South Carolina Academy of Science

BULLETIN
of the
South Carolina Academy of Science
Volume XCII
2019
Including the 92nd Annual Meeting Program

CAMPUS MAP

Ervin Dining Hall (#19)

Leatherman Science Facility (#6)
(SCAS Orals)

Smith University Center (#7)
(SCAS Posters)

McNair Science Building (#5)
(SCAS Registration /
SCAS Judging Room)

Chapman Auditorium (#5)
(Plenary / Governor's Awards /
Student Awards)

Founders Hall Breezeway
(SCJAS Registration)

Parking

Founders Hall (#3)
(SCJAS Orals / SCJAS Judges Room)

Francis Marion University

Street Address for GPS:
4822 E. Palmetto St.
Florence, SC 29506

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 2018-2019

Kevin McWilliams, President ..... Coastal Carolina University
President-Elect (*Position open*) .....
Heather Evans-Anderson, Immediate Past President ..... Winthrop University
John Kaup, Past President ..... Furman University
Latha Gearheart, Program Chair ..... Presbyterian University
Vice-President (*Position open*) .....
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

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 ..... Claflin 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 (*open*) .....
Necrology ..... Pearl Fernandez
Membership ..... Don Jordan (interim)
Publicity ..... Bob Wolff
State Science Fair Coordinator ..... Don Jordan
Website ..... Jeff Pike, John Kaup, Laurie Fladd
High School Research Awards ..... John Kaup, Laurie Fladd
Teacher of the Year ..... Laurie Fladd, Pearl Fernandez

Please visit SCAcademySci.org for a full listing of committee memberships

Publication information

The *Bulletin of the South Carolina Academy of Science* is published each spring in conjunction with the annual meeting of the South Carolina Academy of Science. For archived copies or to correct errata, please contact the editor at dkferris@uscupstate.edu

TABLE OF CONTENTS

Dear Students, Teachers, Scientists, and Colleagues,

I am pleased to welcome you to the 92nd annual meeting of the South Carolina Academy of Science (SCAS). It is an honor to have you all at Francis Marion University, 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. James T. Costa, Executive Director of Highlands Biological Station, from the Department of Biology at Western Carolina University, with us today. Dr. Costa is a Darwin and Wallace scholar and will be delivering a talk entitled, "Darwin's Backyard: Lessons from an Inveterate Experimentiser." We are also excited and honored to present the Governor's Awards for Excellence in Scientific Research and Scientific Awareness to the 2019 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. Jeff Steinmetz and the staff and faculty at Francis Marion University, 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 president, Dr. John Kaup, for his 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-SECOND ANNUAL MEETING
2019 SCHEDULE OF EVENTS

7:30 AM - 10:00 AM	**SCAS Registration**	McNair Science Building (MSB)
7:30 AM – 9:00 AM	Continental Breakfast	McNair Science Building (MSB)
8:30 AM – 10:00 AM	**SCAS Oral Sessions**	Leatherman Science Facility (LSF)
	Biology: Cellular /Molecular	LSF 102
	Biology: Molecular	LSF 104
	Physiology and Health	LSF 107
	Biology: Field / Zoology Environmental Science	LSF 108
	Chemistry / Computer Science Physics / Engineering / Geology	LSF 109
10:00 AM – 11:30 AM	**Poster Session**	**Smith University Center**
	Posters may be set up anytime between 8 a.m. and 10 a.m. *(All posters must be on display by 10:00 a.m.)*	
11:30 AM – 12:15 PM	**Lunch**	**Ervin Dining Hall**
	Pick up lunch ticket with name badge. *BLUE tickets dine between 11:30am-12:15pm* *YELLOW tickets dine between 12:30pm-1:15pm*	
1:30 PM– 2:45 PM	**Plenary Session** **Governor's Awards**	**Chapman Auditorium in MSB**
3:00 PM	**Undergraduate Awards**	**Chapman Auditorium in MSB**

SCAS Judges Conference Room	***McNair Science Building 106***

SOUTH CAROLINA JUNIOR ACADEMY OF SCIENCE
2019 SCHEDULE OF EVENTS

7:30 AM - 10:00 AM	**SCJAS Registration**	**Founders Hall Breezeway**
7:30 AM – 9:00 AM	*Continental Breakfast*	
8:30 AM – 10:30 AM	**SCJAS Oral Session I**	**Founders Hall**
	See SCJAS oral session listing for details & room numbers	
10:30 AM – 10:45 AM	**Break**	
10:45 AM – 12:30 PM	**SCJAS Oral Session II**	**Founders Hall**
	See SCJAS oral session listing for details & room numbers	
[10:00 AM – 11:30 PM]	**SCAS Poster Session**	**Smith University Center**
	Junior Academy members are encouraged to visit SCAS posters	
12:30 PM – 1:15 PM	**Lunch**	**Ervin Dining Hall**
	Ticket is in your badge holder	
	Be sure to have lunch during the time indicated on your ticket	
1:30 PM – 2:30 PM	**SCJAS Oral Session III**	**Founders Hall**
	See SCJAS oral session listing for details & room numbers	
1:30 PM– 2:45 PM	**Plenary Session** **Governor's Awards**	**Chapman Auditorium in McNair Science Building**
3:00 PM – 4:00 PM	**Afternoon SCJAS Activities & Workshops**	**Richardson Hall** *(near Neville & Lassiter Halls)*
	Medical Entomology Acquiring Assessment Skills through the Use of Simulators Journey to the Center of the Atom Planetarium Show: Phantom of the Universe Francis Marion University Campus Tour	
	See page 43 for details on activities and workshops.	
4:15 PM	**SCJAS Awards Ceremony**	**Chapman Auditorium**

SCJAS Judges Conference Room	***Founders Hall 114B***

Plenary Session

Darwin's Backyard: Lessons from an Inveterate *Experimentiser*

Dr. James T. Costa, Professor of Biology, Western Carolina University and Executive Director of the Highlands Biological Station

Dr. James T. Costa is a Professor of Biology at Western Carolina University and is the Executive Director of Highlands Biological Station. Dr. Costa received his bachelor's degree in biology and philosophy from the State University of New York College at Cortland, his Master's in entomology and community ecology from the University of Georgia, and his Ph. D in population genetics and entomology from the University of Georgia. Dr. Costa is also a Darwin and Wallace scholar and serves as a Trustee of the Charles Darwin Trust in London and was awarded the Wallace Medal from the Alfred Russel Wallace Memorial Fund in London. He has written several popular books on Darwin and Wallace, including his most recent book, "Darwin's Backyard: How Small Experiments Led to a Big Theory."

Dr. James T. Costa
Executive Director of Highlands Biological Station

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 Wayerhaeuser (2017) and the **South Carolina Research Authority** (2015-Present) have sponsored the Governor's Awards.

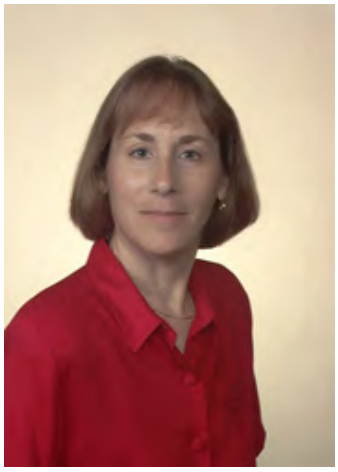
Beginning in 1990, two of these awards were given annually to include an award for scientific discovery and/or an award for scientific awareness. In 2005 the Academy, in conjunction with the Governor's Office, initiated the sponsorship of a third award directed to a gifted young researcher (*only those 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 past10 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.

2019 SOUTH CAROLINA ACADEMY OF SCIENCE
EXCELLENCE IN SECONDARY SCIENCE OR MATHEMATICS TEACHING
is awarded to

Jennifer McLeod-Crady

Ridge View High School

Jennifer McLeod-Crady has taught a variety of engaging science courses for the students of Richland County for over 16 years. Her background in environmental science and natural resource management provides a novel platform for innovation and application in and beyond the classroom. Her problem based learning activities, supplemented with field labs and modern technology, serve the varied learning pathways that exist in our 21st century students. Since 2015, she has mentored 11 students with research experiments and presentations at science symposia. She is viewed as a teacher leader and routinely collaborates with her colleagues to develop highly effective learning environments. It is our pleasure to name you the South Carolina Academy of Science Teacher of the Year.

Jennifer McLeod-Crady
Ridge View High School

I believe hands on inquiry learning helps excite students to ask more questions and become critical thinkers. We have moved to an age where most answers are found on Google. My goal is to create the learning environment where students interact and explore the nature of science instead of just looking up an answer and memorizing content. I am always excited when my students come back and tell me they finally understand what I was doing to them. It was not until their freshmen year in college that they realized the importance of practice, critical thinking, problem solving, and collaboration. They usually come and brag about how easy college has been and that their roommates struggle with the transition from high school to college. This is how I know I have been successful. They can carry the 21st century skills out of my classroom into their future careers.

Please join us in honoring all our 2019 nominees in recognition for their achievements:

Sandra Cole……Spring Hill High School
Angela Hill……...Westwood 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
Tonya Swalgren 2018 ..... White Knoll 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 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 (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, 1st Place
2016: Alexander Abare, Clemson University, 2nd Place
2017: Neema Patel, USC Columbia, 1st Place, and
2017: Reagen Welch, Southern Wesleyan University, 2nd Place
2018: Gillian Horn, Converse College, 1st Place
2018: Lisette Payero, USC Aiken, 2nd Place

TOPICAL SESSIONS SCAS

Saturday, March 30th 2019

BIOLOGY: CELL & MOLECULAR

8:30 AM – 10:00 AM
Leatherman Science Facility (LSF) 102
Moderator: Lori Turner

8:30 AM EFFECT OF RED CLOVER AND INDIGO PLANT EXTRACTS ON MDA-MB-231 TRIPLE NEGTIVE BREAST CANCER CELLS
Michael Stevens, Isaac Daffron, Shelby Tyler, Dorota Abramovitch, Donna Weinbrenner, and Diana Ivankovic, Anderson University.

8:45 AM FISH FORENSICS: DETECTING SEAFOOD SUBSTITUTIONS WITH MOLECULAR METHODS
India Ravenell, LaDonna Samuels and Marlee Marsh, Columbia College.

9:00 AM INVESTIGATING ROLES OF NUCLEAR TRANSPORT PROTEINS DURING EMBRYOGENSIS
Madison Davis and Christine Byrum, College of Charleston

9:15 AM DEVELOPMENT AND ANALYSIS OF AN ACTIVATION TAGGING SYSTEM IN WHEAT
Amanda Askins and C. Nathan Hancock, University of South Carolina Aiken

9:30 AM DETERMING HOW PHF21AA AFFECTS CRANIOFACIAL DEVELOPMENT IN ZEBRAFISH
Lacie Mishoe and April DeLaurier, University of South Carolina Aiken

9:45 AM EVALUATING THE EFFECTS OF ADIPOSE TISSUE FUMARASE KNOCKOUT IN THE DEVELOPMENT OF DIABETES.
Macey Johnson and Norma Frizzell, University of South Carolina School of Medicine.

BIOLOGY: MOLECULAR

8:30 AM –10:00 AM
Leatherman Science Facility (LSF) 104
Moderator: Jeremy Rentch

8:30 AM EXPRESSION OF PRO-APOPTOTIC BAX IN A HIV-1 DEPENDENT LENTIVIRAL VECTOR
Lance Reynolds and William H. Jackson, Jr., University of South Carolina Aiken.

8:45 AM CLONING A HIV-1 VIF-RESISTANT A3G GENE INTO A LENTIVIRAL VECTOR
McKenzie Spires and William H. Jackson, Jr., University of South Carolina Aiken.

9:00 AM OPTIMIZING TOL2 TRANSPOSITION IN ZEBRAFISH
Allison Swiecki and C. Nathan Hancock, University of South Carolina Aiken.

9:15 AM DETERMINING THE ROLE OF IDLRAP1A IN CHOLESTEROL METABOLISM IN ZEBRAFISH
Kali Wiggins and April DeLaurier, University of South Carolina Aiken.

9:30 AM INVESTIGATING THE TRANSPOSITION OF THE HARBINGER3N_DR TRANSPOSABLE ELEMENT IN YEAST
Sarah Zamiela and C. Nathan Hancock, University of South Carolina Aiken.

9:45 AM POPULATION GENETIC STRUCTURE AND NATURAL RATE OF HYBRIDIZATION BETWEEN *SARRACENIA FLAVA* AND *SARRACENIA MINOR* IN FRANCIS MARION NATIONAL FOREST
Jeremy Rentsch, Francis Marion University

PHYSIOLOGY AND HEALTH
8:30 AM – 10:00 AM
Leatherman Science Facility (LSF) 107
Moderator: Julia Krebs

8:30 AM THE EFFECTS OF DIETARY FRUCTOSE AND OMEGA-3 FATTY ACIDS ON MEMORY IN RATS
Ayron Dupert and Michelle Vieyra, University of South Carolina Aiken.

8:45 AM A COMPARISON OF LUNG FUNCTION VALUES AMONG A SCUBA DIVER POPULATION AND IN COMPARISON TO NON-DIVER POPULATION
Gabriel Hudson and Erin Eaton, Francis Marion University.

9:00 AM THE EFFECTS OF FISH OIL SUPPLEMENTATION ON METABOLIC SYNDROME IN FRUCTOSE FED RATS
Jacob Lott and Michelle Vieyra, University of South Carolina Aiken.

9:15 AM THE EFFECTS OF OMEGA-3 FATTY ACIS AND FRUCTOSE ON ANXIETY-LIKE SYMPTOMS IN MALE SPRAGUE-DAWLEY RATS
Daniela Negrete-Moreno and Michelle Vieyra, University of South Carolina Aiken.

9:30 AM THE EFFECT OF COMBINATION BIRTH CONTROL PILLS ON HEART RATE, BLOOD PRESSURE, AND BODY TEMPERATURE
Scarlett Leigh and Marlee Marsh, Columbia College.

BIOLOGY: FIELD & ZOOLOGY; ENVIRONMENTAL SCIENCE
8:30 AM – 10:00 AM
Leatherman Science Facility (LSF) 108
Moderator: Paul Zwiers

8:30 AM COMPARISON OF BENTHIC MICROALGAE BIOMASS FROM THREE SITES THAT DIFFER IN DISTANCE TO THE ESTUARY
Connor Graham and Ann Stoeckmann, Francis Marion University

8:45 AM A TEST OF THE USE OF TIMBER WOLF (*CANIS LUPUS*) URINE TO REDUCE COYOTE (*CANIS LATRANS*) DEPREDATION RATES ON LOGGERHEAD SEA TURTLE (*CARETTA CARETTA*) NESTS
Michael Wauson and William Rogers, Winthrop University.

9:00 AM SCORING METHODS FOR THE BASKING BEHAVIOR OF EASTERN-PAINTED TURTLES (CHRYSEMYS PICTA PICTA) IN THE LAB
Jordan Winebrenner and David Ferris, University of South Carolina Upstate

9:15 AM SULFATE REDUCING BACTERIA IN MODEL CONSTRUCTED WETLANDS
Wesley Brison and Michele Harmon, University of South Carolina Aiken

9:30 AM CULTURABLE BACTERIA ARE PRESENT IN THE FECAL MATTER OF WOLF SPIDERS
Jaena Dominguez and Marlee Marsh, Columbia College

9:45 AM THE EFFECT OF GLOBAL WARMING AND SEA LEVEL RISE ON COASTAL VEGETATION IN THE SOUTHEASTERN UNITED STATES
Richard Stalter, St. John's University

ASTRONOMY / CHEMISTRY / COMPUTER SCIENCE
GEOLOGY / ENGINEERING / PHYSICS
8:30 AM – 10:00 AM
Leatherman Science Facility (LSF) 109
Moderator: Seth Smith

8:30 AM LONG TERM PHOTOMETRY OF THE CLASSICAL NOVAE X SERPENTIS AND V1016 SAGITTARII
Bridget Ierace and Ashley Pagnotta, College of Charleston

8:45 AM DETERMINATION OF LINALOOL CONCENTRATION IN ESSENTIAL OILS BY SPME-GC-MS USING INTERNAL STANDARD CALIBRATION
Khali Emmanuel, Jeffshan John, Joseph Prior, Annette Golonk and Bettie Obi-Johnson, University of South Carolina Lancaster

9:00 AM FRANCIS MARION UNIVERSITY UNDERGRADUATE INNOVATION TEAM: TECHNOLOGY ENABLED HEALTH CARE SOLUTIONS FOR UNDERSERVED POPULATIONS
Matthew Harrington, Joshua Lipps, Patrick Marlowe, Kenneth Araujo, M. Padmaja Rao, Sarah Kershner, and H. Jane Madden, Francis Marion University

9:15 AM A NEW LATE CRETACEOUS MARINE VERTEBRATE ASSEMBLAGE FROM ALLISONS FERRY, FLORENCE COUNTY, SOUTH CAROLINA
Donald Kirkpatrick[1] and David Cicimurri[2]; [1]Horry County Museum, [2]South Carolina State Museum.

9:30 AM SIMILARITY OF THREE-DIMENTIONAL SOLID MODELS USING CONGRUENCY OF TRIANGLES
Christopher Sousa and Rahul Sharan Renu, Francis Marion University.

9:45 AM COALESCENCE OF NEAR CRITICAL SULFUR HEXAFLOURIDE IN MICROGRAVITY
Christian Hawkins and Ana Oprisan, College of Charleston

10:00 AM SPEED LIMIT ENFORCEMENT, MULITCULTURAL APPROACH
Mikhail M. Agrest, The Citadel

POSTER SESSION
Smith University Center
10:00 - 11:30 AM
Posters set up 8-10 a.m., all posters must be on display by 10:00 a.m.

BIOLOGY: CELLULAR

1 OPTOGENETIC DATA MINING USING EMPIRICAL MODE DECOMPOSITION.
Xandre Clementsmith and Sorinel Oprisan, College of Charleston

2 *MOVED TO ORAL PRESENTATION SESSION*

3 THE PATHOGENIC CONCERNS OF PETS IN THE HOME IN REGARD TO SPECIES AND ANIMAL LIFESTYLE.
Cassidy Mahoney and Lorianne Turner, Francis Marion University.

4 THE ROLE OF PROTEIN L-ISOASPARTYL/D-ASPARTYL O-METHYLTRANSFERASE (PIMT) REGARDING SURVIVAL AND RECOVERY FROM *S. MARCESCENS* INFECTION IN *DROSOPHILA MELANOGASTER*
Brittany Mixon, Preston Siegler and Jessica Allen, Columbia College.

5 IDENTIFICATION OF BACTERIAL ISOLATES ORIGINATING FROM THE HUMAN HAND.
Leisa Rauch, Eran Kilpatrick and Annette M. Golonka, University of South Carolina Salkehatchie.

6 IMPACT OF NODAL PERTURBATION ON THE DISTRIBUTION OF NUCLEAR TRANSPORT PROTEINS IN SEA URCHIN NEUROGENESIS.
Ramsha Shams and Christine Byrum, College of Charleston.

BIOLOGY: MOLECULAR

7 EVALUATION OF MPING TRANSPOSITION IN ARABIDOPSIS THALIANA DNA METHYLATION MUTANTS
Dalton Bodie and C. Nathan Hancock, University of South Carolina Aiken.

8 CLONING AN ANTI-VIF SHRNA TO TARGET HIV INFECTION
Madison Carelock and William H. Jackson, Jr., University of South Carolina Aiken

9 INVESTIGATING TRANSDUCTION EFFICIENCIES OF GENE THERAPY VECTORS
Luke Fennel and Jennifer Lyles, Francis Marion University.

10 DETERMINING IF ARABIDOPSIS-PRODUCED PHAGE PROTEINS CAN INHIBIT ERWINIA AMYLOVORA
Reese King and C. Nathan Hancock, University of South Carolina Aiken.

11 DESIGNING AND CLONING AN ANTI-VIF SHRNA TO TARGET HIV INFECTION
Keileigh McMurray and William H. Jackson, University of South Carolina Aiken.

12 DETERMINING THE FUNCTION OF *PHF21AB* IN CRANIOFACIAL DEVELOPMENT IN ZEBRAFISH
Rachel Moment and April Delaurier, University of South Carolina Aiken

13 SEQUENCE ANALYSIS OF A MIRNA-INDUCED ARABIDOPSIS THALIANA MUTANT
Karah Moulton and C. Nathan Hancock, University of South Carolina Aiken

14 FULL CHLOROPLAST GENOME OF NEOTTIA BIFOLIA: COMPARATIVE GENOMICS BETWEEN AN AUTOTROPHIC AND MYCOHETEROTROPHIC ORCHID
Caroline Shelley and Jeremy Rentsch, Francis Marion University.

15 CREATING A REPORTER PLASMID TO ALLOW TESTING OF ANTI-HIV REV SIRNAS
Kylie Tager and William H. Jackson, Jr., University of South Carolina Aiken.

BIOLOGY: FIELD

16 DOOR OPENING BEHAVIOR IN SPRAGUE DAWLEY RATS
Emily Boggs and Shayna Wrighten, Francis Marion University.

17 SURVEY OF CRAYFISH DIVERSITY IN NORTHEASTERN SOUTH CAROLINA AND THE EVALUATION OF CRAYFISH SAMPLING METHODS
Geraldine Cuypers and Jeffrey Steinmetz, Francis Marion University.

18 THE EFFECT OF AILANTHONE AND JUGLONE ON KUDZU GROWTH
Brittny Leonard and Edna Steele, Converse College.

19 POST-FIRE CARBON ASSIMILATION RATES AND SPECIFIC LEAF AREA OF SPECIES WITH DIFFERENT POST-FIRE RECOVERY STRATEGIES
Jesse Martin and Jennifer Schafer, Winthrop Univesity.

20 DETERMINING THE IDENTITY OF THE FUNGAL SYMBIONT OF NEOTTIA BIFOLIA: MOLECULAR AND ANATOMICAL EVIDENCE
Andrew Westfall and Jeremy Rentsch, Francis Marion University.

21 MOSQUITO SPECIES RICHNESS IN RESIDENTIAL AND NON-RESIDENTIAL ENVIRONMENTS
Ron Willis and Mary Katherine Mills, University of South Carolina Aiken.

22 HERPETOLOGICAL SURVEY OF MARSH WILDLIFE MANAGEMENT AREA, MARION COUNTY
Tyler Wright and Jeffrey Camper, Francis Marion University.

ENVIRONMENTAL SCIENCE

23 MERCURY CONTAMINATION IN THE EDISTO RIVER LEADS TO BIOMAGNIFICATION IN FISH
Schuyler Andrulat and Michelle Harmon, University of South Carolina Aiken.

24 BACTERIOPHAGE DETECTION IN THE WATERWAYS AND RUNOFFS OF OUR COMMUNITY
Ryan Covington and Paul E. Richardson, Coastal Carolina University

25 QUANTIFICATION OF MICROPLASTICS IN THE CATAWBA AND PEE DEE RIVER BASINS
Chasity Moore and Cynthia Tant, Winthrop University

26 WAR OF THE WEEDS: A SURVEY OF INVASIVE PLANT INTENSITY ALONG THE SAND RIVER CORRIDOR IN HITCHCOCK WOODS
Shalyn Najjar and Andy Dyer, University of South Carolina Aiken.

27 TESTING DESIGNS FOR THE MORE EFFICIENT AND EFFECTIVE MOSQUITO TRAP
Olivia Shirley, Zahara Slimani, and Paul E. Richardson, Coastal Carolina University.

CHEMISTRY

28 N- AND C-TERMINUS TRUNCATIONS OF 2,4'-DIHYDROXYACETOPHENONE DIOXYGENASE (DAD)
Gabrielle C. Connor, Catherine Haley Cave, Jason A. Weeks and Kenneth M. Roberts, University of South Carolina Aiken

29 INVESTIGATING CAFFEINE CONTENT IN MAJOR CHINESE TEA TYPES
Khalisha Emmanuel, Cynthia McManus, and Li Cai, University of South Carolina Lancaster.

30 INVESTIGATING PROTEIN THIOL OXIDATION AS A CONSEQUENCE OF MITOCHONDRIAL COMPLEX I INHIBITION
Bryan Fitzgerald and Norma Frizzell, University of South Carolina

31 SYNTHETIC EFFORTS TOWARD THE DEVELOPMENT OF STIMULI-RESPONSIVE PROGRAMMABLE POLYMERS: ETHYL ACRYLATE, MALEIC ACID AND HEAT
Courtney Dziewior[1], Sharon M. Strickland[1], Ping Li[2] and Ken D. Shimizu[2], [1]Converse College, [2]University of South Carolina Columbia

ASTRONOMY, COMPUTER SCIENCE, ENGINEERING, MATHEMATICS, PHYSICS

32 PHOTOMETRY OF 56 ARIETIS
Austin Jowers and Saul Adelman, The Citadel

33 COUNTING INTEGER SEQUENCES WITH RESTRICTIONS
Skyler Addy, Zachary Parker and Breeanne Swart, The Citadel

34 *WITHDRAWN*

35 COSMIC RADIATION AT HIGH ALTITUDES
Alexis Edwards and Pat Briggs, The Citadel

36 THE EFFECT OF CONFINEMENT ON IRON OXIDE IN FREE DIFFUSION AND WITH A HORIZONTAL MAGNETIC FIELD
Patrick Simonson, Gabby Seymore, and Ana Oprisan, College of Charleston

37 DATA-DRIVEN CONCEPTUAL DESIGN USING HISTORICAL KNOWLEDGE.
Shikhar Chodha And Rahul Sharan Renu, Francis Marion University

38 DATABASE INDEXING TECHNIQUES FOR ENGINEERING SOLID MODEL RETRIEVAL
Caleb Fulmer and Rahul Sharan Renu, Francis Marion University

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

SCAS JUDGES

SCAS Judges Conference Room ***McNair Science Building 106***

Lorianne Turner, Francis Marion University
Jeremy Rentsch, Francis Marion University
Julia Krebs, Francis Marion University
Paul Zwiers, Francis Marion University
Seth Smith, Francis Marion University
Vernon Bauer, Francis Marion University
Tamatha Barbeau, Francis Marion University
David Boucher, College of Charleston
Erin Eaton, Francis Marion University
Pearl Fernandes, USC Sumter
Zhabiz Golkar, Voorhees College
Nathan Harness, Francis Marion University
Marlee Marsh, Columbia College
Jeannette Myers, Francis Marion University
Bettie Obi Johnson , USC Lancaster
Carole Oskeritzian, USC School of Medicine
Hunter Sims , Francis Marion University
Sheri Strickland, Converse College
Paul Zwiers, Francis Marion University

SCJAS JUDGES

SCJAS Judges Conference Room *Founders Hall114B*

Mikhail M., Agrest, The Citadel
Ashley, Allen, USC Columbia
Duke, Brantley, USC Columbia
Keith, Brauss, Francis Marion University
Jessica, Burke, Francis Marion University
Francis, Burns, USC Salkehatchie
Li, Cai, University of South Carolina Lancaster
Jeff, Camper, Francis Marion University
Heather, Eddy, York Technical College
Robert , Fox
Annette, Golonka, USC Lancaster
Carmela, Gottesman, USC Salkehatchie
Jennifer, Grier, USC SOM Greenville
Jon , Guy, Savannah River
Katherine, Hanlon, Presbyterian College
Wendy , Hatchell, Francis Marion
Chris, Healy, Furman University
Daniel , Kiernan, USC Sumter
Gabrielle, Leith, USC Columbia
Richard, Ly, USC Columbia
Ponn, Maheswaranathan, Winthrop University
April, Martin
Justin, Mogilski, USC Salkehatchie
Jeff, Pike, Savannah River National Laboratory
Lisa, Pike, Francis Marion University
Kaustubha, Qanungo, Trident Technical College
Willy, Ramos, Francis Marion University
Jeremy, Rentsch, Francis Marion University
Corey, Richards, USC Aiken
Dr. Allison, Rice, USC Columbia
J Henry, Slone, Francis Marion University
Ramaier, Sriram,
Breeanne, Swart, The Citadel
Miran , Tyrell,
Yuriy, Veytskin, Savannah River National Laboratory
Bill, Wabbersen, Savannah River
Dorie, Weaver, Francis Marion University
Mary, Williams, Florence Darlington Tech
Robert, Wolff, South University
Shayna, Wrighten, Francis Marion University

SCAS 2019 ABSTRACTS
Alphabetical by author

COUNTING INTEGER SEQUENCES WITH RESTRICTIONS

Skyler Addy, Zachary Parker, and Breeanne Swart
The Citadel

A problem posed in Mathematics Magazine (Problem 2050) asked for the number of sequences for the form a_1, a_2, ..., a_9 given a_i in {1,2,3} and other criteria. In this poster we describe the process we used to count the sequences and how it was simplified into a readable proof. We have submitted the solution to the problem to Mathematics Magazine for consideration to be published.

SPEED LIMIT ENFORCEMENT, MULTICULTURAL APPROACH

Mikhail M. Agrest
The Citadel

The need of speed limiting is based on multiple factors and reasons related to safety. The practice of use of speed humps and other speed limiting devices is very contradicting. Affecting a variety of categories of people use of these devices has to be well supported by reasoning of their features. Actual practice today shows that often the safe speed passing a speed hump is much lower than the assigned speed limit. That leads to drivers' slowing down before the speed humps and their accelerations in the space between the speed humps. As a result, the purpose is not achieved, the safety is not improved, the environment becomes more polluted and the spent money wasted. A multicultural and multidimensional approach is proposed to study these devices, their design and particular features.

