

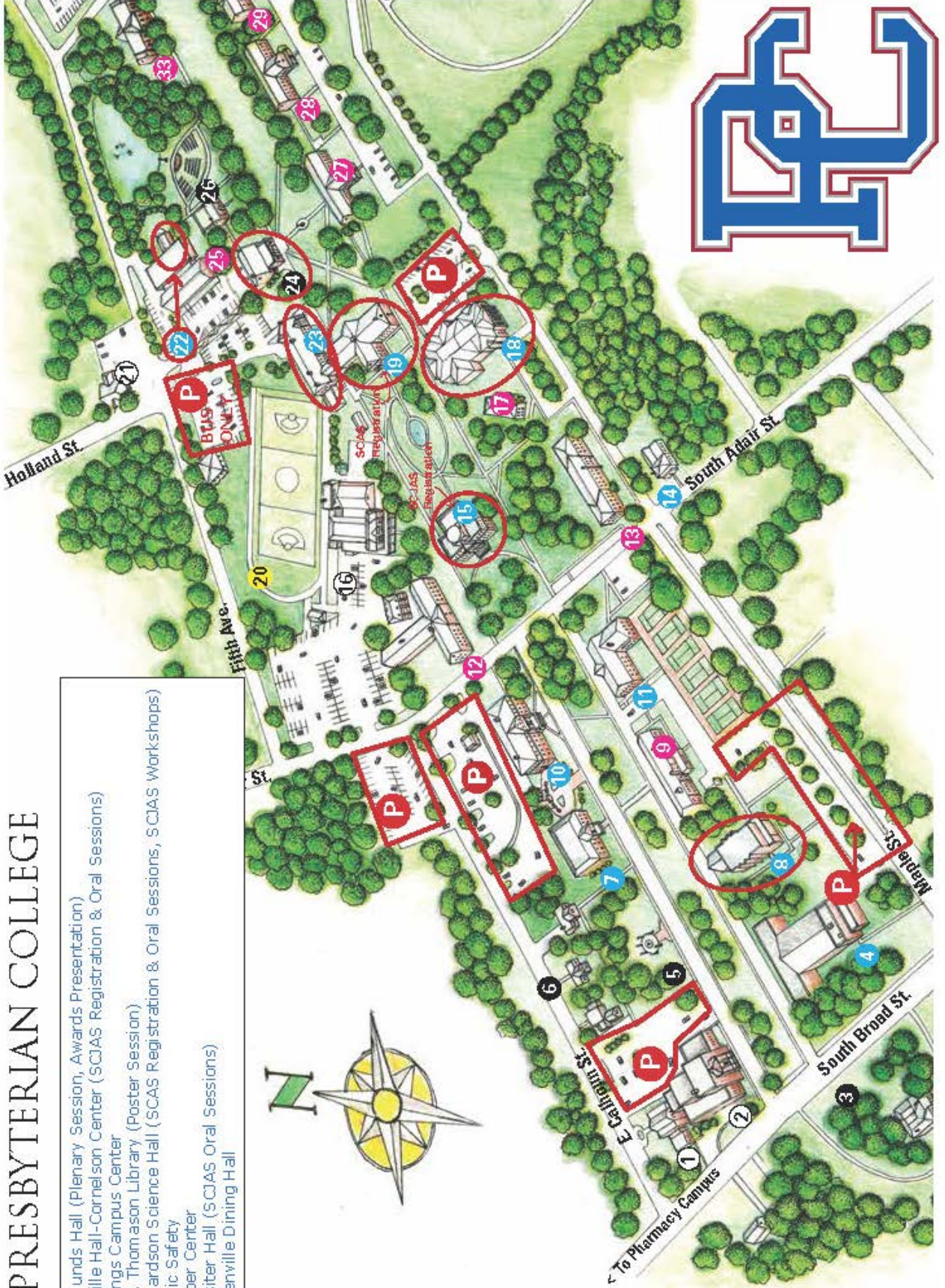


**BULLETIN**  
of the  
**South Carolina**  
**Academy of Science**  
Volume XCI  
2018  
Including the 91<sup>st</sup> Annual Meeting Program



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

*Its purposes are:*

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

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

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

**OFFICERS 2017-2018**

Kevin McWilliams, President .....	Coastal Carolina University
President-Elect ( <i>Position open</i> ).....	
Heather Evans-Anderson, Immediate Past President .....	Winthrop University
John Kaup, Past President .....	Furman University
Latha Gearheart, Program Chair.....	Presbyterian University
Vice-President ( <i>Position open</i> ) .....	
Janie Sigmon, Secretary .....	York Technical College
Edna Steele, Treasurer .....	Converse College
John Kaup, Executive Director, SCJAS.....	Furman University
Don Jordan, Director, MESAS, AAAS/NAAS Rep, .....	Univ. of South Carolina, Columbia
Michele Harmon, Electronic Journal .....	University of South Carolina, Aiken
David K. Ferris, Bulletin Editor .....	University of South Carolina, Upstate
Bob Wolff, Newsletter Editor.....	South University, Columbia
David McQuillan, SCAS Archivist.....	<i>Please see the 2018 "In Memoriam" page</i>

**COUNCIL**

Mei-Quin Chen.....	The Citadel, 2017
Bill Wabbersen.....	Savannah River Site, 2017
Caryn Outten .....	University of South Carolina Columbia, 2017
Melissa Pilgrim .....	University of South Carolina Upstate, 2017
Will Case .....	Converse College, 2018
Michelle Harmon .....	University of South Carolina, Aiken, 2018
Marlee Marsh.....	Columbia College, 2020
Eran Kilpatrick.....	University of South Carolina Salkehatchie, 2020
Jeff Steinmetz .....	Francis Marion, 2020
Julia Swygert.....	Benedict College, 2020
Randall Harris .....	Clafin University, 2020
Chad Leverette .....	University of South Carolina Aiken, 2020
Don Jordan.....	University of South Carolina Columbia, emeritus
Bill Pirkle .....	University of South Carolina Aiken, emeritus
Jim Privett .....	University of South Carolina Sumter, emeritus
David Stroup.....	Francis Marion, emeritus
Tom Reeves .....	Midlands Technical College, emeritus
David Stroup.....	Francis Marion, emeritus

**COMMITTEES**

Governor's Awards.....	Bill Pirkle & Don Jordan co-Chairs
Undergrad Research.....	Eran Kilpatrick, Pearl Fernandes
Patron Membership ( <i>open</i> ).....	
Necrology.....	Pearl Fernandez
Membership .....	Don Jordan (interim)
Publicity .....	Bob Wolff
State Science Fair Coordinator.....	Don Jordan
Website .....	Sean Shuttleworth, John Kaup, Laurie Fladd
High School Research Awards .....	John Kaup, Laurie Fladd
Teacher of the Year .....	Laurie Fladd, Pearl Fernandez

**Please visit [SCAcademySci.org](http://SCAcademySci.org) for a full listing of committee memberships**

**Publication information**

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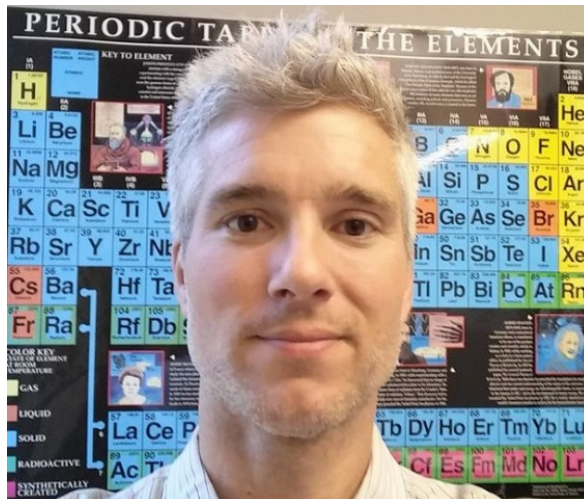
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## Welcome to the South Carolina Academy of Science 2018 Annual Meeting

Dear Students, Teachers, Scientists, and Colleagues,

I am pleased to welcome you to the 91st annual meeting of the South Carolina Academy of Science (SCAS). It is an honor to have you all at Presbyterian College, and I hope you enjoy yourselves while on campus today.

The SCAS is a state-wide, interdisciplinary science organization established in 1924. Membership is open to anyone with an interest in science and includes undergraduate and graduate students, faculty, administrators, and related professionals. The Academy also sponsors the South Carolina Junior Academy of Science (SCJAS), which includes high school students and teachers and provides an opportunity for students throughout the state to present original research at the annual meeting. Our mission is to promote the creation of scientific knowledge; to improve the quality of science education in our state; to foster the interaction of business, industry, government and education in the academic scientific community; to improve public understanding and appreciation of science; and to encourage young people to become involved in science.



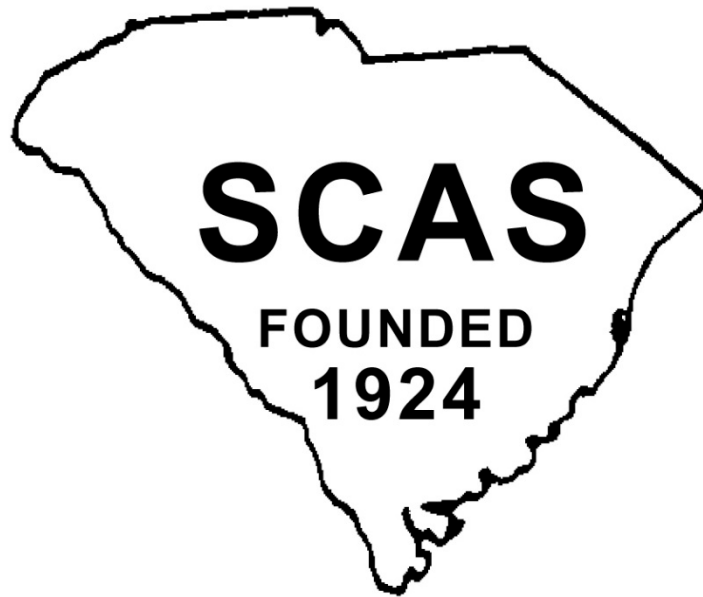
Today, nearly 500 students will be presenting their research across a multitude of STEM-related fields including Biology, Chemistry, Physics, Mathematics, Medicine, and many others. Dissemination of knowledge is paramount to the advancement of science, and we therefore hope you take the time to visit different oral sessions as well as the SCAS poster session to see the exciting and unique work our presenters will be talking about. We are also excited to have our plenary speaker, Dr. Anthony Cammarato from the Department of Medicine and Physiology at John Hopkins University, with us today. He will be talking about the “structural physiology” of cardiac and skeletal muscle as it relates to the basic mechanisms of striated muscle biology. We are also excited and honored to present the Governor’s Awards for Excellence in Scientific Research and Scientific Awareness to the 2018 recipients.

These events, like the majority of scientific research, do not occur without a significant amount of teamwork. I would like to thank all of our sponsors and donors for their generous support of this important event. I would like to thank especially Dr. Latha Gearheart and the staff and faculty at Presbyterian College, for their support and efforts behind the scenes to make this event happen. The SCAS has persisted and succeeded over its 90 years on the literal and figurative backs of volunteer work, most notably the SCAS councilors who toil throughout the year in order to deliver a successful spring meeting. A big thanks to all of you. I would like to especially thank our past presidents (Dr. Heather Evans-Anderson and Dr. John Kaup) for all their help this past year in preparing for this meeting and for securing judges for the SCAS and SCJAS sessions; Dr. David Ferris for his consummate work in preparing our online and printed programs; and Dr. Edna Steele for her thankless job as Treasurer for both the SCAS and SCJAS. Lastly, I’d like to thank all of the students, teachers, mentors, advisors, councilors, scientists, parents, and volunteers who have worked to make today’s meeting a success.

I hope you enjoy the meeting today, and I look forward to working with you all over the next few years as we continue to strengthen and expand our efforts in order to push the goals of the South Carolina Academy of Science forward.



Kevin M. McWilliams  
President, South Carolina Academy of Science  
Associate Professor of Chemistry, Coastal Carolina University





**SOUTH CAROLINA ACADEMY OF SCIENCE  
NINETY-FIRST ANNUAL MEETING  
2018 SCHEDULE OF EVENTS**

<b>7:30 AM - 10:00 AM</b>	<b>SCAS Registration</b>	Richardson Science Hall (RSH)
7:30 AM – 9:00 AM	Continental Breakfast	Richardson Science Hall (RSH)
<b>8:30 AM – 11:00 AM</b>	<b>SCAS Oral Sessions</b>	Richardson Science Hall (RSH)
	Biology: Field and Zoology	RSH 207
	Biology: Molecular / Cellular	RSH 116 (Whitelaw Auditorium)
	Chemistry / Biochemistry	RSH 315
	Math / Computer Science / Physics / Astronomy	RSH 115
	Medicine / Pharmacology / Public Health	RSH 226
<b>10:30 AM – 12:00 NOON</b>	<b>Poster Session</b>	<b>James H. Thomason Library</b>
	Posters may be set up anytime between 8 a.m. and 10 a.m. <i>(All posters must be on display by 10:00 a.m.)</i>	
<b>11:45 AM – 1:15 PM</b>	<b>Lunch</b>	<b>Greenville Dining Hall</b>
	<i>Pick up lunch ticket with name badge. BLUE tickets dine between 11:45am-12:30pm, YELLOW tickets please dine between 12:30pm-1:15pm</i>	
<b>1:30 PM– 2:45 PM</b>	<b>Plenary Session Governor’s Awards</b>	<b>Edmunds Hall</b>
<b>3:00 PM</b>	<b>Undergraduate Awards</b>	<b>Edmunds Hall</b>

<i>SCAS Judges Conference Room</i>	<i>Richardson Science Hall 303</i>
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**SOUTH CAROLINA JUNIOR ACADEMY OF SCIENCE  
2018 SCHEDULE OF EVENTS**

<b>7:30 AM - 10:00 AM</b> <i>7:30 AM – 9:00 AM</i>	<b>SCJAS Registration</b> <i>Continental Breakfast</i>	<b>Neville Hall (atrium)</b>
<b>8:30 AM – 10:30 AM</b>	<b>SCJAS Oral Session I</b> <i>See SCJAS oral session listing for details &amp; room numbers</i>	<b>Neville &amp; Lassiter Halls</b>
<b>10:30 AM – 10:45 AM</b>	<b>Break</b>	
<b>10:45 AM – 12:30 PM</b>	<b>SCJAS Oral Session II</b> <i>See SCJAS oral session listing for details &amp; room numbers</i>	<b>Neville &amp; Lassiter Halls</b>
<b>[10:30 AM – 12:00 PM]</b>	<b>SCAS Poster Session</b> <i>Junior Academy members are encouraged to visit SCAS posters</i>	<b>Library</b>
<b>12:00 PM – 1:30 PM</b>	<b>Lunch</b> <i>Ticket is in your badge holder. Be sure to have lunch during the time indicated on your ticket.</i>	<b>Greenville Dining Hall</b>
<b>1:30 PM – 2:30 PM</b>	<b>SCJAS Oral Session III</b> <i>See SCJAS oral session listing for details &amp; room numbers</i>	<b>Neville Hall</b>
<b>1:30 PM– 2:45 PM</b>	<b>Plenary Session/Governor’s Awards</b>	<b>Edmonds Hall</b>
<b>3:00 PM – 4:00 PM</b>	<b>Afternoon SCJAS Activities &amp; Workshops</b> Richardson Hall (near Neville and Lassiter Halls)	

1. **Biochemistry and Computational Biology Information Session**
2. **Evaluating Human Vital Signs**
3. **Journey to the Center of the Atom**
4. **Visual Neuroscience: how neurons in the brain generate perception**
5. **Presbyterian College Campus Tour**  
*Please see page 46 for SCJAS Workshop descriptions*

<b>4:15 PM</b>	<b>SCJAS Awards Ceremony</b>	<b>Edmonds Hall</b>
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<b>SCJAS Judges Conference Room</b>	<b>Writing Center in Neville Hall</b>
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**Plenary Session**  
**Investigating Big Problems using Little Muscles**

*Dr. Anthony Cammarato*  
*Departments of Medicine and Physiology, Johns Hopkins University*

Heart performance declines with age. Impaired protein quality control (PQC), due to reduced ubiquitin-proteasome system (UPS) activity, autophagic function, and/or chaperone-mediated protein refolding, contributes to cardiac deterioration. The transcription factor FOXO participates in regulating genes involved in PQC, senescence, and numerous other processes. We investigated the influence of heart-restricted manipulation of dFOXO expression in the rapidly aging *Drosophila melanogaster* model. Modest dFOXO overexpression was cardioprotective, ameliorating nonpathological functional decline with age. This was accompanied by increased expression of genes associated predominantly with the UPS, which was validated by a significant decrease in ubiquitinated proteins. RNAi knockdown of UPS candidates accordingly compromised myocardial physiology in young flies. Our work highlights flies as an efficient translational model of cardiac aging and FOXO as a tightly regulated mediator of proteostasis and heart performance over time.

**Biography**

Dr. Anthony Cammarato is an Associate Professor of Medicine and of Physiology at Johns Hopkins University. He holds a bachelor's degree in Biology from Mary Washington College and a Ph.D. in Physiology and Biophysics, from the Boston University School of Medicine. He completed a postdoctoral fellowship at San Diego State University and worked as an assistant research professor at the Sanford-Burnham Medical Research Institute before joining the Johns Hopkins faculty in 2011.

Dr. Cammarato studies basic mechanisms of striated muscle biology employing an array of imaging techniques to investigate “structural physiology” of cardiac and skeletal muscle. *Drosophila melanogaster*, the fruit fly, expresses both forms of striated muscle and benefits greatly from powerful genetic tools. His research utilizes flies, along with other model systems, to help understand conserved myopathy (muscle disease) and protein quality control processes and to perform hierarchical and integrative analysis of muscle function from the level of single molecules and macromolecular complexes through the level of the tissue itself.



**Dr. Anthony Cammarato**  
*Departments of Medicine and  
Physiology  
Johns Hopkins University*

Dr. Cammarato is a member of the American Physiological Society, the Biophysical Society, the American Society for Cell Biology and the Genetics Society of America.

**Publications:**

Viswanathan MC, Schmidt W, Rynkiewicz MJ, Agarwal K, Gao J, Katz J, Lehman W, Cammarato A. Distortion of the Actin A-triad results in contractile disinhibition and cardiomyopathy. *Cell reports*. 2017 Sep 12;20(11).

Blice-Baum AC, Zambon AC, Kaushik G, Viswanathan MC, Engler AJ, Bodmer R, Cammarato A. Modest overexpression of FOXO maintains cardiac proteostasis and ameliorates age-associated functional decline. *Aging cell*. 2017 Feb 1;16(1).

The South Carolina Academy of Science gratefully recognizes  
**Weyerhaeuser 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. Recently Weyerhaeuser (2017) and the **South Carolina Research Authority** (2015-Present) have sponsored 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. 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.



**2018 Governor’s Award for Excellence in Scientific Research**  
is awarded to

**Dr. Judy R. Dubno**

Department of Otolaryngology-Head and Neck Surgery  
College of Medicine, Medical University of South Carolina

This award recognizes Dr. Judy R. Dubno’s record of scientific research excellence in the field of auditory neuroscience, including the impact of her scientific contributions related to hearing loss and aging to the people of South Carolina and the United States. The award also highlights her leadership in scientific societies and in public policy making, public awareness related to hearing loss and the need for improved access and affordability of treatment, and her mentorship to early-career scientists.



Dr. Dubno received her Ph.D. from the City University of New York Graduate Center and completed a postdoctoral fellowship at the University of California, Los Angeles School of Medicine, where she served on the faculty until 1991. At that time, she joined the faculty in the College of Medicine at the Medical University of South Carolina (MUSC) in Charleston and is now a Professor and Director of the Hearing Research Program in the MUSC Department of Otolaryngology–Head and Neck Surgery, where she leads an outstanding and multidisciplinary team of scientists. Her research been continuously funded for more than 35 years by grants from the National Institutes of Health (NIH). Research funding led by Dr. Dubno has brought more than \$70 million to MUSC, in addition to supporting employment and advanced training for many research scientists, technical and administrative staff, postdoctoral fellows, and graduate students. Dr. Dubno’s long history of mentorship of early-career scientists was acknowledged by the MUSC Foundation, when she was awarded the inaugural Peggy Schachte Research Mentor Award “for excellence in furthering the mission of the Medical University of South Carolina in education, research, and service to the citizens of South Carolina.”

Dr. Dubno was elected President of two major scientific societies, is an elected member of two honorary scientific societies, and is a member of the Board of Directors of the Hearing Health Foundation. She was a member of an Advisory Council of the NIH and served on four consensus committees of the National Academies of Sciences, Engineering, and Medicine. She was the recipient of the James Jerger Career Award for Research in Audiology from the American Academy of Audiology, was named the Carhart Memorial Lecturer by the American Auditory Society, received a Presidential Citation from the American Otological Society, and received Distinguished Alumni Awards from the City University of New York and her PhD Program. Dr. Dubno’s extensive record of scholarship, leadership, and mentorship is deserving of this award.

**2018 Governor's Award for Excellence in Scientific Awareness**  
is awarded to

**Dr. John Kaup**

Office of Integrative Research in the Sciences, Furman University

This award recognizes Dr. John Kaup's record of excellence in promoting science education across the state of South Carolina. Dr. Kaup is a highly respected educator who has been an exceptional force for promoting scientific awareness at all levels. He has helped expand our state's STEM infrastructure, brought attention to the outstanding efforts of our teachers and the achievements of our students, and worked to markedly increase the visibility of South Carolina's science enterprise within the public at large.



After completing his B.S. at Xavier University in Ohio, Dr. Kaup received his Ph.D. in Physical Chemistry from the University of Utah in 1997. This work was followed by a postdoctoral appointment at Furman University from 1997-2000 under the direction of Professor Lon B. Knight. John then moved to Clemson University as a Lecturer and Senior Lecturer in the Department of Chemistry until returning to Furman in 2010 as the inaugural Coordinator of Science Education and current Director of Science Education.

Over the past 21 years working at South Carolina institutions of higher education, John has been a prolific champion of communicating science to the public. From his statewide K-12 leadership through the South Carolina Academy of Sciences and South Carolina Junior Academy of Sciences - where he has served as Executive Director since 2014 - to service on the Board of InnoVision and as a participant of the Upstate STEM Task Force, to his engagement as Undergraduate Program Chair for regional and national American Chemical Society meetings, to organizing summer research experiences for dozens of South Carolina's best and brightest science teachers, John has proven himself time and again as an exemplar of scientific dissemination. Dr. Kaup has also developed an impressive array of STEM-based K-12 initiatives on the Furman University campus, including an award-winning STEM Mentors initiative impacting hundreds of underserved middle school students, a research and science exposures program for students enrolled in the South Carolina's Governor's School for Science & Math and other regional high schools, and a comprehensive science equipment loaning program serving schools and other educational institutions across the SC Upstate.

As aptly noted by one of South Carolina's most decorated high school science teachers, "(John) has made a significant impact on hundreds – if not thousands – of students in SC through his efforts to develop and enhance program offerings to strengthen the K-12 STEM education of students and teachers in our state".

## **2018 Recipient of the Governor's Award for Young Researcher Award for Excellence in Scientific Research**

is awarded to

### **Dr. Srikanth Pilla**

Departments of Automotive Engineering & Materials Science and Engineering,  
Clemson University

This award recognizes Dr. Srikanth Pilla's record of scientific research excellence in the fields of sustainable and lightweight multifunctional composites and advanced manufacturing technologies. He is a highly respected scientist with an impressive record of research accomplishments. He has helped expand our state's research infrastructure including establishing advanced composites manufacturing enterprise that elevated the state's stature as the epicenter of innovation in advanced manufacturing. Furthermore, Dr. Pilla's research accomplishments helped to increase state's visibility within the national and international scientific communities.



Dr. Pilla received his Ph.D. in Mechanical Engineering from the University of Wisconsin at Milwaukee in 2009 with a postdoctoral training from Stanford University, CA. He came to Clemson University in 2013 as an Assistant Professor in the Department of Automotive Engineering. Prior to joining Clemson University, Dr. Pilla also worked as an Assistant Scientist at the University of Wisconsin-Madison. Dr. Pilla also spent time in industry having worked at SC Johnson and SuGanit Biorenewables as R&D scientist.

Dr. Pilla's research focuses on the fundamentals and applications of sustainable and lightweight functional materials and manufacturing. His discoveries and innovations have been published in a wide variety of journals. He has co-authored over 100 widely cited, peer-reviewed archival publications. With a H-index of 31, Dr. Pilla's work is highly cited with a citation count of over 3350. He edited the world's leading handbook in bioplastics and biocomposites. His research is supported by the Department of Energy, Department of Agriculture, and National Science Foundation, besides several industries including automotive OEMs. Till date his research has created about \$12.2 millions of funding.

Dr. Pilla's efforts in research and engineering education have garnered him numerous awards, including the 2017 BEPS Outstanding Young Scientist Award, 2017 SAE Foundation Young Industry Leadership Award, 2017 SAE Ralph R. Teetor Educational Award, 2017 Forest R. McFarland Award from SAE, and 2016 Robert J. Hocken Outstanding Young Manufacturing Engineer award from SME. Dr. Pilla was also recognized as USQ's Eminent Visiting Scholar in 2017.

Dr. Pilla is a gifted young researcher whose record of research excellence has depth, quality and consistency, which makes him highly deserving of this award.

**2018 Governor's Award for Excellence in Scientific Research  
at a Predominately Undergraduate Institution**

is awarded to

**Dr. Rizana M. Mahroof**

Department of Biological and Physical Sciences, South Carolina State University

This award recognizes Dr. Rizana M. Mahroof's record of scientific research excellence in the field of Entomology. She is a highly respected scientist with an impressive record of research accomplishments. She has helped expand our state's research infrastructure and increase its visibility within the national and international scientific communities.

Dr. Mahroof received her Ph.D. in Entomology from Kansas State University in 2004. She came to South Carolina State University in 2007 as Assistant Professor in the Department of Biological and Physical Sciences in the College of Science, Mathematics, Engineering and Technology and currently is Professor in the Department. Dr. Mahroof teaches several undergraduate classes in diverse areas of biology including plant sciences, field biology and entomology. She served as an academic advisor for over 30 students and mentored and trained 42 students in the area of entomology.

Dr. Mahroof spent past 10 years of her scientific career in the state of South Carolina. Her research focuses on reducing postharvest losses caused by insect pests in the continuum of farm-to-table. She is well known in South Carolina, across the nation and around the world for her work. Dr. Mahroof has published more than 35 scholarly papers and has authored or reviewed five books. The quality of her publications has been outstanding and it is noteworthy that her papers have been cited many times. Over the course of her career, Dr. Mahroof has received approximately \$10 million in research funding from the US Department of Agriculture (USDA), US Agency for International Development (USAID), and National Science Foundation (NSF). Her research has been continuously funded by the US Department of Agriculture for the past 10 years.

Dr. Mahroof has served as President of the South Carolina Entomological Society (SCES; the leading organization for entomologists in the state). She has received over 28 honors and awards in recognition of research, teaching and mentoring students and has been inducted to the invitation-only Sigma Xi, the Scientific Research Honor Society and Gamma Sigma Delta, the Honor Society of Agriculture.

Her record of research excellence has the depth, quality and consistency that is deserving of this award.

**2018 SOUTH CAROLINA ACADEMY OF SCIENCE  
EXCELLENCE IN SECONDARY SCIENCE OR MATHEMATICS  
TEACHING**

is awarded to

**Tonya Swalgren**

White Knoll High School

Tonya Swalgren has been singled out for her 28 years of inspiring excellent performances from students, and for creating a superlative environment for learning. In addition, she is being recognized for the extraordinary efforts put forth outside of the classroom on behalf of her students and for the benefit of the community. It is our pleasure to name you the SC Academy of Science Teacher of the Year.



**Tonya Swalgren,**  
White Knoll High School

I am very excited to be a nominee for South Carolina Academy of Science Teacher of the Year. I have been a classroom teacher for 28 years. Currently I teach AP physics, physics, and astronomy at White Knoll High School in Lexington, South Carolina. At White Knoll I serve as science department chair and varsity girls tennis coach. I also serve as a mentor and evaluator for first and second year science teachers. My husband and I stay very busy with our seven children and two German Shepherds. I am a graduate of the University of South Carolina and Coastal Carolina University. I love learning and hope to one day earn a doctorate in astronomy.

**Please join us in honoring all our 2018 nominees:**

- Deon Branch ..... Denmark-Olar High School  
Jennifer Sanders ..... Denmark-Olar High School  
Dotty Morris ..... Boiling Springs HS 9th Grade Campus  
David Degenhardt ..... Ridge View High School  
Melissa Kaehny ..... Gray Collegiate Academy  
Jandi Winthrow ..... Charleston Charter School  
April Dailey ..... Mullins High School



## PREVIOUS RECIPIENTS

### **SOUTH CAROLINA ACADEMY OF SCIENCE EXCELLENCE IN SECONDARY SCIENCE OR MATHEMATICS TEACHING (SCAS TEACHERS OF THE YEAR)**

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

## THE DWIGHT CAMPER OUTSTANDING UNDERGRADUATE RESEARCH AWARD



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

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

### CRITERIA AND APPLICATION PROCEDURES

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

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

### Past Recipients

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

2015 McKenzie Perdue, USC Columbia

2016 David Gilbert, USC Aiken, 1<sup>st</sup> Place

2016: Alexander Abare, Clemson University, 2<sup>nd</sup> Place

2017: Neema Patel, USC Columbia, 1<sup>st</sup> Place, and

2017: Reagen Welch, Southern Wesleyan University, 2<sup>nd</sup> Place

## IN MEMORIAM

### DAVID MCQUILLAN SC ACADEMY OF SCIENCE ARCHIVIST

David C. McQuillan passed in his sleep on Tuesday, March 20, 2018. David was employed with the University of South Carolina for 47 years. Since 1974 he worked in the Thomas Cooper Library as the map librarian and previously worked in the University's Geography Department. In addition to being the library's first head of Maps, David served as the SC Academy of Science Archivist for decades. David also served on numerous state and national committee as a member of the Special Libraries Association (SLA). His love of maps and travel led him to represent the University Libraries through membership in the International Federation of Library Associations and Institutions (IFLA). He will be sorely missed for his many stories about his travels, his extensive knowledge of cartographic materials, and his keen collector's eye



He was the son of the late William C. and Mary S. McQuillan. He was preceded in death by his wife of 41 years, Barbara Glatz McQuillan. David traveled extensively, visiting every continent but the Antarctic. Born in Amsterdam, N.Y., David graduated from Gulfport High School, Mississippi, in 1967. For three summers, he had an internship with NASA Mississippi Test Facility in Bay St. Louis. He graduated from the University of Southern Mississippi in 1971 with a BS in geography, and from the University of South Carolina with a masters in librarianship in 1974 and a MA in 1975. For seven years, David served as chair of the Geography and Map Section of the International Federation of Library Associations, and he chaired one year for the Special Libraries Association. He was also an enthusiastic supporter of Columbia's Sterling Chamber Music and the South Carolina Philharmonic. He is survived by his sister, Anne Dopf and her husband, Bryan, nephew Michael, niece Allison, sister Patty and brother Jim. David loved his church, the First Church of Christ, Scientist, and served through the years as a reader, board chairman and usher.

We honor David McQuillan's life-long commitment to scholarship, his community, and the SC Academy of Science.

## TOPICAL SESSIONS SCAS

Saturday, April 14th 2018

### BIOLOGY: FIELD AND ZOOLOGY

8:30 AM – 10:45 AM

Richardson 207

- 8:30 AM A FORTY-SEVEN YEAR STUDY OF THE VASCULAR FLORA OF ABANDONED THOUSAND ACRE RICE FIELD, GEORGETOWN, SOUTH CAROLINA  
Richard Stalter, St. John's University
- 8:45 AM EFFECTS OF HABITAT TYPE AND COYOTES (*CANIS LATRANS*) ON SITE OCCUPANCY BY WHITE-TAILED DEER (*ODOCOILEUS VIRGINIANUS*) AND HOUSE CATS (*FELIS CATUS*)  
Lindsay Arthur, Jessica Cuadra, Kirstie Mundok, Bridget Doyle, and Jonathan Storm, University of South Carolina Upstate
- 9:00 AM BIODEGRADATION OF MATURE FINE TAILINGS BY THE MICROBIAL CONSORTIUM BIOTIGER™ AND FINAL SOLUTION TOXICITY  
Erin Peck and Michele Harmon, University of South Carolina Aiken
- 9:15 AM SURVEY OF PARASITES INFECTING *HEXAGENIA* (EPHEMEROPTERA: EPHEMERIDAE) NYMPHS FROM WESTERN LAKE ERIE  
Amber Zonca and David Malakauskas, Francis Marion University
- 9:30 AM *BREAK*
- 9:45 AM ANURAN SPECIES RICHNESS, DIVERSITY AND COMPOSITION IN A LENTIC VS. LOTIC AQUATIC SYSTEM IN THE COASTAL PLAINS OF SOUTH CAROLINA  
Nathan Platt, Charleston Southern University
- 10:00 AM COPPER AND CHROMIUM HEAVY METAL ANALYSIS OF *FUNDULUS HETEROCLITUS* FROM GEORGETOWN, SOUTH CAROLINA  
Scarlett Leigh, Dung (Kristine) Giang, and Julia Baker, Columbia College
- 10:15 AM COMPARISON OF VIDEO RECORDING VS. IBUTTON DATA FOR ASSESSING THE BASKING BEHAVIOR OF EASTERN-PAINTED TURTLES (*CHRYSEMYS PICTA PICTA*) IN A NOVEL ENVIRONMENT.  
Jordan Winebrenner, Abraham Hernandez, and David Ferris, University of South Carolina Upstate
- 10:30 AM ANALYZING ANTHROPOGENIC EFFECTS ON SANDY BEACHES AND MEIOFAUNAL COMMUNITY COMPOSITION USING METABARCODING  
Douglas Johnson, Jeremiah JonesBoggs, and Julian Smith III, Winthrop University
- 10:45 AM DETERMINING THE FIRST INTERMEDIATE HOST TO PARASITES *GLOSSOCERCUS CARIBAENSIS* AND *CYCLUSTERA IBISAE* THAT ARE FOUND IN *FUNDULUS HETEROCLITUS* IN THE NORTH INLET-WINYAH BAY NATIONAL ESTUARINE RESEARCH RESERVE  
Emilee Masloski and Marlee Marsh, Columbia College

**BIOLOGY: MOLECULAR / CELLULAR**  
**8:30 AM – 10:15 AM**  
**Richardson 116 (Whitelaw Auditorium)**

- 8:30 AM USING SIRNAS TO DOWNREGULATE HIV-1 TAT EXPRESSION AND DECREASE VIRAL PRODUCTION IN SIRNA-PROTECTED T LYMPHOCYTE POPULATIONS  
Christian Fay and William Jackson, University of South Carolina Aiken
- 8:45 AM ALTERING MPING TRANSPOSITION BEHAVIOR USING DIFFERENT PLANT PROMOTERS  
Haley Stone and C. Nathan Hancock, University of South Carolina Aiken
- 9:00 AM CLONING AN INNATE RETROVIRAL GENE APOBEC3G INTO THE LENTIVIRAL VECTOR, PLRED(INS2)R  
Mckenzie Spires and William Jackson, University of South Carolina Aiken
- 9:15 AM THE EFFECT OF HDAC INHIBITION ON TBX5B EXPRESSION  
Alec Jones and April DeLaurier, University of South Carolina Aiken
- 9:30 AM *BREAK*
- 9:45 AM DESIGNING AND CLONING OF AN ANTI-REV SHRNA AGAINST HIV INFECTION  
Geneva Masak and William H. Jackson, University of South Carolina Aiken
- 10:00 AM ASTROCYTES UNDER PRESSURE: EXAMINING CELL MIGRATION IN AN EX-VIVO MODEL OF HYDROCEPHALUS  
Stephen Frederico<sup>1,2</sup>, Ryan Gedney<sup>1</sup>, Michael E. Smith<sup>1</sup>, and Ramin Eskandari<sup>1</sup>, <sup>1</sup>Medical University of South Carolina, <sup>2</sup>College of Charleston
- 10:15 AM COMBINATION OF CANNABINOIDS,  $\Delta^9$ -TETRAHYDROCANNABINOL (THC) AND CANNABIDIOL (CBD), MITIGATE EXPERIMENTAL AUTOIMMUNE ENCEPHALOMYELITIS (EAE) BY ALTERING THE GUT MICROBIOME  
Zinah Al-Ghezi<sup>1</sup>, Prakash Nagarkatti<sup>2</sup>, Hasan Al-Ghetaa<sup>1</sup> and Mitzi Nagarkatti<sup>1</sup>, <sup>1</sup>University of South Carolina School of Medicine <sup>2</sup>University of South Carolina Columbia

**CHEMISTRY / BIOCHEMISTRY**  
**8:30 AM – 10:15 AM**  
**Richardson 315**

- 8:30 AM 1ST GENERATION AMPEROMETRIC BIOSENSING: AN ADAPTABLE TEMPLATE FOR LABORATORY RELEVANT MEASUREMENTS OF GALACTOSE AND XANTHINE  
Gillian Horn and Will Case, Converse College
- 8:45 AM HOMOLOGOUS RECOMBINATION REPAIR FACILITATES REPLICATIVE TRANSPOSITION OF THE *MPING* ELEMENT FROM RICE  
Lisette Payero and C. Nathan Hancock, University of South Carolina Aiken

- 9:00 AM DEVELOPING A YEAST ONE-HYBRID ASSAY FOR EVALUATING PROTEIN BINDING TO THE *MPING* TRANSPOSABLE ELEMENT  
Jacob Reagin and C. Nathan Hancock, University of South Carolina Aiken
- 9:15 AM ENZYMATIC AND MICROBIAL SYNTHESIS OF RARE SUGARS  
Li Cai<sup>1</sup> and Zijie Li<sup>2</sup>, <sup>1</sup>University of South Carolina Lancaster <sup>2</sup>Jiangnan University
- 9:30 AM *BREAK*
- 9:45 AM A COMPUTATIONAL STUDY OF A FAMILY OF COPPER COMPOUNDS  
Brett Smith and Gerard Rowe, University of South Carolina Aiken
- 10:00 AM *ABSTRACT WITHDRAWN*
- 10:15 AM ZINC OXIDE NANOPARTICLE MODIFICATION BY SELF-ASSEMBLY USING SUBSTITUTED CARBOXYLIC ACIDS  
TJ Parkman and Nicholas Marshall, University of South Carolina Aiken

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

**8:30 AM – 10:15 AM**

**Richardson 115**

- 8:30 AM VECTOR POTENTIAL: A DIVERGENCE FREE METHOD FOR MHD CODE  
Payden Shaw and P. Chris Fragile, College of Charleston
- 8:45 AM INVESTIGATING CRITICAL FLUIDS IN SIMULATED WEIGHTLESSNESS  
Christian Hawkins and Ana Oprisan, College of Charleston
- 9:00 AM ACOUSTIC BRAGG IMAGING  
Gunther Martin and Alem Teklu, College of Charleston
- 9:15 AM GAMMA-RAY BURST CLASSIFICATION: NEW INSIGHTS FROM MINING PULSE DATA  
Stanley McAfee and Jon Hakkila, College of Charleston
- 9:30 AM *BREAK*
- 9:45 AM INVESTIGATING THE IMPACT OF EPISODIC STELLAR ACTIVITY ON PLANET FORMATION AND EVOLUTION  
Elyana Crowder<sup>1</sup> and Ana Uribe<sup>1</sup>, Maximiliano Moyano<sup>2</sup>, Giovanni Pinzon<sup>3</sup> and Joe Carson<sup>1</sup>, <sup>1</sup>College of Charleston <sup>2</sup>Universidad Católica del Norte <sup>3</sup>Universidad Nacional de Colombia
- 10:00 AM A NOVEL 3D IMAGING TECHNIQUE FOR CANCER DIAGNOSES  
Blake Mino<sup>1</sup>, David Melnick<sup>1</sup>, Elyana Crowder<sup>1</sup>, and Yu-tsueng Liu<sup>2</sup>, <sup>1</sup>College of Charleston <sup>2</sup>University of California San Diego
- 10:15 AM TRANSLATIONAL RESEARCH METHODS WITH HIGH-RESOLUTION 2D AND 3D TOPOGRAPHIC SCREENINGS FOR DETECTION OF CANCER  
David Melnick, Elyana Crowder, Blake Mino, and Joseph Carson, College of Charleston

**MEDICINE / PHARMACOLOGY / PUBLIC HEALTH**

**8:30 AM – 10:00 AM**

**Richardson 226**

- 8:30 AM MEASURING THE EFFECTS OF CAFFEINE AND EXERCISE ON METABOLIC DISTURBANCES IN RATS FED A HIGH SUCROSE SOLUTION  
Emily Mele and Michelle Vieyra, University of South Carolina Aiken
- 8:45 AM THE EFFECTS OF CAFFEINE AND SUGAR CONSUMPTION WITH AND WITHOUT EXERCISE ON MUSCLE GROWTH AND BONE DENSITY IN RATS  
Jonathan Rodgers and Michelle Vieyra, University of South Carolina Aiken
- 9:00 AM THE EFFECTS OF SUGAR, CAFFEINE AND EXERCISE ON ANXIETY-LIKE SYMPTOMS AND SHORT-TERM MEMORY IN RATS  
Marissa Gross and Michelle Vieyra, University of South Carolina Aiken
- 9:15 AM THE EFFECTS OF ANXIETY REAPPRAISAL AND MINDFULNESS ON PERCEIVED ANXIETY AND EDA, DURING ARITHMETIC VERIFICATION  
Hope Adams and Keri Weed, University of South Carolina Aiken
- 9:30 AM *BREAK*
- 9:45 AM CORRELATION OF THE RS4988235 C/T SINGLE NUCLEOTIDE POLYMORPHISM WITH LACTOSE INTOLERANCE  
Michaela Treadway and C. Nathan Hancock, University of South Carolina Aiken
- 10:00 AM AN INVESTIGATION OF THE ORDER OF APPLICATION OF AN EMOLLIENT WITH A TOPICAL STEROID IN THE TREATMENT OF ATOPIC DERMATITIS  
Andrea Conner and Ashlee Tietje, Southern Wesleyan University

**POSTER SESSION**  
**James H. Thomason Library**  
**10:30 AM-12:00 PM**

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

**BIOLOGY: FIELD / ZOOLOGY / ENVIRONMENTAL SCIENCE**

- 1 FUSED VS. UNFUSED RIB COUNTS ON NEW SAMPLES OF PLIOCENE FOSSIL  
NODIPECTEN SCALLOPS FROM SOUTH CAROLINA  
Mike Allison, Robert Hinson, Preston Snow, Regan Tapp and Matthew Campbell, Charleston  
Southern University
- 2 VOC SPATIAL AND TEMPORAL CHANGES ALONG A TCE PLUME FRINGE AT  
SAVANNAH RIVER SITE  
Tawanda Gallman, Edgar Diaz, Ebony Corbitt, and John B. Williams, South Carolina State  
University
- 3 UNDERSTANDING THE BACTERIOPHAGE POPULATION IN THE PONDS AND  
STREAMS ON THE CAMPUS OF COASTAL CAROLINA UNIVERSITY  
Alyssa LeClaire and Paul E Richardson, Coastal Carolina University
- 4 ACCLIMATION TIME OF EASTERN PAINTED TURTLES (*CHRYSEMYS PICTA PICTA*)  
IN A NOVEL ENVIRONMENT  
Courtney Pitts, Jordan Winebrenner, Abraham Hernandez, and David Ferris, USC Upstate
- 5 COLIPHAGES IN THE AVIARY AT BROOKGREEN GARDENS AND THE  
ENVIRONMENTAL FACTORS THAT INFLUENCE VIRAL POPULATION DYNAMICS  
Olivia Shirley<sup>1</sup> and Paul Richardson<sup>2</sup>, <sup>1</sup>University of South Carolina Aiken <sup>2</sup>Coastal Carolina  
University

**BIOLOGY: MOLECULAR / CELLULAR / MICROBIOLOGY**

- 6 LESIONS OF HIPPOCAMPUS CAN ALTER TIME PERCEPTION  
Tristan Aft<sup>1</sup>, Sorinel Oprisan<sup>1</sup>, Mona Buhusi<sup>2</sup>, and Catalin Buhusi<sup>2</sup>, <sup>1</sup>College of Charleston  
<sup>2</sup>Utah State University
- 7 AN INVESTIGATION OF THE EFFECTS OF FOLIC ACID ON HISTONE  
MODIFICATIONS AND DENDRITIC SPINE DENSITY IN A HUMAN NEURONAL CELL  
LINE  
Rahaf Al Sayed, Whitney Smith and Kimberly Shorter, University of South Carolina Upstate
- 8 ANALYSIS OF F2 ACTIVATION TAGGING WHEAT LINES  
Amanda Askins and C. Nathan Hancock, University of South Carolina Aiken
- 9 GENERALIZED PHASE RESETTING AND PHASE-LOCKED MODE PREDICTION IN  
BIOLOGICALLY-RELEVANT NEURAL NETWORKS  
Dave Austin and Sorinel Oprisan, College of Charleston



- 10 DOES A 10X FOLIC ACID DOSE AFFECT GENE EXPRESSION OF CHROMATIN MODIFYING ENZYMES IN HUMAN NEURONS WITH A GENE KNOCKDOWN OF MTHFR?  
Daniel Clark and Kimberly Shorter, University of South Carolina Upstate
- 11 CHANGES IN THE PREFRONTAL CORTEX REVEALED BY OPTOGENETIC EXPERIMENTS  
Jessica Helms<sup>1</sup>, Xandre Clementsmith<sup>1</sup>, Antonieta Lavin Lavin<sup>1</sup>, and Sorinel Oprisan<sup>1</sup>,  
<sup>1</sup>College of Charleston <sup>2</sup>Medical University of South Carolina
- 12 CLONING AN ANTI-REV SHRNA TO INHIBIT HIV-1 REPLICATION  
Bethany Jameson and William H. Jackson, University of South Carolina Aiken
- 13 COULD MAST CELLS BE EARLY DIAGNOSTIC MARKERS OF COLORECTAL CANCER?  
Nabihah I. Kumte<sup>1</sup>, Alena P. Chumanevich<sup>1</sup>, Ahmed Aladhani<sup>1</sup>, Ioulia Chatzistamou<sup>1</sup>, Tia Davis<sup>1</sup>, Marj Peña<sup>2</sup>, John W. Fuseler<sup>1</sup>, and Carole A. Oskeritzian<sup>1</sup>, <sup>1</sup>University of South Carolina School of Medicine <sup>2</sup>University of South Carolina Columbia
- 14 COMPARING PROGESTERONE LEVELS IN PLASMA AND SALIVA WITH AN EXOGENOUS PROGESTERONE SOURCE  
Jessica Mau and Staci Johnson, Southern Wesleyan University
- 15 CREATING A SHUTTLE VECTOR FOR CLONING ANTI-HIV-1 SHRNAS  
Keileigh McMurray, Kylie Tager, and William H Jackson, University of South Carolina Aiken
- 16 DETERMINING HOW PHF21A AFFECTS CRANIOFACIAL DEVELOPMENT IN ZEBRAFISH  
Lacie Mishoe and April DeLaurier, University of South Carolina Aiken
- 17 MIRNA-INDUCED GENE SILENCING TAGGING IN ARABIDOPSIS THALIANA  
Karah Moulton and C. Nathan Hancock, University of South Carolina Aiken
- 18 THE VIRAL HUNT FOR BACTERIOPHAGES: THE CURE FOR ANTIBIOTIC-RESISTANT BACTERIA MAY BE FOUND ON THE STUDENTS AT CAMPUS OF COASTAL CAROLINA UNIVERSITY  
Lisa Pieterse and Paul E. Richardson, Coastal Carolina University
- 19 UNDERSTANDING THE FUNCTION OF KDM1A USING CRISPR/CAS-9 IN ZEBRAFISH  
Katlin Pugh and April DeLaurier, University of South Carolina Aiken
- 20 EXPRESSION OF PRO-APOPTOTIC BAX IN AN HIV-1 DEPENDENT LENTIVIRAL VECTOR  
Lance Reynolds and William H. Jackson, University of South Carolina Aiken
- 21 DOES HIGH FOLIC ACID ALONGSIDE A GENE KNOCKDOWN OF MTHFR INDUCE HISTONE MODIFICATIONS AND ALTERED NEUROBIOLOGY IN A HUMAN NEURONAL CELL LINE?  
Rachael Schmelz, Daniel Clark, and Kimberly Shorter, University of South Carolina Upstate
- 22 ANALYZING A TOL2-BASED ACTIVATION TAG CONSTRUCT IN ZEBRAFISH AND YEAST  
Allison Swiecki, C. Nathan Hancock, and April DeLaurier, University of South Carolina Aiken

- 23 THE ROLE OF PROTEIN CARBOXYL METHYLTRANSFERASE (PCMT) IN DROSOPHILA MELANOGASTER STRESS RESISTANCE  
Darnecia Sylve, Cristal Gonzalez, and Jessica Allen, Columbia College
- 24 DETERMINING THE ROLE OF LDLRAP1A IN SKELETAL DEVELOPMENT AND CHOLESTEROL METABOLISM IN ZEBRAFISH  
Kali Wiggins and April DeLaurier, University of South Carolina Aiken
- 25 USING CRISPR/CAS9 TO STUDY THE ROLE OF ZMYM2 AND ZMYM3 IN ZEBRAFISH CRANIOFACIAL DEVELOPMENT  
Terence Willoner and April DeLaurier, University of South Carolina Aiken
- 26 IMPROVING THE TRANSPOSITION EFFICIENCY OF THE HARBINGER3N\_DR TRANSPOSABLE ELEMENT  
Sarah Zamiela and C. Nathan Hancock, University of South Carolina Aiken

### **CHEMISTRY / BIOCHEMISTRY**

- 27 AN LC/MS ASSAY FOR THE QUANTIFICATION OF ANALYTES IN THE DAD-CATALYZED REACTION  
Catherine Cave, Najha Smith and Kenneth Roberts, University of South Carolina Aiken
- 28 PHOTOPHYSICS OF PHOTOCHROMIC CHROMOPHORES IN CONFINED ENVIRONMENTS  
Haley Gregory, Ekaterina Dolgoplova, and Natalia Shustova, University of South Carolina Columbia
- 29 NEW STATISTICAL METHODS FOR ANALYZING SIMULATIONS OF MATERIALS AND ITS APPLICATION TO AN IONIC LIQUID  
Stuart Hodge and Mark Berg, University of South Carolina Columbia
- 30 INVESTIGATING THE MPING TRANSPOSITION COMPLEX THROUGH OVEREXPRESSION OF ORF1 AND TRANSPOSASE PROTEINS  
Reese King and C. Nathan Hancock, University of South Carolina Aiken
- 31 RAMAN SPECTROSCOPY OF METHYL-4-DIMETHYLAMINO BENZOATE (MDAB) AND ANALOGS IN FOUR SOLVENTS  
Massiel Payero Garcia and Monty Fetterolf, University of South Carolina Aiken
- 32 SURFACE MODIFICATION USING P-PHENYLENEBIS(DIAZONIUM) SALT, A BIFUNCTIONAL ARYL DIAZONIUM COUPLING AGENT  
Andres Rodriguez and Nicholas Marshall, University of South Carolina Aiken
- 33 THE REMOVAL OF COPPER (II) AQUEOUS IONS VIA HYDROGEL FORMATION OF SODIUM ALGINATE  
Kaybriana Spalding, Audrey Bourdages, and Jennifer Hawk, Converse College
- 34 N- AND C-TERMINAL TRUNCATIONS OF 2,4'-DIHYDROXYACETOPHENONE DIOXYGENASE  
Jason Weeks, Gabrielle Connor, and Kenneth Roberts, University of South Carolina Aiken

- 35 QUANTITATIVE ASSESSMENT OF CARBONYL LONE PAIR-PI INTERACTIONS USING A SMALL MOLECULE MODEL  
Jessica Morgan and Sharon Strickland, Converse College

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

- 36 THERMOELECTRIC CHARACTERIZATION OF POLYVINYLIDENE FLUORIDE/NANO-BI\_2TE\_3 COMPOSITE FILMS  
Sam Bleser and Gregory Smith, College of Charleston
- 37 EVALUATION OF CREDIT RISK MODELS  
Oliver Brown and George Carbaugh, The Citadel
- 38 CAN HOUSE PRICES OF CHARLESTON BE PREDICTED?  
Pang-jui Hsu and Bo Li, The Citadel
- 39 CONFINEMENT EFFECT ON SUPERPARAMAGNETIC NANOCOLLOIDAL SUSPENSION  
Gabrielle Seymore<sup>1</sup>, Ana Oprisan<sup>1</sup>, Sorinel Oprisan<sup>1</sup>, and Ashley Rice<sup>2</sup>, <sup>1</sup>College of Charleston  
<sup>2</sup>University of Tennessee

**MEDICINE / PHARMACOLOGY / PUBLIC HEALTH**

- 40 SPACE WEATHER AND HUMAN PHYSIOLOGY: A DECADAL CASE STUDY  
James Wanliss<sup>1</sup>, Germaine Cornellsen<sup>2</sup>, Brien Washington<sup>1</sup>, and Denzel Brown<sup>1</sup>,  
<sup>1</sup>Presbyterian College <sup>2</sup>University of Minnesota
- 41 THE INFLUENCE OF INDUCED ANXIETY ON EXECUTIVE FUNCTIONS AMONG ATHLETES AND NOVICES MEASURED BY THE P3 WAVE IN A GO/NOGO TASK  
James Waters and Keri Weed, University of South Carolina Aiken
- 42 COMPARISON OF ESTROGEN CONCENTRATION IN BOVINE BLOOD AND SALIVA  
Kira Williams and Staci Johnson, Southern Wesleyan University

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

**SCAS JUDGES**

*SCAS Judges Conference Room*

*Richardson Science Hall 303*

**TBA**

**SCJAS JUDGES**

*SCJAS Judges Conference Room*

*Writing Center in Neville Hall*

**TBA**

## SCAS 2018 ABSTRACTS

### Alphabetical by author

#### THE EFFECTS OF ANXIETY REAPPRAISAL AND MINDFULNESS ON PERCEIVED ANXIETY AND EDA, DURING ARITHMETIC VERIFICATION

Hope Adams and Keri Weed  
University of South Carolina Aiken

The purpose of this study is to see if reinterpreting anxiety in a positive way is equally effective for math anxious students with different levels of mindfulness. A 2 (mindfulness: high or low) by 2 (condition: anxiety reappraisal, no anxiety reappraisal) between subjects design was used. Participants were randomly assigned to one of two reappraisal conditions. The experimental group watched a video that focused on reappraising anxiety within three performance domains: karaoke, public speaking, and math. This video explains that interpreting anxiety positively improves performance in all three domains. The control group watched a promotional video of college students enjoying a winter karaoke gathering. The sample will include 60 undergraduate women. Surveys measured math anxiety and mindfulness (in general and math specific); a median split was used to classify participants into high and low mindfulness groups. Electrodermal activity was measured while participants completed a computerized arithmetic verification task. We expect to find that participants with high mindfulness combined with anxiety reappraisal will result in optimal performance (i.e., better accuracy, faster reaction time, and greater EDA reactivity) and the group with high mindfulness without anxiety reappraisal will perform the worst, because they are aware of their bodily sensations but may interpret them negatively. Data from a pilot study found that self-reported math anxiety was higher for women and for students with negative judgments of their anxiety. Our goal for research is to allow math anxious individuals to reappraise their anxiety positively, and in turn, perform better.

#### LESIONS OF HIPPOCAMPUS CAN ALTER TIME PERCEPTION

Tristan Aft<sup>1</sup>, Sorinel Oprisan<sup>1</sup>, Mona Buhusi<sup>2</sup>, and Catalin Buhusi<sup>2</sup>  
<sup>1</sup>College of Charleston <sup>2</sup>Utah State University

Many species from bees to humans are capable of perceiving and accurately reproducing temporal durations from seconds to tens of hours. Interval time perception is experimentally tested using peak interval (PI) procedure. PI uses light or sounds as a conditioning stimulus (CS), which are turned on at the beginning of each training trial. After a to-be-memorized duration passes, the stimulus is turned off and reinforcement is provided. After successful training, the subjects are tested by turning the CS on for a duration at least three times longer than the training duration and no reinforcement is provided. The subjects react with a wide distribution of responses that looks like a Gaussian (bell-shaped) curve centered at the memorized time. We know from experimental work that lesions on the dorsal hippocampus (DH) area shift the time perception towards shorter durations, whereas lesions of the ventral hippocampus (VH) shift time perception towards longer durations. We successfully developed a computational model that mimics temporal perception and reproduced the experimentally observed temporal shifts.

#### AN INVESTIGATION OF THE EFFECTS OF FOLIC ACID ON HISTONE MODIFICATIONS AND DENDRITIC SPINE DENSITY IN A HUMAN NEURONAL CELL LINE

Rahaf Al Sayed, Whitney Smith and Kimberly Shorter  
University of South Carolina Upstate

Autism spectrum disorders (ASD) are characterized by difficulties in social interactions and increased repetitive behaviors due to abnormal neuromorphology (increased dendritic spines). Previous studies have shown autism is epigenetic in origin. Epigenetic modifications including DNA/histone methylation are altered through the folic acid (FA) metabolic pathway. FA consumption and ASD rates have both increased in recent decades; therefore, we questioned if excess FA consumption is linked to ASD. In our research, we investigated the effects of a 2x FA dose on histone modifications at histone 3 and on dendritic spine density in a human neuronal cell line. We treated SHSY5Y cells with a 2x FA dose or water (control). We isolated histones and determined histone 3 modifications using ELISA format array plates to determine levels of various histone 3 methylation and acetylation marks. We stained control and FA treated neurons with Dil stain to determine the dendritic spine density. Results showed a decrease in active histone methylation and acetylation marks (a pattern associated with decreased gene expression and with ASD) and a significant increase in dendritic spine density in FA treated cells. Our results indicate excess FA could be linked to increases in ASD-related neuromorphology changes and histone modification changes.

COMBINATION OF CANNABINOIDS, Δ9- TETRAHYDROCANNABINOL (THC) AND CANNABIDIOL (CBD), MITIGATE EXPERIMENTAL AUTOIMMUNE ENCEPHALOMYELITIS (EAE) BY ALTERING THE GUT MICROBIOME

Zinah Al-Ghezi<sup>1</sup>, Prakash Nagarkatti<sup>2</sup>, Hasan Al-Ghetaa<sup>1</sup> and Mitzi Nagarkatti<sup>1</sup>

<sup>1</sup>University of South Carolina School of Medicine <sup>2</sup>University of South Carolina Columbia

Multiple Sclerosis (MS), is one of the most common autoimmune disease that affects the central nervous system (CNS). Currently there is no cure for patients suffering from MS, and most treatments involve the use of immunosuppressive drugs that can have adverse side effects or increased toxicity. Cannabis, commonly known as marijuana, is a product of the Cannabis sativa, an annual herbaceous plant, and for several centuries marijuana has been used as an alternative medicine in many cultures. Cannabis sativa produces over 421 chemical compounds, including about 80 terpenophenol compounds named phytocannabinoids, and include both THC and CBD. In the currently study, we show that combination therapy using THC and CBD (THC+CBD) results in amelioration of experimental autoimmune encephalomyelitis (EAE), an animal model of MS, by reducing hind limb paralysis, decreasing immune cellular infiltration into the brain, and mitigating the presences of inflammatory biomarkers, including bacterial-associate lipopolysaccharides (LPS). Interestingly, the gut microbiome plays an important role in immune function and studies have shown that it is altered significantly in MS patients. Inasmuch, we performed 16S rRNA sequencing on experimental groups to investigate the gut microbiome composition after using a combination of the psychotropic THC and non-psychoactive CBD compared to disease controls. Interestingly, we found that EAE mice showed increases in the mucin degrading bacterial species, Akkermansia muciphila, which was significantly reduced in disease mice treated with THC+CBD. Collectively, our data suggests that THC+CBD can ameliorate EAE by preventing accumulation of mucin-degrading bacteria that would lead to increased gut microbial dysbiosis.

FUSED VS. UNFUSED RIB COUNTS ON NEW SAMPLES OF PLIOCENE FOSSIL *NODIPECTEN* SCALLOPS FROM SOUTH CAROLINA

Mike Allison, Robert Hinson, Preston Snow, Regan Tapp and Matthew Campbell  
Charleston Southern University

The two South Carolina Pliocene fossil *Nodipecten* scallops are *Nodipecten collierensis* (Mansfield, 1932) and *Nodipecten peedeensis* (Tuomey and Holmes, 1855). *Nodipecten collierensis* is known by numerous specimens from the Lower Goose Creek Limestone in Berkeley and Charleston counties. All known specimens of *Nodipecten collierensis* have seven ribs on the left valve interlocking with eight ribs on the right valve.

