large and the small tank at week 10. The null hypothesis failed to be rejected and this shows there was no statistically significant effect of tank size on the final size of a guppy.

## ELECTROSPINNING PVDF NANOPOROUS MEMBRANES FOR USE IN AIR GAP MEMBRANE DISTILLATION TO DESALINATE DIRTY WATER

John Mathai

Governor's School for Science and Mathematics

Membrane distillation is a water desalination process that uses a temperature difference to create a diffusion gradient. The goal of this research was twofold: 1) electrospin a PVDF membrane and 2) build a housing unit for the membrane distillation process to occur. In order for the electrospinning process to work efficiently, the membrane must be hydrophobic and porous for water vapor, but not salt. Using electrospinning, a polyvinylidene fluoride (PVDF) suspension was spun into a possible membrane candidate. Multiple PVDF suspensions spun at different air-gap distances, voltages and relative humidities displayed no fiber formation initially. Electrospray and conglomeration dominated the deposition. More PVDF suspensions were mixed with higher percentage PVDF, and fiber formation occurred. Although the fibers deposited were large, causing the membrane to lack the necessary characteristics to function properly, further work is expected to achieve the desired sub 5  $\mu\text{m}$  fiber formation. In addition, sketching, Creo 2.0, 3D printing and aluminum milling allowed for the rapid prototyping and eventual creation of a larger membrane-housing unit that met all of the necessary structural constraints.

## USING DIAGNOSTIC PCR TO ANALYZE TROPHIC RELATIONSHIPS BETWEEN MACROFAUNA AND MEIOFAUNA

Rhea Mathew

Governor's School for Science and Mathematics

The meiofaunal trophic web remains largely unknown, but these trophic relationships are essential to understanding the importance this organism has on higher trophic levels. Relationships between macrofauna and meiofauna are essential to fully understanding the niche and ecological importance of meiofauna. Meiofauna effects organisms in higher and lower trophic levels; therefore, understanding their relationship to other organisms is crucial. Uncovering the trophic relationships of Meiofauna presents many challenges due to their small size. A fairly new method for analysis known as Diagnostic PCR has been proven to have good results in determining the Meiofaunal Trophic Web. By combining specific prey-primer sets with the whole genome of predator DNA, this method allows for uncovering the diet of Macrofaunal organisms. Through extensive research on the behavior and habitat of these organisms and diet analysis, scientists can gain a better understanding of the trophic relations of Meiofauna.

## AN EXPLORATION OF THE USE OF ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY OF EPITAXIAL

Alex Mau

Governor's School for Science and Mathematics

Electrochemical impedance spectroscopy (EIS) was used to analyze the impedance of epitaxial graphene as the graphene was exposed to substances such as air, de-ionized water, and acetone fumes. The results indicated that the graphene did respond to exposure to different substances; however, it was also clear that the graphene was too sensitive to exposure and therefore could not be used in this way to differentiate between different substances. In fact, the results for tests on different substances were, on average, more similar than the results for multiple tests on the same substance.

## IMPACT OF TERT-BUTYL HYDROPEROXIDE CONCENTRATIONS IN RETINAL PIGMENT EPITHELIAL CELL MODELS IN VITRO

Carlan May

Governor's School for Science and Mathematics

Neovascular, or wet, age-related macular degeneration (AMD) is spurred by the collapse of the retinal pigment epithelial (RPE) barrier system. This breakdown in barrier function is often attributed to oxidative stress. As wet AMD occurs, vascular endothelial growth factor (VEGF) spurs the development of new, leaky blood vessels which penetrate the RPE cell layer. The subsequent buildup of subretinal fluid is responsible for the loss of vision in patients with neovascular AMD. Pigment epithelial derived factor (PEDF) acts as a VEGF antagonist. The 44-mer PEDF peptide has been identified as being responsible for the neurotropic properties of PEDF while the 34-mer peptide has been seen to contain antiangiogenic properties. To assess the function of the 44-mer peptide in these processes, oxidative stress must be induced in ARPE-19 cell cultures via treatment with tert-butyl hydroperoxide. However, even in low concentrations, this agent may be lethal to injured cells in culture. To determine the concentration which would prompt oxidative stress without harming the cells, ARPE-19 monolayers were treated with varying tert-butyl concentrations. Barrier integrity was then assessed by measuring transepithelial resistance.

## COOKING CLASS FOR CHILDREN WITH AUTISM TO IMPROVE FRACTION RELATED PERFORMANCE

Samantha McCall and Abigail Tempel

Chapin High School

Autism spectrum disorder refers to a group of complex disorders of brain development characterized by difficulties in social interaction and communication, with many individuals also displaying repetitive behaviors. Scientific studies have demonstrated that early intensive behavioral intervention improves learning, communication and social skills in young children with Autism.

The purpose of this project was to determine if children with Autism would learn fraction skills better with hands on learning rather than in a regular classroom environment. A group of three students (grades 3rd and 4th) were taught fraction skills through cooking, measuring and reading fractions. They attended five, one hour, cooking classes, with all classes including use of fractions in following recipes and measuring ingredients.

To document changes in their abilities to use fractions appropriately, students were given multiple pre-tests and a post-test. Throughout the classes, multiple fraction evaluations were completed by the students. There was an increase in scores for Students A and B, while Student C stayed the same. A matched pairs t-test was completed for both a pre/post-test and an advanced pre/post-test. P-values were 0.33 and 0.50 respectively indicating that this study was not statistically significant.

## INDUCTION OF APOPTOSIS IN ESCHERICHIA COLI CELLS

Victoria McCarthy

Governor's School for Science and Mathematics

Bacterial cells have been proven to go through programmed cell death similar to the apoptosis of mammalian cells. MazF is a bacterial toxin that plays an important role in bacterial apoptosis by cleaving mRNA when it is activated. MazE is the antitoxin that prevents MazF from being activated in the lag and log phases of bacterial cell growth. MazF is capable of cleaving mRNA at the ACA sequence, but the toxin is only active in the stationary phase when there are not enough nutrients to sustain the population. mazF is able to cleave itself due to the ACA sequence on its mRNA, which reduces apoptosis of the bacterial cells. The aim of this research is to study the effect of altering the ACA to another sequence encoding the same amino acid and study its role in bacterial apoptosis. To achieve this goal, mazF was amplified using PCR and digested with XhoI and HindIII. The digested product was cloned into the pBAD vector under the control of an arabinose-inducible promoter E. coli DH10B and transformed with pBAD carrying the modified mazF. The transformed E. coli were grown on M9 minimum medium supplemented with 0.2% arabinose, and 100  $\mu$ l of bacteria were plated onto M9 plates every two hours for 24 hours. The plates were incubated at 37° C and the number of colonies counted after 24 hours of incubation. A 3-log reductions in population in cells expressing the altered mazF mRNA 8 hours post arabinose-induction was observed.

## THE RELATIONSHIP BETWEEN LIPOPROTEINS AND CORONARY HEART DISEASE IN AFRICAN AMERICANS: THE SEA ISLANDS GENETIC AFRICAN AMERICAN REGISTRY

Dixie McCollum  
Governor's School for Science and Mathematics

Using data collected from the Sea Islands Registry of African Americans, research was conducted to test whether or not lipoprotein biomarkers were predictive of myocardial infarction in African Americans of the Sea Islands population with type-2 diabetes. For this study, previously collected data from Project SuGAR including physical examinations and laboratory tests were used. The first objective of the study was to calculate the prevalence of incident vascular events of participants through the year 2011. The second objective was to investigate the relationship between traditional lipid levels, as well as NMR lipoprotein profile, and heart attack using ICD-9 codes. Ultimately, the research conducted showed that myocardial infarction was closely related to type-2 diabetes, and LDL cholesterol levels were predictive of heart attack. While total LDL particle number and small LDL particles did not predict heart attack, it was found that LDL particle size was predictive in the middle tertile relative to the lowest tertile.

## DEVELOPMENT OF A SOCIAL MEDIA APPLICATION FOR GOOGLE GLASS

John McElvenny  
Governor's School for Science and Mathematics

Google Glass is a cutting edge piece of technology that if developed correctly could become very powerful. The objective of this project was to learn more about the development process for Glass by developing an application for it and exploring its features. Snapchat for Glass, or just SnapGlass, is an application that communicated by sending "snaps" to other users. This idea was excellent for Glass, since it communicated by sending pictures, rather than text and it took advantage of Glass's unique features. SnapGlass was designed using a java-based Snapchat API, and several different android activities to allow the user to seamlessly send and open snaps from smartphone users. The development process for Glass is similar to that of an android application since the Glass SDK is based off the android SDK. However, because of its lack of a keyboard and pointing device, Glass has a design process that entails different types of applications than that of a smartphone. SnapGlass takes advantage of Glass's features and can function without a keyboard. SnapGlass was an effective way to differentiate between the development process of Google Glass and that of a smartphone

## EFFECTS OF LIGHT COLOR ON POPULATION GROWTH IN RHODOMONAS SALINA

Patrick McKenzie  
Governor's School for Science and Mathematics

Rhodomonas salina is a marine, phycoerythrin member of the phylum Cryptophyceae; an understudied division of algae. Its ecology and evolution are largely unknown, so the purpose of this experiment was to help uncover and describe a part of its ecology. Four samples of R. salina were grown in three boxes that filtered for red, blue, and white light respectively at the same intensity. Population growth was monitored within the box to try to make an accurate prediction of the light environment in which R. salina grow best. The results showed that R. salina had the fastest growth rates in white light, the second fastest in blue, and the slowest in red light. This indicates that R. salina may live below 10 ft. in the ocean's water column, since red light disappears at about that distance, and red light is the least useful light for R. salina growth. This understanding will provide a better understanding of the ecosystems and food chains in the ocean because, in the areas they live, cryptophytes are often critical to both the total biomass and the dynamics of the food web.

## THE EFFECTS OF VARYING LIGHT WAVES ON ALGAL GROWTH

Lillian Meng  
Southside High School

Unwanted algal growth remains an issue in many aquatic systems. The presence of algae may present a wide array of problems ranging from rendering water impotable to having detrimental effects on aquatic ecosystems. These negative aspects of algal growth demonstrate why it is often beneficial to have the ability to control the growth and spread of algae. Information regarding the effects of various light waves on algal growth may be used not only to better control the growth of algae, but also to prevent future unwanted algal growth that may have harmful effects. This experiment demonstrates the relationship between the length of light waves absorbed by algae samples and the resulting amount of algal growth. Light wavelengths associated with red, blue, and violet of the visible light spectrum have been obtained through applying colored filters to white light. Different samples of algae have been exposed to one of these types of light waves. The effects on algal growth have then been observed through spectrophotometry, revealing a relationship in which certain lengths of the light waves absorbed by algae result in greater amounts of algal growth.

## EFFECTS OF TLR4 AND UCP2 ON NON-ALCOHOLIC STEATOHEPATIS OF THE LIVER

Emmaleigh Messer  
Governor's School for Science and Mathematics

Mice with Toll-like receptor 4 (TLR4) induces the presence of UCP2 (uncoupling protein 2). UCP2 is found in great quantities in the hepatocytes of the Steatotic liver. UCP2 uncouples proteins in the mitochondria causing a decreased production of ATP. Steatotic mice lacking TLR4 have an increased survival rate because they do not produce as much, if any, UCP2 and therefore produce enough ATP. It was confirmed that TLR4 follow the JNK pathway to stimulate UCP2 growth in earlier experiments. During my six weeks, we genotyped the mouse colonies to confirm the presence or absence of TLR4 and UCP2 based on which gene was knocked out. We used Real-time PCR to find the presence of TNF-alpha, TNF-beta and CCL2, which are inflammatory cytokines. We also isolated hepatocytes by the perfusion and removal of the mice liver to be treated with LPS. The cells were cultured over a 24 hour time period and then treated with LPS, a bacteria commonly found in the gut. The RNA of the hepatocytes was then isolated and quantified using a nanodrop technique. The series of experiments showed an increase of NDUF8 and Drp1, both of which show mitochondrial dysfunction in the lard-fat diet fed mice. The mice lacking TLR4 did not show any change, because the LPS was not accepted.

## THE EFFECT OF THE FERMENTATION OF POTATOES ON THE PRODUCTION OF ETHANOL

Paige Mewborn  
Dutch Fork

The purpose of this experiment is to evaluate the efficiency of fermentation as it relates to the amount of ethanol produced. The fermentation process will be altered in three different ways, affecting the Russet potatoes in their production of ethanol by the use of barley malt, all-natural yogurt, and Baker's yeast. Data will be collected and analyzed based on the amount of ethanol produced after 4 weeks of fermentation. Russet potatoes are known to be the most commonly and widely used potatoes in the world, which makes them optimal for this experiment. Fermentation is the conversion or breaking down of sugar, such as starch, into carbon dioxide and ethyl alcohol (also known as ethanol.) Ethanol is used for a variety of fuels and also can be used for the production of alcoholic beverages. This process of fermentation can be accelerated by the use of varying agents such as yeast, barley and wheat, and dairy products such as yogurt or cheese. This experiment will use barley malt, all-natural yogurt, and yeast to accelerate the fermentation process. The duration of the experiment should last about 6 weeks, with the amount of ethanol extracted from each of the varying and enhanced processes of fermentation compared and analyzed.

## THE EVOLUTION OF VILLAINS

Jamie Milliff  
Chapin High School

Fictional criminals in various media are emblematic of what society finds the most terrifying, and tend to shape the heroes that people identify with. Modern culture has become increasingly fascinated with the villain of the fairy tales, yet there has been little to no research into how they have changed over the ages. How much has the perception of evil changed over time? To face this issue, three separate observational case studies of villains from pop culture have been performed on an individual character that has manifested in assorted styles and eras. Those that were chosen were Professor Moriarty from The Adventures of Sherlock Holmes, The Joker from Batman, and Hannibal Lecter from The Silence of the Lambs. The hypothesis is that if a character has been sustained over time, there will be a marked change in the type of threat that he poses in his respective community. Using threat assessment analyses featuring one of the three chosen villains at different points in time, the researcher was able to build profiles based on each time period of the character's portrayal in media. The analyses of the character, which includes scope, inter-human relations, and vulnerability score, are based on an accepted computer science threat assessment. They show that while the target audience directly impacts how "evil" the character is rendered, the true change over time is reflected in the depth of the villain's personality and their steady humanization. This conclusion can be expanded through further research into why these changes occur.