MERCURY CONTAMINATION IN THE EDISTO RIVER LEADS TO BIOMAGNIFICATION IN FISH

Schuyler Andrulat and Michele Harmon
University of South Carolina Aiken

Mercury is a common pollutant in surface waters due to atmospheric deposition from the combustion of fossil fuels. Once in the aquatic environment, mercury may be converted to methylmercury, the chemical form which tends to bioconcentrate in the tissues of fish and other aquatic organisms. These tissue concentrations increase as mercury body burdens are shifted up food chains in a phenomenon known as biomagnification. The greatest risk to humans comes from the consumption of upper trophic-level fish such as the largemouth bass, and lower-trophic level fish such as bowfin and catfish. The cycle of mercury methylation in aquatic sediments, followed by bioconcentration and biomagnification in fish, is enhanced in blackwater river systems such as the Edisto River in South Carolina. Blackwater rivers are characterized by low pH and a high concentration of dissolved organic carbon. Incidentally, this provides optimum conditions for driving the cycle of mercury methylation, bioconcentration, and biomagnification. This study uses publically available data from the US EPA's STORET database and the US Geologic Survey's NWIS database to demonstrate the concept of biomagnification in a natural black water river system. Mercury concentrations in Edisto River water are in the parts-per-trillion range, while fish collected from the river show tissue concentrations in parts per million.

DEVELOPMENT AND ANALYSIS OF AN ACTIVATION TAGGING SYSTEM IN WHEAT

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

Transposable elements are DNA sequences that can excise from one location and reintegrate into a new place within the genome. Transposable elements can be used for mutagenesis because of their ability to induce changes to an organism's genetic sequence. Thus, mutagenesis is used as a tool for gene discovery by providing information on how specific genes effect the growth and development of an organism. A modified version of mutagenesis uses an activation tagging sequence, which shows the function of genes by causing their overexpression. A non-autonomous transposable element used for mutagenesis, known as mPing, was first discovered in rice and requires two proteins, ORF1 and Transposase, for mobilization. An activation tagging version of mPing, known as mmPing20F, was created by inserting an enhancer sequence from the promoter region of the figwort mosaic virus into a hyperactive version of mPing. Plant transformation was used to get mmPing20F:GUS and an ORF1/TPase expression construct inside the wheat genome. The first five generations after cross-pollination were analyzed through PCR analysis and GUS staining to detect transposition and determine transposition rates for each generation. The result of these experiments showed that homozygosity was achieved for the mmPing20F:GUS plasmid and that transposition of mmPing20F in transgenic wheat lines occurred when paired with mobility proteins. Excision behavior of mmPing20F was also analyzed and demonstrated behavior similar to mPing in soybean, rice, and Arabidopsis thaliana. Further work will focus on increasing transposition rate per generation as well as cultivating plants that are homozygous for the ORF1/TPase expression construct.

EVALUATION OF MPING TRANSPOSITION IN ARABIDOPSIS THALIANA DNA METHYLATION MUTANTS

Dalton Bodie and Dr. C. Nathan Hancock
University of South Carolina Aiken

Transposable elements (TEs) are mobile DNA sequences that move from one area in a genome to another through excision and insertion. TE movement is catalyzed by the activity of transposase enzymes. In this project we are testing the TE known as mPing, originally from rice, in the model plant Arabidopsis thaliana. Arabidopsis is a suitable for this project because of its small size and the ease of manipulating its DNA. Our overall question was whether changes in chromatin structure, specifically DNA methylation effects transposition behavior. A mPing transposition construct was transformed control, met1, and ddm1 mutant plants. In order to observe the transposition of mPing, the plants are being tested for GFP using fluorescence microscopy and PCR. This should allow us to determine if the loss of DNA methylation and its associated loosening of the chromatin structure allows for more transposition.

DOOR OPENING BEHAVIOR IN SPRAGUE DAWLEY RATS

Emily Boggs and Shayna Wrighten
Francis Marion University

Recent research has found support for pro-social door opening behavior in rats. The current study examined pro-social behavior in different paradigms. One rat was placed in a closed restrainer inside of a larger arena, and its cage mate was placed free within the arena. Opening of the restrainer door from the outside by the free rat was used as a measure of prosocial behavior. Condition 1 consisted of a larger restrainer and arena and Condition 2 consisted of a smaller arena and restrainer with water inside of it. We found that the rats from Condition 1 had a significantly slower latency to open the restrainer door than the rats of Condition 2. The rats from Condition 1 also had significantly more rears (an indirect measure of activity) which increased over time, and a longer duration of time spent in the restrainer (an indirect measure of how stressful the restrainer is to the animal) than the rats of Condition 2. These results suggest that having a smaller arena and restrainer with water increases pro-social behavior.

SULFATE REDUCING BACTERIA IN MODEL CONSTRUCTED WETLANDS

Wesley Brison and Michele Harmon
University of South Carolina Aiken

Previous studies in wetland environments have shown that sulfides, produced by sulfate-reducing bacteria during the oxidation of organic matter, complex with divalent metal ions, which are precipitated and sequestered in the sediment layer. The objective of this project was to use a model constructed wetland to compare vegetation species for their ability to support sulfate-reducing bacteria, and to see if there is a correlation between sulfate use, sulfide production, and dissolved organic carbon concentration in the pore water. The experiment was conducted on three different plant genera; *Canna, Pontederia, Carex*, and a non-vegetated control. Microbial DNA was extracted from the sediment using a MioBio Powersoil kit and then the relative abundance of *Desulfovibrio vulgaris* was determined by qPCR using primers for the dsrA (dissimilatory sulfite reductase) gene, as well as hgcA gene found in *Desulfovibrio desulfuricans*, a species known for its ability to methylate mercury in wetland environments. Results for all measured parameters indicated distinct differences between vegetated treatments versus controls, as well as differences between vegetation types.

CLONING AN ANTI-VIF SHRNA TO TARGET HIV INFECTION

Madison Carelock and William H. Jackson, Jr.
University of South Carolina Aiken

The Human Immunodeficiency Virus (HIV) is a retrovirus that infects and destroys CD4+ T lymphocytes. The loss of these cells impairs the immune system and leads to Acquired Immunodeficiency Syndrome (AIDS). One protein expressed by HIV that is vital in generating a productive infection is the viral infectivity factor (Vif), which inhibits expression of the host anti-retroviral protein Apolipoprotein B mRNA Editing Enzyme Catalytic Subunit 3G (A3G). A3G is a cytosine deaminase that is packaged into progeny virions during assembly. A3G is activated following entry of the virus nucleocapsid into a new host cell and acts to induce G-to-A hypermutations in the (-) sense DNA during reverse transcription. However, in HIV infected cells, Vif triggers poly-ubiquitination of A3G leading to its proteasomal degradation and a subsequent productive infection. Therefore, Vif is a potential target for antiviral therapies. One way to target and silence viral genes post-transcriptionally is by RNA interference (RNAi) using short-interfering RNAs (siRNAs). SiRNAs are sequence specific that are formed from short hairpin RNAs (shRNAs) that can be designed to target mRNA cleavage. To test this hypothesis, a shRNA was designed to target the vif sequence at nucleotide 5522 of the HIV-1 genomic clone pNL43 (Accession number M19921). This shRNA, shVif5522, consisted of the Vif target site, a short hairpin sequence, and an antisense sequence complementary to the target. The shRNA was converted to a dsDNA, HindIII and BglII sites were added for cloning, and the two strands were synthesized. The dsDNA expressing shVif5522 was cloned into the shuttle vector pH1stuffer(-) following digestion with BglII and HindIII. Two of the resulting clones, pH1Vifsi5522 1.1.2 and pH1Vifsi5522 1.5.8, were verified by PCR to contain the Vif shRNA. Plasmid DNA was sequenced and confirmed that the shRNA was successfully cloned. The shRNAs will next be tested to verify anti-Vif activity.

DATA-DRIVEN CONCEPTUAL DESIGN USING HISTORICAL KNOWLEDGE

Shikhar Chodha and Rahul Sharan Renu
Francis Marion University

The engineering design process is iterative and can be repeated at any phase. These iterations increase the cost of product development and can be reduced by early stage resolution of issues. In early stages of engineering design, concepts are developed by analysing functionalities required. Solutions for achieving all required functions are combined to form a concept. This process of identifying and combining solutions for different functions is conducted systematically using morphological matrices. These matrices list functions as rows and every corresponding column lists a solution for achieving the function. Multiple possible solutions can be generated by navigating through this matrix and selecting and combining one or more solutions from each row. While morphological matrices present a systematic method of identifying and combining solution principles, they have some disadvantages. First, the number of possible combinations can be very large. And, second, the compatibility of solution principles is not guaranteed. To counter these issues, this research proposes the use of historical designs to populate a morphological matrix and use related data to eliminate infeasible combinations. By reusing historical designs, we hypothesize that issue resolution can be conducted in the early stages of design, leading to reduced product development costs and time. This hypothesis will be tested and verified in the coming months.

OPTOGENETIC DATA MINING USING EMPIRICAL MODE DECOMPOSITION

Xandre Clementsmith and Sorinel Oprisan
College of Charleston

Optogenetically evoked local field potentials (LFPs) were recorded from the medial prefrontal cortex (mPFC) of male PV-Cre mice infected with the viral vector (AAV2/5. EF1a. DIO. hChR2(H134R) - EYFP. WPRE. hGH, Penn Vector Core, University of Pennsylvania). We recorded multiple basal conditions followed by a systemic injection with D1 receptors antagonist SCH23390 and/or D2 antagonist sulpiride. Optical stimulation was provided by a blue laser (473 nm) stimulus delivered to mPFC through a fiber optic every 2 seconds and each trial was repeated 100 times. As in the previous study, we used a surrogate data method to check that nonlinearity is present in the experimental LFPs and only used the last 1.5 seconds of steady activity to measure the LFPs phase resetting induced by the brief 10 ms light stimulus. The extracellular signals were sampled at 10 kHz and stored for offline analysis.

In this study, we compared the results obtained by using the traditional nonlinear dynamics approach, i.e. delay embedding of one-dimensional data (time series) of the membrane potential, to the empirical mode decomposition (EMD) or Hilbert-Huang transform. While delay embedding is a reliable method for identifying nonlinear structures of stationary times series, biophysically relevant time series are often (a) too short (b) non-stationary, and (c) the data represent nonlinear processes. The EMD extracts intrinsic mode functions (IMFs) from the original time series based on smooth envelopes defined by local maxima and minima of the sequence. The first IMF is the difference between the original time series and the mean of these envelopes. The same algorithm is applied then to the first IMF to find the second IMF, and so on. We compared the phase resetting determined using the delay embedding dendrogam against the Hilbert transform of IMFs and found a good agreement between the two methods. At the same time, we identified limitations of the delay embedding due to a too short time series that could be addressed using EMD method.

N- AND C-TERMINUS TRUNCATIONS OF 2,4-DIHYDROXYACETOPHENONE DIOXYGENASE (DAD)

Gabrielle C. Connor, Catherine Haley Cave, Jason A. Weeks and Kenneth M. Roberts
University of South Carolina Aiken

The iron-dependent 2,4'-dihydroxyacetophenone dioxygenase (DAD) performs a unique oxidative cleavage of the α-hydroxyketo group of its substrate. In our initial expression and purification of DAD from Burkholderia sp. AZ11 (bDAD), the wild-type enzyme undergoes significant but discrete proteolysis during the purification process, losing 1–4 kDa, even in the presence of an inhibitor cocktail. Interestingly, the specific loses due to proteolysis coincide with N- and C-terminal residues either missing or putatively inessential for activity in the X-ray crystal structure of a close homolog {PDB 5BPX}). In an attempt to circumvent proteolysis without affecting activity, the dad gene from B. sp. AZ11 has been mutated to delete either the 23 or 30 N-terminal residues and/or the nine C-terminal residues of bDAD to give six variant truncates of similar size to those seen in our proteolyzed wild-type samples. These mutated genes were prepared by PCR amplification of the wild-type dad gene using custom primers including either wild-type or truncated start or stop codons in tandem with specific restriction sites. The amplified genes were cloned into the pET20b(+) expression vector and the new vectors transformed into E. coli BL21(DE3) cells for overexpression. The expressed and purified truncated proteins will be evaluated for proteolytic stability and homogeneity with isolated, pure proteins evaluated for activity by UV-Vis absorption assays.

BACTERIOPHAGE DETECTION IN THE WATERWAYS AND RUNOFFS OF OUR COMMUNITY

Ryan Covington and Paul E. Richardson
Coastal Carolina University

Bacteria are an important component of our environment and play a pivotal role in nutrient recycling. One potentially controllable factor regulating environmental bacteria populations is the presence of bacteriophage (viruses that attack bacteria). The scope of this study has been to detect wild bacteriophage in the waterways and runoffs of the Coastal Carolina University

campus, and to examine the environmental factors that affect their presence. Specifically, the study encompassed viruses (coliphages) that infect Escherichia coli strains B, C, and K12. Water samples were collected from different water features on campus, providing an array of environments that could potentially host the targeted phages. After recording water and ambient conditions, samples were tested for evidence of bacteriophage. When phage presence was established, further tests were performed to determine the strain of virus. All recorded data was then reviewed to ascertain what parameters influence proliferation of bacteriophage.

SURVEY OF CRAYFISH DIVERSITY IN NORTHEASTERN SOUTH CAROLINA AND THE EVALUATION OF CRAYFISH SAMPLING METHODS

Geraldine Cuypers and Jeffrey Steinmetz
Francis Marion University

Crayfish are aquatic arthropods that serve important roles in nutrient cycling and ecosystem food chains, and a number of crayfish species are used as bioindicators in water quality monitoring. Although the southeastern United States is a hotspot in crayfish biodiversity, not much is known about species distributions throughout the state. One crayfish of particular conservation interest is the Waccamaw Crayfish (*Procambarus braswelli*). This crayfish is known from a single watershed in South Carolina, and it is believed that *P. braswelli* populations are being threatened by an aggressive, invasive crayfish, *P. clarkii*. Before a conservation plan is developed, the precise distribution of *P. braswelli* must be determined. Our aim was to collect and document distributions of *Procambarus* species in northeastern South Carolina. We collected crayfish using dip nets and baited traps in the summer of 2018. We collected 69 individuals, with the dominant taxa being *P. acutus, P. blandingii,* and *P. clarkii*. To date, we have not collected *P. braswelli*, and our results suggest this species is rare. Together with future collections, our specimens will be used to construct a genetic database that can be used to design an eDNA assay for more sensitive detection of *P. braswelli* populations.

INVESTIGATING ROLES OF NUCLEAR TRANSPORT PROTEINS DURING EMBRYOGENESIS

Madison Davis and Christine Byrum
College of Charleston

The availability of transcription factors and other co-factors in the nucleus is key to processes like cell differentiation. To perform their functions, these molecules must be transported into the nucleus from the cytoplasm, where they are synthesized. This role falls to importins, nuclear transport proteins that facilitate the transfer of such molecules into the nucleus. Although it was once thought that importins were ubiquitously distributed, recent studies show that they are differentially expressed. Each importin is specialized to transport specific cargo and their presence or lack thereof may have an important impact on cell fates. The Byrum lab investigates the spatial and temporal distributions of these molecules in sea urchin embryos. The sea urchin is a useful model for research as its genome has been sequenced, the embryo is transparent (allowing easy visualization of structures during development), and a large body of knowledge exists about developmental processes in this organism. Also, sea urchins are deuterostomes, so they are more closely related to vertebrates than many other animals. This investigation specifically examines distributions of Importin 9 (IPO9) and Importin 11 (IPO11) transcripts using wholemount in-situ hybridization. Based on when and where these transcripts are located, we hope to learn more about which developmental processes they could affect.

CULTURABLE BACTERIA ARE PRESENT IN THE FECAL MATTER OF WOLF SPIDERS

Jaena Dominguez and Marlee Marsh
Columbia College

Very little is known about the presence of bacteria in the fecal matter, or excreta, of spiders. One recent study found little to no growth from wolf spider excreta when they directly streaked the feces onto bacterial media. A study with tarantulas found bacterial growth and unpublished metagenomic data found over 300 species of bacteria in the excreta of wolf spiders. The current study was conducted in order to determine if culturable bacteria are present in the fecal matter of wolf spiders. We hypothesized that there are bacteria present in wolf spider feces, but that growth is limited because the excreta inhibits growth The presence of high concentrations of guanine, uric acid and the very high osmotic pressure in the feces may have been the reason for limited growth in the previous study. Directly spreading the excreta onto agar media may have kept the bacteria immersed in these inhibitory conditions. During this study, 41 wolf spiders were captured in Harbison State Forest and kept in containers for several weeks while fecal samples were collected and studied. The fecal matter from each spider was streaked onto three different agar medium plates; TSA, EMB, and MSA. One half of each plate was smeared with undiluted feces, while the other side was streaked with feces that had been diluted in 2 ml of Nutrient Broth. This comparison would show if the feces did contain bacteria that were still alive and culturable. The first results from 18 spiders using their moist feces, resulted in 16 of the samples having growth on both halves of the plates of at least one media type. Samples were then taken from another 8 spiders where the excreta was drier and streaked onto the plates, with 4 showing growth only on the side where the feces had been diluted. Of the three media types of agar, TSA showed the most growth, followed by MSA and then EMB. These preliminary results provide support for the hypothesis, but further sampling is needed to confirm this.

THE EFFECTS OF DIETARY FRUCTOSE AND OMEGA-3 FATTY ACIDS ON MEMORY IN RATS

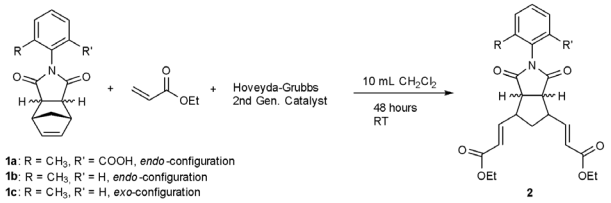
Ayron Dupert and Michelle Vieyra
University of South Carolina Aiken

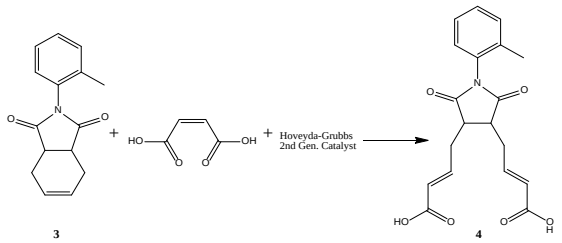
The purpose of this study was to look at the effects of fructose and omega-3s, alone and in combination, on short and long-term memory in rats. Fructose has been shown to impair hippocampal dependent memory, specifically short-term memory, and cause a decline in brain derived neurotropic factors. Omega-3s are important in brain development by increasing synaptic protein expression thereby strengthening hippocampal plasticity necessary for learning and memory. Twenty-four male Sprague-Dawley rats were used in this study. These rats were randomly placed into one of 4 groups containing 6 rats each: 1) 10% fructose , 2) omega-3 fatty acids, 3) fructose and omega-3 together, 4) control (standard rat chow). After 22 weeks the rats were tested for short and long-term memory using a radial arm water maze. Results are still being analyzed but we expect the high fructose diet to will produce worse scores for both types of memory, the omega-3 rich diet will have the best scores, and the combination diet will have an outcome similar to control.

SYNTHETIC EFFORTS TOWARD THE DEVELOPMENT OF STIMULI-RESPONSIVE PROGRAMMABLE POLYMERS: ETHYL ACRYLATE, MALEIC ACID AND HEAT

Courtney Dziewior[1], Sharon M. Strickland[1], Ping Li[2] and Ken D. Shimizu[2],
[1]Converse College, [2]University of South Carolina Columbia

Stimuli-responsive polymers represent an emerging field of smart materials with programmable recognition properties. We have been working toward the development of polymers that remember the response after a stimulus is withdrawn. To this end, we first must synthesize specific functional monomers. While different types of reactions could potentially result in a desired target monomer, we studied the ring-opening cross metathesis reaction (ROM-CM). Previous work attempted to cross monomer 1(a-c) with ethyl acrylate by using the more stable Hoveyda-Grubbs 2nd Generation Catalyst, but failed. We then attempted to achieve new results by using different anhydrides, olefins, solvent systems, and temperatures. We discovered that higher temperatures yielded a cleaner reaction when conducted with certain olefins, but lead to the production of side products in others. In addition, one promising route involved using the new olefin maleic acid in place of ethyl acrylate and crossing it with monomer 3. This appeared to produce the desired product 4 and work is ongoing to first esterify and then isolate the potential product. Future efforts will involve further study of maleic acid and dilute conditions on norbornene reactions and other promising olefins, as well as alternative synthetic routes.





COSMIC RADIATION AT HIGH ALTITUDES

Alexis Edwards and Pat Briggs
The Citadel

Our previous experiments have shown variation in stratospheric cosmic ray intensity between solar noon and solar midnight. Our project is to launch eight weather balloons at three hour intervals equipped to measure cosmic ray and environmental data. We will discuss the variation of cosmic ray intensity and environmental parameters as a function of sub solar angle and altitude.

DETERMINATION OF LINALOOL CONCENTRATION IN ESSENTIAL OILS BY SPME-GC-MS USING INTERNAL STANDARD CALIBRATION

Khali Emmanuel, Jeffshan John, Joseph Prior, Annette Golonka and Bettie Obi-Johnson
University of South Carolina Lancaster

The goal of this research was to develop a novel undergraduate analytical chemistry experiment involving the identification and quantification of the major component(s) of essential oils using the internal standard method with headspace Solid Phase Microextraction (SPME) and Gas Chromatography-Mass Spectrometry (GC-MS). After identifying the major component(s) of the essential oil, students chose an internal standard compound to use based on structural and retention time comparison with the analyte(s). In this experiment, students had the option of optimizing the method parameters including standard solution concentrations, equilibration times, SPME fiber exposure times, and GC-MS run parameters. Initial experiments demonstrated the effectiveness of the internal standard method, with the regression analysis of an external standard calibration curve having poor linearity (R^2=0.3679) and that of an internal standard calibration curve having excellent linearity (R^2=0.9988). The analyte used for this experiment was linalool and its concentration in lavender oil was found to be 23.1%, a -2.12% error from the value on the manufacturer's certificate of analysis of 23.6%. This experiment provides an introduction to test method development, SPME, GC-MS, and the internal standard method for sophomore and junior level students helping them to gain confidence with laboratory skills using inexpensive and widely available reagents. This study is relevant for analytical chemistry, organic chemistry, biochemistry, and biology students interested in reinforcing independent research skills.

INVESTIGATING CAFFEINE CONTENT IN MAJOR CHINESE TEA TYPES

Khalisha Emmanuel, Cynthia McManus, and Li Cai
University of South Carolina Lancaster

Depending on the type of tea the caffeine content varies significantly. In this study, the level of caffeine in various teas from China was determined using techniques adapted from a student lab experiment in organic chemistry. The results evidenced that the chemical composition of teas could be influenced by many factors/variables. This summer project gave us two freshman students a great experience of independent research/directed study.

INVESTIGATING TRANSDUCTION EFFICIENCIES OF GENE THERAPY VECTORS

Luke Fennell and Jennifer Lyles
Francis Marion University

Gene therapy is a cutting-edge technique used to treat genetic disorders by introducing a functional copy of a mutated or absent gene. This type of treatment requires a vector for delivery of the functional gene, and among the most successful gene therapy vectors is Adeno- associated virus (AAV). Gene therapy using AAV vectors has demonstrated tremendous success over the last decade, including the approval of the first commercially available gene therapy treatment for clinical use. AAV vectors are known for their long-term persistence following a single administration of the vector, a property that is critical to the success of the therapy. A potential barrier to long-term persistence is the initial entry of the vector into the host cell. It is known that different serotypes of AAV have different affinities for various cell types. Traditionally, AAV-2 has been the most widely used and widely studied serotype. However, it has been demonstrated that alternative serotypes may have greater affinities for certain cell types than AAV-2, resulting in greater transduction efficiency and ultimately a greater therapeutic effect. As a result, the field has shifted towards the use of alternative AAV serotypes depending on the target tissue, for example, AAV-9 is now used to target hepatocytes (liver cells). Additionally, AAV vectors may contain either single-stranded (ss) or self-complementary (sc) genomes. The configuration of the vector genome upon nuclear entry has also been shown to have an effect on transduction efficiency. While preliminary data demonstrates that both the vector serotype and genome configuration affect transduction efficiency, there is still much characterization that needs to be done. Characterizing the transduction efficiencies of each AAV serotype in common laboratory cell lines and cataloging this information will aid in establishing a vector toolkit. Researchers and clinicians will be able to use this information to ensure that the most suitable vector is being used for the appropriate target tissue or cell line in order to maximize transduction efficiency and therapeutic effect. Specifically, the transduction efficiency of AAV-DJ, a newly engineered serotype of AAV with a hybrid capsid derived from eight serotypes is being investigated in several mammalian cell lines, including HEK293 cells (human), HeLa cells (human), and C2C12 cells (mouse). AAV-DJ is currently a leading candidate for liver gene therapy.

INVESTIGATING PROTEIN THIOL OXIDATION AS A CONSEQUENCE OF MITOCHONDRIAL COMPLEX I INHIBITION

Bryan Fitzgerald and Norma Frizzell
University of South Carolina

The Krebs cycle intermediate fumarate can irreversibly modify protein cysteine residues to generate the stable adduct 2-succinocysteine (2SC), termed protein succination. This cysteine modification is favored by conditions that increase the NADH/NAD+ ratio, which inhibits the NAD+-dependent Krebs cycle. A genetic model of mitochondrial Complex I deficiency that causes Leigh Syndrome, the loss of the NADH dehydrogenase component protein Ndufs4, is associated with this reductive stress, and leads to increased succination. We hypothesized that the chemical inhibition of Complex I activity by rotenone, a pesticide used to model Parkinson's disease, would increase succination as NADH oxidation is also prevented. Surprisingly, in contrast to the Ndufs4 knockout model, rotenone did not increase succination in neurons in vitro. We proposed that rotenone inhibition of Complex I immediately promotes cysteine oxidation (oxidative stress); whereas Ndufs4 deficiency promotes cysteine succination via reductive stress. We further hypothesized that initial oxidative modification would prevent cysteine succination by fumarate. To test this hypothesis, we used immunoblotting to examine the levels of cysteine sulfenylation (-SOH, oxidative marker) on glyceraldehyde-3-phosphate dehydrogenase (GAPDH) following variable exposure to hydrogen peroxide (H2O2) in vitro. Control and oxidized GAPDH were then incubated with fumarate and the levels of 2SC measured. We observed time and concentration dependent sulfenylation of GAPDH. Supporting our hypothesis, prior oxidation of GAPDH resulted in less succination after subsequent treatment with fumarate. This data suggests that cysteine sulfenylation competes with cysteine succination, partially explaining why different Complex I inhibition strategies may lead to either Leigh Syndrome or Parkinson's disease phenotypes.

DATABASE INDEXING TECHNIQUES FOR ENGINEERING SOLID MODEL RETRIEVAL

Caleb Fulmer and Rahul Sharan Renu
Francis Marion University

Retrieval of models can be used as a technique to relate new designs to historical designs and their corresponding quality concerns. The focus of this research is three-dimensional solid model retrieval. Specifically, it is an investigation of database indexing methods to improve search and retrieval times and precision for engineering applications. This research proposes the use of unsupervised learning to form clusters of parts in large databases (~100,000 models). Each group will have a representative model. A new design will be used as a query model and compared to the representative models. Further searching will be performed within groups whose representative models are most similar to the query model. It is hypothesized that this approach will make the search and retrieval process more efficient than existing approaches. Development and investigation will be performed in the coming months.

COMPARISON OF BENTHIC MICROALGAE BIOMASS FROM THREE SITES THAT DIFFER IN DISTANCE TO THE ESTUARY

Connor Graham and Ann Stoeckmann
Francis Marion University

Benthic Microalgae (BMA) have been used as bioindicators in Europe, Australia, and the West Coast of the United States and have been known to indicate water quality in marine estuaries. The first step in BMA bioindication on South Carolina's coast is identifying the microbial community structure. Understanding the community structure of the BMA is a two-part process including determining which species are present and their abundance. Our research focuses on the abundance of the primary producers in the benthic community by measuring chlorophyll a. We collected sediment at three sites in the Winyah Bay-North Inlet Estuary system at the Belle Baruch Marine Laboratory. The sediment samples will go through two main analyses. The first is extracting the chlorophyll a from the sediment samples and calculating the biomass. The second is analyzing sediment samples for environmental factors such as organic matter, moisture content and porewater salinity and pH. We predict that the site furthest from the estuary will have the least amount of biomass. We also predict that the environmental factors will have a positive correlation with cholorphyll a.

FRANCIS MARION UNIVERSITY UNDERGRADUATE INNOVATION TEAM: TECHNOLOGY ENABLED HEALTH CARE SOLUTIONS FOR UNDERSERVED POPULATIONS

Matthew Harrington, Joshua Lipps, Patrick Marlowe, Kenneth Araujo, M. Padmaja Rao,
Sarah Kershner, and H. Jane Madden
Francis Marion University

The goal of this project was to use readily available, user friendly technology to achieve improved health care outcomes for medically underserved groups in the Pee Dee region of South Carolina. This group includes rural, elderly, and low-income citizens who have the highest concentration of chronic health conditions in South Carolina. The primary members of the team are computer science students from Pee Dee region who partnered with students from health sciences, marketing, and fine arts. An app for android-based mobile phones is being developed that will have two main functions: to enable users to search for low or no-cost health resources and to allow users to track key indicators of their overall health, such as blood pressure, blood sugar, cholesterol, weight and vaccinations. This would enable the region's citizens to become engaged in their self-care by communicating effectively with health care providers, thereby improving overall population health literacy and outcomes. This

project is being built using Agile methodology with a variation of Scrum project management framework, a novel application in an academic setting. This research project was funded by South Carolina Research Authority from July 1st 2018 to July 1st 2019.