*Nodipecten peedeensis* has a total of eighteen specimens documented in museum collections. These are from the Upper Goose Creek Limestone with the type lot of four specimens from near Godfrey's Ferry on the Peedee River, one from Lake Waccamaw, NC, and thirteen from Charleston. Additional unpublished specimens from Horry County permit description of the frequency and range of morphological variation. Seventeen out of the eighteen published specimens have seven ribs on the left valve interlocking with eight ribs on the right valve, plus one right valve having six ribs. The new populations of 183 specimens has 47 specimens (25%) with one or two ribs fused on the right valve giving a count of six ribs on the left valve interlocking with seven ribs on the right valve or a count of five ribs on the left valve interlocking with six ribs on the right valve (matching one published specimen). *Nodipecten peedeensis* is the only documented species of fossil or Recent *Nodipecten* with this pattern of fused ribs to produce a low rib count. Out of 183 specimens, 60 are paired, 81 are single right valves, and 42 are single left valves. It is expected that more right valves than left valves would be preserved, but this marine carbonate depositional environment preserved an unusually high number of articulated pairs.

EFFECTS OF HABITAT TYPE AND COYOTES (*CANIS LATRANS*) ON SITE OCCUPANCY BY WHITE-TAILED DEER (*ODOCOILEUS VIRGINIANUS*) AND HOUSE CATS (*FELIS CATUS*)

Lindsay Arthur, Jessica Cuadra, Kirstie Mundok, Briget Doyle, and Jonathan Storm  
University of South Carolina Upstate

Coyotes (*Canis latrans*) are a highly adaptable species that have recently expanded their range into the southeastern United States. While coyotes normally prey on mice, squirrels, and rabbits, they may also reduce local populations of white-tailed deer (*Odocoileus virginianus*) and house cats (*Felis catus*), both feral and domestic. The purpose of this study was to determine whether coyote presence reduced site occupancy by white-tail deer or house cats. During 2011-2017, we placed wildlife cameras within 20 rural forests and 19 urban greenways in Spartanburg County, SC. We used ArcGIS to categorize the habitat within a 1 km radius of each camera to determine whether habitat type influenced site occupancy by each species. We found that coyote presence did not have a significant effect on the occupancy status of either white-tail deer or house cats. We detected coyotes at 63% of our study sites and none of the habitat variables had an effect on site occupancy by coyotes. For white-tailed deer, there was a trend for occupancy status to increase as the amount of forested habitat increased. We also found that house cats were more likely to occupy sites in residential and commercial areas that had reduced forest cover. Our results suggest that coyotes are habitat generalists in Upstate South Carolina, and that they do not influence the distribution of white-tail deer or house cats.

## ANALYSIS OF F2 ACTIVATION TAGGING WHEAT LINES

Amanda Askins and C. Nathan Hancock  
University of South Carolina Aiken

Transposable elements are DNA sequences that can jump from one location to another in the genome, inducing mutations in an organism. These elements can be used for gene discovery because of their ability to change an organism's genome and alter phenotype. Our goal is to use a non-autonomous transposable element known as *mPing*, first discovered in rice, for mutagenesis of wheat. Wheat is one of the most widely grown crops in the world; however, because it is a polyploid, simple gene deletion is not usually sufficient to cause a phenotype. An activation tag shows the function of genes by causing overexpression of nearby genes by inserting promoter sequences into the genome. Thus, we have developed an activation tagging version of *mPing*, called *mmPing20F*, by inserting an enhancer sequence from the figwort mosaic virus promoter into a hyperactive version of *mPing*. Mobilization of this element requires two proteins, ORF1 and Transposase. Our F1 generation of plants showed that *mmPing20F* was able to transpose when combined with plants that express both proteins. Transposition analysis in the F2 generation is being conducted through PCR screening in order to determine the levels of germinal transposition occurring in each line. Our goal is to identify a line that is suitable for production of a large mutagenesis population for gene discovery in wheat.

## GENERALIZED PHASE RESETTING AND PHASE-LOCKED MODE PREDICTION IN BIOLOGICALLY-RELEVANT NEURAL NETWORKS

Dave Austin and Sorinel Oprisan  
College of Charleston

Environment stimuli are continuously processed by the central nervous system (CNS) to better adjust, adapt, and learn new responses that optimize our benefits. At neural level, the external stimuli are coded as spikes of electric activity, called action potentials (APs). Neurons respond to changes in the environment by altering their firing speed, or phase, which means that instead of firing at a regular pace the neuron starts firing faster or they slow down. The amount of change, or resetting, in their firing period is determined by the timing, duration, and strength of the external stimulus. However, neurons connect with each other and create large networks capable of elaborated firing patterns that drive the response of the organism. We modeled the neural network as hierarchically-organized layers of neurons and in each layer the neurons' response is dictated by its own phase resetting behavior. We successfully generalized mathematically and then checked numerically that knowledge of how one isolated neuron responds to a stimulus can help predicting the response of a larger network to complex stimuli.

## THERMOELECTRIC CHARACTERIZATION OF POLYVINYLIDENE FLUORIDE/NANO-BI<sub>2</sub>TE<sub>3</sub> COMPOSITE FILMS

Sam Bleser and Gregory Smith  
College of Chareleston

We investigated the thermoelectric performance of various composite films based on different ratios (1:1, 2:1, 2.5:1) of nano-Bi<sub>2</sub>Te<sub>3</sub> blended into a polyvinylidene fluoride (PVDF) polymer matrix. We measured both the electrical conductivity and Seebeck coefficient using a thin-film thermoelectric characterization apparatus with a four-point probe. We analyzed the surface morphology using a scanning electron microscope and an atomic force microscope.

## ENZYMATIC AND MICROBIAL SYNTHESIS OF RARE SUGARS

Li Cai<sup>1</sup> and Zijie Li<sup>2</sup>

<sup>1</sup>University of South Carolina Lancaster <sup>2</sup>Jiangnan University

Rare sugars, referred to as monosaccharides and their derivatives that rarely exist in nature, can be applied in many areas ranging from foodstuffs to pharmaceutical and nutrition industry. Unfortunately, an important factor restricting the study and utilization of rare sugars is their limited availability, mainly due to limited synthetic methods. Nowadays, microbial and enzymatic transformations have become a very powerful tool in this field but many biosynthetic methods involve a chemical equilibrium (isomerization or epimerization) between two or more sugars that inevitably leads to low to moderate yields and difficulties in product purification. In our work, we developed an efficient one-pot four-enzyme system for the synthesis of rare sugars, starting from common and inexpensive DL-glycerol 3-phosphate. A series of rare sugar diastereomers could be produced on preparative scales without isolation of the intermediates.

## AN LC/MS ASSAY FOR THE QUANTIFICATION OF ANALYTES IN THE DAD-CATALYZED REACTION

Catherine Cave, Najha Smith and Kenneth Roberts  
University of South Carolina Aiken

Oxidation of 2,4'-dihydroxyacetophenone (DHA) by the enzyme 2,4'-dihydroxyacetophenone dioxygenase (DAD) produces benzoic acid and formic acid in the presence of oxygen. The mechanism for this reaction is currently unknown. The DAD reaction is unique in that it cleaves a carbon-carbon bond of the alkyl group of the aromatic ring of DHA, instead of directly on the ring as seen in the intradiol and extradiol dioxygenases. To further investigate the kinetics of DAD, a simple, efficient assay using liquid chromatography-mass spectrometry (LC/MS) needs to be developed. Successful LC/MS assays to quantify analytes require four elements: a rapid and effective quench of the reaction catalyzed by DAD; an efficient separation of analytes by HPLC; strong detection of these analytes by ESI-MS; and an appropriate internal standard for quantitation by mass spectrometry. The LC/MS assay is expected to significantly expand the detection limit of analytes in the reaction catalyzed by DAD, improving both our understanding of the kinetic parameters of DAD and our ability to detect reaction components including UV-inactive analytes and trace products of the reaction.

## DOES A 10X FOLIC ACID DOSE AFFECT GENE EXPRESSION OF CHROMATIN MODIFYING ENZYMES IN HUMAN NEURONS WITH A GENE KNOCKDOWN OF MTHFR?

Daniel Clark and Kimberly Shorter  
University of South Carolina Upstate

Autism spectrum disorder (ASD) rates have increased since the 1990's. Recent studies show a strong link between ASD and epigenetics. Environmental influences (e.g. diet) can induce epigenetic changes such as DNA and histone modifications. Folic acid (FA) is a dietary methyl donor that DNA/histone methyltransferases utilize to alter epigenetics. Methylation of DNA/histones leads to heterochromatin where DNA is tightly wound around histones for less gene expression, a hallmark of ASD. In the mid 1990s, the US and other countries began fortifying grains with FA to prevent spina bifida, though the mechanism is unknown. Further, women with methylenetetrahydrofolate reductase (MTHFR- an enzyme used in metabolism of FA to the methyl group) gene mutations are told to take up to 10x the FDA's recommended daily dosage of FA. We sought to determine if a high FA treatment, with or without MTHFR knockdown, affects expression of epigenetic modifying enzymes in neurons. We ran qPCR arrays for samples treated with water (control) or 10x FA with and without an MTHFR knockdown. We found changes to epigenetic modifying enzymes consistent with a heterochromatin state, indicating decreased gene expression, which is associated with ASD.

## AN INVESTIGATION OF THE ORDER OF APPLICATION OF AN EMOLLIENT WITH A TOPICAL STEROID IN THE TREATMENT OF ATOPIC DERMATITIS

Andrea Conner and Ashlee Tietje  
Southern Wesleyan University

One in every 5,000 people are diagnosed with Atopic Dermatitis (AD) in industrialized countries. Current treatment includes the use of both steroid and emollient creams. Current suggestions for the order of application are contradictory. This study aims to examine the role of the order of application of treatments for Atopic Dermatitis. Hairless mice (SKH-1) were induced to a mild flare-up using 2,4-dinitrochlorobenzene (DNCB) and treated with either 1% hydrocortisone (Cortizone-10 Max Strength) alone, 1% hydrocortisone followed by Cetaphil (emollient), or Cetaphil followed by 1% hydrocortisone. We assessed the efficacy of the treatments by measuring: body weights, area scores, severity scores, and IgE levels. For all measurements, there were no statistically significant differences seen between the treatment groups. Of note, there were also no statistically significant difference seen between the treatment groups and the control untreated group. The findings may be useful in harmonizing the treatment plans in healthcare.

## INVESTIGATING THE IMPACT OF EPISODIC STELLAR ACTIVITY ON PLANET FORMATION AND EVOLUTION

Elyana Crowder<sup>1</sup> and Ana Uribe<sup>1</sup>, Maximiliano Moyano<sup>2</sup>, Giovanni Pinzon<sup>3</sup> and Joe Carson<sup>1</sup>  
<sup>1</sup>College of Charleston <sup>2</sup>Universidad Católica del Norte <sup>3</sup>Universidad Nacional de Colombia

Stellar activity such as flares can greatly impact the viability of life on a planet by increasing the amount of harmful radiation capable of reaching the surface (Osten *et al.* 2010). By investigating young star systems known to exhibit variable brightness, we sought to better characterize episodic activity observable on timescales of days to weeks and its role in the formation and evolution of possible orbiting planets. Using archived imaging data, we analyzed the episodic photometric variability of three young target systems: TW Hya, AT Mic, and AU Mic. Here we present our preliminary results on the significance of these brightness variations and the implications for the systems.



## USING SIRNAS TO DOWNREGULATE HIV-1 TAT EXPRESSION AND DECREASE VIRAL PRODUCTION IN SIRNA-PROTECTED T LYMPHOCYTE POPULATIONS

Christian Fay and William Jackson  
University of South Carolina Aiken

The Human Immunodeficiency virus (HIV-1) acts to infect and destroy CD4 T Helper lymphocytes. The destruction of these cells leads to a gradual loss of immune competence and eventually, the Acquired Immunodeficiency Syndrome (AIDS). HIV-1 is a lentivirus that expresses a regulatory protein that acts to control transcription from the viral promoter/enhancer. HIV-1 Tat functions through binding to the viral trans-activating response element (TAR) which is a small hairpin RNA transcribed as the first 60 nucleotides of all HIV-1 mRNAs. The Tat/Tar association recruits the host PTEFb complex to phosphorylate the C-terminal domain of RNA polymerase II. This activity increases the enzyme's processivity and leads to upregulation of viral transcription. In the absence of Tat, viral transcription is inefficient and replication is inhibited. Our lab has designed and cloned four anti-Tat shRNAs, under the control of the RNA Polymerase III H1 promoter, into the retroviral vector pLGN. Recombinant viruses have been generated using each of these vectors and used to transduce Jurkat and HeLa cells. These cells are GFP-positive indicating successful transduction of the recombinant provirus. Cellular genomic DNA will be analyzed by PCR to verify integration and total RNA will be analyzed for siRNA expression by RT-qPCR. The ability of these shRNAs to inhibit viral replication will be analyzed in HIV-1 challenge tests using the HIV-1 genomic clone pNL.LucR.T2A, which express Renilla luciferase as a marker for virus replication.

## ASTROCYTES UNDER PRESSURE: EXAMINING CELL MIGRATION IN AN *EX-VIVO* MODEL OF HYDROCEPHALUS

Stephen Frederico<sup>1,2</sup>, Ryan Gedney<sup>1</sup>, Michael E. Smith<sup>1</sup>, and Ramin Eskandari<sup>1</sup>

<sup>1</sup>Medical University of South Carolina, <sup>2</sup>College of Charleston

Very little is known about what happens to cell migration in the brain of individuals with elevated intracranial pressure (ICP), especially when elevated ICP is maintained for an extended period of time. The mechanisms of secondary injury to brain tissue resulting from sustained increases in ICP are not fully understood and may provide a means of therapeutic targeting that can prevent cognitive deficits and improve the outcomes of patients with hydrocephalus.

Here we present a model for studying the changes in migratory response of human astrocytes following insult, using an *ex-vivo* model that combines 3D cell cultures and the newly developed pressure-controlled cell culture incubator (PC<sub>3</sub>I).

The PC<sub>3</sub>I allows cells to be exposed to elevated pressure under controlled conditions and is effective at modeling different types of pressure conditions so we may directly study the effects of increased pressure on cellular growth, proliferation, migration, and death of cells. Peptide-conjugated alginate hydrogel scaffolds were formed, and a small aliquot of astrocyte containing alginate was injected to an isolated portion of the hydrogels. The number of cells within the entire scaffold were assessed using a fluorescent LIVE-DEAD assay. Migration was quantified by assessing the change in the number of cells in different regions of the hydrogel over 7 days and 14 days. Total cell change, normalized to initial injection concentration, was measured for each region over time to assess the effects of pressure on cell migration.

Overall, we found differences in the migration of cells following pressure exposure when compared to controls, including an acceleration in the migration of astrocytes in several regions following extended pressure exposure of 8, 24, and 48 hours. We can interpret this as a direct reaction of astrocytes to pressure insult, dependent on the amount of time of pressure exposure, and may have implications in some of the pathophysiology of hydrocephalus. Future experiments are planned to study of the effects of pressure on other cell types including neurons and co-culture models to compare the difference between neuron and astrocyte migration after pressure exposure.

## VOC SPATIAL AND TEMPORAL CHANGES ALONG A TCE PLUME FRINGE AT SAVANNAH RIVER SITE

Tawanda Gallman, Edgar Diaz, Ebony Corbitt, and John B. Williams  
South Carolina State University

In order to monitor the suitability of natural attenuation for remediating the SRS Chemicals, Metals, Pesticides (CMP) Pits plume fringe, intensive sampling of shallow groundwater for different reaches of Pen Branch was conducted from 2005 to 2017. Volatile organic compounds (VOC) were analyzed for the critical hyporheic zone beneath Pen Branch and adjacent floodplain. The study plume originated from CMP Pits, a waste disposal area in operation from 1971 to 1979, when the pits were closed and backfilled. Monitoring well data indicated that perchloroethylene (PCE) and trichloroethylene (TCE) had seeped beneath the vadose zone and formed groundwater plumes reaching the Pen Branch valley below. Although hot spots of TCE were found within the Pen Branch floodplain, it was unknown just how the flow pattern was entering Pen Branch and to what degree natural attenuation was reducing the contaminant load. For this reason, our stations were located along the Pen Branch reach bordering the modelled plume fringe. In general, VOC was highest at sampling stations in the middle study zone. Moderate VOC levels were detected at upstream stations and lowest VOC was found at downstream stations. Collectively PCE, TCE, and their degradation products displayed a favorable yearly trend of contaminant reduction. Total VOC concentrations at some stations declined by about 25% and concentrations of vinyl chloride (VC), a nearly-final stage degradation product increased from 0.0 ppb to about 20 ppb. Temporal patterns display a continued reduction of VOC, while spatial patterns may indicate a slow progression of the plume downstream along Pen Branch.

## PHOTOPHYSICS OF PHOTOCHROMIC CHROMOPHORES IN CONFINED ENVIRONMENTS

Haley Gregory, Ekaterina Dolgoplova, and Natalia Shustova  
University of South Carolina Columbia

Photochromic materials are known for their ability to switch between two isomers when they are irradiated with different wavelengths of light. This property makes them viable materials for utilization in different “smart” materials (e.g. transition lenses) and sensors.

In our work, we focused on understanding the photophysical behavior of diarylethene-based compounds in different environments: solid state, solution, and confined environment of the rigid matrix (metal-organic framework). We extensively characterized prepared materials by UV-vis and diffuse reflectance spectroscopies. As a result, we showed that incorporation of diarylethene-based compounds inside porous framework can drastically change their photophysical properties, which can be utilized for the development of the next generation of sensing materials.

## THE EFFECTS OF SUGAR, CAFFEINE AND EXERCISE ON ANXIETY-LIKE SYMPTOMS AND SHORT-TERM MEMORY IN RATS

Marissa Gross and Michelle Vieyra  
University of South Carolina Aiken

The purpose of this study was to look at the effects of sugar, caffeine diets and exercise, alone and in combination, on anxiety-like symptoms and memory in rats. Both sugar and caffeine have been shown to increase anxiety while exercise decreases it. Sugar and caffeine have detrimental effects on short term memory while exercise can increase neurogenesis and therefore memory performance. Thirty male Sprague-Dawley rats were used in this study. These rats were randomly placed into one of 6 groups containing 5 rats each: 1) sugar, sugar + exercise, 2) sugar and caffeine, 3) sugar and caffeine + exercise, 4) exercise alone, and 5) control. After 16 weeks the rats were put through a battery of behavioral exams including a fur-coat state and light-dark box to test for anxiety-like symptoms and a novel object recognition task to test for short term memory. Videos of the behavior sessions are still being analyzed but we predict that the exercise groups will score the higher on the memory tasks and show decreased anxiety-like symptoms compared to their dietary matched groups without the exercise while the sugar and caffeine alone groups will do more poorly than the control.

## INVESTIGATING CRITICAL FLUIDS IN SIMULATED WEIGHTLESSNESS

Christian Hawkins and Ana Oprisan  
College of Charleston

Critical and supercritical fluids have a variety of applications, from use as machine lubricants in high pressure or high temperature environments to the manufacturing of materials such as aerogel. The compressibility of a fluid rapidly increases as the fluid approaches its critical temperature. Under a gravitational field, this can cause the fluid to stratify, making it difficult to study the optical properties of critical, and near critical fluids. Therefore, it is necessary to study near critical fluids in a reduced gravity environment. The optical properties of fluids also undergo rapid changes near the critical point and critical opalescence results in light attenuation, or turbidity increase, and can be used to probe the universality of critical behavior. Turbidity measurements in critical oxygen suspended in a magnetic field were performed to investigate such behavior in terms of temperature relative to the critical point. We analyzed intensity map data to determine the light transmission and turbidity measurements of 450 nm, 500 nm, and 650 nm light projected through cells containing near critical oxygen.

## CHANGES IN THE PREFRONTAL CORTEX REVEALED BY OPTOGENETIC EXPERIMENTS

Jessica Helms<sup>1</sup>, Xandre Clementsmith<sup>1</sup>, Antonieta Lavin Lavin<sup>2</sup>, and Sorinel Oprisan<sup>1</sup>  
<sup>1</sup>College of Charleston <sup>2</sup>Medical University of South Carolina

Neurons are excitable cells in the sense that an external electrical/chemical stimulus can elicit a large electrical response called an action potential (AP) spike. Neurons form large neural networks, such as the prefrontal cortex (PFC) which is involved in decision making, social behavior, and complex cognitive functions. We record the average electrical activity called local field potentials (LFPs) obtained in vivo from mice. The PFC was stimulated using optogenetics, i.e. shining light with a specific wavelength on the region of interest to force genetically modified neurons to fire Aps. We studied the modulatory effect of dopamine on PFC activity. Dopamine is a chemical released by neurons to send and modulate the signals to other neurons. Among the most studied dopamine pathways is the one involved in reward-motivated behavior. We successfully reconstructed the high-dimensional neural activity from LFPs and compared it against the control cases. This research was supported by NSF Career award IOS 1054914 to SAO, National Center for Research Resources (5 P20 RR016461) and the National Institute of General Medical Sciences (8 P20 GM103499) from the National Institutes of Health, and a grant from the Howard Hughes Medical Institute to the College of Charleston as part of their 2012 Undergraduate Science Education Competition.

NEW STATISTICAL METHODS FOR ANALYZING SIMULATIONS OF MATERIALS AND ITS APPLICATION  
TO AN IONIC LIQUID

Stuart Hodge and Mark Berg  
University of South Carolina Columbia

Chemists can create computer simulations of new materials that generate a time-series of a molecule's fluctuating properties. However, new statistical methods are needed to extract chemical information from these large data sets. This project introduces a new method of time-series analysis, which we call modal correlation functions, and tests it on a simulation of the local electric field in an ionic liquid. The chemical question is whether these new materials behave like supercooled liquids, for example, having either jump dynamics or rate heterogeneity. A previous analysis by multidimensional correlation functions saw features that were attributed to these characteristics. That interpretation predicted a non-Gaussian Green's function. From a matrix of modal correlation functions, we have fully reconstructed this Green's function. However, it is a complex, multivariable function that is difficult to visualize directly. Therefore, we have also created summary statistics that specifically test the Green's function for non-Gaussian behavior. These statistics were tested on the full reconstruction to prove they are numerically practical. The Green's function is found to be Gaussian at all times, a result inconsistent with either jump dynamics or rate heterogeneity. This ionic liquid does not have the characteristics of a supercooled liquid. The interpretation of the previous analysis must be revisited

1ST GENERATION AMPEROMETRIC BIOSENSING: AN ADAPTABLE TEMPLATE FOR LABORATORY RELEVANT  
MEASUREMENTS OF GALACTOSE AND XANTHINE

Gillian Horn and Will Case  
Converse College

Biosensors are analytical devices that can be used to detect markers implicated in various disease states. 1st generation amperometric biosensors rely on a chemical reaction between an analyte and a specific oxidase enzyme that results in the production of hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>.) The resulting peroxide is subsequently oxidized at a working electrode, and this oxidation generates a current that is proportional to the amount of target analyte present.

This presentation presents our current findings toward the development of a 1st generation amperometric biosensor for the detection of galactose and xanthine, which are molecules implicated in galactosemia and xanthinuria respectively. In addition to being a biomarker for xanthinuria, xanthine also serves as an indicator of meat spoilage. These findings will include the advantages of using silane-generated xerogels as enzyme immobilization scaffolds and their effect on biosensor sensitivity and linear stability and analytical recovery. The benefits of incorporating an outer urethane membrane were also studied, as well as the ability of the biosensor to discriminate against common interferents. Xerogel-based amperometric biosensors could provide a new method for diagnosing disease, as well as monitoring food spoilage and may lead to the development of an adaptable template capable of signaling an array of target molecules.

CAN HOUSE PRICES OF CHARLESTON BE PREDICTED?

Pang-jui Hsu and Bo Li  
The Citadel

In this paper, we will discuss how the following factors: distance, crime rate and income affect the house prices around downtown adjacent areas, Charleston SC. After gathering data, we will use R to fit a multiple linear regression model. We would like to predict the house prices based on the significant factors included in the model. A prediction band based on normal theory indicates how house prices vary according to explanatory variables.

**ABSTRACT WITHDRAWN**

## CLONING AN ANTI-REV SHRNA TO INHIBIT HIV-1 REPLICATION

Bethany Jameson and William H. Jackson  
University of South Carolina Aiken

HIV-1, the Human Immunodeficiency Virus, is a retrovirus that attacks and destroys CD4 T helper lymphocytes leading to a progressive inability to fight infection and ultimately the Acquired Immune Deficiency Syndrome (AIDS). A potential target for anti-HIV-1 treatment is the viral regulatory gene, Rev. Rev is a small protein expressed early in virus replication. As Rev builds up in the cell, it is localized to the nucleus where it binds to viral transcripts containing the Rev Response Element (RRE) located within the env coding region. Upon binding, Rev facilitates nuclear export of partially spliced and unspliced mRNAs, which encode the viral structural proteins and genomic RNA for packaging. In the absence of Rev, viral replication is inhibited. The goal of this project is to design and clone an anti-Rev shRNA for use in assays designed to measure the effect on viral replication. The Rev genetic sequence was obtained from the HIV-1 NL43 genomic clone (Accession number M19921) and analyzed for potential siRNA binding sites using the Biosettia shRNA designer (Biosettia.com). One site, located at nucleotides 8622-8640 was selected and used to generate a shDNA for cloning. The shDNA was synthesized (Integrated DNA Technologies) and the resulting oligonucleotides were cloned into the retroviral vector, pSuper.retro.neo+GFP under the control of the RNA Polymerase III H1 promoter.

## ANALYZING ANTHROPOGENIC EFFECTS ON SANDY BEACHES AND MEIOFAUNAL COMMUNITY COMPOSITION USING METABARCODING

Douglas Johnson, Jeremiah JonesBoggs, and Julian Smith III  
Winthrop University

Marine meiofauna, comprising sub-millimeter representative from most animal phyla, is ubiquitous in the marine benthos, ranging from the intertidal to the deep ocean. Continuing controversy exists over their relative importance in benthic ecosystem processes. Therefore, their importance to the essential ecosystem services provided by marine benthos remains open to question. Although recent research has shown that meiofauna can exert significant effects on sediment structure and stability, nutrient cycling, waste removal, and linkage of microbial production to higher trophic levels, whether or not these results are general is unknown. The question is important because the meiofauna is affected by the same anthropogenic stressors to which marine benthic communities are currently exposed. Therefore, in addition to hypothesis-testing, it is also important to have a baseline for comparison in order to detect future changes in marine meiofaunal communities. Broadly, we propose to establish community metabarcoding as a technique at Winthrop University, to use that technique to determine alpha diversity of the meiofaunal communities from two sites differing in degree of anthropogenic stress, and to use a modified version of community metabarcoding to determine trophic connections in these meiofaunal communities.

## THE EFFECT OF HDAC INHIBITION ON TBX5B EXPRESSION

Alec Jones and April DeLaurier  
University of South Carolina Aiken

Valproic acid (VPA) is known to inhibit class I and II HDAC activity and exposure at low doses has been shown to disrupt development of the pancreas, liver, and pharyngeal teeth in zebrafish. Using a high dose of VPA, we observe a strong phenotype in exposed zebrafish, which includes cardiac defects, reduced forelimb growth, and ocular coloboma. This suite of phenotypic defects is identical to phenotypes observed in Tbx5 loss-of-function studies in zebrafish and other model organisms. Transcription factors *tbx5a* and *tbx5b*, paralogs of *tbx5*, have previously been shown to co-express in both the heart and eye, and are responsible for the developing fin buds, and establishing cardiac asymmetry and the retinal axis. Current research suggests these duplicates may have subfunctionalizations in zebrafish, and may be regulated differentially during development. It is not known how VPA or HDACs target Tbx5 expression in zebrafish. However, our initial observations support a hypothesis that Tbx5 is a target of HDAC repression during normal development, and that loss of Tbx5 produces the phenotypes associated with VPA exposure. Semi-quantitative RT-PCR of 1 and 2 dpf larvae, treated with either 0.5 or 1.0 mM VPA, revealed increased *tbx5a* activity in a dose-dependent manner, while a corresponding decrease of *tbx5b* expression was observed. The reduced expression of *tbx5b* observed in VPA-treated fish suggests that it is positively regulated by HDACs, while the increase in *tbx5a* mRNA implies that HDACs normally repress *tbx5a* transcription. Regarding the observed phenotype, which is consistent with loss-of-function of *tbx5a*, subfunctionalization of both paralogs may explain why *tbx5a* is unable to rescue the loss-of-function phenotype associated with *tbx5b* downregulation. qPCR analysis of expression of *tbx5a* and *tbx5b* in VPA-treated fish is in progress; qPCR analysis of expression of downstream targets of Tbx5, including *tbx2b*, *bmp4*, *fgf24*, *hey2*, and *nppa* is also in progress. We will also be analyzing tissue-specific mRNA expression of *tbx5a*, *tbx5b*, *bmp4*, *hey2*, and *vcana* in embryos and larvae using mRNA in situ hybridization to establish if expression levels change with VPA exposure. This research suggests a novel function for Hdacs as upstream regulators of Tbx5, which has important implications for understanding mechanisms in human genetic diseases related to the Tbx5 regulatory pathway, including Holt-Oram Syndrome or other phenotypically-related disorders.

## INVESTIGATING THE *MPING* TRANSPOSITION COMPLEX THROUGH OVEREXPRESSION OF ORF1 AND TRANSPOSASE PROTEINS

Reese King and C. Nathan Hancock  
University of South Carolina Aiken

Transposable elements (TEs) are mobile DNA segments found throughout many organisms' genomes. While most TEs exist in low numbers and are relatively inactive, some regularly relocate to new genomic locations. For these "jumping genes" to be mobilized, proteins must interact with the element's ends and catalyze DNA cleavage. This project studied *mPing*, a highly active rice transposon that is mobilized by two proteins, ORF1 and Transposase. Understanding the ratio and organization of these proteins in the transposition complex sheds light on the transposition mechanism. Previous results indicate that ORF1 forms oligomers and binds to Transposase. To consider the number and function of these proteins in the transposition complex, we tested the effects of ORF1 and Transposase overexpression on transposition rates in yeast. Overexpression of ORF1 increased transposition, while overexpression of Transposase negligibly effected transposition. We thus determined that ORF1 is the limiting factor governing transposition. Subsequently, we tested whether overexpression of partial ORF1 and Transposase proteins would disrupt transposition. We hypothesized that partial proteins having the ability to interact with the complex will disrupt transposition, resulting in a dominant-negative effect. Yeast transposition assays were conducted with the addition of N-terminal and C-terminal halves of the ORF1 and Transposase proteins. The strongest dominant-negative effects (lowest transposition rates) were observed in constructs with overexpression of the ORF1 C-Terminal and Transposase C-Terminal, suggesting that these regions of the proteins contain domains important in transposition complex binding. Of these, the ORF1 C-Terminal domains appear to be more important for transposition complex activation.

## COULD MAST CELLS BE EARLY DIAGNOSTIC MARKERS OF COLORECTAL CANCER?

Nabihah I. Kumte<sup>1</sup>, Alena P. Chumanevich<sup>1</sup>, Ahmed Aladhmi<sup>1</sup>, Ioulia Chatzistamou<sup>1</sup>,  
Tia Davis<sup>2</sup>, Marj Peña<sup>2</sup>, John W. Fuseler<sup>1</sup>, and Carole A. Oskeritzian<sup>1</sup>

<sup>1</sup>University of South Carolina School of Medicine <sup>2</sup>University of South Carolina Columbia

Colorectal cancer (CRC) is one of the three most common causes of cancer-related deaths worldwide. Mast cells (MC) function as initiators and immunomodulators of many inflammatory disorders such as cancer initiation and progression. Once MC reach the tissues where they inhabit during homeostasis, they differentiate into one of two possible phenotypes defined by specific proteases stored inside cytoplasmic granules that characterize MC. In mice, MC that express tryptase are identified as mucosal (M)MC, while MC that express both tryptase and Chymase are identified as connective tissue (CT)MC.

Previous research has found that nearly 85% of sporadic colon cancer has been linked to the inactivation of adenomatous polyposis coli (Apc) gene, a critical tumor suppressor gene which prevents colon malignancies in humans. Similarly in mice heterozygous for the Apc gene (Apc<sup>Min/+</sup>), Apc-deficient cells appear due to the heterozygosity loss.

Screening for CRC is invasive and often avoided by at-risk patients. It's hypothesized that MC slough off in the colonic lumen of sick mice and can therefore be collected using a rectal swab.

Staining of samples revealed and transformation among ApcMin/+ colonic tissue, reasoning that MC may be sloughing off into the lumen of ApcMin/+ mice but not WT mice. The findings also suggest that premalignant stages of CRC are associated with MC phenoconversion from MMC to CTMC. Staining of the rectal swabs suggest that MC slough off in the lumen of the ApcMin/+ group but not the WT group, and that they can be collected through a minimally invasive swab.

## UNDERSTANDING THE BACTERIOPHAGE POPULATION IN THE PONDS AND STREAMS ON THE CAMPUS OF COASTAL CAROLINA UNIVERSITY.

Alyssa LeClaire and Paul E Richardson  
Coastal Carolina University

Bacteriophages are viruses that target strains of bacteria, injecting them with copies of their genetic material, reproducing, lysing the cell, and moving on to the next host. Millions of bacteria inhabit the environment around us, and while it may be difficult for humans to defend themselves from microscopic bacteria, bacteriophages specialize in destroying these microbes. That is why they have an essential role in controlling the microbial population in every environment. The purpose of this study was to collect and identify naturally occurring bacteriophages in the ponds and stream on the campus of Coastal Carolina University and understand the environmental factors that influence this essential population. Environmental conditions on campus were recorded to help determine the factors involved in the bacteriophage population dynamic. Both microbial plaque assays and PCR based methods were used to detect/identify bacteriophages collected from the water samples on campus. The results indicated a plethora of bacteriophages on campus, but not all of these viruses were characterized based on the primer sets used in this study.

## COPPER AND CHROMIUM HEAVY METAL ANALYSIS OF *FUNDULUS HETEROCLITUS* FROM GEORGETOWN, SOUTH CAROLINA

Scarlett Leigh, Dung (Kristine) Giang, and Julia Baker  
Columbia College

In aquatic environments, heavy metals are accumulated from natural sources and human interaction with the environment. The copper and chromium heavy metal concentrations in the fish species *Fundulus heteroclitus* were assessed from the pristine environment of North Inlet of Belle W. Baruch Marine Lab at Hobcaw Barony and the more polluted water in the Georgetown Harbor.

*Fundulus heteroclitus* samples from the North Inlet were easily obtained using minnow traps. Whole fish samples were digested with nitric acid and analyzed by atomic absorption spectroscopy. *Fundulus heteroclitus* samples from the Georgetown Harbor proved more difficult to obtain so samples previously caught from this site by Dr. Marlee Marsh's group at Columbia College were used instead. These samples, however, came without livers which raised another research question on the importance of the liver in metal accumulation in *Fundulus heteroclitus*. As a result, the fish samples were analyzed in two categories: with and without livers.

Copper is an essential nutrient for fish and actually protects them against certain parasites. Recommend levels for healthy fish are 0.15 to 0.20 ppm. Each fish sample was prepared in triplicate and analyzed twice. The sample from Belle W. Baruch without livers had the copper concentration of  $0.15 \pm 0.02$  ppm. The sample from Georgetown Harbor without livers gave a copper concentration of  $0.167 \pm 0.009$  ppm. The Belle W. Baruch sample with livers had the highest concentration of copper at  $0.281 \pm 0.006$  ppm. The results indicate the liver is the organ that accumulates the most copper metal in *Fundulus heteroclitus*. Fish with livers from Belle W. Baruch Marine Lab had the higher concentration of copper than the recommended amount even though their living conditions are monitored. Fish samples without livers from the Georgetown Harbor had a slightly higher copper concentration than those from the North Inlet of Belle W. Baruch Marine Lab probably due to marine environment impacts from the paper mills and antifouling boat paints.

Chromium (III) is an essential element for the human body found in vegetables, fruits, and trace element in the production of insulin. However, chromium (VI) is a toxic, carcinogenic, byproduct of textile manufacturing, stainless steel production, and wood preservation. Chromium tends to accumulate in the gills of fish and the recommended levels of chromium are less than 25 ppm. The sample of fish from Belle W. Baruch without livers showed a chromium concentration of  $3.7 \pm 0.3$  ppm. The sample from Belle W. Baruch with livers had a concentration of  $5.7 \pm 0.3$  ppm. The sample with the highest concentrations of chromium was from the Georgetown Harbor without livers at  $8.2 \pm 0.2$  ppm. The fish obtained from the Georgetown Harbor without livers contained more than twice as much chromium as the fish from Belle W. Baruch Marine Lab. Samples of *Fundulus heteroclitus* with livers from the Georgetown Harbor need to be obtained and analyzed to give a more complete analysis of copper and chromium levels in these fish as compared to those from the North Inlet of Belle W. Baruch Marine Lab.

## ACOUSTIC BRAGG IMAGING

Gunther Martin and Alem Teklu  
College of Charleston

I constructed an Acousto-Optic Bragg imaging system in the Solid State lab of the Department of Physics and Astronomy. Our main objective was to construct an inexpensive imaging system and be able to image a biological object using ultrasound. For this purpose, we constructed a 7 MHz square transducer using a 3D printer available at the College that saved us hundreds of dollars. The propagation of a high frequency wave and metal objects were successfully imaged using this newly constructed system. The next step is to image a biological object such as a leaf. Image processing techniques were utilized to enhance the images obtained. The schlieren photographic technique was also used to study the interaction between an ultrasound beam and laser light.

## DESIGNING AND CLONING OF AN ANTI-REV SHRNA AGAINST HIV INFECTION

Geneva Masak and William H. Jackson  
University of South Carolina Aiken

Human Immunodeficiency Virus (HIV) is a lentivirus that infects CD4 T-lymphocytes, compromising the immune system and leading to the Acquired Immunodeficiency Syndrome (AIDS). One of HIV's regulatory proteins, the regulator of virion proteins (Rev), is fundamental for HIV replication, and functions by facilitating the export of unspliced and partially spliced mRNA out of the nucleus. One way to inhibit this pathway is through RNA interference (RNAi), in which a short interfering RNA (siRNA) can be designed to target a specific mRNA, such as Rev. To create a siRNA targeted to Rev, the Rev sequence from the HIV-1 NL43 genomic clone (Accession number M19921) was analyzed using Integrated DNA Technology's RNAi Design Tool (idt.com). One sequence, located at nucleotides 8526-8542, was selected and a shDNA was designed for cloning into the retroviral vector, pSuper,retro.neo+GFP (pSRNG). The shDNA oligonucleotides were synthesized and cloned into pSRNG under the transcriptional control of the RNA Polymerase III H1 promoter. Once correct cloning of the shRNA is verified, expression studies will be carried out in cell culture to determine the ability of the shRNA to inhibit Rev function.

DETERMINING THE FIRST INTERMEDIATE HOST TO PARASITES *GLOSSOCERCUS CARIBAENSIS* AND *CYCLUSTERA IBISAE* THAT ARE FOUND IN *FUNDULUS HETEROCLITUS* IN THE NORTH INLET-WINYAH BAY NATIONAL ESTUARINE RESEARCH RESERVE

Emiley Masloski and Marlee Marsh  
Columbia College

*Fundulus heteroclitus* serves as hosts to many parasites providing a model system to investigate questions in regards to evolution and ecology of host-parasite interactions in natural populations. Previous research shows that *F. heteroclitus* from the North Inlet Estuary at Belle W. Baruch serve as second intermediate hosts to cestodes, *Glossocercus caribaensis* and *Cyclustera ibisae*. Finding larval parasites in the first intermediate host will complete gaps in the knowledge about these parasites' life cycles. In the experiment, 27 fish were collected from the North Inlet Estuary and were dissected and examined for parasites, specifically the fish gastrointestinal tract. Parasites collected were sent to parasitologist, Dr. Anindo Choudhury, who is the associate editor for the Journal of Parasitology, for identification. The parasites were positively identified as *G. caribaensis* and *C. ibisae*, indicating that the cestodes were still present in the community. Then, possible first intermediate hosts were collected from the North Inlet Estuary; these specimens included snails, clams, and grass shrimp. These specimens were dissected and examined for early stage tapeworms. Parasites found were also sent to Dr. Choudhury to be identified. Several different species of parasites were found in dissection of first intermediate hosts. Parasites identified were isopods, trematodes, and possible cestodes.

COMPARING PROGESTERONE LEVELS IN PLASMA AND SALIVA WITH AN EXOGENOUS PROGESTERONE SOURCE

Jessica Mau and Staci Johnson  
Southern Wesleyan University

Exogenous hormones are utilized to synchronize estrus in beef or dairy cattle. One such device is the controlled internal drug release device (CIDR), which uses a natural progesterone. Blood tests are the normal method to analyze the levels of progesterone circulating in the body. However, some studies have shown this method is not always reliable and have indicated that outside sources of progesterone travel differently within the lymphatic system than the blood (O'Leary *et al.*, 2000). It seems possible that progesterone travels through the lymphatic system at greater levels than the circulatory system to a target tissue when provided by an exogenous source. Our research question was "What is the relationship between progesterone levels in the blood and saliva when an exogenous hormone source is present?" Blood and saliva samples were collected daily for four days from ten multiparous Angus X Hereford cows beginning on day 2 of the 5-day CO-Synch + CIDR synchronization protocol. Levels of progesterone were quantified by enzyme-linked immunosorbent assay (ELISA) kit (ENZO ADI-901-011) in the both plasma and saliva samples. No correlation was found between the level of progesterone between the plasma and saliva samples in this study (Spearman's  $\rho=0.1571$ ), although there was a significant difference between the progesterone levels of plasma and saliva ( $W<0.0001$ ). It remains to be determined if progesterone from an exogenous source depends more on the circulatory system for delivery to target tissue or if a different mechanism for delivery exists in the lymphatic system.

GAMMA-RAY BURST CLASSIFICATION: NEW INSIGHTS FROM MINING PULSE DATA

Stanley McAfee and Jon Hakkila  
College of Charleston

Despite being the most energetic electromagnetic explosions in the universe, gamma-ray bursts (GRBs) are still poorly understood. The literature recognizes two potentially different types of GRB progenitors, although statistical data suggest the existence of three GRB classes. Reliable inference of GRB physics depends on the identification of appropriate classification attributes, as well as on the statistical classification techniques used. It has recently been shown that pulses are the basic unit of GRB emission. We use new data describing GRB pulse characteristics, in conjunction with data mining tools, to provide a more reliable gamma-ray burst classification system and place additional constraints on GRB physics. We demonstrate that fewer pulses are needed to describe GRB emission than has been suggested by previous analyses, and find pulse duration to be one of the greatest delineators between GRB classes.

CREATING A SHUTTLE VECTOR FOR CLONING ANTI-HIV-1 SHRNAS

Keileigh McMurray, Kylie Tager, and William H Jackson  
University of South Carolina Aiken

The Human Immunodeficiency Virus (HIV-1) is a lentivirus that infects and destroys CD4 T Helper cells. The eventual loss of these cells results in a progressive inability of the immune system to protect against infections. The complete loss of immune protection is a hallmark of the Acquired Immunodeficiency Syndrome. (AIDS). There were approximately 36.7 million people living with HIV at the end of 2016. Because current treatments cannot fully remove the virus from infected cells, there is a continued need to investigate methods to prevent virus replication. Our objective is to create a shuttle vector that can be used to insert anti-HIV-1 shRNAs for testing under the control of the RNA Polymerase III H1 promoter. We have amplified the H1 promoter and associated cloning sites from the retroviral vector pSuper.Retro.neo+GFP. The 1.3 kb fragment was gel purified and cloned into the pMiniT 2.0 PCR cloning plasmid, creating a vector that can be used clone and test the efficiency of siRNAs to degrade specific HIV-1 mRNAs.

## MEASURING THE EFFECTS OF CAFFEINE AND EXERCISE ON METABOLIC DISTURBANCES IN RATS FED A HIGH SUCROSE SOLUTION

Emily Mele and Michelle Vieyra  
University of South Carolina Aiken

The purpose of this study was to examine the beneficial metabolic effects caffeine and exercise have in rats who consume excess amounts of sugar. Over 38% of the US population is obese, primarily from excessive consumption of additive sugars found in soft drinks and other sugar-sweetened beverages. Excess sugar consumption has been linked to an increase in type 2 diabetes, non-alcoholic fatty liver disease, and metabolic syndrome. Exercise and caffeine have been shown to prevent weight gain, reduce the risk of type 2 diabetes, and promote lipolysis in rat models. Rats were used during this experiment to simulate the metabolic effects caffeine and exercise have on consuming sugar at a level similar to the average American. Rats were randomly divided into six groups; sugar only, sugar + exercise, sugar + caffeine, sugar + caffeine + exercise, exercise only, and control. After 15 weeks rats were subjected to blood glucose testing, weighting, and euthanasia. Dissections were performed after rats were euthanized and visceral fat and livers were extracted and weighted. A modified Folch procedure was used to extract liver lipid content. Results indicated that the sugar only group accumulated a higher amount of visceral fat, followed by the sugar + caffeine group. This was reflected in the total amount of weight gained. The remaining groups were similar in weight gain and visceral fat content and will need further statistical analysis. Normalization of liver weight is needed to reduce the amount of variance in size and the Folch procedure is underway.

## TRANSLATIONAL RESEARCH METHODS WITH HIGH-RESOLUTION 2D AND 3D TOPOGRAPHIC SCREENINGS FOR DETECTION OF CANCER

David Melnick, Elyana Crowder, Blake Mino, and Joseph Carson  
College of Charleston

We present a method for high-resolution 2D imaging and 3D topographic modeling of the human body, using an inexpensive homespun imaging system and advanced computer vision techniques native to astronomy. During data acquisition, a liquid lens dynamically changed focal settings to rapidly evaluate depth of field information, and thus generate true depth maps using advanced principal component analysis. This same technique was also used to reveal small-scale structures not available to conventional imaging with this kind of device. After acquiring data from an organic specimen, preliminary results show the device's applicability toward early detection and research in cancer, both on a micro and macro scale.

## A NOVEL 3D IMAGING TECHNIQUE FOR CANCER DIAGNOSES

Blake Mino<sup>1</sup>, David Melnick<sup>1</sup>, Elyana Crowder<sup>1</sup>, and Yu-tsueng Liu<sup>2</sup>  
<sup>1</sup>College of Charleston <sup>2</sup>University of California San Diego

Developed to be a low-cost, easy-to-use tool for medical personnel to use in areas of the world without proper medical equipment or care, this device is useful for diagnosing cervical pre-cancer. While cervical cancer is the primary focus of this project, the device could be used for other purposes, such as throat or anal cancer diagnosis. The device and its accompanying software are capable of creating 3D images from a single perspective by taking multiple photos at varying focal powers. The device consists of a pen camera, a liquid lens, and an LED light ring all encased in a slim enclosure. The liquid lens is capable of rapidly changing focus allowing for photos to be taken in quick succession. Using re-purposed astronomy image processing techniques, the photos are combined and a 3D model is created by determining which area of the image is in focus at which focal power. Recent work on the project includes an improved distortion correction code and testing the device on a fetal pig.

## DETERMINING HOW PHF21A AFFECTS CRANIOFACIAL DEVELOPMENT IN ZEBRAFISH

Lacie Mishoe and April DeLaurier  
University of South Carolina Aiken

In humans, mutations in the transcriptional repressor PHF21a (PHD finger protein 21A) causes craniofacial defects resulting in Potocki-Shaffer Syndrome. Previously, it was observed that knockdown of phf21a in zebrafish caused defects to embryonic cartilage. It is therefore hypothesized that Phf21a functions in zebrafish similarly to how it functions in humans, and thus we can use zebrafish to understand the physiology of Potocki-Shaffer syndrome. In our lab, we generated lines of zebrafish with insertions and deletions in the co-orthologs of phf21aa and phf21ab using CRISPR-Cas9. An F0 line was outcrossed to create an F1 generation, and F1 zebrafish are being screened to identify heterozygotes using PCR and T7 endonuclease digest. PCR produces a product which is gel extracted. The product of gel extraction is then heated and slowly cooled, producing mismatches between wild-type and mutant DNA. T7 endonuclease digest of mismatched products results in digestion of the product into two fragments. If a fish is heterozygous for a mutant allele, the T7 assay will reveal two lower bands on a gel which equals the size of the original PCR product. For phf21aa heterozygotes, the PCR product is 995 base pairs and the T7 endonuclease digest products are 720 and 275 base pairs. For phf21ab heterozygotes, the PCR product is 613 base pairs and the T7 endonuclease digest products are 447 and 166 base pairs. The fish that contain the lower bands will be outcrossed to AB wild type fish to generate an F2 line and these fish will also be genotyped. The F2 generation will be increased resulting in 25% homozygous mutants and will be stained with dyes to label the bone cartilage. Using a dissecting microscope, the mutant zebrafish will be screened for evidence of skeletal patterning defects. Studying how disruptions to phf21aa and phf21ab affect skeletal development in zebrafish can help us to understand the normal functions of these genes in craniofacial development and how mutations cause Potocki-Shaffer syndrome defects.



QUANTITATIVE ASSESSMENT OF CARBONYL LONE PAIR-PI INTERACTIONS USING  
A SMALL MOLECULE MODEL

Jessica Morgan and Sharon Strickland  
Converse College

The quantitative assessment of the strength of carbonyl lone pair-pi (CO(lp)-pi) interactions is an important part of understanding the stability and conformational preferences of proteins. Three molecular balances involving a pyridinone arm were synthesized using a modular process; each of these molecular balances was characterized in solution (using <sup>1</sup>H NMR spectroscopy) and in the solid state (using X-ray crystallography). These molecular balances form a well-defined CO(lp)-pi interaction between the pyridinone arm and an aromatic shelf in the folded conformation, and the strength of the interaction was assessed using the folded: unfolded conformation ratio revealed by the integration of relevant signals in the <sup>1</sup>H NMR spectra. The (CO(lp)-pi) interactions appear to be repulsive when the aromatic shelf is electron rich but become attractive when the electron shelf is electron deficient.

miRNA-INDUCED GENE SILENCING TAGGING IN *ARABIDOPSIS THALIANA*

Karah Moulton and C. Nathan Hancock  
University of South Carolina Aiken

Gene silencing is an important tool used to determine gene function. There are many different methods to decrease gene expression, including RNAi, Cas9 mutagenesis, and microRNA induced silencing. miRNA-induced gene silencing involves attaching a microRNA target sequence to an mRNA sequence, inducing the production of tasiRNAs and subsequent degradation of homologous sequences, including redundant genes. We have used a naturally occurring miRNA in *Arabidopsis thaliana*, called miR173, driven by the 35S promoter to induce silencing of random sequences in the genome. In this effort, we identified a mutant that exhibits altered leaf shape, delayed flowering, and reduced seed set in a dominant manner. We are documenting the development of the mutant in detail and working to clone the transgene location. Together these results indicate the feasibility of our silencing tagging strategy and its ability to produce novel phenotypes that were not discovered by other mutagenesis strategies.

ZINC OXIDE NANOPARTICLE MODIFICATION BY SELF-ASSEMBLY USING SUBSTITUTED CARBOXYLIC ACIDS

TJ Parkman and Nicholas Marshall  
University of South Carolina Aiken

Zinc oxide nanoparticles were treated with ethanolic solutions of n-alkyl carboxylic acids with chains containing between 2 and 16 carbons to determine critical chain length and concentration for formation of a self-assembled monolayer. The modified nanoparticles were analyzed using FT-IR, contact angle, and Raman microscopy. Carboxylic acid chains of at least 8 carbons seemed to be required for self-assembly to occur. We also found a direct relationship between concentration and self-assembling ability, as concentrations of 5 mM or greater were much more successful in forming self-assembled monolayers.

HOMOLOGOUS RECOMBINATION REPAIR FACILITATES REPLICATIVE TRANSPOSITION OF THE *MPING*  
ELEMENT FROM RICE

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

Transposable elements make up large portions of plant genomes and influence the overall phenotype. These mobile segments of DNA induce mutations, and thus, are powerful agents in genome evolution. Class II transposable elements use a "cut and paste" mechanism in which the element is excised and reinserted elsewhere in the genome. The rice element *mPing* has been shown to increase in copy number over generations, suggesting the presence of a replicative transposition mechanism. We tested if homologous recombination (HR) repair, a mechanism in which homologous sequences are used to repair double strand breaks, facilitates *mPing* replication by repairing excision sites with an *mPing* containing sequence. We measured repair of *mPing* excision sites in yeast using a reporter system wherein *mPing* disrupts the *ADE2* gene, preventing cell growth until *mPing* excision and repair of the *ADE2* gene. Previous results showed higher *ADE2* restoration in haploid cells than in diploids, suggesting that HR repair occurred more frequently in diploids. To confirm the role of HR repair, transposition assays were performed in HR deficient strains lacking the *RAD51* gene. In HR repair deficient strains, *ADE2* restoration was equal or higher in diploids, suggesting HR repair was responsible for the discrepancy observed in earlier assays. To directly identify cases of replicative transposition, insertion sites from haploid and diploid strains were sequenced to determine *mPing* copy number. Results showed extra copies of *mPing* in HR competent diploid strains, supporting the hypothesis that HR repair functioned as a mechanism for replicative transposition.

RAMAN SPECTROSCOPY OF METHYL-4-DIMETHYLAMINO BENZOATE (MDAB) AND ANALOGS IN FOUR SOLVENTS

Massiel Payero Garcia and Monty Fetterolf  
University of South Carolina Aiken

Raman spectra were obtained for methyl-4-dimethylaminobenzoate (MDAB) in four solvents: dichloromethane, acetonitrile, ethanol, and benzyl alcohol. The Raman peaks associated with the ester functionality—the carbonyl stretch at approximately 1700 wavenumbers, the carbon-oxygen stretch at approximately 1280 wavenumbers, and the OCO bending mode at approximately 850 wavenumbers—shift their positions in other solvents relative to their standard position as measured in acetonitrile. These shifts appear to be the result of direct solvent acceptor interaction with the lone electron pairs on the oxygen atoms in MDAB. Those interactions tend to either weaken the vibrational structure causing a downshift in wavenumber or a strengthening of the vibrational structure causing an upshift in wavenumber. The results for MDAB are compared to five analog molecules each dissolved in the same four solvents.

BIODEGRADATION OF MATURE FINE TAILINGS BY THE MICROBIAL CONSORTIUM BIOTIGER™ AND FINAL SOLUTION TOXICITY

Erin Peck and Michele Harmon  
University of South Carolina Aiken

Alberta Canada contains the third largest oil sand reserve in the world, producing about 2.3 million barrels of oil per day. Oil sands are a mixture of sand, clay, small amounts of water, and the viscous hydrocarbon bitumen. Mature Fine Tailings (MFTs) are the byproduct of oil sand refinement, as bitumen is separated from the sand and clay. MFTs contain many different chemicals and toxic material, such as naphthenic acids, which are potential endocrine disruptors, and polycyclic aromatic hydrocarbons, some of which are carcinogens. These contaminants are of major concern to the environment because of their toxicity and persistence. It has been found that the patented microbial consortium BioTiger™ (BT) has the ability to cometabolically biodegrade specific chemical components that are found in MFTs, including hexanoic acid and phenanthrene. The purpose of this project was to determine if remediation with BT increases the toxicity of MFTs. Test solutions were prepared by combining BT with MFTs in an aqueous solution. The BT/MFT sample was then split; half was immediately cooled to 4°C; and the other half was allowed to incubate for 168 hours at room temperature. Acute toxicity tests were conducted on each solution with the freshwater organism, *Daphnia magna*. Results indicated that incubation with the BT significantly increased the toxicity of the MFT solution.

THE VIRAL HUNT FOR BACTERIOPHAGES: THE CURE FOR ANTIBIOTIC-RESISTANT BACTERIA MAY BE FOUND ON THE STUDENTS AT CAMPUS OF COASTAL CAROLINA UNIVERSITY

Lisa Pieterse and Paul E. Richardson  
Coastal Carolina University

This study aimed to investigate the bacteriophage population that exists among students at Coastal Carolina University. Bacteriophages, or viruses that can only infect bacterial cells, have recently inhabited the medical spotlight due to their ability to lyse bacterial cells, thereby potentially acting as a cure even for antibiotic-resistant superbugs such as MRSA. For this study, ear and nose swabs were sporadically taken from randomly selected student volunteers on campus. Alternatively, a set of returning volunteers was simultaneously sampled each month for a whole academic year in order to gain a better understanding of phage dynamics over a predetermined set of time. These samples were then processed and analyzed via microbial testing using plaque assays along with molecular tests such as PCR analysis and gel electrophoresis. These tests were conducted in order to determine if *Staphylococcus aureus* and *Escherichia coli* bacteriophages were present in samples. The purpose of this study, therefore, is to increase both understanding and comprehension of virus population dynamics on Coastal Carolina University campus and to collect samples that may be used in the future to help fight antibiotic-resistant "superbug" strains of bacteria.

ACCLIMATION TIME OF EASTERN-PAINTED TURTLES (*CHRYSEMYS PICTA PICTA*) IN A NOVEL ENVIRONMENT

Courtney Pitts, Jordan Winebrenner, Abraham Hernandez, and David Ferris  
USC Upstate

We placed wild-caught Eastern Painted Turtles (*Chrysemys picta picta*) in an environmental chamber to determine acclimation time in a novel environment. Acclimation was defined as consistent day-to-day basking behavior. Utilizing iButton and video data, we quantified frequency and duration of both diurnal and nocturnal basking events. Turtles behaved consistently in the novel environment by day 8. This result suggests that laboratory studies should ensure turtles are fully acclimated to a novel environment before data collection begins.

## ANURAN SPECIES RICHNESS, DIVERSITY AND COMPOSITION IN A LENTIC VS. LOTIC AQUATIC SYSTEM IN THE COASTAL PLAINS OF SOUTH CAROLINA

Nathan Platt  
Charleston Southern University

Amphibian populations are declining globally due to pressures such as habitat loss, fragmentation, environmental pollution, climate change and chytridiomycosis caused by chytrid fungi *Batrachochytrium dendrobatidis*. As environmental indicators there is a growing need for research on anuran species diversity and ecology. In this study species richness, diversity and composition were compared in a lentic aquatic system and a lotic aquatic system in the Coastal Plains region of South Carolina due to these systems being vital anuran habitats. Abiotic and biotic factors were assessed to determine the limiting factors in anuran distribution. Visual identification methods, bottle traps, and area based counts were used to determine the species richness, diversity and composition. In the two habitats, frog communities were found to vary notably. In all, the lotic aquatic system was found to have a greater species richness ( $H= 2.607$ ) and diversity ( $EH = 0.843$ ) than the lentic system ( $H= 1.327$ ,  $EH = 0.300$ ). The limiting factors driving anuran distribution were ascertained to be predation and competition rather than ectothermic thermoregulation. The results highlight the importance of aquatic system diversity and the environmental specific stressors that ultimately impact the distribution and richness of anuran species.

## UNDERSTANDING THE FUNCTION OF KDM1A USING CRISPR/CAS-9 IN ZEBRAFISH

Katlin Pugh and April DeLaurier  
University of South Carolina Aiken

Potocki-Shaffer Syndrome (PSS), a human disease that causes craniofacial defects and mental deficiencies, is caused by deficiencies in PHF21A (PHD Finger Protein 21A). PHF21A normally forms a repression complex with other proteins and it is hypothesized that loss of other factors in this complex may also cause physical defects associated with PSS. One of the candidate genes in this complex is *kdm1a* (Lysine-specific demethylase-1), which is important in brain development, pituitary development, and gastrulation during embryogenesis in mice. Knockdown studies in zebrafish suggest lack of *kdm1a* causes brain defects, but skeletal phenotypes were not reported. We hypothesize that *kdm1a* functions in zebrafish development similarly to how it functions in other species, and that mutation of *kdm1a* will produce craniofacial defects in zebrafish. Previously, we created zebrafish lines with insertions and deletions in the *kdm1a* gene using CRISPR-Cas9. An F1 generation was created from the F0 founders and screened for indels in the *kdm1a* gene using PCR and T7 endonuclease digest. An F2 generation was then created by outcrossing F1 fish to wild-type AB fish. Currently, we are screening the F2 generation to determine which fish are heterozygotes. These F2 heterozygotes will be in-crossed to generate F3 fish, 25% of which should be homozygous for potential frameshift mutations. These potential mutants will be sequenced to determine if indels actually produce frameshift mutations. If frameshift mutations are detected, heterozygote lines will be in-crossed to produce mutants which can be screened for skeletal defects using histological staining. Analysis of defects in mutants will reveal functions of *kdm1a* in zebrafish craniofacial development, and will contribute to understanding the roles of individual proteins in the PHF21A repression complex.

## DEVELOPING A YEAST ONE-HYBRID ASSAY FOR EVALUATING PROTEIN BINDING TO THE *MPING* TRANSPOSABLE ELEMENT

Jacob Reagin and C. Nathan Hancock  
University of South Carolina Aiken

The overall goal of this study is to determine the mechanisms that regulate the transposition of the *mPing* element from rice. In order for *mPing* transposition to occur, it is hypothesized that the terminal inverted repeats of the *mPing* sequence must bind to a protein complex composed of ORF1 and Transposase (TPase). The exact manner by which ORF1 and TPase interact with the *mPing* element is unknown. To test the interaction between the proteins and the *mPing* sequence, we are using the yeast one-hybrid system. This employs a Gal4 activation domain conjugated to the protein of interest and a bait sequence inserted in front of a reporter gene in the yeast genome. When the bait sequence is bound by the prey protein, transcription of the reporter will occur allowing for growth of the yeast on selective plates. To facilitate our experiment, *mPing* was PCR amplified using primers with restriction sites and cloned into the Gateway™ compatible plasmid p5e-MCS. Following sequence verification, an LR clonase reaction was performed to move *mPing* into the plasmid pMW2, which contains the reporter gene *HIS3*. Our *mPing* bait plasmid will be transformed into yeast strain YM4271 and tested with varying concentrations of the *HIS3* competitive inhibitor 3-aminotriazole. Once a baseline concentration of the inhibitor is established, yeast one-hybrid assays will be performed to test *mPing* as a bait against wild-type and mutant ORF1 and TPase prey proteins. These efforts will allow us to deduce the role of each DNA-protein interaction in transposition complex formation.