## GLYCOL CHITOSAN BASED NANOPARTICLES DELIVERING CISPLATIN FOR THE TREATMENT OF CANCER

Mitchell Mills  
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Conventional chemotherapy regimens always result in severe systemic toxicity and low anticancer efficacy due to the low water-solubility, short blood circulation time, and non-specific tissue accumulation of anticancer drugs. A promising strategy is using nanoparticles as carriers to deliver those drugs. Nanoparticles have the capacity to improve the drugs' anticancer behaviors by increasing their solubility, prolonging their circulation time in the blood stream, and controlling the drug's specific accumulation and release in tumor tissue either by passive or active targeting mechanism. Cisplatin is a platinum-containing anticancer drug and is clinically used for treatment of testicular, bladder, and ovarian cancers. Its effectiveness is compromised by its gastrointestinal toxicity, renal toxicity, and peripheral neuropathy. Remarkable efforts are urgently needed to improve cisplatin's therapeutic properties and attenuate its side effects. Glycol chitosan (GCS) based nanoparticles might be an ideal candidate for cisplatin delivery since GCS is biodegradable and biocompatible. They have been widely investigated as drug carriers for cancer therapy. Here we propose to utilize GCS based nanoparticle to enhance the delivery of cisplatin. After synthesizing several different nanoparticles, the most ideal were used in an in vitro experiment with SKOV-3

ovarian cancer cells to test the vitality rate of the cells when combined with the nanoparticle. At higher concentrations, the result is promising.

#### OPTICAL PROBES FOR NONINVASIVE MOLECULAR IMAGING OF CANCER BIOMARKERS IN GLIOBLASTOMA CELL LINES

Faith Mitchell

Governor's School for Science and Mathematics

We designed and created non-invasive, near infra-red (NIR) optical imaging probes targeted to specific biomarkers in Glioblastoma (GBM) cell lines. Through western blot analysis, specific proteins were observed to be consistently overexpressed in the GBM cell lines. These unique biomarkers include: transferrin receptor (Tfr) proteins, epidermal growth factor receptor (EGFr) proteins, and platelet derived growth factor receptor (PDGFr) proteins. Probes were created out of short peptides with ends complimentary to the amino acid sequence on the binding site of each respective protein receptor. A fluorescent dye (Dylight- 680) was attached to the free amine group of each peptide. We observed and quantified the uptake of these conjugates through fluorescent microscopy in an effort to optimize the efficiency of the treatments in preparation for use in vivo.

#### THE EFFECT OF PAR-1 ACTIVATION ON SCHWANN CELL MORPHOLOGY IN A 3-D COLLAGEN MATRIX MODEL

Mary Lyn Mitchell

Governor's School for Science and Mathematics

Damage to the axons found in the peripheral nervous system is common as it occurs with contusions and cuts often breaking blood vessels that release thrombin onto its surrounding tissues. Thrombin cleaves off Protease activated receptor 1's (PAR-1) cap revealing the seven amino acid sequence SFLLRNP which binds to another site on PAR-1 causing its activation. PAR-1 is found Schwann cells which are thought to repair damaged axons. Previous research on PAR-1 receptor activation by SFLLRNP alone in a 2D Schwann cell cultures has shown that activating PAR-1 may increase mitosis and alter cell morphology. However, these 2D cultures limit the Schwann cells from interacting with the axons. This project strives to look further at the relationship between activated PAR-1 and Schwann cell morphology in a 3D culture. The 3D model was achieved by placing Schwann cells in collagen matrices. The collagen matrices were treated with 100nM of SFLLRNP and then were collected at three time points (12, 24, and 48 hours) followed by immunocytochemistry staining with antibodies. They were then assessed for cell shape and number of processes using the antibodies anti-vinculin and TRITC – conjugated Phalloidin, which will show the cytoskeleton of the Schwann cells. It was hypothesized that PAR-1 activation would alter the morphology of Schwann cells. The preliminary data showed that PAR-1 did change the shape of Schwann cells from the natural round shape to more amorphous shapes.

#### NONSTEROIDAL ANTI-INFLAMMATORY DRUGS DECREASE VIABILITY AND PRODUCE MORPHOLOGICAL ABERRATIONS IN EARLY CHICKEN DEVELOPMENT

Vaibhav Mohanty

Academic Magnet High School

Nonsteroidal anti-inflammatory drugs [NSAIDs] are commonly consumed by the general population for their therapeutic effects in relieving fever, pain, and inflammation. However, NSAID consumption by pregnant women in their third trimester has been correlated to birth defects in their newborn children. The purpose of this study is to determine if NSAIDs cause abnormalities in morphogenesis. Using the whole embryo culture technique with the chicken model system, the researcher administered varying doses of ibuprofen to approximately stage HH14-16 chick embryos and then scored general morphological characteristics of the embryos after 18-20 hours of culture. Ibuprofen was tested at four doses: one dose that proportionally would be fatal to humans and three sub-lethal doses equivalent to the maximum concentration of ibuprofen in the human bloodstream after consuming an 800 mg, 400 mg, or 200 mg dose. Both the lethal dose and the 800 mg equivalent dose caused significant reduction of viability of the embryos, with severe bleeding and blood pooling in the cardiac regions and several morphological aberrations. The 400 mg and 200 mg equivalent doses did not result in such a reduction of viability, although blood pooling was observed in some cultures given the 400 mg equivalent dose. Embryos receiving the 200 mg equivalent dose appeared morphologically normal. Proteomic analysis of the cardiac tissues will be conducted using matrix-assisted laser desorption/ionization mass spectrometry. Results from this study could have implications on the safety of ibuprofen for child-bearing aged women that have not been appreciated previously.

#### T CELL VACCINES AS AN IMMUNOTHERAPY FOR TYPE 1 DIABETES

Emily Morton

Center for Advanced Technical Studies

The goal of this project is to create a T cell vaccine which will reduce or eliminate circulating autoreactive CD4+ T cells in Type 1 Diabetes (T1D) patients. This vaccine will preserve the Honeymoon Phase, as well as lead to a cure for T1D when administered in conjunction with pancreatic islet transplantation.

When T cell vaccines were studied in Multiple Sclerosis, all patients experienced a significant reduction in circulating autoreactive T cells, and all except one patient experienced no relapses.

The T1D vaccine will be created by isolating CD4+ T cells from diabetic peripheral mononuclear blood cells, then attenuating proliferation and antigen expression in vitro with T Cell Protein Tyrosine Phosphatase. Patients who receive the vaccine are expected to experience a reduction in circulating autoreactive CD4+ T cells, while patients who receive the placebo are expected to experience no change in circulating autoreactive CD4+ T cells.

#### OPTIMIZING NOBLE METALS ADSORPTION FOR CATALYST SYNTHESIS USING STRONG ELECTROSTATIC ADSORPTION (SEA)

Hansen Mou

Governor's School for Science and Mathematics

This research examines the strong electrostatic adsorption (SEA) method of catalyst formation using carbon black, alumina, and silica supports at various pH. At a certain pH, the functional groups on the support's surface reach a maximum level of ionization, causing the support to adsorb the maximum amount of precursor. This point of maximum ionization differs for each support, and it needs to be known in order to make the best catalysts possible with this method. This research examined carbon black (Darco G-60, Oxidized VXC 72), alumina (SBA 200), and silica (Aerosil 380) supports for their maximum uptake of PTA, PdTA, PTC, PdCl<sub>4</sub><sup>2-</sup>, and CoHA precursors via uptake surveys extending from pH 1 to 14. The results showed that SBA 200 adsorbed the most PTC at about pH 4.5, Darco G-60 had a maximum adsorption of PdCl<sub>4</sub><sup>2-</sup> at about pH 2, Oxidized VXC 72 had maximum adsorptions of PTA and PdTA at about pH 12, and Aerosil 380 had a maximum adsorption of CoHA at about pH 12. From this and previous knowledge of the materials and this concept, it is possible to accurately document the optimal uptake pH for other support/precursor combinations by narrowing the pH range for testing. If the point of zero charge (PZC) of the support and the ionic charge of the dissolved precursor are known, a range of possible optimal pH can be determined, allowing future experiments to focus on those points exclusively to save time and resources.

#### PROGRESSION TOWARDS A 3-DIMENSIONAL INNERVATION MODEL OF THE HUMAN BLADDER

Elizabeth Mugo

Governor's School for Science and Mathematics

Overactive bladder is defined as difficulty with the storage of urine in the bladder causing the strong, sudden urge to urinate that can't be controlled. Botulinum toxin (Botox) is a neurotoxin isolated from the bacterium *Clostridium botulinum* and is used to treat overactive bladder by injection into the bladder wall which blocks the nerves that lead to the uncontrollable urge to urinate. However, surgeons have no guide as to the location of the nerves in the bladder. The purpose of our project was to create a 3-dimensional map showing the innervation of the human bladder to serve as a surgical guide for Botox administration. Human cadaveric bladder was embedded and sectioned. Deparaffinized and dehydrated slides were incubated in primary antibody and secondary antibody conjugated with horseradish peroxidase. DAB substrate has been added which creates a stain on the slides. Slides were coverslipped and scanned into single images are re-assembled into a 3-dimensional model. At the conclusion of my contribution to the project, I have stained all sections of the bladder and processed images such that they are ready to be assembled into a 3D map. It is anticipated that the bladder innervation is prominent in the trigone region of the bladder, specifically around the ureteral orifices.

#### THE EFFECT OF BLADE PITCH ON THE ELECTRICAL OUTPUT OF A WIND GENERATOR

Athreya Murali

Heathwood Hall Episcopal School

The purpose of this scientific investigation is to determine the proper blade pitch, or more casually called the angle of attack, of the blades of a wind generator to generate the maximum electrical output. The blade pitch angles tested were 10°, 15°, 17.5°, 20°, and 25°. It was hypothesized that a blade pitch of 15° was the most efficient blade pitch for maximum electrical output. To perform the experiment, a wind generator was built using PVC pipes, an alternating current magneto, a 5 mm screwdriver socket, balsa wood blades, and wooden rotor hubs. An electric leaf blower was placed 2.8 m away from the wind generator. The magneto was connected to a multimeter that measured the voltage output. Ten trials were performed for each of the five different blade pitch angles. Upon collecting these fifty data points it was concluded that the blade pitch angle of 25° was the best blade pitch to generate the greatest electrical output, with an average voltage of 1.42 volts. The data collected does not support the hypothesis, as a blade pitch of 25° produced a greater electrical output than that of 15°.

#### CONSTRUCTION OF A WHITE LIGHT SOURCED COMPUTED TOMOGRAPHY SCANNER PROTOTYPE

Mehrzad Namiranian

Governor's School for Science and Mathematics

An X-Ray Computed Tomography (CT) scanner is an instrument of medical imaging used to study the human body from the 3D scans that it compiles. However, these machines are generally large, expensive and can emit harmful radiation. In order to study the basics of CT and medical imaging there is a need for more cost-effective, non-ionizing alternatives. To accomplish this, we constructed a scanner using white light and practical materials to create a three dimensional image of any suitably sized, transparent object. SolidWorks was used to create the designs of the various components of the scanner, while MATLAB was used to program an assortment of functions that the desk sized CT scanner needed to operate. The aim of this part of the project was to convert the designs into a finished prototype. Our design utilized a main galvanized vent pipe along with two

identical end pieces that were connected through metal tubing. With the help of a laser cutter, we were able to create camera and light mounts as well as end handles that stopped light seepage. Collimators for the camera and light source were designed and tested, as they were an important aspect in increasing image quality by directing the light rays. Our aim was to eliminate the harmful X-ray exposure normally present in CT scanners, while maintaining the capability of taking a snapshot every degree an object rotated, so that these pictures could be sliced and reconstructed together to create a 3D CT image.

#### THE EFFECT OF VERBAL AND TANGIBLE REINFORCEMENT ON TASK ACCURACY OF YOUNG BOYS VS. GIRLS

Caroline Nassab  
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Encouraging children to behave is a skill that many parents and educators strive to achieve. The goal of behavioral reinforcement is to increase the frequency of positive behavior by rewarding children when it is exhibited. Little research has been done on the most effective reinforcement with respect to gender, thus the purpose of this experiment is to determine the effect of verbal and tangible reinforcement on the task accuracy of young boys vs. girls. It was hypothesized that if young boys and girls are rewarded through a verbal reward, a tangible reward, or no reward at all, the verbal and tangible reward will impact task accuracy. An equal number of boy and girl participants was obtained and placed into one of three groups: the control, verbal reinforcement, and tangible reinforcement. Participants were tested individually using the subprogram, Symbol Recognition, of the Biobytes Software. Participants took baseline, experimental, and post-treatment tests where they had to correctly identify the target letter 15 times. During the experimental trials, the control group received no reward, the verbal reinforcement group received positive verbal praise, and the tangible reinforcement group received a nickel for each correct response. Results from ANOVA tests show statistical significance ( $p < 0.05$ ) for the percent success rates of girls in the experimental tests between the verbal and tangible group, and the control and tangible group; statistical significance was also found among success rates for the girls in the tangible reinforcement group between the baseline and experimental tests and baseline and post-treatment tests.

#### THE RELATIONSHIPS BETWEEN RURAL LAND COVERS AND WATER CHEMISTRY UNDER BASE FLOW CONDITIONS IN THE SOUTH CAROLINA PIEDMONT

Emily Navin  
Governor's School for Science and Mathematics

Relatively few studies have examined the influence of rural land covers, such as pasture or row crops, on stream water quality in the Southeastern Piedmont region of the United States. During the summer of 2014 water samples were collected from rural areas in the Savannah, Saluda, and Enoree River watersheds in South Carolina. Fourteen streams draining watersheds with pasture, forest, and row crop land covers were sampled. This study measured pH, conductivity, dissolved oxygen, and water temperature in the field, and collected water samples for both turbidity and chemical analyses. Using a land cover database, the percent pasture and the percent crop cover for each site was determined, which was later used in statistical tests. Specific conductance did not differ significantly between sites with and without crops. However, specific conductance correlated negatively with elevation of the sampling sites. Turbidity was significantly higher at crop sites than non-crop sites. Contrary to expectations, no significant correlation between turbidity and percent pasture was found. Crop sites had a significantly higher median nitrate concentration than non-crop sites. Among sites with no crops, nitrate concentrations correlated positively with percent pasture. Overall, these relationships suggest that row crop land cover has greater effects on stream water quality than does pasture land cover in the Southeastern Piedmont.