COALESCENCE OF NEAR CRITICAL SULFUR HEXAFLOURIDE IN MICROGRAVITY

Christian Hawkins and Dr. Ana Oprisan
College of Charleston

Critical fluids have a variety of applications from manufacturing high-tech materials to industrial lubrication and extracting oils from foods. Phase separation of critical fluids cannot be studied on earth due to the increase in compressibility near the critical point and stratification of fluids by density in gravity. We used direct imaging to record snapshots of phase separation that takes place in sulfur hexafluoride (SF6) in weightlessness conditions on the International Space Station (ISS). The system was at liquid-vapor equilibrium slightly below the critical temperature and further cooled down by a 0.2-mK quench that produced a new phase separation. Both full view and microscopic views of the direct observation cell were analyzed to determine the evolution of the radii distributions. In addition, in microscopic view, we measured the diameter of droplets and bubbles in the system throughout multiple coalescence events leading to further support of the coalescence-induced-coalescence model.

A COMPARISON OF LUNG FUNCTION VALUES AMONG A SCUBA DIVER POPULATION AND IN COMPARISON TO A NON-DIVER POPULATION

Gabriel Hutson and Erin Eaton, PhD
Francis Marion University

The purpose of this study was to investigate possible correlations between lung function values (PEF, IRV, ERV, and FVC) among a diver population, as well as in comparison to a non-diver population. Independent variables for both populations were biological sex, age, and weekly physical activity. Independent variables for the diver population were dive tenure, number of logged dives, certification level, and gas mixture used. A spirometry test was conducted to collect lung function values of both populations. Data from this study suggest a statistically significant relationship between diver and non-diver sex and FVC, dive age and ERV, diver sex and ERV, and non-diver FVC and weekly physical activity.

LONG TERM PHOTOMETRY OF THE CLASSICAL NOVAE X SERPENTIS AND V1016 SAGITTARII

Bridget Ierace and Ashley Pagnotta
College of Charleston

Cataclysmic variable (CV) systems are made up of a white dwarf (WD) that accretes material from its companion star. Classical novae (CNe) occur in CV systems when enough accreted material builds up on the surface of the WD for runaway thermonuclear reactions to occur, which causes a dramatic brightening in the system. It is predicted in the Hibernation Model (Shara et al. 1986) that a post-eruption nova should decrease in brightness by ~1 magnitude per century. To test this model observationally we studied the long term behavior of post-eruption CNe by collected data from the Harvard College Observatory plate archives, literature, and modern telescope observations. Using these data sources I constructed long term light curves of X Ser and V1016 Sgr. Linear fits of the quiescent points showed that the brightness of X Ser declined 0.7 magnitude/century and V1016 Sgr increased 0.7 magnitude/century.

EFFECTS OF RED CLOVER AND INDIGO PLANT EXTRACTS ON MDA-MB-231 TRIPLE NEGATIVE BREAST CANCER CELLS

Michael Stevens, Isaac Daffron, Shelby Tyler, Dorota Abramovitch, Donna Weinbrenner, and Diana Ivankovic
Anderson University

In this study the effects of indigo and red clover plants' extracts on MDA-MB-231 triple negative receptor breast cancer cell metabolism were analyzed. Indigo extracts were prepared from the roots, stems, and leaves of the indigo plant. Red clover extracts were prepared from the blossoms and leaves of the red clover plant. Methanol was used as the solvent for the extraction, and reflux in a Soxhlet extractor was carried out for several hours. The solvent was removed by rotary evaporation. Extracts were lyophilized to remove water, and reproducibly dried products were obtained. An MTS assay was performed to determine the effect of the extracts on the MDA-MB-231 triple negative breast cancer cell line. All three MTS assays produced very similar results, so the same conclusions can be drawn for all of them. Blue indigo, red clover, or the 1:1mixture of the two plant extracts in the 1000 and 500 µg/mL, exposed for 48 hours to the MDA-MB-231 cells, resulted in significantly different absorbance readings compared to the other extract concentrations or cells alone, with p-values ranging from 1 x 10^-7 to 7.2 x 10^-14. Thus, blue indigo, red clover, and mixed blue indigo-red clover extracts may have a cytotoxic effect on MDA-MB-231 breast cancer cells and should be further examined as a possible cancer treatment.

EVALUATING THE EFFECTS OF ADIPOSE TISSUE FUMARASE KNOCKOUT IN THE DEVELOPMENT OF DIABETES

Macey Johnson and Norma Frizzell
University of South Carolina School of Medicine

We have shown that conditions that favor the accumulation of fumarate, an intermediate of the Krebs cycle, occur in the adipocyte during diabetes, and this is associated with impaired protein function. The elevation in fumarate results in the chemical modification of cysteine residues, known as protein succination. In order to examine the significance of this modification, we proposed to generate an adipose specific conditional fumarase knockout mouse. This project aimed to examine if fumarate loss contributed to selective adipose accumulation of succination, both in white adipose tissue (WAT) and brown adipose tissue (BAT). Mice were administered Tamoxifen to induce gene knockout or corn oil (controls) and studied for 9 weeks feeding on either a regular diet or a high fat diet, which we hypothesized would exacerbate the effects of the fumarase knockout. In addition, the mice were incubated at 30 degrees, preventing mice with compromised adipose tissue function to undergo â€˜shivering thermogenesis. Nine weeks post-tamoxifen injection we observed low levels of fumarase, and high levels of protein succination, occurring in the knockout mice compared to the controls. We observed that the knockout mice had elevated protein succination versus controls, but this was not significantly altered by a high fat diet. Remarkably, while the high fat diet led to impaired glucose disposal in control mice, the knockout mice showed enhanced glucose disposal on both diets. Future investigations will examine if alterations in adipose tissue secretory hormones (adipokines) are associated with the unexpected improvement in whole body glucose homeostasis.

PHOTOMETRY OF 56 ARIETIS

Austin Jowers and Saul Adelman
The Citadel

We are studying a magnetic, chemically peculiar star, 56 Arietis, using Stromgren uvby spectrophotometry from the Four College Automated Photoelectric Telescope. Previous papers have discovered a 5-year periodicity in the brightness of the star. With data now covering 21 years of observations, we discuss the unique features of this star.

DETERMINING IF *ARABIDOPSIS*-PRODUCED PHAGE PROTEINS CAN INHIBIT *ERWINIA AMYLOVORA*

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

Fire blight is a devastating disease known to affect a host of fruit trees across Europe and North America. This bacterial infection, caused by *Erwinia amylovora*, affects many important species, including apple, cherry, plum, pear, and rose. Our overall strategy was to use lytic proteins from *Erwinia*-killing bacteriophage to kill blight-causing bacteria. Our intention was to generate recombinant DNA coding for lytic transglycosylase proteins and express them in *Arabidopsis*. These bacteriophage-derived enzymes induce fatal lysis of cells and are bacteria specific because they function by breaking down specific types of peptidoglycan. We hypothesized that expression of viable lytic proteins in plants is possible and could allow inexpensive production of large volumes of protein. We also predict that if blight-susceptible species produced their own bacteria-fighting proteins, they would become blight resistant. This could potentially open many opportunities for producing crops and trees with the ability to flourish in previously “unusable” environments (out of range), opening many acres of land up for food production. If orchards must be planted with high tree density, trees producing bacteria-fighting proteins will be critical for success. We have successfully synthesized two bacteriophage constructs and transformed them into Escherichia coli. One of these constructs has been transformed into Arabidopsis. We are in the process of PCR-verifying the transformed plants, and upon verification of plasmid integration will perform assays to test the ability of plant-produced lytic proteins to inhibit the growth of Erwinia amylovora. At this point, our results suggest that bacteriophage sequences can be transformed into Arabidopsis.

A NEW LATE CRETACEOUS MARINE VERTEBRATE ASSEMBLAGE FROM ALLISONS FERRY, FLORENCE COUNTY, SOUTH CAROLINA

Donald Kirkpatrick[1] and David Cicimurri[2]
[1]Horry County Museum, [2]South Carolina State Museum

A late Cretaceous (Maastrichtian) marine vertebrate fauna has been recovered from rocks of the Pee Dee Formation exposed along the west bank of the Great Pee Dee River at Allisons Ferry, Florence County, South Carolina. Some fossils were obtained by surface collecting, but most were recovered through the disaggregation of bulk matrix, either through dissolving limestone samples in dilute acetic acid or soaking clay/shale matrix in household detergent. Resulting concentrates were sorted with a binocular microscope up to 40x magnification, and to date twenty-nine taxa have been identified. These include a mosasuar, six osteichthyans and twenty-two elasmobranchs. Although some species have previously been reported from the Peedee Formation at the Burches Ferry site in Florence County (Lawrence and Hall, 1987), most were heretofore not known to occur in the state. New elasmobranch records for South Carolina include *Squatina sp., Cantioscyllium sp., Galeorhinus sp., ?Columbusia sp., Scylliorhinus sp. cf. S. ivagrantae, Squatigaleus sp. cf. S. sulphurensis, Plicatoscyllium derameei, Serratolamna serrata, Hamrabatis weltoni, Rhombodus binkhorsti, Raja farishi, Rhinobatos uvulatus, Texabatus corrugatus, Pseudohypolophus sp., Ptychotrygon vermiculata, Ptychotrygon sp. aff. P. winni,* and *Dasyatis sp*. In addition, five osteichthyans are new records, including *Paralbula casei, Anomoeodus phaseolus, Hadrodus sp., Ostraciidae indet., Dercetidae indet*. Most of the species listed above have been reported from Texas and North Carolina, and their discovery in SC may therefore not be surprising. However, the SC material provides additional data on the paleoenvironments inhabited by these taxa, as well as the paleobiogeographic

ranges for the species. Further investigation of the vertebrate paleontology of the Peedee Formation will focus on sampling the entire vertical exposure at Burches Ferry as well as at Cains Landing, a site that is geographically between Burches Ferry (older) and Allisons Ferry (younger). Comparison of paleofaunas occurring at each of these sites will provide a better understanding of any changes in marine vertebrate assemblages, laterally (geographically) and vertically (temporally), that occurred during the Maastrichtian.

THE EFFECT OF COMBINATION BIRTH CONTROL PILLS ON HEART RATE, BLOOD PRESSURE, AND BODY TEMPERATURE

Scarlett Leigh and Marlee Marsh
Columbia College

Birth control pills are a popular method of birth control for many women. In the United States, roughly 10.2 million women use some type of birth control pills. The two main types of birth control pills available to women are combination pills, which contain both estrogen and progestin, and progestin-only birth control pills that do not contain any estrogen. Numerous biological studies have been performed studying the effects of combination birth control pills on blood pressure. However, few studies have examined blood pressure combined with both heart rate and body temperature to study the effects of combination birth control pills. We hypothesize that women taking combination birth control pills will have higher heart rate, blood pressure and body temperature as compared to the control group. This research study consisted of 40 women from Columbia College who were either on combination birth control pills or a member of the control group, which meant they were not on any form of hormonal birth control. Students came in twice a week for eight weeks to have their heart rate, blood pressure, and body temperature measured to determine the effect, if any, of birth control on these 3 factors. The study recently concluded and data is currently being analyzed through statistical analysis (SPSS) using both ANOVA and t-tests.

THE EFFECT OF AILANTHONE AND JUGLONE ON KUDZU GROWTH

Brittany Leonard and Edna Steele
Converse College

Kudzu is an invasive flowering vine that grows in abundance across the United States, especially the southern states. This plant is strangling forestland, ruining ecosystems, and choking crops. The conventional ways of reducing kudzu growth are usually harmful to the environment or simply do not work. This study is designed to test if the allelopathic chemicals (juglone or ailanthone) can suppress the growth of, or even kill kudzu plants. Allelopathic chemicals are produced naturally by plants and when released into the environment, can affect the growth of surrounding plants either negatively or positively. Both juglone (5-hydroxy-1,4-napthoquinone) and ailanthone (16-hydroxytriptolide) have been shown to affect the growth and survival of other plants that it comes in contact with. Because of their herbicidal properties, these allelopathic chemicals have potential use as natural herbicides that are environmentally friendly and safe for humans and animals. In this study kudzu, tomato and corn plants were treated with varying concentrations of either juglone, ailanthone, or dilute detergent solution (control). The photosynthesis (oxygen production), respiration (CO_2 production) were measured. Results obtained from kudzu experiments were compared with those of corn and tomatoes because these plants have previously been reported to be negatively affected by these allelopathic chemicals. This study shows that both ailanthone and juglone had an adverse effect on kudzu, but further studies with larger sample size both in a controlled laboratory environment as well as in the field or their natural habitat are necessary to test the statistical significance of these results.

THE EFFECTS OF FISH OIL SUPPLEMENTATION ON METABOLIC SYNDROME IN FRUCTOSE FED RATS

Jacob Lott and Michelle Vieyra
University of South Carolina Aiken

The purpose of this study was to look at the effects of dietary supplementation of fish oil on the symptoms of metabolic syndrome in fructose fed rats. Fructose rich diets have been shown to produce metabolic syndrome in both humans and rodents while a diet rich in omega-3s has been shown to reduce some of the symptoms of metabolic syndrome. Twenty-four male Sprague-Dawley rats were used in this study. These rats were randomly placed into one of 4 groups containing 6 rats each. These groups were designated fructose, fish oil, fructose and fish oil together, and control groups. The study lasted for 22 weeks. During the last week of the study, blood glucose measurements were taken at 30, 60, 90, 120, and 150 minutes post sucrose consumption. At the end of the study the rats were euthanized. Abdominal fat, livers, and tibias were removed during dissection. The fat and livers were weighed, then the weights were normalized to tibia length. Blood was drawn immediately after euthanasia through a cardiac puncture. An ELISA was run on the serum to determine circulating levels of C-reactive protein. Analysis is still underway but the fish oil groups are expected to have healthier metabolic markers than the fructose only group. The combined diet should be similar to control as the fish oil is expected to mitigate the deleterious effects of the fructose diet.

THE PATHOGENIC CONCERNS OF PETS IN THE HOME IN REGARD TO SPECIES AND ANIMAL LIFESTYLE.

Cassidy Mahoney and Lorianne Turner
Francis Marion University

This study will examine two main questions: whether feline pets or canine pets create a more pathogenic environment in one's home, and whether outdoor pets cause a significant difference in pathogenic bacteria brought inside the home. It will examine

the various bacteria that exist in the typical home, with a focus on the pathogens that pets accumulate in a living space. Consideration of the natural human flora must be compared alongside this, to verify whether the bacteria found are brought forth by pets and if they would actually be harmful to one's health. This analysis will only include canine and feline pets to provide greater focus within the time constraints. Results will be examined to provide knowledge of which bacterial strains are shared between organisms and which may pose a threat to human health.

POST-FIRE CARBON ASSIMILATION RATES AND SPECIFIC LEAF AREA OF SPECIES WITH DIFFERENT POST-FIRE RECOVERY STRATEGIES

Jesse Martin and Jennifer Schafer
Winthrop University

In fire-prone shrublands, plant species can recover after fire by seed recruitment or resprouting. Species that are topkilled redistribute carbon resources from belowground to aboveground to create new shoots. We investigated carbon assimilation rates of species with different post-fire recovery strategies and hypothesized that species that recover only by resprouting, and depend solely on their belowground carbon reserves to persist after fire, would have higher carbon assimilation rates than species that recover by resprouting and/or seed germination. We measured photosynthesis of post-fire resprouts of 11 species in scrubby flatwoods shrublands in Florida. We measured carbon assimilation rates and specific leaf area (SLA) of five to eight individuals of each species in sites approximately 11 months post-fire. We also measured total leaf area of six species (four shrubs and two palmettos). We found a significant difference in carbon assimilation rates among species when measured on a leaf area basis, but differences were not related to post-fire recovery strategy and carbon assimilation rates were not higher in resprouters. When scaled to total plant leaf area, carbon assimilation rates did not differ between palmetto species, but did differ among shrub species due to differences in leaf area. SLA differed among species, and mean photosynthetic rates were positively correlated with mean SLA across species. Our results suggest that species that depend solely on belowground carbon to support post-fire recovery do not require greater post-fire carbon assimilation to persist in fire-prone habitats than species that can recover via seed germination and/or that photosynthetic rates may be constrained by leaf-level traits.

DESIGNING AND CLONING AN ANTI-VIF SHRNA TO TARGET HIV INFECTION

Keileigh McMurray and William H. Jackson
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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). Because current treatments cannot fully remove the virus from infected cells, there is a continued need to investigate methods to prevent virus replication. One way to target HIV-1 is through the viral infectivity factor (Vif). Vif functions by targeting a host anti-retroviral gene termed Apolipoprotein B mRNA Editing Enzyme Catalytic Subunit 3G (A3G) for poly-ubiquitination leading to degradation of A3G and generation of a productive infection. One way to inhibit Vif function may be through the use of RNA Interference by expression of a short hairpin RNA (shRNA) targeted to Vif mRNA. Therefore, the goal of this project was to design and clone an anti-Vif shRNA to downregulate HIV-1 infection. An anti-Vif shRNA was designed to bind at nucleotide 5551 of the HIV-1 genomic clone NL43 (Accession number M19921). The resulting sequence, termed Vifsh5551 converted to dsDNA, synthesized, and cloned into pH1.Stuffer (-). One of the resulting clones was confirmed by PCR to contain the shRNA sequence. The resulting plasmid, termed pH1.Vifsh5551, was sequenced to confirm correct cloning. Current work is underway to test the anti-viral activity of the anti-Vif shRNA.

DETERMINING HOW *PHF21AA* AFFECTS CRANIOFACIAL DEVELOPMENT IN ZEBRAFISH

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In humans, mutations in the transcriptional repressor PHF21a (PHD finger protein 21A) causes Potocki-Shaffer syndrome which is associated with craniofacial defects. Previously, it was observed that knockdown of phf21aa in zebrafish caused defects to larval craniofacial cartilage. It is therefore hypothesized that phf21aa 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 phf21aa using CRISPR-Cas9. An F0 line was outcrossed to create an F1 generation. F1 generation was genotyped to identify heterozygotes. Identified heterozygotes were outcrossed to wild-type fish to create an F2 generation. The F2 generation was genotyped and heterozygotes were identified. F1 and F2 heterozygotes were identified 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 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. Recently we developed PCR primers that can identify heterozygote and wild-type fish based on shifts in band size. In this case, the wild-type PCR product is 641bp and the heterozygote product contains a 641bp band and a lower band of an unknown size representing an insertion. The F3 generation was in-crossed and resulted in roughly 25% homozygous mutants and sequencing analysis revealed a 7bp deletion. Using a dissecting microscope, the mutant zebrafish will be screened for evidence of skeletal patterning defects.

Studying how disruptions to phf21aa 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.

THE ROLE OF PROTEIN L-ISOASPARTYL/D-ASPARTYL O-METHYLTRANSFERASE (PIMT) REGARDING SURVIVAL AND RECOVERY FROM *S. MARCESCENS* INFECTION IN *DROSOPHILA MELANOGASTER*

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Protein L-isoaspartate O-methyltransferase, or PIMT, recognizes damaged L-isoaspartyl and D-aspartyl groups in proteins and catalyzes their repair. PIMT has the tendency to repair proteins that have been damaged due to age rather than other enzymes; proteins tend to age faster and have reduced longevity when there is a buildup of isoaspartate residues present. The PIMT enzyme is responsible for creating a repair pathway that restores the damaged polypeptide to the normal backbone configuration by modifying and minimizing the amount of isoaspartate residues present in the cell. Previous research about *Drosophila melanogaster* has shown that overexpression of PIMT in transgenic flies can lead to increased longevity; this shows that protein damage and accumulation of isoaspartate residues can be a limiting factor in longevity. To understand the importance of PIMT in Drosophila melanogaster, we designed an experiment where flies were fed *S. marcescens* bacteria after a period of starvation, and then tested their recovery using bacterial plating, geotaxis, and chill coma. The results were then analyzed and graphed.

DETERMINING THE FUNCTION OF *PHF21AB* IN CRANIOFACIAL DEVELOPMENT IN ZEBRAFISH

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PHF21A is an element of the BRAF-HDAC complex that causes target gene transcription to be repressed. In humans, mutations in PHF21A can result in a disorder known as Potocki-Shaffer syndrome, which causes craniofacial malformation and neurological defects. Previously, we generated potential mutant lines in zebrafish targeting *phf21ab* using CRISPR/Cas9 mutagenesis. Recently, we genotyped F1 offspring of an F0 line with potential mutations in *phf21ab*. We identified a female F1 heterozygote that was crossed with a wild-type male to generate an F2 line composed of heterozygotes and wild-types. The identification was made using PCR and T7 endonuclease assay . Results were analyzed to look for differences in band sizes to indicate genotypes. The original PCR product is 613bp. If a sample is from a heterozygote, two lower bands (447bp and 166bp digestion products) are created through T7 endonuclease digest. Fish that display all three bands are heterozygous while the fish with just a 613bp band are wild-type. We plan to create two additional lines of fish (using other F1 parents) and rear them into adulthood to generate additional F2 generations. Once F2 fish are adults, heterozygotes will be genotyped and in-crossed to create 25% homozygous mutants. The fish will then be screened for craniofacial phenotypes. This will be done through a staining process to label bone and cartilage two separate colors to make them identifiable. Potential mutant offspring will be sequenced to characterize lesions produced using CRISPR/Cas9 mutagenesis. Through this project and other projects in the lab, we hope to identify the function of the paralogs of *phf21a* (*phf21aa* and *phf21ab*) in zebrafish craniofacial development, and how mutants in these genes may reproduce aspects of PHF21A loss of function in humans. Potentially, this study could result in a zebrafish model for Potocki-Shaffer syndrome.

QUANTIFICATION OF MICROPLASTICS IN THE CATAWBA AND PEE DEE RIVER BASINS

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Plastic pollution has become a worldwide ecological and economic issue. Plastic was originally a chemical-based alternative to using finite ecological goods such as wood and ivory. An overproduction of plastic, improper disposal, and faulty recycling practices have caused plastic to be prevalent in the environment at large. Plastic, and more recently microplastic (plastic pieces smaller than 5mm), pollution in the marine environment has become a major area of concern due to the occurrence of plastic in the guts of many aquatic species. Most research has been focused on marine microplastics; however, there has been very little research on inland freshwaters. In this study, we focused on the Catawba and Pee Dee Rivers and their tributaries to quantify and sort microplastics in surface water, sediment, and invasive freshwater bivalves, Corbicula fluminea. The samples were processed and quantified using the NightSea© fluorescent microscope adaptor. We found that tributaries had significant differences in the quantity of microplastics, and storm flows increased the quantity of microplastics in surface water samples. These data fill previous knowledge gaps in freshwater microplastic research in two of South Carolina's major river basins.

SEQUENCE ANALYSIS OF A MIRNA-INDUCED ARABIDOPSIS THALIANA MUTANT

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Understanding gene function is essential to solving genetic problems or beneficially altering gene expression. An important tool for determining gene function is gene silencing, because it allows you to see how the organism behaves when the targeted protein is absent. The method we used to randomly decrease gene expression of Arabidopsis genes was miRNA-induced gene silencing. This method involves attaching a microRNA target sequence to an mRNA sequence and inducing the production of tasiRNAs. The tasiRNAs subsequently degrade homologous sequences. We transformed a naturally occurring Arabidopsis thaliana miRNA, called miR173, into random positions of the genome. One of the resulting plants was a mutant that exhibits altered leaf shape, delayed flowering, and reduced seed set in a dominant manner. We extracted DNA from plants with the mutant phenotype and are currently working to prepare a DNA library for nanopore sequencing. Nanopore sequencing is a relatively new technique that sequences long strands of DNA through a protein nanopore. This method provides high-throughput sequencing results, but also provides long sequencing reads. We will analyze the nanopore sequencing results by conducting a BLAST search for the transgene sequence using Geneious software, and then analyze adjacent sequences to identify candidate genes. To verify that the identified candidate genes are responsible for the mutant phenotype, we will test for changes in gene expression using quantitative reverse transcriptase (RT) PCR to analyze changes in the mRNA levels. A decrease in mRNA levels in the mutant would confirm that the mutant phenotype is due to gene silencing.

WAR OF THE WEEDS: A SURVEY OF INVASIVE PLANT INTENSITY ALONG THE SAND RIVER CORRIDOR IN HITCHCOCK WOODS

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Hitchcock Woods has immense economic, cultural, historical and ecological value to the Aiken community. However, urban development in the areas surrounding the woods has contributed to the spread of invasive plants. Stormwater runoff from downtown is discharged into the woods through outfall pipes that flow into the Sand River, carrying with it a variety of invasive plant materials. Invasive species out-compete native species that are vital to the health of the woods, and have far-reaching consequences, including habitat degradation and loss of biodiversity. This problem is expected to grow as downtown Aiken and the surrounding areas continue to be developed. Prior to my research, little data existed regarding the extent and severity of these invasive plant infestations in Hitchcock Woods. The goal of my research was to collect baseline data regarding the identity, location, and intensity of these populations in the zones adjacent to the Sand River via a ground-based biological survey. GIS maps produced as a result of this survey show dramatic differences in the intensity of infestations. Information extrapolated from these maps can be used as a tool to assess the effectiveness of current management methods, develop monitoring programs, and contribute to our understanding of the rate of spread of invasive plants. They also serve as the foundation for control and remediation efforts, and help maintenance managers determine how to best allocate limited resources in the fight against encroachment.

THE EFFECTS OF OMEGA-3 FATTY ACIDS AND FRUCTOSE ON ANXIETY-LIKE SYMPTOMS IN MALE SPRAGUE-DAWLEY RATS

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The purpose of this study was to determine the effects of Omega-3 fatty acids and fructose, alone and together, on the anxiety-like symptoms of male rats. Omega-3s have been shown to help decrease the symptoms of anxiety, thus allowing for better coping mechanisms for stress and stress related disorders. Controversy, fructose has been shown to increase anxiety correlated with metabolic syndrome where it increases adiposity and induces a production of cortisol. Cortisol is a stress hormone. Twenty-four male Sprague-Dawley rats were used in this study. The rats were randomly placed into four groups containing six rats each: 1) 10% fructose solution and standard rat chow, 2) omega-3 enriched food, 3) 10% fructose solution and Omega-3 enriched food, and 4) standard rat chow and water (control). After 22 weeks the rats were put through a series of behavioral tests which included fur-coat state, light-dark box, and an elevated plus maze to test for anxiety-like symptoms. Urine was also collected and an ELISA done to determine cortisol levels. Numerical data from the trials has yet to be analyzed but we predict that the fructose group will show more symptoms of anxiety while the omega-3 group will show little to no symptoms of anxiety. The combined fructose and omega-3 group should have similar results to those seen in the control group as we expect the omega-3s to mitigate the negative effects of the fructose.

IDENTIFICATION OF BACTERIAL ISOLATES ORIGINATING FROM THE HUMAN HAND

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The human body provides habitat for a diversity of bacterial species collectively referred to as the normal flora. Identification of various members of the normal flora to the specific level requires a combination of biological staining procedures, biochemical tests and molecular techniques. In this experiment, ten bacterial isolates originating from the hands of nine students and one faculty member at USC Salkehatchie were identified. Classification to a general taxonomic group was accomplished with standard staining and biochemical tests. Polymerase Chain Reaction (PCR) technology, DNA sequencing, and GenBank

nucleotide sequence database analysis provided the first phase of identifications. Eight of the isolates were identified as *Bacillus* species while the other two isolates were identified as *Paenibacillus* and *Micrococcus* species. The samples were then analyzed using matrix assisted laser desorption ionization-time of flight mass spectrometry (MALDI-TOF MS). This technology served to complement the initial molecular work and provide further confidence for species identification. MALDI-TOF MS identified five isolates as *Bacillus megaterium, Bacillus thuringiensis, Bacillus subtilis* and *Micrococcus luteus*. Species identification of the five remaining isolates is in progress. This study used a combination of traditional and emerging molecular technology to systematically identify four species of bacteria that were isolated from the human hand. In addition to contributing to the study of the human normal flora, the diagnostic properties of each isolate will be incorporated into a laboratory resource used by microbiology students at University of South Carolina Salkehatchie.

FISHERIES FORENSICS: DETECTING SEAFOOD SUBSTITUTIONS WITH MOLECULAR METHODS

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It has become increasingly common that fish on the seafood market have been falsely marketed such that the prime fish filet you think you are buying is actually a cheaper, less valued fish. Scallops are included in this group, and what are sometimes marketed as scallops are actually the meat of stingray. Species substitution in commercial seafood is becoming more common because the global fishery industry cannot keep up with the demands of the public, the high profit incentive, an increase in international trade, and a lack of regulation enforcement. In the past, identifying the fish species was done by looking for morphological features when the fish is whole, but fisheries now import in many forms, such as fish blocks, fillets, canned, cured, etc. The goal of this project was to determine the validity of scallops sold on the market in our local grocery stores. Using primers specific for scallops and stingray and Polymerase Chain Reaction, we hypothesize we will be able to determine if the scallops we buy from local grocery stores are truly scallops. Currently the protocol is being optimized and results of scallops tested will be presented.

POPULATION GENETIC STRUCTURE AND NATURAL RATE OF HYBRIDIZATION BETWEEN *SARRACENIA FLAVA* AND *SARRACENIA MINOR* IN FRANCIS MARION NATIONAL FOREST.

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Terrestrial pitcher plants in the genus Sarracenia (Sarraceniaceae) have long fascinated biologists, plant collectors and breeders, as well as the general public. The genus is composed perennial, carnivorous herbs that acquire a portion of their nutrition through the capture and digestion of animal prey. The genus has a patchy distribution, largely owing to their requirement for low-nutrient, acidic soils such as those found in longleaf pine savannas and sphagnum bogs. Francis Marion National Forest, located in the coastal plain of South Carolina, represents a unique opportunity to examine the population dynamics of these endemic species on a scale that may emulate how they may have behaved when their habitat was less fragmented. It is estimated that between 149.7 km2 and 303.5 km2 acres of this national forest is longleaf pine savannah. Given the amount of potential habitat suitable to S. flava and S. minor found in Francis Marion National Forest, this study examines the population genetic structure and natural rates of hybridization between these species in situ. We believe these results will serve as a useful null hypothesis for how these species partition their genetic diversity when their habitat isn't overly disrupted by anthropogenic factors.