## EXPRESSION OF PRO-APOPTOTIC BAX IN AN HIV-1 DEPENDENT LENTIVIRAL VECTOR

Lance Reynolds and William H. Jackson  
University of South Carolina Aiken

The Human Immunodeficiency Virus (HIV-1) is a lentivirus that primarily infects quiescent CD4 T Helper lymphocytes. Following reverse transcription, the HIV provirus integrates into the host cell's genome. Expression of HIV-1 genes is negatively controlled by inhibitory sequences (INS) located throughout the provirus and positively regulated by two genes, HIV-1 Tat and Rev. Tat acts through binding to the viral trans-activation response element (TAR), which is a small hairpin RNA transcribed

as the first 60 nucleotides of all HIV-1 mRNAs. This association recruits the host PTEFb complex, which phosphorylates the RNA Polymerase II C-terminal domain resulting in upregulated transcription from the viral promoter/enhancer. Rev acts by binding the Rev Response Element (RRE), located within the HIV-1 envelope mRNA, and enhancing export of partially spliced and unspliced viral transcripts, which encode structural proteins and genomic RNA. The goal of this project is to utilize these control mechanisms to create a lentiviral vector that is HIV-dependent and therefore capable of expressing genes in only HIV-infected cells. To test this, a Renilla Luciferase/eGFP fusion gene was cloned into the HIV-1 dependent vector pLRed(INS2)R. Initial tests indicated that expression of the fusion gene is HIV-1 dependent. To test the ability of this vector to express potentially therapeutic genes, the pro-apoptotic Bax gene was amplified from pCMV-Bax and cloned in place of Renilla luciferase to form pBaxTNG(INS2)R. Current studies are underway to verify cloning and expression of the Bax/eGFP fusion gene

#### THE EFFECTS OF CAFFEINE AND SUGAR CONSUMPTION WITH AND WITHOUT EXERCISE ON MUSCLE GROWTH AND BONE DENSITY IN RATS

Jonathan Rodgers and Michelle Vieyra  
University of South Carolina Aiken

The purpose of this study was to look at the effects of high sugar and caffeine diets with or without exercise on the development of muscles and bones in rats. Thirty male Sprague-Dawley rats were used in this study. These rats were randomly placed into one of 6 groups containing 5 rats each. These groups were designated sugar, sugar + exercise, sugar and caffeine, sugar and caffeine + exercise, exercise alone, and control groups. After 16 weeks of caring for the rats, they were euthanized. Body composition was analyzed using a DIGIMUS system and the rear limbs were removed for measurement of leg muscles and bones. The bones were then burned and total ash (calcium composition) measured. Analysis is still underway but we expect better bone and muscle development in the exercise groups compared to sedentary groups with some decrease in development in the sugar groups.

#### SURFACE MODIFICATION USING P-PHENYLENEBIS(DIAZONIUM) SALT, A BIFUNCTIONAL ARYL DIAZONIUM COUPLING AGENT

Andres Rodriguez and Nicholas Marshall  
University of South Carolina Aiken

Diazonium-terminated conjugated thin films form on a variety of conductive and nonconductive surfaces through a spontaneous reaction of the diazonium coupling agent p-phenylenebis(diazonium) with the surface. By reacting the diazonium-coated surface with a variety of nucleophiles, a functionalized surface can be obtained. Substrates including glass, gold, and indium tin oxide can be quickly and easily modified using this spontaneous coupling process. These surfaces have been characterized with XPS, voltammetry, infrared and Raman spectroscopy, and atomic force microscopy. This coupling surface modification process is convenient and practical compared to other processes like SAM formation.

#### DOES HIGH FOLIC ACID ALONGSIDE A GENE KNOCKDOWN OF *MTHFR* INDUCE HISTONE MODIFICATIONS AND ALTERED NEUROBIOLOGY IN A HUMAN NEURONAL CELL LINE?

Rachael Schmelz, Daniel Clark, and Kimberly Shorter  
University of South Carolina Upstate

Autism spectrum disorders (ASD) are characterized by epigenetic changes and changes to neuromorphology (e.g. increased dendritic spine density). Epigenetic modifications such as DNA/histone methylation are accomplished through dietary folic acid (FA); FA is metabolized to methyl groups that are added to DNA and/or histones. This pathway involves the synthesis of 5-methyltetrahydrofolate and is promoted by 5-methylenetetrahydrofolate reductase (*MTHFR*). Pregnant women with an *MTHFR* mutation are told to consume FA supplements up to 10x the regular FDA recommended daily amount to prevent neural tube defects, a mechanism that is not understood. We question if FA overconsumption is linked to the rise in ASD rates. Previous experiments in our lab indicate an *MTHFR* knockdown with 10x FA supplementation decreases MECP2 expression, which is linked to increased dendritic spine density. We knocked-down *MTHFR* in a human neuronal cell line (SHSY5Y) and exposed cells to 10x FA. We isolated histones and used an ELISA histone modification array to test for specific histone modifications such as acetylation and methylation. We stained cells with vibrant DiI stain and DAPI to visualize the dendritic spines. Our results are currently still in progress.

#### CONFINEMENT EFFECT ON SUPERPARAMAGNETIC NANOCOLLOIDAL SUSPENSION

Gabrielle Seymore<sup>1</sup>, Ana Oprisan<sup>1</sup>, Sorinel Oprisan<sup>1</sup>, and Ashley Rice<sup>2</sup>  
<sup>1</sup>College of Charleston <sup>2</sup>University of Tennessee

Iron oxide nanoparticles in suspension are attractive for biomedical purposes due to their biocompatibility, superparamagnetic qualities, and cost efficient manufacturing. Many in vivo applications could be implemented using these systems including MRI contrast enhancement, tissue repair, immunoassay, detoxification of biological fluids, hyperthermia, drug delivery, and cell separation. Their ability to be controlled with an external magnetic field proves to be an exciting step toward medical advancement but many issues and phenomenon must be explored before implementing such a treatment.

We conducted multiple experiments using a shadowgraphy method of imaging to record the diffusion process of the magnetic nanocolloids with solely a concentration gradient. A glass cell with degassed water was injected with magnetic nanocolloidal suspension, oriented against the gravitational field and then recorded. A superluminescent diode (SLD) was used as the light source for this process. Cells of multiple geometries, but constant diameter were utilized in order to explore the confinement effect on non-equilibrium concentration fluctuations. Experiments using magnetic field, both horizontal and vertical orientation, and without magnetic field were recorded. To induce the magnetic field, two Helmholtz coils were placed above and below the glass cell setup on the optical bench. Previous data analysis shows that the power law exponents for the structure factor decreases due to the formation of nano-rods in the presence of a magnetic field. We used a dynamic structure factor algorithm for image processing in order to compute the structure factor, to find the power law exponents, and to determine the correlation time of fluctuations.

#### VECTOR POTENTIAL: A DIVERGENCE FREE METHOD FOR MHD CODE

Payden Shaw and P. Chris Fragile  
College of Charleston

We present the Vector Potential (VP) method, a divergence free magnetic field evolution method for the Cosmos++ code. We verify its use on Adaptive Mesh Refinement (AMR), Static Mesh Refinement, and moving mesh in two dimensions with three MHD test problems: the Orszag-Tang vortex, Field Loop Advection, and Smooth Alfvén Wave. It was found that the VP method is able to keep the divergence of the magnetic field close to zero for both refined and unrefined simulations. We also find that the VP method preserves second order convergence in the Alfvén Wave problem. However, in simulations of Field Loop Advection that involves moving mesh, the VP method has some build up of magnetic field divergence. This is caused by Cosmos++ normalizing the divergence with magnetic pressure which is incredibly small in regions of the Field Loop test. Currently, the three-dimensional analog of the VP method is being implemented into Cosmos++. With the implementation of VP in three dimensions, Cosmos++ will be able to efficiently simulate magnetized accretion flow around black holes and neutron stars free of the errors associated with the buildup of magnetic field divergence.

#### COLIPHAGES IN THE AVIARY AT BROOKGREEN GARDENS AND THE ENVIRONMENTAL FACTORS THAT INFLUENCE VIRAL POPULATION DYNAMICS.

Olivia Shirley<sup>1</sup> and Paul Richardson<sup>2</sup>

<sup>1</sup>University of South Carolina Aiken Coastal Carolina University<sup>2</sup>

It has been understood that the presence of coliphages (bacteriophages specific for E. coli) in water is an indirect measurement of fecal contamination. Bacteriophages have been suggested to hold an important role in helping control the bacterial population. This study analyzes the relationship between the presence of coliphages in the water in the aviary at Brookgreen Gardens and how environmental factors (Temperature, pH, and turbidity) affect the presence of these viruses. Coliphages in the water could be deposited by birds that live in the aviary. These birds are in a fixed area, thus it is a great place to look for the concentration of these phages in an environmental setting. Plaque assays were conducted to look for the presence of the coliphages. PCR analysis was done on all samples collected to identify any possible coliphages identified by plaque assays. The results gathered from these methods were varied, with numerous positive results at each site for each week. All PCR tests done on the samples were negative for coliphage identification, indicating these coliphages are unique. These findings confirm that there are indeed bacteriophages present in the Brookgreen Gardens aviary, and pH, turbidity, and temperature did not play a role in the presence of the coliphages. The location in the aviary which yielded the most positive results, site one, was the site at which the birds were most frequently observed defecating, providing indirect evidence that the fecal matter of the birds is the most important factor in bacteriophage presence.

#### A COMPUTATIONAL STUDY OF A FAMILY OF COPPER COMPOUNDS

Brett Smith and Gerard Rowe  
University of South Carolina Aiken

A family of copper compounds containing various pyridylamide ligands have been synthesized in various oxidation states. Mono-, di-, tetra- and pentanuclear copper compounds were investigated for their various properties. This series of copper compounds utilize a pyridyl amide ligand. With the use of density functional theory, the XPS spectra, UV-Vis as well as a J-value were all investigated. The DFT computations successfully explained these spectra, magnetic properties and some of the bonding in this family of copper compounds. Many of these computations utilize the def2- basis set, and a variety of functionals. The J-value calculation utilized CASSCF and BS-DFT methods. The geometries of these compounds were optimized at the M06-L/def2-tzvp level of theory. A variety of different functionals were screened for performance and accuracy in predicting the electronic spectra.

#### THE REMOVAL OF COPPER (II) AQUEOUS IONS VIA HYDROGEL FORMATION OF SODIUM ALGINATE

Kaybriana Spalding, Audrey Bourdages, and Jennifer Hawk  
Converse College

Heavy metal contamination in water sources is an ongoing problem for many communities. Copper is one of the most common heavy metal contaminants. In this study, sodium alginate, a water soluble polymer known to form hydrogels, is used to remove Copper (II) from various aqueous solutions via gel formation. Atomic Absorption Spectroscopy (AAS) was used to determine the

concentration of Copper (II) in the aqueous solutions prior to and after treatment with the sodium alginate. Initially, solutions with varying concentrations of Copper (II) ranging from 0 ppm up to 3000 ppm were studied. A fixed volume of sodium alginate solution was added to the solutions of Copper (II). Gels formed in the presence of the metal ions and were then physically removed. In all cases, removing these gels decreased the concentration of Copper (II) in the original solutions. As the initial concentration of Copper (II) increased, the percentage of the Copper (II) removed decreased. Solutions with similar copper concentrations were then created containing constant concentrations of Nickel (II) metal ions. When compared to the Copper (II) only containing solutions, the mixed metal solutions exhibit a similar trend. However, the net percentage of Copper (II) removed is less. Further studies are being carried out to investigate the dependence of this behavior on the amount of sodium alginate and the presence of other metals.

#### CLONING AN INNATE RETROVIRAL GENE APOBEC3G INTO THE LENTIVIRAL VECTOR, PLRED(INS2)R

Mckenzie Spires and William Jackson  
University of South Carolina Aiken

HIV-1 is a lentivirus encoding 15 proteins, which include three structural proteins (Gag, Pol, and Env), two regulatory proteins (Tat and Rev), and four accessory proteins (Nef, Vif, Vpr, and Vpu). This study focuses on the Viral infectivity factor (Vif), and how it interacts with Apolipoprotein B mRNA editing enzyme, catalytic polypeptide-like 3G (A3G). A3G induces extensive cytosine to uracil mutations, resulting in guanine to adenine substitutions, while Vif prevents A3G incorporation into virions by inducing A3G ubiquitination and proteosomal degradation. The goal of this project is to create a HIV-1 dependent lentiviral vector that expresses a fusion gene incorporating the Vif-resistant D128K A3G and the selectable marker puromycin-N-acetyltransferase using the *Thosea asigna* virus T2A peptide cleavage sequence. The fusion gene will be cloned into pLRed(INS2)R, which we have shown to express genes in a HIV-dependent manner. For this, puromycin-N-acetyltransferase was amplified from pSuper.Retro.puro and used as a template onto which the T2A was added in-frame at the 5' end. This sequence was cloned into pLRed(INS2)R creating pLTP.R. Correct cloning of the T2A/Puro gene was verified by sequencing. The plasmid was linearized for the next cloning step. Subsequently, D128K A3G was amplified from pHA3G-D128K using primers that eliminated the stop codon. A second PCR was used to add a 5â€™ HA tag to A3G to aid in future analyses of expression. The resulting HA-tagged A3G fragment was cloned into the linearized plasmid generating a HA-tagged A3G/T2A/Puro fusion gene under transcriptional control of the HIV-1 LTR. Current studies are underway to verify all cloning steps and test expression of the fusion gene

#### A FORTY SEVEN YEAR STUDY OF THE VASCULAR FLORA OF ABANDONED THOUSAND ACRE RICE FIELD, GEORGETOWN, SOUTH CAROLINA

Richard Stalter  
St. John's University

The objective of this study was to determine vegetation change at an abandoned rice field, Thousand Acre Rice Field in the Winyah Bay Estuary, Georgetown County South Carolina from 1968-1969, 1987-1991, and 2013-2015. The number of vascular plant species at this site was little changed as 20 species were identified in 1968-69 while 22 were identified in 2013-15. A parsimony algorithm was used to evaluate the distribution and co-occurrence of vascular plant species in the Thousand Acre Rice Field sampled at three intervals, 1968-1969, 1987-1991, and 2013-2015. There was a shift in the flora at Thousand Acre Rice Field from 1968-1969 to 1987-1991 and 2013-2015 following Hurricane Hugo in 1989. The invasion of *Phragmites australis* plus rising sea level and increasing water salinity best explains the shift in vegetation at Thousand Acre Rice Field over the 47 year collecting period.

#### ALTERING *MPING* TRANSPOSITION BEHAVIOR USING DIFFERENT PLANT PROMOTERS

Haley Stone and C. Nathan Hancock  
University of South Carolina Aiken

*mPing* is a tourist-like miniature inverted repeat transposable element that is actively jumping in the rice genome. The *Ping* or *Pong* transposable elements serve as the source of the ORF1 and Transposase proteins that mobilize *mPing*. Our goal is to develop the *mPing* element into an effective transposon tagging tool for gene discovery in plants. To be most effective, it is desirable to have transposition occur only in the gametes. This ensures that the resulting mutations will be heritable and affect the entire plant. We are testing if it is possible to induce pollen specific *mPing* transposition in *Arabidopsis* by using the DLL promoter to express the ORF1 and Transposase. Green fluorescent protein, GFP, will be used as a reporter gene to indicate when and where *mPing* transposition occurs. Expression constructs with either a GmUbi, CaMV 35S or DLL promoters driving expression of *Pong* TPase T2A ORF1 SC1 ONE, which contains both *Pong* ORF1 and *Pong* TPase, were made. The floral dip method was used to transform *Arabidopsis* containing the *mPing:GFP* reporter construct. Transgenic lines were selected and fluorescence microscopy is currently being used to assess GFP expression. If the DLL promoter is only producing pollen specific expression, we expect to see little to no GFP expression for the T1 generation compared to the GmUbi and CaMV 35S controls. However, we anticipate that after going through pollen formation the DLL promoter may produce plants with full GFP expression in the T2 generation.

## ANALYZING A *TOL2*-BASED ACTIVATION TAG CONSTRUCT IN ZEBRAFISH AND YEAST

Allison Swiecki, C. Nathan Hancock, and April DeLaurier  
University of South Carolina Aiken

Transposable elements, are segments of DNA that can move from one region to another within the genome when induced. The *Tol2* transposon from Medaka fish has successfully been adapted for transgenesis, integrating foreign DNA, in a wide variety of vertebrates. Our goal is to develop the *Tol2* element into a mutagenesis tool for gene discovery. Activation tagging, a form of transposon tagging, is when a strong enhancer is positioned within the element. Activation tags can induce overexpression of genes, allowing us to learn about the function of genes that may otherwise be hard to study because of lethality or redundancy. Zebrafish are a model for vertebrate development, therefore activation tagging within zebrafish will allow for the discovery of developmental-related genes. A *Tol2*-based activation tag construct was engineered by PCR, digestion, and sequence analysis. The construct consists of the *Tol2* terminal inverted repeats (TIRs) flanking the enhancer region of the Beta-actin promoter. This activation tag was cloned next to the remainder of the Beta-actin promoter, and a *mCherry* reporter gene to indicate if transposition has occurred. A *Tol2* transposase construct was previously engineered to provide transposase, which is necessary to induce transposition of the activation tag in zebrafish. These constructs were coinjected into zebrafish embryos to create a population for measuring transposition rates and look for altered phenotypes. Concurrently, yeast transposition studies are being performed in order to identify methods which increase *Tol2* transposition rates. The yeast studies are testing whether the removal of a Nuclear Export Signal (NES) from *Tol2* transposase will allow for more efficient transposition of *Tol2*.

## THE ROLE OF PROTEIN CARBOXYL METHYLTRANSFERASE (PCMT) IN DROSOPHILA MELANOGASTER STRESS RESISTANCE

Darnecia Sylve, Cristal Gonzalez, and Jessica Allen  
Columbia College

The accumulation of isoaspartate, which spontaneously forms due to deamidation of protein asparaginyl residues and isomerization of protein aspartyl residues, contributes to aging and reduced longevity in cells. Protein carboxyl methyltransferase (PCMT) is responsible for modifying isopartate moieties and beginning a repair pathway that minimizes the abnormal isopartate residues. It has been shown that PCMT overexpression in certain yeast, flowering plants, fruit flies, and human epithelial cells has a substantial positive effect on lifespan under particular conditions. *Drosophila melanogaster* overexpressing PCMT reared under increased temperatures have increased survival and *D. melanogaster* lacking PCMT die faster during *Listeria monocytogenes* or *Staphylococcus aureus* infection. The postulated mechanism for temperature dependence and PCMT overexpression involves the interaction of heat-inducible proteins and PCMT, which the mechanisms for infectious tolerance have not been explored. Here, we examine whether this enzyme could play a role in promoting healthy aging and survival under other stresses. For example, colder conditions instead of heat. Starvation resistance is one of many practical factors that contributes to longevity, as there is potential for energy shortages in any environment. Similarly, the stressors of chill coma, starvation and desiccation are also of interest. These are commonly used to measure physiological and behavioral changes that often accompany aging. We test the role that underexpression and overexpression of PCMT has on flies subjected to these stresses, while also looking for sex differences in the role of this enzyme during stress responses.

## CORRELATION OF THE RS4988235 C/T SINGLE NUCLEOTIDE POLYMORPHISM WITH LACTOSE INTOLERANCE

Michaela Treadway and C. Nathan Hancock  
University of South Carolina Aiken

Lactose intolerance is the inability to digest lactose due to low levels of the lactase enzyme in the small intestine. As a result, lactose travels to the large intestine and induces bacteria growth and intestinal discomfort. Single Nucleotide Polymorphisms (SNPs) are used to analyze the genetic variation in human populations. Previous studies have identified a SNP 14kb upstream of the lactase gene that can predict lactose intolerance with about 90% accuracy in some populations. A homozygous allele CC at the rs4988235 locus is associated with lactose intolerance. The purpose of this study was to test the reliability of the rs4988235 SNP test in a local population. It was predicted that those who reported lactose intolerance but don't show the expected CC genotype may have another medical condition such as Celiac disease or milk allergies. DNA was collected from saliva samples of individuals with self-reported lactose intolerance and genotypes were tested by qPCR. In addition, pedigree analysis of a family segregating for lactose intolerance was performed. We found that 12% of participants with the CC allele did not report lactose intolerance. Similarly, about 25% of participants with the CT or TT genotype reported lactose intolerance. Together this means that the rs4988235 allele was less accurate in our population than what was observed in other populations. Our data confirms that there are multiple mechanisms which cause lactose intolerance, but suggests that genotyping of the rs4988235 SNP could hasten diagnosis.

## SPACE WEATHER AND HUMAN PHYSIOLOGY: A DECADAL CASE STUDY

James Wanliss<sup>1</sup>, Germaine Cornellsen<sup>2</sup>, Brien Washington<sup>1</sup>, and Denzel Brown<sup>1</sup>  
<sup>1</sup>Presbyterian College <sup>1</sup>University of Minnesota

There is a strong connection between space weather and fluctuations in technological systems. Some studies also suggest a statistical connection between space weather and subsequent fluctuations in the physiology of living creatures. This connection, however, has remained controversial and difficult to demonstrate. Here we present support for a response of human physiology to forcing from the explosive onset of the largest of space weather events-space storms. We consider a case study with over 16

years of high temporal resolution measurements of human blood pressure (systolic, diastolic) and heart rate variability to search for associations with space weather. We find no statistically significant change in human blood pressure but a statistically significant drop in heart rate during the main phase of space storms. Our empirical findings shed light on how human physiology may respond to exogenous space weather forcing.

#### THE INFLUENCE OF INDUCED ANXIETY ON EXECUTIVE FUNCTIONS AMONG ATHLETES AND NOVICES MEASURED BY THE P3 WAVE IN A GO/NOGO TASK

James Waters and Keri Weed  
University of South Carolina Aiken

An elite athlete employs complex skills during competition that have been learned and perfected over long periods of training. Skills such as kicking, throwing, and hitting are complicated and require heightened motor control, focus and attention. Attention allocation and motor control can be evaluated by the P3 wave. The P3 represents a neurophysiological measure of cognitive control. Latency is a measure of how fast attention is allocated, while amplitude measures how strong the attention allocation is. Performance anxiety can affect performance; this physiological anxiety can be measured by electrodermal activity (EDA). This study used EDA and anxiety induction to test whether executive functions are positively or negatively influenced by anxiety, as well as whether athletes or novices are better equipped to perform under anxious conditions. This study is a 2 (athlete/novice) by 2 (anxious/resting state) mixed design. We had a total of 50 participants, 25 athletes and 25 novices. Each participant completed a Go/NoGo task once in a resting state and once after anxiety induction. EDA and anxiety self-reports were used to confirm that anxiety had been induced. Half of the participants received stress induction before the first EEG task, and the other half of participants established the baseline before the first task. Due to the drive theory, which suggests motivation to compete creates heightened arousal and allows people to perform at a higher skill level, we expect that all participants will perform better when anxious, but athletes will have a greater advantage due to the anxiety induction.

#### N- AND C-TERMINAL TRUNCATIONS OF 2,4'-DIHYDROXYACETOPHENONE DIOXYGENASE

Jason Weeks, Gabrielle Connor, and Kenneth Roberts  
University of South Carolina Aiken

The enzyme, 2,4'-dihydroxyacetophenone dioxygenase (DAD), is a homotetramer of 177 aa monomers (21 kDa) found in many betaproteobacteria. DAD catalyzes the oxidative cleavage of 2,4'-dihydroxyacetophenone (DHA) into benzoic acid and formic acid. For the purpose of in vitro mechanistic studies, the dad gene was expressed from an E. coli expression vector and DAD purified from the cell contents. Regrettably, the wild-type enzyme undergoes significant proteolysis during the purification process, losing 1–4 kDa even in the presence of an inhibitor cocktail. This results in a heterogeneous mixture of “purified” DAD. A recent X-ray crystal structure of DAD2 depicts the protein without the first 23 N-terminal residues and further indicates that residues 24-30 and 169-177 are not active participants in the core folding and thus not imperative for the overall structure or activity. In an attempt to circumvent proteolysis without affecting activity, the dad gene has been mutated to delete the N-terminal 23 (NΔ23) or 30 (NΔ30) residues and/or the C-terminal 9 (CΔ9) residues of DAD. (The masses of these truncated proteins coincides with those seen for the proteolyzed protein.) The truncated genes will be expressed and the products will be purified. The purification of the truncated proteins will be evaluated for proteolysis and homogeneous, pure proteins will be evaluated for activity by UV-Vis absorption assays.

#### DETERMINING THE ROLE OF LDLRAP1A IN SKELETAL DEVELOPMENT AND CHOLESTEROL METABOLISM IN ZEBRAFISH

Kali Wiggins and April DeLaurier  
University of South Carolina Aiken

Low density lipoprotein receptor adaptor protein 1 (LDLRAP1) is a factor which interacts with low-density lipoprotein receptors (LDLR) in endothelial cells to endocytose lipids from the blood stream. Humans with mutations in LDLRAP1 have familial hypercholesterolemia, an autosomal recessive inherited disorder, resulting in abnormally high levels of blood lipoproteins. Evidence exists that LDLRAP1 may also function in cartilage cells (chondrocytes), and so we hypothesize that Ldlrap1a may also be involved in skeletal development or another cellular function in cartilage. Using CRISPR-Cas9, we previously generated a zebrafish mutant line for ldlrap1a. We have a genotyped F2 ldlrap1a generations and performed in-crosses to generate F3 embryos. In one line, sequencing F3 mutant embryos revealed a 7bp deletion in exon 3. This causes a frameshift resulting missense and a premature stop codon 37bp into exon 3. The mutation is predicted to disrupt the pleckstrin homology domain (PH domain) early in the sequence and any subsequent functional domains. We predicted that we would observe skeletal defects in mutants. However, analysis of F3 offspring revealed no obvious skeletal defects which has led us to investigate the possibility of maternal rescue of larval phenotypes by the normal maternal transcripts and proteins. We currently have an adult homozygous female ldlrap1a mutant which we plan on crossing with a heterozygous male to generate mutants with no functional maternal Ldlrap1a. Since LDLRAP1 has an important role in lipid metabolism in humans, we are expanding our study to look at the effects a mutated ldlrap1a gene has on cholesterol metabolism in zebrafish. We hypothesize that as in humans, Ldlrap1a functions in zebrafish to clear blood lipoproteins. We have already generated a line of ldlrap1a zebrafish that express EGFP in their vasculature by crossing our F2 ldlrap1a (-7bp deletion) fish to our flil1:EGFP line. We plan on developing a high cholesterol diet containing a lipophilic label, which we will then feed to the ldlrap1a:flil1:EGFP line. We plan to use confocal imaging to view the labeled lipids in the fluorescent vasculature. Our prediction is that the zebrafish will exhibit lipid accumulation in their



vasculature indicating a function of *ldlrp1a* in cholesterol clearance from the bloodstream. If zebrafish have a lipid clearance defect, this line could be a useful model to study hypercholesterolemia in humans.

#### COMPARISON OF ESTROGEN CONCENTRATION IN BOVINE BLOOD AND SALIVA

Kira Williams and Staci Johnson  
Southern Wesleyan University

Steroids serve as chemical messengers between certain body tissues. The sex steroid, estrogen and other steroids are able to be measured through different body fluids, such as blood or saliva. However, we do not have a clear understanding of the mechanism by which steroid hormones travel between body systems and fluids. With this in mind, we attempted to answer two questions: Is there a difference in the levels of estrogen in blood versus saliva? And, is there a correlation between the estrogen concentration of blood and saliva? To answer these questions, previously collected blood and saliva samples from beef cows were tested for estrogen via ELISA (ENZO #ADI 901-008) using two different protocols. First, the kit was completed as instructed in the manufacturer, and then again without using the "steroid displacement" solution step. Data was collected and observed to see if there is a correlation between blood and saliva and if the steroid displacement step is critical to this similarity. The results show that there was not a significant difference in the concentration of blood and saliva with the SDS ( $W=0.989$ ), however, there was a significance between blood and saliva without the SDS ( $W<0.001$ ). Data also showed that there is not a significant relationship between estrogen levels in blood or saliva (Spearman's  $p=0.1338$  with SDS and Spearman's  $p=.20229$  without SDS). One significant implication is the possibility that hormones in saliva, while commonly identified as bioavailable, may actually just be bound in a uniquely different way.

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

Terence Willoner and April DeLaurier  
University of South Carolina Aiken

Potocki-Shaffer syndrome (PSS) is a rare contiguous gene-deletion caused by heterozygous interstitial microdeletions of chromosome region 11p11-p12 and is characterized by developmental defects that include intellectual disability and craniofacial anomalies. PSS is associated with mutations in genes encoding factors in the PHF21A protein complex, including KDMA1 (lysine-specific histone demethylase 1A), ZMYM2 (zinc finger protein 198), and ZMYM3 (zinc finger protein 261) proteins. It is hypothesized that these protein complexes affect craniofacial development of zebrafish in a way that reflects their function in humans. Previously, F0 founder fish carrying mutations in *zmym2* and *zmym3* were generated by microinjection of CRISPR constructs including a guide RNA (gRNA) and Cas9 mRNA at the 1-cell stage. Founders were screened by PCR and T7 endonuclease digest, which identifies mutations in the DNA. These founders were used to generate F1 lines. The F1 generation was screened by using tail fin DNA in PCR and T7 endonuclease digest. F1 zebrafish were sequenced and potential frameshift mutations were identified. Zebrafish with potential frameshifts were out-crossed to produce an F2 generation. One of the *zmym2* lines has large enough deletions that can be observed in PCR products run on a 2% gel for 4 hours. Other *zmym2* and *zmym3* potentially mutant F1 and F2 heterozygote lines need to be screened using PCR and T7 endonuclease digest. To confirm the nature of the mutations in the F1 and F2 generations as frameshifts or early stop codons, *E. coli* cells will be transformed with PminiT plasmids containing PCR amplicons from individual confirmed heterozygote fish. Ampicillin-agar plates will be used for positive selection of transformed cells. Four colonies from each plate will be sent for sequencing. In principle, half of clones will contain mutant sequence and half of clones will contain wild-type sequence. The advantage of this system is that we will be able to resolve the nature of lesions in mutant DNA without the complicating effect of a wild-type allele being present, as is currently the case for sequencing heterozygous DNA. If frameshift lesions are detected in DNA samples, these lines will be used to generate homozygous mutants. Lines will be screened using PCR and T7 endonuclease digest, or if there is a large enough indel, PCR products run on a 2% agarose gel will be used to resolve genotypes. The F3 generation will be studied at 7 days post fertilization for anatomical abnormalities in craniofacial development by using Alcian Blue and Alizarin Red histological stains for cartilage and bone. The ultimate goal of this project will be to identify the roles of *zmym2* and *zmym3* in zebrafish development, and how loss of function of these factors may underlie the defects seen in PSS.

#### VIDEO ANALYSIS VERSUS IBUTTON DATA FOR ASSESSMENT OF EASTERN-PAINTED TURTLES (*CHRYSEMYS PICTA PICTA*) BASKING BEHAVIOR.

Jordan Winebrenner, Abraham Hernandez, and David Ferris  
University of South Carolina Upstate

We compared iButton data loggers versus manual scoring of videos for evaluation of Eastern Painted Turtle (*Chrysemys picta picta*) basking behavior. An iButton was attached to the carapace center point of each turtle. Individual turtles were then placed in an environmental chamber for up to 14 days with 24/7 video of the basking platform. Acclimation time was established at eight days within the novel environment. Data from day nine was selected for our comparison. We compared iButton data with manual scoring of videos of the same basking events. Prior field research used iButtons to sample *C. picta* at 12 minute intervals; however, by recording temperatures every three minutes we used a much smaller time interval than prior studies. Results of these analyses will be discussed and impact data analyses methods for future experiments. Our objective was to test the hypothesis that both methods provide equal accuracy and precision for quantifying basking behavior in the laboratory.

## IMPROVING THE TRANSPOSITION EFFICIENCY OF THE *HARBINGER3N\_DR* TRANSPOSABLE ELEMENT

Sarah Zamiela and C. Nathan Hancock  
University of South Carolina Aiken

DNA transposable elements, or transposons, are mobile sequences of DNA that jump from one site in the genome to another in a cut-and-paste manner. They are found in all kingdoms of life and are sorted by homology into groups called superfamilies. The transposable elements from the *PIF/Harbinger* superfamily are one of the more recently discovered superfamilies. We are interested in studying these elements in particular because the *Harbinger3N\_DR* transposable element from zebrafish has been shown to be able to transpose in human cells, where it can be used for transgenesis or mutagenesis. We hope to learn more about its transposition characteristics, as well as develop hyperactive versions that transpose at higher rates. In order for *Harbinger3N\_DR* to “jump” the proteins *Harbinger* ORF1 and *Harbinger* Transposase (TPase) must be present. I have developed *Harbinger* ORF1, *Harbinger* TPase expression constructs and transformed them into yeast together with a *Harbinger3N\_DR* reporter construct. We are performing yeast transposition assays to determine the transposition rate and analyze the excision sites. These results will be compared to *mPing*, another *PIF/Harbinger* superfamily transposable element from rice. We anticipate that these elements will show similarities in their transposition strategies. We can then use strategies that worked for increasing *mPing* transposition rates to make a more efficient *Harbinger3N\_DR* element. This includes removal of nuclear export sequences and mutation of internal sequences.

## SURVEY OF PARASITES INFECTING *HEXAGENIA* (EPHEMEROPTERA: EPHEMERIDAE) NYMPHS FROM WESTERN LAKE ERIE

Amber Zonca and David Malakauskas  
Francis Marion University

Burrowing mayflies, *Hexagenia* spp. (Ephemeroptera: Ephemeridae), are important biomonitoring indicators of mesotrophic water quality. However, little research has been done on parasites infecting *Hexagenia* spp. nymphs and what role parasites may play in *Hexagenia* population dynamics. Therefore, the aim of our study is to catalog parasites of a population of burrowing mayfly nymphs from western Lake Erie, Michigan and to describe basic ecological information such as infection prevalence, parasite loads, host specificity, parasite distribution, and host-parasite population dynamics. Burrowing mayfly specimens were collected as part of ongoing biomonitoring studies and examined for parasites microscopically. Based on tentative morphological identifications, *Hexagenia* nymphs are infected with trematodes in the genus *Crepidostomum*, protists of the genera *Vorticella* and *Epistylis*, and an as-yet-unidentified nematode. Parasites will be molecularly characterized by sequencing appropriate genes. Results from the genomic analysis of burrowing mayfly nymphs show two species present in the samples: *Hexagenia limbata* (n=36; 78%) and *Hexagenia rigida* (n=10; 22%). We present current progress on molecular and ecological work.

**END**

SC Academy of Science Abstracts  
(Sr. Academy)



**SOUTH CAROLINA JUNIOR ACADEMY OF SCIENCE  
2018 SCHEDULE OF EVENTS**

<b>7:30 AM - 10:00 AM</b> <i>7:30 AM – 9:00 AM</i>	<b>SCJAS Registration</b> <i>Continental Breakfast</i>	<b>Neville Hall (atrium)</b>
<b>8:30 AM – 10:30 AM</b>	<b>SCJAS Oral Session I</b> <i>See SCJAS oral session listing for details &amp; room numbers</i>	<b>Neville &amp; Lassiter Halls</b>
<b>10:30 AM – 10:45 AM</b>	<b>Break</b>	
<b>10:45 AM – 12:30 PM</b>	<b>SCJAS Oral Session II</b> <i>See SCJAS oral session listing for details &amp; room numbers</i>	<b>Neville &amp; Lassiter Halls</b>
<b>[10:30 AM – 12:00 PM]</b> <i>Junior Academy members are encouraged to visit SCAS posters</i>	<b>SCAS Poster Session</b>	<b>Library</b>
<b>12:00 PM – 1:30 PM</b>	<b>Lunch</b> <i>Ticket is in your badge holder. Be sure to have lunch during the time indicated on your ticket.</i>	<b>Greenville Dining Hall</b>
<b>1:30 PM – 2:30 PM</b>	<b>SCJAS Oral Session III</b> <i>See SCJAS oral session listing for details &amp; room numbers</i>	<b>Neville Hall</b>
<b>1:30 PM– 2:45 PM</b>	<b>Plenary Session &amp; Governor’s Awards</b>	<b>Edmonds Hall</b>
<b>3:00 PM – 4:00 PM</b>	<b>Afternoon SCJAS Activities &amp; Workshops</b> Richardson Hall (near Neville and Lassiter Halls)	
	<ol style="list-style-type: none"> <li>1. <b>Biochemistry and Computational Biology Information Session</b></li> <li>2. <b>Evaluating Human Vital Signs</b></li> <li>3. <b>Journey to the Center of the Atom</b></li> <li>4. <b>Visual Neuroscience: how neurons in the brain generate perception</b></li> <li>5. <b>Presbyterian College Campus Tour</b> <i>Please see page 46 for SCJAS Workshop descriptions</i></li> </ol>	
<b>4:15 PM</b>	<b>SCJAS Awards Ceremony</b>	<b>Edmunds Hall</b>

<i>SCJAS Judges Conference Room</i>	<i>Writing Center in Neville Hall</i>
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## Afternoon SCJAS Activities & Workshops

### 1. **Biochemistry and Computational Biology Information Session**

Dr. Evelyn Swain and Dr. Stuart Gordon, PC Chemistry and Biochemistry and Biology Departments

**Where: Richardson 315**

The session will give students information about the Chemistry and Biochemistry Programs as well as the new Computational Biology Program here at PC. The students will learn about the interesting courses offered, research opportunities available, and the exciting careers that Chemistry, Biochemistry, and Computational Biology graduates pursue. There will also be a Q&A session with current students.

### 2. **Evaluating Human Vital Signs**

Trey Boyd and Dr. Tim Pysell, PC Physician Assistant Studies Program

**Where: Richardson 221**

Interested in a career in medicine? Come explore the Physician Assistant Program at Presbyterian College. In this workshop, students will get hands-on experience evaluating the human vital signs. Students will learn about and perform the heart rate, respiration rate, pulse oxygenation, temperature, and blood pressure. Students will also get to touch and feel the basic medical instruments including stethoscope, sphygmomanometer, pulse oximeter, and more!

### 3. **Journey to the Center of the Atom**

Bill Wabbersen, Savannah River Site

**Where: Richardson 207**

Students explore atomic structure using the hands-on Isotope Discovery Kit. The session will include brief descriptions of how important nuclear technologies are used within the state of South Carolina.

### 4. **Visual Neuroscience: how neurons in the brain generate perception**

Dr. Phil O'Herron, MUSC

**Where: Richardson 206**

This session will give a brief overview of the organization and function of the visual system. We will watch a video showing how vision is studied in animal experiments. Then we will explore the neuroscience behind several optical illusions.

### 5. **Presbyterian College Campus Tour**

**Where: Richardson Hall** (out front on side facing Neville Hall)

**SCJAS 2018 ANNUAL MEETING ORAL PRESENTATIONS  
PRESBYTERIAN COLLEGE, April 14<sup>th</sup>, 2018**

**BIOCHEMISTRY / MENTORED**

**Neville 106**

- 8:30 AM Olivia Free and Kaitlyn Coghlan, Governor's School for Science and Mathematics  
THE FORMULATION OF BUDESONIDE INHALATION SOLUTION
- 8:45 AM Sidney Smith and Emily Brideau, Center for Advanced Technical Studies  
THE EFFECTS OF TALCUM POWDER ON MOUSE 3T3 CELLS
- 9:00 AM Elizabeth Skeie, Governor's School for Science and Mathematics  
INHIBITION OF PHOSPHATIDYLINOSITOL-3-KINASE BY THE  
FURANOSQUITERPENOID HIBISCONONE C AND ITS DERIVATIVES
- 9:15 AM Jason Occilien, Governor's School for Science and Mathematics  
THE SYNTHESIS OF MONODISPERSE, PACLITAXEL-CONJUGATED, SILICA  
NANODOTS (5-25NM)
- 9:30 AM Rick Karen Kakanou, Governor's School for Science and Mathematics  
THE EFFECTS OF TONALIDE ON NEUROBLASTOMA CELLS AND ITS  
CORRELATION WITH AUTISM SPECTRUM DISORDER
- 9:45 AM Victoria Wilson, Governor's School for Science and Mathematics  
GRP94: A POSSIBLE THERAPEUTIC TARGET FOR MULTIPLE MYELOMA
- 10:00 AM Madelaine Tedrick, Governor's School for Science and Mathematics  
DNA SELECTIVITY OF AT HOOK PEPTIDES
- 10:15 AM Rachel Wilkinson, Governor's School for Science and Mathematics  
KDM4B INHIBITION TO HELP CURE PERIODONTAL DISEASE

**BIOCHEMISTRY / NON-MENTORED**

**Neville 106**

- 2:00 PM Gillian Patton, Spring Valley High School  
THE EFFECT OF NONASSOCIATIVE LEARNING ON OXIDATIVE STRESS IN  
CAENORHABDITIS ELEGANS: A POTENTIAL APPLICATION FOR ALZHEIMER'S  
DISEASE RESEARCH
- 2:15 PM Zachary Kochert, Center for Advanced Technical Studies  
OPTIMIZING DESIGNS OF MUTI-LAYER MICROBIAL FUEL CELLS

**BOTANY / MENTORED**

**Neville 105**

- 11:00 AM Matthew Barton and Melissa Shugart, Governor's School for Science and Mathematics  
THE EFFECT OF COVER CROPS ON THE RATE OF DECOMPOSITION AND NITROGEN MINERALIZATION
- 11:15 AM Kama Cerimele, Governor's School for Science and Mathematics  
CLONING OF THE VACUOLAR H<sup>+</sup>-PYROPHOSPHATASE PROTON PUMP GENE IN SEASHORE PASPALUM
- 11:30 AM Nathaniel Crago, Governor's School for Science and Mathematics  
CLONING OF THE VACUOLAR H<sup>+</sup> - PYROPHOSPHATASE PROTON PUMP GENE IN SEASHORE PASPALUM
- 11:45 AM Brianna Ludlum, Governor's School for Science and Mathematics  
SIFTING GERMPLOASM TO IDENTIFY HYPOALLERGENIC PEANUT GENOTYPES: GAINING AMMUNITIONS FOR FUTURE BREEDING
- 12:00 PM Jonathan Mackey and Brynn Wilkinson, Governor's School for Science and Mathematics  
SHORT TERM AFFECT OF SALT WATER FROM HURRICANE MATHEW STORM SURGE ON COASTAL LOBLOLLY PINE POPULATIONS

**BOTANY / NON-MENTORED**

**Neville 105**

- 8:30 AM Jack Cook, Heathwood Hall Episcopal School  
THE EFFECT OF HEAT ON THE PRODUCTION OF OZONE FROM FERNS IN A SEALED ENVIROMENT
- 8:45 AM Frank Boysia, Spring Valley High School  
THE EFFECT OF VARIED LEVELS OF ACIDITY ON THE GROWTH OF CAULERPA SERTULARIOIDES
- 9:00 AM Hailey Nicks, Heathwood Hall Episcopal School  
THE EFFECT OF DIFFERENT CONCENTRATIONS OF CAFFEINE IN COFFEE ON THE GROWTH OF WISCONSIN FAST PLANTS
- 9:15 AM Briana Gray, Spring Valley High School  
THE EFFECT OF SPENT COFFEE GROUNDS ON THE GROWTH RATE AND DRY MASS OF FRAGARIA VESCA PLANT
- 9:30 AM Victor Ran, Heathwood Hall Episcopal School  
THE EFFECT OF KCL (POTASSIUM CHLORIDE) ON SORGHUM PLANT HEIGHT
- 9:45 AM Cynthia Leonard, Spring Valley High School  
THE EFFECT OF BISPENOL A ADMINISTERED IN CONCENTRATIONS FOUND WITHIN NATURAL RELEASE FROM POLLUTION ON THE GROWTH AND PRODUCTION OF BRASSICA RAPA

10:00 AM Khushi Patel, Spring Valley High School  
THE USE OF ORTHO HOME DEFENCE PESTICIDE IN DETERMINING THE  
LOWEST PESTICIDE AMOUNT AT WHICH NODULE FORMATION IS STUNTED IN  
TRIFOLIUM INCARNATUM

10:15 AM Rahithya Meda, Spring Valley High School  
THE EFFECT OF ZINC ON BRASSICA JUNCEA'S ABSORPTION ABILITIES

### **CELL AND MOLECULAR BIOLOGY / MENTORED**

#### **Neville Theater**

8:30 AM Danielle Dantzler, Governor's School for Science and Mathematics  
DOES THE INFLAMMATORY COMPOUND DOSS PROMOTE CANCER STEM CELLS  
EXPANSION?

8:45 AM Faith Emetu, Governor's School for Science and Mathematics  
AUGUMENTING ANTI- CANCER THERAPY USING THE IMMUNE SYSTEM AND  
CYTOKINES

9:00 AM Chalmers Johnson, Governor's School for Science and Mathematics  
LPAR EXPRESSION LEVELS DURING CHICK RETINAL DEVELOPMENT

9:15 AM William Rumfelt, Governor's School for Science and Mathematics  
THE EFFECT OF CANCER CACHEXIA AND PDTC TREATMENTS ON CARDIAC  
PROTEIN SYNTHESIS

9:30 AM Thien-An Bui, Governor's School for Science and Mathematics  
ESTABLISHING A REFERENCE MODEL FOR TAILLESS'S (TLX) EXPRESSION  
PATTERN AND DEVELOPING A TOOL TO MANIPULATE THE EXPRESSION  
PATTERN OF TLX USING BLUE LIGHT

9:45 AM Madeline Odom, Hamilton Career Center  
THE EFFECTS OF VARYING COLORS OF LIGHT ON VASCULAR SMOOTH  
MUSCLE CELLS

10:00 AM Amber Hazzard, Governor's School for Science and Mathematics  
THE USE OF VERAPAMIL TO MAXIMIZE P-GP EXPRESSION ON THE CELL  
MEMBRANE

10:45 AM Parth Patel, Governor's School for Science and Mathematics  
GLYPHOSATE AND THE INCREASED PREVALENCE OF AUTISM

11:00 AM Lauren Chen, Dutch Fork High School  
IDENTIFICATION OF MICRORNAS AS NEW BLOOD BIOMARKERS TO PREDICT  
BREAST CANCER RECURRENCE

11:15 AM Madison Ranalli and Carter Duke, Hamilton Career Center  
THE EFFECTS OF CIRCUMIN ON FIBROBLAST CELLS AND CIRCUMIN WITH  
METFORMIN ON FIBROBLAST CELLS

11:30 AM Eesha Maisuria, Governor's School for Science and Mathematics  
INTERACTION AND OVER-EXPRESSION OF THE PROTEIN KINASE NEK2 IN  
RELATION TO CENTROSOME APPENDAGES IN LEUKEMIA CELLS

- 11:45 AM Joseph Ebai, Governor's School for Science and Mathematics  
MACROPHAGE POLARIZATION IN TH AORTA FOLLOWING IL-6 INFUSION
- 12:00 PM Shivani Chowdhary, Governor's School for Science and Mathematics  
THE EFFECTS OF OXIDATIVE STRESS ON INDUCING SENESENCE IN HUMAN FIBROBLASTS
- 12:15 PM Emelee Guest, Governor's School for Science and Mathematics  
TREATING MUTATION E900X IN GENE CUL4B USING G-418

**CELL AND MOLECULAR BIOLOGY / NON-MENTORED**

**Neville Theater**

- 10:15 AM Faith Robertson, Heathwood Hall Episcopal School  
THE RELATIONSHIP BETWEEN TEMPERATURE AND ANEUPLOIDY OF HELA CELLS

**CHEMISTRY / MENTORED**

**Neville 106**

- 11:00 AM Joshua Huggins, Governor's School for Science and Mathematics  
EXAMINATION OF ANALYTICAL METHODS FOR MONITORING NITRIFICATION IN CHARLESTON WATER SYSTEM'S DISTRIBUTION SYSTEM
- 11:15 AM Edwina Lewis, Governor's School for Science and Mathematics  
EXPLORING HOW TEMPERATURE AFFECTS THE PERFORMANCE OF A HIGH TEMPERATURE SOLID OXIDE FUEL CELL
- 11:30 AM Hayden Tharpe, Governor's School for Science and Mathematics  
DEVELOPING A REACTOR AND CATALYST FOR AQUEOUS PHASE REFORMING PROCESSES
- 11:45 AM Thomas Richburg, Governor's School for Science and Mathematics  
COCRYSTALLIZATION AND PREDICTIONS OF COCRYSTAL STRUCTURE BASED ON ELECTRONEGATIVITY CALCULATIONS
- 12:00 PM Victor Ruan, Governor's School for Science and Mathematics  
OXYGEN CARRIER SYNTHESIS AND CHARACTERIZATION BY CHEMICAL LOOPING WITH OXYGEN UNCOUPLING



**CHEMISTRY / NON-MENTORED**

**Neville 106**

- 1:30 PM Olivia Antonetti, Heathwood Hall Episcopal School  
NUTRITIONAL CONTENT IN ORGANIC VS INORGANIC VEGETABLES
- 1:45 PM Vikram Kumar, Spring Valley High School  
A COMPARISON OF THE TOTAL FLAVONOLS IN DAUCUS CAROTA,  
CYANOCOCCUS, CITRUS SINENSIS, CITRUS LIMON, ACTINIDIA DELICIOSA,  
AND MANGIFERA INDICA

**COMPUTER SCIENCE / MENTORED**

**Neville 206**

- 8:30 AM Nicholas Deas, Governor's School for Science and Mathematics  
USING IBM WATSON TO IMPROVE NON-SPECIALIST AUDIENCE  
UNDERSTANDABILITY OF RESEARCH ARTICLES
- 8:45 AM Vivian Medina, Governor's School for Science and Mathematics  
A SEMI-AUTOMATED METHOD OF GENERATING GROUND TRUTH FOR  
INVOICES
- 9:00 AM Jaden Tennis, Governor's School for Science and Mathematics  
DEVELOPING AN AUTONOMOUS COGNITIVE ASSISTANT IN THREE  
MODALITIES OF DATA
- 9:15 AM Jesse Han, Governor's School for Science and Mathematics  
USING AN AVERAGE CONSENSUS ALGORITHM TO SECURELY TRANSMIT DATA  
ACROSS MULTIPLE NODES
- 9:30 AM Shashaank Rajaraman, Governor's School for Science and Mathematics  
IMPLEMENTING TENSORFLOW TO ASSIST THE AUTONOMOUS AGENT IN SELF-  
NAVIGATING VEHICLES
- 9:45 AM James Johnson, Governor's School for Science and Mathematics  
INTEGRATING OPTIMIZED HIGH-SPEED AUTONOMOUS CONTROL SYSTEMS
- 10:00 AM Joseph Bhoi, Governor's School for Science and Mathematics  
EXPLORING INTERACTION IN AUGMENTED REALITY THROUGH THE 3D  
GENOME VIEWER

**CONSUMER SCIENCE / MENTORED**

**Neville 222**

- 10:45 AM Ivana Devine and Emilee Daniel, Governor's School for Science and Mathematics  
MODELING CONSUMER'S WILLINGNESS TO BUY AND DISCOUNT REQUIRED TO PURCHASE COUNTERFEIT GOODS THROUGH LOGISTIC MODELS, GENERALIZED STRUCTURAL EQUATION MODELING, AND CENSORED GAUSSIAN IDENTITY MODELS
- 11:00 AM William Simpson, Governor's School for Science and Mathematics  
THE EFFECTS OF INTELLIGENT PACKAGING ON SALES
- 11:15 AM Mehrwan Namiranian, Governor's School for Science and Mathematics  
EVALUATION OF HANDS-ON AND VIDEO RESOURCES FOR TEACHING ECONOMICS AND FINANCIAL LITERACY

**CONSUMER SCIENCE / NON-MENTORED**

**Neville 222**

- 8:30 AM Olivia Merritt, Heathwood Hall Episcopal School  
THE EFFECT OF SILICA-CONTAINING TOOTHPASTE ON DENTAL STAINS
- 8:45 AM Caroline Quan, Heathwood Hall Episcopal School  
THE EFFECT OF VINEGAR AND TAP WATER ON THE RELEASE OF NICKEL IN GRADE 304 STAINLESS STEEL CUPS
- 9:00 AM Isaac Vardi, Center for Advanced Technical Studies  
CLEANER DIESEL EMISSION VIA PARTICULATE FILTRATION
- 9:15 AM Nam Nguyen, Spring Valley High School  
CAN BOTH SYNTHETIC AND NATURAK DYEING METHODS BE COMBINED TO CREATE A NEW DYEING METHOD
- 9:30 AM Jackson Byrd, Heathwood Hall Episcopal School  
THE EFFECT OF COMEDY AND SERIOUSNESS IN ADVERTISING ON THE OPINIONS OF VIEWERS
- 9:45 AM Casey Carter, Spring Valley High School  
ENHANCING THE BIOMECHANICAL DESIGN OF THE FOOTBALL HELMET (CONCUSSION PREVENTION) PT.III
- 10:00 AM Zola Jane Aplin, Center for Advanced Technical Studies  
CAN MINT PRODUCTS IMPROVE CONTINUOUS CONCENTRATION?