#### TEST FOR CORROSION OF IRON IN YEAST AND YOGURT

Samira Nematollahi, Shonte Clement, and Nathaniel Boen  
Southside High School

In large factories today corrosion of the metals used is a serious issue because of the need to replace parts after they have corroded. We designed this lab to determine the effects that different biological substances have on the percentage of iron that corrodes. It was hypothesized that the bacteria present in the yeast will decrease the percent corroded because it is a green inhibitor that can decrease the amount of corrosion. The iron that was put in yogurt was hypothesized to also increase the amount corroded. The corrosion was compared to iron that was placed in a beaker with only the air around it. To determine the percent that has corroded we pre-weighed the iron, put it in the substance for 14 days, and found the new weight. With this experiment we hope to determine whether the bacteria release anything that may help or hinder the formation of rust on the iron.

#### AFFECTIVE CIRCUMPLEX IN MUSIC

Daniel Newsome  
Governor's School for Science and Mathematics

Wilhelm Wundt's theory of affective circumplex has been largely unexplored, despite the fact that it has been around over two hundred years. This theory suggests that affective stimuli will, when graphed on a two dimensional grid with valence and arousal as the axes, naturally fall into a circle formation. Recently, studies have been confirming this hypothesis on a number of stimuli, yet the theory has largely been unexplored. Unfortunately, no such study had been done on affective circumplex in



music. Based on the theory of affective circumplex, the intensity of a piece of music would interact limit the valence of affective reactions. Likewise, it suggests that truly neutral music is rare and that music will end up being categories affectively. This means that when one affective characteristic of music is normalized, listeners focus on the other, and that when both are normalized they still rate the stimuli with the same overall magnitude. This study seeks to answer this debate by showing participants affective music stimuli and asking them to rate them. The stimuli were rated by valence and arousal and mapped onto a two dimensional grid. The results verified the model of affective circumplex in music, as the data formed clear circle. Only three of the thirty stimuli deviated from this circle. When looking back at the data, it was clear that the magnitude of the participants' ratings was consistent. This strange cross between music theory and psychology usually involves psychology proving musical theories, yet this study does the opposite.

#### THE EFFECTS OF SUGAR ALCOHOLS ON STREPTOCOCCUS MUTANS IN THE PRESENCE OF SUCROSE

Karen Ni

Center for Advanced Technical Studies

Fluoride is beneficial to dental health but it can also cause problems such as fluorosis or an increased risk in bone fractures. Sugar alcohols such as xylitol or erythritol could be used instead as a fluoride substitute. However, it is uncertain how effective sugar alcohols will be in the presence of sucrose. They will most likely compete and take the place of sucrose in *S. mutans*, inhibiting its growth because *S. mutans* cannot metabolize the sugar alcohols. To test this hypothesis, the experiment was split into two parts. The first part has *S. mutans* being grown on six types of plates that have differing compositions: agar only, agar and sucrose only, agar and xylitol only, agar and erythritol only, agar, sucrose, and erythritol, and agar, sucrose, and xylitol. The results are expected to be: no presence of *S. mutans* in agar only, agar and xylitol, and agar and erythritol due to a lack of an energy source. The plates with agar, sucrose, and xylitol/erythritol will have less bacterial colonies due to the bacterial growth inhibition effects of sugar alcohols. Data will be analyzed by comparing the amount of colonies present and the size of said colonies to determine whether sugar alcohols are successful in inhibiting the growth of *S. mutans*. The second part will be using human teeth to see whether sugar alcohols are capable of inhibiting the bacteria's ability to degrade teeth enamels. The teeth are autoclaved and weighed before exposing it to six types of solutions: bacterial broth only, bacterial broth and sucrose only, bacterial broth and xylitol only, bacterial broth and erythritol only, bacterial broth, sucrose, and erythritol, and bacterial broth, sucrose, and xylitol. After 24 hours, the teeth will be taken out, bleached and autoclaved before weighing it again to see if there was any inhibition on the activity of *S. mutans*. The teeth are expected to degrade when exposed to bacterial broth and sucrose but the sugar alcohols should be able to inhibit the bacteria so that less tooth mass is lost. These findings can help to show that there are possible healthier substitutes and decrease human reliance on fluoride, improving bone formation in heavily fluoridated areas such as India or Ethiopia. Future work could be done to see whether *S. mutans* can develop a resistance to sugar alcohols, allowing them to utilize xylitol or erythritol for energy.

#### DETERMINING THE EXTENT OF TRYPANOSOMA BRUCEI PEROXIN 13.2 (TBPEX13.2)'S GLUCOSE-DEPENDENT LOCALIZATION OF THE GLYCOSOMES IN THIS ORGANISM

Annah Nieman

Governor's School for Science and Mathematics

African trypanosomiasis spreads throughout Sub-Saharan Africa with the aid of the tsetse fly. The untreated disease is fatal and the drugs that are currently in use are toxic. This research studies parasite-specific essential processes with the goal of identifying new drug targets. Glycosomes are single-membrane bounded organelles unique to the *Trypanosoma* parasites. Glycosomal composition varies in response to environmental conditions and the disruption of glycosomes is lethal to the parasite. Two proteins, *Trypanosoma brucei* Peroxin (TbPEX13.1) and TbPEX13.2 are involved in glycosomal protein import and the silencing of either gene is lethal. Previous research has shown that the protein TbPEX13.1 changes localization in response to changes in extracellular glucose, a nutrient that fluctuates throughout the parasite lifecycle. The overall purpose of this study was to determine the extent to which TbPEX13.2, like TbPEX13.1, exhibits glucose-dependent localization. To do so, the gene TbPEX13.2 was amplified via Polymerase Chain Reaction and ligated into the pGEM vector, transformed into *E. coli*, and followed by the excision of the TbPEX13.2 gene. The DNA sequence of TbPEX13.2 was then successfully sequenced. Due to time constraints, it could not be ligated into the pXS2 expression vector. Therefore, the expression construct was not transfected into trypanosomes and stable cell lines were not selected and TbPEX13.2eYFP expression and localization was not determined. The cloning of TbPEX13.2 into the pGEM vector was successful and TbPEX13.2 was successfully excised back out of the pGEM vector. But due to time constraints it could not be ligated into the pXS2 expression vector.

#### DEVELOPMENT AND IMPLEMENTATION OF AN EXERCISE PRESCRIPTION PROTOCOL FOR LUNG CANCER PATIENTS USING INTERNET-CONNECTED FITNESS TRACKERS

Sloan Nietert

Academic Magnet High School

Lung cancer and its treatment often result in high symptom burden and reduced quality of life [QoL]. Recently, exercise has been recognized as an effective therapy for the disease, and fitness trackers offer a cheap, objective way of measuring this activity. However, feasibility of such data collection among lung cancer patients needs to be established. Forty-three patients with Stage III/IV lung cancer were approached at MUSC's Combined Thoracic Oncology clinic. Participants were given surveys assessing dyspnea, QoL, and depression, and ten agreed to wear a Fitbit Zip® to collect their step counts for seven days. Associations between survey domains and average daily step counts were assessed using

Spearman rank correlations. Forty of 43 patients [93%] participated, and all approached participants agreed to wear Fitbit® pedometers and returned them with usable step counts. Positive correlations with step counts were noted for physical, social, role, and emotional functioning as well as QoL. Negative correlations were observed with pain, constipation, breathlessness, and insomnia.

Despite high symptom burden, this cohort's high participation rate, low survey completion time, and 100% activity data collection confirms study feasibility. Active patients with advanced lung cancer report greater overall QoL, suggesting exercise as a therapeutic target in advanced-stage lung cancer.

#### THE POTENTIAL IMPACTS OF A 1 METER SEA LEVEL RISE AND INCREASED STORMINESS ON THE LANDSCAPE AND WILDLIFE OF THE SOMERSET LEVELS IN THE SEVERN ESTUARY

Olivia O'Connor

Governor's School for Science and Mathematics

This research project was conducted to identify the main concerns, risks, and possible damage that the Somerset Levels of the Severn Estuary in Wales is currently facing. According to the Intergovernmental Panel for Climate Change, it is likely that this area will be affected by a 1 meter sea level rise and increased storminess by 2100. This climate change could be detrimental to the health of the wildlife and landscape of the area, as it may result in excess flooding. The larger purpose of this research is to come to a conclusion on how this change will affect the area and what precautions can be taken to lessen the damage from flooding. In order to identify which areas would be most susceptible to flooding, a series of land surveying was done to measure the elevations of the different areas. With this data, a map was then created with the appropriate data plotted, showing the areas that were most vulnerable to the increase in sea level and most likely to flood.

#### BAND SIZE AND PERFORMANCE

Madison Owen

Chapin High School

Across the state of South Carolina band size varies from school to school, which possibly affects the outcome of the scores at competitions. To determine if size does dictate how well a group performs, I conducted a survey of seventy-seven bands that competed in the state level marching band competition. I asked the directors how many members their band had, and other questions that dealt with factors that size can affect. I received forty-eight responses to my survey that I emailed out to the band directors. The data that I received led to the conclusion that the size of the band was not relevant to the score they received at the competitions. This is because the talent of the band does not just rely in numbers. The abilities of the students enrolled have a greater impact on how well they perform, far more than the amount of them.

#### LIRIODENDRON TULIPIFERA L. EST-SSR MARKER DEVELOPMENT FOR GENETIC LINKAGE MAP CONSTRUCTION

Kayla Owens

Governor's School for Science and Mathematics

*Liriodendron tulipifera* L., commonly known as yellow poplar, is a fast-growing hardwood tree species with great economic value, commonly used in the furniture and honey industries. Genomic resources, such as EST databases and BAC libraries, have been developed for this species. However, at this time, there is no framework genetic linkage map of *L. tulipifera*. Such a map would show the positions of genetic markers relative to one another on a chromosome. It will also allow the recombination frequency to be calculated, which would show the tendency of given genes to separate during meiosis. A framework genetic linkage map is necessary for improved molecular breeding, quantitative trait locus (QTL) mapping, and to provide a base for sequencing the *Liriodendron* genome in the future. In this project, available EST databases were mined for putative polymorphic sequence repeat (SSR) markers in order to develop 190 informative EST SSRs. The DNA used during this project was extracted from control-pollinated *Liriodendron tulipifera* L. plant matter via the CTAB method. Using this DNA, SSR markers were amplified via PCR. The successfully amplified PCRs will undergo fragment analysis in order to determine whether or not a given marker is informative, with distinct allele size differences among individuals. The markers found to be informative will be used to construct the first framework genetic linkage map of *L. tulipifera* with 300 full-sib seedlings

#### ANALYSIS OF THE STEREOTYPE THREAT IN SIXTH GRADE STUDENTS' PERFORMANCE ON A MATH TEST

Sonali Parmar

Heathwood Hall Episcopal School

Since 1972, there has been an ongoing trend in which males have outperformed females on the math section of the SAT, although females perform just as well, if not better than males in the classroom. Many attribute females' lower performance on the SAT to a phenomenon known as the stereotype threat, which is defined as "being at risk of confirming, as self-characteristic, a negative stereotype about one's group" (Steele and Aronson, 1995). Much research involving the stereotype threat has focused on male and female high school or college-aged students. Little research, however, has been conducted using younger students to determine whether younger males and females are also affected by societal stereotypes. The purpose of this research is to determine the effects of the stereotype threat on sixth grade males' and females' performance on a math test. Three groups of sixth-grade students, both male and female, were given two math tests. Group 1 was told that

the first test had previously not shown gender differences, and the second test had shown gender differences. Group 2 was told the opposite: the first test had shown gender differences and the second test had not. Lastly, Group 3, the control group, was not given any statements and was instructed to simply take the test. While there were many trends indicating lower test performance for both males and females due to the stereotype threat, these trends were not statistically significant.

#### EFFECT OF INTERLEUKIN-6 ON TRANSLATIONAL CAPACITY IN C57BL/6 AND APCMIN/+ MICE

Mayank Patel

Governor's School for Science and Mathematics

Cancer cachexia is a multifactorial condition that results in skeletal muscle atrophy; it is responsible for 25 to 30% of all cancer-related deaths. Interleukin 6 (IL-6) is a pro-inflammatory cytokine that has been widely studied as a factor in cachexia development and has potential as a therapeutic target. It has been shown that when IL-6 is overexpressed in male Apcmin/+ (min) mice, protein synthesis will decrease. The purpose of this experiment was to examine the effect of IL-6 on muscle protein and RNA content in female wild type (C57BL/6) and min mice. It was hypothesized that min mice would show decreased protein synthesis in response to IL-6 overexpression. Four groups of mice were examined: B6, B6 + IL6, Min, and Min + IL6. To determine protein and RNA concentrations per unit of muscle, the Fleck Munro Assay was performed. At the time of sacrifice, Apcmin/+ mice had significantly more body weight loss than B6 mice. Min mice lost an average of 4% body weight, while B6 had no change in body weight. There was no significant (two-way ANOVA,  $p = 0.05$ ) difference between min and min + IL-6 in quadriceps RNA concentration. Preliminary analysis revealed a significant (two-way ANOVA,  $p = 0.05$ ) difference between B6 and B6 + IL-6 mice, with B6+IL-6 showing an increase in RNA concentration. No difference was seen between min and min + IL-6 mice. IL-6 overexpression induces an increase in RNA concentration in B6 mice, while a suppression in min + IL-6 mice.