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

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Human Immunodeficiency Virus (HIV) is a retrovirus that infects and destroys CD4+ T cells, gradually decreasing immune competence and leading to Acquired Immunodeficiency Syndrome (AIDS). HIV infection can be treated and suppressed using anti-retroviral therapy, but persistence of the latent HIV reservoir in host cells prevents anti-retroviral treatments from being curative. One approach to targeting and eliminating the viral reservoir is to selectively eliminate cells infected with HIV via expression of a pro-apoptotic gene. The goal of this project is to express pro-apoptotic Bax to induce apoptosis in HIV-infected cells using the lentiviral vector pLRed(INS2)R. In this vector, expression of the reporter gene, dsRed is under the control of three HIV-1 regulatory elements: an inhibitory sequence (INS), the 5' LTR, and the Rev-response element (RRE). Together, these elements inhibit expression in the absence of the HIV regulatory proteins Tat and Rev, and therefore induce expression only in the presence of HIV. We hypothesized that this HIV-dependent vector can be used to express pro-apoptotic genes in HIV-infected cells, while leaving uninfected cells unharmed. The Bax open reading frame from pCMV-Bax was cloned as a fusion gene with eGFP in place of dsRed to create pBaxTNG(INS2)R. In this vector, eGFP is localized to the nucleus using the SV40 Nuclear Localization Signal and can be used to monitor Bax-mediated apoptotic effects in the nucleus. However, eGFP cannot be used to select a stable population of cells without also inducing unwanted apoptosis due to Bax expression. Therefore, a neomycin phosphotransferase expression cassette was cloned just upstream of the 3' LTR in an inverted orientation, creating pBaxTNG(INS2)Rneo. Expression of the selectable marker is under control of the SV40 promoter and is therefore not HIV dependent. Current studies are underway to verify vector function, and if successful, will be followed by HIV inhibition studies.

IMPACT OF NODAL PERTURBATION ON THE DISTRIBUTION OF NUCLEAR TRANSPORT PROTEINS IN SEA URCHIN NEUROGENESIS

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The sea urchin embryo (*Lytechinus variegatus*) is a valuable model for studying the molecular basis of embryogenesis, because it is easy to culture, is genetically and physiologically simple, and, as a deuterostome, has molecular pathways similar to those in vertebrates. During embryogenesis, three germ layers arise: ectoderm, mesoderm, and endoderm. Our lab is particularly interested in the formation of neural ectoderm and how karyopherins may influence the ability of the transcription factor Nodal to influence formation and spatial distribution of ectodermal structures. Nodal and other transcriptions factors are transported to and from the nucleus by nuclear transport proteins called karyopherins. Our lab is examining how expression of karyopherins impacts embryogenesis and which neurodegenerative processes are implicated with the disruption of target karyopherins. One of the karyopherins considered in this study is KPNA2/7, a karyopherin that may help maintain embryo pluripotency before neural differentiation. Using the chemical inhibitor NiCl2 to induce Nodal overexpression, we have compared karyopherin expression in NiCl2-treated and untreated embryos, examining the spatial distributions of karyopherins using wholemount in situ hybridization. In untreated embryos, KPNA2/7 is typically expressed around the mouth, in the gut, and in clusters of cells associated with the ciliary band. Our preliminary studies show that this pattern is perturbed in NiCl2-treated embryos, where KPNA2/7 is found primarily in the archenteron and vegetal regions. To better quantify relative changes in karyopherin levels, our lab is performing reverse transcriptase polymerase chain reactions (RT-PCR) and also plans to examine roles of additional karyopherins expressed in neural tissues. Results of this study will improve understanding of how nuclear transport processes impact neurogenesis and may further implicate karyopherins in neurodegeneration at a systems-based level.

FULL CHLOROPLAST GENOME OF *NEOTTIA BIFOLIA*: COMPARATIVE GENOMICS BETWEEN AN AUTOTROPHIC AND MYCOHETEROTROPHIC ORCHID

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Chloroplasts possess a uniparental mode of inheritance and sequencing the chloroplast genome provides imperative insights into the genetics of photosynthetic organisms. Populations of *Neottia bifolia*, the rare Southern Twayblade, have been discovered on the property of Francis Marion University. Much about the ecology and phylogeography of this species remains a mystery. For example, a closely related species, *Neottia nidus-avis* is a mycoheterotrophic plant that lacks leaves and parasitizes its historic fungal symbiont for carbon resources. Along with the evolution of mycoheterotrophy came the loss of several chloroplast genes critical for photosynthesis. While *Neottia bifolia* appears to be autotrophic, comparative genomics tools could help us identify missing genes in the chloroplast genome if the species is in the early stages of mycoheterotrophy. Further, sequencing the chloroplast genome will provide valuable markers to use as a population genetics resource. Here, we present the results of full chloroplast sequencing using a series of 16 long polymerase chain reactions. Reactions were pooled for Illumina DNA library prep and sequenced using a MiSeq nano flowcell. A reference-based assembly using the chloroplast genome of *Neottia nidus-avis* was performed in Geneious 11.1.3.

TESTING DESIGNS FOR THE MORE EFFICIENT AND EFFECTIVE MOSQUITO TRAP

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Mosquitos are known to spread diseases throughout a community, some of which can be viruses, referred to as arboviruses. In 2017, DHEC reported 158 incidents of arboviruses in South Carolina, including Eastern Equine Encephalitis virus, West Nile virus, Dengue Fever virus, and Zika virus. The infections rate was up from the year before, when 124 incidents of arboviruses were reported in 2016. Monitoring of these infected mosquitos can be a valuable asset for proper health protection in a community. The purpose of this project is collect mosquitos and test them for the presence of disease causing viruses. Before finding the viruses in mosquitoes, however, several processes must first take place, including finding an effective and efficient way to catch these mosquitoes. In order to do this, several designs of mosquito traps were tested during the spring, summer, and fall of 2018. In testing these designs, the number of mosquitoes caught was the sole factor that differentiated each trap. Based on the data collected it was determined that one mosquito trap design was more effective and efficient than the other designs.

THE EFFECT OF CONFINEMENT ON IRON OXIDE IN FREE DIFFUSION AND WITH A HORIZONTAL MAGNETIC FIELD.

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Nanocolloidal suspensions of iron oxide have been used for numerous medical applications, such as MRI contrast enhancement, hyperthermia, drug delivery, and cell separation. We conducted multiple experiments using a shadowgraph method of imaging to record the diffusion process of the iron oxide nanocolloid with a concentration gradient oriented against the gravitational field. Experiments inducing horizontal magnetic fields with Helmoltz coils were also recorded. In addition, we also performed experiments for cells of different geometry, same diameter but different heights to verify the influence of confinement on non-equilibrium concentration fluctuations. Extracted frames from these recordings are processed through a Differential Dynamic

Algorithm (DDA). We computed, the structure function, the structure factor, correlation time and the mass diffusion coefficient. Our results show that the correlation time is strongly affected by the confinement effect due to cells of different geometries.

SIMILARITY OF THREE-DIMENSIONAL SOLID MODELS USING CONGRUENCY OF TRIANGLES

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Objectively quantifying the similarity of three-dimensional models is a well-developed field of research and is driven by the beneficial implications in a manufacturing environment. These benefits include decision support during product design, early identification of quality concerns, and reduced product development time. The research outlined in this project seeks to evaluate triangle congruency as a viable method to assess similarity of solid models. The proposed method compares two solid, three-dimensional solid models by comparing their constituent triangles. Larger the number of congruent triangles shared, the larger is the similarity of the two solid models. The method has been employed to assess the similarity of solid models in an engineering shape benchmark. The results are currently being analyzed to compare the proposed method to methods from literature. Additionally, results are also being analyzed to determine the sensitivity of the proposed method to number of decimal places used to compute side lengths, and sensitivity to resolution of the triangles used to construct the solid models. Conclusions of this research seek to illuminate gaps in literature in regard to the specific function of this method as well as possible avenues to improve this method and increase its relevance as an engineering tool. Future work for this project includes the investigation into methods to discover a single model to optimally and geometrically represent a subset of models within a database. This will effectively eliminate the subjectivity in the categorization process of models in database storage as well as increase performance of the method presented in this research.

CLONING A HIV-1 VIF-RESISTANT A3G GENE INTO A LENTIVIRAL VECTOR

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This study focuses on the HIV-1 Viral infectivity factor (Vif), and how it interacts with a host anti-retroviral protein called Apolipoprotein B mRNA editing enzyme, catalytic polypeptide-like 3G (A3G). During HIV infection, A3G is normally packaged into progeny virions, and following infection of a subsequent host cells, acts to induce extensive cysteine to uracil mutations, leading to guanine to adenine substitutions and provirus inactivation. However, Vif prevents A3G incorporation into virions by inducing A3G ubiquitination and proteasomal degradation The goal of this project was to develop a lentiviral vector that expresses a fusion gene incorporating a Vif-resistant form of A3G (D128K) and the selectable marker, puromycin-N-acetyltransferase,. This fusion gene was created by triplex PCR, which eliminated the A3G stop codon and linked the two genes together using the Thosea asigna virus T2A peptide cleavage sequence. During the cloning process, a Ha tag was added to the 5' end of A3G to assist with detecting A3G expression. The fusion gene was then cloned into the lentiviral vector, pLRed(INS2)R, which we have previously shown to express a Renilla luciferase/eGFP fusion gene in a HIV-dependent manner. Current work is underway to analyze the function of the Vif-resistant vector, pLHaATP(INS2)R and to determine if the vector can limit generation of a productive infection.

THE EFFECT OF GLOBAL WARMING ON SEA LEVEL RISE ON COASTAL SOUTH CAROLINA VASCULAR PLANT SPECIES

Richard Stalter
St. John's University

Richard Stalter, Rahema Nasary, Abiesha Smith, Khadija Yousuff, Amanda Garcia, Demetrios Limperopoulos, John Baden Meryem Toppa In the present study, we examine the effect of rising sea level, a product of global warming, on the distribution of coastal vegetation at five sites in South Carolina. Rising sea level with a concomitant increase in water salinity and duration of submergence is changing plant diversity in coastal salt marsh and brackish marsh communities. We present data at three brackish marsh abandoned rice fields, and a salt marsh at the Baruch institute, Georgetown County, and a fifth site, a skeleton live oak stand in southeastern Beaufort County. Rising sea level has impacted vegetation at the 3 abandoned rice fields reducing vascular plant diversity at the two least saline sites, Air Port and Alderly. *Sporobolus alterniflorus* a salt marsh associate is now present at Alderly, the least saline abandoned rice field, testimony to rising sea level and increase in water salinity. The more flood tolerant *Borrichia frutescens* is replacing *Sporobolus pumilus* at the salt marsh at Clam Bank. A stand of live oak, *Quercus virginiana*, has been replaced by salt marsh taxa, *Salicornia virginica* and *S. alterniflorus* at the Beaufort County site. Sea level has been rising at a rate of 3 mm/yr since 1930 and may rise at a greater rate in the future, impacting the vegetation of the aforementioned communities and additional coastal marsh and upland communities along the east coast of the United States.

OPTIMIZING *TOL2* TRANSPOSITION IN ZEBRAFISH

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Transposable elements are DNA segments that move within the genome when induced by transposase proteins. The transposable element from Medaka fish has successfully been adapted for integrating foreign DNA into a wide variety of vertebrates. In order to increase the usefulness of *Tol2* as a transgenic tool, our goal is to optimize *Tol2* transposition in zebrafish. To achieve this, there are two separate components to the project. The first uses activation tagging, a form of transposon tagging, in order to 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. An activation tag is created when a strong enhancer is positioned within the transposable element. Our activation tag construct consists of the *Tol2* terminal inverted repeats flanking the enhancer region of the beta-actin promoter. This activation tag was cloned in front of the mCherry reporter gene to indicate when transposition occurs. A Tol2 transposase expression construct controlled by a heat inducible promoter was engineered to induce transposition of the activation tag in zebrafish. The two constructs were coinjected into zebrafish embryos to create a population for measuring transposition rates. Upon heat shocking the embryos, a loss of mCherry expression within the zebrafish will indicate the transposition of the activation tag away from the reporter gene. As a result of the activation tag landing somewhere else within the genome, it is expected that a mutant phenotype can also be observed. The second study investigates whether the removal of a Nuclear Export Signal (NES) from the *Tol2* transposase will increase the efficiency of *Tol2* transposition. We hypothesize that the NES is keeping *Tol2* transposase outside of the nucleus, thus lowering the rate of *Tol2* transposition. Comparison of rate of transgene integration rates for control and NES removed versions of transposase mRNA will indicate if the NES functions to suppress Tol2 transposition.

CREATING A REPORTER PLASMID TO ALLOW TESTING OF ANTI-HIV REV siRNAS

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The Human immunodeficiency virus (HIV) is a retrovirus that infects and kills CD4+ T-cells, weakening the host's immune capacity. The Acquired Immune Deficiency Syndrome (AIDS) occurs when an infected individual has one or more opportunistic diseases and a T cell count of less than 200/µl. Although current drug treatments control HIV replication, they are not curative. Another way to inhibit HIV replication might be through the use of short hairpin RNAs (shRNAs) that are designed to target viral mRNA and induce RNA interference. ShRNAs are single-stranded molecules that are cleaved into double-stranded small interfering RNAs (siRNAs) by the host enzyme, Dicer. The complementary RNA strand, termed the guide strand, is then utilized by the host RNA induced silencing complex (RISC) to bind to and cleave the targeted viral mRNA, thereby silencing the gene. A potential target of RNA interference is the HIV-I Regulator of Virion Expression (Rev), which functions to bind partially spliced and unspliced mRNAs and export them to the cytosol for translation, or in the case of unspliced mRNAs, to also act as the virus genome. Therefore, a shRNA was designed to target HIV-I Rev at nucleotide 8403 of the HIV genomic clone pNL43 (Accession number M19921). The resulting RNA was converted to dsDNA, HindIII and BglII sites were added for cloning, and both strands were synthesized. Revsh840, the anti-Rev shDNA, was cloned into the shuttle vector pHI.Stuffer(-) to create the pHIRevSh8403 plasmid. Successful cloning was verified by PCR and direct sequencing. To test the anti-Rev activity of this shRNA, a reporter plasmid is currently being created. For this, pCMV-B-gal was digested with XhoI, located within the B-gal 3 prime untranslated region (3 prime UTR). Next, a portion of pNL43 containing Rev Exon 2, which includes the Rev 8403 target site, will be cloned into the 3 prime UTR of pCMV-B-gal. Anti-Rev shRNAs targeted to this sequence are expected to silence B-gal activity, providing an efficient way to access specificity of anti-Rev shRNAs.

A TEST OF THE USE OF TIMBER WOLF (*CANIS LUPUS*) URINE TO REDUCE COYOTE (*CANIS LATRANS*) DEPREDATION RATES ON LOGGERHEAD SEA TURTLE (*CARETTA CARETTA*) NESTS

Michael Wauson and William Rogers
Winthrop University

Over the past four years, coyotes (*Canis latrans*) have depredated 24.18% of loggerhead sea turtle (*Caretta caretta*) nests on the night they were laid on South Island beach at the Tom Yawkey Wildlife Center, near Georgetown, SC. This resulted in an estimated 3,435 eggs lost each year there. A South Carolina Department of Natural Resource Turtle Technician Team patrolled the beach at dawn every morning to cage and catalog loggerhead eggs and nests but were unable to cost-effectively protect the nests the night the eggs were laid. To test a new method to dissuade coyote depredation, I used dispensers filled with wolf urine to simulate timber wolf (*Canis lupus*) activity on seven sections of the beach and left seven sections as controls. A Fisher exact test showed a depression in depredation rates where urine was present compared to that of the control areas (Fisher exact test, p=.0075). The results suggest this may be an example of exploitative competition in the absence interference competition. Furthermore, there may be kairomones in the wolf urine that allow the exploitative competition to exist even when coyotes haven't been exposed to wolves in many generations. With daily teams patrolling the beaches already, this could be an inexpensive, non-invasive way of dealing with coyote depredation on loggerhead nests elsewhere.

DETERMINING THE IDENTITY OF THE FUNGAL SYMBIONT OF *NEOTTIA BIFOLIA*: MOLECULAR AND ANATOMICAL EVIDENCE

Andrew Westfall and Jeremy Rentsch
Francis Marion University

Mutualism is an integral part for the survival of a multitude of species and is observed in at least ninety-five percent of angiosperms. The most common type of plant mutualism is an association with fungi known as arbuscular mycorrhizae. This association, of fungi in the plant roots, increases the plant root's surface area. This increased surface area allows the plant to obtain additional water and nutrients; in turn, the plant feeds the fungus. The family Orchidaceae heavily depends on this mutualism for germination and more, depending on the species. The Southern Twayblade, *Neottia bifolia*, is a rare orchid found in the United States and Canada. Because of its rarity and peculiar habitat, few scientific studies have been completed on it. Most orchids species documented so far have only had a mutualistic relationship with one species of fungus at a time. However, preliminary research on N. bifolia has failed to reveal the identity of this fungal symbiont conclusively. Preliminary research has been largely confined to DNA extraction, PCR, and gel electrophoresis. Normally, these methods would suffice in amplifying the locus for one species, but conducting these procedures revealed a larger than average band, implying the presence of multiple fungi in the genomic DNA extraction. Therefore, we propose to use cloning techniques with *Escherichia coli* to isolate and sequence each amplicon individually and identify the fungal symbiont; separating it from potential contaminants.

DETERMINING THE ROLE OF *LDLRAP1A* IN 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 bloodstream. Humans with mutations in LDLRAP1 have familial hypercholesterolemia, an autosomal recessive inherited disorder, resulting in abnormally high levels of blood lipoproteins. We hypothesize, as in humans, Ldlrap1a functions in zebrafish to prevent the accumulation of blood lipoproteins. To study the role of *ldlrap1a* in zebrafish, a reverse genetics approach was taken by using CRISPR-Cas9 to generate a mutant zebrafish line for ldlrap1a. In-crosses with heterozygous F2 *ldlrap1a* zebrafish were performed to generate F3 embryos. Sequencing of F3 mutant DNA and cDNA revealed a 7bp deletion in exon 3. This caused a frameshift resulting missense and a premature stop codon 37bp into exon 3. To study cholesterol clearance, we did a high cholesterol diet experiment. A heterozygous in-cross with the 7bp deletion line was performed, and the larvae were fed a high cholesterol or control diet from 4.5dpf until 9.5dpf, and then fish were stained with Oil Red O to label lipids. In fish fed the high cholesterol diet, homozygous mutants appeared to have more lipids in their blood stream compared to wild-type zebrafish, and in some cases, what appeared to be lipid deposits were seen in the vasculature of the zebrafish. Next, we plan to quantify the cholesterol and perform qPCR on genes involved in lipid metabolism. If zebrafish have a lipid clearance defect, this line could be a useful model to study hypercholesterolemia in humans.

MOSQUITO SPECIES RICHNESS IN RESIDENTIAL AND NON-RESIDENTIAL ENVIRONMENTS

Ron Willis and Mary Katherine Mills
University of South Carolina Aiken

Mosquitoes are Dipteran insects in the family Culicidae, which contains multiple species that are able to transmit (vector) pathogens to humans and animals, including *Anopheles*, *Culex*, and *Aedes* mosquitoes. Female mosquitoes must blood-feed to produce eggs, and if the source is infected, the mosquito can transmit the ingested pathogens to a naive host during the subsequent blood meal. After a blood meal, the female lays the eggs in aquatic environments. Once the egg hatches, it can become a free-flying adult within 5-7 days. Of interest, humans often build residential homes close to the natural habitat of mosquitos, including habitats near lentic water systems (minimum flow or no flow of water), streams, and coastal zones. Control of mosquito populations and mosquito species surveillance are critical to limiting disease transmission to humans by these blood-feeding insects. The purpose of this study was to determine the mosquito abundance and species richness across different areas of Aiken, SC. We trapped mosquitoes using five CO2-baited, CDC light traps at two sites containing a lentic water system, a (a) residential and (b) non-residential site, every two weeks. Using dichotomous key, we identified trapped mosquitoes to species and all other insects to order. We found multiple vector mosquito species at both sites, and observed a drastic effect of temperature on mosquito abundance. We also observed slight differences in insect abundance and species richness between the two sites. Overall, this study demonstrates the importance of mosquito surveillance, as public health risk is linked to the vector mosquito abundance.

SCORING METHODS FOR THE BASKING BEHAVIOR OF EASTERN-PAINTED TURTLES (CHRYSEMYS PICTA PICTA) IN THE LAB

Jordan Winebrenner and David Ferris
University of South Carolina Upstate

We placed wild-caught Eastern Painted Turtles (*Chrysemys picta picta*) in an environmental chamber to determine acclimation time to our novel environment. Acclimation was defined as consistent day-to-day basking. Utilizing iButton, manual scoring of videos, and Ethovision software, we quantified the frequency and duration of diurnal basking events. Although highly variable, there was a behavioral "plateau" for basking frequency by day 9 while the mean basking duration plateaued sooner. Our result suggests that laboratory studies should ensure turtles are fully acclimated to a novel environment before data collection begins. We then compared our data collection methods: iButton, manual video scoring, and Ethovision automated video tracking. The comparison assessed how three methods compared in terms of overall behavioral tracking success.

HERPETOTOLOGICAL SURVEY OF MARSH WILDLIFE MANAGEMENT AREA, MARION COUNTY

Tyler Wright and Jeffery Camper
Francis Marion University

Abstract: A short-term herpetological survey of a state owned and managed property, Marsh Wildlife Management Area, that was purchased on December 28, 2005 from the Marsh Furniture Company. The survey was performed between January 31, 2018 and September 12, 2018. Marsh is an approximately 3506.07 ha plot located in Marion County, SC. The tract includes a variety habitat types including river floodplains, hardwood forest, extensive pine, mixed pine-hardwood forest and diverse longleaf pine. This diversity of habitat is a key feature in the coastal plain of the southeastern United States giving it the most reptile and amphibian species in all of North America with more than 100 species. Interest arose in this area due to its proximity to another state owned and managed property, Woodbury Wildlife Management Area, which has had studies conducted on its premises in past years. This survey was crucial for surveying another public land system to document species and help aid in information to stop the species extinction crisis particularly in herps.

INVESTIGATING THE TRANSPOSITION OF THE HARBINGER3N_DR TRANSPOSABLE ELEMENT IN YEAST

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

DNA transposable elements are mobile sequences of DNA that use a cut-and-paste mechanism to "jump" from one site in the genome to another. They are found in all kingdoms of life and are sorted by homology into groups called superfamilies. The Harbinger3n_Dr transposable element, from zebrafish belongs to the PIF/Harbinger superfamily. We are interested in studying this element because it has previously been shown to transpose in human cells, where it can be used as a tool for transgenesis or mutagenesis. Our goal is to learn more about its transposition characteristics, as well as develop hyperactive versions that transpose at higher rates. Previous experiments have shown that the Harbinger ORF1 and Harbinger Transposase (TPase) proteins must be present for Harbinger3n_Dr to jump. I have developed Harbinger ORF1 and Harbinger TPase expression constructs and transformed them into yeast together with a Harbinger3n_Dr reporter construct. Yeast transposition assays showed that Harbinger3n_Dr transposes at a very low rate. Sequence analysis revealed that Harbinger3n_Dr transposition can result in imprecise repair of excision sites. These results suggest that either the yeast cells are not a very compatible host of this element or that our assay is not effectively measuring transposition. Because we observed some imprecise repair of Harbinger3n_Dr excisions sites, we are testing if providing a homologous template in a diploid yeast will allow for precise repair of the excision sites. If imprecise repair was the limiting factor, this strategy should allow us to observe the true number of transposition events.

END

SC Academy of Science Abstracts
(Sr. Academy)

SOUTH CAROLINA JUNIOR ACADEMY OF SCIENCE
2019 SCHEDULE OF EVENTS

7:30 AM - 10:00 AM	**SCJAS Registration**	**Founders Hall Breezeway**
7:30 AM – 9:00 AM	*Continental Breakfast*	
8:30 AM – 10:30 AM	**SCJAS Oral Session I**	**Founders Hall**
	See SCJAS oral session listing for details & room numbers	
10:30 AM – 10:45 AM	**Break**	
10:45 AM – 12:30 PM	**SCJAS Oral Session II**	**Founders Hall**
	See SCJAS oral session listing for details & room numbers	
[10:00 AM – 11:30 PM]	**SCAS Poster Session**	**Smith University Center**
	Junior Academy members are encouraged to visit SCAS posters	
12:30 PM – 1:15 PM	**Lunch**	**Ervin Dining Hall**
	Ticket is in your badge holder *Be sure to have lunch during the time indicated on your ticket*	
1:30 PM – 2:30 PM	**SCJAS Oral Session III**	**Founders Hall**
	See SCJAS oral session listing for details & room numbers	
1:30 PM– 2:45 PM	**Plenary Session** **Governor's Awards**	**Chapman Auditorium in McNair Science Building**
3:00 PM – 4:00 PM	**Afternoon SCJAS Activities & Workshops**	**Richardson Hall** *(near Neville & Lassiter Halls)*

Biochemistry and Computational Biology Information Session

Evaluating Human Vital Signs

Journey to the Center of the Atom

Visual Neuroscience: how neurons in the brain generate perception

Francis Marion University Campus Tour

4:15 PM **SCJAS Awards Ceremony**	**Chapman Auditorium**
SCJAS Judges Conference Room	***Founder's Hall 114B***

Afternoon SCJAS Activities & Workshops

(3:00 – 4:00 PM; NOTE: Planetarium show begins at 3:15)

1. Medical Entomology, Dr. Robert Wolff, South University

Where: Leatherman Science Facility (LSF) Room 102

This workshop will focus on a review of the types of arthropods (insects, spiders, ticks) that have medical importance, how to reduce fears of arthropods (where there is little or no reason to be afraid), and some basic information on how wonderful it is to actually pay attention to them. The use these arthropods in educating about the science, health, and the environment will be included for the students and a focus for the teachers.

2. Acquiring Assessment Skills through the Use of Simulators

Dorie Weaver and Wendy Hatchell, FMU Nursing Program

Where: Lee Nursing Building – 2nd Floor Skills Lab (#4 on campus map)

Hands-on activities use simulators in the FMU Nursing Program. Listen to heart, lung and bowel sounds and palpate (feel) peripheral pulses. See examples of wound models and IV insertions (nothing sharp – we are simulating today).

3. Journey to the Center of the Atom, Bill Wabbersen, Savannah River Site

Where: Leatherman Science Facility (LSF) Room 108

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. Francis Marion University Campus Tour

Where: Stokes Administration Building (SAB) (entrance by the clock tower/statue) (#1 on campus map)

Admissions ambassadors will lead students on a tour of the FMU campus

5. Planetarium Show: Phantom of the Universe *(NOTE: 3:15 start)*,

Dr. Jeannette Myers, Professor of Astronomy; FMU Department of Physics and Engineering

Where: Dooley Planetarium, CEMC 235 (Meet outside Chapman Auditorium and you will be lead to CEMC)

Phantom of the Universe is a new planetarium show that showcases an exciting exploration of dark matter, from the Big Bang to its anticipated discovery at the Large Hadron Collider. The show is offered to planetariums worldwide free of charge. It is narrated by Tilda Swinton.

The show reveals the first hints of its existence through the eyes of Fritz Zwicky, the scientist who coined the term "dark matter." It describes the astral choreography witnessed by Vera Rubin in the Andromeda galaxy and then plummets deep underground to see the most sensitive dark matter detector on Earth, housed in a former gold mine.

From there, it journeys across space and time to the Large Hadron Collider at CERN, speeding alongside particles before they collide in visually stunning explosions of light and sound, while learning how scientists around the world are collaborating to track down the constituents of dark matter.