## **ENGINEERING / MENTORED**

### **Neville 109**

- 8:30 AM Shawn Potter, Governor's School for Science and Mathematics  
RELAXATION AND ADHESIVE BIOMECHANICAL PROPERTIES OF  
BIOSYNTHETIC MATERIALS FOR A PREOPERATIVE BRAIN MODEL
- 8:45 AM Ridhi Chaubey, Governor's School for Science and Mathematics  
KNOCK! KNOCK! WHO'S THERE? – ARTIFICIAL NEURAL NETWORK AND DEEP  
LEARNING MODELING
- 9:00 AM Aika Washington, Governor's School for Science and Mathematics  
PHYSICAL SCALE MODELING OF TENSEGRITY ROBOTS
- 9:15 AM Duncan Harmon, Governor's School for Science and Mathematics  
AUTOMATING A HUMAN ASSEMBLY PROCESS IN A BRASS MANUFACTURING  
COMPANY USING THE YUMI COLLABORATIVE ROBOT
- 9:30 AM Allison Troup, Governor's School for Science and Mathematics  
THE MECHANICAL STUDY OF HYDROGELS AND AN ORGANOGEL AS  
POTENTIAL SYNTHETIC BRAIN PHANTOM
- 9:45 AM Austin Bevenour, Governor's School for Science and Mathematics  
COLLABORATIVE ROBOTS AND THEIR APPLICATIONS IN THE WORKPLACE
- 10:00 AM Dawson Leviner, Governor's School for Science and Mathematics  
PNEUMATIC TECHNOLOGY AND ITS APPLICATIONS IN SOFT ROBOTICS
- 10:15 AM Grayson Bockman, Governor's School for Science and Mathematics  
IMPROVING THE MECHANICAL FUNCTION OF A NUCLEUS PULPOSUS  
IMPLANT FOR INTERVERTEBRAL DISC REPAIR
- 10:45 AM Martin Driggers, Governor's School for Science and Mathematics  
SPRAYING AND SURVEYING APPLICATIONS OF DRONES TO THE PRECISION  
AGRICULTURE INDUSTRY: WRITING PROTOTYPE SOFTWARE TO  
AUTOMATICALLY FLY A DRONE FOR SURVEY OR SPRAY PURPOSES
- 11:00 AM Austin Taylor, Governor's School for Science and Mathematics  
THEORETICAL EXAMINATION OF PHASE BEHAVIOR IN MULTI-COMPONENT  
MODEL MEMBRANES
- 11:15 AM Nicholas Peckich, Governor's School for Science and Mathematics  
ASSEMBLY LINE IMPROVEMENTS OF EFFICIENCY AND SAFETY AND THEIR  
EFFECT ON THE WORKING CLASS USING THE YUMI COLLABORATIVE ROBOT  
AS A MODEL
- 11:30 AM Justin Cox, Governor's School for Science and Mathematics  
A SELF-FORMING NIO-MC DUAL-PHASE MEMBRANE FOR CO<sub>2</sub> CAPTURE FROM  
SIMULATED FLUE GAS
- 11:45 AM Revery Johnson, Governor's School for Science and Mathematics  
DEGRADATION OF NYLON VERSUS SELAR BOTTLES IN MULTI-JET 3D  
PRINTERS

**ENGINEERING / NON-MENTORED (SESSION A)**

**Lassiter 118**

- 9:00 AM Alexander Dixon, Center for Advanced Technical Studies  
NARCOTIC IDENTIFICATION
- 9:15 AM Tyler White, Spring Valley High School  
THE EFFECT OF MODIFIED SOCCER HEADGEAR ON THE FORCE OF A SOCCER BALL DURING SOCCER HEADING
- 9:30 AM Madison Gepper, Center for Advanced Technical Studies  
ASSISTIVE TECHNOLOGY PACK FOR STUDENTS WITH DOWN SYNDROME
- 9:45 AM Jackson McFadden, Spring Valley High School  
THE EFFECT OF NEODYMIUM MAGNETS ON THE AMOUNT OF SALT FILTERED OUT OF A SEAWATER REVERSE OSMOSIS SYSTEM
- 10:00 AM DuBose Tuller, Heathwood Hall Episcopal School  
THE EFFECT OF THE BICYCLE SAFETY DEVICE ON CYCLIST'S ABILITY TO DETECT CARS BEHIND THEM
- 10:15 AM Joseph Pope, Heathwood Hall Episcopal School  
THE EFFECT OF CHANGING THE ACTION OR BARREL LENGTH OF A SHOTGUN
- 10:45 AM Siddharth Gianey, Spring Valley High School  
THE EFFICIENCY OF THE THERMAL ENERGY CREATED BY DIFFERENT TYPES OF COMPUTERS ON THE TIME TAKEN FOR A PHONE TO CHARGE USING THE THERMAL ENERGY
- 11:00 AM Chase DaMoude, Center for Advanced Technical Studies  
IDENTIFYING AN OPTIMAL PETROL/BIO DIESEL TRANSPORTATION FUEL BLEND.
- 11:15 AM Eric Keeler, Center for Advanced Technical Studies  
BACK BRACE INSERT FOR SCOLIOSIS
- 11:30 AM Anna Jackson, Center for Advanced Technical Studies  
ENGINEERING A WATERPROOF ADHESIVE BANDAGE WRAPPER
- 11:45 AM Maria Frattaroli, Center for Advanced Technical Studies  
IMPROVEMENT OF THE TOE PAD FOR POINTE SHOES ACCORDING TO FOOT SHAPE

**ENGINEERING / NON-MENTORED (SESSION B)**

**Lassiter 119**

- 9:00 AM Riley Haywood, Heathwood Hall Episcopal School  
THE EFFECT OF CHANGING WIND SPEED ON THE AMOUNT OF VOLTAGE PRODUCED FROM A WIND BELT
- 9:15 AM Wyatt Hill, Center for Advanced Technical Studies  
OPTIMIZATION OF TURBINE BLADES ON NON-TRADITIONAL WIND TURBINES

- 9:30 AM Austin Carnes, Center for Advanced Technical Studies  
IMPROVEMENT OF SOLAR PHOTOVOLTAIC EFFICIENCY BY IMPLEMENTING A COOLING SYSTEM
- 9:45 AM Nithin Saravanapandian, Spring Valley High School  
BUILDING A MULTI-SENSOR MOBILE ROBOT THAT CAN FREELY MOVE, DETECT HUMAN MOVEMENT, AND DETERMINE THE GENERAL SHAPE AND POSITION OF A HUMAN SUBJECT TO BE COMPATIBLE WITH AN AUGMENTED REALITY HEADSET.
- 10:00 AM Asher Huddleston, Spring Valley High School  
THE EFFECT OF FIBER TYPE ON HEAT RETENTION IN SLEEPING BAGS
- 10:15 AM Mary Ballentine, Center for Advanced Technical Studies  
CREATING THE LOFSTRAND CRUTCH GYROCUP
- 10:45 AM Ellie Hoos and Regan Dargan, Center for Advanced Technical Studies  
ENGINEERING OF AN ELECTROTHERAPY KNEE SLEEVE
- 11:00 AM Brianna Stanley, Heathwood Hall Episcopal School  
THE EFFECTS OF A METAL OBSTRUCTION ON A GPS TRACKER
- 11:15 AM Alyssa Williams, Spring Valley High School  
THE EFFECT OF WHEEL AND DRIVE TYPES ON THE OVERALL PERFORMANCE OF A ROBOT IN TESTS OF ALIGNMENT AND TRACTION
- 11:30 AM Paul Dubberly, Spring Valley High School  
THE EFFECT OF  $\text{Li}_2\text{CO}_3$  ELECTROLYTE CONCENTRATION ON ARLB PERFORMANCE
- 11:45 AM Kayla Wohleber, Center for Advanced Technical Studies  
MOMMA BEAR BRACELET

**ENVIRONMENTAL SCIENCE / MENTORED**  
**Neville 110**

- 8:30 AM Hannah Willis, Governor's School for Science and Mathematics  
SEA LEVEL RISE AND COASTAL EROSION'S IMPACT ON LATE-ARCHAIC SOUTHEASTERN UNITED STATES SHELL RINGS
- 8:45 AM Abigail Evans, Governor's School for Science and Mathematics  
MEASUREMENT OF GAS-TO-PARTICLE PARTITIONING COEFFICIENTS OF VOLATILE ORGANIC COMPOUNDS
- 9:00 AM Abhimanyu Sailesh, Blythewood High School  
THE EFFECT OF FLAVONOID GALANGIN ON THE CELL VIABILITY AND TOXICITY OF MCF-7 HUMAN BREAST CANCER CELLS EXPOSED TO POLYCYCLIC AROMATIC HYDROCARBONS (PAHS)
- 9:15 AM Collin Myers and Savannah Finely, Governor's School for Science and Mathematics  
MEASURING THE RATE OF LIGAND EXCHANGE REACTIONS: ELUCIDATION OF COPPER AND NICKEL TOXICITY IN AQUATIC ENVIRONMENTS

- 9:30 AM Jaden Yam, Governor's School for Science and Mathematics  
THE APPLICATION OF PVP-COATED NANOPARTICLES FOR OIL REMOVAL FROM SYNTHETIC SEAWATER IN THE PRESENCE AND ABSENCE OF FULVIC ACID
- 9:45 AM Anne McElvenny, Governor's School for Science and Mathematics  
THE EFFECT OF ORGANIC MATTER ON THE AGGREGATION RATES AND KINETICS OF SILVER NANOPARTICLES

**ENVIRONMENTAL SCIENCE / NON-MENTORED (SESSION A)**

**Lassiter 220**

- 9:00 AM Sreya Varanasi, Spring Valley High School  
THE EFFECT OF HORDEUM VULGARE, RICE HULL, AND OAK LEAF LITTER ON THE PREVALENCE OF MICROCYSTIS
- 9:15 AM Annie Lobitz, Spring Valley High School  
THE EFFECT OF PSEUDOMONAS PUTIDA ON THE DEGRADATION OF OIL IN SALTWATER AND FRESHWATER ENVIRONMENTS
- 9:30 AM Siri Avula, Spring Valley High School  
THE EFFECT OF SODIUM HYPOCHLORITE ON THE HEART RATE OF DAPHNIA MAGNA
- 9:45 AM Jayra Penaloza, Spring Valley High School  
AN ECOLOGICAL STUDY ON THE COASTAL REGIONS OF SOUTH CAROLINA TO DETERMINE THE CAUSE OF SOIL NUTRIENT DEPLETION BASED ON THE UNIQUE CONDITIONS AND INDUSTRY
- 10:00 AM Maeghan Ainsworth, Center for Advanced Technical Studies  
ANALYZING THE EFFECT OF WEATHER ON EVACUATED TUBES
- 10:15 AM Morgan Lowman and Kamryn Shealy, Center for Advanced Technical Studies  
DO PEOPLE'S MICROBIAL SIGNATURES AFFECT THEIR ENVIRONMENT?
- 10:45 AM Madeline Ashcraft, Heathwood Hall Episcopal School  
THE EFFECT OF THE LOVES TRUCK STOP ON THE QUALITY OF WATER IN THE NEARBY WETLANDS
- 11:00 AM Riana Shelley, Heathwood Hall Episcopal School  
THE EFFECT OF WATER FILTRATION ON TERRAIN
- 11:15 AM Erin Blalock, Spring Valley High School  
THE EFFECT OF UV EXPOSURE ON TIO<sub>2</sub> NANOMATERIALS REDUCTION OF P-CHLOROBENZOIC ACID CONCENTRATION IN AQUEOUS SOLUTIONS THROUGH PHOTOCATALYSIS
- 11:30 AM Kayla O'Grady, Spring Valley High School  
THE EFFECT OF COPPER(II) SULFATE PENTAHYDRATE ON ABSCISIC ACID IN CUCURBITA PEPO

11:45 AM Vinita Cheepurupalli, Spring Valley High School  
NOVEL MOSQUITO TRAP: THE USE OF ACOUSTICS AND OLFACTION TO ATTRACT MALE MOSQUITOES

12:00 PM Vamsi Gorrepati, Spring Valley High School  
THE EFFECT OF ACETAMINOPHEN (ANALGESIC) AND DIPHENHYDRAMINE (ANTIHISTAMINE) ON NOCICEPTION RESPONSE OF CAENORHABDITIS ELEGANS, HEART RATE OF EISENIA FETIDA, AND MORTALITY OF BOTH E. FETIDA AND C. ELEGANS

### **ENVIRONMENTAL SCIENCE / NON-MENTORED (SESSION B)**

#### **Lassiter 222**

9:00 AM Sera Zell, Spring Valley High School  
THE EFFECT OF HIGH DENSITY POLYETHYLENE SIZE ON DECOMPOSITION RATE

9:15 AM Fatima Jatoi, Spring Valley High School  
THE EFFECT OF BISPENOL A ON THE MATING BEHAVIORS OF GRYLLODES SIGILLATUS

9:30 AM Emily Carpenter, Spring Valley High School  
THE EFFECT OF PLANT MEDIUMS WITH NITRATE CONCENTRATION FROM WATER RUN OFF

9:45 AM Amal Verma, Spring Valley High School  
THE EFFECT OF KAPOK FIBER AND RAW COTTON FIBER WITH FERROMAGNETIC PARTICLES ON OIL REMOVAL FROM WATER

10:00 AM Keshav Nair, Spring Valley High School  
THE EFFECTS OF CLINOPTILOLITES VS. CONTROL-RELEASE FERTILIZER ON NITRATE LEACHED FROM SILT LOAM SOIL

10:15 AM Allison Hall, Heathwood Hall Episcopal School  
THE EFFECT OF PLASTICS ON DAPHNIA'S HEART RATE, AND MORTALITY RATE

10:45 AM Brandon Snyder, Center for Advanced Technical Studies  
THE EFFECTS OF WEATHER CONDITIONS ON SOLAR PHOTOVOLTAIC PANELS

11:00 AM Kaouri Marie Alipio, Spring Valley High School  
THE RELATIONSHIP OF MICROALGAE AND BACTERIA IN WASTEWATER TREATMENT

11:15 AM Kristina Trifonova, Spring Valley High School  
THE EFFECT OF HYPERACCUMULATOR BIOCHAR APPLICATION ON SOIL PROPERTIES AND PLANT GROWTH OF VIGNA RADIATA

11:30 AM Jay Patel, Spring Valley High School  
THE EFFECTS OF ALUMINUM OXIDE AND MANGANESE IRON OXIDE NANOPARTICLES ON THE EXTRACTION OF MOTOR OIL FROM BUCEPHALA ALBEOLA FEATHERS

- 11:45 AM Pranav Bellukutty, Spring Valley High School  
THE EFFECTS OF NATURALLY MODELED ACIDIC CONDITIONS ON THE GROWTH OF THE PHYTOPLANKTON GYMNODINIUM
- 12:00 PM Elizabeth Dillon, Spring Valley High School  
THE EFFECT OF RUBBER PLAYGROUND SURFACES ON SURROUNDING SOIL PROPERTIES: A FIELD STUDY

**MATHEMATICS / MENTORED**

**Neville 206**

- 11:00 AM Tyler Feemster, Governor's School for Science and Mathematics  
THE EFFECT OF TRANSITION PROBABILITIES IN A SIMULATION ON THE RHEOLOGICAL PROPERTIES OF COMPLEX FLUIDS
- 11:15 AM Brennan Ravan, Governor's School for Science and Mathematics  
EVALUATING LIMITS OF SERIES
- 11:30 AM Brittany Bynum, Governor's School for Science and Mathematics  
MATHEMATICAL INEQUALITIES INVOLVING FIBONACCI NUMBERS

**MATHEMATICS / NON-MENTORED**

**Neville 206**

- 11:45 AM Nico Adamo, Heathwood Hall Episcopal School  
THE RELATIONSHIP BETWEEN CONDUCTOR AND DISCRIMINANT OF AN ELLIPTIC CURVE OVER  $\mathbb{Q}$

**MICROBIOLOGY / MENTORED**

**Neville 221**

- 8:30 AM Leah Hoffner, Governor's School for Science and Mathematics  
SUBCELLULAR PH CHANGES IN CORRELATION TO GLUTATHIONE METABOLISM
- 8:45 AM David Bombard, Governor's School for Science and Mathematics  
PROTEIN SPECIFICITY OF THE HYPERACTIVE MUTANT MMPING20
- 9:00 AM Marie Sanyang, Governor's School for Science and Mathematics  
EXPRESSION AND PURIFICATION OF FEPI INVOLVED IN IRON REGULATION IN *S. POMBE*
- 9:15 AM Lanie Croft, Governor's School for Science and Mathematics  
IDENTIFICATION OF CANDIDATE LIPID DROPLET STRUCTURAL PROTEINS IN *TRYPANOSOMA BRUCEI BRUCEI*
- 9:30 AM Zeanmarj Ramos and Morgan McManus, Governor's School for Science and Mathematics  
ASSESSMENT OF ANTIBIOTIC RESISTANCE IN AGRICULTURAL PRODUCTION



**MICROBIOLOGY / NON-MENTORED**

**Neville 221**

- 9:45 AM Garrett Kaufman, Spring Valley High School  
THE EFFECT OF ARTIFICIAL SWEAT CORROSION ON THE ABILITY OF COPPER, ALUMINUM, AND STAINLESS STEEL FOILS TO INHIBIT THE GROWTH OF ESCHERICHIA COLI.
- 10:00 AM Johannamarie Nwanagu, Heathwood Hall Episcopal School  
THE EFFECT OF COPPER AND SORBIC ACID ON AMPICILLIN-RESISTANT BACTERIA
- 10:15 AM Kierson Sutton, Spring Valley High School  
THE EFFECT OF TRANSITION METALS AND ORGANIC ACIDS ON ESCHERICHIA COLI
- 10:45 AM Isabella Clarke and Mercedes Perez-Shillington, Heathwood Hall Episcopal School  
THE EFFECT OF TIME ON BACTERIA ON SPINACH LEAVES
- 11:00 AM Luke Zhang, Spring Valley High School  
THE EFFECT OF PET AND PVC PLASTIC POLLUTION ON THE BIOMASS OF NANNOCHLOROPSIS OCULATA
- 11:15 AM Pranav Guntupalli, Spring Valley High School  
THE EFFECT OF VARYING MAGNESIUM NITRATE AND TEMPERATURE LEVELS ON THE GROWTH OF CHLORELLA SP.
- 11:30 AM Sachet Urs, Spring Valley High School  
THE EFFECT OF CYCLOPS COPEPOD PREDATION ON THE PROMOTION OF GROWTH WITHIN MICROCYSTIS AERUGINOSA POPULATIONS THROUGH CHEMICAL SIGNALING
- 11:45 AM Julia Lauterbach, Heathwood Hall Episcopal School  
WHICH CHOPSTICK SURFACE, EITHER WOODEN, METAL, OR PLASTIC, WOULD ENABLE THE MOST E COLI BACTERIA TO GROW?
- 12:00 PM Ahad Chattha, Spring Valley High School  
THE EFFECTS OF DRY HEAT AND MOIST HEAT STERILIZATION METHODS ON NON-PATHOGENIC STRAINS OF ESCHERICHIA COLI IN GROUND BEE
- 12:15 PM Abhijith Nair, Spring Valley High School  
THE SYNERGISTIC EFFECT OF EPIGALLOCATECHIN-3-GALLATE (EGCG) AND ARTEMISININ ON THE PLASMODIUM MORTALITY RATES OF PHYSARUM POLYCEPHALUM AND CELL MOTILITY/CHEMOTAXIS OF DICTYOSTELIUM DISCOIDEUM UTILIZED AS AN AMOEBCIC HOST

## **PHYSICS / MENTORED**

### **Neville 306**

- 10:45 AM Patrick Smith, Governor's School for Science and Mathematics  
ESTIMATING PERSISTENCE LENGTH OF SSDNA USING FLUORESCENCE  
CORRELATION SPECTROSCOPY AND A COMPUTER SIMULATION
- 11:00 AM Joseph Williams, Governor's School for Science and Mathematics  
MODELING THE ELECTRICAL CHARACTERISTICS OF PLATINUM ELECTRODES  
FOR USE IN SIMULTANEOUS STIMULATION AND RECORDING OF NEURONS
- 11:15 AM James Byrne, Governor's School for Science and Mathematics  
ESTIMATING PERSISTENCE LENGTH OF SSDNA USING FLUORESCENCE  
CORRELATION SPECTROSCOPY AND COMPUTER SIMULATION
- 11:30 AM Nikhil Gottipaty, Spring Valley High School  
ULTRASENSITIVE PORTABLE NITROGEN DIOXIDE MONITOR
- 11:45 AM Christopher Poston, Governor's School for Science and Mathematics  
ANALYZING INFORMATION TRANSFER PATTERNS IN EAST ASIAN FINANCIAL  
MARKETS
- 12:00 PM Ian O'Dell, Governor's School for Science and Mathematics  
REFINING THE PHOTOLITHOGRAPHY PROCEDURE FOR THE USE OF  
MEASURING HALL VOLTAGES
- 12:15 PM Ishrat Singh, Governor's School for Science and Mathematics  
HIRES ANALYSIS OF EIGHT CANDIDATE DUSTY ABSORBERS: IMPLICATIONS  
FOR CHEMICAL EVOLUTION IN GALAXIES

## **PHYSICS / NON-MENTORED**

### **Neville 306**

- 9:00 AM Anika Nair, Spring Valley High School  
THE EFFECT OF DIFFERENT COLORED ROSOIDEAE ROSA PETAL  
ANTHOCYANIN PIGMENTS ON THE AMOUNT OF ELECTRICITY GENERATED  
FROM A PHOTOVOLTAIC CELL
- 9:15 AM Caitlin Kunchur, Dutch Fork High School  
STUDYING THE ACOUSTICAL EFFECTS OF REVERBERATION
- 9:30 AM Dalton Arndt, Spring Valley High School  
THE EFFECT OF SKATE BLADE SHARPNESS ON THE COEFFICIENT OF  
FRICTION OF ICE
- 9:45 AM Jasmine Hughley, Spring Valley High School  
THE EFFECT OF DIFFERENT EARBUD TIPS ON THE PRESSURE OF SOUND  
TRANSMITTED
- 10:00 AM Clay Mitchell, Heathwood Hall Episcopal School  
THE DIFFERENCE IN FLIGHT MANEUVERABILITY BETWEEN A RACING DRONE  
AND A DJI PHANTOM 4

10:15 AM Aaron Stark, Spring Valley High School  
THE EFFECT OF THE ANGLE OF A BICYCLE WHEEL RELATIVE TO A CAR ON  
THE VOLTAGE INDUCED DUE TO ITS ROTATION

**PHYSIOLOGY AND HEALTH / MENTORED**

**Neville 322**

9:00 AM Melat Tarekegne, Governor's School for Science and Mathematics  
CAN PAIRED ASSOCIATIVE STIMULATION MODULATE BRIAN PLASTICITY AND  
MOTOR EXCITABILITY IN STROKE PATIENTS?

9:15 AM Jacob Palchak, Governor's School for Science and Mathematics  
VALIDATION OF WRIST-WORN CONSUMER HEART RATE MONITORS DURING  
EXERCISE

9:30 AM Kelvin Aduma, Governor's School for Science and Mathematics  
ROLE OF ALPHA-PINENE IN THE DEVELOPMENT OF AUTISM SPECTRUM  
DISORDERS

9:45 AM Nolan Jenkins, Governor's School for Science and Mathematics  
AN ASSESSMENT OF THE FACTORS ASSOCIATED WITH GLOBAL STROKE RISKS

10:00 AM Chelse VanAtter, Governor's School for Science and Mathematics  
EPA4B EXPRESSION IN THE CRANIOFACIAL DEVELOPMENT OF AFRICAN  
CICHLID FISHES

10:15 AM Lindsay Gardner, Governor's School for Science and Mathematics  
EXAMINING DIFFERENCES IN MALE AND FEMALE AGED MOUSE BRAINS

10:45 AM Calvin Aduma, Governor's School for Science and Mathematics  
EFFECT OF BENZYL SALICYLATE ON NEURONAL CELL LINES 2266 AND 2267

11:00 AM Jada Wilson, Governor's School for Science and Mathematics  
REDUCING ENOLASE EXPRESSION AND ACTIVITY TO PREVENT HARMFUL  
DAMAGE IN SPINAL CORD INJURY

11:15 AM Rasikh Hamid, Governor's School for Science and Mathematics  
MITIGATING THE IMMUNE RESPONSE OF TRANSPLANT TISSUES

11:30 AM Daniela Ramos Mendoza, Governor's School for Science and Mathematics  
THE EFFICIENCY OF MODIFIED TEMOZOLOMIDE IN GLIOBLASTOMA CELL  
DEATH

11:45 AM Michaela Palmer, Governor's School for Science and Mathematics  
THE EFFECT OF DIET ON COGNITIVE FUNCTION

12:00 PM Shirley Mathur, Governor's School for Science and Mathematics  
INDICATION FOR BONE REMODELING IN THE LATERAL ASPECT OF YOUNG  
WHITE-TAILED DEER DISTAL FEMORA

**PHYSIOLOGY AND HEALTH / NON-MENTORED**

**Neville 121**

- 8:30 AM Serena Parmar, Heathwood Hall Episcopal School  
THE EFFECT OF TURMERIC ON THE REGENERATION RATE OF PLANARIAN,  
GIRARDIA TIGRINA
- 8:45 AM Mikaila Widener, Spring Valley High School  
THE EFFECTS OF TWO DIFFERENT TRAINING SCHEDULES ON THE VERTICAL  
JUMP HEIGHT OF VOLLEYBALL PLAYER
- 9:00 AM Haley Nazario, Center for Advanced Technical Studies  
EVALUATING WOMEN'S AWARENESS OF HEART ATTACK SYMPTOMS
- 9:15 AM Ty Jones and Van Clarke, Heathwood Hall Episcopal School  
PLAYING POSITION VS HELMET IMPACT FORCES IN FOOTBALL
- 9:45 AM Crawford Latham, Spring Valley High School  
THE EFFECT OF TAURINE CONCENTRATION ON HEAD REGENERATION IN  
PLANARIAN
- 10:00 AM Danielle Alston, Center for Advanced Technical Studies  
THE ENHANCEMENT OF FIDGET DEVICES
- 10:15 AM Claire McDonald, Heathwood Hall Episcopal School  
THE EFFECT OF NICOTINE ON DROSOPHILA MELANOGASTER LIFESPAN AND  
NUMBER OF OFFSPRING
- 10:45 AM Mark Wild, Spring Valley High School  
THE EFFECT OF THE PACING STRATEGY OF HIGH SCHOOL MALE CROSS  
COUNTRY RUNNERS ON THE FINISH TIME AND HEART RATE OF THE  
RUNNERS
- 11:00 AM Jalyn Anderson, Center for Advanced Technical Studies  
CORRELATION BETWEEN RED AND PROCESSED MEAT AND TYPE 2 DIABETES
- 11:15 AM Jim Blair, Heathwood Hall Episcopal School  
THE EFFECT OF FOOTBALL POSITION PLAYED ON FORCE OF IMPACT TO THE  
HEAD
- 11:30 AM Noah Hook, Spring Valley High School  
THE EFFECT OF ULTRASOUND ON SALMONELLA JAVIANA, AEROMONAS  
HYDROPHILA, YERSINIA RUCKERI, EDWARDSIELLA ICTALURI, AND  
ESCHERICHIA COLI DECONTAMINATION
- 11:45 AM Shane Mikolajczak, Center for Advanced Technical Studies  
PREVENTION OF CHRONIC MEMORY LOSS IN ALZHEIMER'S PATIENTS  
THROUGH DIET CHANGE
- 12:00 PM Isabelle Herndon, Heathwood Hall Episcopal School  
THE EFFECT OF DIET ON THE LIFESPAN OF DROSOPHILA MELANOGASTER

- 1:30 PM Maryah Lance, Spring Valley High School  
THE EFFECT OF THE VARIOUS TYPES OF SNEAKERS ON THE TYPE AND AMOUNT OF INJURY ON VARSITY GIRLS' BASKETBALL PLAYERS
- 1:45 PM Camille Cowley, Center for Advanced Technical Studies  
IS THERE AN ASSOCIATION BETWEEN GRANULOMATOSIS WITH POLYANGIITIS AND A HISTORY OF SINUS PROBLEMS?
- 2:00 PM Dawn Nguyen, Spring Valley High School  
THE EFFECT OF DEVELOPMENTAL NUTRITION ON ETHANOL ADDICTION IN DROSOPHILA MELANOGASTER
- 2:15 PM Meredith Radtke, Center for Advanced Technical Studies  
EXPLORING CHRONIC HICCUPS
- 2:30 PM Deiveek Kerai, Spring Valley High School  
THE EFFECT OF LIVATREX, GANODERMA LUCIDUM, THEANINE, AND VITAMIN E IN COMBINATION WITH ETHYL ALCOHOL ON THE RESPONSE TO THERMOTAXIS IN CAENORHABDITIS ELEGANS

**PSYCHOLOGY AND SOCIOLOGY / MENTORED**

**Neville 305**

- 9:00 AM Michael Mulvaney, Governor's School for Science and Mathematics  
THE COBRA EFFECT OF U.S. FOREIGN INTERVENTION IN THE MIDDLE EAST AND AFRICA
- 9:15 AM Alannah Quinn, Governor's School for Science and Mathematics  
NUMERICAL ESTIMATION IN GLASS PATTERNS
- 9:30 AM Kathleen Tatusko, Governor's School for Science and Mathematics  
HOW MOTHER'S BELIEF IN MISINFORMATION IMPACTS THEIR CHILDREN'S MEMORY
- 9:45 AM Bailey Clark, Governor's School for Science and Mathematics  
THE METHODOLOGY BEHIND REPRESENTING SELF: THE ROLE OF INSTAGRAM IN IDENTITY FORMATION
- 10:00 AM Felicia McGill, Governor's School for Science and Mathematics  
EFFECTS OF CONNECTEDNESS ON VISUAL ENUMERATION
- 10:15 AM Jackie Booker Jr. and William Billbrough, Governor's School for Science and Mathematics  
COMPARING THE SOCIODEMOGRAPHIC DATA FROM A SURVEY PERTAINING TO INTELLECTUAL PROPERTY RIGHTS INFRINGEMENT ON RESPONDENTS IN SHANGHAI, CHINA AND CHARLESTON, SOUTH CAROLINA
- 10:45 AM Nainaa Oberoi, Governor's School for Science and Mathematics  
ONE WORD SAYS IT ALL
- 11:00 AM Sarah Fowler, Governor's School for Science and Mathematics  
NAMING THE DIMENSIONS OF EMOTIONS IN A SCENE

11:15 AM Elise Pyon, Governor's School for Science and Mathematics  
AUTISM SEVERITY IN CHILDREN WITH FRAGILE X SYNDROME AND GENETIC VARIATION

11:30 AM Annelise Waling and Andrew Poore, Governor's School for Science and Mathematics  
CORRELATION OF FACTOR ANALYSIS OF CONSUMER DISPOSITION TOWARDS COUNTERFEIT GOODS WITH RESPECT TO SOCIO-DEMOGRAPHIC VARIABLES

### **PSYCHOLOGY AND SOCIOLOGY / NON-MENTORED**

#### **Neville 321**

8:30 AM Jareer Imran, Spring Valley High School  
THE RELATIONSHIP BETWEEN THE ECONOMIC STATUS OF A POPULATION AND THE INDOOR AIR QUALITY OF THE SCHOOL SERVING THE POPULATION

8:45 AM Andrew Miller, Spring Valley High School  
THE EFFECT OF VIRTUAL REALITY EDUCATION TOOLS ON THE RETENTION OF INFORMATION

9:00 AM Sydney Hannibal, Spring Valley High School  
THE EFFECT OF PHOTO TAKING ON STUDENT VISUAL AND AUDITORY MEMORY OF MATERIAL PRESENTED

9:15 AM Towns Christian, Heathwood Hall Episcopal School  
HOW AGE AND GENDER AFFECT INSTAGRAM USE

9:30 AM Kit Mullins, Heathwood Hall Episcopal School  
THE EFFECT OF REWARD AND PUNISHMENT ON THE ACCURACY OF TEST TAKING

9:45 AM Mary Sox, Spring Valley High School  
RESIDENTS' PERCEPTION TOWARD TOTAL ECLIPSE WEEKEND

10:00 AM Elizabeth Shytle, Spring Valley High School  
THE RELATIONSHIP BETWEEN RACE OF SHOOTER OF MASS SHOOTING, NUMBER OF VICTIMS, NUMBER OF FATALITIES, AND LOCATION OF MASS SHOOTINGS ON NUMBER OF TWEETS POSTED BY A GUN ADVOCACY GROUP

10:15 AM Tyrell Fleshman, Spring Valley High School  
THE EFFECT OF MOBILE DEVICES ON A STUDENTS ABILITY TO OBTAIN A RETAIN INFORMATION

10:45 AM Bridgette Ravindra, Spring Valley High School  
THE EFFECT OF TRENDING WORLD EVENTS ON SENTIMENT ANALYSIS AND RELEVANCY INTERVALS USING ANALYTICS SOFTWARE ON TWITTER DATA.

11:00 AM Ryan Davis and Evan Barker, Heathwood Hall Episcopal School  
THE EFFECT OF MEDIA ON A PERSON'S ABILITY TO ACCURATELY READ EMOTIONS

11:15 AM Charlotte Hughes, Heathwood Hall Episcopal School  
THE EFFECT OF GENDER, GRADUATING CLASS, AND GRADE LEVEL ON ERB READING COMPREHENSION SCORES OVER TIME

- 11:30 AM Christian Lee, Spring Valley High School  
THE EFFECT OF BILINGUALISM ON MONOLINGUALISM ON THE IDENTIFICATION OF FOREIGN LANGUAGES
- 11:45 AM Kate Willhide, Heathwood Hall Episcopal School  
THE EFFECT OF CONCENTRATION-IMPROVING MUSIC ON READING COMPREHENSION
- 12:00 PM Elizabeth Morris, Heathwood Hall Episcopal School  
SIMULATED DRIVING WITH DISTRACTIONS
- 1:30 PM Jacob Ho, Spring Valley High School  
THE EFFECT OF FITNESS ON EXECUTIVE FUNCTIONING OF THE BRAIN IN HIGH SCHOOL AGE CHILDREN
- 1:45 PM Erin Byrd, Spring Valley High School  
THE EFFECT OF DIFFERENTIATED TEST FORMAT AND QUESTION TYPE ON READING COMPREHENSION TEST PERFORMANCE
- 2:00 PM Sarayu Das, Spring Valley High School  
THE EFFECTS OF A VISUAL AID ON CONTROLLING PUBLIC BEHAVIOR ON PHARMACEUTICAL POLLUTION
- 2:15 PM Rachael Nall, Spring Valley High School  
THE EFFECT OF TOPSPIN SERVES, FLOAT SERVES, AND JUMP SERVES ON THE TYPE OF PASS MADE BY HIGH SCHOOL VOLLEYBALL PLAYERS

### **ZOOLOGY / MENTORED**

#### **Neville 122**

- 11:00 AM Samantha Brinson and Jonathan Beatriz, Governor's School for Science and Mathematics  
FEEDING RESPONSE TO GROOVED AND SCENTED 3D PRINTED FLOWERS BY VANESSA CARDUI
- 11:15 AM Shona Fitzer, Governor's School for Science and Mathematics  
THE EFFECT OF HUMAN TRAFFIC ON BIRD BEHAVIOR
- 11:30 AM Phoebe Capps, Governor's School for Science and Mathematics  
EFFECTS OF LOW POND STOCKING DENSITY ON SPOTTED SEA TROUT IN HIGH TEMPERATURE MARICULTURE PONDS
- 11:45 AM Sarah Elliott, Governor's School for Science and Mathematics  
EFFECTS OF VARYING HORSE CARE FACTORS ON THE SUSCEPTIBILITY TO COLIC IN HORSES
- 12:00 PM Harrison Snow and Rebecca Flanagan, Governor's School for Science and Mathematics  
DETERMINATION OF HOX D11 GENE INFLUENCE ON CHICKEN EVOLUTION IN EMBRYONIC DEVELOPMENT

12:15 PM Amanda Hardin, Governor's School for Science and Mathematics  
SOIL INVERTEBRATE DIVERSITY IN WINTHROP UNIVERSITY'S SUCCESSION  
PLOTS

**ZOOLOGY / NON-MENTORED**

**Neville 122**

- 8:30 AM Jordan Nealey, Spring Valley High School  
THE EFFECT OF CAFFEINE ON THE FORAGING BEHAVIOR AND  
REPRODUCTION OF DROSOPHILA MELANOGASTER
- 8:45 AM Lauren Mehta, Spring Valley High School  
THE EFFECT OF SOUND FREQUENCIES ON THE GROWTH RATE OF THE  
PHYSARUM POLYCEPHALUM
- 9:00 AM Ben Feldman, Heathwood Hall Episcopal School  
THE EFFECT OF GENETICALLY MODIFIED MAIZE VS ORGANIC MAIZE ON  
FODDER PREFERENCES IN PROCYON LOTOR.
- 9:15 AM Connor Myrick, Spring Valley High School  
THE EFFECT OF VARIOUS LIGHT BULB AND ACCOMPANYING VISIBLE LIGHT  
FREQUENCIES ON POGONOMYRMEX OCCIDENTALIS ACTIVITY
- 9:30 AM Catherine Barron, Heathwood Hall Episcopal School  
THE EFFECT OF IRGASAN OF THE EMBRYONIC DEVELOPMENT OF ARBACIA  
PUNCTULATA
- 9:45 AM Pallavi Rao, Spring Valley High School  
THE EFFECT OF MONOSODIUM GLUTAMATE ON PLANARIAN MEMORY  
RETENTION
- 10:00 AM Jane McCallum, Spring Valley High School  
THE EFFECT OF SOLANUM LYCOPERSICUM, ALLIUM SATIVUM, AND MENTHA  
PIPERITA AS DETERRENTS ON DROSOPHILA MELANOGASTER
- 10:15 AM Shubhanjali Minhas, Spring Valley High School  
THE EFFECT OF ALUMINUM ON THE MECHANOSENSORY BEHAVIOR OF C.  
ELEGANS



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

### THE RELATIONSHIP BETWEEN CONDUCTOR AND DISCRIMINANT OF AN ELLIPTIC CURVE OVER $\mathbb{Q}$

Nico Adamo  
Heathwood Hall Episcopal School

Saito (1988) establishes a relationship between two invariants associated with a smooth projective curve, the conductor and discriminant. Saito defined the conductor of an arbitrary scheme of finite type using p-adic étale cohomology. He used a definition of Deligne for the discriminant as measuring defects in a canonical isomorphism between powers of relative dualizing sheaf of smooth projective curves. The researcher in this paper uses the fact that this relationship is analogous to that of conductor to discriminant in the case of elliptic curves, Saito's result, as well as analysis of data on conductors and discriminants to determine whether patterns exist between discriminant and conductor of elliptic curves. The researcher finds such patterns do in fact exist and discusses two main patterns: that of the conductor dividing the discriminant and that of the conductor "branching" in a predictable way. These patterns also allow for easier algorithms for computing conductors.

### EFFECT OF BENZYL SALICYLATE ON NEURONAL CELL LINES 2266 AND 2267

Calvin Aduma  
Governor's School for Science and Mathematics

Autism Spectrum Disorder (ASD) is the name of a group of pervasive, early childhood, neuronal developmental disorders that affect infants all the way into adulthood. Children and adults affected with ASD have a wide range of symptoms with different levels of disabilities. The causes of ASD are unknown, however, research suggests that both genes and the environment play important roles. A study examined toxicant exposure during the prenatal period in parents of children with ASD and reported a potential association between toxicant exposures in the prenatal period and autism risk. In this research, Benzyl Salicylate was tested for effects on neuronal morphology. Two neuronal cell lines: 2266 (Female) and 2267 (Male) were cultured for a week and then divided into an 8-well chamber. The two cell lines treated with concentrations 15.625 ng/mL, 31.25 ng/mL, and 62.5 ng/mL of Benzyl Salicylate for 48 hours. They were then stained with Eosin and Hematoxylin and observed under a microscope for morphological changes of the neurons such as axon degeneration, axonal elongation, syncytia formation, and chromatolysis. In comparison to the control, benzyl salicylate did not significantly affect the two neuronal cell lines. Further research will need to be done to confirm these results.

### ROLE OF ALPHA-PINENE IN THE DEVELOPMENT OF AUTISM SPECTRUM DISORDERS

Kelvin Aduma  
Governor's School for Science and Mathematics

Autism Spectrum Disorder (ASD) is a developmental disorder with broad ranges of symptoms depending on the person affected. These symptoms affect the child's mental development, communication, and social skills. A direct cause for ASD has not yet been discovered, but it is suspected that environmental and genetic factors may make adolescents, especially males, more susceptible to expressing ASD. Previous studies have shown that exposure to environmental chemicals such as fragrances result in lack of neuronal and brain development in children. In this research, the effects of  $\alpha$ -Pinene, a chemical found in perfumes and colognes, were tested in neuronal cell lines to check for morphological changes. Two neuroblastoma cell lines, one derived from a male (CRL-2267) and the other, a female (CRL-2266), were treated with various concentrations of  $\alpha$ -Pinene (15.6 ng/mL–62.5 ng/mL) along with the negative control for 48 hours. The cells were then stained with hematoxylin and eosin (H&E) and observed under an Olympus IX71 light microscope for morphological changes. The results indicated that at 62.5 ng/mL, the male and female cell lines showed significant syncytia formation and axonal thinning. These effects could also be seen in the 15.6 ng/mL but became more evident in the 33.3 ng/mL. In the 62.5 ng/mL, many neurons underwent apoptosis, resulting in a lack of information. Preliminary results indicate  $\alpha$ -Pinene might have detrimental effects on neuronal cell lines. This research is part of a bigger project to raise awareness of how fragrances may contribute to ASD.

### ANALYZING THE EFFECT OF WEATHER ON EVACUATED TUBES

Maeghan Ainsworth  
Center for Advanced Technical Studies

This is a continuation project from last year. Previously this project looked at if there was an inexpensive material that would improve evacuated tubes internally. From the previous year's findings, it was determined that fiberglass insulation had the most detrimental impact on the solar evacuated tubes, whereas aluminum heat fins improved the solar evacuated tubes the most because of this aluminum heat fins were used in both sets of evacuated tubes to have the best data possible. This year's project looks at what environmental factors affect solar evacuated tubes the most. The problem statement for this project is how different environmental contaminants affect solar evacuated tubes. Data was and will be collected through "side-by-side" trials, which means that the contaminated and non-contaminated tubes will run simultaneously. Running trials in this fashion will add validity to the conclusions drawn. So far data has been collected for a proof of concept phase, the flour simulation phase, and the light layer dust simulation phase, the heavy dust layer, and snow. In the future, there will be fog simulation and rain

simulation trials. As the project progresses more contaminants may be added to test a greater diversity of environmental contaminants. The next step is to start data collection on fog simulation.

### THE RELATIONSHIP OF MICROALGAE AND BACTERIA IN WASTEWATER TREATMENT

Kaouri Marie Alipio  
Spring Valley High School

Algae has been proven to have many uses. One common use of algae in the scientific community is for oils useful in the creation of biofuels. However, another lesser known use for algae is wastewater treatment. This research was aimed to determine if there was a significant difference when the algae and bacteria were both grown in the wastewater. The research was to cultivate the microalgae and bacteria in wastewater and determine if it had an effect on removing significant amounts of phosphate. It was hypothesized that growing the microalgae and bacteria in the same environment, particularly wastewater, would help remove significant amounts of waste in the wastewater. There were four experimental groups during the experiment. One was wastewater containing only the microalgae, the second was the wastewater only containing bacteria, the third was wastewater containing both the microalgae and bacteria, and the last group was the control with nothing being grown in it. The solution was grown for 2 ½ weeks in a homemade bioreactor and was placed under grow lights. Presence of phosphate in the wastewater was measured using the phosphate detector kit. Statistical results showed that there was no significant difference ( $p=0.090$ ) in the amount of phosphate removed from each treatment. Statistical analysis showed no significant differences, however the data itself showed a pattern that suggests that the microalgae does a good job at removing toxic waste, such as phosphate, from wastewater.

### THE ENHANCEMENT OF FIDGET DEVICES

Danielle Alston  
Center for Advanced Technical Studies

A medical intervention will be designed as an out-of-the-way device that will benefit people who struggle with social anxiety problems, and possibly people with other psychological disorders. Surveys have been distributed out to the public that asks for people's age, if they have a psychological disorder/social anxiety, their gender, what they do to discard their symptoms, and what contraptions they prefer for a fidget device. I deciphered the information to create designs that I will produce and test. After 3 prototypes are created, one of each each design, 14 people a week will test the intervention. These tests will be followed by surveys that will ask for feedback from the device, what could be changed, what they liked, which device they liked more, gender, age, if they have a psychological disorder/social anxiety and additional feedback. The surveys will be collected on Fridays and interpreted on the following Sunday so modifications can be made to the device's design. During the upcoming week, the new devices will be tested and the surveying process will repeat. After a month of surveying, the final product will be modified and it will be ready to be presented.

### CORRELATION BETWEEN RED AND PROCESSED MEAT AND TYPE 2 DIABETES

Jalyn Anderson  
Center for Advanced Technical Studies

Type 2 diabetes is highest among African American men and women. Physicians alert individuals to reduce their sugar intake, but there are natural and added sugars in foods that most type 2 diabetics do not consider such as processed meat and red meat. African American men, women, and young adults who consume large amounts of red meat and processed meat on a daily basis have a higher risk of contracting type 2 diabetes because of the processed and added sugars in the meat. I will be distributing a questionnaire to 200 African American subjects. The questionnaire will ask the participant to select one of the three listed age groups, followed by how much red meat they approximately consume in a week, concluded with if they have diabetes, prediabetes, or do not have the disease at all. The questionnaire will be distributed in Irmo, Columbia, and the West Columbia area at churches and doctor's offices. The data will be analyzed, graphed, and then conclusions will be recorded. The data will be represented by percentages and the units will be out of the total amount of people who participated (300). If the graphs show that majority of the diabetics and prediabetics consume large amounts of red and processed meat, then the hypothesis will be supported by the data findings. The hypothesis will only be refuted if the graph shows that majority of the diabetics and prediabetics do not consume a large or medium amount of red meat. Future work would be to bring more awareness to an underlying cause of type 2 diabetes.

### NUTRITIONAL CONTENT IN ORGANIC VS INORGANIC VEGETABLES

Olivia Antonetti  
Heathwood Hall Episcopal School

The purpose of this study is to determine if there is a nutritional difference in organic vs inorganic vegetables. The tested vegetables were green beans, brussels sprouts, broccoli, carrots, and asparagus. Carbohydrates, fats, and proteins were tested by four reagent tests: Benedict's, Lugol's, Biuret, and Sudan IV. The energy content was found using a homemade calorimeter. The hypothesis for this project states that if vegetables are compared between organic and inorganic, there will be a difference between the amount of calories, carbohydrates, proteins, and fats. If there is a difference between organic and inorganic, then inorganic will contain more calories, fats, carbs, and proteins. The null hypothesis stated that if vegetables are compared

between organic and inorganic, there will be no difference in calories, carbohydrates, proteins, and fats. The results of this study supported the hypothesis because the inorganic vegetables contained more calories than the organic vegetables (in all cases except for the carrot in which the organic vegetables contain more calories). This experiment will benefit consumers, because it will inform them whether or not to buy organic vegetables.

#### CAN MINT PRODUCTS IMPROVE CONTINUOUS CONCENTRATION?

Zola Jane Aplin  
Center for Advanced Technical Studies

This experiment is to determine if peppermint, spearmint, or wintergreen mint products can improve student concentration. It is predicted that peppermint products will result in the highest scores on a concentration test given to high school students. Students in grades 9-12 will take a short concentration test online multiple times over the course of a few weeks and will self report their scores. Each time they take the test they will be under the influence of a different mint product such as a piece of gum or hard spearmint lifesaver. The possible mint products are peppermint, spearmint, and wintergreen mint gum, the same three hard mints, and the same three types of oils through an oil diffuser. Results will be collected through a google form posted by teachers in google classroom. Data will be analyzed using a A-NOVA test. The conclusion should be that students have their highest scores with peppermint gum or with peppermint oil. Scores will determine these results. The results of this experiment could help students with and without attention-deficit disorders do better on tests and quizzes by determining the best conditions to take them under. Future studies could test more concentrated mint products as well as other scents and flavors such as fruits, cinnamon, or lavender.

#### THE EFFECT OF SKATE BLADE SHARPNESS ON THE COEFFICIENT OF FRICTION OF ICE

Dalton Arndt  
Spring Valley High School

Ice skates are a very important tool to those who play ice hockey. Ice skates can be sharpened many different ways but the most common are  $\frac{3}{8}$ ,  $\frac{1}{2}$ , and flat (goalie cut). It is commonly believed that the deeper the hollow on the skate the greater stop ability occurs. In this experiment a  $\frac{3}{8}$ ,  $\frac{1}{2}$ , and flat skates were used in order to see if the friction between the skates and the ice helped create this stopping power. The hypothesis for this experiment was that the amount of friction would not be dependent upon the sharpness of the skate blade. In this experiment two skates were held together using a threaded rod and the threaded rod was held between the skates with nuts and washers. In order to keep the skates parallel, in order to reduce error, a parallel piece of steel was placed in between the skates. Then the skates were pulled 60.26 cm (2 feet) in one direction and the average amount of newtons it took to move that distance was recorded. When the results were collected and analyzed using a one way ANOVA it was found that there was a significant difference between each of the three skates at an  $\alpha=0.01$ ,  $F(2, 87)=172.05$ ,  $p<0.01$ .

#### THE EFFECT OF THE LOVES TRUCK STOP ON THE QUALITY OF WATER IN THE NEARBY WETLANDS

Madeline Ashcraft  
Heathwood Hall Episcopal School

In the fall of 2016, construction began on a new Loves Truck Stop. This truck stop, at the corner of Bluff Road and Beltline Boulevard, borders on a stretch of wetlands. The water quality was tested in November of 2016, before the truck stop opened, as well as January of 2017. The purpose of this experiment is to determine the effect of the Loves Truck Stop on the quality of the water in the nearby wetlands after a year of operation. The pH, mercury, dissolved oxygen, and turbidity of the water was tested in January of 2017, a few months after opening, and the same parameters were measured in December of 2017. 10 samples were taken from 2 separate locations, each sample tested for pH, mercury, dissolved oxygen, and turbidity. The results show that the pH, mercury, and dissolved oxygen levels stayed fairly constant, but the turbidity levels increased significantly, which is a negative effect. These results support the hypothesis.

#### THE EFFECT OF SODIUM HYPOCHLORITE ON THE HEART RATE OF DAPHNIA MAGNA

Siri Avula  
Spring Valley High School

Disinfectants are ubiquitously being used to disinfect water systems for purification purposes, however, this may put the lives of aquatic organisms living in these water sources at risk. The purpose of this research study was to determine how certain concentrations of a disinfectant, sodium hypochlorite, could affect the lives of *Daphnia magna*. It was hypothesized that if the *Daphnia magna* were exposed to certain concentrations ( $\frac{1}{2}$  ppm, 1 ppm, 2 ppm, or 4 ppm) of sodium hypochlorite, for 24 hours, then the organism would have an abnormal heart rate that was higher or lower than usual. Fifty *D. magna* were submerged in different concentrations of sodium hypochlorite to test which concentrations these organisms could survive within. After twenty-four hours, the heart rate of each *Daphnia magna* was observed and recorded. The mean heart rates for each of the concentrations were compared using a one-way ANOVA [ $F(4,45)=2.43$ ,  $p=0.061$ ], which indicated no statistical significance in the heart rates of the *D. magna*. Despite the determination that the exposure to concentrations of sodium hypochlorite was insignificant, the health of the organisms was still negatively impacted, with multiple organisms that suffered, and even died, within the concentrations of sodium hypochlorite greater than 2 ppm.

## CREATING THE LOFSTRAND CRUTCH GYROCUP

Mary Ballentine

Center for Advanced Technical Studies

The purpose of this experiment is to create a product that will allow people who use lofstrand (forearm) crutches to transport open containers of liquid. Since the hands of people who require the use of lofstrand are occupied, they are unable to hold a cup while they walk from one destination to another. To make the GyroCup, a gyroscope will first need to be made. A cup holder will then be placed in the center of the gyroscope. This will be placed inside of a watertight capsule that has a strap secured to the top portion of it. The GyroCup will be carried by having the user wrap the strap around the handle of their crutch and then place their hand over the strap to keep it in place. While it could be used by anyone that requires the use of lofstrand crutches, this product is being made specifically for my sister to be able to carry mugs of tea, so she will be the test subject during the duration of this experiment. To test it, she will place a graduated cup of water in the device and then will proceed to walk twenty feet. The amount of water spilled will be measured. If there is any spillage, the device will be reconfigured to reduce the amount of water that is spilled while walking. The product will be considered a success if she is able to walk twenty feet with a full cup with no liquid spilled.

## THE EFFECT OF IRGASAN ON THE EMBRYONIC DEVELOPMENT OF ARBACIA PUNCTULATA

Catherine Barron

Heathwood Hall Episcopal School

This experiment demonstrates the effect of Irgasan on the embryonic development of sea urchins. The purpose of this experiment is to find if 0%, 0.01%, 0.1%, 1%, 1.7% Irgasan has a negative effect on the development of sea urchin embryos. Once the sea urchins arrived, they were injected with a .5% solution of potassium chloride that caused them to release their gametes. After the eggs and sperm were collected in separate cups, pipettes of egg and sperm were taken up and placed into petri dishes. The dishes were each filled with 25 ml of salt water that contained 0%, 0.01%, 0.1%, 1%, or 1.7% irgasan. After 17 hours the embryos were examined and data was collected on how far they had developed. When looking at the embryos under a microscope, it was clear (especially in the higher concentrations) that the chemical was affecting the embryos. They were discolored, misshapen, and had slow growth. Statistically it did not show an effect on the embryos because the averages of growth were not significantly different. In conclusion the embryos were negatively affected, but statistically it was not shown because of uneven levels of embryos in the petri dishes. This experiment demonstrates the effect of Irgasan on the embryonic development of sea urchins. The purpose of this experiment is to find if 0%, 0.01%, 0.1%, 1%, 1.7% Irgasan has a negative effect on the development of sea urchin embryos. Once the sea urchins arrived, they were injected with a .5% solution of potassium chloride that caused them to release their gametes. After the eggs and sperm were collected in separate cups, pipettes of egg and sperm were taken up and placed into petri dishes. The dishes were each filled with 25 ml of salt water that contained 0%, 0.01%, 0.1%, 1%, or 1.7% irgasan. After 17 hours the embryos were examined and data was collected on how far they had developed. When looking at the embryos under a microscope, it was clear (especially in the higher concentrations) that the chemical was affecting the embryos. They were discolored, misshapen, and had slow growth. Statistically it did not show an effect on the embryos because the averages of growth were not significantly different. In conclusion the embryos were negatively affected, but statistically it was not shown because of uneven levels of embryos in the petri dishes.

## THE EFFECT OF COVER CROPS ON THE RATE OF DECOMPOSITION AND NITROGEN MINERALIZATION

Matthew Barton and Melissa Shugart

Governor's School for Science and Mathematics

Cover crops are key for improving soil properties for subsequent crops. Leguminous and nonleguminous cover crops each have their own specific effects on soil quality. Mixtures of these cover crops may provide the benefits of both simultaneously; legumes fix nitrogen into the soil and decompose quickly while nonlegumes tend to retain nitrogen and water. To model the optimal ratio of legume to grass cover crops for decomposition, 150 samples were prepared with set amounts of sand, organic farm soil, and water; these were divided into 6 treatments of 25 replicates each with the addition of different ratios of dried clover (legume) powder to dried rye (nonlegume) powder. Five replicates from each treatment were placed in mason jars and routinely monitored for CO<sub>2</sub> output; CO<sub>2</sub> is produced as plant tissues decompose. The remaining samples were harvested, mixed with KCl, shaken, and centrifuged. Liquid extracts of these samples' supernatants were used to analyze ammonium and nitrate production. A 3:1 ratio of clover to rye produced the most CO<sub>2</sub>, followed by 100% clover. Samples containing more rye produced less CO<sub>2</sub>. T1 (100% clover) and T6 (control) samples returned much higher nitrate concentrations than samples containing rye (suggesting nitrogen immobilization among samples containing rye); ammonium concentrations increased as the amount of clover increased. These data show that a higher ratio of clover to rye in a mixture is best for decomposition, and the presence of rye in said mixture may be sufficient to prevent NO<sub>3</sub> leaching and retain atmospheric nitrogen in the soil.

## THE EFFECTS OF NATURALLY MODELED ACIDIC CONDITIONS ON THE GROWTH OF THE PHYTOPLANKTON *GYMNODINIUM*

Pranav Bellukutty  
Spring Valley High School

Ocean acidification over the past decade has become a global issue. It affects many marine organisms that utilize calcium carbonate shells or skeletons. These organisms are at risk from the increased carbon dioxide (CO<sub>2</sub>) levels, which results in decreased pH of seawater (Edmunds et al., 2016). As a result, many reef-building corals have lost the ability to produce their own skeletons. Australian researchers show that 67% of the northern reefs have died (Life and death after Great Barrier Reef bleaching, 2016). This experiment's purpose was to determine the effects of ocean acidification on the dinoflagellate *Gymnodinium* to show the impact of ocean acidification on the whole marine ecosystem. Plankton may seem insignificant, yet they are an essential part of the marine food web as an energy source to consumers. It was hypothesized that *Gymnodinium* grown in regular ocean water pH would have a greater absorbance at 530 nm than *Gymnodinium* grown in more acidic conditions. First the solutions were made, with both groups' solutions being distributed to 10 test tubes each and placed under the light bar for one week. After the week, the final absorbance was measured at 530 nm using a Spectrovis and was recorded. Then the final absorbance was subtracted from the initial absorbance to give the change in absorbance. A T-test determined the values were insignificant, as  $p > 0.05$  ( $T = 1.79$   $p = .107$ ). The hypothesis was not supported because the test yielded insignificant results.

## COLLABORATIVE ROBOTS AND THEIR APPLICATIONS IN THE WORKPLACE

Austin Bevenour  
Governor's School for Science and Mathematics

This research is focused on implementing the YuMi robot into Anderson Brass' manufacturing line. This was accomplished through development of software and grippers that allowed the YuMi to identify, pick up, and move brass stock pieces in and out of a mock-up of the large machines at Anderson Brass. There was also development of a program and grippers that could pick up two brass pieces and screw them together, but due to limitations, it wasn't completely finished.

## EXPLORING INTERACTION IN AUGMENTED REALITY THROUGH THE 3D GENOME VIEWER

Joseph Bhoi  
Governor's School for Science and Mathematics

With the growth of Augmented Reality, the interest in developing new and exciting applications is increasing exponentially. However, the technology and the practicality of Augmented Reality is still complicated. This research focused on improving the user interface and the best way to implement it onto the HoloLens (head mounted Augmented Reality headset). User interfaces are very tricky to incorporate and can make or break an application. To increase the adoption of a new piece of technology, it needs to have a purpose and be easy to use. This research primarily explored the latter. The project was done using Microsoft Visual Studio, Unity 3D, and the Microsoft HoloLens. To increase the likelihood of adoption, the 3D Genome Viewer had to be intuitive. The HoloLens has no mouse and keyboard; instead, the user utilizes hand gestures and voice commands to interact with the HoloLens. The gestures are great, the HoloLens has little trouble recognizing them. However, the voice commands do not work very well. Because of these problems, some features needed to be added to make the Genome Viewer easy to use. Rotation, Scaling, and a Graphical User Interface were added to make the 3D Genome Viewer as intuitive as possible.

## THE EFFECT OF FOOTBALL POSITION PLAYED ON FORCE OF IMPACT TO THE HEAD

Jim Blair  
Heathwood Hall Episcopal School

The purpose of this project was to see the effect that football position played has on force of impact to the head. To conduct this experiment Riddell concussion sensors were put in the helmets of high school varsity football players. When the season was over I collected the data from the concussions sensors of players that signed consent forms. The data was measured in alerts and sub alerts. From the data I found that linemen received a greater force of impact to the head than skilled position (wide receivers and running backs). I believe I got these results because linemen go head up against some of the biggest players on the field every play and this gives them a greater chance to hit their head hard.

## THE EFFECT OF UV EXPOSURE ON TiO<sub>2</sub> NANOMATERIALS REDUCTION OF P-CHLOROBENZOIC ACID CONCENTRATION IN AQUEOUS SOLUTIONS THROUGH PHOTOCATALYSIS

Erin Blalock  
Spring Valley High School

Titanium dioxide (nTiO<sub>2</sub>) displays photocatalytic properties which are derived from the production of hydroxyl radicals which oxidize nearby organic molecules on the TiO<sub>2</sub> surface. A specific micropollutant, p-chlorobenzoic acid (pCBA) is a potential indicator of radical production in the photocatalysis. This experiment determined the photocatalytic ability of TiO<sub>2</sub>, through measurements of absorbance and concentration of pCBA remaining after 30 min interval. The study investigated the effects of

a UV light on the photocatalytic ability of TiO<sub>2</sub>, as well as whether or not photocatalytic oxidation caused by UV light occurs in TiO<sub>2</sub> and pcb aqueous solutions. It was hypothesized that if TiO<sub>2</sub> nanomaterials are placed in 4- chlorobenzoic acid in varying amounts of UV light illumination, then the TiO<sub>2</sub> exposed to higher amounts of UV illumination will lower absorbance indicating an increased production of hyper-reactive hydroxyl radicals that attack the the micropollutant p-chlorobenzoic acid (pCBA), and a decreased concentration of p-chlorobenzoic acid (pCBA). The amount of pCBA remaining was determined by the absorbance proportion multiplied by 15 mg of pCBA. A one-way ANOVA ( $\alpha = 0.05$  ( $F(2, 24) = 1.55$ ,  $p < 0.05$ ) and an equal variance, demonstrated that there was no significant difference between the adsorption of the non UV exposed pCBA containing TiO<sub>2</sub> and the control, however there was a significant difference between those two groups and the UV exposed pCBA containing TiO<sub>2</sub>. These results indicate that TiO<sub>2</sub> when treated with UV light, effectively reduces the concentrations of pCBA.

#### IMPROVING THE MECHANICAL FUNCTION OF A NUCLEUS PULPOSUS IMPLANT FOR INTERVERTEBRAL DISC REPAIR

Grayson Bockman  
Governor's School for Science and Mathematics

Low-back pain is one of the chief complaints of patients to their primary physicians, and its main cause is degeneration in the intervertebral disc (IVD). Direct and indirect costs of disc degeneration total more than 100 billion dollars a year in the United States alone. Frequently, this degeneration starts in the nucleus pulposus (NP), the main load-bearing section of the IVD. Previous work has been done to create an implant to replace degenerate NP from acellular bovine NP (ABNP), but the mechanical function must be improved. To optimize the implant, ABNP was tested with different levels of osmotic compression and different concentrations of a crosslinking solution. Dynamic mechanical analysis (DMA) was performed to test the mechanical capabilities of the ABNP, differential scanning calorimetry (DSC) was attempted to confirm crosslinking, and a water content analysis was taken. The results of the DMA showed that the ABNP with higher levels of crosslinking had greater stiffness under mechanical stress than those without. DSC data was obscured due to water artifacts, and it could not be concluded if crosslinking had occurred. Water content of the NP tissues stayed consistent between variables. Overall in this study, it was shown that crosslinking impacts mechanical capabilities but osmotic pressures did not.

#### PROTEIN SPECIFICITY OF THE HYPERACTIVE MUTANT MMPING20

David Bombard  
Governor's School for Science and Mathematics

Transposable elements are DNA capable of movement within the genome. The rate at which the transposon moves (transposition rate) can be determined. mPing, a transposon found in rice, and a mutant of mPing, mmPing20, with 7 interior base pair differences both require proteins to enable movement. Previous research shows that mmPing20 transposes at roughly 1.5x the rate of mPing when a protein construct combining parts of Ping and Pong proteins was used. By using one protein type at a time (either Ping or Pong), we can determine if mmPing20's hyperactivity is specific to Ping or Pong proteins and how they react to the base pair changes. To test this we utilized yeast transposition assays with yeast transformed with a transposon (either mPing or mmPing20) interrupting the ADE2 gene producing adenine, needed by yeast to grow. The yeast colonies growing on the transposition assay plates were counted and the transposition rate was calculated. The experiments showed that when Ping proteins were used, mmPing20 transposed at 2.76x that of mPing but when Pong proteins were used, mmPing20 transposed at 1.80x that of mPing. ORF1 proteins are thought to bind to the interior of transposons so since mmPing20's base pair differences were in its interior, the binding of the Ping ORF1 must be affected. Further, the transposition rates of mPing and mmPing20 when Pong proteins were used indicated that Pong ORF1's binding behavior was less affected by the 7bp differences than Ping since the rates were not as different.

#### COMPARING THE SOCIODEMOGRAPHIC DATA FROM A SURVEY PERTAINING TO INTELLECTUAL PROPERTY RIGHTS INFRINGEMENT ON RESPONDENTS IN SHANGHAI, CHINA AND CHARLESTON, SOUTH CAROLINA

Jackie Booker Jr and William Billbrough  
Governor's School for Science and Mathematics

The concept of Intellectual Property Rights infringement is becoming more and more popular. With the globalization of the world economy, consumers and sellers, alike, are finding it easier to access and distribute these goods. The goal of this research was to find out what caused consumers in Shanghai, China and Charleston, South Carolina to purchase counterfeit goods. By distributing surveys to these two locations, the researchers collected basic socio-demographics of each respondent along with Likert scale item-responses to gather the data corresponding to certain statements throughout the survey. These responses were then interpreted using STATA. After interpreting the raw data, percentages for the factors, Willingness to Buy and Known Past Purchases, were compared using the Pearson Correlation Method, thus revealing the levels of correlation between Willingness to Buy and Known Past Purchases for the respondents in both locations. It was found that although Shanghai consumers were exposed to a larger market of these items, they do have a lower Willingness to Buy and a smaller Required Discount to Buy than those in Charleston.

## THE EFFECT OF VARIED LEVELS OF ACIDITY ON THE GROWTH OF *CAULERPA SERTULARIOIDES*

Frank Boysia  
Spring Valley High School

*Caulerpa sertularioides* is an invasive seaweed native to regions near the Mediterranean Sea. It is used as a staple in many sushi dishes and in aquariums as a nitrate absorber. The purpose of this experiment was to find which pH that would provide the most growth for the ferns in a 2 week time span. It was predicted that the 8.0 pH ferns would grow the most in comparison to the other groups because the average pH of the Mediterranean Sea is 8.0. 30 ferns were planted in each treatment of 7.0 pH water, 8.0 pH water, and 9.0 pH water. The water treatment with 8.0 pH was used as the control. The ferns were measured in weekly intervals. The ferns in the 7.0 pH water had the highest average length in both weeks. At the end of the first week, the 9.0 pH ferns had the smallest average. At the end of the second week, the 8.0 pH ferns had the smallest average. Overall, the 9.0 pH ferns had the largest change in average length and the 7.0 had the smallest overall change. A One-Way ANOVA [ $F(2, 90)=2.33, p=0.103$ ] was run to test if there was a difference between the start and end average lengths, and the end results were found to not be statistically significant.

## FEEDING RESPONSE TO GROOVED AND SCENTED 3D PRINTED FLOWERS BY *VANESSA CARDUI*

Samantha Brinson and Jonathan Beatriz  
Governor's School for Science and Mathematics

The proboscis of fluid feeding insects is a potential source of engineering innovation to expand capabilities for handling small volumes of liquid, particularly in medicine. Observation of the proboscis in the wild is extremely challenging. The goal of this project was to develop an artificial flower for controlled feeding conditions and observation in the lab. With successful feeding from an artificial flower, we could track the fluid flow and determine how the physical characteristics of the proboscis relate to fluid movement. We evaluated how flower characteristics impact feeding using an artificial flower. The final 3D printed flowers were based on an origami model. We hypothesized that flowers with grooves would improve the ability *Vanessa cardui* had to find the nectar. Similarly, we hypothesized that scented flowers would be more attractive for feeding. We observed and timed the butterflies visiting and feeding from randomized flowers. We however found no significant difference between grooved and smooth flowers or scented and unscented flowers. These results suggest that a simple, artificial flower design may be effective or that other natural flower characteristics need to be incorporated.