#### A GENETIC MAP INVESTIGATION OF ADVENTITIOUS ROOTING AND THE CORRELATION BETWEEN GENETIC MARKERS AND ROOTING TYPES OF PEACHES

Shawn Patel

Governor's School for Science and Mathematics

Adventitious rooting is the ability of plants to regenerate a root system from a removed shoot and allows for mass cloning of the specific plant genotype and phenotype. Unfortunately, some plant species root very poorly because they do not possess adventitious rooting, but the genetic basis of this deficiency is not known. The goal of this research is to identify the exact genetic factors behind the adventitious rooting of peaches which would allow isolation of the gene and could potentially lead to DNA splicing. Two separate peach populations, A and C, are being phenotyped for their adventitious rooting ability. Approximately ten, twenty-centimeter long cuttings of current year wood were taken from each of the 378 trees in the A population and the 57 trees in the C population. The leaves were completely stripped and the stems were dipped in IBA (indole-3-butyric acid) and placed in a soilless media mixture composed of vermiculite and perlite. They were then placed in the greenhouse and kept misted under certain water exposure and constant temperature for four weeks. The cuttings were then scored for mortality, callus formation, root formation, and bud breakage. These factors help to determine the presence of adventitious rooting in the populations. DNA from the dried leaf tissues of each tree of the same populations were extracted, quantified, and quality checked. These extractions were sent off to be sequenced in order to obtain a more detailed genetic map allowing for the isolation of the rooting gene.

#### THE EFFECT OF VARIOUS TYPES OF PACKAGING ON THE CARBONATION IN COCA-COLA

Sonali Patel and Emma Shealy

Heathwood Hall

The purpose of this study was to explore the possible relationship between container type and carbonation level in Coca-Cola. The main appeal of a carbonated drink can, for some people, may be the carbonation in the beverage itself. If the Coca-Cola glass bottle contains the most carbonation then the hypothesis of this experiment will be supported. The independent variable was the three different Coca Cola containers being tested, aluminum cans, glass bottles, and plastic bottles. The dependent variable was the amount of carbonation in each of the containers. The experiment's data was collected by conducting various trials of the Coca-Cola from different types of containers between 24 hour periods. A literature review was conducted by looking up articles on the Coca Cola products and on carbonation. The results of this experiment suggest that either aluminum cans, glass bottles, or plastic bottles have the most carbonation out of their other test subjects.

#### ANALYSIS OF SPACE-TIME RECEPTIVE FIELDS OF SILICON-BASED GANGLION AND CORTICAL CELLS IN THE PHYSIOLOGIST'S FRIEND CHIP USING MATLAB SOFTWARE

Carla Jane Pax

Governor's School for Science and Mathematics

It has been known for decades that individual neurons in the brain respond selectively to distinct types of sensory or motor information. For instance, in the visual processing areas, some brain cells respond only to stimuli presented at a specific orientation while other cells respond to stimuli moving in a particular direction. Such feature selectivity of a retinal neuron's receptive field is presumed to be static meaning that it does not change over time. However, our sensory perception is

dynamic, adapting within tens of milliseconds to the ever-changing environment. The hypothesis of this research is that the neural basis for the dynamics of sensory perception partially emerges from the dynamics of individual neural responses. With a natural eye, it is difficult to test this hypothesis, and even modern neuroscience textbooks describe receptive fields only by their spatial properties. This research will test the above hypothesis by using the Physiologist's Friend Chip to produce action potentials based on the stimuli it is presented. The stimuli will be computer controlled using the Bar and Wave V7.6.5 program. The three aims of this research include a) comparing the size of the center and antagonistic surround of retinal receptive fields; b) determining if the retinal receptive fields peak at the same time; and c) demonstrating whether the orientation selectivity of cortical neurons is sufficiently accounted for by an elongated receptive field. This research supported the hypotheses that the chip functions similarly to a natural eye.

#### THE EFFECT OF WATER COLOR ON THE THERMAL CAPACITY OF A SOLAR HEAT CAPTURING DEVICE

Payton Phillips  
Heathwood Hall Episcopal School

The purpose of this research project was to analyze the effectiveness of yellow, black, blue, and colorless water colors as thermal storage materials in a solar heating device; to explore the possibility of supplying inexpensive heat to a room during the winter. Tests were conducted to determine which color would store the most thermal energy and release the most energy as heat. The device was designed to be placed against a window, which allowed the materials to capture the sun's energy as heat during the day. The device consisted of four separate twelve by twelve inch boxes and was surrounded with insulation except for the window side. Fans on the back of the device pushed air through each box continuously. A temperature probe was placed in front of each intake and output opening exiting into the 1 room. The purpose of this design was to allow measurement and comparison of the input and output air temperature. The temperature was measured every twelve minutes for four days. Data were averaged and analyzed using a one-way ANOVA test( $\alpha=0.05$ ). The mean of the change in temperature ( $^{\circ}\text{C}$ ) for the control was 1.25, black 1.41, blue 0.68, and yellow 0.78. The results showed black water had the greatest change of temperature every twelve minutes, and held the heat energy the longest during the time when it was not exposed to sunlight. This experiment provides validation of an inexpensive solar heat capturing device and tested water colors that can provide an efficient way to heat a room finding black water to be the most efficient.

#### THE EFFECTS OF HIGH FAT DIET INDUCED OBESITY ON THE TRANSLATIONAL CAPACITY AND EFFICIENCY IN THE SKELETAL MUSCLE OF MICE

Nathan Pignone  
Governor's School for Science and Mathematics

Obesity is an extremely common and rapidly growing medical conditions and is often a result of an unhealthy diet. Skeletal muscle is important for a healthy metabolism and regular function. Therefore, it is a fitting study model for muscular effects of obesity which disrupt the metabolic balance of protein turnover. Specifically, this study will focus on how obesity impacts translational capacity and efficiency. The purpose is to better understand what occurs metabolically within the skeletal muscles. For this experiment, three treatments of C57BL/6 mice were used. Two groups (3 and 18 months old) were fed a standard chow diet ( $n=10$  each), the final group was 18 months old and fed a high-fat diet ( $n=10$ ). The right quadriceps were tested for protein and RNA content and concentration to determine translation capacity and efficiency. Both the 18 month chow and high-fat diet (HFD) groups had significantly higher body weights from the 3 month chow treatment at sacrifice with HFD group also being significantly higher than the 18 month chow group. The 18 month chow sacrifice muscle weights were the only group that displayed significance to the younger control, (set at 0.05) despite the gap in total body weight between the HFD group and the other two groups. Relative muscle weight to body weight comparisons low muscle mass in the HFD mice. HFD mice also demonstrated severe declines in both RNA and protein concentration and content. All groups lived similar lives, so the diet is most likely to have caused these differences.

#### IDENTIFICATION OF POST-TRANSLATIONALLY MODIFIED (O-GLCNAC) HEPATIC PROTEINS IN FASTED AND RE-FED MICE

Mattie Piness  
Governor's School for Science and Mathematics

Diabetes mellitus type 2 affects over eight percent of all Americans. However, despite the prevalence of the disease, much is unknown. Previous studies have shown that O-linked N-acetylglucosamine (O-GlcNAc) modification of proteins increases in frequency when blood glucose levels are elevated. We sought to determine which proteins receive the O-GlcNAc modification as well as the function of those proteins in response to hyperglycemia. To identify the modified proteins, we created a unique methodology based on a combination of established techniques. Samples from a control group of fasted mice modeled lower blood glucose levels and from an experimental group of fasted then re-fed mice modeled higher blood glucose levels. Dimethyl labeling was applied to distinguish the experimental and control mice. A lectin weak affinity chromatography (LWAC) column was used to isolate O-GlcNAc modified proteins. The identity of the modified proteins was determined with a combination of heavy and light mass spectrometry. The initial steps of this novel protocol were successful. Dimethyl labels appeared on the mass spectra and enabled us to confirm an increase in O-GlcNAc modification in response to glucose in the re-fed mice. Future studies will utilize this labeling technique in combination with chromatography and mass spectrometry with larger sample sizes to further understand the role of O-GlcNAc modification in Diabetes mellitus.

ARTICULAR CARTILAGE AND ITS POTENTIAL FOR REGENERATION WHEN GROWN USING  
A NOVEL TECHNIQUE FOR CULTURING

Joshua Pope  
Governor's School for Science and Mathematics

Articular cartilage is found inside the rotator joints of the body. The articular cartilage acts as a sort of cushion for the joints during movement in order to prevent friction. During a normal life the articular cartilage is subjected to a substantial amount of damage leading to a multitude of issues concerning the rotating joints. Chondrocytes, which are the cells that make up the articular cartilage, were grown using the hanging drop technique while suspended in both regular chondrocyte media and media supplemented with methylcellulose. The hanging drop technique should create 3-D balls of chondrocytes known as spheroids with augmented regenerative potential. The objective of this research was to observe the effect that growing the spheroids in supplemented media has on the properties of the spheroids being produced.

THE EFFECT OF PLANT SPECIES ON ZINC ABSORPTION

Aidan Powers  
Heathwood Hall Episcopal School

This experiment is focused on the topic of phytoextraction and is trying to determine at which zinc contamination levels can Dwarf Essex Rape, Sun Flower, Indian Mustard, and Vates Collards most effectively absorb zinc. Phytoextraction is the absorption of pollutants from soil with plants. Seven levels of zinc were administered to the plants. There were 15 plants per species and four species. One plant from each species acted as a control and had no zinc mixed into the soil. The plants were planted in July and were allowed to grow until September when the zinc was introduced and mixed evenly throughout the soil. The plants were given until December to absorb the zinc until they were cut from the base of the stem and dried. Although it would have been better to have sixty data points (one for every plant) to analyze, the number had to be reduced to thirty by pairing each plant which was given the same amount of zinc. This is because there was not enough biomass to complete the inductively coupled plasma process. Then, using inductively coupled plasma, the levels of zinc in the plants were determined. The Sun Flowers were the only plant species which experienced a downwards trend in absorption as the levels were increased. The Indian Mustard and Vates Collards had the most prominent upwards trend, while the Dwarf Essex rape's absorption levels fluctuated. The results show that the most successful plant at absorbing zinc is Vates Collards. In the order of decreasing effectiveness were Indian Mustard, Dwarf Essex Rape, and Sun Flower.

THE CORRELATION BETWEEN IMPLICIT AND EXPLICIT RACIAL ATTITUDES

Olivia Price  
Heathwood Hall

The purpose of this experiment was to determine if there was a direct correlation between implicit and explicit racial attitudes. Racial biases are prevalent in many aspects of life, they are difficult to control and sometimes people are not even aware of these thoughts. The results from this study could help educate people about these racial disparities and reduce the harmful effects these attitudes may be exerting. In this study, participants are administered an Implicit Associations Test (IAT), that measures a person's implicit bias. The test is designed to detect the strength of a person's automatic association between mental representations of objects in memory. In the racial IAT, words with both negative and positive connotations flash on the screen along with images of Caucasian and African American people. Participants are supposed to respond as quickly as possible without thinking, if the response time is too slow, there will be no results and the participant will be asked to retest. The hypothesis is if human subjects are given an Implicit Associations Test (IAT), then the results will indicate a direct correlation between implicit and explicit racial attitudes and a stronger preference for a person's own race/ethnicity will be shown. The results showed significance and supported the hypothesis. In conclusion, this experiment could prove helpful in the field of psychology because further knowledge of these implicit biases and how they correlate to explicit attitudes can be used to prevent the exertion of harmful effects.

A SONAR DEVICE TO AID THE VISUALLY IMPAIRED

Matthew Quan  
Heathwood Hall

In this research project, tests were conducted to see whether a person could avoid a series of objects without vision, while using a custom made sonar device. This device would eventually be used to assist the blind. For the experimentation, an obstacle course was set up which consisted of objects which one might come across every day. There was a large toy jeep, two foldable chairs, a row of balls, two bicycles, a low lying rideable toy, two large lawn chairs, and a large gate. The test subjects were asked to navigate through the obstacle course while detecting, and avoiding, as many objects as possible. The results showed that the test subjects were able to complete the obstacle course while detecting and avoiding every single object 23 of the 40 trials. The most missed object was the low lying rideable toy which was about 8 inches of the ground. Overall, the device seemed to be capable of detecting a variety of different objects. It was also able to help the test subjects navigate throughout the obstacle course well. Even though there were only 23 perfect runs, out of the 280 combined opportunities there were for the test subjects to detect any of the 7 different objects, only 23 objects were missed.

## EVALUATION OF CARBON BASED CATALYSTS FOR WATER ELECTROLYSIS AND CO<sub>2</sub> ELECTRO-REDUCTION

Andrew Re

Governor's School for Science and Mathematics

With the decrease in supply of nonrenewable resources, water electrolysis and CO<sub>2</sub> Electro-reduction have recently received attention as means of converting renewable energy into storable products. Platinum, the most commonly used catalyst for these reactions, has become too rare to use on a large scale. Previous studies have shown that carbon based materials may provide a viable alternative catalyst. This research focused on testing the activity of Ti<sub>2</sub>AlC, carbon black, and ketjen black towards both water electrolysis and CO<sub>2</sub> reduction in hopes of discovering a potential alternative. Electrodes were constructed of each material and placed in a cell with an Ag/AgCl reference electrode. Using cyclic voltammetry, the current through the cell was measured against the potential. The current through the cell indicates the amount of reduction or oxidation taking place within the cell at a given potential. The CO<sub>2</sub> reduction experiment was conducted similarly to water electrolysis except in the presence of CO<sub>2</sub>. The results of these experiments concluded that ketjen black is the best contender of the materials tested for water electrolysis. Ti<sub>2</sub>AlC was the only material to show any slight activity towards CO<sub>2</sub> reduction. The products of CO<sub>2</sub> reduction could be better described through further experimentation using gas chromatography. Future studies in water electrolysis should focus on testing more possible materials or combining ketjen black with nonprecious materials to improve catalytic activity. In CO<sub>2</sub> reduction, more titanium carbide materials should be tested as well to find an even more active catalyst.

## NOTHING BUT NET: THE SCIENCE OF SHOOTING HOOPS

Romello Reed

Greenville Technical Charter High School

How does the projectory angle of a basketball affect the shot type.