Q&A for 10-15 minutes after the 30-minute show

SCJAS 2019 ANNUAL MEETING ORAL PRESENTATION SESSIONS
FRANCIS MARION UNIVERSITY, MARCH 30TH, 2019

Session Locations

(Please see next page for presentation times)

Biochemistry / Mentored ..... **Founders Hall 111 A**
Biochemistry / Non-Mentored ..... **Founders Hall 111 A**
Botany / Mentored ..... **Founders Hall 111 B**
Botany / Non-Mentored ..... **Founders Hall 111 B**
Cell and Molecular Biology / Mentored ..... **Founders Hall 114 A**
Chemistry / Mentored ..... **Founders Hall 108 A**
Chemistry / Non-Mentored ..... **Founders Hall 111 A**
Computer Science / Mentored ..... **Founders Hall 140 A**
Computer Science / Non-Mentored ..... **Founders Hall 140 B**
Consumer Science / Mentored ..... **Founders Hall 255 A**
Consumer Science / Non-Mentored ..... **Founders Hall 255 A**
Engineering / Mentored ..... **Founders Hall 250 B**
Engineering / Non-Mentored ..... **Founders Hall 222 B**
Environmental Science / Mentored ..... **Founders Hall 213 B**
Environmental Science / Non-Mentored (Session A ..... **Founders Hall 213 A**
Environmental Science / Non-Mentored (Session B ..... **Founders Hall 213 C**
Mathematics / Mentored ..... **Founders Hall 140 B**
Mathematics / Non-Mentored ..... **Founders Hall 140 B**
Microbiology / Mentored ..... **Founders Hall 213 B**
Microbiology / Non-Mentored ..... **Founders Hall 216 B**
Physics / Mentored ..... **Founders Hall 210 B**
Physics / Non-Mentored ..... **Founders Hall 210 B**
Physiology and Health / Mentored ..... **Founders Hall 142 A**
Physiology and Health / Non-Mentored ..... **Founders Hall 142 B**
Psychology / Mentored ..... **Founders Hall 251 A**
Psychology / Non-Mentored ..... **Founders Hall 251 B**
Sociology / Mentored ..... **Founders Hall 251 A**
Sociology / Non-Mentored ..... **Founders Hall 251 C**
Zoology / Mentored ..... **Founders Hall 213 B**
Zoology / Non-Mentored ..... **Founders Hall 210 A**

SCJAS 2019 ANNUAL MEETING ORAL PRESENTATIONS
FRANCIS MARION UNIVERSITY, March 30TH, 2019

BIOCHEMISTRY/ MENTORED
Founders Hall 111 A

9:45 AM IDENTIFICATION OF NOVEL COMPOUNDS THAT INHIBIT GROWTH OF *PSEUDOMONAS AERUGINOSA* BY TARGETING PENICILLIN-BINDING PROTEIN 3 (PBP3)
Daphne Dang, South Carolina Governor's School for Science & Mathematics

10:00 AM CHEMICAL MODIFICATION OF TOBACCO MOSAIC VIRUS (TMV) NANOPARTICLES
Ronak Patel, South Carolina Governor's School for Science & Mathematics

10:15 AM THE EFFECT OF FIASMA ON IL-6 SECRETION AND EXPRESSION STIMULATED BY LPS AND PALMITIC ACID IN RAW 264.7 MACROPHAGES
Audrey Pope, South Carolina Governor's School for Science & Mathematics

10:45 AM HEME OXYGENASE 1 AS A CYTOTOXIC TARGET FOR A NOVEL ISOFLAVONE, ME-344
Richard Sandvoss, South Carolina Governor's School for Science & Mathematics

10:30 AM *BREAK*

11:00 AM STUDYING THE TRANSPORT RATE OF RHODAMINE 123 BY P-GLYCOPROTEIN
Esha Hegde, South Carolina Governor's School for Science & Mathematics

11:15 AM ANALYSIS OF THE CYSTEINE DESULFURASE MECHANISM USED BY THE PLP BOUND PROTEIN SUFS
Katherine Porter, South Carolina Governor's School for Science & Mathematics

BIOCHEMISTRY / NON-MENTORED
Founders Hall 111 A

9:30 AM THE EFFECT OF WHEY AND PLANT PROTEIN POWDER ON THE TOTAL GROWTH OF WORMS
Walker Draffin and Henry Haywood, Heathwood Hall Episcopal School

BOTANY / MENTORED
Founders Hall 111 B

11:00 AM ENVIRONMENTAL CONDITIONS ON RED DRUPELET INCIDENCE
Mackenzie Meadows, South Carolina Governor's School for Science & Mathematics

11:15 AM WEED DIVERSITY DECREASES PEST ABUNDANCE WITHOUT YIELD LOSS
Melina Madden, South Carolina Governor's School for Science & Mathematics

11:30 AM THE LONG-TERM EFFECTS OF HURRICANE HUGO ON THE GROWTH AND RECOVERY OF SOUTH CAROLINA'S COASTAL TEMPERATE FORESTS
John Besser and Jack Stuckey, South Carolina Governor's School for Science & Mathematics

11:45 AM THE EFFECTS OF ASCORBIC ACID AND MELATONIN ON WHITE DRUPELET DISORDER IN "APACHE" BLACKBERRIES
Alexis Coulombe, South Carolina Governor's School for Science & Mathematics

12:00 PM DEVELOPING A PCR-BASED SNP GENOTYPING METHOD FOR THE TOMATO SELF-PRUNING GENE
Melinda Elser, South Carolina Governor's School for Science & Mathematics

12:15 PM IDENTIFYING THE IDEAL GROWTH CONDITIONS OF WHEAT CROPS IN THE PEE DEE USING GENOME WIDE ASSOCIATION STUDIES
Jeffrey Jiang, South Carolina Governor's School for Science & Mathematics

BOTANY NON-MENTORED
Founders Hall 111 B

8:30 AM THE EFFECT OF ACID RAIN ON PLANT GROWTH
Nadine Hanna, Heathwood Hall Episcopal School

8:45 AM THE EFFECT OF BIOCHAR AND RHIZOBIUM LEGUMINOSARUM ON THE GROWTH RATES OF *ERUCA SATIVA* AND SOIL NITRATE AND PHOSPHORUS LEVELS IN SUBOPTIMAL SOIL
Ridha Fatima, Spring Valley High School

9:00 AM GENETICALLY MODIFYING RICE TO FIGHT IRON DEFICIENCIES
Rachel Faris, Center for Advanced Technical Studies

9:15 AM THE EFFECT OF LED, UV, AND FLUORESCENT LIGHT ON *LACTUCA SATIVA* IN A HYDROPONIC SYSTEM
Serena Parmar, Heathwood Hall Episcopal School

9:30 AM THE EFFECT OF LEUCOBRYUM GLAUCUM ON THE GROWTH OF *BRASSICA RAPA* AND SOIL COMPOSITION
Sydni Moore, Spring Valley High School

9:45 AM THE EFFECT OF VARIED LEVELS OF SALINITY ON CHLOROPHYLL A LEVELS IN *CAULERPA SERTULARIOIDES*
Frank Boysia, Spring Valley High School

10:00 AM THE EFFECT OF VARIOUS AMMONIA CONCENTRATIONS ON THE RATE OF SEED GERMINATION IN *FRAGARIA ANANASSA*
Karah Barry, Spring Valley High School

10:15 AM THE POTENTIAL CORRELATION BETWEEN SOIL PH AND COLOR VIBRANCY OF YELLOW CHRYSANTHEMUM BLOOMS, *DENDRANTHEMA GRANDIFLORA*
Savannah Smith, Heathwood Hall Episcopal School

10:30 AM *BREAK*

10:45 AM THE EFFECT OF GLYPHOSATE TOLERANT SOYBEANS ON THE PH, NITROGEN, AND PHOSPHORUS LEVELS OF THE SOIL
Andrew Polson, Spring Valley High School

CELL AND MOLECULAR BIOLOGY / MENTORED
Founders Hall 114 A

8:30 AM THE EFFECTS OF TEMOZOLOMIDE ANALOG (TMZ-A) ON LN229 AND U87 GLIOBLASTOMA CELL LINES
Paula Salazar, South Carolina Governor's School for Science & Mathematics

8:45 AM THE POTENTIAL EFFICACY OF TARGETED GOLD NANOPARTICLES IN THE MICRO-CT IMAGING OF LN229 HUMAN GLIOBLASTOMA CELLS
Rachel Eisenhart, South Carolina Governor's School for Science & Mathematics

9:00 AM ASSESSING THE EFFECTS OF HEPARIN-COATED NANOPARTICLES AS A TREATMENT FOR RESTENOSIS
Peyton Clark, South Carolina Governor's School for Science & Mathematics

9:15 AM USING SANGER SEQUENCING TO DIAGNOSE A PATIENT WITH BMD
Kenneth Winterfeldt, South Carolina Governor's School for Science & Mathematics

9:30 AM CLONING OF CANDIDATE GENES FROM SEASHORE PASPALLUM
Marissa Haller, South Carolina Governor's School for Science & Mathematics

9:45 AM CLONING OF CANDIDATE GENES FROM SEASHORE PASPALLUM
Benjamin Brickle, South Carolina Governor's School for Science & Mathematics

10:00 AM CLONING THE DRM2 GENE IN ARABIDOPSIS THALIANA FOR FURTHER RESEARCH IN PLANT PATHOGENIC DEFENSE
Abigail Dowling, South Carolina Governor's School for Science & Mathematics

10:15 AM ATRX MUTATIONS IN IDH1-MUTATED MICE NEURAL STEM CELLS
Layne Scopano, South Carolina Governor's School for Science & Mathematics

10:30 AM *BREAK*

10:45 AM EFFECTS OF THE HPV VACCINE GARDASIL 9 ON NATURAL KILLER CELL LIGAND EXPRESSION ON TUMOR CELLS
Hunter Smith, South Carolina Governor's School for Science & Mathematics

11:00 AM THE TRACING OF MESOTHELIAL-DERIVED CELLS
Brent Hadley, South Carolina Governor's School for Science & Mathematics

11:15 AM AN INVESTIGATION OF THE ROLE OF NEURAMINIDASE IN LUPUS NEPHRITIS
Caitlin McDade, South Carolina Governor's School for Science & Mathematics

11:30 AM NOVEL STRATEGIES TO IMPROVE DELIVERY OF ANTICANCER DRUGS ACROSS THE BLOOD-BRAIN BARRIER TO TREAT GLIOBLASTOMA
Adriana Carter, Academic Magnet High School

11:45 AM THE EFFECT OF DECREASED LOAD ON THE TEMPOROMANDIBULAR JOINT
Alura Luck, South Carolina Governor's School for Science & Mathematics

12:00 PM THE EFFECTS OF MECHANICAL LOAD ON CARDIOMYOCYTES
Albert Rancu, South Carolina Governor's School for Science & Mathematics

12:15 PM PROFIBROTIC GENE RESPONSE OF WHOLE SKIN VS. FIBROBLAST SAMPLES TO TGFB TREATMENT
Rylee Bodony, South Carolina Governor's School for Science & Mathematics

1:30 PM COMPARING THE EFFECT OF TGFB ON EXTRACELLULAR MATRIX GENE EXPRESSION IN WHOLE SKIN AND DERMAL FIBROBLASTS
Michael Pennell, South Carolina Governor's School for Science & Mathematics

1:45 PM ANALYZING THE ROLE OF THE GLYCOCALYX IN WHOLE-CELL MECHANICS USING ATOMIC FORCE MICROSCOPY
Emily Fast, South Carolina Governor's School for Science & Mathematics

2:00 PM EXPLORING THE ROLE OF CIRCULATING MIR-134 IN BREAST CANCER RECURRENCE
Lauren Chen, Dutch Fork High School

CHEMISTRY / MENTORED
Founders Hall 108 A

8:30 AM PRODUCTION OF GOLD NANOPARTICLES VIA SOLUTION SYNTHESIS
Paul James Balmediano, South Carolina Governor's School for Science & Mathematics

8:45 AM SYNTHESIS OF NANOPARTICLES FOR BIOMEDICAL APPLICATIONS
John Estock, South Carolina Governor's School for Science & Mathematics

9:00 AM GRAPHENE DEVICE FABRICATION AND CHARACTERIZATION
Jacob Nalley, South Carolina Governor's School for Science & Mathematics

9:15 AM SYNTHESIS OF GRAPHENE USING CHEMICAL VAPOR DEPOSITION
Tyler Taylor, South Carolina Governor's School for Science & Mathematics

9:30 AM INVESTIGATING NON-COVALENT INTERACTIONS VIA SYNTHETIC MOLECULAR DEVICES
Brian Torreon, South Carolina Governor's School for Science & Mathematics

9:45 AM ANALYSIS OF DFT PROGRAMS VASP AND CP2K USED FOR MODELING ADSORPTION, CATALYSIS, AND ADVANCED MATERIAL PROPERTIES
Noah Klimkowski Arango, South Carolina Governor's School for Science & Mathematics

10:00 AM SYNTHESIS OF CORANNULENE-BASED COVALENT ORGANIC FRAMEWORKS (COFS)
Nishi Patel, South Carolina Governor's School for Science & Mathematics

10:15 AM NANOCOMPOSITE CONDUCTIVE FIBERS VIA SOLUTION BLOW SPINNING FOR REAL-TIME WOUND SENSING
Gavin Stafford, South Carolina Governor's School for Science & Mathematics

10:30 AM *BREAK*

10:45 AM MULTI-LAYER WOUND DRESSING THROUGH SOLUTION BLOW SPINNING
Nathan Sigmon, South Carolina Governor's School for Science & Mathematics

CHEMISTRY / NON-MENTORED
Founders Hall 111 A

8:30 AM THE EFFICENCY AND ENERGY STORAGE OF 0%, 10%, 25%, 50%, 75%, AND 100% ETHANOL CONCENTRATIONS IN GASOLINE
Catherine Barron, Heathwood Hall Episcopal School

8:45 AM REDUCED-GRAPHENE OXIDE SEMI-PERMANENT HAIR DYE: DURABILITY AND TOXICITY
Charlotte Hughes, Heathwood Hall Episcopal School

9:00 AM THE EFFECT OF TEMPERATURE ON THE REACTION TIME OF VINEGAR AND BAKING SODA
Ellie Singerling, Heathwood Hall Episcopal School

9:15 AM ANALYZING THE EFFECT OF ADDITIVES ON SOAP'S BASE PH VALUE
Pritish Das, Heathwood Hall Episcopal School

COMPUTER SCIENCE / MENTORED
Founders Hall 140 A

8:30 AM LINE FOLLOWING, OBSTACLE AVOIDANCE, AND FLIGHT STABILITY IN AUTONOMOUS QUADROTOR DRONES
William Bain, South Carolina Governor's School for Science & Mathematics

8:45 AM ENABLING DATA COLLECTION FOR GAIT ANALYSIS USING FLOOR VIBRATIONS
Lani McGuire, South Carolina Governor's School for Science & Mathematics

9:00 AM APPLICATIONS OF MACHINE LEARNING ALGORITHMS IN LIDAR-BASED AUTONOMOUS VEHICLES
Daniel Li, South Carolina Governor's School for Science & Mathematics

9:15 AM MAKING CYBER SECURITY MORE ACCESSIBLE TO STUDENTS
Johnathan McDowell, South Carolina Governor's School for Science & Mathematics

9:30 AM LOCATING AND EXTRACTING CIRCUIT SYMBOLS FROM CIRCUIT DIAGRAMS THROUGH COMPUTER VISION
Maya Brown and Maximus Keane, South Carolina Governor's School for Science & Mathematics

9:45 AM USING CONVOLUTIONAL NEURAL NETWORKS FOR THE AUTOMATED SCORING OF THE BENDER-GESTALT TEST II
Caitlin Harrington and William Ramsey, South Carolina Governor's School for Science & Mathematics

10:00 AM IMPLEMENTATION OF CYBERSECURITY WITHIN MARINE CORPS LAV-C2 SYSTEMS
Brianna Fuller, South Carolina Governor's School for Science & Mathematics

10:15 AM AN AUTOMATED HARDENING AND SECURITY MONITORING PROGRAM FOR LINUX
Brendan McManamon, South Carolina Governor's School for Science & Mathematics

10:30 AM *BREAK*

10:45 AM DOMAIN SPECIFIC LANGUAGE GENERATION FOR EVENTUALLY CONSISTENT DATA REPLICATION
David Brown and Jaden Stutts, South Carolina Governor's School for Science & Mathematics

11:00 AM EXPLORING AUTONOMOUS VEHICLE SYSTEMS USING RACECAR MODELS
Derrick Joyce, South Carolina Governor's School for Science & Mathematics

11:15 AM SOFTWARE DEVELOPMENT FOR HIGH-SPEED AUTONOMOUS GROUND VEHICLES
Hollis Smith, South Carolina Governor's School for Science & Mathematics

11:30 AM USING CONVOLUTION NEURAL NETWORKS TO CLASSIFY CORAL SPECIES
James Atwater, South Carolina Governor's School for Science & Mathematics

11:45 AM ROBOTIC MAPPING: PATHFINDING USING DEAD RECKONING TECHNIQUES
Jyoti Adusumilli, South Carolina Governor's School for Science & Mathematics

COMPUTER SCIENCE / NON-MENTORED
Founders Hall 140 B

9:45 AM USING A MACHINE LEARNING ALGORITHM TO DETECT BASAL CELL CARCINOMA IN MICROSCOPE SLIDES OF MOHS EXCISIONS
Luke Zhang, Spring Valley High School

10:00 AM COMPARISON OF TWO IMAGE ENHANCEMENT TECHNIQUES: HISTOGRAM EQUALIZATION AND GAMMA METHOD
Abhimanyu Sailesh, Blythewood High School

10:15 AM THE EFFECT OF SENSORY IMPLEMENTATIONS ON INFORMATION RETAINED FROM VIRTUAL REALITY MEDIA
Andrew Miller, Spring Valley High School

CONSUMER SCIENCE / MENTORED
Founders Hall 255 A

11:00 AM AN EXPLORATORY ANALYSIS OF COUNTERFEIT BUYERS
William Hobbs, South Carolina Governor's School for Science & Mathematics

11:15 AM AN ANALYSIS OF THE ECONOMIC, ENVIRONMENTAL, AND ETHICAL BENEFITS OF REPROCESSING SINGLE USE MEDICAL DEVICES
Niko Petersen, South Carolina Governor's School for Science & Mathematics

11:30 AM COUNTERFEIT CULTURE: THE EFFECT OF BRAND STATUS ON CONSUMER WILLINGNESS TO BUY COUNTERFEITS IN SHANGHAI AND CHARLESTON

Natasha Aust, South Carolina Governor's School for Science & Mathematics

11:45 AM BACKYARD BULGARI: AVAILABILITY AS A FACTOR IN CONSUMER WILLINGNESS TO BUY COUNTERFEIT GOODS
William Joseph, South Carolina Governor's School for Science & Mathematics

CONSUMER SCIENCE / NON-MENTORED
Founders Hall 255 A

8:30 AM IMPACT OF ALTERNATIVE METHODS OF MENSTRUAL HEALTH MANAGEMENT ON YOUNG WOMEN
Eden Turek, Center for Advanced Technical Studies

8:45 AM STORM DRAIN HYDROELECTRIC GENERATOR
David Wamai, Center for Advanced Technical Studies

9:00 AM DEVELOPING A PORTABLE THERMAL ELECTRIC BATTERY
Michael Lopez, Center for Advanced Technical Studies

9:15 AM THE CORRELATION BETWEEN THE FLAVOR OF A VAPE LIQUID AND THE KETONES PRODUCED
Caroline Tinch, Heathwood Hall Episcopal School

9:30 AM THE EFFECT OF THE BRAND OF FEMININE HYGIENE PRODUCTS ON THE NUMBER OF CHEMICALS ABSORBED INTO A SOLUTION
Logan Trull, Heathwood Hall Episcopal School

9:45 AM THE EFFECT OF SPF ON THE UV RAYS ABSORBED
Reid Avery and Owen Bennett, Heathwood Hall Episcopal School

10:00 AM INVESTIGATION AND COMPARISON OF POPULAR WATER BOTTLE BRAND'S QUALITY OF WATER BEFORE AND AFTER HEATING
Hanna Coetsee, Heathwood Hall Episcopal School

10:15 AM THE EFFECT OF PERMANENT, SEMI-PERMANENT, AND TEMPORARY DYES ON THE TENSILE STRENGTH OF HAIR
Briana Gray, Spring Valley High School

10:30 AM *BREAK*

10:45 AM THE EFFECT OF GENDER ON PURCHASING HABITS AMONG ADOLESCENTS
Isabelle Herndon, Heathwood Hall Episcopal School

ENGINEERING / MENTORED
Founders Hall 250 B

8:30 AM NIO-MC DUAL-PHASE MEMBRANES FOR CO2 CAPTURE FROM SIMULATED FLUE GAS
Cooper Schroeder, South Carolina Governor's School for Science & Mathematics

8:45 AM DISCERNING HOW CATALYST SUPPORT INFLUENCES THE PRODUCTS IN AQUEOUS PHASE GLYCEROL PROCESSING

Benjamin Hodges, South Carolina Governor's School for Science & Mathematics

9:00 AM GUIDED LAMB WAVE NONDESTRUCTIVE EVALUATION FOR METALLIC STRUCTURE INTEGRITY INSPECTION
Adam Hakimji, South Carolina Governor's School for Science & Mathematics

9:15 AM GEOMETRIC ANALYSIS OF ASYMMETRICAL FAULT SYNTHESIS FOR THREE-PHASE TRANSFORMER CONNECTIONS USING COMPUTER SIMULATION
Nicholas Daly, South Carolina Governor's School for Science & Mathematics

9:30 AM CHARACTERIZATION OF GOLD NANOPARTICLE ENCAPSULATED POLYMERSOMES FOR BRAIN IMAGING
Kayleigh Kelly and Anais Lawson, South Carolina Governor's School for Science & Mathematics

9:45 AM OPTIMIZING BACTERIAL CELLULOSE PAPER PRODUCTION FOR FOLDING ORIGAMI
Michael Madden, South Carolina Governor's School for Science & Mathematics

10:00 AM BIKE TO THE FUTURE: CONNECTION IS KEY
Camilla Aragon, South Carolina Governor's School for Science & Mathematics

10:15 AM OPTIMIZATION OF PAPER PRE-CREASING TO ENABLE REPRODUCIBLE FOLDING OF MIURA-ORI ORIGAMI STRUCTURES
Kollin Campbell, South Carolina Governor's School for Science & Mathematics

10:30 AM *BREAK*

10:45 AM TIO2 NANOSTRUCTURES OBTAINED BY ANODIZATION FOR BIOMEDICAL APPLICATIONS
Doyle Hayden and Leighton O'Dell, South Carolina Governor's School for Science & Mathematics

11:00 AM INVESTIGATING THE MECHANICAL PROPERTIES AND FAILURE CHARACTERISTICS OF DENTAL ARCHWIRE
Austin Geer, South Carolina Governor's School for Science & Mathematics

11:15 AM DETERMINING THE RELATIONSHIP BETWEEN AMOUNT OF BIOMASS, NUTRIENTS, AND SOIL GRAIN SIZE TO STRENGTH IN BIO-CEMENTED SIMULANT MARTIAN SOIL
Frankie Hawkesworth, South Carolina Governor's School for Science & Mathematics

11:30 AM TEACHING ROBOT COMPANIONS TO ASSIST HUMANS VIA NATURAL LANGUAGE AND GESTURES
Michael Bertram, South Carolina Governor's School for Science & Mathematics

11:45 AM ROBOTIC MAPPING: TESTING AND CORRECTING ROOMBA SPEED ACCURACY
Akhil Adusumilli and John Yonce, South Carolina Governor's School for Science & Mathematics

12:00 PM EVALUATION OF PLATELET ACTIVATION AND ADHESION ON TEFLON® GRAFTS
Lillian Slaughter, South Carolina Governor's School for Science & Mathematics

ENGINEERING / NON-MENTORED
Founders Hall 222 B

8:30 AM ANALYSIS OF THE IMPLEMENTATION OF BIOMATERIALS IN THE SURGICAL SCREW
Olivia Hardy, Center for Advanced Technical Studies

8:45 AM SHAKEY WAKEY: A PORTABLE INNOVATION TO WAKE THE DEAF, HEARING IMPAIRED, ELDERLY, AND CHILDREN
Kelsey Krusen, Center for Advanced Technical Studies

9:00 AM ORAL STIMULATION FOR AUTISM
Allie Anderson, Center for Advanced Technical Studies

9:15 AM THE WALKABOUT
Kayla Frady, Center for Advanced Technical Studies

9:30 AM HEATED PORTABLE MUSCLE ROLLER FOR SHIN PAIN
Eliza Leslie, Center for Advanced Technical Studies

9:45 AM SHINING LIGHT ON THE ISSUE OF HARMFUL MICROORGANISMS
Emily Melton, Center for Advanced Technical Studies

10:00 AM INCREASING THE COMFORT OF SCOLIOSIS BRACES
Muskaan Mehta, Center for Advanced Technical Studies

10:15 AM UNDERWATER CAMERA
Jacob Harrison, Center for Advanced Technical Studies

10:30 AM *BREAK*

10:45 AM OPTIMIZATION OF NON-TRADITIONAL WIND TURBINES
Wyatt Hill, Center for Advanced Technical Studies

11:00 AM THE EFFECT OF A MOTORIZED GIMBAL ON LOCAL ACCELEROMETER-BASED POSITION TRACKING
DuBose Tuller, Heathwood Hall Episcopal School

11:15 AM THE EFFECT OF WIND SPEED ON VOLTAGE GENERATED; USING AN RC AIRCRAFT'S PROPELLER AS A GENERATOR
Aaron Sawyer and Aidan Willhide, Heathwood Hall Episcopal School

11:30 AM A FUNCTIONALITY INVESTIGATION COMPARING A NON-COMMERCIAL AND TWO COMMERCIAL UPPER ARM GUARDS AND THEIR EFFECTIVENESS AT IMPACT FORCE DISSIPATION.
Asa Arnold, Spring Valley High School

11:45 AM THE USE OF GRAVITY TO POWER A UV LIGHT PURIFICATION SYSTEM
Jacob Ho, Spring Valley High school

12:00 PM THE EFFECT OF SOCCER HEADGEAR ON THE FORCE OF A COLLISON BETWEEN TWO HEADS
Tyler White, Spring Valley High School

12:15 PM THE EFFECT OF WHEEL TYPE ON THE SPEED OF A MOBILE ROBOT
Alyssa Williams, Spring Valley High School

1:30 PM THE EFFECT OF LATTICE AND HONEYCOMB STRUCTURE ON THE SHOCK ABSORPTION CAPABILITY OF MODEL CRASH BARRIERS
Simon Wyatt, Spring Valley High School

1:45 PM THE IMPACT OF DAMPER PROPERTIES ON THE AMPLITUDE AND FREQUENCY OF BLUFF BODY BEHAVIORS UNDER VORTEX-INDUCED VIBRATION FOR MARITIME ENGINES
Sirawit Shimpalee, Spring Valley High School

ENVIRONMENTAL SCIENCE / MENTORED
Founders Hall 213 B

9:00 AM EFFECTS OF RIPARIAN VEGETATION AND LOCAL HABITAT QUALITY ON THE DIVERSITY AND ABUNDANCE OF FISH IN PIEDMONT STREAMS OF SOUTH CAROLINA
Joshua Geden and Grace Park, South Carolina Governor's School for Science & Mathematics

9:15 AM 2,2',3,5',6-PENTACHLOROBIPHENYL (PCB-95) INDUCED TOXICITY ON EARLY DEVELOPMENT OF ZEBRAFISH (DANIO RERIO)
Victoria Paul, South Carolina Governor's School for Science & Mathematics

9:30 AM EFFECTS OF SILVER NANOPARTICLES ON MICE HEALTH
Justin Thomas, South Carolina Governor's School for Science & Mathematics 9:00 AM

ENVIRONMENTAL SCIENCE / NON-MENTORED
Founders Hall 213 A

8:30 AM THE EFFECT OF THE CITY WASTEWATER TREATMENT PLANT ON WATER IN THE COLUMBIA AREA
Addie-Grace Cook, Heathwood Hall Episcopal School

8:45 AM THE EFFECTS OF NATURAL BIOACCUMULATOR AND HYPERACCUMULATOR BIOCHARS FOR SOIL PHYTOREMEDIATION AND COMPOUND SUSTAINABILITY OF NITROGEN, PHOSPHORUS, POTASSIUM, AND PH BY *LEPIDIUM SATIVUM*
Ronit Pathak, Spring Valley High School

9:00 AM THE EFFECT OF POLYSTYRENE MICROPLASTICS ON THE HEART RATE IN *DAPHNIA MAGNA*
Matthew Li, Spring Valley High School

9:15 AM THE EFFECT OF VARIOUS BARRIERS ON SOIL ERODIBLITY
William Hale, Spring Valley High School

9:30 AM THE EFFECT OF *BACILLUS CEREUS* VERSUS BIOCHAR IN THE ABILITY TO DECREASE CHLOROTHALONIL AND INCREASE *RHIZOBIUM* BACTERIA IN SOILS
Srestha Samaddar, Spring Valley High School

9:45 AM OPTIMIZATION OF POLYSTYRENE DECOMPOSITION USING MEALWORMS
Caylin Lomoriello, Center for Advanced Technical Studies

10:00 AM THE EFFECT OF A *EUCALYPTUS GLOBULUS* BIOLARVICIDE ON THE GROWTH RATE OF A NON-TARGET ORGANISM, *CHLORELLA VULGARIS*
Josephine Gardiner, Spring Valley High School

10:15 AM THE EFFECT OF ORGANICALLY GROWN BANANAS ON THE LIFESPAN OF *DROSOPHILA MELANOGASTER*
Morgan Iseman, Heathwood Hall Episcopal School

10:30 AM *BREAK*

10:45 AM AMBIENT AIR QUALITY OF "BLUE COLLAR" AND "WHITE COLLAR" WORK ENVIRONMENT
Paul Davis, Spring Valley High School

11:00 AM WASTEWATER FILTRATION OF ALOCASIA CALIFORNIA
Courtney Tharp, Chapin High School

11:15 AM THE EFFECT OF WOOD TYPE ON XYLEM PORE SIZE DEGENERATION
Paulina Trifonova, Spring Valley High School

ENVIRONMENTAL SCIENCE / NON-MENTORED
Founders Hall 213 C

8:30 AM THE EFFECT OF *RHIZOPUS STOLONIFER*, *SORDARIA FIMICOLA* AND *COPRINUS CINEREUS* ON THE DECOMPOSITION RATES OF NEWSPAPER
Rachael Nall, Spring Valley High School

8:45 AM THE EFFECT OF HYDROGEN PEROXIDE (6%), HUMIC ACID (6%), AND DECAYING *HORDEUM VULGARE* ON *PYROCYSTIS FUSIFORMIS* GROWTH AND BIOLUMINESCENCE
Connor Myrick, Spring Valley High School

9:00 AM THE EFFECT OF L-THEANINE AND VITAMIN B12 IN C. ELEGANS EXPOSED TO A NEONICOTINOID PESTICIDE ENVIRONMENT
Christian Lee, Spring Valley High School

9:15 AM THE EFFECT OF HEATHWOOD'S RUNOFF AND WATER QUALITY ON THE GILLS CREEK WATERSHED
Jackson Meriwether, Heathwood Hall Episcopal School

9:30 AM THE EFFECT OF BROMINE, HARDNESS, CYANURIC ACID, AND PH ON TAP WATER
London Patel, Heathwood Hall Episcopal School

9:45 AM AN ANALYSIS ON THE POTENTIAL EFFECT OF CLIMATIC CONDITIONS ON CORN AND PEANUT PRODUCTION IN THE COASTAL REGIONS OF SOUTH CAROLINA
Jayra Penaloza, Spring Valley High School

10:00 AM THE EFFECT OF DIFFERENT LEVELS OF CARBON DIOXIDE ON THE OXYGEN PRODUCTION OF *THALASSIA TESTUDINUM*
Jonathan Caruso, Spring Valley High School

10:15 AM THE EFFECT OF DROUGHT TOLERANCE ON STEM LENGTH IN WISCONSIN FAST PLANTS
Tremayne Ansani, Spring Valley High School