## ESTABLISHING A REFERENCE MODEL FOR TAILLESS'S (TLX) EXPRESSION PATTERN AND DEVELOPING A TOOL TO MANIPULATE THE EXPRESSION PATTERN OF TLX USING BLUE LIGHT

Thien-An Bui  
Governor's School for Science and Mathematics

In this study, cancer stem cells (CSCs) have been considered a potential therapeutic target for treating malignant tumors. Previous research has shown that the Tailless gene (Tlx) correlates with a neural stem cell's ability to self-replicate, but the exact interactions between Tlx's expression pattern and cellular behavior are unknown. Two projects, the Suttgart Site-Specific Knock-In (SKI) and the Blue Light Induction Model (BLIM), were conducted to establish a reference for Tlx's default expression pattern and create a tool to manipulate Tlx's expression pattern, respectively. While the SKI was unsuccessful, the plasmid transfection of EL222 and C(120)5 in BLIM was successful. However, the blue light induction has yet to be tested.

## MATHEMATICAL INEQUALITIES INVOLVING FIBONACCI NUMBERS

Brittany Bynum  
Governor's School for Science and Mathematics

Various Fibonacci proofs, identities, and inequalities were proved by different means such as graphical analysis using calculus, Arithmetic Mean - Geometric Mean inequality (AM-GM), Jensen's inequality, and mathematical induction. This was done as a means to assist in the understanding of patterns and sequences and how they establish bounds on values of convergent sequences.

## THE EFFECT OF DIFFERENTIATED TEST FORMAT AND QUESTION TYPE ON READING COMPREHENSION TEST PERFORMANCE

Erin Byrd  
Spring Valley High School

The purpose of this experiment was to see how student performance differed between a computer-based and paper-based format of a reading comprehension test as well as between a multiple choice and short answer version of that test. 46 high school students took a reading comprehension test that contained three reading passages and a total of twenty questions. Students could have either had a paper-based test (PBT) or a computer-based test (CBT), with either multiple choice or short answer questions. It was predicted that the scores of the PBT and the CBT would not be different, the multiple choice scores would be higher than the short answer scores, and there would be no interaction effect between the test format and question type on the test scores. The first two hypotheses were supported, but the third was not. Using a two-way ANOVA, the scores of the PBT were not significantly different from the scores of the CBT ( $F(1,42) = 0.954, p = 0.334$ ), and students scored significantly higher

on the multiple choice test than the short answer test ( $F(1,42) = 2.909$ ,  $p = 0.095$ ), at  $\alpha=0.10$ . A significant interaction was found between test format and question type ( $F(1,42) = 4.346$ ,  $p = 0.043$ ), so simple effects were used to determine where the significance lay. Overall, student performance was equal regardless of the test format, and students performed better on multiple choice tests compared to short answer.

#### THE EFFECT OF COMEDY AND SERIOUSNESS IN ADVERTISING ON THE OPINIONS OF VIEWERS

Jackson Byrd  
Heathwood Hall Episcopal School

This experiment was designed to understand the effect that comedy or seriousness in an advertisement can have on a typical viewer. The purpose of this experiment was to see if comedy is a better marketing strategy than seriousness. The hypothesis being tested was if comedy was better for advertising than seriousness. And the Null Hypothesis was that if comedy was implemented into a commercial, then the viewers opinion on the product would not change. The first step in this project was to develop the survey that would be used to obtain the data required. Once done, 100 survey participants were required to take the survey to gather data. After all of the participants had taken the survey, and all of the data was acquired, the next step was to analyze the data in various ways. A descriptive, statistical, and graphical analysis was needed, along with the Anova analysis, which shows whether there is a significant statistical difference between the two data sets. Once the data analysis was complete, the results were able to be shown more clearly. The Anova analysis showed that the data collected did not support the hypothesis, but rather it supported the null hypothesis.

#### ESTIMATING PERSISTENCE LENGTH OF ssDNA USING FLUORESCENCE CORRELATION SPECTROSCOPY AND COMPUTER SIMULATION

James Byrne  
Governor's School for Science and Mathematics

Fluorescence Correlation Spectroscopy (FCS), along with computer calculations, was used in order to obtain a relationship between the persistence length of ssDNA, specifically small chains of thymine, and the concentration of  $Mg^{2+}$  ions in the solution along with the ssDNA. The computer simulation generated and averaged chains of different diffusion lengths, then using the program HYDRO, compared these generated chains to the data collected from the FCS. By doing this, we found that the  $Mg^{2+}$  ions had a large decrease in both the diffusion coefficient and persistence length between the concentrations of  $10^{-4}$  M and  $10^{-3}$  M and was relatively stable at other ion concentrations.

#### EFFECTS OF LOW POND STOCKING DENSITY ON SPOTTED SEA TROUT IN HIGH TEMPERATURE MARICULTURE PONDS

Phoebe Capps  
Governor's School for Science and Mathematics

Mariculture is a specialized branch of aquaculture involving the cultivation of marine organisms. Spotted Sea Trout are a recreationally important fish in South Carolina; this research aimed to study the cultivation of this species in mariculture ponds. Larval fish produced by broodstock fish in Charleston, South Carolina were raised at a density significantly lower than usual at the Waddell Mariculture Center. In previous years, WMC stocked SST at high densities of 125,000-150,000 larvae per 0.325-hectare pond. Survival rates were typically average, however, the fish were typically thin and frail. Over the last few years, rising temperature and changing "growing seasons" has affected the survival of SST at the previously mentioned densities. This work aimed to reevaluate stocking densities by stocking 6 ponds with 50,000 larvae in a similar temperature bin (summer). Lower stocking density proved to produce healthy fish and dramatically increased survival. This study points out various other factors that contribute to the survival and condition of fish at such a temperature and the abundance of zooplankton. The results of this study will help WMC find the optimal stocking density during the summer so that they can fill the South Carolina waterways with the largest number of healthy fish.

#### IMPROVEMENT OF SOLAR PHOTOVOLTAIC EFFICIENCY BY IMPLEMENTING A COOLING SYSTEM

Austin Carnes  
Center for Advanced Technical Studies

This study is dedicated to fixing a problem that has existed in solar photovoltaics since the beginning of photovoltaics leading to overheating and lowered efficiency. The hypothesis for this is by implementing a cooling system then the efficiency will improve in the cell. The methods for this first to test the limit of the PV cells to get a power curve for valid evidence. Second is to test different cooling methods for use in the PV cell. Third will be to build a small module and test to selected cooling method. So far results show that PV cells that are cool do have a higher output than non-cool. With that the results support my hypothesis of increased efficiency and maintaining efficiency. With this research there can be more knowledge spread of this problem and systems can be put in place against. Further in the future a solar photovoltaic module will be built to test the system in a bit of a larger scale.



## THE EFFECT OF PLANT MEDIUMS WITH NITRATE CONCENTRATION FROM WATER RUN OFF

Emily Carpenter  
Spring Valley High School

Nitrogen found at high concentrations can cause severely harmful effects on plants and animals that come in contact with it. As nitrogen is used in excess amounts on poor farming land, it is quickly becoming a deadly pollutant to ecosystems worldwide. Malnourished soil can not hold these levels, so new growth mediums like perlite could be used to better control this situation. It was hypothesized that when a controlled growth medium had a sodium nitrate (a common ingredient in fertilizers) solution washed through it compared to distilled water, the resulting concentration of nitrates will be higher. It was also hypothesized that the perlite growth medium would produce less nitrates found in its water runoff compared to potting mix (used to represent poor soil). Thirty trials were conducted for each group: a controlled for perlite and potting mix, and a 0.0003 M sodium nitrate solution with perlite and potting mix. A two-sample z-test revealed that the 0.0003 M did influence the nitrate run off with a -16.010 and -98.561 test values for the perlite and potting mix (respectively) and p-values of less than 0.001 for both. A correlation coefficient showed a strong positive correlation for both perlite and potting mix and revealed that at nitrate levels higher than 0.353 ppm, perlite reduces the run off concentration more than potting soil. This experiment proved to show that perlite is a better choice for protecting farms against nitrogen leaching.

## ENHANCING THE BIOMECHANICAL DESIGN OF THE FOOTBALL HELMET (CONCUSSION PREVENTION) PT.III

Casey Carter  
Spring Valley High School

Concussion research has become a very relevant topic across various media outlets. In the NFL there was an increase of 58% on the amount of concussions during the regular season in 2016. Concussions are very serious injuries to the brain and there needs to be as much data as possible to continue preventing their occurrence. The purpose of this continued research study was to seek a solution that would help with the prevention of concussions in the sport of football. The hypothesis stated, "If there is an attachment added to cover the brain-stem area of the football helmet, there will be a decrease in the kinetic energy measured; with the application of the attachment on the lower rated helmet, there will still be a decrease in the measurement of kinetic energy". Experimentation was conducted at the Virginia Tech University Impact Biomechanics Laboratory. The manufactured version of the advanced prototype was tested upon a four and five star rated helmet for back, side and front impact locations. The results of the experimentation supported the hypothesis. For the Peak Linear Acceleration test, the four star rated helmet had a decrease in impact measured for all locations (front,back, side) with the addition of the prototype. The five star helmet showed a decrease in the back location with the prototype. For the Peak Angular Acceleration test, the four star rated helmet had a decrease in impact for the locations back and side with the addition of the prototype. The five star rated helmet showed a decrease in the amount of impact measured for all locations with the prototype. For Peak Angular Acceleration test there was a decrease in the amount of force measured for the locations back and side with the addition of the prototype. The five star helmet the back showed a decrease in the amount of force measured with the addition of the prototype. In conclusion, the data partially supports that the application of the advanced attachment onto a lower rated helmet has the abilities to decrease the amount of impact as well as in a higher rated helmet.

## CLONING OF THE VACUOLAR H<sup>+</sup>-PYROPHOSPHATASE PROTON PUMP GENE IN SEASHORE *PASPALUM*

Kama Cerimele  
Governor's School for Science and Mathematics

There is a gene in some land plants that allows them to survive under higher salt stress than other plants can. One such species is the turf grass Seashore paspalum (*Paspalum vaginatum*), which contains a vacuolar H<sup>+</sup> pyrophosphatase proton pump that allows the plant to more efficiently move sodium ions out of the water it is taking in. This allows it to live under conditions with higher salt stress. In this study, we isolated and amplified the gene that codes for this stronger proton pump. By utilizing polymerase chain reactions (PCRs) with varying primers and nested primers, we effectively amplified the selected target gene (PV26462). We then ligated this gene into a cloning vector and transferred it into E. coli, after which we isolated the recombinant plasmid DNA. We sent this isolated plasmid DNA to the New England BioLabs for sequencing to confirm that the gene had been properly inserted. In future research, blunt-end subcloning of the target gene will be performed. By using blunt-end subcloning, the gene will be introduced into an Agrobacterium. This product will be used to infect the calluses from samples of other turf grass species, allowing these transgenic plants to grow in higher-salt conditions.

## THE EFFECTS OF DRY HEAT AND MOIST HEAT STERILIZATION METHODS ON NON-PATHOGENIC STRAINS OF *ESCHERICHIA COLI* IN GROUND BEEF

Ahad Chattha  
Spring Valley High School

*Escherichia coli* is a Gram-negative, rod-shaped bacterium which grows in the intestinal tract of animals and humans and other environments. Pathogenic strains have been known to cause deadly diseases, such as hemorrhagic colitis and hemolytic uremic syndrome, whose symptoms include diarrhea, fever, kidney failure, and more. It is commonly found in food, especially meat products, like beef. Treatments have been made to kill it, but with using chemicals. The general population's demand is leaning towards foods with little to no processing, which includes those treated with only heat. The two types of heat sterilization used in this study were moist heat (using water vapor) and dry heat (no water vapor). It was hypothesized that the population of E.

coli on a beef patty would decrease more when it was exposed to moist heat sterilization. For experimentation, 90 beef patties were inoculated with a non-pathogenic strain of *E. coli*, and were divided into one of three groups. One group received moist heat sterilization through a pressure cooker, another group received dry heat sterilization through an oven, and the last group had no treatment. Agar plates were then plated and counted using a colony counter. A one-way ANOVA found a significant difference between at least one pair of means, with  $F(2,87)=782.06$ ,  $p<0.001$ . A Tukey test found a significant difference between the control and the dry heat group, the control and the moist heat group, but no significant difference between the moist heat and dry heat groups.

#### KNOCK! KNOCK! WHO'S THERE? – ARTIFICIAL NEURAL NETWORK AND DEEP LEARNING MODELING

Ridhi Chaubey

Governor's School for Science and Mathematics

Analyzing vibrational patterns, such as knocking, for identification can be used to help with safety and security. Applications of the identification process can be used in the Internet of Things industry and smart technology, such as smart homes. The objective of this research project was to use artificial neural networks to measure the vibrations of a door caused by a person knocking, and use that data to identify the knocker. One hundred sets of knock vibration data were collected from five test subjects and compared to ensure that this project was actually feasible. The experiment showed that although there was a lot of variation there was a distinct pattern in the overall knocks. A second program was written using artificial neural network technology to train the computer to learn the knock vibration patterns and to use this data to identify the person knocking. The results were able to find that knock vibrations can be used to identify a person, and that can lead to the prospect of using more sensitive vibrations to identify and detect humans.

#### NOVEL MOSQUITO TRAP: THE USE OF ACOUSTICS AND OLFACTION TO ATTRACT MALE MOSQUITOES

Vinita Cheepurupalli

Spring Valley High School

Mosquitoes are a major concern to human health because they can serve as vectors to pass agents that cause diseases, such as malaria or the Zika virus, with a multitude of harmful side effects, like seizures, coma or death. Different commercial mosquitocidal agents exist, but the overuse of them have caused mosquitoes to develop resistance. To help reduce mosquito populations, non-chemical mosquito traps can be created with the use of olfaction and acoustics to attract the mosquitoes. The purpose of this experiment was to test various methods to attract, trap, and kill mosquitoes. It was hypothesized that if an acoustic test, an olfaction test, and an acoustic and olfaction test are used as a mean to attract adult male mosquitoes into a trap, the acoustic and olfaction test would be the most effective. It was also hypothesized that out of a range of 200 to 600 Hz, the frequency that would best attract mosquitoes would be in the range of 300-500 Hz and that when comparing extracts of *Agaricus bisporus*, *Musa acuminata*, and a control, the *A. bisporus* extract would best attract adult male mosquitoes. *Culex quinquefasciatus* were used as the model mosquito, and steam distillation was used to create the *A. bisporus* and *M. acuminata* extracts. For the olfaction test, mosquitoes were introduced to tubes with filter paper on one end and filter paper soaked in an extract on the other end, and for the acoustic test, speakers were set on each side of the tube and emitted various sound frequencies. Movement of the mosquitoes was observed. One way ANOVAs and post-hoc Tukey tests were conducted, and it was found that there was a significant difference between the following treatment trials and the control: 500 Hz, 400 Hz, and 300 Hz ( $F(5,114)=13.44$ ,  $p<0.001$ ); the mushroom and banana ( $F(2,57)=12.162$ ,  $p<0.001$ ); and the 400 Hz/mushroom, 0 Hz/mushroom and 400 Hz/DI H<sub>2</sub>O ( $F(3,76)=7.145$ ,  $p<0.0001$ ). Thus, the hypothesis was supported. Sounds of frequency 300 to 500 Hz and the smell of the mushrooms and the bananas were effective attractants. Since a combination of the *A. bisporus* extract and a sound frequency of 400 Hz was the most effective attractant, a natural mosquito trap utilizing these could be developed as a potential commercial product.

#### IDENTIFICATION OF MICRORNAS AS NEW BLOOD BIOMARKERS TO PREDICT BREAST CANCER RECURRENCE

Lauren chen

Dutch Fork High School

MicroRNAs (microRNAs) are short sequences of RNA (about 22 nucleotides) that are involved in the regulation of gene expression. Previous studies have suggested that a number of microRNAs are recognized as new biomarkers for cancers. The aim of this study is to identify specific microRNAs in serum, which may serve as potential diagnostic and prognostic biomarkers and therapeutic targets for breast cancer. Quantitative real-time PCR (qRT-PCR) array analyses of microRNAs in sera from four pairs of recurrent and nonrecurrent breast cancer patients were performed. Those differentially expressed microRNAs were verified in serum samples from 42 breast cancer patients. The prognostic values of the selected microRNAs were statistically analyzed, determined by the correlation between microRNA expression and tumor parameters. Three microRNAs (miR-134, miR-483-5p and miR-139-3p) in serum were identified as novel disease biomarkers and potential therapeutic targets for breast cancer. This is significant because current methods of detecting the recurrence of cancer, such as computed tomography (CT) scans and magnetic resonance imaging (MRI), are extremely expensive. If microRNAs in serum exosomes can be used for prognosis, then the process will become significantly more affordable.

## THE EFFECTS OF OXIDATIVE STRESS ON INDUCING SENESCENCE IN HUMAN FIBROBLASTS

Shivani Chowdhary  
Governor's School for Science and Mathematics

Oxidative stress, specifically from hydrogen peroxide exposure, was performed to determine if it induced senescence in cell lines such as Hela cells and primary human fibroblasts. The purpose of this experiment was to find the optimal stage, concentration, and time of exposure to induce the greatest number of senescent cells. After dividing cultures of both the Hela and human fibroblasts cells in order to reduce confluency, the cells were placed in a six well plate and exposed to hydrogen peroxide for two hours at various concentrations. The plates were checked at twenty-four-hour intervals, and then fixed with senescence associated beta-galactosidase as a biomarker to observe the senescent cells in culture. It was hypothesized that hydrogen peroxide exposure would increase the number of senescent cells due to the accumulation of reactive oxygen species. The data indicated that, there was an increase in the number of senescent cells following 48 hours of treatment. The number of senescent cells peaked following 72 hours of treatment and did not change significantly as result of 96 hours of treatment supporting our hypothesis.

## HOW AGE AND GENDER AFFECT INSTAGRAM USE

Towns Christian  
Heathwood Hall Episcopal School

This experiment was conducted in order to determine whether or not someone's gender would affect the way they use Instagram. For this experiment, a survey was created and sent to twenty three willing participants (male = 11; female = 12) via email. The participants were either male or female high school students and ranged in age from fourteen to eighteen years of age. They were asked a series of questions about the way they use their Instagram account. It was hypothesized that females are more likely to delete a post if it did not receive enough "likes", and to become more self conscious with their appearance in pictures posted online. The results supported the hypothesis. The results showed that females are more likely to delete pictures because they did not receive enough "likes", and are also more likely to become self conscious with the way they look in photos online. Future studies could be conducted to find out if there are differences depending on the ages of the participants.

## THE METHODOLOGY BEHIND REPRESENTING SELF: THE ROLE OF INSTAGRAM IN IDENTITY FORMATION

Bailey Clark  
Governor's School for Science and Mathematics

Visual studies research is a type of qualitative research methods that analyzes cultural imagery to generate meaning. Culture can be analyzed both quantitatively and qualitatively. While quantitative methods prove more effective over large samples, the data collected are neither as detailed nor as rich as data collected from qualitative methods. Phenomenology, heuristic inquiry, autoethnography, grounded theory, ethnomethodology, and semiotics are all qualitative research methods that can be useful in visual studies research. For the purposes of this study, I drew from the first four methods listed to understand the use and meaning of images for the participants in this study. I want to know the specifics of association: how are the subjects reacting, what posts are they double-tapping—more than the typology of the post, but the unique contents of each and every post. The aims of phenomenology are to gain meaning and understanding from every day, lived phenomena. Subjects in this group have an experience, and researchers try to understand what that experience means for that group. Heuristic inquiry is phenomenology with first-hand intense experience of phenomena by the researcher. Ethnography is the study of culture, while autoethnography is the study of one's own culture, drawing from one's own lived knowledge and the lived knowledge of others within that culture. Finally, grounded theory is a method of developing methodology for deriving theory (Patton, 2002). Through qualitative research, this study developed a method for determining the relationship between the users' double-tap on Instagram and the representation of self.

## THE EFFECT OF TIME ON BACTERIA ON SPINACH LEAVES

Isabella Clarke and Mercedes Perez-Shillington  
Heathwood Hall Episcopal School

The purpose of this experiment was to determine the effect of time on bacteria on spinach leaves. The hypothesis was that the amount of time in the fridge will directly cause the amount of bacteria present on the spinach leaves to increase. In the experimentation process, a total of 5 time trials (Day 1, 2, 3, 4, 5) were conducted, with 10 spinach leaves for each trial. According to the data, bacteria on the spinach cut leaves increased over time. In order to calculate the results, an ANOVA single factor test was used. From the results of the ANOVA test, it was found that the data sets are statistically different than one another ( $p < 0.01$ ). This experiment is significant because it has applications in investigating more effective ways to store food, to reduce the amount of bacteria.

## THE EFFECT OF HEAT ON THE PRODUCTION OF OZONE FROM FERNS IN A SEALED ENVIROMENT

Jack Cook  
Heathwood Hall Episcopal School

The purpose of this study was to compare the effect of heat on the production of ozone from ferns. It was hypothesized that if ferns are exposed to temperatures of 80, 85, 90, 95, and 100 degrees fahrenheit, then there will be a greater amount of ozone present. Ferns produce isoprene, a volatile organic compound (VOC), which when combined with nitrogen oxides produce ozone. Five ferns were placed in sealed aquariums to be tested for times intervals of ten days and a month. At the end of the ten days ozone test strips were then used to test the ozone levels. The ozone test strips were unable to read any level of ozone which has caused our experiments results to be inconclusive. The researchers concluded that this lack of ozone may have been caused by multiple reasons. First, the researchers believe that there was not enough nitrogen oxides present for the isoprenes that may have been created to react with and thus produce ozone. The researchers also believe that the ozone test strips used may not have been sensitive enough to pick up the small amounts of ozone that may have been created. The researchers finally conclude that the tests may have created no ozone at all.

## IS THERE AN ASSOCIATION BETWEEN GRANULOMATOSIS WITH POLYANGIITIS AND A HISTORY OF SINUS PROBLEMS?

Camille Cowley  
Center for Advanced Technical Studies

The disease Granulomatosis with Polyangiitis (GPA) is an autoimmune disorder that causes vasculitis. This study's objective is to gain knowledge based on patient's experience with sinus issues before their diagnosis of Granulomatosis with Polyangiitis. The objective of this study was to survey patients with GPA to learn how many of them suffered from sinus issues before their diagnosis. The survey provided information that was used to make possible associations between GPA and a history of sinus problems. The survey was administered to patients with GPA through online forums in which the survey was posted for them to answer. The survey contained six questions that helped identify if they had the disease and what sinus issues they had experienced. Another group of people without the disease were surveyed to act as the control group. The results of the responses to the surveys were analyzed in a statistical manner that determined how strong of an association there is between GPA and a history of sinus problems. The findings in this study allowed for future associations to be made between this disease and other health complications and has potential to aid in learning more about how this disease develops in someone.

## A SELF-FORMING NIO-MC DUAL-PHASE MEMBRANE FOR CO<sub>2</sub> CAPTURE FROM SIMULATED FLUE GAS

Justin Cox  
Governor's School for Science and Mathematics

In recent years, the atmospheric concentration of carbon dioxide (CO<sub>2</sub>) has increased greatly, leading to global warming. The biggest source of carbon dioxide is flue gas produced by power plants burning fossil fuels. One solution is to form Mixed Electron and Carbonate-ion Conducting (MECC) Membranes to capture carbon dioxide from flue gas. The MECC Membranes that we tested were formed from Nickel Oxide (NiO) and Molten Carbonate (MC), formed from a molten mixture of sodium and lithium carbonate. We formed membranes with two different proportions of NiO-MC: 6:2 and 8:4. It was discovered that the membrane with the 6:4 proportion had a 16% increase in CO<sub>2</sub> permeability, and is thus more effective for CO<sub>2</sub> capture.

## CLONING OF THE VACUOLAR H<sup>+</sup> - PYROPHOSPHATASE PROTON PUMP GENE IN SEASHORE PASPALUM

Nathaniel Crago  
Governor's School for Science and Mathematics

The Vacuolar H<sup>+</sup>-Pyrophosphatase Proton Pump Gene is a gene that allows plants to effectively pump ions from their surroundings into their center vacuoles through the use of a very strong proton pump (Li et al, 2009). This ability to effectively pump things such as sodium, chloride, and potassium ions into its center vacuole, so that the excess of these ions cannot wreak havoc on the natural and delicate chemical processes inside a plant cell, means that plants that express this gene can survive in environments with higher salt content. If this gene can be isolated, amplified, and cloned, then it can be possible to make transgenic plants that would express this gene and be able to survive in high salt conditions in which they otherwise cannot survive. The use of multiple polymerase chain reactions with succeeding primers and nested primers allowed us to effectively amplify, and will later allow the lab to clone, the target gene in the high salt tolerant plant seashore paspalum (*Paspalum vaginatum*).

## IDENTIFICATION OF CANDIDATE LIPID DROPLET STRUCTURAL PROTEINS IN TRYPANOSOMA BRUCEI BRUCEI

Lanie Croft  
Governor's School for Science and Mathematics

*Trypanosoma brucei brucei* causes Human African Trypanosomiasis (HAT), also known as African Sleeping Sickness. It causes spiking fevers and the disruption of circadian rhythms that, when left untreated, lead to death. Current treatments for HAT are limited, expensive, and can be fatal themselves. The World Health Organization estimates 61 million people are at risk of infection. Finding new treatments for HAT is imperative. *T. brucei* uses lipid droplets (LDs) to store essential fatty acids. The

short, fatty acid myristate may be essential for *T. brucei*, is rarely found in blood, can only be made through fatty acid synthesis, and may be stored within LDs. Targeting proteins associated with myristate containing LDs may be an effective approach to developing new treatments. LD structural proteins, however, have not been previously identified in *T. brucei*. We searched the TrypTag database for proteins that localize with lipid droplets. After bioinformatic screening, we identified five candidate LD structural proteins. We built RNA interference (RNAi) constructs to knock down expression of these candidate LD structural proteins in *T. brucei*. We verified that the RNA interference plasmids were correctly constructed by restriction enzyme digest, gel electrophoresis, and sequencing. These RNAi constructs will allow us to determine if the absence of these proteins affect LDs in *T. brucei*. By identifying LD structural proteins and learning more about their involvement in fatty acid storage, these proteins may provide new treatment options for HAT.

#### IDENTIFYING AN OPTIMAL PETROL/BIO DIESEL TRANSPORTATION FUEL BLEND.

Chase DaMoude  
Center for Advanced Technical Studies

How can petrol diesel and biodiesel be used to get the best fuel mileage, cut down on emissions, and obtain a peak petrol diesel to biodiesel fuel ratio? If the best ratio between diesel and biodiesel is found, then diesel fuel efficiency can be optimized for multiple diesel applications while reducing emissions. Will be split up into 5 phase, although phase 5 may not be reached. Phase 1 will be to test the fuels and what temperature they burn at to make sure the fuel doesn't burn too hot or too cold because a diesel truck runs off compression, which is when the piston compresses the fuel. Which got the information that was wanted that the fuel would gradually increase with the more diesel that is the ratio. In phase 2 and 3, the efficiency will be tested of the fuel blends by first testing the horsepower, and then the Revolutions Per Minute (RPMs) of the fuel. In phase 4 the experiment will move from the lab into the real world scenarios. The real world testing will begin by using a diesel truck to test the fuel mileage and its efficiency in the diesel engine. Phase 5 will be to test the fuel mileage and efficiency in a bus, to help make it so young children do not breathe in Carbon Monoxide, soot, and other carcinogenic gases while they ride the school bus.

#### DOES THE INFLAMMATORY COMPOUND DOSS PROMOTE CANCER STEM CELLS EXPANSION?

Danielle Dantzer  
Governor's School for Science and Mathematics

Research has shown that chronic inflammation regulates the development and function of cancer stem cells (CSCs). Docusate or dioctyl sodium sulfosuccinate (DOSS), drives both COX-2 and PPAR $\beta$  in the inflammatory pathway. It was inferred that because of the link of chronic inflammation in both DOSS and cancer stem cells, DOSS promotes CSCs expansion. The goal is to see if there is a link between DOSS and CSCs expansion. To test the effect of DOSS on CSCs expansion, vector stem cells were plated into wells and treated with four conditions of DOSS. The growth of single cells was measured by an software analyze NIH ImageJ and was read by an Synergy H1 Hybrid Reader. The results showed a classic dose responsiveness with the highest concentration of DOSS, having the highest number of single cells.

#### THE EFFECTS OF A VISUAL AID ON CONTROLLING PUBLIC BEHAVIOR ON PHARMACEUTICAL POLLUTION

Sarayu Das  
Spring Valley High School

Water pollution has been a growing problem for decades. As human societies develop to sustain a greater population, limited thought is being put into the impact on the environment. Due to this, many common pollutants, such as pharmaceuticals, are being found in growing numbers in the aquatic environment. The most common ways that pharmaceuticals are disposed of includes placing them in the trash, pouring them down the sink, and/or flushing them down the toilet. Although easy and quick, these methods are unsafe and can have devastating impacts on the aquatic ecosystem. The purpose of this experiment was to test whether educating the public about this issue would change their minds about their disposal methods. It was hypothesized that after reading the brochure provided, individuals would change the way they disposed of pharmaceuticals. This is because the brochure would explain the vast environmental impact that incorrect disposal of pharmaceuticals can have on the aquatic ecosystem. The experiment was conducted by sending out a pre-survey to 40 households, and then splitting the sample size into two groups and giving one a brochure and one no brochure. A post-survey was then sent out to determine whether the brochure had impacted the audience. T-tests were run to compare the no brochure (control) and the brochure (experimental) groups. The p-value of the brochure group was less than the alpha value of 0.05, and the p-value of the no brochure group was greater than the alpha value of 0.05, thus the alternative hypothesis could be supported, which meant that the brochure had a visual impact on the subjects. With the influence of reading a brochure about this issue, up to 95% of the individuals that participated in this survey had a different outlook on pharmaceutical disposal techniques.

## THE EFFECT OF MEDIA ON A PERSON'S ABILITY TO ACCURATELY READ EMOTIONS

Ryan Davis and Evan Barker  
Heathwood Hall Episcopal School

Emotional Intelligence is, in a way, your level of compassion: how well you can monitor one's emotions and plan accordingly. This experiment was conducted to determine whether a 5-minute video displaying a strong emotion would affect how a person would do on the Well Quiz-a multiple choice quiz where you choose an emotion out of the 4 answers based on what you see in the picture. Two groups of 18 students watched two separate videos and then completed the Well Quiz. There results were then compared to one group of 18 students that had completed the Well Quiz without watching a video. One video was meant to display a more sad emotion, while the other showed happiness. Trials were conducted via a google forms being sent out to three different groups: Sophomores, Juniors, and Seniors. All data from the forms was recorded onto Google Sheets, where graphs were made via Google Sheets. Overall, while Group 3, the Seniors had the highest score overall, there was not a significant difference between the groups that watched videos and the group that did not, so the null hypothesis failed to be rejected ( $p=0.82$ ). Future studies could include Boy vs Girls, people over the age of 25, and seeing how the groups would do if the videos were switched around.

## USING IBM WATSON TO IMPROVE NON-SPECIALIST AUDIENCE UNDERSTANDABILITY OF RESEARCH ARTICLES

Nicholas Deas  
Governor's School for Science and Mathematics

Research data is growing at an alarming rate, and non-specialists in a field of study will struggle to stay up-to-date on current research findings. However, artificial intelligence may offer a solution to help understand the overwhelming amount of data available. Artificial intelligence methods, such as the Neural Network and machine learning, work similarly to logical human thinking because of the complexity and efficiency of the human brain. However, these algorithms are quicker and often times more accurate, allowing them to perform classification and other tasks even more efficiently. IBM Watson is a supercomputer with multiple deep neural networks, machine learning programs, and other tools available. Using IBM Watson's available tools, this study creates and scores extractive summaries of research articles to condense the amount of information and make them easier to read. An extractive summary involves creating summaries based on sentences and phrases already present in a given piece of text, so this study focuses on the goal of summarizing by reducing the amount of details and information present. The results showed that when trained with the abstracts, introductions, and discussions of different articles, Watson was able to create relevant summaries using sentences already present, condensing articles to its sentences with more general information, as shown by high Rouge scores when compared to parts of the article. This study showed that Watson's tools are a promising method to extract information from journal articles and present the general ideas and topics in a summary.

## MODELING CONSUMER'S WILLINGNESS TO BUY AND DISCOUNT REQUIRED TO PURCHASE COUNTERFEIT GOODS THROUGH LOGISTIC MODELS, GENERALIZED STRUCTURAL EQUATION MODELING, AND CENSORED GAUSSIAN IDENTITY MODELS

Ivana Devine and Emilee Daniel  
Governor's School for Science and Mathematics

This study analyzed the differences between Shanghainese and Charlestonian consumers' willingness to purchase counterfeit goods and the discount they would need to do so. A written survey was administered by the College of Charleston in Charleston, South Carolina, and a digital survey was distributed by a distribution firm in Shanghai, China. Overall, Charlestonians were more willing to purchase counterfeit goods, and if a consumer was Shanghainese it was likely that they would require a higher discount to purchase a counterfeit good. Furthermore, a consumer's perception of risk associated with purchasing counterfeit products was highly correlated with being Shanghainese.

## THE EFFECT OF RUBBER PLAYGROUND SURFACES ON SURROUNDING SOIL PROPERTIES: A FIELD STUDY

Elizabeth Dillon  
Spring Valley High School

The widespread use of rubber surfacing as an alternative to wood mulch in outdoor environments is indicative of its cost-effectiveness, low maintenance requirements, and resistance to decay. In order to assess the environmental consequences of recycled rubber-surfaced playgrounds, the properties of soil exposed to rubber playground surfaces (RM1-3) and a wood mulch playground (WMC) were tested. It was hypothesized that RM soil would have higher zinc levels and a lower pH than WMC soil, that soil pH would be statistically the same at each sampling distance between rubber playground locations, and that NPK levels would show no significant change between distances and locations. Soil was sampled from 0, 1.5, and 3 meters from the playground perimeter and tested for pH and NPK; some samples were subject to more extensive laboratory testing. NPK results were analyzed with ANCOVA and ANOVA and pH results with Kruskal-Wallis tests at  $\alpha = 0.05$ . Soil pH displayed no significant differences between perimeter distances. The soil pH of WMC and RM2 showed significant differences ( $F(3, 140) = 3.86, p=0.011$ ), with RM2 having a higher pH. NPK results indicated no significant differences between distances or locations. Zinc levels in lbs/acre for RM1-3 were more than four times greater than WMC's zinc levels. Significant differences between P and K results and laboratory tests highlight the limitations of the testing methodology. As this study specifically addressed one region, soil type, and rubber surface, similar studies for different ecological areas and rubber surface types could indicate significant differences in soil properties not shown in this research, especially concerning zinc levels.

NARCOTIC IDENTIFICATION  
Alexander Dixon  
Center for Advanced Technical Studies

This project is about the narcotic diversion, with specific that is occurring in hospitals. Narcotic diversion is the stealing or syphoning of drugs from reserves. Fentanyl is a highly sought after and addictive drug, sold for large amounts on the black market. The main problem with fentanyl diversion is caused by doctors, especially anesthesiologists who work with narcotics multiple times a day, with almost unlimited access. A survey of 260 anesthesiologists from the Medical College of Wisconsin graduating between 1958 and 1988 reported that 32 percent used drugs to "get high" and 15.8 percent had been drug dependent. (Medical college of Wisconsin) The optimal time for diversion to occur is at time of disposal, this is due to the fact that the only precautionary measure is notarized disposal. Notarized disposal is a procedure in which a nurse watches a doctor dispose the narcotic, and in the case of fentanyl a clear liquid, and co-signs saying that the doctor did actually dispose of the narcotic. The problem with this system is that in some cases, like fentanyl, the liquid is clear. My project looks to create an easy to use and safe apparatus that would create a contained, secluded, every day test environment to contain by products, and potentially hazardous reagent reactions. This is so that these preliminary reagents will be more viable in the OR setting, to potentially limit diversion.

SPRAYING AND SURVEYING APPLICATIONS OF DRONES TO THE PRECISION AGRICULTURE INDUSTRY:  
WRITING PROTOTYPE SOFTWARE TO AUTOMATICALLY FLY A DRONE FOR SURVEY OR SPRAY PURPOSES

Martin Driggers  
Governor's School for Science and Mathematics

Spraying and surveying applications of drone technology to the precision agriculture industry are becoming more widespread. The market of drones in agriculture is predicted to be in the billions of dollars in the coming years, and much of that money will come from precision agriculture. Research to determine the areas where drone technology is the most profitable and feasible needs to be undertaken and application prototypes need to be developed. The focus of this research project was to develop an application prototype to fly a DJI drone across a field, survey it, and then use the information gathered from the flight to spray crops in a targeted way not possible with conventional crop dusters. Using objective-C, an app was developed to survey a field and spray it depending on the value of NDVI from that area. Results from the test flights indicated that this idea is feasible. While the project lacked the hardware to spray the field, it was tested and determined very feasible that such an endeavor would work and be profitable.

THE EFFECT OF  $\text{Li}_2\text{CO}_3$  ELECTROLYTE CONCENTRATION ON ARLB PERFORMANCE

Paul Dubberly  
Spring Valley High School

Energy storage devices are in great demand in the 21st century, and Aqueous Rechargeable Lithium Batteries (ARLBs) are promising ways to meet that demand. ARLBs differ from traditional Lithium-ion batteries in their electrolyte which is a lithium containing aqueous solution as opposed to an organic solution. The purpose of this experiment is to determine whether  $\text{Li}_2\text{CO}_3$  is a feasible electrolyte and to determine its optimal concentration. It was hypothesized that the voltage produced by a battery using 1M  $\text{Li}_2\text{CO}_3$  as electrolyte would be statistically greater than the voltage produced by a battery using 0.1M  $\text{Li}_2\text{CO}_3$  as electrolyte at  $\alpha = 0.05$ . The average values recorded for 0.1M  $\text{Li}_2\text{CO}_3$  and 1.0M  $\text{Li}_2\text{CO}_3$  are ( $M = 0.18\text{V}$ ) and ( $M = 0.202\text{V}$ ) respectively. Because of the recorded voltages were small and  $\text{Li}_2\text{CO}_3$  is only partially soluble in water, it was concluded that  $\text{Li}_2\text{CO}_3$  was not a promising electrolyte material.

MACROPHAGE POLARIZATION IN THE AORTA FOLLOWING IL-6 INFUSION

Joseph Ebai  
Governor's School for Science and Mathematics

The goal of this summer research was to establish the prevalence of pro-inflammatory and anti-inflammatory macrophages in the aortic ring samples of mice that were infused with Interleukin-6. Furthermore, this research could possibly give more insight into the signals that initiate and promote aneurysm growth in humans that are afflicted with abdominal aortic aneurysms, also known as AAA. Through the use of antigen retrieval and immunohistochemistry, results were obtained, but the results were contrary to what was expected.

## EFFECTS OF VARYING HORSE CARE FACTORS ON THE SUSCEPTIBILITY TO COLIC IN HORSES

Sarah Elliott

Governor's School for Science and Mathematics

Colic is the leading cause of death among equines and is a term that refers to a severe cause of abdominal pain in horses. Previous studies determined broad causes of colic such as the fact that water intake has some effect on colic susceptibility or that feed may affect a horse's risk of colic, but a specific amount of water recommended to avoid colic or a type of feed that caused more colics was not determined. This research project sought to find more specific causes of colic. Two surveys were created: one for horse that had colicked within the past year and another for horses that had not colicked. Questions were asked such as: "What feed does the horse eat?" and "Approximately how much water does the horse drink?". These questions were sent to the patients of Carter Veterinary Services via email. After two weeks, the responses were analyzed. Graphs were created to represent the data. As a result of this survey, it can be concluded that the more hay a horse eats, the greater the risk of colic. The more water a horse drinks, the lower the chances of colic. The amount of time a horse is in the stall did not conclusively affect the incidence of colic. Finally, the best stall bedding to reduce colicking is wood shavings. Overall, this study provided a great insight on the specific causes of colic and will allow horse owners to be better informed when making choices about their horse's daily care.

## AUGUMENTING ANTI- CANCER THERAPY USING THE IMMUNE SYSTEM AND CYTOKINES

Faith Emetu

Governor's School for Science and Mathematics

Lung cancer is one of the most common cancer types, yet many of the most ground-breaking cancer immunology therapies are ineffective. Determining proper cytokine dosages to stimulate proliferation is vital to furthering efficacy of lung cancer immunology research. Refining the efficacy of T Cell proliferation advances cancer immunotherapy for melanoma patients. Based on prior research, IL-2 and IL-15 are similar stimulants that activate T cells. They prove to be equally effective, except IL-2 stimulated cells are bigger and show more growth. In lab, mouse spleen cells underwent a CD3 stimulation to observe the difference between IL-2 stimulated cells and IL-15 stimulated cell and to determine which interleukin concentration is most effective and least toxic to cells IL-15 stimulated cells and IL-2 stimulated cells both showed similar results. They both proliferated at about the same rate at about the same dosages. It was concluded, IL-2 induce proliferation in activated T Cells, but do not induce proliferation in naïve T Cells. IL-2 and IL-15 both prove to be able to best induce proliferation of T cells at similar dosages.

## MEASUREMENT OF GAS-TO-PARTICLE PARTITIONING COEFFICIENTS OF VOLATILE ORGANIC COMPOUNDS

Abigail Evans

Governor's School for Science and Mathematics

Volatile Organic Compounds (VOCs) are compounds that have a composition that allow for them to evaporate under normal atmospheric conditions of temperature and pressure. VOCs have been recognized to significantly influence human health and air quality. The composition of aerosol, relative humidity, and temperature are factors that work together to influence the interactions between VOCs and aerosol. The dominant partitioning mechanism for apolar VOCs is hydrophobic interactions between VOCs and water-insoluble organics of aerosols. These interactions have not been found to be influenced by relative humidity. Compared to the apolar VOCs, fewer studies have been performed on the polar and ionizable VOCs. It is recognized that the sorption mechanism of polar and ionizable VOCs on aerosols involves partitioning in the hydrophilic phase. Relative humidity significantly affects this mechanism. In this experiment, 1,2-dichlorobenzene (DCB) is used to aid in establishing an experimental method to measure the gas-to-particle partitioning coefficient (Kip). A LabView program was developed for controlling temperature so that the effect of temperature on Kip could be investigated.

## THE EFFECT OF TRANSITION PROBABILITIES IN A SIMULATION ON THE RHEOLOGICAL PROPERTIES OF COMPLEX FLUIDS

Tyler Feemster

Governor's School for Science and Mathematics

This paper examines the mechanics of viscoelastic fluids and their applications. The Elastic Dumbbell Model is further explored through manipulation of program variables. The research explained connects variables from transition probabilities within the Elastic Dumbbell Model to physical, measurable properties, specifically relaxation time and stress tolerance. Understanding the connection between these variables and their physical properties will allow researchers, scientists, and engineers to design fluids with variations of those same physical properties.



## THE EFFECT OF GENETICALLY MODIFIED MAIZE VS ORGANIC MAIZE ON FODDER PREFERENCES IN PROCYON LOTOR.

Ben Feldman  
Heathwood Hall Episcopal School

The purpose of this experimentation is to examine the effects of organic maize vs genetically modified maize on the fodder preferences in *Procyon lotor* or Eastern raccoons. Raccoons were given a choice between organic and genetically modified maize to observe their preference. Anecdotal evidence suggests that mice, when given the option, prefer organic maize. The aim of this experiment was to examine this preference in *Procyon lotor*. Raccoons are known to have no preference in their feed choices however, this experiment suggests that raccoons do have a preference for organic maize. In this study the independent variable was the type of maize and the dependent variable was the preference expressed by the raccoons. The hypothesis for this experiment was that if raccoons are given the option between genetically modified or organic maize they will prefer the organic maize. There is also evidence to suggest that animals who consume organic maize thrive more so than animals who consume genetically modified maize. The hypothesis was supported by the higher percent mass decrease in the organic maize, and a significantly lower percent mass change in the genetically modified maize.

## THE EFFECT OF HUMAN TRAFFIC ON BIRD BEHAVIOR

Shona Fitzer  
Governor's School for Science and Mathematics

The aim of this research was to explore ways in which foot traffic and car traffic affects bird behavior. The behaviors of individual birds and the number of people and cars that passed through several outdoor recreational spaces in Greenville, South Carolina were observed. The number of cars and the number of people that a bird is used to sharing its habitat with were found to have opposite effects on the time it takes for that bird to return to an area occupied by a human. In locations with more foot traffic, the difference is larger between this return time and its previous return time to the same shared space. However, in locations with more cars, this time difference is smaller. This information can be used to balance the number of cars and humans with the activity of birds depending on the priorities of a situation.

## THE EFFECT OF MOBILE DEVICES ON A STUDENTS ABILITY TO OBTAIN A RETAIN INFORMATION

Tyrell Fleshman  
Spring Valley High School

As there are many positives to the usage of mobile devices, many negatives are present as well. One harmful negative is the distraction that mobile devices may cause during the completion of tasks. Another harmful negative is the length at which someone uses a mobile device. 3 classes were used in this experiment; C Class, D Class, and E Class. Steps were taken to analyze the distraction of mobile devices among students within a classroom and to analyze the effect of time on the memory within a student. Within these steps, a test was given to students based on newly given information. After the test were completed, a One-way ANOVA was conducted to compare the grades from the 3 classes. The raw data showed that C class had the lowest scores compared to D and E Class. Finally, data was collected from 13 chosen participants from each class who took all 3 tests on all 3 days. The data from these participants was used to calculate the slope of the scores for each participant. The means of the slopes for each class was analyzed using another One-Way ANOVA. The raw data showed that the 13 participants from D Class were the only ones to show a negative slope average. After analyzing the data, a p-Value of 0.131 was given. This p-Value showed that the means for C, D, and E Class were not equal. In conclusion, mobile devices were not an effective distraction towards the grades of the participants of the distracted class (E Class). Also, time did not prove to be a significant negative towards the grades of a student.

## NAMING THE DIMENSIONS OF EMOTIONS IN A SCENE

Sarah Fowler  
Governor's School for Science and Mathematics

Emotions are a fundamental part of daily life. Two interconnected studies were conducted to create emotion clusters from a list of emotion words and use those clusters to rate a naturalistic stimulus—an episode of Sherlock. The correlations that can be drawn from the data collected can then place numerical values on an emotion word. Having these values makes it easier to analyze the similarity of emotion words and how emotional states relate to one another. The results of these studies will be used in further research dealing with predicting emotions of a human participant based on fMRIs.

## IMPROVEMENT OF THE TOE PAD FOR POINTE SHOES ACCORDING TO FOOT SHAPE

Maria Frattaroli  
Center for Advanced Technical Studies

Ballet, although an art form, can lead to a series of injuries that occur regularly in dancer who are especially training on pointe. However, some types of feet are better fit for this training based off of which toe the brunt of the force is being exerted. Without well fitting cushioning for the toes, injuries are even more likely to occur because it is the failure to effectively absorb the forces exerted on the foot that cause 33% of dance injuries (Caselli 2017). If there was a customized cushion for each of the four foot

shapes, it would have a guaranteed efficiency for each dancer. The creation and administration of a survey will give insight on which foot shape to make a mold for first. After taking molds of dancer's feet according to their foot shape using ballistics gelatin, a prototype will be able to be produced and eventually 3D printed for further testing and eventually use. Using the gelatin molds, exact dimensions and suggestions of material will be provided to allow the precise amount of padding needed for each foot shape customization. Therefore, this innovation would prove to be successful if the customized toe pad provides more support, less negative space between the toes and the pointe shoe, and lessens the amount of bruising or injury of the toes. In the future, this could expand the number of dancers who are able to dance on pointe as well as decrease injuries caused by the inefficient padding of pointe shoes.

#### THE FORMULATION OF BUDESONIDE INHALATION SOLUTION

Olivia Free and Kaitlyn Coghlan  
Governor's School for Science and Mathematics

Budesonide is a corticosteroid that treats the symptoms of asthma to allow for easier breathing. There is not currently a solution formulation of budesonide for the purposes of inhalation due to the molecule's hydrophobicity. In this research, we used a nanoparticle-based surfactant solubilizer to aid the dissolution of the budesonide molecule. Over a period of six weeks, we formulated three budesonide solutions, each with a different mixing time. With the goal of creating the most stable budesonide solution we tested and compared these formulations. Using a sixty-degree Celsius oven and a forty-degree Celsius accelerated chamber, we conducted a stability study to accelerate the testing of the longevity of the solutions. A High Performance Liquid Chromatography machine was used to test the solutions for purity and measure the amount of active pharmaceutical ingredient that remained in solution. At the end of the stability study, the ninety-minute mix formulation was the most stable. Because of the inconsistencies in the collected data, this experiment brings forth no concrete conclusions.

#### EXAMINING DIFFERENCES IN MALE AND FEMALE AGED MOUSE BRAINS

Lindsay Gardner  
Governor's School for Science and Mathematics

The gender differences seen in the development of the neurodegenerative diseases, Alzheimer's disease and Parkinson's disease, are a prevailing topic in today's neuroscience research. These statistical differences between the genders could be caused by a number of deviations in the concentrations of chemical substances and neuron support cells. In an effort to observe these deviations, this study focused on distinguishing the differences in the levels of dopamine, astrocyte activations, and microglial activation between the sexes. In performing this experiment, four aged mouse brains, two females and two males, were sectioned. These sections were stained antibodies for TH, GFAP, and Iba-1, which are present in dopamine, astrocyte activations, and microglial activations, respectively. Sections were mounted onto slides, dried, and observed under the microscope, and the mean density of the stain was calculated using ImageJ and Excel and analyzed. Staining these antibodies revealed minimal differences between the genders in regard to dopamine levels, astrocyte activation or microglial activation. Although no significant gender differences were observed, in future research more brains would be included into the research and a wider variety of mouse brains would most likely be considered. Using the information that may be obtained from this study could be beneficial to finding more reasons for why there are such substantial differences in the development of neurodegenerative diseases.

#### ASSISTIVE TECHNOLOGY PACK FOR STUDENTS WITH DOWN SYNDROME

Madison Gepper  
Center for Advanced Technical Studies

Children with Down Syndrome have physical abnormalities such as underdeveloped wrist bones, hypotonia, and co-occurring ADHD that can hinder their productivity in both mainstream and special needs classrooms. In order to counteract some of the abnormalities, a pack of Assistive Technology will be created to assemble to the child's desk. If children with Down Syndrome use the AT pack, then teachers will report "corrected" behavior and claim that the pack was adaptable, easily assembled, adjustable, and requires minimal to no assistance to operate because each component of the AT pack addresses the physical abnormalities in children with Down Syndrome. Teachers will assemble and use the pack (that contains a writing slope with a tablet holder, a tactile footrest, and a tactile seat cover) in their classroom for approximately two weeks. The teacher will then complete a survey for each individual student that addresses the effectiveness of each aspect of the desk and the overall success and usefulness of the product in the classroom. Ideally, the results will prove that the AT pack will improve student improvements and "correct" some of the negative effects of their physical abnormalities. The data will be analyzed using Likert scale. If student performance improves and the surveys yield positive results, it can be concluded that the AT pack lead to those improvements. The implications of these findings would suggest that more teachers should use AT packs in their classrooms to improve student performance. In the future, more children and teachers should be tested and/or surveyed.

## THE EFFICIENCY OF THE THERMAL ENERGY CREATED BY DIFFERENT TYPES OF COMPUTERS ON THE TIME TAKEN FOR A PHONE TO CHARGE USING THE THERMAL ENERGY

Siddharth Gianey  
Spring Valley High School

The purpose of this experiment was to make use of the wasted thermal energy that is created by computers that people use everyday by converting it into electrical energy to do something like charging a phone. It was hypothesized that if the thermal energy given off from a laptop or a desktop was used to charge a phone from 0-10%, then the energy created would charge the phone from 0-10% in at most double the time it took for the phone to charge from the wall socket. This is because there was a higher power draw from laptops and desktops when compared to a phone. This experiment was conducted by first starting a stress test on the computer, maximizing usage and heat generation. Then, using an infrared thermometer, the hottest area on the computer was measured and the thermoelectric generator device was placed on that area. Afterwards, the iPhone 6 Plus was plugged in to the lightning cable from the device and the time to charge was measured. Because this study was only about comparing different computers efficiency in charging the phone to the control, the wall socket, a series of 2 sample z-tests were used with an  $\alpha=0.05$  and the  $H_0$  was the claim, each comparing a form of the control data to one of the experimental groups. The results of those z-tests were  $z = -44.43$ ,  $p<0.001$  (one tailed) for 200% of the control being compared to the Macbook Pro group,  $z = -29.16$ ,  $p<0.001$  (one tailed) for 200% of the control being compared to the Dell XPS 15 group,  $z = -0.27$ ,  $p>0.100$  (one tailed) for 200% of the control being compared to the desktop group, and  $z = -65.55$ ,  $p<0.001$  (one tailed) for 200% of the control being compared to the ATandT Router group. The hypothesis was partially supported because the desktop group worked.

## THE EFFECT OF ACETAMINOPHEN (ANALGESIC) AND DIPHENHYDRAMINE (ANTIHISTAMINE) ON NOCICEPTION RESPONSE OF CAENORHABDITIS ELEGANS, HEART RATE OF EISENIA FETIDA, AND MORTALITY OF BOTH E.

FETIDA AND C. ELEGANS  
Vamsi Gorrepati  
Spring Valley High School

Pharmaceutical pollution continues to increase each year but its adverse effects on the environment are still largely unknown. Pharmaceuticals can enter the terrestrial ecosystem when animal manure and sewage sludge are applied to land as a fertiliser or when irrigated with contaminated water. To understand the extent to which common drugs impact the ecosystem, two commonly polluting pharmaceuticals, acetaminophen and diphenhydramine, which have been found in many cities such as Chicago, Dallas, and most notably The Great Lakes, were studied. Various concentrations were tested on *E. fetida* and *C. elegans*. Indicators such as heart rate was observed for *E. fetida*, nociception response for *C. elegans*, and mortality for both. It was hypothesized that when acetaminophen and diphenhydramine were introduced, all indicators would be negatively affected. Thirty trials were conducted for each test. The results indicated the pharmaceuticals had a significant impact on heart rate, nociception response, and mortality of both *E. fetida* and *C. elegans* respectively: ( $F(6,48)=262.33$ ,  $p<0.001$ ), ( $F(6,27)=169.67$ ,  $p<0.001$ ), ( $F(8,48)=2.98$ ,  $p=0.0086$ ), ( $F(6,27)=169.67$ ,  $p<0.001$ ). With heart rates increasing by 171% for *E. fetida* in some cases and nociception response decreasing by over 46% for *C. elegans*, it was concluded that both populations were negatively affected by acetaminophen and diphenhydramine. Based on experimentation, even small concentrations of pharmaceuticals in the environment can have detrimental effects to certain organisms, severely impacting the ecosystem.

## ULTRASENSITIVE PORTABLE NITROGEN DIOXIDE MONITOR

Nikhil Gottipaty  
Spring Valley High School

The purpose of this experiment was to create a diode laser that could detect concentrations of  $NO_2$  both faster and more accurately than chemiluminescence.  $NO_2$  is a harmful greenhouse gas that leads to the formation of ozone. It was hypothesized for the first experiment that if the amount of  $NO_2$  in the cavity is increased, then the signal picked up by the detector will go down. The  $NO_2$  was inserted into a cavity at set amounts and measurements were taken using the diode laser. Measurements were taken every 0.5s for 50s and averaged. The sensitivity was then calculated by placing the averaged points for varying concentrations of  $NO_2$ . The linear relationship between the integrated signal and  $NO_2$  concentrations was very strong for each test with  $R^2$  values over 0.99. It was hypothesized for the second experiment that if the integration time nears 10s, then the accuracy of the laser will increase. Zero air was run through the cavity and measurements were taken for 10 minutes at varying integrations times. The data was then assembled into an alan chart and a 10 second integration time was concluded to be the most effective.

## THE EFFECT OF SPENT COFFEE GROUNDS ON THE GROWTH RATE AND DRY MASS OF FRAGARIA VESCA PLANT

Briana Gray  
Spring Valley High School

To test spent coffee grounds as a natural alternative to the harmful chemical fertilizers used by farmers on large crop fields was this purpose of this experiment. There are many negative effects of the excessive amounts of chemicals and pesticides used on plants directly, as well as its surrounding environment, including the farmers who interact with them. SCG is beneficial because of its caffeine, phosphorus, and nitrogen contents. Phosphorus and nitrogen are helpful nutrients that are found within SCG. Caffeine helps quicken the growth process, but only to a certain extent. It was hypothesized that the 8% SCG group would

produce the greatest dry mass and fastest growth rate. The plant fertilized in this study was *Fragaria vesca*, which were grown from seeds for six weeks in five experimental groups. After six weeks, the sprouts were uprooted and air dried. Proceeding that, the average dry masses were found and the growth rates were calculated. After experimentation, it was found that the 4% SCG group had the highest average and growth rate, which may be due to measurement errors. An ANOVA test was done, showing that a main effect of SCG levels was found. Significant differences were found between the 4% group ( $M=128.5$ ,  $SD=13.4$ ) and its two closest groups, 2% ( $M=31.1$ ,  $SD=6.8$ ) and 6% ( $M=98.9$ ,  $SD=37.4$ ). It can still be concluded that the SCG was beneficial because all averages were higher than the control.

#### TREATING MUTATION E900X IN GENE CUL4B USING G-418

Emelee Guest

Governor's School for Science and Mathematics

CUL4B is one of the most commonly mutated genes that results in x-linked intellectual disability. Mutations in CUL4B result in symptoms such as short stature, hypogonadism, abnormal gait, speech delay, prominent lower lip, and tremors. Because it is a single-base nucleotide mutation resulting in a premature stop codon, the approach to treatment is to attempt to create a "read through mutation". Previous studies have tested treatments on diseases with premature stop codons and found that the "read through" effect can restore function to various different proteins. It has been shown to be affective in diseases such as cystic fibrosis, Duchenne muscular dystrophy, hemophilia, and cystinosis (Zingman et.al, 2007). The "read through" effect is when a protein continues to be created even in the presence of a premature stop codon. In this study, we used G-418, an aminoglycoside, to see if it can allow read-through of the stop codon. These ideas were tested using Western Blotting, which tested for the protein size, along with Immunofluorescence, which tested where the protein was located in the cell. The Western Blots confirmed that mutation E900X does in fact result in a truncated protein. The study also showed that CUL4B protein is usually localized in the nucleus for both the Wild Type Cells and the mutant cells. Interestingly, the E900X cells had a larger abundance than both the treated cells and the healthy cells. The next steps are to observe the effects of G-418 on protein size and to understand why the E900X cells proliferated.

#### THE EFFECT OF VARYING MAGNESIUM NITRATE AND TEMPERATURE LEVELS ON THE GROWTH OF CHLORELLA SP.

Pranav Guntupalli

Spring Valley High School

The impending depletion of nonrenewable energy sources has resulted in worldwide research for new, renewable resources. Biofuels are an emerging source of energy that utilize the carbohydrates of biomass such as algae and palm trees. This research was aimed at improving the growth of *Chlorella* sp. for purposes of biofuel production. It was hypothesized that a larger magnesium nitrate concentration and room temperature conditions would most increase the growth of *Chlorella* sp. A homogenous *Chlorella* sp. solution was equally distributed among 30 Erlenmeyer flasks already containing 120 mL of distilled water. An equal number of 15 mg, 5 mg, and 0 mg magnesium nitrate treatments were created. Half of the treatments were exposed to room temperature and half to 35°C. After 11 days, the algae were separated from the solution through filtration. There were significant differences,  $F(5,22)=22.25$ ,  $p<0.001$ , in mass between the high nutrient and low nutrient treatments, the low nutrient and controlled treatments, and the high nutrient and controlled treatments. A Scheffe test determined that there was no significant difference between the means of the different temperature treatments. These results suggest that certain nutrients, especially nitrates and phosphates, can be used to increase the growth of algae for the purpose of biofuel production.

#### THE EFFECT OF PLASTICS ON DAPHNIA'S HEART RATE, AND MORTALITY RATE

Allison Hall

Heathwood Hall Episcopal School

The purpose of this project is to determine how plastics affect the heart rate, mortality rate, and reproduction, of *Daphnia magna*. It was hypothesized that if *Daphnia magna* are fed plastics then their heart rates will increase, their reproduction will increase and the mortality rate will increase. The plastics were ground up in a coffee grinder and made into solutions using spring water. The mortality and heart rate were measured every day for four days. The average heart rate for low was 196.77 beats per minute. The average for medium was 225.99. The average for high was 226.20. The average for the control was 213.07. The average mortality rate for low was 2.16. The average for medium was 2.58. The average for high was 2.99. The average for control was 3.08. The heart rate data showed that after day three there was a significant difference between the low and high. The high plastic levels had a higher heart rate. Therefore plastics can have an effect on *Daphnia magna* heart rate over time. The mortality rate was significant on day two between the low and the high. The low plastics had more *Daphnia magna* alive on day two. Thus implying that the plastics were harmful to the *Daphnia*. The rest of the days did not have a significant difference. This was most likely due to the short life span of the *Daphnia*.