## THE EFFECT OF MEDIA SUPPLEMENTS ON DIFFERENTIATION OF HUMAN ADIPOSE DERIVED STEM CELLS INTO UROEPITHELIAL CELLS

Sayaka Reed

Governor's School for Science and Mathematics

Recently, human Adipose Derived Stem Cells (hADSCs) have received attention as a potential cell source for organ regeneration, due to the ease of access as compared to bone marrow stem cells and the more controversial embryonic stem cells. Studies have demonstrated that ADSCs possess the multipotent capability of differentiating into several cell types including uroepithelial cells. They also possess immunosuppressant properties, making them easier to be accepted in organ transplants. Patients with bladder cancer have difficulty recovering from radiation treatment due to damage in the urinary epithelial lining. The damage leads to a lack of barrier function by the epithelium leading to cystitis. The purpose of this study is to test the hypothesis that cell culture media supplements can help differentiate hADSCs towards an uroepithelial cell lineage. The hADSCs were cultured in Keratinocyte Serum-Free Medium (KSFM) supplemented with All Trans-Retinoic Acid (ATRA), and their effects on specific cytokeratin and uroplakin uroepithelial markers were measured using RT-PCR and immunofluorescence at the mRNA and protein levels, respectively. The results indicate that there was an increase in the cytokeratins, specifically CK17 and CK20, and the uroplakins UPIb and UPII respectively. In addition, the control stem cell markers CD 90 and CD 105, which should have decreased, increased marginally. Although differentiation was successful, the results were incomparable to actual uroepithelial cells. The ultimate goal is to encapsulate the differentiated uroepithelial cells in hydrogels and apply them to damaged tissue to help in the recovery of the epithelial lining.

## JUST KEEP SWIMMING: AN APPROACH TO ALZHEIMER'S VIA COMMON-SUBSTANCE INGESTION

Natalie Reszczynski

Dutch Fork High School

Approximately five million Americans are affected by Alzheimer's every year. Alzheimer's affects the brain, specifically by depleting the memory, and is caused when the neurons can no longer communicate with each other. Ginkgo biloba is given to improve patients' memories, yet other substances have been suggested to be a memory enhancer greater than ginkgo biloba. This research will give *Carassius auratus auratus*, or comet goldfish, various natural medications and place them in an aquarium maze, followed by a measuring of the amount of time for them to complete the maze. It is predicted that the medicated fish's swim time through the maze will decrease, showing a benefited memory of the maze. The substances chosen to test include ginkgo biloba, Asian Ginseng, Omega 3, and Vitamin B12 because each of these substances are suggested to improve memory. Each substance should improve the fish's memory functioning; and ginkgo biloba is currently given to patients with Alzheimer's. The purpose of using ginkgo biloba will be to assure that the test and maze theory of showing an increase in memory is valid as well as to provide a basis for comparison as to whether the substances tested are in fact better at improving memory than the ginkgo biloba that is currently being given. The plan is to build an aquarium maze containing plastic sheets with circular holes in them for the fish to swim through. The medicinal substances will be infused in the water, and absorbed through the fish's scales. Using a control of fish without medication as a comparison, the time it takes the fish to complete the maze will be repeatedly tested. If the substances are improving the memory, then there should be a decrease in the time it takes the fish to swim the maze.

## THE GENDER GAP: THE EFFECT OF OVARIAN FUNCTION IN THE CACHECTIC RESPONSE AND IL-6 DURING CACHEXIA PROGRESSION

Olivia Reszczynski  
Dutch Fork High School

Cancer cachexia is a devastating condition involving the loss of muscle and fat, as well as biochemical abnormalities due to chronic underlying disease such as cancer. IL-6, a pro-inflammatory cytokine, has proven to be a major driver of cancer cachexia in mouse models and humans. Studies regarding cachexia and IL-6 have largely been conducted in male mice; however, sex differences in cachexia development and IL-6 response using the ApcMin/+ mouse have been detected. The ApcMin/+ mouse has a nonsense mutation in the Apc gene, predisposing it for colon cancer and cachexia. Though proven that hypogonadism is a factor in cachexia in males, research has not been conducted to determine the effect of ovarian function on IL-6 response in the female. The purpose of this study is to determine the effect of ovarian function in the cachectic response and IL-6 during cachexia progression. The hypothesis of this study is that loss of ovarian function will aggravate effects of IL-6 and increase pro-inflammatory macrophages during cachexia cancer progression in the ApcMin/+ mouse. Female ApcMin/+ mice were bred and maintained at USC. Mice were subjected to ovariectomy, systemic overexpression of IL-6, or both procedures. Immunohistochemical analysis within the tibialis anterior muscle was performed to determine fiber cross-sectional area, fiber type analysis, and M1/M2 macrophage populations. Preliminary analysis has validated quantification of cross-sectional area. Future analysis will determine the effects of ovarian function and IL-6 expression on fiber type shifts and macrophage infiltration during the progression of cancer cachexia in female ApcMin/+ mice.

## LAND USE AND SURROUNDING STREAMS: COMPARING FORESTED, PASTORAL, AND AGRICULTURAL LAND COVERS TO DETERMINE POSSIBLE HUMAN IMPACT IN THE SAVANNAH, SALUDE, AND ENOREE RIVER BASINS

Lindsey Richardson  
Governor's School for Science and Mathematics

Stream ecosystems are influenced by the land cover around their watersheds. However, relatively few studies have examined the impact of rural land covers, such as pasture or agriculture (row crops), on streams in the Southeastern Piedmont. In this study, land cover, channel geomorphology, and fish abundance and diversity were compared across rural streams in the Savannah, Saluda, and Enoree River Basin Watersheds. It was expected that streams in watersheds with greater pasture and/or agricultural cover would have increased channel incision, lower fish diversity, greater homogenization of fish species, and lower diversity of size classes. Preliminary results demonstrate that the sites draining agriculturally were significantly more incised, had a greater width-depth ratio, and had lower diversity of size classes than the other sites. However, no other significant differences existed in biological parameters between sites with and without surrounding agriculture. From the results, it can be seen that agricultural land covers negatively affect stream quality, which shows that human influence leads to a degradation of South Carolina's watersheds.

## OXIDATIONS FACILITATED BY BIS-UREA BENZOPHENONE MACROCYCLES

William Rivers  
Governor's School for Science and Mathematics

Common industrial oxidants produce stoichiometric amounts of waste and, occasionally, dangerous byproducts. Singlet oxygen is a more environmentally friendly oxidant but produces a variety of products, so it is not used in industry. Benzophenone macrocycles employ singlet oxygen to oxidize guest molecules that are inside them, so certain products are favored due to the limited space. Also, some singlet oxygen reactions do not usually occur, such as the oxidation of gamma-butyrolactone. To synthesize the macrocycle, bromine groups were added to each of the methyl groups in 4, 4-dimethylbenzophenone and reacted with protected urea to form the protected macrocycle. The urea molecules were then removed to form the final macrocycle, which was purified through recrystallization. Thermogravimetric Analysis (TGA) was used to calculate the loading ratio of the guest molecule to macrocycle, with dimethyl sulfoxide (DMSO) and gamma-butyrolactone as guests. Benzophenone macrocycles were used to oxidize gamma-butyrolactone with ethyl acetate or tetrahydrofuran (THF) as solvents. Proton-Nuclear Magnetic Resonance (H1-NMR) revealed that the gamma-butyrolactone was oxidized using ethyl acetate. The oxidized compound was not the desired product and further analysis of this compound is needed to verify its structure. In future experiments, the concentration of the gamma-butyrolactone should be lowered and the irradiation time should be lengthened.

## THE EFFECT OF DIFFERENT NUTRIENTS LEVELS IN SOIL ON THE OXYGEN PRODUCTION RATE OF WISCONSIN FAST PLANTS (BRASSICA RAPA)

Isabelle Robinson and Carter Smith  
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This study investigated the effect of nutrients levels in soils, and their effect on the oxygenation rate of the Wisconsin Fast Plants grown in the different soils. The independent variable in this experiment is the five different types of soil used, and the dependent variable is the oxygen level produced by the Wisconsin Fast Plants. This study is beneficial, because while growing plants one can use the soil that allows plants to produce the most oxygen to help the environment. The motivation for this

project came from hearing a USC Honor student talk about her work on a similar topic. The problem that was being studied was whether the nutrients levels in soil, in particular nitrogen, affect the oxygenation rate of the plants grown in them. In order to make progress in discovering the answer to our problem, seeds were planted in five different soils: Heathwood's greenhouse soil, Black Kow soil, Miracle-Gro Garden soil, Miracle-Gro Potting Mix, and Scotts' Topsoil. The oxygenation rate of the plants was measured every five days, for three trials. The hypothesis was, if plants are grown in soil with a higher nitrogen content, then they will produce more oxygen. The null hypothesis was that the oxygenation rate of the plants would not vary based on the soil they were grown in, and this was accepted. The results indicated that the soil with the highest nitrogen percentage did not produced the highest oxygenation rate.

#### ECONOMICS OF THE EYE: DEVELOPING AN ALTERNATIVE TO TRADITIONAL PACKAGING EYE TRACKING STUDIES

Logan Robinson  
Governor's School for Science and Mathematics

Clemson University is one of three universities in the United States that has a Packaging Science program, and the only one which performs eye tracking studies to evaluate packaging within the department. Eye tracking is a very useful tool; however it can be very expensive to perform a study. Even after purchasing the necessary equipment, including IR markers, glasses, and software, which can easily run into the tens of thousands of dollars, the test products often vary from study to study, meaning that every study incurs a materials cost. (A single section of shelving fully stocked with groceries can easily cost hundreds of dollars.) Partially due to this cost, relatively few groups perform marketing focused eye tracking studies. This research attempted to mitigate the costs of conducting a study while maintaining quality and accuracy in results. Instead of purchasing physical items to stock the shelves for a study, researchers used computer-generated items printed onto paperboard. Researchers were able to conduct a multi-faceted study using this method, which included comparisons of dog food brands and favorite BBQ sauces. Using the printed dog food shelving, researchers were able to determine which brand attracted the most attention. Researchers then compared data from the three-dimensional areas tested and were able to conclude that the printing method yielded comparable and reliable results.

#### THE EFFECT OF DIFFERING CONTACT METHODS ON THE SPREAD OF GERMS IN CLASSROOM ENVIRONMENTS

Amelia Robinson-Brown and Alyce Petit  
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This experiment tested to see if there is a difference between the spread of germs in human to human contact versus object to human contact. This experiment was done in two early childhood classrooms with a completely safe germ simulator. There have been no other studies testing this and very few that are similar. The few previous studies that were located have failed to address a difference in contact type. Conducted by directly applying the simulator to either a human or object, this study took one hour to perform. The main impact of this experiment is helping prevent the transmission of infectious, and deadly, diseases. It was hypothesized that if simulated germs are placed on a human subject, then the simulated germs would spread more than if placed on an inanimate object. The data collected in the experiment did support the hypothesis because the infection rate of the second trial was 2% higher than that of the first.

#### COMPARING STATE TAX INCENTIVES FOR AEROSPACE MANUFACTURING CLUSTER GROWTH

Gavin Roser  
Governor's School for Science and Mathematics

South Carolina has felt the ripple effects of The Boeing Company's recently constructed Charleston plant in the form of new jobs, higher average income, and improved infrastructure. Boeing's multi-million dollar investment in the state has increased the flow of suppliers into South Carolina, while also expanding the correlated support chain. This sequence of compounding growth is described in the University of South Carolina's Economic Impact Study as the influx of aerospace-related companies attributed to Boeing. Building on the findings of the Economic Impact Study, legislative reform can maximize South Carolina's cluster growth with readily available tax incentives and public financing. This study aims to evaluate the calculated quality of in-state tax incentives and perform a direct comparison of similar incentives existent in competitor aerospace industry states. In a joint effort of the South Carolina Aerospace Initiative and the South Carolina Department of Commerce, the comparison of competitor aerospace states revealed a deficiency of tax incentives in South Carolina and pinpointed the most common aerospace-specific tax incentives.

#### USING A DATA WAREHOUSE TO ANALYZE INFORMATION ABOUT INSURANCE CLAIMS AND POLICIES

Jeff Rubillo  
Governor's School for Science and Mathematics

Big companies involving insurance, social media, and retail amass large amounts of data from day to day. Every time a user enters information about their profile on social media or about the order they would like to place, these data must go somewhere to be processed. These are stored in large databases, or data warehouses, that hold information about each person or entry. With these data, it is possible to generate significant reports which would benefit the company and assist in making informed business decisions. On the front end, most people are not aware of the potential these data possess. The back end



process of examining data can significantly impact profits and reduce financial risks. The goal of this experiment was to discover if management reports could be generated from Seibel's insurance data warehouse, which was accomplished after an analysis of their warehouses.

#### HETEROAGGREGATION OF CITRATE-COATED SILVER NANOPARTICLES WITH POLYSTYRENE AND SILICA PARTICLES

Jack Runge

Governor's School for Science and Mathematics

Silver nanoparticles (AgNPs) have many different useful properties and are incorporated into many industrial products. However, once these particles enter the environment after use, they pose a threat to the safety of many organisms. Overall though, not much is known about these particles and how they interact with their environment. There is especially a lack of research as to how these particles aggregate with different particles. Investigating the stability of AgNPs in the presence of other colloids will give a better understanding of the mobility and toxicity of the particles in the environment. The zeta potentials of isolated AgNPs, AgNPs in the presence of polystyrene, and AgNPs in the presence of silica were taken via electrophoretic light scattering and compared with both kinetics and spectra data from UV-Vis spectroscopy. Both the zeta potentials and the data taken from UV-Vis spectroscopy indicated that the AgNPs were the most stable in the presence of polystyrene particles, less stable isolated, and least stable in the presence of silica particles. The average critical coagulation concentration (CCC) of the AgNPs in the presence of the polystyrene particles, isolated AgNPs, and AgNPs in the presence of the silica particles were  $170.9 \pm 4.7$ ,  $149.7 \pm 2.0$ , and  $81.9 \pm 9.3$  mM NaNO<sub>3</sub>, respectively. Further research using transmission electron microscopy will determine the exact interactions between these particles.