10:30 AM *BREAK*

10:45 AM THE EFFECT OF WHITE VINEGAR, HYDROGEN PEROXIDE, AND SODIUM TETRABORATE ON *MICROCYSTIS AERUGINOSA* POPULATIONS' CYANOTOXIN AMOUNTS
Sachet Urs, Spring Valley High School

11:00 AM RECYCLING HABITS OF STUDENTS AT CHAPIN HIGH SCHOOL
Kathryn Smith, Chapin High School

11:15 AM A NEW ESTIMATE OF MARINE ICE UNDER AMERY ICE SHELF
Madeleine Maylath, Chapin High School

MATHEMATICS / MENTORED
Founders Hall 140 B

8:30 AM GRAPHICAL ANALYSIS OF THE EFFECT OF FLOW RATE ON COMPLEX FLUIDS
James Davis, South Carolina Governor's School for Science & Mathematics

8:45 AM MODELING CELLULAR MOVEMENT INSIDE COLLAGEN GELS
John Lu and Travis Pence, South Carolina Governor's School for Science & Mathematics

MATHEMATICS / NON-MENTORED
Founders Hall 140 B

9:00 AM A NEW PERSPECTIVE ON ZETA FUNCTIONS UNDER THE NUMBER FIELD FUNCTION FIELD ANALOGY
Nico Adamo, Heathwood Hall Episcopal School

9:15 AM AN OPTIMAL INFORMATION-THEORETIC DESIGN OF MYOELECTRIC PROSTHETIC UNDER BPSK MODULATION
Sparsho De, Spring Valley High School

9:30 AM THE EFFECT OF MONOPOLY GROUP AND IMPROVEMENT LEVEL ON THE RETURN ON INVESTMENT OF MONOPOLY PROPERTIES
Andrew Sobel, Heathwood Hall Episcopal School

MICROBIOLOGY / MENTORED
Founders Hall 213 B

11:00 AM THE EFFECTS OF ACIDIFICATION OF SWINE WASTE ON BACTERIAL GROWTH
Kaitlyn Cimney, South Carolina Governor's School for Science & Mathematics

11:15 AM THE TYPE 6 SECRETION SYSTEM AND ITS IMPACT ON GUT BACTERIA SURVIVAL
Juhwan Cho, South Carolina Governor's School for Science & Mathematics

11:30 AM SILENCING CYTOCHROME P51 GENE WITH DSRNA TO COMBAT PEACH FUNGAL PATHOGENS
Virginia Kenan, South Carolina Governor's School for Science & Mathematics

11:45 AM OPTIMIZING THE USE OF HYDROTHERMAL CARBONIZATION IN LIVESTOCK DISPOSAL
Daniel Hilbourn, South Carolina Governor's School for Science & Mathematics

12:00 PM THE ROLE OF CD73 IN REGULATING PRO-INFLAMMATORY INTERLEUKIN IL-6 VIA NF-KAPPA B DURING *PORPHYROMONAS GINGIVALIS* INFECTION
Chetna Patel, South Carolina Governor's School for Science & Mathematics

12:15 PM VISUALIZING NANOPARTICLES IN THE FUNGAL PATHOGEN, *ASPERGILLUS FLAVUS*
Jenny Schaffer, South Carolina Governor's School for Science & Mathematics

MICROBIOLOGY / NON-MENTORED
Founders Hall 216 B

8:30 AM THE EFFECT OF YEAST STRAIN ON BREAD WEIGHT AND ACIDITY
Callie Haddock, Spring Valley High School

8:45 AM THE EFFECTS OF ACETYLSALICYLIC ACID AND METHYLTHIONINIUM CHLORIDE (MTC) ON MORTALITY OF *CAENORHABDITIS ELEGANS* WITH THE CL2006 STRAIN
Jay Patel, spring Valley High School

9:00 AM THE EFFECT OF SODIUM FLUORIDE, TURMERIC, AMPICILLIN, AND XYLITOL EXPOSED TO SODIUM LAURYL SULFATE ON THE INHIBITION OF *STREPTOCOCCUS MUTANS* BIOFILMS
Anika Nair, Spring Valley High School

9:15 AM THE EFFECT OF SOAPS WITH AND WITHOUT TRICLOSAN ON THE HEALTH OF *PENICILLIUM ITALICUM*
Michael Moran and Alexander Roberts, Heathwood Hall Episcopal School

9:30 AM THE ANTIBACTERIAL EFFECT OF COTTON INFUSED WITH COLLOIDAL SILVER AND COTTON INFUSED WITH COLLOIDAL COPPER ON NON-VIRULENT STRAINS OF *E. COLI* OVER SHORT PERIODS OF TIME
Yash Patel, Spring Valley High School

9:45 AM THE EFFECT OF NITROGEN STARVATION OF CHLORELLA SP. ON THE MASS OF THE PROTEOBACTERIA SHEWANELLA ONEIDENSIS
Pranav Guntupalli, Spring Valley High school

10:00 AM THE EFFECT OF PROLONGED EXPOSURE OF COPPER SULFATE IN GERMICIDE ON THE GROWTH OF MICROBES
Johannamarie Nwanagu, Heathwood Hall Episcopal School

10:15 AM TRICLOSAN SOAP EFFECTIVENESS AT KILLING BACTERIA WHEN DILUTED WITH WATER
Sam Barker and Daniel Sobel, Heathwood Hall Episcopal School

10:30 AM *BREAK*

10:45 AM THE EFFECT OF THE AMOUNT OF PENICILLIN DISKS ON THE GROWTH OF E.COLI AND HOW TIME CHANGES THE EFFECTIVENESS OF PENICILLIN
Evan Barker, Heathwood Hall Episcopal School

11:00 AM THE EFFECT OF CHLORINE AND BROMINE ON THE AMOUNT OF BACTERIA ON THE SKIN OF RAW POULTRY PRODUCTS
Jimmy Ruskell, Heathwood Hall Episcopal School

11:15 AM CONCEPTUALIZATION OF LACT IN CONJUNCTION WITH EGCG FOR CELL-TARGETING APOPTOSIS WITHIN *C. ELEGANS* UTILIZED AS A RAPIDLY PROLIFERATING CANCER MODEL FOR TUMORIGENESIS PREVENTION/SUPPRESSION
Abhijith Nair, Spring Valley High School

PHYSICS / MENTORED
Founders Hall 210 B

10:45 AM INJECTION OF GOLD NANOPARTICLES INTO PVDF + DMSO SOLUTION
Julian Taliaferro, South Carolina Governor's School for Science & Mathematics

11:00 AM MEASURING CHANGES IN SURFACE MAGNETISM USING THE PLANAR HALL EFFECT
Nghia Nguyen, South Carolina Governor's School for Science & Mathematics

11:15 AM PROBING DISTANT GALAXIES USING GRAVITATIONALLY LENSED QUASARS
Sienna Brent, South Carolina Governor's School for Science & Mathematics

11:30 AM EFFECT OF MAGNESIUM IONS ON THIAMINE PYROPHOSPHATE'S (TPP) ABILITY TO STABILIZE THE CLOSED STATE OF THE TPP RIBOSWITCH
Elijah Hayes, South Carolina Governor's School for Science & Mathematics

11:45 AM TILTED ACCRETION DISK'S PRECESSION AND THE EFFECTS ON RELATIVISTIC JETS
Tri Nguyen, South Carolina Governor's School for Science & Mathematics

12:00 PM NOVEL APPROACH IN CREATING A BIMETALLIC METAL ORGANIC FRAMEWORK BY INCORPORATING RHODIUM INTO A COPPER BENZENE-1,3,5-TRICARBOXYLATE THIN FILM TO INCREASE CONDUCTIVITY
Vamsi Gorrepati, Spring Valley High School

PHYSICS / NON-MENTORED
Founders Hall 210 B

9:00 AM THE IMPACT OF GRAVITY ON THE HABITABILITY AND STRUCTURE OF LIFE ON TRAPPIST-1E
Frazier Peluso, Heathwood Hall Episcopal School

9:15 AM THE EFFECT OF TWISTED AND BRAIDED WEAVE TYPES ON THE DETERIORATION AND BREAKAGE OF KEVLAR FIBERS
Caitlin Aycock, Spring Valley High School

9:30 AM EFFECT OF DIFFERENT PERSONAL LISTENING DEVICES ON SOUND PRESSURE MEASURED AT THE TYMPANIC MEMBRANE
Andrew Mott, Spring Valley High School

9:45 AM THE EFFECT OF DIFFERENT EXTRACTION METHODS OF ANTHOCYANINS IN PETUNIA ×ATKINSIANA PLANTS ON THE PERFORMANCE OF DYE-SENSITIZED SOLAR CELLS
Sahil Thakkar, Spring Valley High School

10:00 AM EVALUATING THE STRENGTH AND DURATION OF REVERBERATION AND ITS INFLUENCE ON SPEECH INTELLIGIBILITY
Caitlin Kunchur, Dutch Fork High School

10:15 AM THE EFFECTS OF THE BOAT'S HULL DESIGN ON SPEED AND MANEUVERABILITY
Preston White, Spring Valley High School

PHYSIOLOGY AND HEALTH / MENTORED
Founders Hall 142 A

8:30 AM THE ROLE OF VITAMIN A IN SUPPORT OF VISION
Cynthia Collins, South Carolina Governor's School for Science & Mathematics

8:45 AM HISTOLOGICAL EXAMINATION OF WHEEL TRAINING ON DIURNAL FLUCTUATIONS IN MOUSE SKELETAL MUSCLE
Autumn Ashley, South Carolina Governor's School for Science & Mathematics

9:00 AM THE EFFECT OF CHEMOCHEMICAL DOXORUBICIN ON FEMALE OVARIAN FUNCTION AND FERTILITY
Elizabeth Colmer, South Carolina Governor's School for Science & Mathematics

9:15 AM IS LPA RECEPTOR 1 USED BY RETINAL GANGLION CELLS TO FIND THEIR CORRECT CONNECTION IN THE BRAIN?
Madeline Babb, South Carolina Governor's School for Science & Mathematics

9:30 AM CD8+ T-CELLS HAVE A BIPHASIC ROLE DURING POST-MYOCARDIAL INFARCTION CARDIAC REMODELING
Reed Studer, South Carolina Governor's School for Science & Mathematics

9:45 AM AGE-RELATED CHANGES IN MYELINATION OF THE MOUSE AUDITORY NERVE
Robert Dullanty, South Carolina Governor's School for Science & Mathematics

10:00 AM NEONATAL OPIOID WITHDRAWAL CARE IN SOUTH CAROLINA: STANDARDS OF CARE IN SELECT HOSPITALS
Jenna Flake, South Carolina Governor's School for Science & Mathematics

10:15 AM HISTOLOGICAL ANALYSIS OF THE OSTEOARTHRITIC KNEE JOINT IN DHGPS TREATED WITH MSCS
Heather Cosh, South Carolina Governor's School for Science & Mathematics

10:30 AM *BREAK*

10:45 AM DEVELOPMENT OF AN ARTIFICIAL NEURAL NETWORK ALGORITHM TO ASSESS CARTILAGE HEALTHINESS
Jonathan Ye, Academic Magnet High School

11:00 AM EFFECTS OF STRESS (HYPOXIA) ON PRO-INFLAMMATORY CYTOKINE PRODUCTION FROM ASTROCYTES
Michael Mai, South Carolina Governor's School for Science & Mathematics

11:15 AM EFFECT OF ESTROGEN ON SKELETAL MUSCLE ANABOLIC SIGNALING IN THE APC MIN/+ MOUSE
Cecilia Coler, South Carolina Governor's School for Science & Mathematics

11:30 AM REMOTE ISCHEMIC CONDITIONING (RIC) IMPROVES NEUROBEHAVIORAL OUTCOMES AND CEREBRAL BLOOD FLOW IN A MICE MODEL OF TRAUMATIC BRAIN INJURY
Abigail Fralick, South Carolina Governor's School for Science & Mathematics

11:45 AM MEASUREMENT OF SMOOTHNESS OF REACH IN PATIENTS WITH PARKINSON'S DISEASE
Haakim Waraich, South Carolina Governor's School for Science & Mathematics

PHYSIOLOGY AND HEALTH / NON-MENTORED
Founders Hall 142 B

8:30 AM THE EFFECT OF RADIOFREQUENCY ELECTROMAGNETIC RADIATION (RF-RMR) OF AN LTE 1900 MHZ MOBILE PHONE ON THE REPRODUCTION IN THE P AND F1 GENERATIONS IN DROSOPHILA MELANOGASTER
Fatima Jatoi, Spring Valley High School

8:45 AM HOW MUCH DO TEACHERS REALLY KNOW ABOUT FOOD ALLERGIES?
Shelby Lewis, Center for Advanced Technical Studies

9:00 AM THE HEART RATE OF DAPHNIA MAGNA WHEN EXPOSED TO ETHANOL AND RESVERATROL DURING DEVELOPMENT
Khushi Dave, Spring Valley High School

9:15 AM THE ACCURACY OF DIFFERENT BLOOD GLUCOSE METERS IN RELATION TO THE TRUE BLOOD GLUCOSE LEVEL
Asher Huddlestun, Spring Valley High School

9:30 AM THE INCIDENCE OF DEEP VEIN THROMBOSIS AMONG VARYING TRAUMA PATIENT POPULATIONS IN COLUMBIA, SC
Amanda Murray, Chapin High School

9:45 AM THE EFFECT OF CHAENOMELES SPECIOSA (DRI) ON THE RESPONSE TO THERMOTAXIS IN CAENORHABDITIS ELEGANS EXPOSED TO ETHANOL DURING DEVELOPMENT
Deiveek Kerai, Spring Valley High School

10:00 AM ANALYZING DEHYDRATION IN HIGH SCHOOL ATHLETES
Jack Mensch, Center for Advanced Technical Studies

10:15 AM SOULAR 365: THE SUSTAINABLE PURIFICATION OF UNSANITARY WATER IN LESS DEVELOPED COUNTRIES
Laney Hayes, Chapin High School

10:30 AM *BREAK*

10:45 AM THE EFFECT OF DEVELOPMENTAL NUTRITION WITH PUERARIA MONTANA EXPOSURE ON ETHANOL ADDICTION IN DROSOPHILA MELANOGASTER
Dawn Nguyen, Spring Valley High School

11:00 AM THE EFFECT OF EXCESS 2-AMINOETHANESULFONIC ACID ON LOCOMOTION IN PLANARIA
Crawford Latham, Spring Valley High School

11:15 AM THE COMPARISON OF SUNSCREEN, MOISTURIZER, AND FOUNDATION WITH THE SAME SPF AND ITS RELATIVE REFLECTION OF UV RADIATION
Sydney Hook, Spring Valley High School

11:30 AM THE OPIOID CRISIS IN CORRELATION WITH WISDOM TEETH REMOVAL SURGERY
Ashley Noller, Center for Advanced Technical Studies

11:45 AM EVALUATING THE AWARENESS OF POLYCYSTIC OVARY SYNDROME
Sabria Bowman, Center for Advanced Technical Studies

12:00 PM CAN BONE MARROW TRANSPLANTS CURE ALLERGIES?
Taylor Sullivan, Center for Advanced Technical Studies

12:15 PM SEBORRHEIC KERATOSIS
Abrielle Brown, Center for Advanced Technical Studies

12:30 PM THE EFFECT OF MUSIC THERAPY ON SPEECH INDEPENDENT OF MUSICAL PREFERENCE
David Abdulrahman, Chapin High School

PSYCHOLOGY / MENTORED
Founders Hall 251 A

10:00 AM YOUNG CHILDREN'S NEGATIVE INTERPRETATION IN MEMORY RECALL IS RELATED TO MOTHER'S NEGATIVITY IN REMINISCING CONVERSATIONS
Victoria Botzis and Divine Cade, South Carolina Governor's School for Science & Mathematics

10:15 AM EFFECTS OF GREENSPACE EXPOSURE ON STRESS AND MOOD OF COLLEGE STUDENTS
Zayden Van Vleet, South Carolina Governor's School for Science & Mathematics

10:30 AM *BREAK*

10:45 AM EFFECTS OF SPEECH RATE ON SELF-MONITORING AND LEXICAL ERROR FREQUENCY IN MOTHERS WITH THE FMR1 PREMUTATION
Caroline Sizemore, South Carolina Governor's School for Science & Mathematics

11:00 AM UNDERSTANDING THE LANGUAGE OF FEMALE FMR1 PREMUTATION CARRIERS
CarNya Sutton, South Carolina Governor's School for Science & Mathematics

PSYCHOLOGY / NON-MENTORED
Founders Hall 251 B

8:30 AM THE EFFECT OF MINDFULNESS ON SHORT-TERM MEMORY IN TEENAGERS
Christina Smith, Heathwood Hall Episcopal School

8:45 AM THE EFFECT OF CLOTHING ON TEST TAKING ABILITIES
Pamela Ann Pope, Heathwood Hall Episcopal School

9:00 AM THE EFFECT OF EXTRACURRICULAR ACTIVITIES ON THE EMOTIONAL EXHAUSTION, DEPERSONALIZATION, AND SENSE OF PERSONAL ACCOMPLISHMENT (BURNOUT) OF ACADEMICALLY HIGH-ACHIEVING ADOLESCENTS
Jane McCallum, Spring Valley High School

9:15 AM THE EFFECT OF DIFFERENT METHODS OF MEMORY
Anna Shainwald, Heathwood Hall Episcopal School

9:30 AM THE EFFECT OF TAI CHI AND JAZZ MUSIC ON THE MEMORY OF MIDDLE SCHOOL STUDENTS
Maryah Lance, Spring Valley High School

9:45 AM AN INVESTIGATION INTO HOW WELL INDIVIDUALS FROM THE Z GENERATION ARE ABLE TO IDENTIFY THE DIFFERENCE BETWEEN RACISM AND STEREOTYPES IN DIFFERENT SCENARIOS.
Nam Nguyen, Spring Valley High School

10:00 AM TESTING THE CORRELATION BETWEEN THE MUSIC LISTENED TO IN CHILDHOOD AND ADOLESCENT PERSONALITY/BEHAVIOR
Adam Schiferl, Chapin High School

10:15 AM THE MENTAL HEALTH OF TRANSGENDER YOUTH IN COMPARISON TO CISGENDER YOUTH
Mary Fern, Heathwood Hall Episcopal School

10:30 AM *BREAK*

10:45 AM THE EFFECT OF COMPOSITE FACES ON PERCIEVED ATTRACTIVENESS
Taahera Islam, Spring Valley High School

11:00 AM THE EFFECT OF THE LUNAR CYCLE ON THE FEMALE REPRODUCTIVE SYSTEM
Brooklyn Moore, Heathwood Hall Episcopal School

11:15 AM THE EFFECT OF AUTHORITARIAN, AUTHORITATIVE, AND PERMISSIVE PARENTING STYLES ON SELF-IMAGE IN MALE AND FEMALE HIGH SCHOOL TEENS
Mark Wild, Spring Valley High School

11:30 AM THE EFFECT OF SUBLIMINAL MESSAGING ON A SIMPLE DECISION OF AN INDIVIDUAL.
Molly Caballero, Heathwood Hall Episcopal School

11:45 AM THE EFFECT OF MENTAL IMAGERY ON BASKETBALL SHOTS
Hugh Willcox, Heathwood Hall Episcopal School

12:00 PM FINDING A BALANCE: A STUDY OF EATING DISORDERS IN FEMALE COMPETITIVE GYMNASTS
Tessa McArthur, Chapin High School

12:15 PM EVALUATING PHYSICAL COMPETENCE AWARENESS IN FEMALES
Kennedy Stodden, Center for Advanced Technical Studies

1:30 PM THE EFFECT OF LEARNING TO PLAY A MUSICAL INSTRUMENT ON CREATIVE ABILITY IN MIDDLE SCHOOL STUDENTS
Grayson Fletcher, Chapin High School

1:45 PM THE EFFECT OF THE USE OF AN ELECTRONIC DEVICE BEFORE BED ON SLEEP QUALITY
Erin Byrd, Spring Valley High School

2:00 PM THE EFFECT OF SOUND AND FOOD ON THE INTELLECT AND RESULTANT BEHAVIOR OF WILD SQUIRRELS.
William Morris, Heathwood Hall Episcopal School

SOCIOLOGY / MENTORED
Founders Hall 251 A

8:30 AM THE HISTORY OF LORDS PROPRIETORS' SEAL RECOVERED FROM NORTH CHARLESTON "DEAD HOUSE"
Randi Gamble, South Carolina Governor's School for Science & Mathematics

9:00 AM POCKOY: WHAT SHELL RINGS CAN SAY ABOUT CULTURES OF THE PAST
Eugenia Fulcher, South Carolina Governor's School for Science & Mathematics

9:15 AM FACTORS OF RISK STATUS AND PERSISTENCE OF UNDERGRADUATE STUDENTS AT THE UNIVERSITY OF SOUTH CAROLINA LANCASTER
John Shaheen, South Carolina Governor's School for Science & Mathematics

9:30 AM FORENSIC ARCHAEOLOGY: UTILIZATION OF RESOURCES AND STRATEGIES IN ORDER FOR THE ACCURATE IDENTIFCATION OF SKELETAL REMAINS
Brooks Taylor, South Carolina Governor's School for Science & Mathematics

9:45 AM THE DEVELOPMENT OF CREATIVE MINDS: A CASE STUDY OF TECHNOLOGY IN GSSM AND HSASNU STEM CLASSROOMS
Justin Cacal and Isabel Strinsky, South Carolina Governor's School for Science & Mathematics

SOCIOLOGY / NON-MENTORED
Founders Hall 251 C

8:30 AM THE EFFECT OF PUBLIC AND PRIVATE SCHOOLING ON TEENAGE BOYS TOXIC MASCULINITY
Margaret Roney and Austin Tuller, Heathwood Hall Episcopal School

8:45 AM UTILIZING BIG DATA TO UNDERSTAND PUBLIC PERCEPTION IN NECESSARY POLICY CHANGES BEFORE AND AFTER A MASS SHOOTING
Elizabeth Shytle, Spring Valley High School

9:00 AM *BREAK*

9:15 AM A SIMULATION OF POTENTIAL ECONOMIC LOSS DUE TO LEGAL IMMIGRATION CRACKDOWNS
Jareer Imran, Spring Valley High School

9:30 AM THE EFFECT OF ENROLLMENT IN A MIDDLE SCHOOL MAGNET PROGRAM AND A STUDENT'S PERCEIVED STRESS AND AMOUNT OF SLEEP
Taylor Hamilton-Hankins, Spring Valley High School

9:45 AM THE EFFECT OF THE GAMIFICATION OF SOFTWARE ON THE AMOUNT OF USER ENGAGEMENT IN SOCIAL MEDIA SOFTWARE IN HUMANS
Ethan Ho, Spring Valley High School

10:00 AM RISK ASSESSMENT OF CARDIOVASCULAR DISEASE AMONG VARYING DEMOGRAPHIC AND SOCIOECONOMIC POPULATIONS
Haley Nazario Ramos, Center for Advanced Technical Studies

10:15 AM THE EFFECT OF ASYMMETRIC DOMINANCE ON IDEOLOGICAL PERSUASION IN VOTING-AGE PARTICIPANTS THROUGH NEWS ARTICLES
Pallavi Rao, Spring Valley High School

10:30 AM *BREAK*

10:45 AM THE EFFECT OF INFLUENCER'S GRADE LEVEL ON HIGH SCHOOL FRESHMAN MOVIE CHOICES
Robert Golden, Heathwood Hall Episcopal School

11:00 AM ETHNICITY AND ASSOCIATION TO COSMETIC SURGERY AND BODY DYSMORPHIC DISORDER IN HIGH-SCHOOLED FEMALES
Monica Sanchez, Chapin High School

11:15 AM COMPARATIVE STUDY OF THE EFFECTS OF SCREEN TIME ON ADOLESCENTS AND ADULTS
Sachin Patel, Marion High School

11:30 AM THE EFFECT OF GOVERNMENT ASSISTED HEALTHCARE AND SELF PROVIDED INSURANCE ON PATIENT SATISFACTION IN SOUTH CAROLINA
Sera Zell, Spring Valley High School

11:45 AM THE EFFECT OF PHOTOSHOP ON THE ABILITY TO DIFFERENTIATE BETWEEN ORIGINAL, SEMI-EDITED, AND MILDLY EDITED PHOTOS IN HIGH SCHOOL STUDENTS
Kayleigh VanAlstine, Spring Valley High School

ZOOLOGY / MENTORED
Founders Hall 213 B

9:45 AM THE EFFECTS OF URBANIZATION ON AMPHIBIAN AND REPTILE POPULATIONS IN THE PIEDMONT AREA
Catlyn Johnson, South Carolina Governor's School for Science & Mathematics

10:00 AM THE GENETIC AUTHENTICATION OF MALAGASY CRAYFISH SAMPLES
Landon Bradshaw, South Carolina Governor's School for Science & Mathematics

10:15 AM THE IMPACT OF TIMING OF INCREASED SALINITY ON THE DEVELOPMENTAL AND GROWTH RATES OF ANAXYRUS TERRESTRIS TADPOLES
Ashlyn Reining, South Carolina Governor's School for Science & Mathematics

ZOOLOGY / NON-MENTORED
Founders Hall 210 A

8:30 AM A NOVEL APPROACH IN CREATING A BIOINSECTICIDAL REPELLENT USING CYMBOPOGON, LAVANDULA, AND ROSMARINUS OFFICINALIS ESSENTIAL OILS (EOS) WITH AN ATTRACTIVE SUGAR BAIT
Aisha Siddique, Spring Valley High School

8:45 AM THE EFFECT OF ALUMINIUM HYDROXIDE ON THE FECUNDITY OF *DROSOPHILA MELAGNOSTER*
James Andreen, Spring Valley High School

9:00 AM THE EFFECT OF VARYING OXYGEN LEVELS ON *LITHOBATES CATESBEIANUS*
Myles Roberts, Heathwood Hall Episcopal School

9:15 AM THE EFFECT OF GREEN TEA POLYPHENOLS ON THE FORAGING BEHAVIOR, REPRODUCTION, AND MASS OF *DROSOPHILA MELANOGASTER*
Jordan Nealey, Spring Valley High School

9:30 AM THE EFFECT OF THE OVERCONSUMPTION OF SUGAR ON THE REPRODUCTION OF *DROSOPHILA MELANOGASTER*
Siri Avula, Spring Valley High School

9:45 AM THE EFFECT OF ACIDIC LEMON, GINGER, PEPPERMINT, AND VINEGAR EXTRACTS ON THE RELATIVE RATE OF REPELLENCY OF *CULEX PIPIENS*
Christine Encarnacion, Spring Valley High School

10:00 AM THE EFFECT OF AN ALTERNATIVE BLOOD MEAL SOURCE FROM GLYCINE MAX ROOT NODULES ON THE EGGS LAID AND SUCCESSFUL LARVAL BIRTH OF *CULEX PIPIENS*
Parth Patel, Spring Valley High School

10:15 AM THE EFFECT OF ETHANOL, N-ACETYL CYSTEINE, VITAMIN C, AND GLUTATHIONE ON BEHAVIOR AND HEALTH IN *C. ELEGANS* EXPOSED TO ACRYLAMIDE
Khushi Patel, Spring Valley High School

10:30 AM *BREAK*

10:45 AM ASSESSING THE COMBINED EFFECTS OF HEAT STRESS AND NUTRITION DEFICIENCY AND THEIR EFFECT ON LONG TERM POTENTIATION IN *CAENORHABDITIS ELEGANS*
Spandana Anchoori, Spring Valley High School

11:00 AM THE EFFECT OF INTAKE OF THE NON-CALORIC SWEETENERS MALTODEXTRIN AND SUCRALOSE ON THE MEMORY OF *DUGESIA DOROTOCEPHALA*
Caroline Brindel, Spring Valley High School

11:15 AM THE EFFECT OF SUCRALOSE CONCENTRATION ON MORTALITY OF *DAPHNIA MAGNA*
Andrew Juhn, Spring Valley High School

11:30 AM THE EFFECTS OF THE PESTICIDES IMIDACLOPRID, ATRAZINE, AND ROUNDUP ON *DAPHNIA MAGNA* HEART RATE
Afaf soliman, Spring Valley High School

11:45 AM THE EFFECTS OF ENVIRONMENTAL CHANGES ON THE OVERALL PRODUCTIVITY OF *POGONOMYRMEX OCCIDENTALIS*
Lilly Abernathy, Heathwood Hall Episcopal School

12:00 PM THE EFFECT OF SALT CONCENTRATIONS ON MOSQUITO GROWTH
Van Clarke, Heathwood Hall Episcopal School

SCJAS ABSTRACTS

(Listed alphabetically by author's last name)

THE EFFECT OF MUSIC THERAPY ON SPEECH INDEPENDENT OF MUSICAL PREFERENCE

David Abdulrahman
Chapin High School

Music therapy is a relatively new form of treatment, so the undiscovered effects on speech specifically are interesting. More specifically, I am looking deeper into the application of music therapy in speech therapy and its benefits. Furthermore, the impact of music void of musical preference of the subject is something left unexamined, so looking into this effect is very intriguing to me. Therefore, The purpose of this research is to look further into the process of music therapy and its application in professional settings. I look to do so through the incorporation of melodies composed of notes from various scales, including major, natural minor, harmonic minor, melodic minor, and altered scales. This is designed to be void of musical preference when involving scales as it is not based on previous music or songs that the subject would select. My hypothesis is that through these melodies applied to the curriculum as an implementation to their speech therapy, there can be remedial effects independent of the preference of these students. These benefits would be measured through a pre and post test and a statistical significance t-test. This information will be collected through the use of this experiment with elementary children at Chapin Elementary in the speech therapy program. This will be based on performance on a post test after they are exposed to a certain pattern of notes found in different types of scales and see their performance level compared to the pre test without the exposure to music.