## MITIGATING THE IMMUNE RESPONSE OF TRANSPLANT TISSUES

Rasikh Hamid

Governor's School for Science and Mathematics

Organ transplantation is one of the foremost branches of surgery today. Hundreds of thousands of patients are in need of an organ transplant. However, large amounts of transplant organs are being discarded due to short preservation times. Ice-free cryopreservation is a method that is more cost-effective and has a lower risk of damage to the tissues than conventionally frozen cryopreservation. We tested the ice-free cryopreservation method, hypothesizing that it allows for storage while mitigating the immune response of the transplant. Fresh, nonpreserved porcine arteries were compared with ice-free cryopreserved arteries through histopathology, immunochemistry, and MALDI Imaging Mass Spectrometry. The arteries were examined for N-linked glycan signatures correlating to inflammation and an immune response. In the preliminary results of the study, 60 N-linked glycans have been mapped across the arterial tissues. Some of these N-linked glycans have shown significantly greater presences in arteries expected to have increased immune responses. Matching the MALDI images with the immunohistochemistry stains will allow us to determine which N-linked glycans are correlated to inflammation. We can use the intensities of the N-linked glycan signatures to quantify the immune response in each of the arteries. Then, we will then be able to determine whether ice-free cryopreservation allows storage while mitigating the immune response of the transplant.

## USING AN AVERAGE CONSENSUS ALGORITHM TO SECURELY TRANSMIT DATA ACROSS MULTIPLE NODES

Jesse Han

Governor's School for Science and Mathematics

Average consensus is a concept essential to coordinating the flow of information between multiple computational machines. The process allows individual devices to act as a single system, working toward a shared goal. With the prevalence of decentralized computer systems growing, average consensus is the key to having each of the individual nodes, or machines, reach the same final conclusions and properly coordinate their actions. To accomplish this, the nodes must reveal confidential information about their personal states to the rest of the system, creating concerns about privacy. The proposed solution, based on previous research, utilizes homomorphic encryption and a random scaling multiplier in order to mask the node's true state value. The method securely encrypts the node's data while remaining time-efficient due to compression. To test the average consensus algorithm within a real-world setting, the project was concentrated on implementing the algorithm using a set of single-board computers. The produced code worked as intended, and indicated that the concept would function accurately in practice. With further development, the average consensus technology could be applied to systems such as swarm robotics, drones, and self-driving cars to control decentralized systems precisely and with complete privacy.

## THE EFFECT OF PHOTO TAKING ON STUDENT VISUAL AND AUDITORY MEMORY OF MATERIAL PRESENTED

Sydney Hannibal

Spring Valley High School

Parents and teachers struggle with coming up with ways to improve students long-term retention about what they learn in class. Many studies show that taking pictures of certain things people experience in life help with memorization. This experiment, in particular, focused on the effect of students taking photos on material they learn on their memorization skills -- testing whether or not taking pictures boosts their visual and auditory memory on the material. It was hypothesized that the students would remember more about what they learned and took pictures of than the ones they did not take pictures of. 26 high school students participated, where they watched a slideshow presenting eight animals, providing them with a picture of each animal and a video that gave two short facts for each. The students then took photos of the first four presented animals. Three days later, the students came back and took a short quiz, testing them on the animals they learned from the presentation. The quiz showed how the students did on the questions of the animals they took pictures of and the ones they did not take pictures of. A Two-Sample T-Test was performed to compare the two groups. The statistical test revealed that there was a significant difference between the means, with a t-value=2.34 and p-value=0.023,  $p < \alpha$  ( $\alpha=0.05$ ). This showed that the students remembered more about the information of the animals they took pictures of than the animals they did not take pictures of.

## SOIL INVERTEBRATE DIVERSITY IN WINTHROP UNIVERSITY'S SUCCESSION PLOTS

Amanda Hardin

Governor's School for Science and Mathematics

The biodiversity of soil invertebrates that dwell in the four succession plots owned by Winthrop University, located in Rock Hill, South Carolina, is discussed. Samples were extracted using Berlese funnels and identified through stereomicroscope and scanning electron microscope pictures and pre-existing keys. They were also prepped for DNA analysis and sequenced, specifically the 18S ribosomal section of DNA. The most abundant species of soil invertebrates found in each plot were separated and sorted, then alpha and beta diversity tests were done to show the diversity between the plots. It was shown that the older of the plots were more diverse than the more recently established ones. The hypothesis that plots with larger year-of-establishments gaps are more diverse was also supported. Differences between not only number of unique species but also variation of families was examined. This information, along with the identification information collected, can be used to further understand soil fauna in the area, and the DNA sequencing data can be used in metabarcoding. This research was conducted at Winthrop University, funded in part by INBRE, and mentored by Dr. Julian Smith III.

## AUTOMATING A HUMAN ASSEMBLY PROCESS IN A BRASS MANUFACTURING COMPANY USING THE YUMI COLLABORATIVE ROBOT

Duncan Harmon  
Governor's School for Science and Mathematics

Over the summer I collaborated with Anderson Brass Company (ABCO) and Integrated Systems Incorporated (ISI), two local companies. I worked closely with ASEA Brown Boveri's (ABB) YuMi collaborative robot, designing an application for it in ABCO's manufacturing process. Using the Integrated Vision software of the YuMi I was able to program it to pick up pieces of brass in any orientation and place them in a fixture to be machined in. While the YuMi worked for the process, there are robots available to companies which are better suited to the task I tried to automate; however, these robots were not available to us as we only had access to the YuMi.

## THE EFFECT OF CHANGING WIND SPEED ON THE AMOUNT OF VOLTAGE PRODUCED FROM A WIND BELT

Riley Haywood  
Heathwood Hall Episcopal School

In this experiment, a scaled model of a wind belt, a mechanism used to harness wind energy, was built and tested at 5 different wind speeds in order to find the relation between wind speed and voltage produced. The independent variable was wind speed and the dependent variable was voltage produced. The hypothesis was, if wind speed increases, then the voltage produced will increase. The null hypothesis was, if wind speed increases, then there will be no increase in the voltage produced. The voltage was first run through a full wave bridge rectifier in order to change it from alternating current to direct current, then through a 470 $\mu$ f smoothing capacitor and a 100K $\Omega$  resistor to create a steady, constant voltage output. The results of this experiment supported the hypothesis and showed that there is a linear relation between wind speed and voltage, meaning a wind belt, on a larger scale, could be an efficient alternate way to harness wind energy.

## THE USE OF VERAPAMIL TO MAXIMIZE P-GP EXPRESSION ON THE CELL MEMBRANE

Amber Hazzard  
Governor's School for Science and Mathematics

This research was conducted to develop a potential treatment for Alzheimer's disease. P-glycoprotein has been shown to transport amyloid beta aggregates that are thought to be responsible for the neurotoxicity in Alzheimer's disease. We hypothesized that treatment with Verapamil can alter P-glycoprotein expression and an increase in P-glycoprotein present on the cell membrane would increase the transport of amyloid beta aggregates. This would slow and potentially stop the progression of Alzheimer's disease. To test this hypothesis, Madin Darby Canine Kidney (MDCK) cells were grown, treated with various concentrations of Verapamil, and then fixed and stained. The images were analyzed to determine the effect of Verapamil on the expression of P-glycoprotein on the cell membrane. The results show that Verapamil increases P-glycoprotein expression with an inverse dose dependency. The inverse dose dependency was unexpected and has not been reported previously.

## THE EFFECT OF DIET ON THE LIFESPAN OF DROSOPHILA MELANOGASTER

Isabelle Herndon  
Heathwood Hall Episcopal School

This experiment was conducted in an effort to show the effect of diet on one's lifespan by using *Drosophila melanogaster* as a model organism. *Drosophila* (fruit flies) are often used as a model organism for humans. In this experiment, *Drosophila* were fed according to various popular diets, and their death rates were compared to those *Drosophila* on a control group diet of Carolina Fruit Fly Food.

Trial one of this experiment began when four groups of *Drosophila* were transferred into four separate vials. The amount of flies in each vial were counted. Each vial contained food which was based on a certain diet. One vial had food according to an Atkins diet, one to a Paleo diet, one to a Vegan diet, and one to a control diet. The vials were left for one week. At the end of that week, the percentage of the flies that had died were counted. At the start of this experiment, it was hypothesized that if one group of flies was fed based on a more restrictive diet, then their death percentage would be higher than that of a control diet.

The results of this experiment did not support the hypothesis. Results showed that the control diet had the lowest death percentage with an average of 45%, while the Paleo diet had the highest death percentage with an average of 97.83%. From this data, it was concluded that restrictive fad diets can be rather harmful in comparison to a more control diet.

## OPTIMIZATION OF TURBINE BLADES ON NON-TRADITIONAL WIND TURBINES

Wyatt Hill  
Center for Advanced Technical Studies

What optimal blade design, size, and pitch, optimizes a dual rotor wind turbines output? If an optimal blade can be found for a single rotor turbine design, and then applied to a dual rotor turbine then the efficiency for the wind turbine will increase. The purpose of the experiment is to find the optimal blade pitch and design that outputs the most power. Which then can be optimized to be applied to a dual rotor turbine system. The procedure involves choosing existing blade designs and then running

voltage tests at varying pitches. Then the TSR is found for the chosen optimal blade design. Finally the chosen blade design is then tested to find the current output of the blade. The results showed that a blade pitch between 15 and 25 degrees gave the best efficiency output. In conclusion, so far, the optimal blade pitch is in between the range of 15 and 25 degrees. These implications can be applied to non traditional wind turbines, to improve their efficiency. Future work to be done is to create a dual rotor prototype.

#### THE EFFECT OF FITNESS ON EXECUTIVE FUNCTIONING OF THE BRAIN IN HIGH SCHOOL AGE CHILDREN

Jacob Ho  
Spring Valley High School

An increasingly sedentary lifestyle of modern children may have negative repercussion in their development and academics. The purpose of this study was to look for a possible relationship between fitness and executive functioning. It was hypothesized that fitness would indeed exhibit a strong positive correlation with executive function, and that the mile run and the trailmaking test (TMT) part A would have the strongest relationship and the weakest would be between the sit-and-reach and the letter fluency task. Sit ups and TMT part B would have the second highest correlations of the fitness tests and the executive functioning tests respectively. 30 students were accumulated from the SVHS PE classes. Their fitnessgram scores were given by the coaches since it was a normal part of the PE curriculum. Then in class, they took the TMT part A and B, as well as the verbal fluency test. After a correlational test was run, the critical value was determined to be 0.361 at an alpha of 0.05. Push ups proved to have correlations with all but TMT part B, sit ups with only letter fluency, sit-and-reach with no relationships, and the mile run with all but category fluency. This partially supported the main hypothesis that fitness is correlated with executive functions, with 7 of the 16 relationship having supported significance. This research shows the importance of exercise to our growth and development cognitively.

#### SUBCELLULAR PH CHANGES IN CORRELATION TO GLUTATHIONE METABOLISM

Leah Hoffner  
Governor's School for Science and Mathematics

The thiol redox balance is important for the function of prokaryotes and eukaryotes, playing a pivotal role in maintaining the proper function of particular proteins. These protein structures are stabilized by disulfide bonds. Glutathione (GSH) is an antioxidant that is believed to be essential for thiol redox control (Kumar, 2011) and shown to be a major cellular redox buffer (Grant and Posci, 1999 and 2004). pH changes may have a prominent influence on maintaining the ratio between reduced the glutathione and oxidized glutathione redox buffer (GSH: GSSG). Using *S. cerevisiae* (brewer's yeast) as a model organism, we planned to find the correlation between GSH metabolism and pH changes during redox stress which would subsequently provide us insight about GSH trafficking and its metabolism. The period of research mentioned was unable to discover the correlation due to the death of the yeast cells.

#### THE EFFECT OF ULTRASOUND ON *SALMONELLA JAVIANA*, *AEROMONAS HYDROPHILA*, *YERSINIA RUCKERI*, *EDWARDSIELLA ICTALURI*, AND *ESCHERICHIA COLI* DECONTAMINATION

Noah Hook  
Spring Valley High School

Water pollution is a growing problem in today's societies and will keep growing if certain measures are not taken. Dangerous bacteria that contaminate wounds, fish, and water can lead to less food and water for communities. Everyday there are new ideas to clean water without using chemicals like chlorine that can harm the human body. Ultrasonic waves, which are sound waves above 20,000 hertz, may be a way to decontaminate water of bacteria. To test whether or not ultrasound is an effective way to kill bacterial colonies, 5 different bacteria (*Salmonella javiana*, *Aeromonas hydrophila*, *Yersinia ruckeri*, *Edwardsiella ictaluri*, and *Escherichia coli*) underwent ultrasound exposure at 4.6 mhz and 9.6 mhz for 5 minutes each. Each bacteria was split into 3 groups, one being control, one being 4.6 mhz, and the last being 9.6mhz. This was completed by inoculating water with certain bacteria, then exposing it to ultrasound, and lastly performing serial dilutions in order to count individual bacterial colonies. Following the dilutions, each 1 mL test tube had 20 microliters removed from it and placed onto a quadrant of a petri dish three times, ending up with 2 petri dishes with 24 20 microliter dots. The quadrants of the petri dishes were labeled by their dilution ratio. After incubation, bacterial colonies in the dilution ratio that have the least amount of colonies (but more than 5) were counted and were reverted back to the original inoculation to find total amount of colonies after ultrasound exposure.

#### ENGINEERING OF AN ELECTROTHERAPY KNEE SLEEVE

Ellie Hoos and Regan Dargan  
Center for Advanced Technical Studies

Engineer a knee sleeve (nylon and spandex combination) that will have electrotherapy capabilities. Creating this knee sleeve will make it more convenient for people with knee-injuries to do pre-rehabilitation and rehabilitation even when they are not at the physical therapists office or other rehabilitation location. Electrical stimulation patches will be attached onto the inside of the knee sleeve. The patches will be connected to a portable NMES unit. The sleeve will have a zipper incorporated for easier

use getting it on and off. If possible, we will incorporate TENS capabilities around the knee for pain management in our prototypes.

#### THE EFFECT OF FIBER TYPE ON HEAT RETENTION IN SLEEPING BAGS

Asher Huddlestun  
Spring Valley High School

People who go camping in cold environments without proper protection may get hypothermia or frostbite. This project looked at heat retention in several natural fibers commonly used in the textile industry. The purpose of this analysis was to find which natural fiber was the best at retaining heat in cold temperatures. Heat retention is how well something works as an insulator. It was hypothesized that a custom mix of duck down, goose down, and cotton fibers would keep the temperature above  $-10^{\circ}\text{C}$  for the most amount of time. Each model sleeping bag had 26.7 grams of insulation. The Custom sleeping bag was created with a 1:1:2 ratio of duck down: goose down: cotton. Four trials were completed to see which fiber or mix would be the best at retaining heat: cotton, goose down, duck down, or the Custom mix of those three insulations. Those insulations were picked as they are commonly used in sleeping bags and textiles used in camping in cold weather conditions. An ANOVA test ( $F(3,12)=19.67$ ,  $p<0.001$ ) was run on the data with alpha equal to 0.05. It was concluded that cotton fibers were the worst at retaining heat and that there was no significant difference between duck down, goose down, and the Custom mix. Future research will have to test the difference of the Model Sleeping Bags without cotton, as well as different ratios of duck and goose down.

#### EXAMINATION OF ANALYTICAL METHODS FOR MONITORING NITRIFICATION IN CHARLESTON WATER SYSTEM'S DISTRIBUTION SYSTEM

Joshua Huggins  
Governor's School for Science and Mathematics

The purpose of the study was to show the ongoing nitrification process in a local water distribution system in Charleston, South Carolina and to observe which method best predicts nitrification levels. All pipelines in water distribution systems undergo nitrification at some level, depending on water use. This study samples various water taps in different locations across the distribution system to monitor nitrification. To properly test and understand how much nitrification has occurred, multiples tests must be performed; such as chlorine, pH, free ammonia, and higher nitrite and nitrate levels. Samples closer to main lines or the treatment plant often see the higher levels of chlorine which generally coincide with less nitrification. Nitrification is a natural process within distribution systems that does not pose threats to human health as long as it is managed with sufficient flushing.

#### THE EFFECT OF GENDER, GRADUATING CLASS, AND GRADE LEVEL ON ERB READING COMPREHENSION SCORES OVER TIME

Charlotte Hughes  
Heathwood Hall Episcopal School

The purpose of this study was to determine the relationship between gender, graduating class, grade level, and reading comprehension scores over time on the ERB tests. It was hypothesized that the reading comprehension scores on ERB tests would vary depending on gender, males' scores would increase from 6th to 8th grade, and that the ERB Vocabulary and Verbal Reasoning sections would reflect a similar gender gap to the reading comprehension gender gap. The independent variables were gender, grade, and graduating class, and the dependent variables were scores on the Reading Comprehension, Vocabulary, and Verbal Reasoning tests. ERB data for HHES graduating classes 2018-2021 from years 2013-2017, grades 4-8 for the Reading Comprehension, Vocabulary, and Verbal Reasoning portions of the test were obtained. The data was analyzed four ways using descriptive and inferential statistics and graphical analysis. Statistical analysis showed that there was no significant difference ( $p > 0.05$ ) between males' and females' scores in the Reading Comprehension, Vocabulary, and Verbal Reasoning portions of the test, and that there was no significant difference between males' percentile scores from 6-8th grade. However, there was a significant difference between some graduating classes' percentile scores on average. This rejected the hypothesis, accepting the null hypothesis, but did not confirm other researchers' findings for lack of national or international reading comprehension test score data.

#### THE EFFECT OF DIFFERENT EARBUD TIPS ON THE PRESSURE OF SOUND TRANSMITTED

Jasmine Hughley  
Spring Valley High School

It has been observed in multiple experiments that teenagers use earbuds to listen to amplified music, these actions can lead to symptoms caused by possible hearing loss. The purpose of this experiment was to determine which earbud shape transmits higher levels of pressure in order to better understand which earbud shape is more detrimental to a person's health. It was hypothesized that if the shape of the earbud was narrower and shorter, like the single flange ear bud, then the pressure of the sound transmitted would be higher dB. In order to test this hypothesis, the experiment consisted of playing a choice of three different songs through an earbud at different distances (0 cm,  $\frac{1}{4}$  cm, or  $\frac{1}{2}$  cm) away from a sound pressure level meter (SPL) and recording the highest decibel levels observed. The earbud had one of the two earbud tips (single flange and bi flange) attached in each trial. The results of this experiment showed that the bi flange earbud transmitted higher level decibels that



were more statistically significant ( $p=0.003 < \alpha=0.01$ ) than the single flange earbud tip ( $p=0.130 > \alpha=0.01$ ). Moving the earbud different distances from the sound pressure level meter (SPL) had a large effect on the sound pressure transmitted, however, the song selections did not have a large impact on the result. Both earbuds played at maximum volume produced levels at and above 90 dB at 0cm away and at  $\frac{1}{4}$  cm. If a person were using the earbuds, with either of the flanges (single flange or bi flange), at maximum volume, they could possibly experience symptoms of hearing loss.

#### THE RELATIONSHIP BETWEEN THE ECONOMIC STATUS OF A POPULATION AND THE INDOOR AIR QUALITY OF THE SCHOOL SERVING THE POPULATION

Jareer Imran  
Spring Valley High School

Previous studies suggest that harmful environmental pollutants such as airborne particulates may disproportionately impact people of lower incomes. The purpose of this study was to determine whether environmental justice exists in public elementary schools. It was hypothesized that schools with higher percentages of minority students and students who qualify for free or reduced lunch would have poorer air quality. Air quality was measured using air sample collectors, from which the number of particles deposited over a five-day period could be counted under a microscope and examined. The mean particle count of each school was taken and a linear regression test was run to determine if a significant correlation was present. The r- and p-values from the regression analysis were assessed. The test for demographic and lunch data reported  $r(4)=0.796$ ,  $p=0.204$  and  $r(4)=0.781$ ,  $p=0.219$  respectively. This indicated that the correlation was not significant and as such, the hypothesis was rejected. However, an ANOVA test found a significant difference does exist between at least one pair of means, with  $F(2,14)=31.96$ ,  $p<0.001$ . Prompted by the ANOVA results, additional tests were done to determine if a relationship existed between particle count and other variables. No correlation was found between particle count and variables of traffic, school age, or HVAC. Analysis of internal differences indicated significant differences between classrooms in an individual school. In addition, the potential impact of the indoor air quality on student performance in standardized science test score was found to be significant with  $r(4)=-0.960$ ,  $p=0.040$ .

#### ENGINEERING A WATERPROOF ADHESIVE BANDAGE WRAPPER

Anna Jackson  
Center for Advanced Technical Studies

Currently, adhesive bandages are wrapped in a thin paper wrapper; this leaves the bandage susceptible to contamination when in contact with water. Adhesive bandages can become exposed to liquids in flooding, at doctor's offices, at the pool, etc. They are frequently used in first aid kits and the treating of wounds by first aid responders. Exposure to bacteria, that can lead to cancer and diseases is a common fear in contaminated waters that can also contaminate medical supplies. By creating a waterproof package for individual bandages, waste, cost and the fear of contamination will be reduced. The packaging will also make the bandage easier to open, use and apply. Once engineered, the bandage will be submerged in water, dyed red with food coloring, for varying amounts of time. The dye will stain the bandage in any areas that it comes in contact with it. Another analysis method will be to place the bandage in water filled with bacteria. The bandage will then be swabbed and a plate will be streaked to see if anything grows. If the innovation places both of these tests, resisting water and contamination, it is successful. The tests will be repeated multiple times and the packaging will be adjusted as needed.

#### THE EFFECT OF BISPHENOL A ON THE MATING BEHAVIORS OF GRYLLODES SIGILLATUS

Fatima Jatoi  
Spring Valley High School

Bisphenol A (BPA) is a chemical commonly used in polycarbonate plastics and epoxy resins. Many organisms, including humans, are constantly exposed to this chemical, which in past studies was found to affect the reproductive system. Some of BPA's effects are still unknown, such as its effects on mating behavior. As such, the purpose of this study was to test the effects of BPA on the mating behaviors of male *Grylloides sigillatus* (crickets). It was hypothesized that the male crickets exposed to BPA would have a decreased mating interest, as evinced by a lower number of chirps in a one minute time span than crickets not exposed to BPA. The experiment was conducted using two groups of male crickets, one exposed to BPA and the other not. After 24 hours, each male cricket was placed with twenty female crickets, and the number of times the cricket chirped in one minute was counted. All crickets were then tested for the presence of BPA. A t-test found that crickets that were exposed to BPA chirped significantly less than crickets that were not,  $t(18)=3.38$ ,  $p<0.05$ . Thus, it is likely that BPA, being an endocrine disruptor, disrupted the crickets' ecdysteroids, the sex hormones in insects, causing the male crickets to be less attracted to the females, thus chirping less. Since crickets are a model organism for human behavior, this study may imply that BPA affects human mating behaviors as well.

## AN ASSESSMENT OF THE FACTORS ASSOCIATED WITH GLOBAL STROKE RISKS

Nolan Jenkins

Governor's School for Science and Mathematics

Stroke is the second leading cause of adult mortality in the world. In order to reduce the number of deaths from stroke, there needs to be a way to quickly prioritize countries which need aid. However, this cannot be done without ranking countries in an order that will show which ones are more affected by stroke than others. Therefore, a metric was created to fulfill this purpose using mortality data from three different cardiovascular diseases, including stroke, to rank every nation with readily available data. This metric identified Mongolia as the most affected nation, and Mongolia was further investigated to determine the accuracy of the metric. It was determined that the metric was able to accurately identify a nation with a high-risk population.

## LPAR EXPRESSION LEVELS DURING CHICK RETINAL DEVELOPMENT

Chalmers Johnson

Governor's School for Science and Mathematics

Lysophosphatidic acid (LPA) is a known extracellular signaling molecule which activates distinct receptors as encoded by LPAR genes. Recent work by Dr. Birgbauer has shown that LPA causes growth cone collapse in retinal ganglion cells (RGCs), suggesting that it is an important axon guidance molecule. We used the chick visual system as a model in order to study LPAR receptor (LPAR) gene expression levels and patterns in the retina. We were looking at LPAR 4 specifically, because it is the least researched. To do this, we used a quantitative reverse-transcription polymerase chain reaction (qRT-PCR) machine. Our results suggested to us that LPAR 4 tends to be expressed more in later stages of development. Discovering LPAR expression patterns in the retina could aid in identifying and treating congenital retinal defects such as albinism.

## INTEGRATING OPTIMIZED HIGH-SPEED AUTONOMOUS CONTROL SYSTEMS

James Johnson

Governor's School for Science and Mathematics

While autonomous vehicles are growing in popularity, there exists a tradeoff between control and speed. With control directly affecting safety of a vehicle, it is prioritized at the detriment of speed. However, with speed being essential to emergency responses, methods are required for optimizing speed while retaining a high degree of control. This research project aims to convert a proportional integral derivative controller, visual servoing system, and potential field navigator into Robot Operating System (ROS) nodes, integrate them with the Rapid Autonomous Complex-Environment Competing Ackermann-steering Robot (RACECAR) developed at the Massachusetts Institute of Technology, tune them for speed, and integrate them together to complete a test course of various obstacles. Our optimized algorithm variants achieved an increase in processing speed by 20 times, but did not outcompete completely rewritten variants in the test courses. This indicates that the optimization methods provide benefits, but that algorithms themselves must be rewritten to operate at the highest efficiency. Future research will incorporate the optimization methods into the rewritten algorithms to benefit from both effects. Additional algorithms will also be considered for revision and optimization.

## DEGRADATION OF NYLON VERSUS SELAR BOTTLES IN MULTI-JET 3D PRINTERS

Revery Johnson

Governor's School for Science and Mathematics

Multi-Jet 3D-printing is a method of printing similar to inkjet printers. The print head on these printers has 40 jets which use piezo-electric actuators to open an orifice allowing liquid material to be dispensed in the desired area. The ProJet series of printers from 3D Systems use Selar containers to hold the wax print-material. An issue occurred with the printer where the jets would clog and misfire causing very bad prints. It was hypothesized that the Selar was melting and leaching into the wax and getting stuck in the jet. New Nylon containers were created to test whether the theory was correct. The printers were stressed every day with prints and then Drop masses were run as a test. The Nylon bottles accompanied by built-in processes were able to mitigate the issue and bring the printers close to expected quality.

## PLAYING POSITION VS HELMET IMPACT FORCES IN FOOTBALL

Ty Jones and Van Clarke

Heathwood Hall Episcopal School

The purpose of this project is to analyze football helmets' force sensor data and see if there are patterns between position and helmet impact forces. Independent variable: The different positions that are used for data. Dependent variable: The data of how many blows were received and the amount of force exerted. Our procedure included sending out human consent forms for the varsity football players, gaining their consent and turning in the forms to the HHESEpiscopal School Athletic Director. The Athletic Director then arranged for Riddell Co. to release anonymous proprietary helmet sensor data for use in this study. In this study, the independent variable (IV) was player position and the dependent variable (DV) was helmet impact forces. After reviewing and analyzing the data and comparing the results to the hypothesis, the results supported the hypothesis. Independent variable: The different positions that are used for data. Dependent variable: The data of how many blows were received and the amount of force exerted.

## THE EFFECTS OF TONALIDE ON NEUROBLASTOMA CELLS AND ITS CORRELATION WITH AUTISM SPECTRUM DISORDER

Rick Karen Kakanou  
Governor's School for Science and Mathematics

Autism is a disease that impacts the nervous system. The range and severity of symptoms can vary from person to person. Common symptoms include difficulty in communication, social interactions, obsessive interests, and repetitive behaviors. It is believed that Autism Spectrum Disorder (or ASD) is caused by a combination of genetic and environmental factors, but recent studies suggest that exposure to environmental chemicals may play a critical role in its pathogenesis. The focus of this investigation was to study the compound Tonalide. Our hypothesis was that two cell lines; CRL-2266 (female) and CRL-2267 (male), subjected to Tonalide would show similar neuromodifications to that of someone suffering from ASD. The research involved cultivating a cell line until an ample amount of cells were present. After cultivation the cells were exposed to the Tonalide. Immunostaining was performed to inspect the results of the Tonalide on the cells under a microscope. After analyzing the cells we found that as concentration increased the number of dead cells and degenerated axons. These results show that Tonalide does have some effect on neuroblastoma cells. While we cannot blatantly state Tonalide causes ASD it does have an effect similar to that of ASD. Future studies in this research can involve studying the chemical structure of Tonalide to understand what about it causes neurological effects.

## THE EFFECT OF ARTIFICIAL SWEAT CORROSION ON THE ABILITY OF COPPER, ALUMINUM, AND STAINLESS STEEL FOILS TO INHIBIT THE GROWTH OF *ESCHERICHIA COLI*

Garrett Kaufman  
Spring Valley High School

Due to an increase in antibiotic resistant strains of bacteria, new methods for killing bacteria without the use of antibiotics and caustic chemicals are being sought out. Research has shown that some metals can be used as a way to kill bacteria on contact. This experiment was designed to see how well copper, aluminum, and stainless steel were able to inhibit the growth of *E.coli* after artificial sweat corrosion. This was intended to mimic extended contact with human sweat from handling. It was hypothesized that metal subjected to corrosion would be less effective against bacteria than metal that was not corroded. Pieces of metal foil were corroded in an artificial sweat solution of urea, lactic acid, and distilled water. These along with non-corroded counterparts were submerged in this solution for 72 hours. These strips were placed in inoculated bacterial broth. The inhibition of the bacterial growth were measured using optical density with a spectrophotometer. The results were analyzed with an ANOVA at alpha equal to 0.05. This ANOVA ( $F(6,147)=2.16, p<0.001$ ) showed that the data were significant. To locate the the points of significant difference a scheffe test was conducted and found significant differences between all but several groups. Based on the descriptive statistics collected, however, it can be concluded that the hypothesis was not supported. While the trend of the means seems to support the hypothesis the differences are either insignificant or can be attributed to factors other than antibacterial performance.

## BACK BRACE INSERT FOR SCOLIOSIS

Eric Keeler  
Center for Advanced Technical Studies

The purpose of the back brace insert for scoliosis is to provide comfort into the daily lives of people who suffer from scoliosis. This brace is able to stop the hard brace from cutting into people wearing them, meanwhile not disturbing the effective integrity of the brace after the insert to determine its effectiveness. Each tester will do a few simple tasks and then they will score their comfort while doing the tasks on a 1 to 15 scale. The data will be collected by taking the average scores from both tests (with and without the brace insert) and then seeing which had the most comfort. The data will prove the insert successful if an average shows that the testers felt more comfort while performing the tasks. If the insert improved comfort then the overall goal will be achieved.

## THE EFFECT OF LIVATREX, *GANODERMA LUCIDUM*, THEANINE, AND VITAMIN E IN COMBINATION WITH ETHYL ALCOHOL ON THE RESPONSE TO THERMOTAXIS IN *CAENORHABDITIS ELEGANS*

Deiveek Kerai  
Spring Valley High School

Fetal alcohol syndrome (FAS) is a disorder that is resulted from the consumption of alcohol by pregnant women. Substances like Livatrex, theanine, vitamin E, and reishi mushroom may help prevent the onset of symptoms including, poor intrauterine growth and delayed developmental milestones. *C. elegans* is an excellent model for FAS as there are many stimuli that can be tested to show changes in neurological capability. The purpose of this experiment was to test the efficiency of treatments against FAS modeled by *C. elegans*. It was hypothesized that theanine would allow for the highest percentage of *C. elegans* in the coldest section of the thermotaxis gradient. For experimentation, 6 square petri dishes, divided into 4 sections, were seeded with *C. elegans*. During this time, 30 microliters of ethanol and each treatment was added. The petri dishes were then placed on a thermotaxis gradient, with temperature increasing from one side to the other, and the number of *C. elegans* in each section was recorded after 72 hours. However, percentages were used as results because there were a different number of *C. elegans* that matured in each petri dish. A percentage would yield a quantification that would fit all petri dishes. A two-way ANOVA was

conducted at  $\alpha=0.10$ . The p-value for the percentage and treatment showed statistically insignificant results with  $p=0.9998$ . The p-value for the percentage and section number showed statistically significant results for that with it being 0.0933. Regardless, Livatrex appeared to be the most effective treatment.

#### OPTIMIZING DESIGNS OF MUTI-LAYER MICROBIAL FUEL CELLS

Zachary Kochert

Center for Advanced Technical Studies

The start date for the current project is August of 2017 and the end date is May 2018. The hypothesis for this project is if a Multi-Layer MFC or a MFC with other various amendments can be successfully designed and created then more voltage can be harnessed from one setup. In this project the expectation is to make MFCs a more attractive fuel source for consumers and energy production companies. Two pathways are being pursued and researched. The first is finding additives for the mixture that will either give them more energy to produce more electricity or allow them to produce for an extended period of time. Two examples of these are Biochar or Charcoal (carbon) which increases the conductivity of the soil and allows more microbes to make contact in turn producing more voltage, and Glucose which gives the microbes more energy to produce a higher voltage longer. The second pathway is adding more anodes. This means that instead of having the standard one anode, more anodes are added to the cell for increased contact with microbes and greater compiled voltage. In the project the main area of improvement in voltage output is the addition of carbon. The current data concludes that the amendment of carbon to the mixture will allow more voltage to be harnessed from one setup proving the hypothesis. The carbon amendment will be tuned to the best percentage along with the improvement of ease of use for the cells through more work and experimentation.

#### A COMPARISON OF THE TOTAL FLAVONOLS IN *DAUCUS CAROTA*, *CYANOCOCCUS*, *CITRUS SINENSIS*, *CITRUS LIMON*, *ACTINIDIA DELICIOSA*, AND *MANGIFERA INDICA*

Vikram Kumar

Spring Valley High School

Degenerative diseases, as well as bacterial infections are caused by oxidative stress, and are a huge problem in the world. Antioxidants are needed to safely balance the harmful effects of free radicals without causing any damage to the body. Bioactive compounds which have powerful antioxidative abilities and can treat and prevent degenerative diseases. One of these many polyphenol derivatives is flavonols, which have are contained in many common edible plants. Examples are carrot, blueberry, lemon, kiwi, orange, and mango. Flavonols can be measured by creating an aqueous extract. 5 mL of the aqueous extract were mixed with 5 mL of Folin-Denis reagent and heated on a hot plate for a minute. The resulting solution was transferred into cuvettes and placed into a spectrovis that was pre-calibrated to a blank of Folin-Denis reagent. The extracts were measured for absorbance at a wavelength of 320 nm to determine relative flavonol levels. An ANOVA test at  $\alpha = 0.05$  ( $F(5)=1024, p < 0.05$ ) was used to test the significance of the results. The ANOVA test returned a p-value of  $< 0.05$ , meaning the data was significant. This is because  $p < 0.05$  is less than the alpha value, which means that means the null hypothesis that there was no difference between the extracts was rejected, as there were significant differences in the flavonol levels. The hypothesis that green colored extract would have the highest level of flavonols was not supported by the data, as blueberry has the highest level of flavonols.

#### STUDYING THE ACOUSTICAL EFFECTS OF REVERBERATION

Caitlin Kunchur

Dutch Fork High School

The acoustical reverberation of a room affects both music and speech, so it is valuable to develop physical methods to evaluate the acoustics. This project studies and develops techniques for measuring reverberant sound intensity and decay time for comparing acoustics of different rooms. The results of this project could benefit designs of classrooms and other spaces used for speech and conversation. Three rooms were compared: a bedroom, a foyer, and a bathroom. In the first experiment, the relationship between sound level and distance ( $1/r^2$ ) was measured to understand the strength of reverberation, by playing a steady sound source and measuring the sound intensity using a smartphone and a laptop. To understand the duration of the reverberation, the same procedures were followed, except the steady sound was stopped and analyzed using an oscilloscope software on a laptop. The analysis showed that the reverberation strength increased with decreased absorption and the duration increased with volume in the expected way. The connection between these physical measurements and speech clarity is being studied and will be discussed.

#### THE EFFECT OF THE VARIOUS TYPES OF SNEAKERS ON THE TYPE AND AMOUNT OF INJURY ON VARSITY GIRLS' BASKETBALL PLAYERS

Maryah Lance

Spring Valley High School

The purpose of this experiment was to determine whether copper (II) sulfate pentahydrate can positively or negatively affect the amount of abscisic acid (ABA), represented by parts per million (ppm), produced by Cucurbita pepo plants. If the copper (II) sulfate pentahydrate were to positively affect the amount of ABA, the plants would undergo fermentation quickly and have a more vibrant color to the leaf and stem. It was hypothesized that the copper (II) sulfate pentahydrate would cause the zucchini plant to produce less ABA, thus causing poor physical characteristics of the plants, such as poor color and poor growth. There

were 2 groups in this experiment consisting of 30 zucchini plants, a control group and an experimental group. The control group was given only water and sunlight everyday until the plants finished fermentation. The experimental group was given the same amount of sunlight but 26% concentrated copper (II) sulfate pentahydrate everyday. Both groups had the same amount and type of soil. After the control group plants finished fermentation, the ABA was measured using an electrochemical ABA sensor, also referred as an ABA meter, obtained from Amazon.com. This measures the amount of ABA produced by each plant. Each plant was separated from the rest. The unpooled independent t-test, represented by graph 4, shows the statistical significance of this experiment, having a low p-value. The control group (M=0.75, SD=0.12) reported significantly higher levels of ABA ppm than the experimental group (M=0.12, SD=0.06),  $t(29) = 23.90$ ,  $p < 0.0001$ .

#### THE EFFECT OF TAURINE CONCENTRATION ON HEAD REGENERATION IN PLANARIAN

Crawford Latham  
Spring Valley High School

Taurine is an amino-acid derivative that is present in high concentrations in animal neural tissues as well as areas of inflammation. Taurine is known to be involved in the processes of the brain including development and transmission and is highly concentrated in neural tissues. This research was conducted to determine taurine's effect on regenerating neural tissue in planarian. Since taurine is known to help limit inflammation and encourage the proliferation of neural stem cells, it was hypothesized that the taurine would affect the speed of regeneration. There were three different groups including the control, each containing thirty planarian. The control group was suspended in regular spring water whereas the experimental groups were suspended in a water-aurine solution, with a concentration of 50  $\mu\text{m/L}$  or 100  $\mu\text{m/L}$ . The planarian were decapitated and their heads removed from the dishes. Regeneration was then observed daily with measurements taken at days one, four, and seven. Taurine was not shown to create a significant difference in length and regeneration. Both experimental groups demonstrated statistically significant differences within themselves, but not from one other or the control. The control group showed no significant difference within itself, whereas both experimental groups exhibited significant differences. There was no significant difference between the control group and the experimental group. These statistics were obtained using a one-way ANOVA at a confidence level of 95%. These statistics did not support the hypothesis, suggesting that taurine does not have a significant effect on regeneration in planarian.

#### WHICH CHOPSTICK SURFACE, EITHER WOODEN, METAL, OR PLASTIC, WOULD ENABLE THE MOST E COLI BACTERIA TO GROW?

Julia Lauterbach  
Heathwood Hall Episcopal School

The purpose of this study is to determine how the type of chopstick surface affects the growth of Escherichia coli bacteria in a controlled environment. The hypothesis is that on a wooden chopstick surface, that is of rougher texture than plastic and metal, the bacteria will live longer and grow faster than on a smooth, hard surface chopstick surface. After growing the Escherichia coli bacteria cultures, the sanitized chopstick surfaces were contaminated with the bacteria and allowed to dry. The chopsticks were rinsed in nutrient broth to remove bacteria that adhered to the surface. The rinse solution was transferred to nutrient agar plates and allowed to incubate under controlled conditions. The independent variable was the type of chopstick surface (soft bamboo wood, hard painted wood, metal, and plastic), the dependent variable was the count of bacterial colonies after 48 hours and 72 hours at 37°C in an incubator, providing a direct measure of the survival and potential growth of bacteria on the different surfaces. The bacteria in the colonies were then counted using computer software. For each surface, five different samples were prepared to gain information about reproducibility. The results clearly showed that the plastic surface favored the growth of bacteria, while both wooden surfaces and the metal surface clearly showed lower bacterial counts. The inferential statistics added another level of support for the conclusion that there is in fact a significant difference between the materials used in experimentation and their ability to sustain bacterial contamination.

#### THE EFFECT OF BILINGUALISM ON MONOLINGUALISM ON THE IDENTIFICATION OF FOREIGN LANGUAGES

Christian Lee  
Spring Valley High School

Learning a new language is a slowly dying fad in the United States for college students even though the benefits are abundant. The purpose of this study was to identify if there was a significant difference in identifying languages that were not familiar to their original tongue. It was hypothesized that the bilingual individuals would be able to identify more foreign languages than the monolingual individuals because of the exposure to a culturally different language. Participants were given three tries to identify as many languages as possible that were read off in 20 second phrases by the computer program. The 20 second phrases could be replayed as many times as wanted. After three incorrect attempts, the program ended and displayed the score. Each correct answer boosted the score by 50; incorrect answers were not penalized. This procedure was repeated three more times to produce a mean and to reduce outliers. Results showed that the mean amount of languages identified by bilingual individuals was 5.4 and the amount of languages identified by monolingual individuals was 3.8. The highest mean score was 10 but one participant identified 13 languages in a single attempt. On three separate occasions no languages were identified. A 2-sample T-test was conducted to test the significance of the study. The p-value was  $p=0.043$  and the alpha value was 0.05 so the null hypothesis was rejected and the claim of the alternate hypothesis was supported.

THE EFFECT OF BISPHENOL A ADMINISTERED IN CONCENTRATIONS FOUND WITHIN NATURAL RELEASE  
FROM POLLUTION ON THE GROWTH AND PRODUCTION OF BRASSICA RAPA

Cynthia Leonard  
Spring Valley High School

Endocrine disruptors have been a topic of growing concern among many in recent years. Bisphenol A is a widely known endocrine disruptor. The research done on BPA and other various endocrine disruptors has been mainly focused on the effect they have on hormones within mammals or fish or the effects they have on the growth and development of these organisms. The purpose of this study is to determine how endocrine disruptors potentially affect plant life. It was hypothesized that higher concentrations of BPA would most affect Brassica rapa seeds. 140 Brassica rapa seeds were exposed to concentrations of 0 g/l, 0.1 g/l, 0.3 g/l and 0.5 g/l of BPA by being watered with these solutions once every two days. After the plants were fully matured, the dry mass of the plants were taken.

PNEUMATIC TECHNOLOGY AND ITS APPLICATIONS IN SOFT ROBOTICS

Dawson Leviner  
Governor's School for Science and Mathematics

The intention of this research was to explore the use of soft robotics in manufacturing applications. My work focused on constructing a four-armed rubber/silicone gripper powered by pneumatics. The molding that formed the gripper's shape was 3D printed, resulting in a robotic gripper called "Starfish," due to its shape. I applied this technology to a production environment to explore possible future applications.

EXPLORING HOW TEMPERATURE AFFECTS THE PERFORMANCE OF A HIGH TEMPERATURE SOLID  
OXIDE FUEL CELL

Edwina Lewis  
Governor's School for Science and Mathematics

The field of solid oxide fuel cells is vast and contains many uncertainties in methods and procedures. This paper explores the process behind making a solid oxide fuel cell, focusing mostly on the ink making process. This process starts from the glycine-nitrate combustion until it reaches the addition of binders and the mixing of the ink into a pudding-like texture. A secondary focus that the paper explores is the assembling process of the cell. This process includes the screen-printing of the cathode and the correct order of the cell. The paper then analyzes the preliminary tests of the cell to see how it performs. These tests indicate whether the cell is a working representation of a solid oxide fuel cell. This was also confirmed by a mathematical analysis of the cell which considered the cell's change in enthalpy and its change in entropy.

THE EFFECT OF PSEUDOMONAS PUTIDA ON THE DEGRADATION OF OIL IN SALTWATER  
AND FRESHWATER ENVIRONMENTS

Annie Lobitz  
Spring Valley High School

Bioremediation is a method used to clean up environmental contaminants in a more environmentally friendly and cheaper method compared to using manual labor or machinery. The contaminants could be oil or other potentially harmful chemicals, and they can be detrimental to ecosystems by killing certain species, enhancing the growth of other species, etc. Microorganisms such as bacteria, plants, or fungi can be used to degrade these contaminants by digesting them and converting them into less harmful substances. In this particular study, the bacterial species *Pseudomonas putida* was studied to see if it has bioremediation abilities in both a saltwater environment and a freshwater environment. The bacteria were grown in the same conditions (i.e. temperature, light, and moisture), but one group had approximately six grams to simulate ocean water. The groups were plated and oil was added onto the samples and left for 48 hours. The samples were then poured into test tubes to measure how much oil was left over after the testing period. The results support the hypothesis which was that the freshwater group would degrade the oil more than the saltwater group. Using an ANOVA and post-hoc tukey statistical tests, the results were significant. This research adds to to the growing field involving bioremediation.

DO PEOPLE'S MICROBIAL SIGNATURES AFFECT THEIR ENVIRONMENT?

Morgan Lowman and Kamryn Shealy  
Center for Advanced Technical Studies

Many experiments have studied the impact that humans have on the indoor environment, leaving many researchers to speculate that an air signature can be traced to a particular individual. One study done at the University of Oregon verified this by sampling the air signature surrounding eleven individuals. They found that each environment was unique, proving an individual can release their own microbial cloud (Meadow, 2015). These studies have concluded that human occupancy is a cause of elevated bacterial concentrations in the indoor environment (Hospodsky, 2012), but none have focused on what factors, such as gender and age, may affect this change. This project's purpose is to determine what factors specifically affect their microbial signature present in the room. This is done by having rooms with either one gender or one age group, and testing the air signature with petri dishes, environmental swabs, and a TSI particle sizer. After the samples were collected, they were

cultured in petri dishes to extract the DNA for identifying the organisms present. This provides evidence for correlation of gender or age and the resultant microbial community.

#### SIFTING GERMLASM TO IDENTIFY HYPOALLERGENIC PEANUT GENOTYPES: GAINING AMMUNITIONS FOR FUTURE BREEDING

Brianna Ludlum  
Governor's School for Science and Mathematics

A prevalent and increasing issue in the world is peanut allergies. Allergic reactions can range anywhere from minor to deadly. They actually send someone to the emergency room every three minutes (FARE, 2017). The amount of allergic reactions to peanuts is on the rise in America, and many researchers are trying to reduce this number. There are many experiments underway to find better ways to treat allergies and to identify the cause of these allergic reactions, primarily in regards to how a person's immune system responds to these allergies. However, the purpose of our research is to identify unique molecular genotypes within the peanuts in order to identify whether molecular differences can ultimately lead to identifying what triggers allergic reactions. We performed SDS-PAGE gels on 109 different peanut genotypes and examined their banding patterns. From these gels, we were able to identify a common banding pattern, and found 20 special genotypes that differed from those patterns. Differences could mean lighter bands, missing bands, or bands that were in different locations-higher or lower than usual. These 20 special genotypes will go to Clemson campus so they can be observed further. From them, we can find their amino acid sequence to find what causes those genotypes to be possibly allergenic. After that, we can alter those sequences and create new, hypoallergenic peanuts that are safer. Hopefully these modified peanuts will help decrease the amount of allergic reactions to peanuts in the United States and around the world.

#### SHORT TERM AFFECT OF SALT WATER FROM HURRICANE MATHEW STORM SURGE ON COASTAL LOBLOLLY PINE POPULATIONS

Jonathan Mackey and Brynn Wilkinson  
Governor's School for Science and Mathematics

Hurricanes have devastating effects on the coast of South Carolina every time one passes. Their high winds and storm surge completely destroy coastal forest ecosystems. The project that we worked on focused on the immediate affects of Hurricane Matthew on these coastal forests. More specifically we focused on the affects of the storm surge on coastal loblolly pine and wax myrtle forests at Hobcaw Barony, located near Georgetown, South Carolina. These forests were divided into 20 meter by 100 meter plots, in these plots every tree was assigned a number and marked with a tag. The first method we used to gather data was to measure the DBH of the trees in these plots and use these data to calculate the basal area and mortality of the plots. The second method we used was to measure the amount regeneration in these same plots. From the mortality data we gathered, we observed that large trees weren't as affected immediately by Hurricane Matthew. From the regeneration data we observed that loblolly pines regenerated at slower rates in plots that were covered by the storm surge and that wax myrtles faired only a little better. From this we learn that loblolly pines are at a competitive disadvantage after storm surges, as they are not able to regenerate quickly. This project has helped us to learn more about patterns forests have after hurricanes strike.

#### INTERACTION AND OVER-EXPRESSION OF THE PROTEIN KINASE NEK2 IN RELATION TO CENTROSOME APPENDAGES IN LEUKEMIA CELLS

Eesha Maisuria  
Governor's School for Science and Mathematics

The second highest cause of death is cancer, a disease caused by uncontrolled division of abnormal cells. Centrosomes, organelles that facilitate cell division, have a possible role in cancer. One of the unique traits of centrosomes are the presence of distal appendages, which are noticeably lesser in leukemia cells. NIMA-Related Kinase 2 (Nek2), an early acting protein kinase, has been found to be associated with the disappearance of these distal appendages. The aims of this research are (a) to conduct Western Blot analysis to determine expression of Nek2 in various leukemia cell lines; (b) to conduct an Immunofluorescence Assay to identify and compare levels of centrosome appendages in these cells; and (c) to conduct a Yeast Two Hybrid system to determine Nek2 interaction with other proteins in the centrosome cascade. The results indicate that U937 and K562 cell lines had the greatest overexpression of Nek2, while KG1a cell line had one of the lowest expression, but still higher than normal cells. The results also showed that K562 and KG1a had no significant differences in the number of centrosome appendages, while U937 and KG1a had a significant difference in the number of centrosome appendages. Finally, the results for Yeast Two Hybrid system indicated that Nek2 did interact with the truncated version of certain kinase proteins in the centrosome pathway.

#### INDICATION FOR BONE REMODELING IN THE LATERAL ASPECT OF YOUNG WHITE-TAILED DEER DISTAL FEMORA

Shirley Mathur  
Governor's School for Science and Mathematics

In this project, we examined the innate stiffness of bone material in the distal lateral femora of young white-tailed deer. We researched this property of bone in order to develop a better understanding of how bone function differs in different regions of the femur. We experimented on this property of bone material by taking small cubic samples of bone and loading them in

compression to test their stiffness in all three orientations – axial, transversal, and radial. After testing the stiffness of over thirty cubes, we analyzed our results and compared them to those of previously conducted similar research in the medial region of deer femora to see whether or not bone function differs amongst these two regions. We found that the function does appear to differ, as the results of our study were different than those of the previous research conducted in the medial region of young white-tailed deer femora.

THE EFFECT OF *SOLANUM LYCOPERSICUM*, *ALLIUM SATIVUM*, AND *MENTHA PIPERITA* AS DETERRENTS ON  
*DROSOPHILA MELANOGASTER*

Jane McCallum  
Spring Valley High School

Around the world, mosquitoes cause millions of deaths every year. In order to deter these pesky insects, scientists have found and created several chemicals that are commonly used in commercially available insect repellents. These chemicals are, unfortunately, often corrosive and harmful to the environment. Also, some of the countries that are plagued by mosquito borne illnesses do not have access to these commercially available insect repellents. The purpose of this project was to find a natural resource that could be used as an insect repellent. Three potential natural insect repellents were chosen: *Solanum lycopersicum* (common tomato), *Allium sativum* (common garlic), and *Mentha piperita* (common peppermint). It was hypothesized that Allium sativum would repel the highest percentage of *Drosophila melanogaster* from an attractant. *Drosophila melanogaster* were placed in a test chamber with two attached, alternative feeding chambers and had to choose between feeding chambers containing an attractant or the attractant in combination with the potential repellent. A 2 sample z test, with a critical value of -1.65, was used to analyze the results. None of the potential repellents were able to support the claim that fewer *Drosophila* would choose the chamber containing the potential repellent because in all cases, the p value was higher than the alpha value of 0.05, but garlic had the lowest z score of -0.36. *Allium sativum* was the closest to working as a repellent, but there was not enough evidence to support the claim that it repelled *Drosophila*.

THE EFFECT OF NICOTINE ON *DROSOPHILA MELANOGASTER* LIFESPAN AND NUMBER OF OFFSPRING

Claire McDonald  
Heathwood Hall Episcopal School

The purpose of this experiment is to determine the effect of nicotine on *Drosophila melanogaster* lifespan and number of offspring. It was hypothesized that if the amount of nicotine solution is increased, then *Drosophila* will have a shorter lifespan and fewer offspring. Four different concentrations of nicotine were mixed by filling jars with 10 mL of water and using a micropipette to measure each amount of nicotine, using 3 uL, 6 uL, 9 uL, and 12 uL as the amounts. Each vial of food was made by mixing 10 mL of food with 8 mL of the nicotine solution. Five test tubes were assembled, each with a different concentration of nicotine, and four male *Drosophila* and four female *Drosophila* were placed in each vial. The number of living *Drosophila* was recorded every day for 25 days. The data reveals that the flies that were not exposed to the nicotine food had much longer lifespans and they produced offspring. The 3 uL group had one fly at the end, but the rest died by day 18. The 6 uL group died after the 19th day. The 9 uL group had two flies left, but the rest of the group died at day 21. The 12 uL group died at day 7. The control group started to reproduce on day 15. These results support the hypothesis that the *Drosophila* exposed to nicotine would have shorter lifespan and fewer offspring than the control group.

THE EFFECT OF ORGANIC MATTER ON THE AGGREGATION RATES AND KINETICS OF SILVER NANOPARTICLES

Anne McElvenny  
Governor's School for Science and Mathematics

Due to the rise in use and many questions raised regarding Silver Nanoparticles (AgNPs), we tested the behavior of the AgNPs against different water properties and the effects of ion concentration of Sodium Nitrate (NaNO<sub>3</sub>). The water properties included the presence of Natural Organic Matter (NOM) from Pacific Ocean and Everglades samples. We used Dynamic Light Scattering (DLS) to measure the hydrodynamic diameter, which correlates to the aggregation rates and kinetics of the AgNPs. The diameter increases because particles aggregate, increasing the overall size. We graphed these results against the different ion concentrations. We concluded that as the concentration of Sodium Nitrate increase, the aggregation rates of AgNPs also increase. This could be attributed to the surface charge screening in presence of counter ions. We also determined that the different NOMs did not show significant influence on the aggregation rates of AgNPs. Future works will continue to test how nanoparticles react in various environments with different physiochemical properties.

THE EFFECT OF NEODYMIUM MAGNETS ON THE AMOUNT OF SALT FILTERED OUT OF A SEAWATER REVERSE  
OSMOSIS SYSTEM

Jackson McFadden  
Spring Valley High School

The purpose of this experiment was to test if the addition of neodymium magnets made a significant difference on the efficiency of a reverse osmosis machine in filtering salt out of imitation seawater (salt water with a concentration of 35 ppt). "It was hypothesized that if more magnets are added to the solution, less salt would be able to pass through the system, thus the overall system readings would be lower." It was also hypothesized that the average salinity would decrease by at least 5 ppt. 1 liter of



imitation seawater solution was put into the pressure tank on the water side. The pressure was preset to 30 psi and then the “seawater” was run through the system. After being forced through the system, the salinity of the water was then recorded using an optical refractometer that measured the grams of salt in one liter of water, also referred to as “parts per thousand”, but will be referred to as ppt throughout this paper. Levels of the independent variable measured the results of a 0-Magnet group, a 14-Magnet group, and a 28-Magnet group. An ANOVA test revealed that there was no statistical difference between the means,  $F(2,87) = 1.75$ ,  $p > 0.05$ . It can be concluded that the neodymium magnets did not adversely or beneficially affect the machine’s efficiency at filtering salt out of the water, thus rejecting the hypothesis. These findings were not statistically significant, but with a few alterations to the procedures and to the materials, there is a possibility that a correlation between the two variables could be found.

#### EFFECTS OF CONNECTEDNESS ON VISUAL ENUMERATION

Felicia McGill

Governor's School for Science and Mathematics

Visual enumeration refers to the process by which individuals determine quantity without sequentially counting. When people enumerate small quantities, for example less than 5 items, it is referred to as subitizing (G.S. Starkey, B.D. McCandliss). As quantities increase, so does difficulty in enumerating correctly and accurately. Therefore, many people use a method called groupitizing by which they group larger quantities together in order to enumerate them. This experiment aimed to look at how grouping by connectedness (Palmer, S. and Rock) affects visual enumeration. In everyday life, experiments like these can assess mathematical skills, and early signs of numerical cognition impairments. The total experiment consisted of 420 trials of dot stimuli that were flashed to 11 participants for 0.15 seconds. There were 4 different types of arrangements for the dots, with 105 trials per condition. The respondents were told that the answer choices ranged from 2-50, but in fact only prime numbers were possible answers. In 2 out of the 4 conditions, most subjects could accurately enumerate up to 5 dots 100% of the time. These successful conditions were those which connected the dots with lines, as opposed to the other two conditions which did not. Among the unconnected conditions, success rates were never higher than 60%. These findings provide further evidence for Gestalt’s principle of uniform connectedness, which explains that connected items can be more easily enumerated than unconnected ones.

#### THE EFFECT OF ZINC ON BRASSICA JUNCEA'S ABSORPTION ABILITIES

Rahithya Meda

Spring Valley High School

In many developing countries, sufficient and inexpensive resources needed to provide their citizens with safe and healthy food are not available. Because of various issues such as money, many areas are searching for cheap and accessible methods to prevent contaminants from entering through the ground and toxicating their food. One way to eliminate this is through a process called phytoremediation. Phytoremediation is when plants are used to eradicate harmful metal contaminants from the soil. They are able to do this by absorbing the metals into their roots. In this experiment, Brassica juncea seeds were planted into the soil with varying amounts of zinc to see how much zinc the plants could remove. The purpose was to see which group of plants could not only consume the most zinc, but grow the longest roots, which would much aid in the phytoremediation process. It was hypothesized that if Brassica juncea is grown in an environment with 2.6 ppm of zinc present, then it will result in the most absorption of the metal and inhibit the greatest root growth. In this experiment, 3 groups of plants were grown having a zinc concentration of 0.8 ppm, 2.6 ppm, and 3.7 ppm. After a period of 6 weeks, 5 plants chosen at random from each group were measured for their absorbance. This was done by viewing pieces of the plant’s root combined with a Zincon reagent under the microscope. The reagent allowed for the color of the root tissue to change to a shade of blue depending on the amount of zinc present. The darker the blue, resulted in more zinc being present. Each shade was then matched with its closest color on a color scale ranging from 0.0m ppm to 4.0 ppm. A one-way ANOVA was conducted and then a post-hoc tukey test. The results showed that at  $\alpha = 0.05$ ,  $F(2, 12) = 12.67$ ,  $p < 0.001$ . Because the p-value was less than the alpha value, it was concluded that the null hypothesis was rejected. The tukey test then confirmed that there was a difference in mean concentrations between groups 0.8 ppm and 3.7ppm, and groups 2.6 ppm and 3.7 ppm. It was concluded that the plant Brassica juncea was very efficient in the phytoremediation process. As the zinc concentrations increased, the zinc absorption amount increased as well. Overall, the plant group containing 2.6 ppm of zinc concentration inhibited the great root growth and was able to absorb much zinc.

#### A SEMI-AUTOMATED METHOD OF GENERATING GROUND TRUTH FOR INVOICES

Vivian Medina

Governor's School for Science and Mathematics

This project came about to solve a problem in a bigger project, one in which an insurance company contracted the German Research Center for Artificial Intelligence (DFKI) to autonomize the making of medical invoices. DFKI was given access to the database necessary to recreate a set of 60 previously made invoices along with a scanned image set of those original invoices—information to create an output and information to verify the output. The project came about in the process of verifying the output; to check the values from the code, researchers would have to spend valuable time looking at all of the original invoices, all of which vary in format and content, finding which information was needed, and typing out those values into a document where they could be directly used to assess the accuracy of the code. Therefore, the need to make this ground truth extracting process semi-autonomous became vital to the progress of the bigger project. The result of the research came about in a code that

successfully does half of the human's part in collecting ground truth and extracts the wanted data from the set of images into a document with fair accuracy.

#### THE EFFECT OF SOUND FREQUENCIES ON THE GROWTH RATE OF THE PHYSARUM POLYCEPHALUM

Lauren Mehta  
Spring Valley High School

A large part of the environment is made up of soundwaves. Infrasound, audible sound, and ultrasound are the three most commonly found in nature. Even though these soundwaves are a key part of the environment, they have been neglected in research when it comes to their relationship with organisms. This study found the correlation between soundwaves and single-celled organisms. It was hypothesized that when two specific soundwave frequencies were played regularly during the Physarum polycephalum's life cycle, the higher of the two frequencies would have a higher growth rate. Thirty of these protists were tested, one set of ten with a high frequency, one set of ten with a low frequency, and one set of ten with no frequency. A one-way ANOVA was run, and the conclusions of this test showed that the high frequency's growth rate was faster. However, the overall objective of this study was to find if the frequencies grew faster compared to the regular growth pattern of the Physarum Polycephalum. The raw data and ANOVA results showed that the frequencies do grow at a faster rate.

#### THE EFFECT OF SILICA-CONTAINING TOOTHPASTE ON DENTAL STAINS

Olivia Merritt  
Heathwood Hall Episcopal School

The purpose of this study is to determine the effect of silica-containing toothpaste on dental stains on eggshells. There were three different dental stains tested during this experiment: Coke, coffee, and red wine, as well as three different toothpastes: Arm and Hammer Complete Care plus whitening, Colgate Total Whitening, and Crest Pro-Health. The hypothesis states "if Colgate Total Whitening, Arm and Hammer Complete Care plus whitening, and Crest Pro-Health toothpastes are used on common dental stains applied to egg shells, then the eggshell will become the most white on the stains from the Crest Pro-Health toothpaste, and therefore have a positive change." In each trial there were the three stains with one of the previously mentioned toothpastes. Each egg was soaked in the stain overnight, and then let dry for 24 hours. Each egg was then brushed ten times clockwise and ten times counterclockwise with a pea-sized amount of toothpaste. After completing 30 trials, an ANOVA test and descriptive statistical analysis was taken for that data. Both inferential and descriptive statistical tests suggested that the Colgate Total Whitening toothpaste was most effective at removing the stains from the eggshells; however, the Crest Pro-Health toothpaste had more consistent results overall. In conclusion, the Colgate Total Whitening toothpaste had the most positive effect, therefore having the highest average removal for each stain.