#### MEXICANIN I INHIBITS FIBROCYTE GENERATION FROM MOUSE SPLENOCYTES ACCOMPANIED BY DOWN REGULATION OF KLF4

Maya Rush

Governor's School for Science and Mathematics

Tumor metastasis is a multiple step process which affects all cancer patients. Previous research in Dr. Walden Ai's lab at the University of South Carolina's School of Medicine showed that deficiency of kruppel-like factor 4 (KLF4), a transcription factor, reduced tumor lung metastasis and was associated with decreased fibrocyte generation from splenocytes. Given that there is a strong association between fibrocyte levels and tumor metastasis, it was hypothesized that the inhibition of KLF4 would reduce fibrocyte generation leading to decreased tumor metastasis. Mexicanin I and C188-9 were used to assess the inhibitory effect on KLF4 and fibrocyte generation from mouse splenocytes. The expression levels of KLF4 downstream targets were examined by real-time PCR and Western blotting. Both Mexicanin I and C188-9 inhibited KLF4 expression and fibrocyte generation, but Mexicanin I was more efficient. Microscopic examination revealed that the fibrocyte generation was far less expressed when treated with 0.1  $\mu$ L of Mexicanin I, compared to 2  $\mu$ L of C188-9. When the splenocytes were treated with 0.1  $\mu$ M of Mexicanin I there was one fibrocyte cell. After being treated with 2  $\mu$ M of the C188-9 there was only 1 spindle like cell left. Real time PCR revealed that the expression of fibroblast specific protein-1 (FSP-1) and CXCR4 was notably reduced with the treatment of Mexicanin I. The KLF4 inhibitor Mexicanin I inhibits fibrocyte generation from murine splenocytes.

#### EXAMINATION OF THE FLOW OF ACETAMINOPHEN

Farris Sabir

Southside High School

A substance's flow is determined by the characteristics of the substance in motion and the material through which it travels. Overall, the conditions of certain parts of the human body create a diverse environment for the flow of pharmaceutical substances, from the distance at which the body part is located with respect to the ground and the pressure of the fluids through which the flow must occur through. In fact, according to Bernoulli's equation, flow velocity shares a directly proportional relationship with pressure and height. This experiment, which utilizes acetaminophen in particular, simulates this environment by allowing velocity and height to be manipulated to measure the diffusion of acetaminophen. Although we are not measuring pressure exactly, this variable affects the change in the concentration of the substance as to most effectively simulate the dispersal of acetaminophen across a digestive tract. We theorize that velocity will be directly associated with the rate of diffusion of acetaminophen to a certain extent, as there is a distinct shift between laminar and turbulent flow with a certain change in velocity. By changing the orientation of height of flow, we may also create this turbulent flow and therefore, disrupt the diffusion of the substance.

#### THE EFFICACY OF HOME REMEDIES, CITRIC ACID AND TEA TREE OIL, ON THE INHIBITION OF STAPHYLOCOCCUS EPIDERMIDIS

McKenna Savoca

Heathwood Hall Episcopal School

Millions upon millions of people are infected with a skin disease called acne vulgaris, and one of the major bacterias stemming from this disease is called Staphylococcus epidermidis. In this experiment, the efficacy of two different home remedies, lemon

juice and tea tree oil, is tested on the bacteria *Staphylococcus epidermidis*. It is hypothesized that the growth of *S. epidermidis* will be inhibited by a small degree by the lemon juice and by a larger degree by the tea tree Oil. The null hypothesis is that the citric acid and tea tree oil will have no affect on the inhibition of *S. epidermidis*. The inhibition of the bacteria is the dependent variable, while the independent variables are 100% lemon juice, 50% lemon juice, 100% tea tree oil, and water. After letting the *S. epidermidis* grow for several days, the bacteria is transferred onto 9 plates. In order to measure inhibition, the agar disc diffusion method is used on all 9 plates, and each independent variable has 3 plates each. The zones of inhibition around each disc are measured to the nearest millimeter, and the data was then imported into an Excel spreadsheet where statistical analysis was conducted. Data suggests that tea tree oil is statistically significant as a solution that can effectively inhibit the growth of *S. epidermidis* because the P-value is significantly greater than 0.05 and the F is greater than the F critical . The data collected for 50% lemon juice and 100% lemon juice suggests that both have a minimal effect on the inhibition of *S. epidermidis* because the P-value was greater than 0.05. Therefore, the hypothesis, the growth of *S. epidermidis* will be inhibited by a small degree by the 50% lemon juice and 100% lemon juice and by a larger degree by the tea tree oil, failed to be rejected.

#### FACET ENGINEERING ON THE TIP OF GOLD NANORODS

Zachary Scott

Governor's School for Science and Mathematics

Research was conducted on the development of different shapes and sizes of gold nanorods, a developing research field with a wide range of applications. It is not understood how some shapes of gold nanorods form, so this research focused on determining more about the mechanism of formation. The seed mediated growth method was used to make various nanorods of different shapes. Adding different amounts of gold seed allowed for different aspect ratios to be found, proving that there can be control over sizes of gold nanorods. Factors such as Cu(NO<sub>3</sub>)<sub>2</sub> concentration allowed the different shapes to form. The next step in this research is finding which nanorods are needed for different applications.

#### THE EFFECT OF XYLEM FILTERS ON REDUCING WATER CONTAMINATION

Jenna Seubarran

Greenville Technical Charter High School

Water pollution is a major issue in society today that can come from Point and Nonpoint Sources. This experiment contains tests to reduce pollution including coliform bacteria. To complete this experiment coliform, pH, phosphate and nitrates tests were taken from the middle, upstream, and upstream underneath the bridge at the Reedy River in Downtown Greenville. After these tests were taken a xylem filter was built to filter and clean the water. Once the tests with the filter were conducted the results for the coliform bacteria came back negative for the first test. When referring back to notes about the xylem filter, thoughts were constructed to why the results came back negative. The xylem tubing grew a fungus and that fungus was dropped into the clean water. In conclusion, the xylem filter has not fulfilled the original hypothesis that the xylem filter will cleanse dirty water.

#### EDITING FOR A BRIGHTER FUTURE

Sarah Sharpton

Chapin High School

This project is a study on the effects of a review of an essay by a higher-level English student in comparison to the traditional peer review used in classrooms. It measured the effects in terms of students' confidence in their essay. It was designed to determine which method is most effective in order to improve the writing skills and confidence of students. Two Honors English 3 classes at Chapin High School were partnered with to conduct the study. Each class wrote an essay as an assignment, and the entire class peer edited the essays except for five randomly selected students from each class. Those who were selected worked with an AP English student instead. The students who peer edited took a survey on how peer editing affected their confidence in their writing, and the ten experimental students took a pre- and post-survey on how the different style of editing affected their confidence. According to the post-survey, the experimental students experienced an average of a 23% increase in confidence level. It was also interesting to note that of students whose essays were peer edited, the largest group felt that peer editing mostly helped with spelling and mechanics, while the largest group of experimental students felt that editing with an AP student addressed their wording and phrasing issues.

#### ALCOHOLISM SKIPPING GENERATIONS

Cameron Shull

Chapin High School

The hypothesis is that people will be more likely to have an alcohol dependency if someone in their family does also and that it will skip generations more often than not. This research was conducted by creating a survey asking if the survey taker was an alcoholic and who in their family had/is an alcoholic, the survey was then put on social media. The data that was collected went against the hypothesis in that the results were that it tended to not skip generations when it did run in the family. Some results were not able to be used due to the person who took it being underage. Many results were unable to be used because the alcoholism didn't run in the survey taker's family. For the future of the project, more results are going to be obtained.

Statistics have been done that prove my hypothesis wrong. In the results where the results weren't included for where alcoholism didn't run in the family, it skipped generations 22.7% while it didn't skip 77.3%. For the survey results, 48.8% of the survey takers didn't have alcoholism running in their family at all.

#### DOES HIGH SCHOOL STRESS PROGRESS

Alexander Siegfried  
Chapin High School

This project is about the differences in stress seen in the different grade levels and genders in the high school setting. My hypothesis is that the ability to handle stress will decline through the grade levels in high school. The initial idea was to compare the differences in handling stress between the two genders but data gathered through the survey, suggested that there is a more significant change when moving through the grade levels than the two genders. This project entered a second phase to further explore the acquired data.

Data was collected through a National Health Institution survey that finds a hardiness score based on the questions. The survey was given to multiple grade levels and genders to produce a mean hardiness score for each gender in each grade level. It was observed that the hardiness went down through the grade levels and that females generally had a higher hardiness score than males. The difference between males and females was different at a linear rate while it was exponential for grade level.

This data shows that the initial hypothesis was correct and females do have a better ability of handling stress. This also supports previous research that male brains are more hardwired for one task objectives like survival while female brains are more hardwired towards multitasking like caring for a child. As stated by Dr. Nussbaum in my 2014 interview.

#### LONG-TERM MONITORING OF HURRICANE HUGO'S EFFECTS ON SANTEE EXPERIMENTAL FOREST, NEAR CHARLESTON, SC

Olivia Smithson  
Governor's School for Science and Mathematics

In September of 1989, Hurricane Hugo struck the South Carolina coast, causing damage to cypress forests due to winds and tidal surges. In order to better prepare for future natural disasters, a study was created to observe the forests' compositions for 20 years after Hugo. Within the Hurricane Hugo study, four sites were monitored for their long-term change of regeneration after Hurricane Hugo. Of these four, three were studied for understory regeneration: Beidler forest, in Harleyville, SC; Hobcaw forest, in Georgetown, SC; and the Santee Experimental Forest in the Francis Marion National Forest, located in Huger, SC. The number of seedlings and saplings were recorded every three years in all sites. Santee was the closest site to the storm and had 47-70 percent of all hardwood trees damaged. In 1994, bald cypress and water tupelo were the dominant species in the swamp overstory. The invasive species, Chinese tallow, was present in the entire twenty years of the study. Bald cypress seedlings and saplings decreased by 2013. From 2000 to 2013, the green ash seedling count almost reached 0. Chinese tallow small saplings showed little variation over the years. Twenty five years after Hugo, results show that the Santee cypress swamp did not return to pre-hurricane composition. In order to know if the cypress swamp will ever return to its original composition, the forest must be studied further. This data will allow for better preparation before another storm and provide a possible description of the forests' compositions for the years after.

#### SAFE AND SIMPLE: DESIGNING MINIATURE COMPUTERIZED TOMOGRAPHY SCANNERS FOR MULTIPURPOSE SCIENTIFIC TESTING WITHIN RESEARCH LABORATORIES AND CLASSROOMS

Bethany Spencer  
Governor's School for Science and Mathematics

Computerized Tomography (CT) scanners are medical imaging devices that utilize ionizing radiation to view inside the human body and generate 3D scans. These devices are large, expensive, and have a high risk of radiation exposure. As a result, using one of these for the purpose of teaching and understanding the operation of fundamental imaging is complicated, cost prohibitive, and dangerous. We were tasked to create a simple and a more viable option. Through an engineering project, our lab worked to create and implement a miniature, white light scanner. The purpose of the overall project was to use simple, everyday materials such as metal duct working, Matlab, and SolidWorks to design, build and test a miniature and safer, classroom version of the normal medical CT scanners. This new scanner could then be used in future projects such as designing multi-purpose scanners that could potentially do varying types of scans. The first major part of this multistep process was designing the scanner. In the large spectrum of this project, this particular project focused just on design. A computer aided design program, SolidWorks, was used to construct and render the individual parts of the scanner, from base to camera system. The program was then used to test the structures before the building process began. The main purpose of this portion of the endeavor minimized mistakes and maintained cost effectiveness and time efficiency. The result was a completed scanner design that was ready to be used in future projects.

## DYNAMICS OF A SINGLE PARTICLE FALLING THROUGH A FUNNEL: AN ANALYSIS OF THE EFFECTS OF FRICTION ON AVERAGE TRAJECTORY DURATION

Jay Sridharan

Governor's School for Science and Mathematics

The objective of this research was to investigate the phenomena simulated by Zhang et. al. concerning a single frictional, inelastic sphere falling through a funnel. Zhang asserts that for funnel walls angled greater than 45 degrees above the horizontal, certain phenomena – such as the trend of average duration increasing as the angle increases – become extremely evident. These trends are important considerations when one is using a funnel system in order to accomplish a task such as limiting exit velocity or minimizing duration of time spent within the funnel. After plotting the average duration of a single acrylic sphere falling at various locations along the length of the funnel wall, we concluded that Zhang's assertions do not hold true for every case.

## DYNAMIC REGULATION OF BIODIESEL PRODUCING ESCRECHIA COLI BIOSYNTHETIC PATHWAYS

Thomas Stanton

Governor's School for Science and Mathematics

FAEE (Fatty Acid Ethyl Ester) is a biodiesel valued as an alternative to the depleting fossil fuel supply. This is due to its high energy density, low water solubility, and low toxicity to production hosts like *E. coli*. The engineered W strain of *E. coli* has been developed to contain biosynthetic pathways that produce FAEE from fermentable sugars. The W strain contains a dynamically regulated FAEE pathway with three distinct modules. Accumulation of the key intermediate ethanol in *E. coli* inhibits cell growth, and thus, FAEE production. Since ethanol in module B is produced at a much faster rate than fatty acyl-CoA (in module A), FAEE yields (in module C) can be improved by controlling ethanol production to match fatty acyl-CoA production. Due to the dynamic pathways of the W strain, induction by L-arabinose, a 5-carbon sugar, increases FAEE production. To test the sensitivity of L-arabinose induction in increasing FAEE production, we added various concentrations of up to 0.2% L-arabinose to W cell cultures and then used gas chromatography to analyze the products. We discovered that, at the tested concentrations, L-arabinose induction is not effective in maximizing FAEE yield. Future projects include manipulation of specific genes in module B. Less efficient enzymes in that pathway would slow ethanol production and increase FAEE production.