THE EFFECTS OF ENVIRONMENTAL CHANGES ON THE OVERALL PRODUCTIVITY OF *POGONOMYRMEX OCCIDENTALIS*

Lilly Abernathy
Heathwood Hall Episcopal School

The purpose of this experiment was to study how environmental factors, specifically heat and humidity affect the foraging activity of Harvester Ants. If the environment plays an important role in the lives of ants, how much more could these environmental factors have an affect on the human population? Knowing that the environment plays a factor in the world of insects, it was hypothesized that a colony of ants placed in a habitat with increased humidity and heat levels would collect more food and be more productive. To conduct this experiment, three colonies of harvester ants, each containing about thirty workers, were placed in separate environments of differing environmental conditions. The first was introduced to high heat, the second to high heat and high humidity and the third remained a controlled environment set to the surroundings of the room. Food was placed in a container and the ants were allowed to feed for twelve hours. At the end of the trials, the environment which consisted of higher heat and humidity produced the most active ants, having foraged more pieces of food and visibly dug the most tunnels. This leads to the conclusion that under these conditions, the majority of Western Harvester ants would be more productive in an environment like this, however this could lead to ecological issues if there suddenly becomes a shortage of food. In theory more active and productive ants would appear to be a positive result, when in actuality it will probably lead to harming natural ecosystems.

A NEW PERSPECTIVE ON ZETA FUNCTIONS UNDER THE NUMBER FIELD FUNCTION FIELD ANALOGY

Nico Adamo
Heathwood Hall Episcopal School

In this paper we present striking similarities between the zeta function of an elliptic differential operator and the Hasse-Weil Zeta Function, showing they both give rise to self-intersection numbers. This observation supports a more rigorous formulation of the function field analogy. Repercussions of this result on such a theory are discussed. Proofs are given relating the zeta function of an operator to the Selberg Zeta Function, which connects the Selberg Zeta Function to the Hasse-Weil Zeta Function. Finally, both functions are connected to Selberg's "relative trace formula". This connection lays the groundwork for a geometric theory of zeta functions as discussed in Brown (2009).

ROBOTIC MAPPING: TESTING AND CORRECTING ROOMBA SPEED ACCURACY

Akhil Adusumilli and John Yonce
South Carolina Governor's School for Science & Mathematics

The purpose of our research is to use a dead reckoning program to allow a Roomba to navigate around an area. Dead reckoning is the process of using only your initial location and the information from your environment as you navigate to determine your current location. We accomplished this task through controlling the Roomba using a Raspberry Pi, a small computer, which communicates to the Roomba via a serial port on the Roomba and can send sensor information to the Raspberry Pi. Various trials that we conducted allowed us to compare our calculations for speed to those of the Roomba. In the trials, we tested the Inertial Measurement Unit's (IMU) distance, versus the Roomba's commanded distance, versus measured distance, and found that the most accurate measurement was the wheel encoders on the Roomba. From there, we measured using the wheel encoders in order to navigate with the most accuracy. After calibration, we created a mapping system to work in a 5x11 grid, in which each square was 50cm x 50cm. Using a pathfinding algorithm called A*, the Roomba was able to navigate in this grid. The final

task we accomplished was to remove the limitations on the Roomba by removing the grid. The Roomba is now capable of navigating to a commanded point through the shortest path, around obstacles. The application of our accomplishments is the implementation of this dead reckoning system into other robotic systems, such as drones and self-driving cars.

ROBOTIC MAPPING: PATHFINDING USING DEAD RECKONING TECHNIQUES

Jyoti Adusumilli
South Carolina Governor's School for Science & Mathematics

The purpose of my research was to use dead reckoning to program a Roomba to navigate a given space. Dead reckoning is the process of only using an initial location and the measurements you can get from your environment to navigate to determine your current location. We accomplish this through controlling the Roomba a using a Raspberry Pi microcomputer. The Raspberry Pi communicates to the Roomba via a serial port which can send sensor information from the Roomba to the Pi. I discovered that the Roomba's sensors for determining its velocity is inaccurate, so I made a series of computations using the wheel encoders to determine its position. The Roomba uses a point-based system to navigate the world and I programmed the Roomba to move from point to point using the A* algorithm, which is a pathfinding algorithm that determines the set of points that takes the Roomba to the goal in the shortest time. Right now, I have successfully written the program that can accurately move the Roomba from one point to any other point and detect obstacles in the world. Because the math for the bots is the same, this technology can be implemented to real needs, like search and rescue drones, self-driving cars, agricultural, and military automation.

ASSESSING THE COMBINED EFFECTS OF HEAT STRESS AND NUTRITION DEFICIENCY AND THEIR EFFECT ON LONG TERM POTENTIATION IN *CAENORHABDITIS ELEGANS*

Spandana Anchoori
Spring Valley High School

Rising temperatures and famine has led to many people suffering physically, however, there are also possible neurological reasons why these people are unable to perform as well as others. The purpose of this study was to test whether heat shock and starvation had any combined effect on memory retention in *C. elegans*. It was hypothesized that if *C. elegans* were exposed to the combined effects of increased heat stress and decreased nutrition levels, then the overall number of *C. elegans* that were trained with the information would be reduced by more than 50%. Experimentation was accomplished by splitting the nematodes into the three temperature groups: 20°C, 27.5°C, 30°C. Each temperature group was then split into either normal food or starvation. Within each of these groups, the nematodes were first trained to remember which arms in a radial arm maze to go to, and were later exposed to the heat shock and starvation. Then, they were tested to see if they were able to retain the information by being placed back into the radial arm maze. A two-way ANOVA test was run to test the difference in the means, and was proven to have a difference in temperature, but not in heat shock at = 0.05. The p value for temperature was <0.001, however, the p value for heat shock was 0.044. Therefore, the hypothesis was supported and as the temperature and starvation increased, the number of *C. elegans* to actually have retained the information decreased.

ORAL STIMULATION FOR AUTISM

Allie Anderson
Center for Advanced Technical Studies

The goal is to make a product that is silicone based, fits in a childs mouth, vibrates, has a removeable tip, and is rechargeable. The handle is going to be 3-D printed; the mouthpiece is going to make out of silicone, but it is going to be holloe, so that it can be filled with a freezable gel. the product will be sucessful if it charges and vibrates

THE EFFECT OF ALUMINIUM HYDROXIDE ON THE FECUNDITY OF *DROSOPHILA MELAGNOSTER*

James Andreen
Spring Valley High School

Flame retardants have seen more widespread use in recent years. This rise in use has led to widespread health concerns, such as being carcinogenic. This study investigated the possible effects of aluminium hydroxide ($Al(OH)_3$) on fecundity in *Drosophila* cultures. It was hypothesised that an increase in $Al(OH)_3$ would lead to a decrease in fecundity. The test was conducted by mixing Al(OH)3 into the fly media at different concentrations, 0%, 60%, and 75%. Then counting the number of fully grown offspring after 21 days. The results seemed to indicate there were more offspring in the control group, however the ANOVA at α=0.05 indicated that the null-hypothesis was not rejected with the P=0.1301. Due to the study being inconclusive, no assumptions can be drawn about the health concerns of aluminium hydroxide. In conclusion, due to rising safety concerns, the effect of aluminum hydroxide on fecundity at high concentrations was studied, and the results were inconclusive.

THE EFFECT OF DROUGHT TOLERANCE ON STEM LENGTH IN WISCONSIN FAST PLANTS

Tremayne Ansani
Spring Valley High School

Droughts have shown to have a significant effect on agriculture and the environment. The purpose of this experiment was to observe whether a moderate drought stress would affect the stem lengths of the P1 generation of Wisconsin Fast Plants®. It was hypothesized that the Wisconsin Fast Plants® P1 generation control would have a greater stem length than the P1 generation under drought stress. Two groups were created; a group under drought stress and a control group not under drought stress. The group under drought stress received half the amount of water that the control group received. Plant heights were recorded every other day throughout the experiment. A two-sample t test ($t(16) = -1.21$, $p = 0.244$) was taken between the P1 generation under drought stress and the control. The data showed that the difference was not statistically significant. The hypothesis was not supported by the results, because the P1 generation control did not have a greater stem length than the drought stress treatment. This suggests that the simulated moderate drought is not detrimental enough to affect stem length.

BIKE TO THE FUTURE: CONNECTION IS KEY

Camilla Aragon, Yaj Patel, and Shayla Carney
South Carolina Governor's School for Science & Mathematics

The Bike to the Future group explored infrastructure in cities, particularly in Hartsville, South Carolina, and how it can be improved through changes to the streets to make it accessible for all kinds of transportation. I focused on ease of transportation for those travelling to and from school. In a lot of places, roads are mostly geared toward automobiles, but it is important to have road equality, so roads are accessible for not only automobiles, but also bicycles and pedestrians especially since many people in Hartsville do not have access to cars. We traveled to Greenville, South Carolina and Atlanta, Georgia to study infrastructure changes and see how they worked to integrate bicycle, pedestrian, and automobile traffic. We saw many great examples of road equity, especially on the campus of Georgia Tech. After rendering ideas of infrastructure that we could implement in Hartsville, we created sketches of additions we wanted to add to the streets and sent them to the city in order for them to get approved for temporary installment. Some of these sketches were made with the idea to make it safer for the students of GSSM when travelling around the city, since we cannot drive while at school. Adding these small and temporary infrastructure changes that we made to the city helped improved safety of those not traveling by motor vehicle, as we saw many people using our installments. It also increased driver awareness as we saw a trend in lower speeds by vehicles on the streets.

A FUNCTIONALITY INVESTIGATION COMPARING A NON-COMMERCIAL AND TWO COMMERCIAL UPPER ARM GUARDS AND THEIR EFFECTIVENESS AT IMPACT FORCE DISSIPATION.

Asa Arnold
Spring Valley High School

Lacrosse is a fast-paced contact sport that allows for players to strike one another with a lacrosse stick. This aspect of the game has led to many injuries, mostly muscle contusions known as bruises. Severe bruising can not only lead to medical complications but it can also negatively affect the choices of the players. The purpose of this investigation was to test materials of two commercial upper arm guards and one non commercial guard to compare and determine the most effective arm pad. The hypothesis was if the non-commercial upper arm guard was designed correctly then it would be superior at impact force dissipation over the commercial upper arm guards. In order to test the arm guards, a weight was dropped from a specific height onto the arm pads with a force plate underneath. The force plate measured the force in newtons transferred from the falling weight. The descriptive statistics showed slight favor in the cheap arm pad being the best. However, a one way ANOVA test ($F(3, 120)=1.11$, $p=0.347$) found that the results were most likely due to random probability which means the results were statistically insignificant. Even though the investigation showed no superior upper arm guard just having an arm pad in place to prevent stick induced injuries is better than nothing being there at all. Further tests in the actual design of the arm pads could prove to show a superior upper arm guard.

HISTOLOGICAL EXAMINATION OF WHEEL TRAINING ON DIURNAL FLUCTUATIONS IN MOUSE SKELETAL MUSCLE

Autumn Ashley
South Carolina Governor's School for Science & Mathematics

Cancer-induced cachexia is characterized by the rapid decrease in body weight through the loss of muscle mass, and largely affects the mortality of cancer patients. Exercise has proven to increase quality of life scores and functionality of patients with cancer and may provide beneficial effects in the attenuation of cancer-induced muscle wasting. This preliminary study sought to evaluate the effects of an exercise regimen on skeletal muscle through histochemical methods. Healthy untrained male C57BL/6 mice were divided into three groups: 1) no wheel access controls, 2/3) 2 weeks of wheel access sacrificed after the light (7PM) and after the dark (7AM) cycle. The tibialis anterior (TA) was cryosectioned and used to evaluate myofiber changes in cross-section area (CSA), oxidative capacity by succinate dehydrogenase (SDH), and noncontractile tissue (surrogate maker for extracellular matrix) via wheat-germ agglutinin (WGA). Access to wheel provided statistically significant increase in total hindlimb weight, and extracellular matrix. Furthermore, wheel training increased overall CSA but not relative frequency of positive SDH fibers when compared to controls. While exercise is capable of inducing protein synthesis in untrained mice, we determine that training is necessary for increased hypertrophy.

USING CONVOLUTION NEURAL NETWORKS TO CLASSIFY CORAL SPECIES

James Atwater
South Carolina Governor's School for Science & Mathematics

The research was done with Convolutional Neural Networks (CNN), a method designed in the 1990's and has been successfully used over the past decade. The goal of the research was to learn how to create a CNN could correctly identify different coral species at a high rate of efficiency. The program that created would then be uploaded into an aquatic robot which navigates underwater areas on its own to catalog life. To create a test model, a CNN was created to differentiate between cats and dogs. It was able to do so at 98 percent accuracy, and so that became the working model. The next step of the project was to understand how to differentiate between the coral species properly using a relatively small dataset of photos. This process was done by taking the images and individually splicing them into hundreds of smaller, more pixelated photos for the computer to later group. Unfortunately, the when the spliced images were fed back into the clustering algorithm it would only ever return a blank white image. The reason for this is still unknown. Theoretically, however, if this problem were to be later solved, the image would then be reassembled by reversing the affects of the splicing, thereby putting the image back together like a jigsaw puzzle. From there the labeled points would be used for later training by the computer. Then the trained model would be uploaded into the aquatic robot to differentiate between coral species.

COUNTERFEIT CULTURE: THE EFFECT OF BRANDSTATUS ON CONSUMER WILLINGNESS TO BUY COUNTERFEITS IN SHANGHAI AND CHARLESTON

Natasha Aust
South Carolina Governor's School for Science & Mathematics

The production and sale of counterfeit goods is a controversial issue in today's society, largely impart to differing intellectual property rights between countries involved in global trade. This study analyzed consumer's opinions regarding the purchase of counterfeit goods in both the Shanghai and Charleston area to witness how the market is viewed from people directly at the source, the consumers. Respondents answered a series of likert-scale questions that categorized their opinions under three variables: Risk, BrandStatus, and Ethics. To account for variances in background, each participant was likewise asked to complete a socio-demographic survey prior to the completion of the other questions. This data was then placed in tables and regressions were run to determine positive and negative variances between the Shanghai and Charleston groups. After regression tests it was concluded that Charlestonians are more inclined to purchase counterfeit goods than Shanghainese. Moreover, as the BrandStatus variable increases among Shanghainese, their willingness to buy a counterfeit product decreases. While as BrandStatus increases among Charlestonians, so does their willingness to buy a counterfeit.

THE EFFECT OF SPF ON THE UV RAYS ABSORBED.

Reid Avery and Owen Bennett
Heathwood Hall Episcopal School

The purpose of this project is to gather data on which type of SPF blocks UV rays the best. It was hypothesized that the higher the SPF of the sunscreen, the less the UV rays would be detected. Sunscreen was collected from the same brand and from the same website. The UV-lamp and the 4-cups were set up in the shape of a rectangle. A lid was laid flat on the ground, and the UV-lamp was placed on the lid. The sunscreen was used to cover the UV detecting card and allowed it to detect how much UV Radiation could get through. A hair dryer was used to dry the sunscreen. The card was then placed under the UV lamp, which was turned off. Once everything was set-up, the lamp and the stopwatch were turned on at the same time. At each previously chosen time interval, data was collected from the cards readings in order to tell the amount of UV rays detected.

THE EFFECT OF THE OVERCONSUMPTION OF SUGAR ON THE REPRODUCTION OF *DROSOPHILA MELANOGASTER*

Siri Avula
Spring Valley High School

The quality of diet plays a major role in lifestyle choices and can potentially impact reproduction. Many individuals in today's society consume high amounts of sugar on a daily basis (Tasevska et al., 2012). Sugar can cause hormone imbalances; this can affect the levels of the estrogen and testosterone found in the body. The purpose of this study was to help determine the possible risks in reproduction from over consuming sugar. It was hypothesized that if the *Drosophila melanogaster* were given high amounts of sugar to consume, then the *Drosophila* given no sugar would have higher reproduction rates. To begin experimentation, the P1 generation of flies were used to reproduce an F1 generation of flies. There were two experimental groups: sixty flies were given 2.5 grams of sugar and another sixty were given 5 grams. These sugar-fed flies were used to see how they would reproduce and were compared to the reproduction of flies on a normal diet. A one-way ANOVA [$F(2,27)=26.699$, $p<0.05$], followed by a post-hoc Tukey test, was conducted to see if a significant statistical difference existed between the different groups of offspring produced. The hypothesis was supported; there was a statistically significant difference between the control group and each experimental group, with the sugar-fed flies reproducing significantly less flies than those not given any sugar. Based off of the descriptive and inferential statistics, it can be concluded that a high amount of sugar consumed may lower reproduction in fruit flies.

THE EFFECT OF TWISTED AND BRAIDED WEAVE TYPES ON THE DETERIORATION AND BREAKAGE OF KEVLAR FIBERS

Caitlin Aycock
Spring Valley High School

Kevlar, along with other high tensile strength materials, are used in products of grave importance, such as military grade resources. The purpose of this study was to determine which kind of woven Kevlar, braided or twisted, could endure more strain. Understanding which kind of weave is stronger could be used in the future production of products that rely on this material. It was hypothesized that the braided Kevlar, when tested using a Mark-10 series 5 tensile strength machine will have a higher breaking point (in Newton meters) than that of the twisted and straight cords. When the different samples were prepared, they were clipped into the Mark-10 and pulled apart using a handle. The machine read the exact force required (Nm) in each trial. It was found that the control group with the straight strands consistently had the highest breaking point (Nm) with a mean of 7.7. The braided average was the lowest at 4.3, and twisted with 4.9. It was concluded that the unwoven strands were significantly stronger than the twisted and braided groups when tested on the Mark-10 due to $p<\alpha$ ($.001<.05$). Each mean is significantly different due to the resulting intervals of the tukey test. When comparing the strength of twisted, braided, and straight strands, the straight group was the strongest, and braided was the weakest.

IS LPA RECEPTOR 1 USED BY RETINAL GANGLION CELLS TO FIND THEIR CORRECT CONNECTION IN THE BRAIN?

Madeline Babb
South Carolina Governor's School for Science & Mathematics

For my research I was involved in investigating the role of LPA receptor one in the LPA signaling process in chicken embryos. To investigate this I dissected embryonic chickens for their retinal ganglion cells, treating them with the inhibitor (AM-095) and LPA, and later staining them to count how many growth cones had collapsed. If LPA receptor one was not in use during the LPA signalling process, the proportion of collapsed growth cones in dishes treated with the inhibitor and those without would be approximately the same. When the results of both dishes were graphed it was seen that the proportions were in fact the same and so it could be concluded that LPA receptor one does not play a part in the LPA signalling process in the embryonic stages of chicken development.

LINE FOLLOWING, OBSTACLE AVOIDANCE, AND FLIGHT STABILITY IN AUTONOMOUS QUADROTOR DRONES

William Bain
South Carolina Governor's School for Science & Mathematics

The purpose behind this research is to advance the way that drones detect and move around objects, follow lines, and remain stable in their flight. The underlying reason for this is to make autonomous drone deliveries and pickups for online shopping companies such as eBay and Amazon more reliable and safer. This way, thirty minute and one-hour deliveries will become a possibility as they become safer and legal. The methodology for this is to write algorithms and python programs to accomplish each of these individual tasks. Then these algorithms are tested in a secure flight space for stability. As problems in these algorithms are detected, they are recorded and corrected through plentiful fine-tuning. This is done through flight logs recorded in Queue Ground Control, an Ubuntu program. The results of this were inconsistent, sometimes with the drone crashing into ceiling of the flight space, and sometimes with the drone completing the whole course in under a minute. The main issues are in altitude control when avoiding obstacles. However, things such as AR Tag detection have proven to be consistently successful. Line detection is only an issue at sharp turns of 90 degrees or more. The flight stability is very consistent, and the drone maintains a stable altitude as it hovers in a horizontal plane.

PRODUCTION OF GOLD NANOPARTICLES VIA SOLUTION SYNTHESIS

Paul James Balmediano
South Carolina Governor's School for Science & Mathematics

Applications, such as targeted drug delivery, solar power, and pollution treatment, can benefit from the use of gold nanoparticles. An example of an application is the use of gold nanoparticles in organic solar cells. If the correct size, concentration, and placement in the organic solar cell are used, there will be a direct enhancement to the light absorption of the cells. The purpose of this research is the high-yield production of uniform quasi-spherical gold nanoparticles in the size range of 60-100 nm. The particles were synthesized in a solution with Tris Base (TB) solution and Gold as the precursor. The solution refluxed reaction at 96° Celsius in a hot water bath for 30 minutes. Once the particles were an orange-red in color, they are deposited into test bottles. Samples were analyzed using an Ultraviolet-Visible Spectrometer, X-ray Diffractor, and Scanning Electron Microscope to view the sizes and composition of the nanoparticles. The nanoparticle samples from the first two trials were larger than the intended size range. The last trial was the most successful which yielded a size of 64 nm. In future research, gold nanoparticles will be used in multi-metallic core nanoparticles and targeted drug delivery through encapsulated nanoparticles.

THE EFFECT OF THE AMOUNT OF PENICILLIN DISKS ON THE GROWTH OF E.COLI AND HOW TIME CHANGES THE EFFECTIVENESS OF PENICILLIN

Evan Barker
Heathwood Hall Episcopal School

The purpose of this experiment was to see if adding penicillin disks would inhibit the growth of *E.Coli* K12 and to see if the longer the variables spent in the petri dish then would the penicillin lose its effectiveness. The independent variable was the penicillin disks and the dependent variable was the *E.Coli*. For the experiment, E.Coli was put on half of a petri dish using a sterile cotton swab while the penicillin disks were put on the other half. After 3 days the petri dishes were checked to see if *E.Coli* had grown close to the penicillin disks and pictures were taken of each petri dish so that later the amount of bacteria could be graded on a scale of 0 - 5 where 0 is no bacteria and 5 is bacteria existing very close to the penicillin disk(s). This was done for two more days to test how the effectiveness of penicillin changes over time. The experiment resulted in a direct correlation that the more penicillin disks present the less likely the *E.Coli* is to grow as well as the more time the two variables spend in the same petri dish the less effective the penicillin. The two hypotheses were If there are more penicillin soaked disks of paper in a petri dish, then there will be less bacteria and If the penicillin disks and *E.Coli* spend more time in the dish, then there will be more bacteria. The hypotheses were supported.

TRICLOSAN SOAP EFFECTIVENESS AT KILLING BACTERIA WHEN DILUTED WITH WATER

Sam Barker and Daniel Sobel
Heathwood Hall Episcopal School

The purpose of this experiment was to determine whether diluting antibacterial soap with water diminishes the effectiveness of Triclosan Soap. To test the hypothesis, 60 petri dishes were filled with Nutrient Agar, then Staphylococcus epidermidis was streaked across each plate. After incubating in a 37°C incubator for 24 hours, the antibiotic sensitivity discs that had been soaked in Triclosan soap concentrations of 100%, 75%, 50%, 25% and, 0% were placed into 60 sterile petri dishes with about 2 discs per petri dish depending on the size of the bacteria colony. The plates were incubated an additional 48 hours and the petri dishes were taken out of the incubator and had the diameters of the area in which no bacteria survived around the filter paper, measured. The results of the experiment found that there was a gradual decline of the zone of inhibition's diameter by about 0.33mm or 32.6% every time the Triclosan Soap concentration was decreased by 25%. This finding suggests that if you use antibacterial soap, you should not dilute antibacterial soap because there would be a noticeable decrease in the effectiveness of said soap.

THE EFFICENCY AND ENERGY STORAGE OF 0%, 10%, 25%, 50%, 75%, AND 100% ETHANOL CONCENTRATIONS IN GASOLINE

Catherine Barron
Heathwood Hall Episcopal School

The purpose of this experiment is to determine how much energy different concentrations of ethanol in gasoline store and how efficient 0%, 10%, 25%, 50%, 75%, and 100% concentrations of ethanol are. The hypothesis of this experiment is that if 0%, 10%, 25%, 50%, 75%, and 100% concentrations of ethanol in gasoline (by volume) are tested against pure gasoline, then they will be less efficient and store less energy. To begin the experiment, 3 mL of each concentration, poured into the crucible under the 250 mL beaker, and the temperature of the water was taken before and after testing. The concentration was lit and burned, the burn time was recorded. Three trials per concentration were run. The average change in temperature was calculated, and from this the number of calories per concentration was calculated. From the calorimetry data, there was not a clear pattern of what was occurring.40 mL of each concentration were poured into a lawn mower, and the time each concentration ran in the lawn mower was recorded. The lawn mower running times did show that the pure gasoline was most efficient with a running time of 4.54, and that the 100% ethanol concentration was least efficient because the lawn mower would not start. The part of the hypothesis stating that the ethanol concentrations will be less efficient than gasoline was proven true, but the part of energy production was inconclusive.

THE EFFECT OF VARIOUS AMMONIA CONCENTRATIONS ON THE RATE OF SEED GERMINATION IN *FRAGARIA ANANASSA*

Karah Barry
Spring Valley High School

Pesticides are commonly used substances that are utilized to prevent bugs and unwanted forces from consuming or disrupting the growth of crops. Studies have shown that the chemicals used in many pesticides have various damaging effects on the growth, germination, and predictability of plants that they are applied to. One of the dangerous chemicals that are commonly used in many pesticides is ammonia, a nitrogen-hydrogen compound that is used in these pesticides due to their toxic nature. Previous research has shown that when isolated, the growth of several common crops (such as cotton and corn) is inhibited when grown with exposure to ammonia. The purpose of this research was to determine and identify the effects of ammonia on the rate of germination in one commonly grown crop in the United States, *Fragaria ananassa* (more commonly known as the strawberry). It was hypothesized that increased levels of ammonia concentrations would decrease germination times. The 150 trials of strawberries grown in biodegradable seedling trays were combined with various concentrations of ammonia (ranging from 1.2 to 2.4 ppm) and observed over the span of approximately seven weeks. With a p-value of 0.258, it was determined that

the null hypothesis was failed to be rejected, and it was unlikely that the differences shown in the results were due to random sampling. From this, it was shown that despite the differences in the germination rates of the grown plants, the final results were not statistically significant enough to have any clear effects.

TEACHING ROBOT COMPANIONS TO ASSIST HUMANS VIA NATURAL LANGUAGE AND GESTURES

Michael Bertram
South Carolina Governor's School for Science & Mathematics

Workplaces in manufacturing contexts, especially automotive assembly, often require the transport of heavy parts, and today many of those lifts are done by pre-coded machines or people. However, in a more dynamic setting, it may be required for the robot to go off script, so it may stop on command in wait for another part to be added or removed for any adjustments needed. The pre-coded machines do not have this dynamic, and some parts are simply too heavy for people. To this end, we develop a teaching-learning framework for the robot to learn from multi-modal human demonstrations to assist its human partner in collaborative tasks. By taking advantage of our approach, humans can teach robots just like teachers teach students how to carry heavy parts via natural language and gestures. The Myo Armband is employed to acquire human gestures and parametrize human driving modes to train the robot. We then use natural language processing and structured dialogue to communicate with the robot combined with the wearable sensing to create a functioning, dynamically moving robot. Afterwards, the robot can learn what each driving mode is through the Random Forests (RF) algorithm. The proposed approach is implemented on a smart companion robot, which assists the human in carrying a heavy part around an assembly line. Testing results suggest that the human labor can be reduced by using natural language and wearable sensing, and the robot can effectively collaborate with the human to accomplish the shared task in collaborative manufacturing contexts.

THE LONG-TERM EFFECTS OF HURRICANE HUGO ON THE GROWTH AND RECOVERY OF SOUTH CAROLINA'S COASTAL TEMPERATE FORESTS

John Besser and Jack Stuckey
South Carolina Governor's School for Science & Mathematics

In September 1989, Hurricane Hugo hit the Southeast coast of the United States. This hurricane did a massive amount of damage to the forests of South Carolina. Since then scientists at the Baruch Institute of Coastal Ecology have monitored tree growth and death in four coastal temperate forests affected by the hurricane. Forest trees can be categorized as resilient, resistant, susceptible, or a usurper. These classifications summarize how a certain species will respond to a disturbance, but can also change depending on the makeup of the forest. The goal of the study is to find out if the forests returned to the state they were in pre-Hugo, and find how wind damage, water salinity of surge, and competition between trees affected recovery. While we were at Hobcaw Barony, we worked with numbers such as DBH (the diameter at breast height) and calculated graphs to determine trends in the vitality of the trees that made up each forest and each forest type. One invasive species, the Chinese Tallow, increased rapidly in number after the hurricane due to holes in the canopy from tree death. The Loblolly pine species also took over parts of the forests, quickly becoming a large part of the tree population where it hadn't before the hurricane. This research is important because this data can be used to predict outcomes of future hurricanes and help scientists figure out a way to prevent major tree death.

PROFIBROTIC GENE RESPONSE OF WHOLE SKIN VS. FIBROBLAST SAMPLES TO TGF-B TREATMENT

Rylee Bodony
South Carolina Governor's School for Science & Mathematics

Scleroderma is an autoimmune rheumatic disease that involves fibrosis, or the hardening of the skin and internal organs. Conditions in the autoimmune category, although widespread, are not completely explored and there remains a lot to discover on the subject. As of today, there are no FDA-approved agents to either stop or reverse fibrosis. To contribute to fibrosis research, I am comparing the fibrotic responses of ex vivo and in vitro skin fibroblast samples to TGF-ß treatment. The target genes are quantified using qRTPCR and analyzed with a paired t test. The data gathered gives a insignificant p value for the ex vivo skin samples. Though limited minutely by this, it is still apparent that the experimental results show the in vitro fibroblasts having a stronger response to the treatment then the ex vivo fibroblasts. This knowledge is important because it will help researchers decide whether their experiments would benefit more from fibroblasts still imbedded in the whole skin or fibroblasts which have been suspended and isolated from the tissue based on how strong the response needs to be.