#### PREVENTION OF CHRONIC MEMORY LOSS IN ALZHEIMER'S PATIENTS THROUGH DIET CHANGE

Shane Mikolajczak  
Center for Advanced Technical Studies

**No abstract submitted**

#### THE EFFECT OF VIRTUAL REALITY EDUCATION TOOLS ON THE RETENTION OF INFORMATION

Andrew Miller  
Spring Valley High School

This paper examines the prospects of virtual reality (VR) in aiding and/or replacing traditional education methods. The purpose of this experiment was to test the viability of virtual reality in education and also see alternative uses for virtual reality. Two groups utilized the two different methods to learn about a subject and were assessed on how well the information was retained. They were assessed using a nine-question quiz that included questions about the subject and opinion-based questions on the medium used. It was believed that the group using the virtual reality application would produce better results on the post-assessment than the traditional group. Based on the results, the group that utilized the traditional method of learning produced a better mean score on the post-assessment than the virtual reality group. However, based on the independent t-test conducted, there was no significant difference between the scores of the two groups,  $t(22) = 1.36$ ,  $p > 0.05$ . From this, it can be assumed that either method could be used interchangeably. Most of the participants, on the other hand, believed that virtual reality applications should only be used as supplemental material rather than standalone material.

#### THE EFFECT OF ALUMINUM ON THE MECHANOSENSORY BEHAVIOR OF C. ELEGANS

Shubhanjali Minhas  
Spring Valley High School

Parkinson's disease (PD) is a major neurological disease that involves the degradation of dopamine neuron networks within the brain and the accumulation of the alpha-synuclein protein. Although these phenomena are typical of PD patients, it is unknown how they develop. Previous research has led to the hypothesis that environmental factors such as pesticides and heavy metals lead to the onset of PD-like symptoms (Zhou, Wang, and Klaunig, 2013). Thus, aluminum, a metal found in many pieces of

cookware and utensils, was analyzed in its soluble form, aluminum nitrate nonahydrate  $[Al(NO_3)_3 \cdot 9H_2O]$ , in order to observe its relation to the onset of mechanosensory impairment in *C. elegans*. It was hypothesized that exposure to aluminum nitrate would cause the impairment of basal slowing response, measured in body bends per 20 seconds, and a decrease in response to touch stimulus. It was also hypothesized that conditions of *C. elegans* would worsen over time. Worms were exposed to 0 M,  $1.43 \cdot 10^{-11}$  M, or  $1.59 \cdot 10^{-10}$  M of aluminum. A positive control of nitric acid was also used. Significant differences were found between the positive control and the 1st and 2nd experimental groups over time ( $1.43 \cdot 10^{-11}$  M,  $p = 0.004$ ,  $1.59 \cdot 10^{-10}$  M,  $p = 0.038$ ), while time had no significant effect on number of body bends within the negative control, the 1st experimental group, and the 2nd experimental group. An ANOVA and Tukey test ( $\alpha = 0.05$ ) pooling data at all timepoints showed that significant differences existed for body bends between 1st experimental group and negative control group worms ( $p = 0.047$ ). Touch stimulus data analysis indicated that significant differences occurred between the positive control group and the 1st and 2nd experimental groups as well as between the negative control group and the 1st and 2nd experimental groups ( $p < 0.001$ ). These results show that aluminum had a negative effect on *C. elegans* mechanosensory behavior, as it caused worms to move faster in a bacterial lawn and also demonstrated the lack of response to external stimuli.

#### THE DIFFERENCE IN FLIGHT MANEUVERABILITY BETWEEN A RACING DRONE AND A DJI PHANTOM 4

Clay Mitchell

Heathwood Hall Episcopal School

The purpose of this experiment was to explore the behavior of two different drones, a DJI Phantom 4 and a scratch-built racing drone, performing the same maneuvers. The hypothesis ( $H_0$ ) in this experiment is that there are no flight differences between a DJI Phantom 4 and a racing drone. The hypothesis ( $H_1$ ) in this experiment is that there are flight differences between a DJI Phantom 4 and a racing drone. The statistical analysis used in this experiment was a two sample t-test assuming equal variances. Since some values were negative, the absolute values of the negative numbers were used for the t-tests in this study. The t-scores favor neither drone overall as there are four negative and four positive t-scores; therefore, the conclusion suggests that there are no differences in flight maneuvers between a racing drone and a DJI Phantom 4.

#### SIMULATED DRIVING WITH DISTRACTIONS

Elizabeth Morris

Heathwood Hall Episcopal School

The purpose of this study is to compare driving under the influence of alcohol to driving under the influence of texting to determine while results in more errors. The stated hypothesis for this study is that: the number of mistakes a teen driver makes will be higher when the teen drives under the influence of alcohol, then when they drive under the influence of texting. To begin each of the twenty students took a fifteen point survey then began testing. Each subject was given a two minute practice run, to get to know the simulator, then they were tested on the same track three different times with a different distraction each trial. The first trial was with no distractions, the second was while texting responses to five different questions and the third trial was while wearing beer goggles that simulated having a blood alcohol concentration (BAC) of .10 to .17. A total of 477 mistakes were made throughout the entire 20 subjects. Once averaged together out of 100 the average percent for the baseline was 50.16%, for texting it was 23.61% and for drunk driving it was 11.63%. From these results the hypothesis that driving under the influence of alcohol would cause more distractions than driving while texting is proved correct.

#### THE EFFECT OF REWARD AND PUNISHMENT ON THE ACCURACY OF TEST TAKING

Kit Mullins

Heathwood Hall Episcopal School

The purpose of this research project is to determine the effect of reward or punishment on test taking. Both female and male seventh graders were tested, making up three separate groups: reward, punishment, and control. The reward group was told if they made a 90% or higher on the test then they would get to pick out of the prize box, while the punishment group picked out of the prize box first and was told if they didn't make a 90% or higher on the test then they would have to give the prize back. The control group just took the test, and was used to compare as a base line. The test the seventh graders took contained of sixth grade level english grammar. The hypothesis was that there will be a difference in English test score between the control group and the reward and punishment group. It is also hypothesized that the reward group will score higher on the English test than the punishment group. The null hypothesis was that there will be no relation between the grade of the test taker with a reward and a test taker with a punishment compared to the control group. Surprisingly, the hypothesis was not supported, and the reward and punishment groups were close in average grades, while the control group was below that.

#### THE COBRA EFFECT OF U.S. FOREIGN INTERVENTION IN THE MIDDLE EAST AND AFRICA

Michael Mulvaney

Governor's School for Science and Mathematics

American foreign aid and intervention has been a central point of debate for as long as the nation has existed. United States mediation has many goals, chief among these being the promotion of peace, security, economic development, and humanitarian advancements. Despite these goals and the trillions of dollars spent to achieve them, life around the world, especially in areas of great turmoil, has not clearly improved. In many cases, it has gotten worse since an intervention by the United States. This

study traces the effects of intervention events as they spread from their origin into other countries around the world. Most emphasis was put on The CIA's Operation Cyclone in the 1970s and 1980s, new and existing alliances with the United States, and the War in Iraq and Afghanistan in the 2000s. Time was also spent looking at various smaller intervention and aid events, such as CIA assisted coups, arm sales, and aid distributions in Afghanistan, Iraq, Syria, Yemen, Somalia, Nigeria, and Iran. We used various governance, development, and humanitarian indicators as well as more tangible data such as death tolls and monetary expenditure to trace the outcomes of these events for the years between 1979-2016. In many cases, the results were contradictory to what was expected by the Government of the United States. The perverse incentives (and armament) they gave to the peoples of the regions came back to cost them.

#### MEASURING THE RATE OF LIGAND EXCHANGE REACTIONS: ELUCIDATION OF COPPER AND NICKEL TOXICITY IN AQUATIC ENVIRONMENTS

Collin Myers and Savannah Finely  
Governor's School for Science and Mathematics

In this research, the behavior of copper and nickel was studied when exposed to different ligands at various concentrations. Traces of copper and nickel can be found in local water sources, but little is known about just how safe these metals are to the environment, especially nickel. To test how these metals would complex, ligands such as nitrilotriacetic acid (NTA) were tested when mixed with the metal solutions, and spectrofluorimetry was used to analyze the complexing nature. Calcein was used to initiate the reaction, much like the way these metals would complex in a natural environment. The data generated shows how kinetically stable the substance is based on the amount of free calcein remaining over time. The results will help to better understand toxicity in a water source based on its ability to react. This can further help protect from pollution since the behaviors of metals in water can be observed.

#### THE EFFECT OF VARIOUS LIGHT BULB AND ACCOMPANYING VISIBLE LIGHT FREQUENCIES ON *POGONOMYRMEX OCCIDENTALIS* ACTIVITY

Connor Myrick  
Spring Valley High School

Numerous ecological systems are built upon the foundation laid by keystone species, such as ants, whose relationships are typically mutualistic. Different light bulbs emit various wavelengths of light with different energy outputs. Often animal and insect behaviors are dictated by circadian rhythms, internal clocks that regulate the internal processes of organisms, and zeitgebers, which are environmental cues (such as light and temperature) that alert and help modulate circadian rhythm. This experiment was conducted with the purpose of viewing how lights, affect the nest building activity of the insect, *P. occidentalis*. It was hypothesized that LED lights would have the least negative effect on ant activity. For this experiment, a series of ant farms were placed beneath a light bulb for seventy-two hours and the length of the tunnel was measured every eight hours. This procedure was repeated four times, with a different variable including, LED bulbs, fluorescent bulbs, and halogen bulbs and no-light. To analyze the data, an ANOVA and post hoc test were performed at  $\alpha=0.1$ , which revealed that there was enough evidence to support the claim,  $F(1,36)=1.82$ ,  $p=0.161$ . In fact the LED bulbs had a positive effect on the ants, since ant activity was greater in LED lights than in darkness. To conclude, the hypothesis was partially supported because the statistical analysis revealed that half of the data had differences between the means and this difference became more prominent as time passed.

#### THE SYNERGISTIC EFFECT OF EPIGALLOCATECHIN-3-GALLATE (EGCG) AND ARTEMISININ ON THE PLASMODIUM MORTALITY RATES OF *PHYSARUM POLYCEPHALUM* AND CELL MOTILITY/CHEMOTAXIS OF *DICTYOSTELIUM DISCOIDEUM* UTILIZED AS AN AMOEBIC HOST

Abhijith Nair  
Spring Valley High School

*Plasmodium falciparum* is an organism that causes the deadliest type of malaria. Its methods of adhesion and drug resistance make it lethal and difficult to treat. Artemisinin is a drug currently used as treatment, but resistance is increasing exponentially. A secondary drug to be used synergistically with artemisinin has been sought after. *Physarum polycephalum* is in the Plasmodium class and is biologically similar. This study focused on an accepted method of synergy-based prophylaxis, while maintaining neurological capabilities of *Dictyostelium discoideum*. EGCG (Epigallocatechin-3-gallate) is a cost-efficient, longer-lasting, and natural drug that has provided exceptional synergic results. The combination would offer treatment, while allowing the patient to recover with minimal neurological damage. The preliminary test was run using a well-plate synergy-test. Using 6 concentrations for each drug and combinations, the MIC (Minimum Inhibitory Concentration) was calculated. A fungal culture was created, and 10 random grids were chosen to count the active veins before and after this MIC was introduced. Two petri dishes were marked using a semi-marcation line, and *D. discoideum* was cultured to test for chemotaxis. Approximately 24 hours after introducing the MIC, the amoeba spores were quantified and coded into two groups. The hypothesis was supported for the fungal test with  $t(9)=10.18$ ,  $p=0.000001$ . The hypothesis was supported for the amoeba test with  $t(9)=0$ ,  $p=0.5$ . Therefore, results are statistically significant, displaying effectivity within the synergic combination. The FIC (Fractional Inhibitory Concentration) at  $2.18 > 1$  showed remarkable synergy between artemisinin and EGCG.

THE EFFECT OF DIFFERENT COLORED *ROSOIDEAE ROSA* PETAL ANTHOCYANIN PIGMENTS ON THE AMOUNT OF ELECTRICITY GENERATED FROM A PHOTOVOLTAIC CELL

Anika Nair  
Spring Valley High School

Researchers are looking for new ways to generate solar energy in a cheaper, safer, and faster method. Anthocyanin pigment photovoltaic cells have been used in solar cells due to their ability to convert light energy into electrical energy. Fruit dyes have been incorporated into photovoltaic cells due to the anthocyanin pigments they contain, but roses, which also contain anthocyanin, have not yet been tested. The purpose of this analysis was to test if anthocyanin pigments from a *Rosoideae rosa* petal could generate more electricity than a photovoltaic cell made from copper. It was hypothesized that the darker the anthocyanin pigment, the higher the voltage of the cell. This was assumed as darker anthocyanin pigments were proven to have higher concentrations of anthocyanins and have high pH values, which can conduct electricity. Experimentation was accomplished by using rose colors of purple, red, pink, and yellow and using copper as the basis of comparison. The cells containing anthocyanin pigments were created along with a titanium dioxide paste and were put under direct light. The copper cells were made by adding a sodium bicarbonate solution to the copper sheets. A one-way ANOVA test was run to test a difference in the means, and was proven to have a difference at  $\alpha = 0.05$  when  $p = 0.0001$ . The hypothesis was mostly proven, resulting in the darkest color, purple, having the highest amount of electricity generated, but followed by the copper having the second highest electricity amount, instead of the next darkest color, red.

THE EFFECTS OF CLINOTPITOLITES VS. CONTROL-RELEASE FERTILIZER ON NITRATE LEACHED FROM SILT LOAM SOIL

Keshav Nair  
Spring Valley High School

Agricultural leaching is where nutrients, minerals, and chemicals from the soil contaminate the groundwater after rainfall and irrigation. A method used to prevent leaching is the use of nitrate inhibitors but recently other minerals have been used. The purpose of this experiment was to find a more abundant and efficient method of reducing nitrate leaching in soil. The effectiveness of clinotpitolite minerals versus control-release fertilizer were observed in this experiment. It was hypothesized that control-release fertilizer will more effectively reduce the amount of nitrate leached from silt loam soil than clinotpitolites. A one-way ANOVA showed that the differences between the control ( $n = 30$ ,  $M = 9.667$ ,  $SD = 0.232$ ), the clinotpitolite soil mixtures ( $n = 30$ ,  $M = 4.300$ ,  $SD = 0.474$ ), and the control-release fertilizer soil mixtures ( $n = 30$ ,  $M = 5.247$ ,  $SD = 0.580$ ) were not statistically significant,  $F(5,174) = 67.45$ ,  $p < 0.001 < \alpha = 0.05$ . A post hoc Tukey test was performed on the data at  $\alpha = 0.05$  for the nitrate concentrations of different soil/mineral mixtures to determine where the mean differences lie. The results showed there was no significant difference between the before and after of the control, but there was a significant difference between the after for the control and the after of the clinotpitolie and control-release fertilizer soil mixtures. There was also a significant difference between the before and after of the clinotpitolite soil mixtures, the before and after data of the control-release fertilizer soil mixtures, but no difference of the after data of the clinotpitolie and control-release fertilizer soil mixtures. These results showed the difference in the effectiveness of the clinotpitolie soil mixtures versus the control-release fertilizer soil mixtures in reducing nitrate leaching was not statistically significant.

THE EFFECT OF TOPSPIN SERVES, FLOAT SERVES, AND JUMP SERVES ON THE TYPE OF PASS MADE BY HIGHSCHOOL VOLLEYBALL PLAYERS

Rachael Nall  
Spring Valley High School

There are three main types of serves in volleyball: float serves, jump serves, and topspin serves. These three types of serves can be returned with an underhand pass or an overhand pass. The purpose of this study was to determine if there was a difference between the type of serve performed and the resulting type of pass. It was hypothesized that all three of the volleyball serves would be mainly returned by underhand passes, but the float serve would have the most number of overhand passes. Also, it was hypothesized that the jump serve and topspin serve would be mainly returned by underhand passes. The data in this study was obtained from tryouts of sixteen year old volleyball players at the Plex Indoor Sports in Sandhills where 51 serves were observed. The sample size of the jump serves was too small so it was taken out of the analysis. This could have been due to the fact that the results were only gathered from sixteen year old volleyball players rather than a higher age range which would have potentially utilized more jump serves to produce the maximum power. The passes of the float serve and topspin serve were extremely similar. This was probably why no significant difference ( $t(40.7) = 0.68$ ,  $p = 0.5$ ) was detected in the passes returned in the two sample t-test at alpha value 0.05.

EVALUATION OF HANDS-ON AND VIDEO RESOURCES FOR TEACHING ECONOMICS AND FINANCIAL LITERACY

Mehrwan Namiranian  
Governor's School for Science and Mathematics

This paper examines research done on Economics and Financial Literacy teachers in order to discover the most effective type of resource. Teachers were asked to rate several online resources and to answer questions about their general opinions on hands-on resources and video resources used in economics and financial literacy. The means of evaluating these resources involved online surveys sent through e-mail. Although it was found that the effectiveness of each type of resource was fairly the same,

teachers preferred hands-on resources. Additionally, they claimed their students preferred hands-on resources. Teachers either taught grades 4 through 5 or high school. The goal of this research was to determine what type of research-hands-on or video is more effective at teaching economics and financial literacy in the classroom. The results showed that hands-on resources were more effective based on the opinions of teachers since the rubric evaluations had similar mean scores. Surprisingly, the majority of teachers believed that video resources were easier to implement.

#### EVALUATING WOMEN'S AWARENESS OF HEART ATTACK SYMPTOMS

Haley Nazario

Center for Advanced Technical Studies

Cardiovascular disease holds a societal stigma of being a man's disease; however, this mentality is detrimental to another demographic who is undereducated in the area of heart attacks: women (Albarran, J.W, etc, 2006). This is because women experience a more atypical presentation of symptoms than men. This study's objective is to determine women's ability to correctly identify the heart attack symptoms specific to their gender. If women were asked to name female symptoms of a heart attack, then they would only cite the male related warning signs. To achieve this, a survey will be supplemented to men and women. Its content will cover heart attack differences between genders. Then a video will be viewed, describing symptom differences and other areas previously tested on. Lastly, a post test will be administered, and the results will portray women's understanding of heart attack symptoms. Paired T testing will be used to analyze the mean difference between the pre and post evaluations. A successful procedure would be the hypothesis being supported through a discrepancy between the two mean scores indicating a lack of awareness within females. However, the goal of the campaign portion of the project would be successful when recognition of symptoms are increased within the female demographic. The implications of this project would be to stimulate concerted efforts to increase female awareness of heart attack symptoms. Future work would focus on shifting risk profiles of a heart attack patient as well as conducting more studies on women with cardiovascular diseases.

#### THE EFFECT OF CAFFEINE ON THE FORAGING BEHAVIOR AND REPRODUCTION OF DROSOPHILA

MELANOGASTER

Jordan Nealey

Spring Valley High School

The purpose of this experiment was to determine the effects of caffeine on the foraging behavior and reproduction of *Drosophila melanogaster*. It was hypothesized that if higher doses of caffeine were given, then the *Drosophila* would choose the lesser ideal option for their nutritional needs and the least amount of fertility would occur within that generation than *Drosophila* exposed to no caffeine. In testing the F1 generation for foraging behavior, the flies ingested varying doses (.001 g, .002 g, .005 g, .014 g, and .024 g of caffeine) and were given 15 minutes to forage for nutritionally substantial (banana) and nutritionally unsubstantial (sugar) food. In order to forage, two jars were placed into cut corners of a bag. The flies were transferred into the bag from the top of the Ziploc and foraged for either the banana or sugar. In testing the F2 generation, the mass of *Drosophila* population was calculated for the *Drosophila* whose F1 generations went to banana and to sugar. An ANOVA test [ $F(5,1148) = 5.21$ ,  $p < .001$ ] on the effect of caffeine concentrations on the foraging behavior of *Drosophila* was significant. Both hypotheses for the reproduction of the F2 generation were supported. The mass of the F2 banana culture [ $r = -0.8530$ ,  $r^2 = 0.727686$ ,  $p < 0.030807$ ] was significantly correlated with caffeine concentration while the mass of the F2 sugar culture [ $r = 0.7949$ ,  $r^2 = 0.631944$ ,  $p < 0.058758$ ] was not. These results imply a high overall effect of caffeine on *Drosophila*.

#### THE EFFECT OF DEVELOPMENTAL NUTRITION ON ETHANOL ADDICTION IN *DROSOPHILA MELANOGASTER*

Dawn Nguyen

Spring Valley High School

Alcohol addiction and other substance abuse disorders have led to unhealthy life choices and mortality around the world. Thus, research has been conducted to study the correlation between epigenome and environmental factors in order to raise awareness and help for others. The purpose of this experiment was to analyze whether developmental nutrition affected ethanol addiction. It was hypothesized that the *Drosophila melanogaster* raised in a poor nutritional environment would consume the most ethanol. In order to test this hypothesis, the experiment consisted of raising the fruit flies in the developmental environments. Once the organisms became adults, a 0.1% ethanol and 5% sucrose mixture was introduced using a capillary feeding (CAFE) assay. This was used in order to study the ethanol consumption between each developmental treatment over two weeks. An average consumption rate of microliters per day was recorded. An ANOVA test [ $F(2,10) = 6.85$ ,  $p = 0.013$ ] showed that nutritional treatments impacted ethanol addiction. The Scheffé test found that the Fs of the rich treatment compared to the poor and control treatments to be greater than the critical value, 8.2. Overall, the cultures raised in rich developmental nutrition had the highest ethanol consumption.

## CAN BOTH SYNTHETIC AND NATURAL DYEING METHODS BE COMBINED TO CREATE A NEW DYEING METHOD

Nam Nguyen  
Spring Valley High School

The experiment was conducted in order to see if synthetic and natural dyes can be used together to make a dye mixture. It was hypothesized that both test groups will maintain an average of 4 by the end, with the mordant group having a higher average. Testing was done by dyeing cotton swatches with the dye mixtures (made with store-bought synthetic dye and homemade natural dye). The swatches then went through 5 fastness trials, their final status was recorded based on a scale of 1-5. The same swatches were used throughout the fastness trials, no new swatches were introduced. The mean of each fastness trial from each data sets were taken, and 6 independent t-tests were used to see significance between the two means. The p-values for the start, trial 1, trial 2, trial 3, trial 4, and trial 5 are .369, .438, 0, 0, .003, and .136 respectively. Using an alpha value of .05 with  $p < .05$ , trials 2, 3, and 4 showed significance while the p values at the start, trial 1, and trial 5 do not. The t-values for the start, trial 1, trial 2, trial 3, trial 4, and trial 5 are .91, .78, 7.42, 5.06, 3.29, and 1.53 respectively. Using a critical value of 1.311, trials 2 through 5 showed significance, while the start and trial 1 did not. This shows that there is no significance difference between the two datasets at the start and towards the end, which means that there could be no difference overall, should more fastness trials be conducted.

## THE EFFECT OF DIFFERENT CONCENTRATIONS OF CAFFEINE IN COFFEE ON THE GROWTH OF WISCONSIN FAST PLANTS

Hailey Nicks  
Heathwood Hall Episcopal School

The purpose of this experiment was to study the effects of various concentrations of caffeine, found in coffee, on the growth of Wisconsin Fast Plants. Three different volumes of coffee were compared in the study, being 10 oz, 6 oz, and 2 oz, and all of which were Community Coffee Ground Dark Roast. The effects of the three liquids were compared to those of the control group. The plants were set up to absorb a mixture of water and the three respective ounces of the liquid coffee (or simply just water in the case of the control group), and were left to grow for a total of 15 days. The hypothesis was that the greatest concentration of caffeine, contained in the 10 oz of coffee, will have the greatest effect, and will cause the greatest acceleration of plant growth. In addition, the null hypothesis was that the control group would cause the greatest acceleration of plant growth, since it contained no caffeine. The results of the experiment supported neither the hypothesis nor the null hypothesis, since the 6 ounce group showed the most mean plant growth by the end of the fifteen day experiment period. In conclusion, this experiment could prove to be beneficial for plant growth, and determining if different caffeine concentrations could possibly act as a sort of stimulant for botanical growth.

## THE EFFECT OF COPPER AND SORBIC ACID ON AMPICILLIN-RESISTANT BACTERIA

Johannamarie Nwanagu  
Heathwood Hall Episcopal School

This experiment was conducted to research the effects of transition metals and organic acids on antibacterial resistant *Escherichia coli* bacteria using copper sulfate, sorbic acid, and ampicillin resistant *E. coli* by mixing 12g of  $\text{CuSO}_4$  and 2.8g sorbic acid into 500mL of nutrient agar, and growing the ampicillin resistant *E. coli* on petri dishes with the  $\text{CuSO}_4$ +Sorbic acid and some with plain nutrient agar. The independent variable (IV) in this study was the  $\text{CuSO}_4$ +Sorbic acid used in some of the plates, and the dependent variable (DV) was the number of colonies that grew on each plate. The hypothesis was if ampicillin resistant *E. coli* is grown in a petri dish with copper sulfate and sorbic acid added into the agar, then the bacteria will not grow. The results indicate the plates with the  $\text{CuSO}_4$ +sorbic acid experienced almost one third of bacterial colony growth the plates without  $\text{CuSO}_4$ +sorbic acid, and had no visible colonies. These results seem to support the hypothesis, but the bacterial colony counter phone app called "Colony Counter" that over counted the number of colonies in the the  $\text{CuSO}_4$ +sorbic acid plates. The reason why the the bacterial colony counter counted nonexistent bacteria is because the sorbic acid mixed into the agar did not fully dissolve (either because of over saturation or poor mixing), and solidified with white speckles dispersed in the agar that colony counter mistook as colonies.

## ONE WORD SAYS IT ALL

Nainaa Oberoi  
Governor's School for Science and Mathematics

Emotions are considered to be a basic part of human nature; however, emotions can be quite difficult to understand. For this research project, the goal was to divide 76 emotion words into clusters containing words that were similar to each other. Emotions can have many different dimensions; Valence and Arousal are the dimensions considered in this paper. After many analyzations, 16 individual clusters were formed. The clusters were groups of similar words with one word that described the entire set.

## THE SYNTHESIS OF MONODISPERSE, PACLITAXEL-CONJUGATED, SILICA NANODOTS (5-25NM)

Jason Occilien

Governor's School for Science and Mathematics

Paclitaxel is an anti-cancer drug, often used in chemotherapy, to treat almost all types of solid tumor cancers. The cell population in a tumor tissue can be divided into two distinct groups, namely the differentiated cells that make up >95% of the cells and the stem-like cells or CSCs with <5%. Although CSCs constitute a relatively small fraction of cancer cells, they are highly resistant to therapy as they prevent the drug from entering the cell cytoplasm and replenish lost cells after therapy. Paclitaxel is most effective when given as an injection, but prolonged use can lead to drug resistance in the CSC cells. One way to increase the efficiency of Paclitaxel is to tag them with nanoparticles that have a small size (5-20nm) and can bypass the internal defense system. The aim of this research is to synthesize monodisperse, paclitaxel-conjugated nanodots. The particles were synthesized using a silica based powder, TEOS (Tetra Ethyl Ortho Silicate), mixed with ammonium buffer, (pH 9), followed by a DLS, dynamic light scattering machine to measure particle size. The particles were then attached to paclitaxel, and an NMR, or nuclear magnetic resonance spectroscopy, was used to confirm the conjugating of paclitaxel. The product will be tested on cancer cell lines. This research was successful in synthesizing nanoparticles of size 5-25nm, and the paclitaxel was also successfully tagged. But, due to time constraints, they were not tested on cell lines.

## REFINING THE PHOTOLITHOGRAPHY PROCEDURE FOR THE USE OF MEASURING HALL VOLTAGES

Ian O'Dell

Governor's School for Science and Mathematics

The purpose of this research was to reduce the time required to perform an experiment that tested the Hall effect under the effects of certain organic compounds. In the experiment, the scientist must bond wires to a thin film of metal and a mounting chip that connects the film to an electromagnet lock-in. My job was to remove the long process of wire bonding from this experiment. To accomplish that job, I was given a wired plate, and was instructed to redesign a Hall bar pattern to fit it, as well as find an efficient way to create the Hall bar. I had to account for the process of photolithography, which included creating a new shadow mask, finding the optimum way to expose the silicon chips on which the Hall bars were placed, while ensuring that they were still usable in the lab. The final results were a much larger Hall bar, shadow masks constructed of ink and metallic paint on transparency sheets, scanned by sweeping light across the sample in strips.

## THE EFFECTS OF VARYING COLORS OF LIGHT ON VASCULAR SMOOTH MUSCLE CELLS

Madeline Odom

Hamilton Career Center

Research shows that variations of the Opsin proteins are responsible for a higher response to different light sources. This has given scientists a control over cells and allowed the deactivating of overactive cells in lab mice. In this experiment, vascular smooth muscle cell line was started and subcultured until the appropriate number of cells were reached. Thirty six wells were required for the experiment. Cells were exposed to concentrations of 0%, 25%, 50% and 100% Opsin II proteins. The cells were exposed to the proteins over a period of 48 hours. Then, the first plate received blue light for ten minutes, the second plate received green, and the third plate received red light. Results were then found using the live/dead assay with the AMG microscope. The images showed the largest amount of growth with cells exposed to the 100% proteins and red light. The plate exposed to blue light had a majority of dead cells. Then, live cells were counted using the Biotek Synergy 4 machine. This machine showed quantitative data that supported the images from the AMG microscope.

## THE EFFECT OF COPPER(II) SULFATE PENTAHYDRATE ON ABSCISIC ACID IN CUCURBITA PEPO

Kayla O'Grady

Spring Valley High School

The purpose of this experiment was to determine whether copper (II) sulfate pentahydrate can positively or negatively affect the amount of abscisic acid (ABA), represented by parts per million (ppm), produced by Cucurbita pepo plants. If the copper (II) sulfate pentahydrate were to positively affect the amount of ABA, the plants would undergo fermentation quickly and have a more vibrant color to the leaves and stem. It was hypothesized that the copper (II) sulfate pentahydrate would cause the zucchini plant to produce less ABA, thus causing poor physical characteristics of the plants, such as poor color and poor growth. There were 2 groups in this experiment consisting of 30 zucchini plants, a control group and an experimental group. The control group was given only water and sunlight everyday until the plants finished fermentation. The experimental group was given the same amount of sunlight but 26% concentrated copper (II) sulfate pentahydrate everyday. Both groups had the same amount and type of soil. After the control group plants finished fermentation, the ABA was measured using an electrochemical ABA sensor, also referred as an ABA meter, obtained from Amazon.com. This measures the amount of ABA produced by each plant. Each plant was separated from the rest. The unpaired independent t-test, represented by graph 4, shows the statistical significance of this experiment, having a low p-value. The control group (M=0.75, SD=0.12) reported significantly higher levels of ABA ppm than the experimental group (M=0.12, SD=0.06),  $t(29) = 23.90$ ,  $p < 0.0001$ .



## VALIDATION OF WRIST-WORN CONSUMER HEART RATE MONITORS DURING EXERCISE

Jacob Palchak

Governor's School for Science and Mathematics

The purpose of this study was to test the validity of the heart rate monitors on the Apple Watch 2 and Fitbit Charge HR during exercise. Ten subjects performed treadmill, cycling, and TRX suspension training exercises and their heart rates were tracked continuously using five devices: two Fitbit Charge HR's on one arm (one worn on the upper wrist and the other on the lower wrist), two Apple Watch 2's on the other arm (one upper, one lower) and one Polar H7 Chest Strap. Data was collected from the Apple Watch using the Apple Health and Motifit apps and data was collected from the Fitbit Charge HR using [www.squashleagues.org](http://www.squashleagues.org). Our results indicated that the Apple Watch had a lower overall Mean Absolute Percent Error (MAPE), both watches had a lower overall MAPE of approximately 1.76% when worn at the upper wrist position, and a significantly higher MAPE of approximately 3% during TRX interval training.

## THE EFFECT OF DIET ON COGNITIVE FUNCTION

Michaela Palmer

Governor's School for Science and Mathematics

Obesity rates have skyrocketed in recent years in America due to diet and increased portion sizes. A diet of saturated fats, trans fats (now made illegal by the FDA), and high levels of sugar result in increased insulin levels and can lead to type II diabetes or obesity. High fat diets can lead to lower levels of insulin in the brain resulting in memory functions to be disabled. In rodents, the hippocampus of six high fat diet mothers and six control chow diet (AIN-93 diet) mothers were studied with different antibodies to measure the difference in protein expression between the different diets. Ultimately, this allowed us to see that the insulin receptors are turned off in the HFD rodents, and they were turned on in the control diet rodents.

## THE EFFECT OF TURMERIC ON THE REGENERATION RATE OF PLANARIAN, GIRARDIA TIGRINA

Serena Parmar

Heathwood Hall Episcopal School

Cell regeneration has great significance in the field of science. Its advancement can lead to faster healing of damaged tissue in the human body. There have been many studies on au-tumerone, a compound in turmeric, that have revealed its ability to stimulate neural stem cell reproduction and generate healing properties. Every multicellular organism can regenerate to a certain extent. Humans regenerate skin cells constantly and when healing wounds. Animals like the brown planaria, *Girardia tigrina* have the ability to regenerate parts of their body when transected. This study was conducted to test the effect of turmeric on the regeneration rate of *Girardia tigrina* compared to a control group in water. During this experiment, incised planaria were exposed to various concentrations of turmeric (0%, 0.00875%, 0.0175%, and 0.025%) for 4 days. Their lengths were measured every 24 hours, and the measurements, along with the percent changes, were analyzed in single factor ANOVA tests. The data showed positive growth for overall length of the planaria in control, 0.0175%, and 0.025% groups, however no statistically significant data was found. Additional ANOVA tests were run on mean percent change from day 1-4 and statistically significant data was found between 0% and 0.00875%. The hypothesis, which stated if *Girardia tigrina* are treated with turmeric, then the regeneration rate will be increased was rejected. The null hypothesis that there would be no difference in tail regeneration rate between planaria treated with turmeric and the control failed to be rejected.

## THE EFFECTS OF ALUMINUM OXIDE AND MANGANESE IRON OXIDE NANOPARTICLES ON THE EXTRACTION OF MOTOR OIL FROM BUCEPHALA ALBEOLA FEATHERS

Jay Patel

Spring Valley High School

As the industrial revolution increased demands and sales, petroleum has risen to be the largest import. There is an increase in the amount of oil and petroleum being spilled and they are proving to be hazardous to the wildlife, including a variety of bird species. The purpose of this experiment was to find a more effective way to extract oil from *Bucephala albeola* feathers than the current method, which is not efficient. It was hypothesized that if Aluminum Oxide and Manganese Iron Oxide nanoparticles were used to extract oil, then the Manganese Iron Oxide nanoparticles more effective than the Aluminum Oxide nanoparticles at removing oil from the *Bucephala albeola* feathers. Twenty feathers had motor oil applied to them, and half were treated with Aluminum Oxide nanoparticles and the others with Manganese Iron Oxide nanoparticles. They were then massed before and after the extraction process. A two sample t-test ( $t(9)=5.53, p<0.001$ ) determined that there was a significant difference between the two treatments. The Aluminum Oxide nanoparticles had an average difference of 0.220 grams after the extraction while the average difference for Manganese Iron Oxide was 0.0255 grams. In conclusion, the treatment consisting of the Aluminum Oxide nanoparticles was more efficient at removing the oil.

THE USE OF ORTHO HOME DEFENCE PESTICIDE IN DETERMINING THE LOWEST PESTICIDE AMOUNT AT WHICH NODULE FORMATION IS STUNTED IN TRIFOLIUM INCARNATUM

Khushi Patel  
Spring Valley High School

The modern world is awash with pollutants of many varieties. One of the most prevalent of these pollutants are the pesticides which are sprayed across acres of crops to avoid mass quantities of harmful pests (Damalas and Eleftherohorinos, 2011). Pesticide usage around the household has increased over the past few years (Ye et al., 2013). The purpose of this research was to discover the lowest amount of pesticide exposure that has negative effects on the symbiotic relationship between legumes and rhizobia. It was hypothesized that the medium pesticide amount would be the first to show signs of a weakened relationship between the plant and rhizobia. Three treatments of high, 8 mL, medium, 4 mL, and low, 2 mL, of Ortho Home Defense Pesticide were devised and introduced to the environment of three 30-plant treatments of Trifolium incarnatum. Plant height and leaf number data were collected every week for a total of 6 weeks before the plants were removed from their trays. Root nodules were counted and the roots of each plant were also massed. A One-Way ANOVA [ $F(3, 82) = 2.46, p = 0.069$ ] conducted on the root nodule data from the final week resulted in a p-value of 0.069. When compared to an  $\alpha$ -value of 0.05, this data was not statistically significant. There was not sufficient evidence to suggest that pesticides negatively effect nodule formation.

GLYPHOSATE AND THE INCREASED PREVALENCE OF AUTISM

Parth Patel  
Governor's School for Science and Mathematics

The Increased prevalence of Autism Spectrum Disorder (ASD) is often correlated with the heighten use of glyphosate. Glyphosate is used as an herbicide, but it also doubles as an antibiotic. This chemical finds its way into our diet and harms our nerve cells via the release of a compound known as Lipopolysaccharides (LPS). LPS is released from the bacterial lysis that glyphosate causes in the gut flora, as LPS is found of the cell walls of gram negative bacteria. The hypothesis was that secretions from bacteria exposed to glyphosate (experimental group) would cause more axonal degeneration in the nerve cells as opposed to secretions from bacteria regularly grown in medium (control group). The 2266 (female) and 2267 (male) neuroblastoma cell lines were used to test the hypothesis. In the experimental groups, the secretions of bacteria exposed to glyphosate caused more axonal degeneration than the control group. Although Glyphosate cannot be directly called an environmental cause of ASD, it definitely caused axonal damage.

THE EFFECT OF NONASSOCIATIVE LEARNING ON OXIDATIVE STRESS IN CAENORHABDITIS ELEGANS: A POTENTIAL APPLICATION FOR ALZHEIMER'S DISEASE RESEARCH

Gillian Patton  
Spring Valley High School

Alzheimer's disease results in learning and memory deficits due to toxic changes in the brain caused by amyloid- $\beta$  plaques and oxidative stress (Alzheimer's, 2011). Oxidative stress is caused by the overproduction of free radicals, which are uncharged molecules containing an unpaired valence electron (Morcos and Hutter, 2009). Nonassociative learning is a type of cognitive processing that only uses one stimulus instead of two related stimuli. Cognitive processing promotes neural growth and learning, while Alzheimer's inhibits it. The purpose of this study was to test how nonassociative learning impacts oxidative stress and thus, if it might be considered as a potential treatment option for Alzheimer's disease. It was hypothesized that the application of nonassociative learning would reduce the effects of oxidative stress on *C. elegans*, resulting in increased mobility and egg-laying. Mechanosensory, chemosensory, and novel environment habituation were used to increase mobility and egg-laying in *C. elegans*, in opposition to a hydrogen peroxide treatment that induced oxidative stress. The equation  $F(3,236)=44.73, p<0.0001$  was used to run the one-way ANOVA for time to paralysis. The Tukey test demonstrated differences between the control group and all of the experimental groups. The equation  $F(3,16)=4.72072, p=0.021252$  was used to run the one-way repeated measures ANOVA for egg-laying. The Fisher test demonstrated differences between the control group and the mechanosensory and chemosensory groups. It was concluded that the application of nonassociative learning to *C. elegans* reverses the negative effects of oxidative stress, stimulating mobility and egg-laying.

ASSEMBLY LINE IMPROVEMENTS OF EFFICIENCY AND SAFETY AND THEIR EFFECT ON THE WORKING CLASS USING THE YUMI COLLABORATIVE ROBOT AS A MODEL

Nicholas Peckich  
Governor's School for Science and Mathematics

My research focused on the use of collaborative robots and the delivery systems which would be used to deliver them stock material. After visiting with Anderson Brass, which is a local brass manufacturer in Hartsville, SC and Integrated Systems Inc. located in Darlington, SC, I began to design a robotic automation system that could make the assembly line process more efficient and safer for the workers. I created two functional Lego mechanisms designed to work with the YuMi collaborative robot and its vision system. The final mechanisms demonstrate a work environment where collaborative robots would be able to do the dangerous portions of the assembly line process so that worker injuries would be reduced.

## AN ECOLOGICAL STUDY ON THE COASTAL REGIONS OF SOUTH CAROLINA TO DETERMINE THE CAUSE OF SOIL NUTRIENT DEPLETION BASED ON THE UNIQUE CONDITIONS AND INDUSTRY

Jayra Penaloza  
Spring Valley High School

Soil is defined as the loose upper layer of the Earth's surface composed of rock, mineral particles, nutrients, and decayed organic matter that sustain complex ecosystems. However, the natural nutrients found in soil can easily be depleted through natural events such as climate change and human-caused events as a result of development and changes in economy. This ecological study was conducted on the coastal regions of South Carolina which include the coastal zone, inner coastal plain, and outer coastal plain to determine the main cause of soil nutrient depletion. This is important in an ever changing climate which heavily affects the agricultural industry as a result of changes in soil. To conduct the meta-analysis, data was derived from national databases regarding agricultural statistics. It was then analyzed using one way ANOVA tests to test for differences in means for each year of data, 2014-2016. It was hypothesized that the coastal zone of South Carolina would be most affected by soil deprivation due to proximity to the ocean, which brings in salt water and frequently floods the land causing the depletion of water-soluble nutrients. It was observed that during 2014 to 2016 the crops grown had diminished slightly, but, in some areas, had flourished greater than before. At  $\alpha = 0.05$ , the p values were greater than alpha making data statistically insignificant. In conclusion, the hypothesis was rejected given that the null was not rejected and thus there was not enough information to support the claim or alternative hypothesis.

## THE EFFECT OF CHANGING THE ACTION OR BARREL LENGTH OF A SHOTGUN

Joseph Pope  
Heathwood Hall Episcopal School

The purpose of this experiment was to examine the effect of changing the type of action or the barrel length on the power of a shotgun. To do this the researcher fired three different types of shotguns including a long barrel manual action shotgun, a short barrel manual shotgun, and a short barrel semi-automatic shotgun were fired at a paper target made from  $\frac{1}{2}$  of a pack of paper. The number of pages of paper the shotgun pellets broke was then recorded. This step was repeated three times for every gun and then an average number of pages were determined for each gun and compared to each other. The average number of pages broken by each shotgun are as follows: the long barrel manual shotgun broke 84.67 pages, the short barrel manual shotgun broke 96.67 pages, and the semi-automatic shotgun broke 79 pages, This means that the shotgun that had the most power was the short barreled manual shotgun, followed by the long barreled manual shotgun, and then the short barreled semi-automatic shotgun. In the end, the results ended up being that a short barrel manual shotgun produces the most power. This does not support the the hypothesis that the long barrel manual shotgun would produce the most power. Instead the research suggests that a short barreled manual shotgun is able to produce more power when the pellets impact the target than any other type of gun tested in this experiment.

## ANALYZING INFORMATION TRANSFER PATTERNS IN EAST ASIAN FINANCIAL MARKETS

Christopher Poston  
Governor's School for Science and Mathematics

This research uses statistical transfer entropy to map the strength and directionality of connections between major financial companies in South Korea, China, and Japan. A matrix of daily stock prices was compiled from the SSE 250, KOSPI 200, and NIKKEI 225 stock indices, which was then fitted to a logarithmic trend. By modeling the price curves of different companies as connected, stochastic processes and calculating the information-theoretic transfer entropy between them, this study developed a network of the connections between nodes in each country and sector.

After the price trends were discretized, a sliding-window plot of transfer entropy was generated for each of the countries in the study. Companies were grouped by financial sector – banking, insurance, investment, real estate – in order to facilitate analysis of information transfer trends between sectors. The research found that compared to both China and Japan, South Korea experienced a significant increase in transfer entropy across all financial sectors. The mapping for Japan shows a spike in mid-2013 which this study attributes to massive bond purchases by the Bank of Japan. Total transfer entropy matrices (TTEs) were also generated for each country in order to compare relationships between individual companies. The most notable result displayed by the aggregate matrices was a consistently lower transfer entropy between companies of the same type (compared to those from other financial sectors).

## RELAXATION AND ADHESIVE BIOMECHANICAL PROPERTIES OF BIOSYNTHETIC MATERIALS FOR A PREOPERATIVE BRAIN MODEL

Shawn Potter  
Governor's School for Science and Mathematics

Neurosurgeons can improve primarily with experience which can be maximized with the proper training materials. The experience of the neurosurgeons right now is coming from either cadavers or actual surgery. Cadavers are not unlimited since there are a limited amount of people donating their body to science. It would be a lot safer if the surgeons were not gaining experience from surgeries which is exactly what you want them to have the experience for. MRI scans of patients can be 3D printed to create a model that exactly replicates the patient's brain. The problem is that there are no materials that can be 3D printed and act like the brain. Hydrogels and emulsions are the closest materials to the brain. The purpose of this project is to

test hydrogels' and organogels' biomechanical properties in an effort to find one that most closely resembles the brain. The hydrogels with the closest perceived mechanical properties to the brain are ones that include a varying combination of a chromium variant, gelatin, oils, agarose, and water. The emulsion with the closest mechanical properties to that of the brain is one with a mixture of lecithin, flax seed oil, borax, and water. The results will allow neurosurgeons to be more successful in the surgeries they perform and it will also allow for faster learning of techniques by neurosurgeons.

#### AUTISM SEVERITY IN CHILDREN WITH FRAGILE X SYNDROME AND GENETIC VARIATION

Elise Pyon

Governor's School for Science and Mathematics

Fragile X Syndrome (FXS) is a rare genetic disorder that causes neurodevelopmental deficits. It is caused by a mutation on the FMR-1 gene due to an excessive amount of CGG repeats, which inhibits the growth of Fragile X Mental Retardation Protein (FMRP), an essential protein for neural plasticity. Children with FXS often develop autism, a disorder characterized by mental delays and physical features but an unknown cause. To study the correlation between children's behavior and genetic variation, CGG repeats and FMRP levels were studied. Higher CGG repeats would indicate a more severe autistic behavior, while higher FMRP levels would indicate typical development. In this experiment, the number of CGG repeats and FMRP levels were compared to a child's CARS score to determine if those two variables were the determining factor in the severity of autism. High amounts of both correlated to a high CARS score.

#### THE EFFECT OF VINEGAR AND TAP WATER ON THE RELEASE OF NICKEL IN GRADE 304 STAINLESS STEEL CUPS

Caroline Quan

Heathwood Hall Episcopal School

Consumption of nickel rich liquids and foods pose a risk to human health, causing reactions such as dermatitis. This study examines the amount of nickel that leaches out of grade 304 stainless steel cups with respect to time. The hypothesis of this experiment is that if given enough time, the liquids will react to the nickel in the stainless steel cups, and then nickel will leach out into the cup's contents. The null hypothesis being that if the cups, since they are not given enough time and/or do not react to the nickel in the stainless steel cups, will not leach nickel into the cup's contents. 15 grade 304 stainless steel cups contained 300 mL of tap water, and 15 cups contained 300 mL of white distilled vinegar. Using the equation of a calibration curve of Absorbance vs. Known Nickel Amounts to calculate the amount of nickel in the liquids, samples were taken from each of the 30 cups at 8, 24, and 32 hours. At 8 hours, on average the cups containing tap water leached 5.16  $\mu\text{g/mL}$  of nickel, and the cups containing vinegar leached 0  $\mu\text{g/mL}$  of nickel. At 24 hours, on average the cups containing tap water leached 24.5  $\mu\text{g/mL}$  of nickel, and the cups containing vinegar leached 110.  $\mu\text{g/mL}$  of nickel. The results of 32 hours were not included in the final analysis because of uncertainties. Although the final analysis of this data proved significant, there were statistical uncertainties.

#### NUMERICAL ESTIMATION IN GLASS PATTERNS

Alannah Quinn

Governor's School for Science and Mathematics

The Random Regular Numerosity Illusion (RRNI) is a phenomenon in which an organized array of dots is perceived to be more numerous than a random array of dots. Previous studies have focused on the correlation between the organization of the pattern and the subject's ability to enumerate the dots. The current research tested the possibility that other spatial features – such as density or area – could be the source of this illusion by using Glass patterns. Glass patterns are two random arrays of dots which have been copied and layered on top of one another. They allow a manipulation of organization or coherence while controlling for density and area. Subjects were shown two Glass patterns with varying coherence and asked to choose which was more numerous. While there was a clear effect of relative quantity, there was no effect of organization, contrary to previous RRNI studies. Future studies would directly manipulate area and density to further test the idea that organization is not the limiting factor in the estimation of quantity.

#### EXPLORING CHRONIC HICCUPS

Meredith Radtke

Center for Advanced Technical Studies

Hiccups are defined as involuntary spasms of the diaphragm which causes the glottis to force shut resulting in the act of hiccups. In this study, research will be conducted on myself and my condition of chronic hiccups. To many doctor's knowledge, their studies have come back inconclusive on to what this condition is. There will be a series of research conducted to determine if I can find any new information for a diagnosis of these unknown hiccups. If I induce myself in different environmental factors, like food, my hiccups will increase. The way to utilize the hiccups to determine the results of the different environmental factors were to record the amount of times I hiccuped for a week while I was at home and for another week while I was at school. The induced environmental factors are food, stress and exercise. Studies and experiments will be conducted in each of these factors to see if one may cause hiccups to increase more than others. Studies will also be conducted to see if my diagnosis of Celiac disease and GERD also have an impact on the condition. Ideally the results will conclude as the environmental factors will result in an increase of hiccups. The data will be analysed through the number of hiccups performed by each factor. In conclusion,

the inducement of environmental factors cause the hiccups to increase. The findings of this study can result in a improvement to my overall health.

#### IMPLEMENTING TENSORFLOW TO ASSIST THE AUTONOMOUS AGENT IN SELF-NAVIGATING VEHICLES

Shashaank Rajaraman  
Governor's School for Science and Mathematics

When it comes to autonomous vehicles, one issue usually brought up is whether a computer can be trusted to navigate a car, something thought only to be operable by humans. With advancements in the field, autonomous vehicles have become the focus of the automotive and computer science fields of research. At the Clemson University International Center for Automotive Research, the project focused on developing the program in an autonomous vehicle in order to recognize traffic signals and signs. This was assisted by the use of a software package named TensorFlow developed by Google. TensorFlow assists the autonomous programming through a process called "Deep Learning", where the device itself essentially learns what to do in a given situation. Using this application, images were classified into one of six, unique, traffic signals using Inception, a pre-trained model trained on a vast library of pictures. By retraining this model to assist us on our endeavour, a powerful software was developed that could help recognize traffic signs. Developed using the Python language, an algorithm was constructed that classified images according to their function. The images could be recognized at any angle and at a modest distance. We successfully trained the software to work at an accuracy of 60%, after training the code with a relatively low number of images in each category. This accuracy rate suggests that with more training, this program can become more accurate and efficient, thus improving safety in the long run.

#### ASSESSMENT OF ANTIBIOTIC RESISTANCE IN AGRICULTURAL PRODUCTION

Zeanmarj Ramos and Morgan McManus  
Governor's School for Science and Mathematics

Antibiotic resistance has become one of the most significant global threats to human health. The CDC reports at least 2 million cases a year have been found in the United States alone. Antibiotic drugs work on the microbial level to treat and prevent infections caused by bacteria, but the FDA reports that 70% of these infectious bacteria have become resistant to the antibiotics with which they are often treated. Widespread antibiotic use in animal production agriculture creates risk of direct exposure to antibiotic resistant pathogens and creates reservoirs of antibiotic resistance that may be transferred to pathogens through environmental contamination. To determine which animal production system had the highest frequency of antibiotic resistance genes, DNA was extracted from a panel of 140 *Escherichia coli* isolates and PCR was used to identify samples that contained the CTX and intL antibiotic resistance genes. We found the CTX antibiotic resistance gene in 32% of dairy cattle samples, 24% of beef cattle samples, and 50% of swine samples. We found the intL antibiotic resistance gene in 5% of dairy cattle samples, 0% of beef cattle samples, and 75% of swine samples. These results suggest that different animal production systems may foster antibiotic resistance at different rates with dairy cattle and swine having higher frequencies than beef cattle.

#### THE EFFICIENCY OF MODIFIED TEMOZOLOMIDE IN GLIOBLASTOMA CELL DEATH

Daniela Ramos Mendoza  
Governor's School for Science and Mathematics

Glioblastomas are a neurological disease and its standard treatment is the chemotherapeutic drug, Temozolomide [TMZ]. However, the use of TMZ only prolongs the one-year survival rate by 6-10%. One way to increase the efficiency of TMZ is to modify the chemical structure. The aim of this research is to modify TMZ by either adding an Ester group [TMZ-E] or a carboxylic acid [TMZ-A] to the chemical structure. And to test these modified drugs along with unmodified TMZ on an oligodendrocyte cell line, LN-229. The cells were treated at a concentration of 0-50  $\mu\text{M}$  for twenty-four hours, followed by a trypan blue assay to determine cell death. The results indicate that TMZ-E was more effective at killing glioblastoma cells than TMZ and TMZ-A. At 0.8  $\mu\text{M}$  TMZ-E killed about 67.4% of the cancerous cells as compared to unmodified TMZ which killed 30%. These various TMZs will also be tested on other cancer cell lines.

#### THE EFFECT OF KCL (POTASSIUM CHLORIDE) ON SORGHUM PLANT HEIGHT

Victor Ran  
Heathwood Hall Episcopal School

Potassium Chloride, KCl, is added into the fertilizers for plants and crops. Sorghum, especially, needs some KCl fertilizer when they grow. The purpose of this experiment is to define how initially adding different amount of KCl affects the height of growth of sorghum seeds. The independent variable is KCl concentration in percentage (%). The dependent variables are Light, water, temperature, soil, wind, ages and variety of plants. The hypothesis states that if the amount of KCl is increased, then the sorghum will grow taller. The null hypothesis states that increasing KCl will not affect sorghum plant height. The research technique is experimentation. The effect of KCl on sorghum plant height is summarized in the tables above. Since the height of sorghum plants is proportion to from 0% to 12.5% concentration of KCl solution added, the hypothesis is supported by the data. This research project will help the scientific community find out how to use Potassium Chloride to affect the growth of sorghum plant.

THE EFFECTS OF CIRCUMIN ON FIBROBLAST CELLS AND CIRCUMIN WITH METFORMIN ON FIBROBLAST CELLS  
Madison Ranalli and Carter Duke  
Hamilton Career Center

Previous experiments have been performed testing circumin with gemcitabine on pancreatic cancer but not many others. The results show that the mice which were treated with circumin and gemcitabine suppress proliferation, angiogenesis, NF- $\kappa$ B, and NF- $\kappa$ B-regulated gene products. These results provide further evidence supporting the hypothesis and an experimental basis for using circumin alone. Circumin could stop cancer cell growth and be an effective treatment for pancreatic cancer. Metformin pills were crushed and circumin pills were opened. The water used to dilute the metformin must first be distilled so it is sterile. One metformin pill, 500mg, will be diluted into one liter of water. One circumin pill, 500mg, will be diluted in 10 ml of water. Each concentration was exposed UV light under a fume hood for approximately 20 minutes before introducing them to the fibroblasts. The fibroblasts were passaged on CO<sub>2</sub>-dependent media and incubated to ensure there was a high enough count of viable cells to perform the tests on. While the cells were growing, they had to be  $\hat{a}$ fed or given nutrients through FBS (fetal bovine serum). 10% FBS and 1% antibiotics were added to the media. Then, the entire solution of media was filtered to ensure no extra particles or bacterium got into the plates. Once the cells were plated and allowed to grow for a 48 hour period, the circumin alone, metformin and circumin together, metformin alone, paclitaxel alone were introduced for an exposure time of 48 hours. Next, 125 microliters of paclitaxel was added in the 1st row of wells, 125 microliters of metformin in the 2nd row, 125 microliters of circumin in the 3rd row, 62.5 microliters of metformin and circumin together, and a control with 1 mL of media in a different plate. Assays were run and results showed combination metformin and circumin to have the highest viability while circumin alone had the highest percentage of cell death.

THE EFFECT OF MONOSODIUM GLUTAMATE ON PLANARIAN MEMORY RETENTION  
Pallavi Rao  
Spring Valley High School

Monosodium glutamate (MSG), a food additive, is widely consumed, but is speculated to have adverse effects on health. It is known to impact the nervous system through excitotoxin production. The purpose of this study was to determine how MSG affects developing and fully functional nervous systems by using planaria as a model organism for memory retention. It was hypothesized that regenerating planaria in a 10mM dose of MSG would display the longest learning times and make the most number of incorrect decisions within the maze. Planaria were conditioned to enter the right branch of a Y-maze using an LED light as a negative stimulus. After being trained, the planaria were split into a group in MSG and a group in water. Within these groups, half of the planaria were dissected and half were not. After two weeks, the planaria were tested for memory retention using the same process as the training period. A one-way ANOVA revealed that mean learning times were significantly different from each other at  $\alpha=0.05$ ,  $F(3,115) = 55.90$ ,  $p < 0.05$ . A Tukey test identified that the group which regenerated in MSG displayed significantly higher learning times compared to the other groups. Another one-way ANOVA displayed that the mean number of incorrect decisions were significantly different from each other at  $\alpha=0.05$ ,  $F(3,115) = 25.53$ ,  $p < 0.05$ . A Tukey test showed that the group which regenerated in MSG made a significantly greater amount of incorrect decisions in the maze. The hypothesis was supported, as the group that regenerated in MSG displayed both significantly higher mean learning times and mean number of incorrect decisions. It was concluded that MSG had a negative effect on both fully functional nervous systems as well as developing nervous systems.

EVALUATING LIMITS OF SERIES  
Brennan Ravan  
Governor's School for Science and Mathematics

Mathematicians are interested in classifying numbers and distinguishing between different sets of them. Work in pure mathematics has been used in such diverse fields as encryption, astrophysics, and phylogenetics. Riemann sum are a method of approximating an integral with a summation, and the reverse can be done to approximate a summation with an integral. The squeeze theorem states that if an upper bound and a lower bound of a function converge to the same limit, the function must converge to that limit. Using these techniques, the limiting value of a series of exponential terms can be found in a closed form. Similar methods might be applicable to the Euler-Mascheroni constant to determine whether it is rational or irrational.

THE EFFECT OF TRENDING WORLD EVENTS ON SENTIMENT ANALYSIS AND RELEVANCY INTERVALS USING ANALYTICS SOFTWARE ON TWITTER DATA  
Bridgette Ravindra  
Spring Valley High School

Data analytics is emerging as a critical field to intelligently utilize the vast trail of data we create in our daily lives. An analysis of data trends can reveal patterns that can predict human behavior in areas such as health care, Ecommerce and consumerism, among others (Kim, 2017). The purpose of this experiment was to study the correlation between a Twitter hashtag's sentiment and its trending duration using IBM Watson Analytics. The hypothesis was that a major event associated with a more positive sentiment would trend longer than more negatively associated counterparts. The experiment relates to Hedonic adaptation, the psychological theory that states that humans will return to a relatively happy state despite a negative or positive turn of events (Halvorson, 2012). The sentiment was first analyzed on a smaller scale by randomly selecting 30 tweets within each hashtag

studied and then on a larger scale using IBM Watson Analytics. For the trend analysis test, the total number of tweets for each hashtag was recorded daily. Manual sentiment analysis yielded a strong correlation of “happy” sentiment with entertainment hashtags, “sad” with natural disaster, “fearful” with health and medicine, and “neutral” with the control group #selfie. A Chi Square Test for Independence was run at  $\alpha = 0.05$  on the average number of tweets for the hashtags in each category and showed a direct correlation between the category and sentiment  $\chi^2(15, N = 120) = 37.731, p < 0.05$ . Thus, the hypothesis was supported because the entertainment hashtags with positively associated sentiments trended longer than more serious hashtags exhibiting negative sentiments, and there was a direct correlation between the category of the tweet and its sentiment.

#### COCRYSTALLIZATION AND PREDICTIONS OF COCRYSTAL STRUCTURE BASED ON ELECTRONEGATIVITY CALCULATIONS

Thomas Richburg

Governor's School for Science and Mathematics

In this research, the electronegativity of several compounds was calculated by a computer program and cocrystals were successfully grown. The compounds were assembled in the program, which output the information with which predictions were made pertaining to the structure of the cocrystals before their growth. Two observable crystals were created: one of 1,3-bis(pyridine-4-ylmethyl)urea and (E)-3-(perfluorophenyl)acrylic acid, and one of 1,3-bis(pyridine-4-ylmethyl)urea and 4,4'-dihydroxybenzophenone. The general predictions made by the group proved to be accurate, thus validating the predictions. Further research can be done to pre-emptively predict structures in more complex scenarios.