## BUDGETING THE DEFENSE EFFICIENTLY: EFFECT OF NUTRIENT DEFICIENCY AND INSECT HERBIVORY ON TANNIN CONCENTRATIONS IN JAPANESE KNOTWEED

David Strickland

Governor's School for Science and Mathematics

Tannins are polymers of phenolic molecules produced by plants that can act as defense compounds by creating an unpalatable sensation and causing somatic damage to guts of insect herbivores. This study focused on delineating the ability of plants to produce tannins when faced with nutrient-sufficient vs nutrient-deficient environment; also we were interested in assessing the influence of herbivory on the tannin concentration within the above nutrient treatments. We analyzed the concentration of tannins in leaf tissues of Japanese knotweed (*Fallopia japonica*) that were grown under nitrogen deficient conditions (sugar added) and nitrogen sufficient condition (fertilizer added) from 2009 to 2013. Green leaves with (10-20% loss of leaf area) and without herbivore damage were collected during June 2014, from plants grown at Musser Fruit Research Farm, Seneca, SC, that were exposed to nutrient treatments. Total tannin concentration did not vary with either nutrient treatment or herbivory. Despite similar total tannin content, the plants grown under nitrogen deficiency had a higher concentration of extractable tannins. The leaves with herbivore-damage had marginally higher fiber-bound tannins. We conclude that under lower soil nutrient levels knotweed produces more extractable tannins to protect the already acquired biomass, and mobility of extractable tannins within plants could enhance the defense capability of knotweed.

## CREATING A MOBILE APPLICATION FOR COLLEGE STUDENTS VIA GAMIFICATION

Crystal Sylvester

Governor's School for Science and Mathematics

Colleges and universities are constantly creating new opportunities and expanding existing ones for students so that they may fully utilize their undergraduate education experience. However, these opportunities are often lost on college students because they are not communicated effectively. For example, most schools just list these opportunities at orientation sessions, soon to be forgotten in a wave of academic preparation, dorm decorating, and last-minute tasks. One promising approach consists of a mobile application (app) that reminds students to take advantage of opportunities, such as visiting the Career Center to find internships and exploring the breadth of online courses. Although this method has potential, such an app would need to be engaging to college students; otherwise, it would see little use. A recent trend in app development is gameification, which is defined as the concept of applying game mechanics and game design techniques to engage and motivate people to achieve their goals. The project utilized gameification to make the app as interesting as possible; it was based off of the popular board game Chutes and Ladders. Additionally, the app was coded using the Massachusetts Institute of Technology's App Inventor 2. By the end of the six-week program, the app, called the Academic Pathway of the College of Charleston, was fully functioning on the Android platform.

## COOKING CLASS FOR CHILDREN WITH AUTISM TO IMPROVE FRACTION RELATED PERFORMANCE

Abigail Tempel and Samantha McCall  
Chapin High School

Autism spectrum disorder refers to a group of complex disorders of brain development characterized by difficulties in social interaction and communication, with many individuals also displaying repetitive behaviors. Scientific studies have demonstrated that early intensive behavioral intervention improves learning, communication and social skills in young children with Autism.

The purpose of this project was to determine if children with Autism would learn fraction skills better with hands on learning rather than in a regular classroom environment. A group of three students (grades 3rd and 4th) were taught fraction skills through cooking, measuring and reading fractions. They attended five, one hour, cooking classes, with all classes including use of fractions in following recipes and measuring ingredients.

To document changes in their abilities to use fractions appropriately, students were given multiple pre-tests and a post-test. Throughout the classes, multiple fraction evaluations were completed by the students. There was an increase in scores for Students A and B, while Student C stayed the same. A matched pairs t-test was completed for both a pre/post-test and an advanced pre/post-test. P-values were 0.33 and 0.50 respectively indicating that this study was not statistically significant.

## THE EFFECT OF RUNOFF ON PLANT GROWTH

Paris Tomlin and Lydia Comer  
Heathwood Hall Episcopal School

This project researches a deeper look into how runoff affects plant growth. The researchers have tested how different types of runoff can hinder the height of a plant, while comparing it to the same type of plant that contains no runoff. The researchers knew that this topic has been studied before, but found it interesting and intriguing to do their own research, and find their own results. The researchers wanted to find ways to help the environment and plants around them. The project was tested by growing plants in a suitable environment and measuring each plant's heights. The researchers were looking for a way to prove how much harm the world today has affected nature all around our community.

## THE AMOUNT OF ENERGY OUTPUT FROM A FUNGI-BASED MICROBIAL FUEL CELL (MFC) UTILIZING GRAPHENE ELECTRODES

Edoardo Tremolada  
Spring Valley High School

Researchers today are trying to find more environmentally friendly solutions for the situation we are in today with the emission of greenhouse gasses in our atmosphere. One of those is a microbial fuel cell (MFC), which creates energy from metabolic processes of usually a bacteria. However, most MFC's are not as efficient or powerful to be implemented in everyday uses. The purpose of this experiment was to see if changing the microorganism used to yeast with graphene electrodes instead of a bacteria would provide a sufficient amount of voltage. Also to be certain the electrodes were not the ones only providing more power, a test was run with regular aluminium electrodes. A control group with *E. coli* as the microorganism was used for comparison. The MFC was recorded for every 30 minutes for 15 hours each. The control did not create sufficient voltage;  $r(31) = 0$ ,  $p > 0.05$ , while the MFC with yeast with regular and graphene electrodes did provide significant voltage;  $r(31) = 0.4220$ ,  $p < 0.05$  and  $r(31) = 0.4600$ ,  $p < 0.05$ , respectively. These tests were analyzed with a Sign test, at the  $\alpha = 0.05$  level.

## THE DEVELOPMENT OF A LID FOR A NOSEY CUP TO IMPROVE EFFICIENCY

Connor G. Walpole and Jason W. Shaffer  
The Center for Advanced Technical Studies

The nosey cup is limited in its effectiveness to prevent aspiration and rehabilitate dysphagia due to spillage and loss of contents. By developing a lid it will minimize spillage, maintain functionality, improve efficiency, and optimize effectiveness. Due to the necessity of a lid for a nosey cup, several models will be constructed through engineering software and fabricated by means of a 3D printer. The designs will be tested and the most effective model will serve as the final product. After collecting the data and analyzing it, there will be modifications respectively. By developing a lid for a nosey cup, the quality of life for any individual that may benefit from the utilization of a nosey cup will be enhanced, dignity will be restored, and it will consequently aid in the rehabilitation process.

## SITE-SPECIFIC MUTAGENESIS OF RAD51 IN ESCHERICHIA COLI

Zachary Walsh  
Governor's School for Science and Mathematics

RAD51 is a gene whose protein is vital in homologous recombination, where it acts as a single-stranded "cage" for DNA to attach to and copy a template strand in order to repair double-stranded breaks due to harmful exposure to UV light. RAD51 is also a proto-oncogene which is over expressed in cancer cells. The absence of RAD51 leads immediately to cell death.

Investigating RAD51 would be extremely beneficial to both biochemical research and cancer research. In spite of its importance in cell repair systems, very little is known about the regulation of RAD51. This project aimed to elucidate the mechanisms which control RAD51 and to determine suitable vessel bacteria for the RAD51 expression by mutating the RAD51 gene in *E. coli*. Our research determined that the *E. coli* strain Db3.1 was ideal for the plasmid DNA. Mutating RAD51 in order to clarify its pathways is the next step in this investigation.

#### POLYMERS CONTAINING HIGHLY POLARIZABLE CONJUGATED SIDE CHAINS AS HIGH-PERFORMANCE ALL-ORGANIC NANODIELECTRIC CAPACITORS

Albert Wang  
Dutch Fork High School

Organic Nanodielectric Polymer Capacitors tainted with gold plating were prepared in this experiment using the hot press method to determine the effectiveness of their applications in energy storage by analyzing their energy density and D-E Loop. The results procured from this study demonstrated the feasibility of the organic copolymer, PTTHEMA-co-PBA capacitor and its possible applications for energy storage in comparison to the homopolymer, PTTHEMA. The copolymer was capable of reaching a field of about 120 MV/m, whereas; the homopolymer was only capable of reaching about 30 MV/m. The significant difference in their field strengths demonstrates the success of the copolymer transfer agent PBA. Moreover, charged and discharged electric energy densities of both the homopolymer and copolymer were examined by electric displacement-electric field (D-E) hysteresis loop measurements on pressed films. Similar to commercialized inorganic ceramic polymers such as biaxial-oriented polypropylene (BOPP), both polymers displayed strong linear correlation while demonstrating narrow D-E loops suggesting low dielectric loss. Furthermore, the copolymer capacitor shows better mechanical properties than the homopolymer and produced a freestanding film. Specifically, the apparent success of the copolymer over the homopolymer will be concluded, with the aim of developing novel, successful organic polymer capacitors that display low dielectric loss with high breakdown strengths. In essence, the outcome of this project determined the effectiveness of the organic copolymer capacitor as seen by comparing to the homopolymer base—with the hopes of finding an alternative and innovative method of encapsulating and accumulating energy at an economic, environmental, and production decrement.

#### THE IMPACT OF TEMPERATURE ON THE EFFICIENCY OF A NEWTON'S CRADLE

Shuai Wang  
Heathwood Hall School

The purpose of this experiment was to find out if there is a relationship between temperature(T for short) and kinetic energy transferring by observing and calculating the efficiency of a Newton's Cradle in different T variables. The efficiency means the lost of kinetic energy divided by the initial kinetic energy, which can be calculated through the distance that the ball on the left side is lifted and the distance that the ball on the right side swings out. (Finnigan 1987) In three T settings, which are 0°C, room temperature, RT for short, which was 22.3°C, and 95°C, the ball on the left side of the Newton's cradle was lifted 13cm (initial distance, Di for short) away from the next ball. After dropped the ball, measure the distance that the right side ball swings out (final distance, Df for short) with Logger Pro. The results indicated that there is only a slight difference between Di and Df, which could be concluded that changing of T did not give an effect on the difference between Df and Di, calculated as Di-Df(AD for short). From the data collected, T does not affect the efficiency of the Newton's cradle. In conclusion, T does not affect kinetic energy.

#### THE EFFECT OF ALKALINE BATTERIES ON BRASSICA RAPA PLANTS GROWING HEIGHT

Yufei Wang  
Heathwood Hall Episcopal School

This study is researching the impact of the heavy metal or chemicals in alkaline batteries on general Brassica Rapa plant height while the plants are growing. Letting people know why humans need to recover batteries instead of throwing them away into landfills and the ground is the focus of this research. The alkaline batteries have all been cut to let the chemicals seep into soil where the Brassica rapa plants are placed. The result shows a very strong and harmful effect from the batteries to the Brassica rapa plants when the plants are growing over a certain period. For conclusion, the pollutants in the batteries made impact on the height, leaves, flowers and even its health of Brassica Rapa plants. The more batteries it has in the pot where the Brassica Rapa plants grows, the more impact it makes on the plants. Into a bigger picture, as people trying to protecting the environment, the base of protecting can be human need to stop discard alkaline batteries everywhere.

#### DEVELOPING A COMPUTER MODEL THAT PREDICTS THE OUTCOME OF CORNEAL COLLAGEN CROSSLINKING

Deidra Ward  
Academic Magnet High School

Keratoconus is a degenerative disorder of the cornea that affects 1 in 2000 people worldwide. Corneal collagen crosslinking [CXL] has been developed as a treatment option for this disorder. Many different CXL protocols exist, so the development of a model that can predict the effect a certain CXL protocol will have on the cornea is necessary. Current models of CXL do not account for oxygen, but it has been shown in various studies that oxygen is needed for CXL. To fill this gap, an oxygen-dependent model of CXL was developed. Corneas were crosslinked for 10, 20, and 30 minutes, and tensile tests were

performed to determine the Young's Modulus [YM]. The results of the tensile tests were compared to the model that was developed and used to validate it. Ultimately, it was concluded that the oxygen-dependent diffusion model that was developed was successful in modeling the CXL procedure and could be useful in determining the efficacy of different CXL protocols and optimizing the CXL procedure.

#### VARIOUS FISH SPECIES ABUNDANCES AND DIVERSITY IN RELATION TO PERCENT COVERAGE OF MACROALGAL GROWTH

Kristy Waterlander  
Governor's School for Science and Mathematics

The North Carolina coastal region represents only a small part of the South Atlantic Bight but it serves as an important independent microcosm. This region supports many different species of fish that scientists know very little about. One aim of the Marine Resources Monitoring, Assessment, and Prediction (MARMAP) program is to learn more about the fish populations and diversity in this region. The goal of this project was to study the relationship between fish populations and percent coverage of macroalgae growth. Macroalgae is the generalized term used in this project for the outcroppings of plant life on hard-bottom ocean floor. There is some evidence that areas with higher macroalgae have higher populations of fish associated with them. Using video cameras on the ocean floor, this study accurately measured and calculated the fish populations and percent coverage of algae growth. Results met expectations, in that fish populations generally increased with an increased percent coverage of algae growth. However, a surprising find was a slight decrease in overall diversity with increased percent macroalgae coverage. Further studies are necessary to better understand this surprising finding.

#### THE EFFECT OF THREE DIFFERENT COMMERCIAL FERTILIZERS ON THREE VARIOUS GRASS TYPES

Matt Watford  
Heathwood Hall Episcopal School

The purpose of this experiment is to determine how various commercial fertilizers impact and affect the growth of different grass species. The types of *Cynodon dactylon* that were used are as follows: Bermuda Grass, Rye Grass, and Smart Blend. The types of fertilizers that were used are as follows: Sta-Green Lawn Food, Sta-Green Starter Fertilizer, and Shake 'n' Feed. The hypothesis for this project is that Sta-Green Starter fertilizer will cause Rye grass to grow better than all other mixtures or control groups. The null hypothesis is that no other tested fertilizer or seed combination will impact the growth of the grass. The growth was judged by how healthy the grass looked while growing and the height of the grass. Statistical analysis was conducted after the data was collected shows that there is a statistically significant difference in the mixture of grass seed and fertilizer. The analysis disproved the hypothesis and the Smart Blend grass seed by itself grew the tallest and thickest as evidenced by the difference in the groups by seeing how the F value in the ANOVA test was much greater than the F-crit value.