#### THE RELATIONSHIP BETWEEN TEMPERATURE AND ANEUPLOIDY OF HELA CELLS

Faith Robertson

Heathwood Hall Episcopal School

The purpose of this experiment is to investigate the relationship between aneuploidy and the storage temperature of HeLa cervical cancer cells. An aneuploid cell is a cell that has an abnormal amount of chromosomes, either more or less than 42 chromosomes. The goal is to further research the “medical mystery” of HeLa cervical cancer cells, the first line of human cells to survive in vitro, or in a test tube, and provide research for stimulating an accurate environment for studying. Cells were stored at three different temperatures for 24 hours prior to examination. The hypothesis is that the cells closest to body temperature would be the least aneuploid and the coldest ones would be the most. This data supports half of the hypothesis. The data suggests that the coldest cells, the 25°C room temperature cells, are the most aneuploid. However, this data also suggests that the 33°C cells were the least aneuploid, followed by the body temperature (37°C) cells. The conclusion that can be drawn is that cells stored at temperatures other than body temperature will behave differently than how they would behave in the body. As this study demonstrates, it is critical that scientists are able to accurately study HeLa cells.

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#### OXYGEN CARRIER SYNTHESIS AND CHARACTERIZATION BY CHEMICAL LOOPING WITH OXYGEN UNCOUPLING

Victor Ruan

Governor's School for Science and Mathematics

Global warming has become an increasingly pressing issue and many seek to mitigate the effects of these increasing temperatures or to stop them altogether. One way to do so is through a process called chemical looping with oxygen uncoupling (CLOU), which was the topic of my research. Current carbon capture technologies are capable of capturing carbon, but the problem is that this process is too expensive due to the separation of the carbon emissions from the nitrogen in the air that must be performed before the carbon is captured. The CLOU process provides an alternative to this costly separation process by providing a source of pure oxygen. Doing so allows the separation of the carbon emissions from nitrogen to be avoided altogether.

My research focused specifically on finding the combination of oxygen carriers and support compounds that would yield the largest percent of oxygen, thereby optimizing the amount of carbon emissions that react with the oxygen from the oxygen carrier. It was found that among those tested, the ones without support compounds released the highest percentage of oxygen.

#### THE EFFECT OF CANCER CACHEXIA AND PDTC TREATMENTS ON CARDIAC PROTEIN SYNTHESIS

William Rumfelt

Governor's School for Science and Mathematics

Cancer cachexia, a severe wasting disease, often accompanies the advanced stages of cancer. This experiment examined the impact of cachexia and Pyrrolidine dithiocarbamate (PDTC) on cardiac protein synthesis. PDTC increased protein synthesis and attenuated wasting in the liver and skeletal muscle in previous studies, but its impact on the heart has not been determined. Male B6 and Apc min/+ mice were randomly selected to either cage control or PDTC treatment at 16-18 weeks of age. The groups were injected with either PBS or PDTC daily. Following two weeks of treatment, tissues were snap frozen to be homogenized at a later date. Western blot analysis was used to determine cancer and PDTC's effects on P70S6K, AKT (T308), and rPS6K protein expression. Cancer did not alter heart mass in weight stable mice and short-term PDTC treatment did not alter heart mass, Phospho-Akt expression, or P70S6K protein expression. Interestingly, PDTC increased Phospho-RpS6 levels. This is intriguing because Phospho-RpS6 is a downstream marker of protein synthesis, while levels of upstream markers that are found before the synthesis of protein were not increased. Future research is needed to determine whether PDTC altered inflammatory signaling in the heart and if PDTC has a different effect on mice with severe weight loss.

#### THE EFFECT OF FLAVONOID GALANGIN ON THE CELL VIABILITY AND TOXICITY OF MCF-7 HUMAN BREAST CANCER CELLS EXPOSED TO POLYCYCLIC AROMATIC HYDROCARBONS (PAHS)

Abhimanyu Sailesh

Blythewood High School

Polycyclic aromatic hydrocarbons (PAHs) are chemical compounds ubiquitous in the environment; many of which are known human and animal carcinogen. The purpose of this study was to investigate MCF-7 epithelial breast cancer cells' viability and toxicity following a short-term in vitro exposure to a cocktail of PAHs and benzo[a]pyrene (B[a]P) separately in the presence and absence of varying concentrations of flavonoid galangin. It was predicted that presence of galangin will completely or partially block the damaging effects of PAHs. It was hypothesized that exposing the cells to 7 $\mu$ M cocktail of PAHs or 10 $\mu$ M B[a]P in the presence of 30 $\mu$ M galangin would reduce the toxicity and increase the mitochondrial activity of the cells as compared to that in the absence of galangin. Experimentation was accomplished by exposing identical samples containing 75,000 MCF-7 cells each for 24 h to exposure medium containing 10 $\mu$ M B[a]P alone, 7 $\mu$ M cocktail of PAHs alone, various doses (5 $\mu$ M, 30 $\mu$ M, 100 $\mu$ M) of galangin alone, mixture of 10 $\mu$ M B[a]P and the various doses of galangin, and mixture of 7 $\mu$ M cocktail of PAHs and the various doses of galangin. Viability of the sample cells were measured by MTT assays, whereas their toxicity were measured by LDH assays done on spent exposure media. The results are as follows, at significance level ( $\alpha$ ) = .05, 7 $\mu$ M cocktail of PAHs in the presence of 100 $\mu$ M galangin was found to be highly toxic to the cells after 24 h of exposure. At  $\alpha$  = .05, 7 $\mu$ M cocktail of PAHs, 7 $\mu$ M cocktail of PAHs concomitant with 5, 30 or 100 $\mu$ M of galangin, 10 $\mu$ M B[a]P concomitant with 100 $\mu$ M of galangin, and 100 $\mu$ M of galangin alone considerably reduced the viability of the cells.

#### EXPRESSION AND PURIFICATION OF FEPI INVOLVED IN IRON REGULATION IN S. POMBE

Marie Sanyang

Governor's School for Science and Mathematics

The aim of this project was to purify and characterize the His-tagged Fep1 protein through the use of bacterial expression plasmids with the aid of biochemical and spectroscopic tools. *Schizosaccharomyces pombe* is a useful model eukaryotic system for studying regulation of iron homeostasis. Results from both *S. pombe* and *Saccharomyces cerevisiae* have shed light on the key players of this complex regulation. Proteins like monothiol glutaredoxins (Grxs) are present in both types of yeasts yet display different regulatory functions. Since *S. pombe* and *S. cerevisiae* share a common ancestor, the lab hypothesized that extrapolating the knowledge obtained from *S. cerevisiae* to *S. pombe* would allow the lab to fully understand the function of monothiol glutaredoxins in *S. pombe*. The lab planned to obtain these results through the purification and characterization of Fep1 (from *S. pombe*) in vitro using the bacterial expression plasmids pET-28a(+)-6xHIS-Fep1(2-564)WT and pET28(+)-Fep1-6xHIS(1-564)WT.

#### BUILDING A MULTI-SENSOR MOBILE ROBOT THAT CAN FREELY MOVE, DETECT HUMAN MOVEMENT, AND DETERMINE THE GENERAL SHAPE AND POSITION OF A HUMAN SUBJECT TO BE COMPATIBLE WITH AN AUGMENTED REALITY HEADSET.

Nithin Saravanapandian

Spring Valley High School

Augmented reality is a recent application of technology that has brought a new world of opportunities. One such application could be the addition of robots to be compatible with an augmented reality headset, which would allow for many new ways of efficient communication and work. One such use of robots along with AR is in military or police applications, such as reconnaissance or survey operations, as they can gather much more information and data and are less likely to be detected than



a human. The purpose of this project was to build a mobile multi-sensor robot that could use various sensors to detect and determine human movement, general shape and position. This information would be used in future studies to allow an augmented reality headset to generate a 3D digital marker of where the human subject is located. This would allow a user to scan a subject with the robot, and then see where that subject is physically located in relation to the user, regardless of any obstacles restricting the user's view of that subject. It was hypothesized that such a robot can be built to the size constraints of 20cmx20cmx20cm using only Raspberry Pi, Brickpi, and Lego Mindstorm related items. The robot was tested on its sensor functions and mobility to determine how well it could detect human movement. After further tests the robot was found to not be able to detect human movement on its own, but could obtain basic information on the location of a human subject.

#### TARGETING THERAPEUTICALLY RESISTANT HER2+ BREAST CANCERS

Alexander Schaffer  
May River High School

Mammary Carcinomas are one of the leading causes of cancer. In 20% of these cancers, the cause is related to an overexpression of the Erb-B2 gene, leading to an excess of the HER2 protein. Treatments are available; however, these treatments tend to see a therapeutic resistant recurrence. A novel target, target A, has shown to overcome this resistance. By treating HER2+ cells with inhibitor A and studying the effects with PCR, IHC, and Western Blotting, the resistance can be overcome: limiting cell proliferation and increasing cell apoptosis.

#### THE EFFECT OF WATER FILTRATION ON TERRAIN

Riana Shelley  
Heathwood Hall Episcopal School

The purpose of this project was to determine the effect different methods, with a focus on terrains, with respect to water and its filtration. Four methods of filtration were used in this experiment: a grassy terrain, a sand and gravel filled terrain, a dirt terrain with plastic and trash throughout, and a Brita® filter. Water was first collected from a rain water pond in five different bottles. The water was then tested for dissolved oxygen (DO) and pH levels. Then, water from each bottle was filtered through each terrain and filter. They were then tested for dissolved oxygen and pH after filtration. The independent variable was the filtration method and the dependent variable was the DO and pH levels. The hypothesis is if the terrain has nutrients and plants, then the water will have lower levels of dissolved oxygen and pH. The null hypothesis is if the terrain has nutrients and plants, then the water will not have lower levels of dissolved oxygen and pH. The results of this experiment are statistically insignificant. However, the difference in pH levels before and after the plastic terrain and sandy terrain are notable. No filter works significantly best to clean the pond water. In conclusion, neither terrain or Brita® worked better to clean the water.

#### THE RELATIONSHIP BETWEEN RACE OF SHOOTER OF MASS SHOOTING, NUMBER OF VICTIMS, NUMBER OF FATALITIES, AND LOCATION OF MASS SHOOTINGS ON NUMBER OF TWEETS POSTED BY A GUN ADVOCACY GROUP

Elizabeth Shytle  
Spring Valley High School

Twitter, a social networking site with over 330 million monthly users, allows the average person access to people around the world, as well as news about what is happening in different regions. In this project, a chosen gun advocacy group's Twitter was analyzed to find correlation between the number of Tweets posted in a single day by the group based on the number of people killed or wounded in a mass shooting that day, the race of the perpetrator, and the location of the shooting. NCapture was used to collect the Tweets from the Twitter account, and the Mass Shootings Database and Stanford Geospatial Center provided the majority of the data for individual shootings. All independent variables were expected to have a negative linear impact on the number of Tweets. In the case of location, it was predicted that shootings occurring in the Southeast would cause a smaller amount of Tweets than shootings in other parts of the country. All confidence intervals were tested at  $\alpha = 0.05$ . The claims that when  $x \geq 5$  were wounded would show a significant decrease in number of Tweets ( $p = 0.296$ ), and a nonwhite shooter would cause a decrease in Tweets ( $p = 0.256$ ) were not supported. The claims that less tweets would occur if  $\geq 5$  people were killed ( $p = 0.022$ ) and that less Tweets would occur if the shooting took place in the Southeastern US ( $p = 0.002$ ) was supported by the data.

#### THE EFFECTS OF INTELLIGENT PACKAGING ON SALES

William Simpson  
Governor's School for Science and Mathematics

Companies are always searching for a method to increase their product's desirability, and intelligent packaging has gained some attention for its potential to increase sales. Intelligent packaging refers to packaging that monitors its contents and provides the consumer with information about the contents. There are very few examples of intelligent packaging being used in the current market, and its impact on sales hasn't been investigated. The Sonoco Institute of Packaging Design and Graphics was asked to investigate intelligent packaging's effect on sales by Braskem, a Brazilian petrochemical company. Braskem submitted their own intelligent packaging design, a package that detected when the product was no longer optimal. Braskem's intended audience was parents, so the lab tested the packaging's appeal when applied to baby food and kid's sunscreen. A total of 59

participants participated in the study, which gave promising results. The kid's sunscreen and the baby food were purchased 20% more often when intelligent packaging was utilized. The eye tracking data showed that the labelled package was looked at more often and for longer periods of time, both of which support the increase in sales. The collected survey data indicates interest in intelligent packaging, but also indicated a lack of knowledge. The results indicate an increase in sales when intelligent packaging is utilized, but also indicates that some advertising will be necessary to promote the concept.

#### HIRES ANALYSIS OF EIGHT CANDIDATE DUSTY ABSORBERS: IMPLICATIONS FOR CHEMICAL EVOLUTION IN GALAXIES

Ishrat Singh

Governor's School for Science and Mathematics

Quasar absorption systems (QASs) offer a way to spectroscopically study chemical evolution in galaxies, allowing one to better understand important astrophysical processes like stellar evolution, planet formation, and the development of life. Because their rich H I content can produce a substantial fraction of observable stars, classes of QASs including Lyman limit systems (LLSs) and damped Lyman- $\alpha$  absorbers (DLAs) provide a direct probe for analyzing the chemical evolution of metals in galaxies. QASs exhibiting dust absorption lines, known as "dusty" galaxies, are hypothesized to be more metallicity enriched than similarly-redshifted QASs lacking dust-related absorption. Using the IRAF data reduction package and the apparent optical depth method, the quasar spectra of two candidate dusty QASs, a DLA at  $z=0.692$  toward the quasar 3C 286 and an LLS at  $z=1.795$  toward the quasar Ton 618, were analyzed. A search for rare elements led to a novel identification of Ga in the LLS. Relative to comparable dust-free QASs, at  $-1.34 \pm 0.05$  dex, the DLA's metallicity was significantly lower than the mean metallicity at its redshift, whereas the LLS's metallicity,  $+0.86 \pm 0.12$  dex, was much higher than the mean metallicity at its redshift. However, due to the insufficient sample size of this study, more data is needed to determine a definite trend. Raw data for six additional QASs located along the sightline toward the quasar Q1246-057 ( $z=2.247$ ) are provided as well, and will be analyzed in full in a future study.

#### INHIBITION OF PHOSPHATIDYLINOSITOL-3-KINASE BY THE FURANOSQUITERPENOID HIBISCONONE C AND ITS DERIVATIVES

Elizabeth Skeie

Governor's School for Science and Mathematics

Furanosteroids like Wortmannin are proven to inhibit the continuation of the phosphatidylinositol-3-kinase (PI-3K) pathway. This pathway is upregulated in highly proliferative cells, such as cancer cells. Although it is able to effectively inhibit the PI-3K pathway, Wortmannin has off-target effects, is unstable in neutral pHs, and needs a time-consuming chemical synthesis, all of which prevents it from being considered as a chemotherapeutic drug. Recently published work from this lab showed that Hibisconone C, a structurally similar furanosteroid, has the ability to inhibit PI-3K. Using activated T-cells which are known to upregulate the PI-3K pathway, the ability of Hibisconone C derivatives to inhibit the PI-3K pathway were tested and the requirements of the carbonyls in the inhibitor necessary to inhibit the pathway were investigated. The hydrolyzation of the left carbonyl proved to prevent inhibition of the PI-3K pathway while the hydrolyzation of the right carbonyl still allowed for inhibition. The results of this research will direct future synthesis projects to create a more specific, stable, and potent inhibitor of the PI-3K pathway.

#### ESTIMATING PERSISTENCE LENGTH OF SSDNA USING FLUORESCENCE CORRELATION SPECTROSCOPY AND A COMPUTER SIMULATION

Patrick Smith

Governor's School for Science and Mathematics

DNA molecules are critical to cell life and development, as they are the basis for cell replication and synthesis of crucial proteins. Due to the phosphate in the backbone of DNA, it is negatively charged, so, with positive particles in the solution, the overall charge of the DNA will be changed. This increase in the overall charge of the molecule allows it to bend as the negatively charged backbone held the helical DNA in a straight progression of the helix, but, without the negative charge, the helix contorts and folds over itself. Because of these effects, a model for the shape and interactions of the cations and the DNA is critical. For the simulation, experimental results of the diffusion coefficients of DNA at multiple cation concentration serve as a basis for the simulation. For experimentation, we used Fluorescence Correlation Spectroscopy to obtain the diffusion times of the molecules, and, by using a known dye with a known diffusion coefficient, converted the diffusion times to diffusion coefficients of the DNA molecules. The simulation then made multiple virtual chains of DNA and found their diffusion coefficients, which were then compared to those of the experimental results using a defined cost function. This simulation yielded results that express a clear pattern, but contains too much noise in data, so we could not be certain of the conclusions we obtained. From this, we saw that our data showed potential for improvement, but shows that we were not successful in making an accurate simulation.

## THE EFFECTS OF TALCUM POWDER ON MOUSE 3T3 CELLS

Sidney Smith and Emily Brideau  
Center for Advanced Technical Studies

In the 1970s, doctors found particles of talcum powder in a number of ovarian tumors which sparked the controversy about whether or not talcum powder is linked to ovarian cancer. Studies since then have suggested that talcum powder does in fact directly cause ovarian cancer; however, those studies tend to exhibit response bias. Due to the structure of the female reproductive system, the talc would first have to travel through the cervix before it were to come in contact with the ovaries. This study's goal is to determine if there is a correlation between talcum powder and cervical cancer. In this study, Mouse 3T3 Cells will be used in this experiment as they closely emulate the behavior of cervical cells. Each sample of cells will be exposed to different amounts of talc powder, each for a different interval of time in order to observe if increased talcum powder use for an extended amount of time makes it more likely for a woman to develop cervical cancer. Cancer takes up to 10 years to develop, so for this particular experiment signs of dysplasia in the cells will be recorded as cancerous activity. In order to analyze the data, the transformation and growth of the 3T3 cells will be observed. This will be done by noticing if the cells have created clusters within the petri dishes. If the cells develop clusters, change in morphology can be assumed and further observation can be done to determine if cancer is forming.

## DETERMINATION OF HOX D11 GENE INFLUENCE ON CHICKEN EVOLUTION IN EMBRYONIC DEVELOPMENT

Harrison Snow and Rebecca Flanagan  
Governor's School for Science and Mathematics

There is overwhelming evidence that supports the belief that present-day birds evolved from prehistoric dinosaurs. From similarities in genotypes to striking resemblances in limbs, all evidence points in the direction of such a lineage. The mechanism driving this evolution is not as well known. However, recent discoveries have revealed the importance of Hox genes (a category of homeotic genes) in this process. Hox genes are clusters of genes involved in the embryonic development of most organisms. In short, they determine the specialization of cells along the crania-caudal axis, and give rise to vertebrae, limbs, and other structures such as body segments as seen in insects. All Hox genes contain homeoboxes that code for transcription factors responsible for this differentiation. This research studied one Hox gene in particular, Hox D11; its role, its prevalence, and its locations where its expression was most visible in chicken embryos via *in situ* hybridization. It was found that limb and tail regions showed heavy prevalence of Hox D11 mRNA expression, indicating that this particular gene could be responsible in part for the patterning of these specific structures, but this needs to be confirmed by western blot analysis for proteins. Since Hox genes have been present between various species across time, further research could also be conducted to compare the Hox gene expressions of chicken embryos with alligators, an older relative of the dinosaur, to prove their shared lineage.

## THE EFFECTS OF WEATHER CONDITIONS ON SOLAR PHOTOVOLTAIC PANELS

Brandon Snyder  
Center for Advanced Technical Studies

Solar energy is one of the largest renewable energy sources available in today's market. The energy that a solar photovoltaic panel obtains from the sun is related to the sun's irradiance and weather conditions of the operating panel. The purpose of this project is to determine how different weather conditions can impact the efficiency of a solar panel? Weather conditions such as cloud coverage, ice, dust, and snow will be tested with simulation materials on miniature solar panels rather than industrial solar panels due to the multiple weather conditions to be tested. If the surface of the solar photovoltaic panels are covered by the weather simulation material, then the materials will have an effect on the output of the panels. In the project, six solar panels will be used in the experiment, three of the 2-volt photovoltaic panels and three of the 10-volt photovoltaic panels. One out of the three of both of the 2-volt and 10-volt panels will be the control and not have a weather simulation material on the panel. Out of the weather conditions that were tested, cloud coverage, Ice, dust, and snow each showed how each weather simulation material effected the pv cell. The hypothesis is accepted because through the data obtained during the trials shows the trend of the solar panels producing less voltage as more weather simulation material is added. More weather conditions will be tested in the future such as fog and rain etc.

## RESIDENTS' PERCEPTION TOWARD TOTAL ECLIPSE WEEKEND

Mary Sox  
Spring Valley High School

The research was conducted to examine the residents' of Columbia, SC, perception of the Total Eclipse Weekend in 2017. The study involved analyzing three hundred five online surveys using exploratory factor analysis. It was hypothesized that there would be a list of significant factors with at least three items. In the survey there were eleven demographic questions and twenty-three statements. The sample was obtained via Facebook by using the snowball method. Participants ranked their agreement of the statements using a seven-point likert scale. Using varimax rotation for the factor analysis, four factors were considered significant, namely, environment, influence on community, tourism, and infrastructure. The results are important and useful for helping the city to improve its methods in tourism for the benefit of the residents which ultimately results in adding significantly to the local and state economy.

## THE EFFECTS OF A METAL OBSTRUCTION ON A GPS TRACKER

Brianna Stanley  
Heathwood Hall Episcopal School

The purpose of this study is to determine the effects of a metal obstruction (aluminum foil) on a GPS tracker and how these effects may change the reliability of the tracker. The hypothesis states that if an 8x8 piece of aluminum foil is wrapped around a GPS tracker then the tracker will become extremely inaccurate. Two different kinds of GPS trackers were moved down a course as a control; the Whistle 3 and the DreamClub. Every minute the location of the trackers was recorded. This was repeated twice to get the most accurate results. The trackers were then wrapped in 8"x8" sheets of aluminum foil and the whole process was repeated two more times. The distance between the points the trackers recorded and where the trackers actually were at the time was measured and placed on a graph. The trackers during the aluminum foil trials were completely inaccurate. The information that the trackers recorded said that they had never left the starting point. In conclusion, it is very possible for a metal obstruction to render the tracker completely useless, if not making it highly inaccurate. The same may be the case for areas with any sort of other obstruction, such as a large building, canyon, or cavern.

## THE EFFECT OF THE ANGLE OF A BICYCLE WHEEL RELATIVE TO A CAR ON THE VOLTAGE INDUCED DUE TO ITS ROTATION

Aaron Stark  
Spring Valley High School

When a bicycle is connected to the back of a car with a bike rack, the bicycle's wheels spin while the car is in motion due to the wind coming over the top of the car. This accessible mechanical energy is most often wasted. The purpose of this research was to try to reuse that mechanical energy as a raw "generator" to produce electricity for the car through Faraday's law. It was hypothesized that if the bike wheel was angled at 30 degrees, then more voltage would be induced than if the wheel were angled in other positions. Data was collected by manipulating the angle of the wheel via the straps of the bike rack and then spacing 24 magnets equally around the wheel. A coil was placed next to the wheel so that the magnets would pass under it as the wheel rotated. The coil was connected to an oscilloscope which showed the waveforms of the voltage that was induced each time a magnet passed under the coil. The hypothesis that the 30 degree configuration would induce more voltage than other configurations was supported. The 30 degree angle configuration induced significantly larger voltages than any other angle configuration tested for both directions at  $\alpha = 0.05$ ,  $F(3, 116) = 1525.04$ ,  $p < 0.001$  (North) and  $\alpha = 0.05$ ,  $F(3, 116) = 1670.01$ ,  $p < 0.001$  (South), respectively. It was concluded that tilting the wheel at an angle parallel to the curvature of the car (in this case, 30 degrees) would maximize the induced voltage for the contraption and thus would be most efficient for future application.

## THE EFFECT OF TRANSITION METALS AND ORGANIC ACIDS ON ESCHERICHIA COLI

Kierson Sutton  
Spring Valley High School

Escherichia coli is a gram negative bacterium that is commonly found in the intestines of warm-blooded organisms such as the human species. The purpose of this study is to see if people could use transition metals and organic acids as an alternative for antibiotics. It was hypothesized that transition metals would inhibit the growth of E.coli more than organic acids. Twelve different variable groups were tested in three sets. The first set was made of two different organic acids groups, glutamic acid and aspartic acid. The second set was made up of two different transition metals: Iron (III) Sulfate and Copper Sulfate. The third set was made of a combination of both the transition metals and the organic acids. E. coli was grown in nutrient broth and exposed to the appropriate independent variable. Growth was measured using optical density. After 24 hours of growth, optical density was measured via absorbance using a SpectroVis at a 420nm. The data was analyzed using a multiple regression test. An ANOVA test was ran based off of the hypotheses  $H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4$ , and  $H_1$ : at least one mean is different, at  $\alpha = 0.05$ . The results of the ANOVA showed that at  $\alpha = 0.05$ ,  $F(8, 81) = 3.00220$ ,  $p < 0.001$ . Based on this, it can be concluded that at least one mean was statistically significant from the others because  $p < 0.001 < \alpha = 0.05$ . The variable that inhibited bacterial growth the most was the Iron (III) Sulfate.

## CAN PAIRED ASSOCIATIVE STIMULATION MODULATE BRIAN PLASTICITY AND MOTOR EXCITABILITY IN STROKE PATIENTS?

Melat Tarekegne  
Governor's School for Science and Mathematics

In the United States, stroke is the fifth leading cause of death. A stroke occurs when blood circulation to a region of the brain is cut off, causing there to be a lack of oxygen in the brain. Strokes often result in impairment of the motor pathways of the body, leading patients to experience lack of motor control. In this experiment, a new technique, Paired Associative Stimulation (PAS), was tested to see its effects on the motor control of stroke patients. Specifically, increased motor cortical excitability was looked for. Through a series of four visits, PAS10, PAS25, PAS100 were tested on seven healthy controls and seven stroke patients. CSP, rMT, PP, RC, and MEP were measured in each visit. With these results, the MEP rate was calculated, as well as the Motor Threshold difference to see the effects of the PAS. Through these calculations, it was found that PAS10 inhibits motor cortical excitability instead of facilitating it.

## HOW MOTHER'S BELIEF IN MISINFORMATION IMPACTS THEIR CHILDREN'S MEMORY

Kathleen Tatusko

Governor's School for Science and Mathematics

It is known that interviewer bias is able to influence how children recall events (Ceci and Bruck, 1993; Bruck, Ceci, and Hembrooke, 2002). Principe et al. (2013) found that when mothers have been misinformed about their children's experiences it can lead to children's false report of events. In this study, we manipulated mother's belief in the misinformation and their degree of control to examine how these factors can influence children's memory recall. In this study, we used those two categories of mothers and then used a belief manipulation in order to make the two categories into four: outcome-oriented/strong suggestion, process-oriented/strong suggestion, outcome-oriented/weak suggestion, and process-oriented/weak suggestion. The results concluded that the two groups of mothers who were given the strong suggestion manipulation had a higher belief. Those mothers also were the most biased in their conversations with their children. The children of the outcome oriented/ strong suggestion mothers made the most false reports had the most details in their false reports.

## THEORETICAL EXAMINATION OF PHASE BEHAVIOR IN MULTI-COMPONENT MODEL MEMBRANES

Austin Taylor

Governor's School for Science and Mathematics

Many structural and safety hazards, especially in the aerospace and automotive industries, are invisible to an outside observer. More automotive and aerospace manufacturers are becoming more focused on composite materials, where many parts are now bonded. As of now, there are few feasible methods of detecting defects within the bond layer without implementing destructive evaluation. Non-contact methods of non-destructive evaluation (NDE) for bond layer inspection could allow for faster manufacturing, quality assurance, and cheaper manufacturing. The research conducted explored two methods of non-destructive evaluation (NDE) for structural health monitoring (SHM). One, a hybrid method, employs a piezoelectric lead zirconate titanate (PZT) - scanning laser Doppler vibrometer (SLDV). The other, a fully non-contact method, employs two air coupled transducers (ACT-ACT). It was found that both of these methods could detect damage to a specimen, and each method has different benefits. More research must be conducted to determine the full extent to which each method can analyze a specimen.

## DNA SELECTIVITY OF AT HOOK PEPTIDES

Madelaine Tedrick

Governor's School for Science and Mathematics

Certain proteins bind to DNA that contain specific sequences. HMGA proteins use AT hook motifs to bind to adenine and thymine rich DNA. During embryonic development, the binding between these proteins and DNA is present and normal. However, if these proteins bind to DNA during adulthood, the process can result in metastatic cancer. The purpose of this project is to gain a greater understanding of peptides that mimic the AT hook motif and their preference for different DNA sequences. This project tests the binding of a few peptides with many different DNA sequences. To do so, peptide is titrated into DNA and the fluorescence, which is affected by binding, is measured. The fluorescent emission value at 517 nm is measured as a function of peptide concentration and the data are then fit using the Michaelis-Menten equation, giving the average K value for each experiment. This value is the binding constant for the binding of each DNA by the peptide, and it represents how readily the peptide binds to that particular DNA. If the value is a low number, then the peptide binds to the sequence more tightly, but if the value is higher, it binds with more difficulty. The purpose of this experiment is to determine whether peptides with AT hooks show an affinity for specific DNA sequences over others. Results show that DNA sequences with "AT" in them tend to have lower binding constants and, therefore, are bound more easily by AT hook peptides than other sequences.

## DEVELOPING AN AUTONOMOUS COGNITIVE ASSISTANT IN THREE MODALITIES OF DATA

Jaden Tennis

Governor's School for Science and Mathematics

Due to advances in computing power and increased access to large datasets, machine learning has become a viable way of fostering productive and intuitive interactions between humans and computers. However, previous research and product developments, such as Apple's Siri and Amazon's Alexa, have been primarily limited to processing single modalities of data. This project sought to develop a more flexible and human-like cognitive assistant capable of making decisions based on its understanding of auditory, visual, and natural language input. This involved creating software that identifies songs based on short clips, recognizes the faces of users, and understands and produces language using a combination of statistical analysis and machine learning. To facilitate smooth user interface, the front end of the application used Amazon's voice recognition software hosted on the Echo Dot. Systems of this kind have widespread applications, including cognitive assistants for personal use and various professional uses.

## DEVELOPING A REACTOR AND CATALYST FOR AQUEOUS PHASE REFORMING PROCESSES

Hayden Tharpe  
Governor's School for Science and Mathematics

Glycerol is a byproduct in the production of biofuel that can be converted into hydrogen gas and carbon dioxide by way of an aqueous phase reforming (APR) process. Our focus was to bridge the gap between computational simulations and the physical world. The reactor that was built to run the APR processes needed a few optimizations, including heating the glycerol solution to reaction temperature by the time it reached the catalyst. Heating tape, adjusting the reaction temperature, and increasing the oven temperature were all tried in order to reach the desired 200°C reaction temperature. A 4.3 weight % Pt supported SiO<sub>2</sub> catalyst was also synthesized by dissolving tetraamineplatinum (II) nitrate in water and saturating the powder SiO<sub>2</sub> support with the solution, heating it overnight at 120°C, and performing calcination by allowing the other elements to burn off in a furnace at 600°C with nitrogen gas running over the powder. Our catalyst and reactor are going to be used to create H<sub>2</sub> from an otherwise unused byproduct, glycerol, which in turn will help create clean energy via hydrogen fuel cells etc. This advancement can help bring the planet one step closer to depending solely on clean and renewable energy.

## THE EFFECT OF HYPERACCUMULATOR BIOCHAR APPLICATION ON SOIL PROPERTIES AND PLANT GROWTH OF VIGNA RADIATA

Kristina Trifonova  
Spring Valley High School

Unlike fertilizers that lead to nitrate leaching, biochars have emerged as a natural way to increase plant nutrient uptake and crop yields and to improve soil acidity and quality. However, often large biochar amendments are required to produce significant effects on soil. This study aimed to determine the effectiveness of biochar made with hyperaccumulator plants, which are characterized by high cellulose levels and porosity. It was hypothesized that hyperaccumulator biochar-amended soil would lead to an increase in soil pH over time, plants with higher root to shoot ratios and total dry mass yields, and higher amounts of nitrogen, phosphorus, and potassium than wood biochar amended soil and soil with no amendment. Biochar was made from sunflower, kale, and pine wood bark at 330°C, and mung beans were grown in a 2% biochar soil mixture for 75 days. There was no significant difference between the effects of the different types of biochar on soil pH, nitrogen, potassium, or plant root to shoot ratios ( $p > 0.05$ ). However, biochar-amended soil showed increased phosphorus retention ( $K(3) = 12.786$ ,  $p = 0.005$ ). The relationship between soil pH and time was modeled by a quadratic trend ( $F(3, 180) = 3.21$ ,  $p = 0.024 < \alpha = 0.05$ ), as pH decreased for 60 days and then increased, while the control decreased constantly ( $p = 0.057 > \alpha = 0.05$ ). Plants in the bark and control groups had significantly higher total dry masses than those in the kale group, while dry masses of plants in the sunflower group were not significantly different from any others ( $F(3, 27) = 5.02$ ,  $p = 0.007 < \alpha = 0.05$ ). It can be concluded that, while not more advantageous than bark biochar, hyperaccumulator biochar is an equally effective way to increase soil cation-exchange capacity, while repurposing contaminated hyperaccumulator plants.

## THE MECHANICAL STUDY OF HYDROGELS AND AN ORGANOGEL AS POTENTIAL SYNTHETIC BRAIN PHANTOM

Allison Troup  
Governor's School for Science and Mathematics

The brain is an intricate organ, composed of white matter, gray matter, blood vessels, nerves, and dura matter. The study and surgical intervention of the brain is limited by the availability of cadavers for research and experience in the operating room. This work proposes the use of a 3D phantom brain tissue to create a realistic model of the brain with accurate mechanical properties of the brain. In particular, this study assess the mechanical properties of synthetic materials and porcine brain and tests properties of stress, strain, relaxation, and adhesion. Gelatin-based hydrogels and oil-based emulsions served as the two candidates for a brain substitute material. Results demonstrate that 1.7% Chromium 3.5% Gelatin was more similar to porcine brain in compression properties as shown by compression stress strain analysis and the other properties. This study has found a viable material substitute for the fabrication of a 3D brain phantom that aims to improve the learning experience of medical students and the preoperative planning of surgeons.

## THE EFFECT OF THE BICYCLE SAFETY DEVICE ON CYCLIST'S ABILITY TO DETECT CARS BEHIND THEM

DuBose Tuller  
Heathwood Hall Episcopal School

The purpose of this study is to determine the efficiency of the Bicycle Safety Device (BSD) on how far away cyclists can detect a car behind them. The BSD is a device that can detect objects behind it, chimes when it does so, and records how far away the object was in feet (up to 23ft.). The independent variable for this study was whether or not the BSD's chime was turned on, and the dependent variable was the value recorded by the BSD. The null hypothesis stated that the BSD would have no effect on cyclist's car detection ability, and the hypothesis stated that a cyclist would be able to correctly detect cars behind him/her from a greater distance and more accurately. The BSD was added onto a cyclist's bike, and the cyclist used it to determine how far away cars were behind him with and without the chime and how often he correctly predicted that there was a car behind him. After 20 days of cycling the BSD was determined to be slightly more efficient than the control, meaning that the cyclist was able to detect cars behind him from farther away. However, the difference was not large enough to be statistically significant, so the null hypothesis was supported. The cyclist was correctly able to identify cars behind him without the chime more consistently, suggesting that the BSD may yield false positives.

THE EFFECT OF CYCLOPS COPEPOD PREDATION ON THE PROMOTION OF GROWTH WITHIN *MICROCYSTIS AERUGINOSA* POPULATIONS THROUGH CHEMICAL SIGNALING

Sachet Urs  
Spring Valley High School

Harmful cyanobacterial blooms are a major threat to the world and need to be studied and researched more carefully. This research is aimed towards finding out if the predation of cyanobacteria actually causes more harm than good. There were three groups of 15 dishes that were all filled with 200 mL of distilled water. Cloth boundaries were made to split each dish in half (side A and side B) and they were hot glued to the glass. Each of the dishes contained 4 mL of *Microcystis aeruginosa* in both side A and side B. One group of dishes contained 4 mL of *Cyclops* copepods in side A, another group contained 6 mL of copepods in side A, and the last group contained no copepods at all. Five cyanobacteria diameters were measured and recorded from each dish over the course of four days. An ANOVA [F(2, 177)= 84.10, p<0.001] indicates there was a significant difference between the amount of copepods added and the cyanobacteria cell diameters. The 4 mL of copepods group had a noticeably larger average cyanobacteria diameter than the control group and the 6 mL of copepods group had a substantial difference from the control group. This data supports the claim that predation of *Microcystis aeruginosa* by *Cyclops* copepods does indeed cause increased cyanobacteria growth in the long run.

EPHA4B EXPRESSION IN THE CRANIOFACIAL DEVELOPMENT OF AFRICAN CICHLID FISHES

Chelse VanAtter  
Governor's School for Science and Mathematics

Epha4b gene expression may contribute to variances in facial formation including functional differences such as nose shape and clinical conditions such as cleft palate. During craniofacial development, neural crest cells migrate to the pharyngeal arches then differentiate to form bone, muscle, and cartilage cells. The Eph/ephrin signaling pathway guides the streams of migrating neural crest cells into the pharyngeal arches; epha4b, a gene encoding an Eph receptor, contributes to this signaling pathway. To determine how epha4b expression differs between species at different developmental stages, in situ hybridization, a process that stains areas of gene expression, was performed. African cichlid fish are an ideal model because species have evolved various morphologies based on their feeding. For instance, species such as *Labeotropheus fuelleborni* evolved a short mandible for biting and species such as *Maylandia zebra* evolved a long mandible for suction feeding. *M. zebra* embryos demonstrated low epha4b expression in pharyngeal arch one while *L. fuelleborni* demonstrated more epha4b expression, suggesting a negative correlation between level of epha4b expression and mandible length. Understanding the factors contributing to craniofacial development and variation will help discover treatments for facial birth defects and conditions.

THE EFFECT OF *HORDEUM VULGARE*, RICE HULL, AND OAK LEAF LITTER ON THE PREVALENCE OF *MICROCYSTIS*

Sreya Varanasi  
Spring Valley High School

Cyanobacterial harmful algal blooms are becoming more prevalent issues throughout the world, threatening ecosystems, posing risks to human health, and resulting in millions of dollars in economic damage. Conventionally, treatment approaches have been chemical or physical, but these are harmful to aquatic life or inefficient, respectively, which presents the biological approach as a favorable alternative. To assess the effects of low-effort and cost-effective treatments, *Hordeum vulgare*, rice hull, and oak leaf litter were individually applied to *Microcystis* cultures and compared to two negative controls (*Microcystis* alone and cotton on *Microcystis*) and a positive control (CuSO<sub>4</sub>). This research was aimed at comparing the capabilities of these treatments on minimizing the size of cyanobacterial blooms, through optical density. It was hypothesized that *Hordeum vulgare* would be the most effective treatment because barley straw releases phenolic compounds. Separately, observations of the effects of these treatments on *Daphnia magna* populations were noted in separate cultures without *Microcystis*. Optical density was taken of the groups with cyanobacteria at 730 nm prior to adding treatments and repeated twice on weekly intervals. After calculating the decrease in OD, an ANOVA at alpha equals 0.05 was used to determine whether there were any significant differences between the means. The ANOVA determined that the values were not significant, as p>alpha (F(5, 37) = 1.31, p=0.283), showing that none of the treatments had significantly different effects. Thus, the hypothesis that *Hordeum vulgare* would be the most effective in decreasing *Microcystis* prevalence was not supported.

CLEANER DIESEL EMISSION VIA PARTICULATE FILTRATION

Isaac Vardi  
Center for Advanced Technical Studies

Diesel engines are famously known for dirty emissions, so how can diesel emissions potentially be cleaner? There are many ways to reduce pollution via biofuels, diesel particulate filtration (DPF) or EGR (Exhaust Gas Recirculation), catalytic oxidation, pre-DPF water injection technique and many more. This project focuses on 2 major types of reduction biodiesel and particulate filter. In this study multiple experiments will be performed to identify the cleanest burning diesel fuel. B25, B30, and B50 were chosen to be tested. The particulate filter part of the project will be designing a new filter that will be affordable and self installable. What kind of solution could be used to reduce pollution from a diesel engine? If biodiesel is used and a particulate filter is installed then the emissions coming from the diesel engine will be cleaner. The first phase of the project involved burning B25,

B30 and B50 in lanterns with chimneys. Each chimney has a layer of cheesecloth on top to collect the particulate matter. Each trial is tested for 1 hour and the mass of the cloth is collected. In the second phase a particulate filter is being redesign to be more affordable and easily replaced. For each trial, the particulate filter is connected to a modified exhaust pipe that is connected to an engine. Each trial is ran for 1 hr. The data collected for the blends show that B50 makes the least amount of emissions while B25 makes the most and B30 is in the middle. So if biodiesel and a particulate filter are used on a diesel engine then it will reduce the amount of pollution that is made. These are just 2 ways to reduce pollution. Some future work that will be conducted would be making a final filter product that can be tested in a diesel vehicle.

#### THE EFFECT OF KAPOK FIBER AND RAW COTTON FIBER WITH FERROMAGNETIC PARTICLES ON OIL REMOVAL FROM WATER

Amal Verma  
Spring Valley High School

Oil spills have accompanied the development of the industrial economy, but oil spill contingency plans are costly and inefficient. Sorbents have been gaining popularity as cost efficient and abundantly available materials to be used, but they have a relatively low oil sorption capacity. This can be fixed through the use of magnetic nanoparticles. This research was aimed at combining ferromagnetic nanoparticles and various natural sorbents to maximize the sorption of oil. The sorbents used were cotton and kapok fiber. Experimentation was conducted by randomly placing sorbents into jars filled with water and oil, and weighing how much oil was absorbed by each sorbent after a day. It was hypothesized that the cotton with the ferromagnetic nanoparticles would work the best at absorbing oil. Five trials were tested for each sorbent, and the average oil absorbed by all the bags was recorded. The results indicated that ferromagnetic nanoparticles had a significant impact on the amount of oil absorbed by the sorbents: ( $F(3,16)=19.33, p<0.001$ ). The results also showed that the cotton absorbed more oil than the kapok fiber. It was concluded that the cotton with ferromagnetic nanoparticles worked the best out of all the sorbents to absorb oil. The Tukey test indicated that Cotton with ferromagnetic particles and Kapok with ferromagnetic particles as well as the Cotton Fiber and Kapok Fiber show significant difference.

#### CORRELATION OF FACTOR ANALYSIS OF CONSUMER DISPOSITION TOWARDS COUNTERFEIT GOODS WITH RESPECT TO SOCIO-DEMOGRAPHIC VARIABLES

Annelise Waling and Andrew Poore  
Governor's School for Science and Mathematics

In this study, we determined if and what parts of a respondent's background correlated with their concern for brand status, risk awareness, and ethics in terms of counterfeit goods using factor analysis. The results for this study came from a survey distributed in Charleston, South Carolina and Shanghai, China. We found that respondents from the Shanghai sample were more concerned about brand status, understood more about the risks associated with buying counterfeits, and were more conscious of the ethical concerns regarding counterfeit goods. Additionally, we found that older people were less concerned about brand status. The most interesting finding of our study is that, with all other variables held constant, being part of the Shanghai sample results in higher values for each factor, in our analysis.

#### PHYSICAL SCALE MODELING OF TENSEGRITY ROBOTS

Aika Washington  
Governor's School for Science and Mathematics

The purpose of this research experiment was to find a reproducible method for scaling up tensegrity robots physically. Many of the tensegrity robots that have been previously designed have not been prototyped physically. They have only been simulated, due to complications that arise as they get larger. The reason behind this is that complications arise when tensegrity robots begin to get larger; the arms of the robot arms get larger and bulkier, and therefore more power is needed to move the robot. In this research experiment, the ultimate goal was to find a set of parameters that could remain the same over gradually larger models. The parameters that were chosen to be controlled were the bending moment of the tensegrity robot's arms and the spring constant of the elastic that holds the arms together. Polylactic acid (PLA) was used to create the tensegrity robot's arms, and a spring constant of 0.6253 kg/s<sup>2</sup> was measured. These parameters were used successfully to double the size of the tensegrity robot by keeping constant the ratio of the bending moment of the arm to its elasticity.

#### THE EFFECT OF MODIFIED SOCCER HEADGEAR ON THE FORCE OF A SOCCER BALL DURING SOCCER HEADING

Tyler White  
Spring Valley High School

Soccer is the most played sport in the world, with over 256 million people actively playing "The Beautiful Game." Soccer is also the only sport where the players intentionally use their head to clear, pass, and score the ball. An estimated 300,000 sport-related brain injuries occur every year in the United States, and 8.9% of high school injuries and 5.8% of college injuries are concussions (Gessel *et al.*, 2007). In response to multiple studies showing the dangers of heading, soccer headgear was created. Its purpose is to reduce forces on the brain caused by contact to the head, whether it be via ball, player, or ground. These headgears wrap around the head and are made of foam and other force-absorbing materials. The purpose of the experiment was to determine the best material for force reduction for soccer headgear. It was hypothesized that the modified headgear,



specifically expanded polyethylene, would significantly decrease impact force of the ball on the head. A force sensitive resistor was used to track the force of three groups, expanded polypropylene, expanded polystyrene, and the control. The speed was controlled as well. The statistics showed that the polypropylene was statistically better at reducing force than the control and polystyrene. Polystyrene was not an effective material for force resistance. The success of the polypropylene is possibly due to the hexagonal shape, in comparison to the circular shape of polystyrene and the control headgear.

#### THE EFFECTS OF TWO DIFFERENT TRAINING SCHEDULES ON THE VERTICAL JUMP HEIGHT OF VOLLEYBALL PLAYER

Mikaila Widener  
Spring Valley High School

Volleyball conditioning during off season training focuses on developing core and leg strength. Due to its success in causing hypertrophy, weight training is the primary strategy for building the muscle in the legs. More recently, plyometric exercises have been implemented into the conditioning regimen of many sports. This study aimed to compare the effectiveness of a primarily plyometric schedule versus a primarily weightlifting schedule. It was hypothesized that the weight lifting-based conditioning would improve vertical jump height the most. For this study, a 30 to 70 percent ratio of weight lifting to plyometrics and vice versa was installed into the off season conditioning of a high school volleyball player. The participants' standing jump and approaching jump was recorded. For the control, the preconditioning vertical jump height of each participant was taken. Group 1 (70% plyometric training) displayed the greatest improvement with an increased height of 3.0004 cm standing and 2.8702 cm approaching. There was only a 0.9144 cm increase in the standing and approaching jump height after training for Group 2 (70% weight lifting group). A dependent t-test ( $t(14) = -3.25, \alpha = 0.05 > p = 0.006$ ) showed that there was a significant difference between the average vertical jump height before and after training for the standing jump of Group 1. Another dependent t-test ( $t(14) = -3.53, \alpha = 0.05 > p = 0.003$ ) revealed that there was also a significant difference between the average vertical jump height before and after training for the approaching jump of Group 1. The t-test ( $t(14) = -1.02, \alpha = 0.05 > p = 0.351$ ) used to analyze the difference in the means of the pre- and post- training of the average standing jump and approaching jump ( $t(14) = -0.95, \alpha = 0.05 > p = 0.361$ ) of Group 2 showed there was no significant difference. These results suggests that a primarily plyometric training regimen will improve a volleyball player's vertical jump height more efficiently.

#### THE EFFECT OF THE PACING STRATEGY OF HIGH SCHOOL MALE CROSS COUNTRY RUNNERS ON THE FINISH TIME AND HEART RATE OF THE RUNNERS

Mark Wild  
Spring Valley High School

Pacing strategy is something all runners have to consider every time they race. It can be difficult to correctly pace, especially for high school runners. The purpose of this project was to analyze the pacing of the cross country runners tested to better understand necessary pacing for medium distance races. It was hypothesized that if the effect of performing with even pacing in male high school cross country runners was tested, then it would be found that even pacing proved to bring overall faster finishing times and slower increasing heart rate throughout the race compared to pacing that did not qualify as even. The participants of this experiment consisted of a group of ten boys from a high school cross country team, running three threshold runs consisting of 4 miles each. The heart rate was looked at before the workout and at each mile marker, for a total of 5 readings. The evening pacing group showed faster finish times and lower percentage heart rate increase for the means and medians. One-way ANOVAs were done at  $\alpha = 0.1$  to differentiate between the two groups in relation to heart rate increase and finish time. The ANOVA dealing with heart rate yielded a p-value of 0.649, meaning the difference in heart rate was not found to be significant. However, the ANOVA testing difference in finish time had a p-value of 0.000. This proved it to be significant, meaning the even pacing group was found to run faster overall finish times.

#### KDM4B INHIBITION TO HELP CURE PERIODONTAL DISEASE

Rachel Wilkinson  
Governor's School for Science and Mathematics

Periodontal disease is an oral inflammatory disease that affects much of the American population and currently has no cure. The inflammatory response is controlled by the coordinated genes, KDM4B and KDM1A. KDM4B causes inflammation while KDM1A suppresses it. Therefore, a reduction in KDM4B expression and an increase in KDM1A expression would lower inflammation. Previous research has shown that ML324 is a probable candidate for treating periodontal disease through inhibition of KDM4B. During this research derivatives of Drug 8, a drug targeted to inhibit KDM4B, were synthesized. We tested ML324 along with Drug 8 and its two derivatives on cell cultures. The inflammatory response was measured and compared. Our results show that ML324 continues to be a promising candidate, Drug 8 suppressed the inflammatory response to a lesser degree, and the two derivatives of Drug 8 did not suppress any inflammation.

## THE EFFECT OF CONCENTRATION-IMPROVING MUSIC ON READING COMPREHENSION

Kate Willhide  
Heathwood Hall Episcopal School

In this experiment, the effect of concentration-improving music on students' reading comprehension was tested. The purpose of this experiment was to determine whether music that claims to enhance concentration would have any noticeable effect on students' reading comprehension skills. 27 students took 4 reading comprehension tests over the span of a month, with 1 test per week at the same time every week. The time allotted for test-taking was 15 minutes. Test 1 established a baseline score, and the following 3 tests had a different music track playing as background noise while students were taking the assessment. Students completed a post-assessment survey, indicating whether they listened to music while studying, what kind of music, and how distracting they perceived the testing environment to be. Descriptive statistics were run on raw scores, followed by a single-factor ANOVA test. No overarching trends were visible in the data; 14 students improved over the course of the experiment, others declined, still others showed no pattern in their scores. The ANOVA test results ( $\alpha=0.05$ ) had a P-value of 0.08, an F-value of 2.29, and an F-crit value of 2.69. Therefore, the null hypothesis failed to be rejected. There is no statistically significant difference between the reading comprehension scores in the control group with silence and the experimental groups exposed to concentration-improving music.

## THE EFFECT OF WHEEL AND DRIVE TYPES ON THE OVERALL PERFORMANCE OF A ROBOT IN TESTS OF ALIGNMENT AND TRACTION

Alyssa Williams  
Spring Valley High School

The purpose of this experiment was to determine which base type produced the most efficient robot in tests of alignment and traction. It was hypothesized that there would be a significant difference between the mean angles of deviation and distances travelled. It was also hypothesized that the robot with the straight drive and combination wheels would have the lowest angle of deviation and farthest distance travelled overall (in meters). The bases were tested for alignment by autonomously driving the bases along a planned path and measuring the angle of deviation from the optimal trajectory in degrees. To test traction, a weighted box was placed in the robot's path and the robot's overall distance of forward motion was recorded after a specified number of seconds. Welch's tests were performed in place of ANOVAs in the absence of equal variances and they revealed a significant difference between the means in the alignment data,  $F(5, 79.2744)= 106.50, p<0.05$ , and the traction data,  $F(5, 78.7050)= 3567.51, p<0.05$ , supporting the first hypothesis. The bases with the lowest mean angle of deviation were the straight drive bases and the bases with the longest mean distance traveled were the straight driven bases with combination and omnidirectional wheels, partially supporting the second hypothesis. These findings are significant because they suggest that straight drives with combination or omnidirectional wheels are best for performing tasks requiring high linear accuracy and traction. This could influence future robot designs.

## MODELING THE ELECTRICAL CHARACTERISTICS OF PLATINUM ELECTRODES FOR USE IN SIMULTANEOUS STIMULATION AND RECORDING OF NEURONS

Joseph Williams  
Governor's School for Science and Mathematics

The most major obstacle to the simultaneous stimulation and recording of neurons is the difference between the energy required to artificially stimulate a neuron and the energy that the neuron releases when it fires. Though models have been generated for platinum electrodes that attempt to predict the extent to which this "noise" occurs in order to facilitate its removal, there are some that question the reliability of the concepts behind these models. In this project, we attempt to generate our own model for the electrical characteristics of platinum in terms of Access resistance (R) and Capacitance (C). We then test our model at a variety of different frequencies, amplitudes, and offsets and attempt to predict R and C. Our experimental setup consists a simple four electrode array of  $100\mu\text{m}$  by  $200\mu\text{m}$  platinum electrodes, an NaCl solution, two  $10\text{K}\Omega$  resistors, an oscilloscope, an arbitrary waveform generator, and a MatLab program.

## SEA LEVEL RISE AND COASTAL EROSION'S IMPACT ON LATE-ARCHAIC SOUTHEASTERN UNITED STATES SHELL RINGS

Hannah Willis  
Governor's School for Science and Mathematics

I worked with the South Carolina Department of Natural Resources Heritage Trust Archaeologists on a Late Archaic period shell ring on Edisto Island. I completed punch tests along marked lines of a gridded map to determine how deep the shell ring reached into the earth. I kicked a pointed rod into the earth and measured the difference in height from entering and exiting the shell layers to determine the depth or height of the shell ring. Every fifth punch test included a shovel test, so a shovel would pierce the earth and remove the contents to examine for accuracy of punch readings and possible trends in artifacts. One hypothesis is that part of this shell ring was used as a workshop to make and repair tools for the people who lived there. Another section of the shell ring contained a high concentration of carved bone pins and other rarer artifacts, indicating that part of the shell ring was probably used for ceremonial purposes. The possibility of sections of purpose of the shell ring is a new discovery. These sections give the idea that the shell rings might have been divided into a village of sorts with each section dedicated to a different purpose. This is a new theory that will lead to yet more research and data collection.

## REDUCING ENOLASE EXPRESSION AND ACTIVITY TO PREVENT HARMFUL DAMAGE IN SPINAL CORD INJURY

Jada Wilson

Governor's School for Science and Mathematics

Approximately one in fifty thousand people suffer from spinal cord injury (SCI). This type of injury is extremely damaging and causes permanent neurological deficiencies. In this study, enolase activity was targeted by treating rats with the injury with ENOblock, Lipopolysaccharides (LPS), and both ENOblock/LPS. In previous studies, it was concluded that it is possible to improve/treat this condition by blocking neuron specific enolase (NSE). Neuron specific enolase is a protein associated with SCI that has been shown to increase the damage after a secondary injury that is due to the activation of inflammatory cascades and changes in NSE levels. It has also been shown that, after treatments of ENOblock (an enolase inhibitor) NSE levels decreased which could result in the development of a salutary treatment. In this study, the effects of ENOblock and LPS on induced rat cells was observed on several proteins. It was concluded that multiple treatments of ENOblock did not result in a significant increase in cell viability. However, the treatments appeared to be harmless to the cells. Further, there did not appear to be a significant effect on cell proteins.

## GRP94: A POSSIBLE THERAPEUTIC TARGET FOR MULTIPLE MYELOMA

Victoria Wilson

Governor's School for Science and Mathematics

Multiple Myeloma is a malignant plasma-cell cancer with little known about its pathogenesis and no cure. Previous studies attribute the cancer's development to the upregulation of the Unfolded Protein Response (UPR) of its cells. This is an evolutionally conserved process that responds to an abundance of misfolded or unfolded proteins released from the endoplasmic reticulum. Among the signaling cascades of the UPR, grp94 is a downstream chaperone protein that assists in the folding of proteins. This protein chaperone proves to be a promising target because greater concentration of the glycoprotein shows a correlation with worsening stages of Multiple Myeloma. If the inhibition of grp94 has a negative impact on the cancer's cell survival, then this supports its use as a promising therapeutic target. Western Blots and Cell Proliferations Assays were conducted to measure the effects of WS13 (a grp94 inhibitor) on Multiple Myeloma plasma cell survival. From the results, WS13 decreases cell proliferation. The Western Blots of Caspase-7 and HSP90 reveal that grp94 induces apoptosis of the Multiple Myeloma cells, but does not induce UPR. Since grp94 is linked to the pathogenesis of the malignant cancer and the UPR, then the fact this study supports that the inhibitor does not induce UPR, but decreases cell proliferation is promising. From this study, the inhibition of grp94 is a promising method for decreasing cell survival of Multiple Myeloma cells.

## MOMMA BEAR BRACELET

Kayla Wohleber

Center for Advanced Technical Studies

Simulated presence therapy is a non pharmacological treatment that utilizes audio recordings of a loved one to calm a distressed patient. As of now, this approach has only been tested on those with dementia. In an effort to reduce the excessive fear children experience at times of separation, the focus of this study is on measuring the effectiveness of simulated presence therapy on children with separation anxiety. Each child selected to participate in this study will wear the Momma Bear Bracelet for two consecutive weeks. This bracelet consists of a fabric wristband and a plush centerpiece that will hold a small recording device. A parent and/or guardian will be able to record short and encouraging messages that their child can easily play back at any moment. A daily log will be kept by the parent of the child to track his or her progression. Along with the daily log, a series of surveys will also help analyze the the benefits, and any improvements that will need to be made, of the bracelet. A survey will be taken before the treatment begins to serve as a base and a control. Another survey will be taken after the treatment to assess if there was any improvement in the child's behavior. If the parent and child follow all the rules that this study entails, the child's separation anxiety is expected to reduce.

## THE APPLICATION OF PVP-COATED NANOPARTICLES FOR OIL REMOVAL FROM SYNTHETIC SEAWATER IN THE PRESENCE AND ABSENCE OF FULVIC ACID

Jaden Yam

Governor's School for Science and Mathematics

Oil spills have detrimental effects to marine, animal, and human health. Current oil remediation techniques like in situ burning, dispersants, booms, and skimming are ineffective and may further release harmful substances into the environment. Nanotechnology is working to develop a cost-effective and non-toxic method to aid oil remediation by utilizing magnetic nanoparticles. Iron oxide nanoparticles are magnetic and have a low toxicity. A co-precipitation technique was used to synthesize polyvinylpyrrolidone (PVP)-coated iron oxide nanoparticles in ambient temperatures. These nanoparticles were then used to separate MC252 crude oil from synthetic seawater samples under environmentally relevant conditions. Low amounts of Suwannee River fulvic acid (1 ppm) were added to samples in order to simulate conditions in the open ocean. Fulvic acid slightly reduced the oil removal efficiency, decreasing the percentages from 91.9% to 91.0% without and with fulvic acid respectively. Fluorescence spectroscopy was used to measure the oil removal efficiency. There was a high oil removal efficiency under environmentally relevant conditions.

#### THE EFFECT OF HIGH DENSITY POLYETHYLENE SIZE ON DECOMPOSITION RATE

Sera Zell  
Spring Valley High School

As technology evolves there is a constant increase in plastic production and waste. In fact, an estimate 8 million tons of plastic waste is dumped in the ocean every year. This research was conducted on the decomposition rate of high density polyethylene, a plastic is many common plastic products. The purpose of this experiment was to study the effect of high density polyethylene size has decomposition rate. It was hypothesized that microplastics (squares of plastic between 1 mm<sup>2</sup> and 25 mm<sup>2</sup>) would have a higher decomposition than macroplastics (squares with a surface area greater than 400 mm<sup>2</sup>) in the span of a month. Thirty squares of microplastics and thirty squares of macroplastics were placed in cups of potting soil. These cups were placed outside under a covered area, and were left for one month to decompose. Plastics were massed beforehand and after hand, and a percent decomposition was calculated. A two sample t-test determined that there was a statistically significant difference in microplastics and macroplastics showing that macroplastics, had a higher decomposition percentage.

#### THE EFFECT OF PET AND PVC PLASTIC POLLUTION ON THE BIOMASS OF NANNOCHLOROPSIS OCULATA

Luke Zhang  
Spring Valley High School

Marine phytoplankton populations are a vital part of many ocean ecosystems and the biosphere as a whole. Phytoplankton not only produce 70% of the Earth's oxygen, but are also the largest carbon sink on Earth. However, as a result the recent increase in the production and waste of plastic, many tons of plastic find their way into the plastic each year. This experiment was conducted to see if the presence of plastic in the water affected phytoplankton growth. It was hypothesized that the control group would have the highest dry mass, the PET group would have the second highest, and that the PVC group would have the lowest dry mass. Phytoplankton cultures were grown in a ocean water mix in glass jars below a window for a period of 21 days. There were 45 jars in total, which were randomly assigned to 3 experiment groups. Each group had 1 g of its respective plastic inserted at the start of the growth period. After the growth period, samples of each culture were taken and centrifuged, dried at 70° C for 72 hours, and weighed to find the dry mass. It was found that the PVC and control groups had significantly higher dry masses than the PET group. A one way ANOVA was conducted at a 95% confidence interval a p-value of 0.019 was found. A Tukey post-hoc test was then done and both the control and PVC groups' masses were found to be significantly greater than the PET groups.

END

SC Junior Academy of Science Abstracts

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