#### EUKARYOTIC MICROBIAL DIVERSITY OF THE ICEMOLE; A REVOLUTIONARY EXPLORATORY ICE PROBE COMBINING MELTING AND DRILLING

Sara Watson  
Governor's School for Science and Mathematics

The IceMole is an ice probe combining melting and drilling technologies for use in environments such as Antarctica and Enceladus, a moon of Saturn. The Minimally Invasive Direct Glacial Exploration (MIDGE) project focuses on keeping the IceMole sterile in these environments so as to avoid contaminating fragile ecosystems. Last field season (approximately November to February), the IceMole conducted field tests in Antarctica. Prior to complete sterilization, the IceMole was swabbed to test for DNA. The results showed DNA, as expected. During field tests, meltwater from drilling was collected. Tests again confirmed the presence of DNA, so a clone library was constructed using Polymerase Chain Reaction (PCR) transformation and Restriction Fragment Length Polymorphism (RFLP) techniques. Sequencing results showed no bacterial contamination in either the rinses or the swabs. The rinse water contained marine and ice-specific fungi. However, the swabs showed common skin and air fungi, likely from the environment where the IceMole was originally built. Although DNA testing results after sterilization yielded nothing, future researchers will now be aware of what organisms might contaminate results and the environment if sterilization fails.

#### THE EFFECT OF PLATINUM CATALYST (MEA) LOADING (.4/.4 g/cm<sup>2</sup>) (.4/.1 g/cm<sup>2</sup>) (.1/.4 g/cm<sup>2</sup>) AT TEMPERATURES OF (70°C, 80°C, 90°C), AND RELATIVE HUMIDITIES OF (50%, 75%, 100%), ON THE POWER OF A POLYMER ELECTROLYTE MEMBRANE FUEL CELL

John Weiss  
Heathwood Hall Episcopal School

With resources and training done at the University of South Carolina, this research was completed with the intent to discover whether the power of a Polymer Electrolyte Membrane Fuel Cell (PEM) is affected by three different catalyst (MEA) loadings; each at three different temperatures, and three different relative humidity readings (RH). The procedure consisted of the assembly of the fuel cells and the running of the fuel cell testing system, which measures the current, voltage, and power. The

results were analyzed with power/current comparison graphs, as well as an Analysis of Variance (ANOVA) test for each of the nine variables.

The results showed the highest amount of power in the .4/.4 (mg/cm<sup>2</sup>) loading at 800C and 100% RH. The lowest power readings were in the .4/.1 loading. It is important to note the reaction on the hydrogen side of the MEA (anode) is significantly shorter than the reaction on the oxygen side of the MEA (cathode). This is because the kinetics of the reaction on the cathode catalyst takes twice as long as the anode side. To balance the rate of the reaction, there must be twice the loading on the cathode catalyst. Because of this, the loading of .1/.4 produced a lower power reading than the .4/.4 loading but a higher reading than the .4/.1 loading. Therefore, with a ratio of 1:2 (anode:cathode loading), the higher the MEA loading, the higher the power.

#### ANALYSIS AND RECOMMENDATIONS OF ONLINE LEARNING RESOURCES FOR TEACHERS WHO LEAD ECONOMICS AND FINANCIAL LITERARY COURSES IN K-12 SCHOOLS

Sydney White  
Governor's School for Science and Mathematics

While the economic vitality of most of the world's population depends on financial literacy and economic knowledge, these are scarce resources. Increasing financial and economic education may seem like an easy task, but a majority of teachers are uncomfortable teaching these subjects because of their lack of knowledge. This leads to a cycle of ignorance, with only a select few people exempt. Teachers are not the only pathway to financial and economic education; however, the Internet is full of useful resources. Unfortunately, suitable websites are often difficult and time consuming to locate. If teachers were given a list of useful online economic and financial literacy resources, they would be able to use them in their classroom and would be more comfortable teaching the subjects. Approximately 100 free online resources were compiled and analyzed. Then rubrics were created that evaluated resources based on their quality, content, reinforcement of concepts, aesthetics, along with other criteria. There was a rubric for each type of resource: website, YouTube channel or video website, game, or app. The resources were evaluated and average rubric scores were examined. The final resource list was created with the resources sorted into sections by type, then into subsections by grade level. The final list included a brief description of each resource along with a link and the source's type (finance- or economics-based). These resources included useful links to organizations such as Gen I Revolution and Secret Millionaires Club.

#### ANALYSIS OF ELECTRONIC CIGARETTE VAPORS FOR CARBONYLS

Hannah Wilder and Rebecca Wu  
Southside High School

With the rise in popularity of e-cigarettes or 'vaping,' especially among young people believing the practice to be harmless, more information is needed to better inform the public in their decision-making regarding the activity. In this work, we describe the analysis of electronically-produced vapors of commercially available nicotine-vaporization liquids and variable voltage vaporizers for carbonyl byproducts by liquid chromatography. Carbonyls have been collected by dinitrophenylhydrazine (DNPH) derivatization and desorption with acetonitrile. Analyses have been performed on a novel, inexpensive liquid chromatography system utilizing both UV and stop-flow Raman detection. Carbonyls have been effectively separated and detected using the novel method. The system has been chosen for its ease of use and appropriateness for an educational setting.

#### THE EFFECT OF GENDER AND GENRE ON WORD USAGE AS MEASURED BY LINGUISTIC INQUIRY AND WORD COUNT

Mary Royall Wilgis  
Heathwood Hall Episcopal School

In this experiment, the effect of gender and genre on word usage, as measured by Linguistic Inquiry and Word Count (LIWC), was observed. This information would be beneficial to society because it helps understand the intersection between gender and communication as well as how the artistic minded versus the science minded convey meaning. It was hypothesized that there will be a statistically difference in word usage in males and females, as well as in art and science categories, as measured by LIWC, in TED talks. The Null Hypothesis is that there will be no statistical difference in word usage in males and females, as well as in art and science categories, as measured by LIWC, in TED talks. This was accomplished by analyzing 100 randomly selected scripts from live TED talks. These scripts were then entered into the LIWC word analysis program where each word was compared to an online dictionary and put into one or more categories. This data was then imported into excel where statistical analysis was conducted. This statistical analysis revealed that there was no statistically significant difference between the word usage of males and females and the word usage of science and art, or any of these categories compared to the control group. This was determined because the P-Value was greater than .05 for all of the sets of data. Therefore, the null hypothesis failed to be rejected.



THE EFFECT OF RAINFALL VARIATIONS ON WATER CHEMISTRY, FISH ABUNDANCE AND DIVERSITY, AND CHANNEL GEOMORPHOLOGY IN AGRICULTURAL STREAMS WITHIN THE SALUDA AND UPPER SAVANNAH RIVER BASINS

Brandi Windham

Governor's School for Science and Mathematics

Stream water quality, biological communities, and habitat structure in agricultural areas may vary greatly depending on climatic conditions. This study addressed streams draining watersheds with active row crop land cover in the South Carolina Piedmont (Saluda and upper Savannah River basins) during two summers of varying rainfall. Specifically, this study addressed if the difference in rainfall would affect water chemistry, fish abundance and diversity, and channel geomorphology. It was expected that rainfall would affect the fish abundance and diversity along with the stream quality negatively. While most measured variables did not differ significantly between the two years with varying rainfall conditions, bankfull depth was marginally significantly greater in 2013 reflecting the higher rainfall that summer. The incision ratio was also significantly higher in 2014 compared to 2013. A significantly higher QHEI in 2014 may reflect the greater variety of runs, pools and riffles when the water levels were normal. The iron and sulfate concentrations were higher in 2013, while the chlorine and nitrate concentrations were higher in 2014. Despite greater habitat quality scores in 2014, our results suggest that total fish abundance and diversity are relatively insensitive to the variations in rainfall recorded during this period of study. Further research could address what amount of rainfall would affect the habitat quality and fish diversity significantly.

THE EFFECT OF GENETICALLY MODIFIED AND ORGANIC CORN ON THE AMOUNT OF CORN CONSUMED BY WILDLIFE

Jordan Withycombe

Heathwood Hall Episcopal School

The purpose of this project was to investigate if there is a correlation between genetically modified and organic corn feed for wild animals and the amount of corn consumed when given the choice. Genetically modified corn is when scientist change proteins at the genetic level of the seed corn. Two types of Pioneer genetically modified corn were used, one being 3371 with Round-up Ready and LibertyLink genes and another type, 33G71, that contained both of these genes as well as the a third one called the Herculex (HXRW). The third type of corn was an organic shelled corn which had not been genetically modified. Thirty cups of each type of corn was added to labeled tubs and then placed on the ground in the woods about 5 feet apart for three weeks. Also, a trail camera was set up to capture any movement by the tubs. At the end of the three weeks the corn was measured in cups and the data was collected. After 21 days, the wildlife had eaten 6 cups of Pioneer 3371 and 4 cups of Pioneer 33G71. From the organic tub, 21 cups of corn was consumed. These findings concluded that when given a choice wildlife consumed organic corn over GM corn by percent, thus, supporting the hypothesis that there would be a difference in the amount of corn consumed.

OPTIMIZING UNDERWATER TURBINES TO IMPROVE THE EFFICIENCY OF OCEAN ENERGY GENERATION

Tyler Wrenn

Center for Advanced Technical Studies

The goal of this project is to design and fabricate a more efficient underwater turbine blade to optimize ocean energy generation. This project will focus the blade design on aquatic animal fins to an existing underwater turbine device to improve efficiency. Since aquatic animals use specific distinct fin designs constantly and highly efficiently, it seems reasonable to mimic the design for turbine blades.

The goal of this study is to mimic aquatic animal fins on existing turbine blades to improve efficiency by using an Ampair UW100. For this project an underwater flow meter from PASCO was used to measure water flow rates in the test tank and a high voltage sensor from Vernier with Logger pro software was used to analyze output from the generator. Results to date indicate that a trolling motor can be used to produce various flow rates from .412-.836 m/s. At trolling motor speed 4 a speed of .412 m/s is achieved, trolling motor speed 6 a speed of .612 m/s, trolling motor speed 7 a speed of .710 m/s, trolling motor speed 8 a speed of .836 m/s is achieved. So far the maximum voltage reached was 15.208 V with a motor speed of 8. Current blade designs include a pectoral fin of a humpback whale, tuna fish and sail fish and the dorsal fin of a dolphin. The next phase of this project has involved 3D printing of turbine blades in various designs and the creation of a metal hub for quick blade changes between trials.

AUGMENTING A VIRTUAL PROTOTYPING ENVIRONMENT WITH A DOMAIN-SPECIFIC VISUALIZATION FRONT END

Zachary Wyman

Governor's School for Science and Mathematics

The purpose of this project was to augment an existing simulation environment with a visualization front end for smart farming scenarios. Using real world machinery as a testing environment for software that autonomously-controls equipment is neither cost effective nor safe. A simulation environment in which virtual prototypes of smart farming applications are graphically displayed would ensure safety, reliability and efficiency of the systems under development in a cost-efficient way

in order for the smart farming controller to be able to be used on a commercial level. The farming Simulator 2014 game provided the basic visualization frontend for the simulation of smart farming systems. Using Lua scripts to modify the game, an external program was able to control the tractor inside the game. XML files were used as the communication medium between the simulation framework and the game. Both the tractor within the game as well as the simulator can read and write to the XML files, allowing for two way communication and interaction. The Farming Simulator was used as testing environment to control the automated tractor in certain scenarios. The final step will be to add XML support to the smart tractor program. Then the existing smart tractor controller may be tested and its functionality may be verified safely and reliably.

#### LACTATE THRESHOLD AND VO<sub>2</sub>MAX AS PREDICTORS OF RUNNING PERFORMANCE

Allie Young

Governor's School for Science and Mathematics

Lactate threshold, maximal oxygen consumption VO<sub>2</sub>MAX, and running economy are considered the three best predictors of running performance. While in the past runners typically only have thought of VO<sub>2</sub>max when measuring their performances, recently, lactate threshold is becoming just as popular. This study sought to measure if lactate threshold data was a reliable predictor of running performance in the 1 mile and 3.1 mile (5K) times. Nineteen subjects performed a laboratory based progressive treadmill VO<sub>2</sub>max test, and a 1 and 3.1-mile race in random order over a period of three weeks. Field tests were used to gather maximal effort race performance times, which we compared with both lactate threshold data and VO<sub>2</sub>MAX data. The results show that lactate threshold correlates more closely with both the one-mile and 5K race performances that did VO<sub>2</sub>MAX data.

#### OBJECTIVE ASSESSMENT CRITERIA FOR MEDIAN BASED FILTERING OF IMPULSE NOISE CORRUPTED IMAGES

Bertrand Zhang

Academic Magnet High School

Impulse noises can seriously corrupt images. Median based filters are used to remove impulse noises. However, these filters introduce distortions while removing impulse noises. Traditionally, the capability of a median based filter in reducing impulse noises is simply measured by MSE (mean square error) or SNR (signal-to-noise ratio) based criteria. However, MSE or SNR based criteria is not very effective in filtering assessment for impulse noise corrupted images because it makes no difference between impulse and non-impulse noises, ignores spatial distributions and fails to take into account the sensitivity of human vision. Because of these shortcomings, subjective assessment has been used as supplement, which is not quantitative, inaccurate, uneconomic and inefficient. This paper proposes a set of objective criteria, named Target Criteria, as an alternative. The proposed criteria measures impulse noise reduction, image structure preservation and visual sensitivity by distinguish impulse and non-impulse noise and taking into consideration of spatial distribution and human visual sensitivity. A computer simulation study shows that the proposed criteria provide a number of advantages in objective assessment of median based filtering for impulse noise corrupted images and identifying filter's strength and weakness, which are unavailable with traditional MSE or SNR based criteria and subjective evaluation.

#### BIO-COMPATIBLE HYDROGELS FOR CONTINUOUS GLUCOSE MONITORS

Gordon Zhang

Governor's School for Science and Mathematics

The Wang Group Lab in the Chemical Engineering Department of the University of South Carolina has developed an effective continuous glucose monitoring (CGM) device utilizing a bio-compatible hydrogel to detect glucose concentration in diabetic patients. The purpose of this experiment was to synthesize a gel with high stability (that is, not prone to decomposition), high porosity (allows sugar to pass through quickly and not collect), and high selectivity (reacts only with glucose, not other sugars) for use in a commercially viable CGM. We created gels with discrete ratios of key components and tested their properties using a rheometer. Through these experiments, we found an optimized recipe that exhibits the properties of stability, porosity, and selectivity. This recipe, in combination with the Wang group's CGM, may prove useful to diabetic patients seeking a faster, more accurate, and more convenient alternative to current blood-prick monitors

**SCJAS ABSTRACTS END**

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## NOTES



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