YOUNG CHILDREN'S NEGATIVE INTERPRETATION IN MEMORY RECALL IS RELATED TO MOTHER'S NEGATIVITY IN REMINISCING CONVERSATIONS

Victoria Botzis and Divine Cade
South Carolina Governor's School for Science & Mathematics

Conversations at home between mother and child can impact children's patterns of memory recall and storytelling. Conducting research into this special phenomena can be helpful in legal situations and interviews, where children are expected to give a truthful and accurate account of past events. Three different experiments were conducted with dyads of mother and child: A shared memory task where mother and child talked about shared memories that made the child happy, sad, scared, and angry; an electronic survey that asked the mother how she would react in theoretical ambiguous situations; and a slime task where

children were asked to react to a person doing ambiguous actions. Through completing these three experiments with mothers and their children, I found that children with mothers who had a more negative interpretation of ambiguous events were more likely to interpret ambiguous situations negatively themselves. This knowledge is significant in legal contexts because it allows interviewers to modify interrogation techniques so that children can give testimonies without being manipulated or unintentionally deceitful.

EVALUATING THE AWARENESS OF POLYCYSTIC OVARY SYNDROME

Sabria Bowman
Center for Advanced Technical Studies

The goal of this research is to evaluate the awareness of Polycystic Ovary Syndrome among women of varying age groups. PCOS is a common hormone abnormality of reproductive-aged women by the overproduction of androgen, menstrual abnormalities, and polycystic ovaries. Up to 70% of women remain undiagnosed and many women are unaware of the existence of this disease. The overall goal is to raise awareness in order to eventually increase the attention that is given to PCOS not only in women themselves but also in healthcare professionals to ensure a better understanding of treatment for these patients. Studies have shown that this high percentage of women who are undiagnosed derives from the lack of education and awareness of this disorder. If women among varying age groups are shown a public service video on Polycystic Ovary Syndrome, then their performance on the awareness survey will increase significantly These results will be reflected in the observations of potential trends and correlations that may appear between the varying age groups of women over the period in which the video is viewed and comprehended.

THE EFFECT OF VARIED LEVELS OF SALINITY ON CHLOROPHYLL A LEVELS IN *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 salinity concentration that would provide the most beneficial change in chlorophyll A and B Concentrations for the ferns in a 1-month time span. It was predicted that the ferns in the 35 ppt salinity concentration would have the most beneficial chlorophyll level in comparison to the other groups because the average salinity of the Mediterranean Sea is 35. 30 ferns were planted in each treatment of 30ppt water, 35 ppt water, and 40 ppt water. The water treatment with 35 ppt was used as the control and the ferns were measured in daily intervals so a total of 30 measurements were taken per salinity level. After the 2 week experiment, the hypothesis was supported because the plants that were planted in the 35 g/L salinity had the closest absorbance value to 0. The plants in the 40 g/L water constantly increased throughout the experiment and the plants in the 30 g/L increased during the first week but decreased during the second week. This decrease could be due to the heightened adaptiveness of the plant. A one-way ANOVA was run on the end of the second-week data and it yielded a p-value of <.00001 which meant that there was a significant difference between the salinity concentrations.

THE GENETIC AUTHENTICATION OF MALAGASY CRAYFISH SAMPLES

Landon Bradshaw
South Carolina Governor's School for Science & Mathematics

The marbled crayfish (*Procambarus virginalis*) is a relatively new species that emerged by macromutation nearly 30 years ago from Procambrus fallax. Despite its short existence, it has already become an invasive species because of its ability to reproduce clonally and its environmental adaptability. The marbled crayfishes' high adaptability allows it to thrive in diverse conditions throughout the globe. It is very important to correctly identify marbled crayfish because, to do epigenetic research with them, we need to know the epigenetic profile. This experiment analyzed two Malagasy crayfish samples to test if they were Procambarus virginalis. This work was necessary because it is the only way to distinguish between different crayfish species besides morphology which is subjective. DNA was isolated from the abdominal tissue of 2 unknown crayfish samples, analyzed by PCR, and compared to known DNA reference sequences. The results for crayfish #1 were inconclusive because the insert was not incorporated by the plasmid, but it was confirmed that crayfish #2 was *Procambarus virginalis*. Future work on the marbled crayfish will be to help establish a methylome sequence. This methylome sequence will show average methylations to the DNA, helping further understand the epigenetics of clonal tumor evolution.

PROBING DISTANT GALAXIES USING GRAVITATIONALLY LENSED QUASARS

Sienna Brent
South Carolina Governor's School for Science & Mathematics

Quasar absorption line spectroscopy is a powerful tool to probe the gas in and around distant or faint galaxies because the galaxy can be studied independent of its brightness. Identifying the gas composition is crucial for understanding the evolution process of galaxies. The quasar serves as a background light source, enabling us to measure the column densities of chemical elements along the line of sight through which the quasar shines. Gravitationally lensed quasars (GLQs) are especially useful as they provide multiple lines of sight through the galaxy and other foreground absorption systems allowing observation of smaller-scale structure in a galaxy's interstellar medium. Measuring element abundances and their projected separations yield

estimates of gradients in H I column density and metallicity. Determining element abundances requires both metal line and neutral hydrogen column densities. This project identifies GLQs with significant metal line absorption (Mg II, Fe II, Ca II, and Na I) as possible targets for having significant hydrogen absorption as well. Hydrogen absorption lines in low redshift lens galaxies typically have wavelengths in the ultraviolet and require space-based observation. Spectra of 70 GLQs from the Sloan Digital Sky Survey (SDSS) were searched for metal lines and their equivalent width was measured using SPECP. Ten GLQs have multiply lensed images (>2). GLQs with metal line absorption in their spectra are possible targets for future observing proposals to identify and measure the H I and metal line column densities of the lens galaxy and any other significant absorbers along the lines of sight.

CLONING OF CANDIDATE GENES FROM SEASHORE *PASPALLUM*

Benjamin Brickle
South Carolina Governor's School for Science & Mathematics

Drought and salt stresses limit the amount of agricultural production every year. In this study, five predicted genes (m11, m23, m26, m28, and m31) that responded to both stresses were chosen from RNAseq database of seashore paspallum (*Paspallum vaginatum*), which is a warm-seasoned turf grass that is native to coastal regions. This grass is tolerant to many environmental factors such as salt and drought. The genes were cloned, and their effectiveness was evaluated in the model species Arabidopis via *Agrobacterium*-mediated plant transformation. In the research, rapid amplification of cDNA ends, DNA digestion, DNA ligation, DNA transformation into *E. coli* and *Agrobacterium*, colony PCR to detect the gene harboring in the host cell, plasmid DNA isolation, and gel electrophoresis techniques were used to conduct the experiments. Five and three prime ends of one of the candidate genes, m11, was cloned and sequenced. With these results, full length cDNAs can be cloned based on this sequence. In the future, the gene will be delivered into *Agrobacterium* via electroporation and transformed into *Arabidopis* using the floral dip method. The transgenic plants will be tested to see if the candidate gene positively impacts the plant's response to salt and drought stresses. This strategy can also be implemented to crop species, which would lead to more resistant crops. The result would be an increase in agricultural production every year.

THE EFFECT OF INTAKE OF THE NON-CALORIC SWEETENERS MALTODEXTRIN AND SUCRALOSE ON THE MEMORY OF *DUGESIA DOROTOCEPHALA*

Caroline Brindel
Spring Valley High School

Non-caloric sweeteners are rapidly growing in day to day use in food and beverages. With this swift increase in usage, questions are raised on the safety of these sweeteners. The purpose of this research was to determine if the consumption of the non-caloric sweeteners maltodextrin and sucralose affects the memory of planaria. It was hypothesized that after consuming a boiled egg mixed with splenda, containing both maltodextrin and sucralose, the speed the planaria completed a pathway based on memory would be slower than if fed a sweetener with maltodextrin or sucralose individually. The planaria were randomly divided into four groups. After this they were timed in a maze finding the original speed and to memorize the maze. After completion they were fed 0.20 grams of an egg yolk mixed with the assigned sweetener. The following day the planaria were timed in the maze again. This took place until each group had 15 completed trials. The time each planaria took for completion of the maze before consumption was then subtracted from that after consumption to find the change in time. A series of descriptive statistics was performed for the data showing that all three sweeteners caused a loss of memory compared to the control group, but as hypothesized the splenda group the only group to have a positive mean meaning an increase in time taken for the planaria to complete the maze after consumption. However, an ANOVA showed the data was insignificant, $F(3,45)=0.98$, $p=0.409$.

SEBORRHEIC KERATOSIS

Abrielle Brown
Center for Advanced Technical Studies

This project is focused on finding a natural solution to Seborrheic Keratosis. Seborrheic Keratosis is a prevalent skin condition-- in about 75% of the population over the age of 50-- and has no current natural or cost effective treatment. If patients apply a mixture of frankincense essential oil in a castor carrier oil to seborrheic keratosis for the duration of one month, then the coloration and appearance of seborrheic keratosis will decrease. Participation in this experiment is completely voluntary and patient information will be kept confidential. In addition, a survey to eligible patients will be administered to determine the connection between Seborrheic Keratoses to family history and sun exposure.

DOMAIN SPECIFIC LANGUAGE GENERATION FOR EVENTUALLY CONSISTENT DATA REPLICATION

David Brown and Jaden Stutts
South Carolina Governor's School for Science & Mathematics

Online Data Saving Processes are often times taken by a top-down, negative approach. This results in manually updating, constantly checking, and fixing issues that are derived from the pessimistic approach. In this project, a bottom-up, optimistic approach is taken to create a stable environment for saving processes. The idea behind this is called eventual consistency, meaning that if data is saved and replicated in very small time frames, where it seems to be happening simultaneously, then no data will be lost. This would be used on online platforms, such as shopping or music websites where users have accounts.

Our research focus was to create a computer language under the domain of eventual consistency. The use of a specific language is to make coding programs easier for the software engineers by defining a custom grammar which supports the constant data saving and replication.

LOCATING AND EXTRACTING CIRCUIT SYMBOLS FROM CIRCUIT DIAGRAMS THROUGH COMPUTER VISION

Maya Brown and Maximus Keane
South Carolina Governor's School for Science & Mathematics

Electronic diagrams are beneficial and effective tools for planning and preparing to install electricity in facilities around the world. If the individual components of the diagrams, as well as their interconnections, are recognized and identified quickly, errors and mistakes in wiring can be avoided. Algorithmic efficiency is an important element to consider when designing a program for automatic circuit symbol interpretation because it can prevent time and money loss during circuit implementation. With the use of computer vision, we automate the process of locating and identifying components of circuit diagrams in this study. The particular method we used, template matching, paired with neural network training allows for quicker and more efficient recognition of templates within the images used for experimentation.

AUTONOMOUS LAND-BASED NAVIGATION IN COMPLEX ENVIRONMENTS

Dylan Bruss
South Carolina Governor's School for Science & Mathematics

Autonomous vehicles are becoming more and more of a viable alternative to the inefficient transportation system of today. However, for this solution to be sustainable, these vehicles need control mechanisms that allow them to efficiently make complicated navigation decisions based on the world around it. In this project, we created an algorithm to navigate a predetermined course, using signs and other visual markers to help determine the position of the vehicle at various points. Our algorithm was fairly successful, only having minor navigation issues at particularly complicated portions of the track.

THE EFFECT OF THE USE OF AN ELECTRONIC DEVICE BEFORE BED ON SLEEP QUALITY

Erin Byrd
Spring Valley High School

It is important for people to get the proper amount of sleep each night, especially for adolescents, but it has been found that many children do not get enough sleep. Studies show that using cell phones and other electronic devices before bed can negatively interfere with sleep (White et al., 2011). The purpose of this experiment was to see if sleep quality would improve when electronics were not used before bed or when Night Shift was used during electronic device use before bed. It was predicted that not using an electronic device before bed would be the best for improving sleep quality and increasing REM sleep, followed by using Night Shift during electronic device use before bed. Four high school students participated in the study for a total of 60 nights. They used their cell phone for 20 minutes before going to bed for the first 20 nights of experimentation, followed by using their cell phone with Night Shift turned on for 20 minutes before going to bed for the next 20 nights, and then not using their phone before going to bed for the last 20 nights. The hypothesis was partially supported because the Tukey test that was performed after the MANOVA and ANOVA found that only the sleep quality scores for No Phone Use were significantly higher than Phone Use (w/o Night Shift) ($p = 0.014$) and Phone Use (w/ Night Shift) ($p = 0.004$), while Phone Use (w/ Night Shift) ended up being slightly lower than Phone Use (w/o Night Shift). Also, only the REM sleep percentages for No Phone Use were significantly higher than just Phone Use (w/o Night Shift) ($p = 0.070$). In conclusion, eliminating electronic device use before bed improved both sleep quality and REM sleep, while using Night Shift on one's iOS device before bed does not significantly impact sleep quality and REM sleep.

THE EFFECT OF SUBLIMINAL MESSAGING ON A SIMPLE DECISION OF AN INDIVIDUAL.

Molly Caballero
Heathwood Hall Episcopal School

The purpose of this project is to show or illustrate how difficult/easy and effective/ineffective it is to use an unconscious visual stimuli in order to affect an individual's decision. The tests being performed are a control test, in which a group takes a survey without being shown a video, a subliminal messaging test in which a red rectangle subliminal message is shown and another subliminal messaging test in which a blue subliminal message is show. The hypothesis is that the implementation of a visual subliminal message into a video will affect the decision of the individual who watches it. The null hypothesis is that the implementation of a visual subliminal message into a video will not affect the decision or opinion of the individual who watches it.

THE DEVELOPMENT OF CREATIVE MINDS: A CASE STUDY OF TECHNOLOGY IN GSSM AND HSASNU STEM CLASSROOMS

Justin Cacal and Isabel Strinsky
South Carolina Governor's School for Science & Mathematics

This study was designed to show how technology is used to educate students at two residential high schools, one in Shanghai, China (HSASNU) and the other in Hartsville, South Carolina (GSSM). Specifically, HSASNU's STEM academy and GSSM's GoSciTech programs were studied. The goal was to learn how the exposure to technology would affect the Chinese students' STEM interest in both schools. It was hypothesized, prior to arriving in China, that technology use would be similar or the same to that of GSSM. Data was collected through explanatory mixed methods. Focus groups were held at HSASNU and GSSM with the Chinese students, interviews were conducted with STEM faculty members, and STEM classes and labs were observed. The data collected was then coded for present patterns and themes, including STEM interest and student opinion. This analysis showed that the STEM Academy was more student-based and included more learning technology in its curriculum than that of HSASNU's regular classes, however the STEM academy was also found to be in its development phase. GoSciTech was also found to utilize student-based learning approaches, but contrary to HSASNU teacher-based learning approaches were also equally utilized when pertaining to technology. Because GoSciTech has a formally defined curriculum, these findings can help faculty at GSSM aid in the future development of the STEM Academy.

OPTIMIZATION OF PAPER PRE-CREASING TO ENABLE REPRODUCIBLE FOLDING OF MIURA-ORI ORIGAMI STRUCTURES

Kollin Campbell
South Carolina Governor's School for Science & Mathematics

When folding origami structures, it is much easier to create a design when the paper has already been folded. This is because creases in the material allow it to be easily folded the same way it was initially. The process of pre-creasing is to create narrow, deep valleys in the desired media to help complete a complex step or fold. The GraphTec Cutting Plotter CE6000-40 is a device that moves a blade along a designated pathway, cutting patterns in the desired media. This can be used to make pre-creases by replacing the blade with an empty ballpoint pen. With the goal of consistently creating ideal pre-creases for making Miura-Ori structures, several variables were tested, specifically the cutting force the machine applies, how fast the pre-creases are made, the number of passes over the design, the size of the pen's ballpoint, and whether the media used was infiltrated with Ammonium metatungstate (AMT). To test each variable, cross-sections of the creases were measured to determine the depth of the crease and where the deepest point was located. After observing all the results, it was concluded that the ideal settings for making pre-creases are done with non-infiltrated media, the smallest ball diameter, a low speed, low number of passes, and a cut force near, but not greater than, 25. While pre-creases can be made using a higher cut force, the process often results in the machine ripping the media and would not be beneficial for mass production.

BIKE TO THE FUTURE: CONNECTION IS KEY

Shayla Carney and Camilla Aragon
South Carolina Governor's School for Science & Mathematics

The Bike to the Future group explored infrastructure in cities, particularly in Hartsville, South Carolina, and how it can be improved through changes to the streets to make it accessible for all kinds of transportation. I focused on ease of transportation for those travelling to and from school. In a lot of places, roads are mostly geared toward automobiles, but it is important to have road equality, so roads are accessible for not only automobiles, but also bicycles and pedestrians especially since many people in Hartsville do not have access to cars. We traveled to Greenville, South Carolina and Atlanta, Georgia to study infrastructure changes and see how they worked to integrate bicycle, pedestrian, and automobile traffic. We saw many great examples of road equity, especially on the campus of Georgia Tech. After rendering ideas of infrastructure that we could implement in Hartsville, we created sketches of additions we wanted to add to the streets and sent them to the city in order for them to get approved for temporary installment. Some of these sketches were made with the idea to make it safer for the students of GSSM when travelling around the city, since we cannot drive while at school. Adding these small and temporary infrastructure changes that we made to the city helped improved safety of those not traveling by motor vehicle, as we saw many people using our installments. It also increased driver awareness as we saw a trend in lower speeds by vehicles on the streets.

NOVEL STRATEGIES TO IMPROVE DELIVERY OF ANTICANCER DRUGS ACROSS THE BLOOD-BRAIN BARRIER TO TREAT GLIOBLASTOMA

Adriana Carter
Academic Magnet High School

Glioblastomas (GBM) are malignant WHO Grade IV brain tumors that are notorious for having a low median survival rate of 14.6 months when treated with chemotherapy and radiation. Drug delivery to GBM is inhibited by the blood-brain barrier (BBB), a selectively permeable membrane that is necessary to preserve homeostasis and prevent harmful toxins from entering the brain. Medications are often unable to treat brain tumors as a result of this hindrance, which may be one contributing factor to the low median survival rate of GBM. Currently, many different methods of drug delivery to help bypass the BBB have been researched, but each method has its drawbacks. This study observed the role of Alzet pumps as a potential novel treatment method to bypass the BBB. The research group used ten humanized mice models to test the effects of LCL-768 on GBM with

the use of Alzet pumps compared to a control group that only used the GB vehicle. Based on the data and observations from the use of Alzet pumps, the researcher was able to discover more about the relationship between GBM and the BBB. Alzet pumps also proved to be successful in allowing the drugs to bypass the BBB to treat GBM. In the future, the use of Alzet pumps in conjunction with LCL-768 could be tested with larger animal models and could eventually be taken to clinical trials to further test the effects of them as an efficient drug delivery strategy to improve the outlook of patients with GBM.

THE EFFECT OF DIFFERENT LEVELS OF CARBON DIOXIDE ON THE OXYGEN PRODUCTION OF *THALASSIA TESTUDINUM*

Jonathan Caruso
Spring Valley High School

Recent experiments have reported a drastic increase in CO_2 in the atmosphere over the past century. Future projections conclude that it will continue to rise over the next 50 years and on. This excess CO_2 sequesters into the seawater which leads to ocean acidification. This is a large problem to be faced in the near future where many plants may not withstand the increased effects. This experiment was led to determine what would become of the seagrass Thalassia testudinum in the future environment. Seagrass is the base of the food chain in the marine ecosystem as it provides food and shelter for larger organisms. 20 samples of seagrass were divided into 5 groups of 4. Each group was given a specified amount of CO_2, determined by projections of future CO_2 levels, besides the control group which was not given any CO_2. A week after adding the CO_2, dissolved oxygen samples were taken over 9 days to see how well the plants responded. The results gathered showed slightly higher oxygen levels that decreased slowly as the plants died. Assuming the CO_2 did raise the oxygen production, it may not have lasted very long until the CO_2 returned to its normal levels. Regardless, the tested null hypothesis that the seagrass would show increased levels of oxygen as more carbon dioxide was added failed to be rejected. The p value of 0.995 confidently shows that the statistics gathered were significant but the data does not support the tested hypothesis.

EXPLORING THE ROLE OF CIRCULATING MIR-134 IN BREAST CANCER RECURRENCE

Lauren Chen
Dutch Fork High School

MicroRNAs (miRNAs) are short sequences of RNA (about 22 nucleotides) that are involved in the regulation of gene expression. My previous study has identified the serum miR-134 as a new biomarkers to predict breast cancer recurrence after primary treatment. To further study the function of miR-134 in breast cancer progression, I transfected miR-134 into breast cancer and macrophage cells. I found that overexpression of miR-134 had no effect on tumor cell proliferation but induced macrophage phenotypic changes. Interestingly, the conditioned medium from miR-134 overexpressed macrophage cells promoted the growth of tumor cells. My results suggested that circulating miR-134 may promote tumor progression and recurrence by potentially mediating the interaction between tumor cells and immune cells.

THE TYPE 6 SECRETION SYSTEM AND ITS IMPACT ON GUT BACTERIA SURVIVAL

Juhwan Cho
South Carolina Governor's School for Science & Mathematics

By exploring the properties of bacteria within the guts of leeches, we can understand and infer the properties of similar human gut bacteria. For example, the Type VI Secretion System found in certain types of bacteria has a significant effect on the competition between cells in the gut microbiome. A species such as Aeromonas veronii with genes that code for a T6SS, a protein nanoweapon capable of injecting toxins into other cells, will be more likely to survive in an gut microbiome than a species without. To see the effects of this bioweapon in action, we extracted Aeromonas samples from the stomachs of leeches and sequenced their genomes. The sequenced genomes showed that if the genes that code for a T6SS are present, then biochemical tests in the form of killing and motility assays can be performed to see if the protein secretion system truly had an effect on a species' survival in its environment. The effects of this killing mechanism could possibly have medical applications as a form of antibiotic.

THE EFFECTS OF ACIDIFICATION OF SWINE WASTE ON BACTERIAL GROWTH

Kaitlyn Cimney
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A fundamental issue of keeping pigs on farms is the disposal and maintenance of their waste. Typically funneled into a lagoon by spraying the waste through slates in the pigs' quarters with water, this waste contains potentially harmful bacteria, including potentially antibiotic resistant strains. In addition to the risks of exposure, this waste is also used as fertilizer for food given to livestock. This waste is subjected to antibiotics, creating a dangerous selection for these antibiotic resistant traits. Based on research in European countries such as Denmark and Sweden, it was hypothesized that acidifying the waste could efficiently eliminate the bacteria. We attempted to determine the most effective pH and time of exposure for bacterial death. By adding sulfuric acid to liquified pig waste, we lowered the pH of the waste to pH 6, 4.5, 3, and 2. We collected samples zero, one, three, and twenty-four hours after acidification. For each experimental pH, we then incubated diluted samples on plates for approximately 24 hours. A pH of 2 resulted in the most bacteria death within three hours of acidification. The next step is to evaluate the cost of acidification for farmers based on the volume of their waste pond. This would enable the farmers to dispose

of the waste in a safer and more profitable way. It also benefits the consumer, since antibiotic resistance could potentially be avoided.

ASSESSING THE EFFECTS OF HEPARIN-COATED NANOPARTICLES AS A TREATMENT FOR RESTENOSIS

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Atherosclerosis which leads to coronary artery disease, is the leading cause of death in America and the current treatment is Percutaneous Coronary Intervention (PCI). PCI involves inserting a catheter into the blocked area of the artery and inflating a balloon or releasing a metal stent to keep the artery open. A major drawback of PCI is the occurrence of Restenosis, or re-narrowing, of the artery. A contributor to restenosis is proliferation and migration of Vascular Smooth Muscle Cells (VSMCs) into the arterial space following PCI. Previous studies have shown that Heparin (an anticoagulant) has a negative effect on VSMC proliferation. Therefore, it is theorized that targeted delivery of heparin-coated nanoparticles might minimize the effects of restenosis. The aim of this research is to test the cytotoxicity of various concentrations (0% to 50%) of heparin coated iron-oxide based nanoparticles on Human Umbilical Vein Endothelial Cells (HUVECs) for a period of twenty-four hours. A viability assay and an MTS assay were then performed to check for toxicity. The results of the viability assay did not show a statistically significant change in the number of live cells after treatment and the MTS assay showed an upward trend in HUVEC proliferation. These results indicate that the nanoparticles do not have a detrimental effect on the cells as compared to the control. Further investigation is underway to determine if these nanoparticles can be used as a viable treatment for restenosis.

THE EFFECT OF SALT CONCENTRATIONS ON MOSQUITO GROWTH

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The purpose of this project is to test the different concentrations of salt in still water and observe mosquito's growth. First the experimenter filled up the beakers with fresh water and then proceeded to put different concentrations of salt into the beakers. After that the experimenter placed about 30 mosquito larvae into the beakers with different amounts of salt concentrations. The Hypothesis was is if exposed to high concentrations of salt then it will negatively affect mosquito growth. The independent variable (IV) was the concentrations of salt and the dependent variable (DV) was the number of mosquitos growing without drawbacks. The results were that all the mosquitos from the water with zero salt survived while the mosquitos in the water with 0.5 teaspoons of salt all but 2 survived. With 1 teaspoon all but 6 survived and with 1.5 teaspoons all but 5 survived. In the water with 3 teaspoons of salt had only 16 survive while 14 died. The conclusion of this was that the data supported my hypothesis of when more salt was added the rate of mortality would increase as well. These results do support the hypothesis.

INVESTIGATION AND COMPARISON OF POPULAR WATER BOTTLE BRAND'S QUALITY OF WATER BEFORE AND AFTER HEATING

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The purpose of this study was to test the effect of heat on the water quality within disposable plastic water bottles and to compare popular brands. The starting hypothesis was that Dasani would have the best quality water before and after heating at 55 and 76.6 degrees Celsius. To test the quality of the water, a Baldwin Meadows water test kit was purchased, which allowed for the testing of 14 different qualities of water. These were total alkalinity, pH, total hardness, iron, copper, bromine, lead, nitrite, nitrate, total chlorine, free chlorine, cyanuric acid, fluoride, and carbonate. After the procedures were conducted, the data was recorded and analyzed for final conclusion. Before heating at 55 degrees Celsius, the brands with the most to the least number of chemicals in the ideal range was as follows:1. Deer Park 2. Food Lion 3. Aquafina 4. Dasani. After being heated at 55 degrees Celsius, they were then ranked as: 1. Deer Park 2. Dasani 3. Aquafina/Food Lion. Before being heated at 76.6 degrees Celsius, the order was: 1. Deer Park 2. Food Lion 3. Dasani 4. Aquafina. After being heated at 76.6 degrees Celsius, the order was the same except for the switch of Dasani to #4 and Aquafina to #3. Overall, it can be concluded that Deer Park and Food Lion generally have the most number of chemicals in ideal ranges before and after heating with Aquafina and Dasani almost always at the bottom of the list.

EFFECT OF ESTROGEN ON SKELETAL MUSCLE ANABOLIC SIGNALING IN THE APC MIN/+ MOUSE

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Skeletal muscle homeostasis involves the balance of skeletal muscle protein synthesis to degradation. Stimuli such as nutrition, insulin, and hormones regulate skeletal muscle anabolic signaling through the mTORC1 signaling axis and is dysregulated with disease. Cancer-induced cachexia is defined as unintentional muscle mass loss. The ApcMin/+ mouse is a model of cancer-induced cachexia and exhibits suppressed mTORC1 signaling. Previous have shown differential responses in cachexia's progression in the female Min mouse and could be attributed to ovarian function. Purpose: The purpose of this study is to examine the role of long-term estrogen on skeletal muscle anabolic signaling in the female Min mouse. Methods: B6 and ApcMin/+ mice were randomly allocated to SHAM or E2 treatments at 11 weeks. Mice were sacrificed at 18 weeks of age after a 5 hour fast and gastrocnemius muscle was used for protein analysis. Results: Body weight decreased in the ApcMin/+ mouse,

however Estrogen preserved body weight loss in the ApcMin/+ mouse. Similarly, gastrocnemius weight decreased in the ApcMin/+ mouse, and estrogen preserved muscle loss. Estrogen increased uterine weight in both mice. Estrogen suppressed ribosomal protein S6 activation while activation of eukaryotic elongation factor binding protein 1 was increased in the B6 mouse. In the ApcMin/+ mouse estrogen increased rpS6 and 4EBP1 activation. Conclusion: Long term estrogen rescued muscle mass in the female ApcMin/+ mouse. While long term estrogen suppressed anabolic signaling in the B6 mouse, estrogen improved anabolic signaling. Estrogen may be a potential therapeutic treatment for females when ovarian function is suppressed.

THE ROLE OF VITAMIN A IN SUPPORT OF VISION

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As humans age, many notice progressive deterioration in vision. This is because of photoreceptor cell death, specifically the rod and cone cells that make up the retina. These rods and cones are primarily made of vitamin A. Thus, vitamin A is important for vision. Since Vitamin A is inert, once it enters the body it must be transported to the eye so it can be used to maintain the structure of the retina and the photoreceptor cells within it. The deterioration in vision that humans experience while aging is brought upon by the shutdown of these Vitamin A cellular pathways in the systemic tissue (liver, intestine, etc.). Furthering our understanding of these pathways is key to preventing future vision problems brought on by aging. By conducting body-wide shutdown of the vitamin A pathways in Zebrafish models, it was found that the model quickly experienced severe vision loss, overall retinal distortion, and photoreceptor cell death. While Zebrafish are important to use as models because they were easier to develop, mice better mirror the effects this mutation would have on humans. In the mouse models, the shutdown mutation was isolated to different organs so that the location of the key pathways could be confirmed. As expected, the key pathways were located in the systemic tissue. This isolated mutation is also being used to determine if and where other pathways exist. Further research is currently being conducted on these possible alternative vitamin A pathways.

THE EFFECT OF CHEMOCHEMICAL DOXORUBICIN ON FEMALE OVARIAN FUNCTION AND FERTILITY

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Females are born with the total amount of ovarian eggs they will ever have, and their ovarian reserve at a given time dictates their fertility. However, there are many cancer treatments that can affect female fertility, although it is not known how long the effect lasts post treatment or how it occurs. This study was conducted to understand both the short-term and long-term effects of a common cancer drug, doxorubicin (DOX), on female fertility through the imaging of ovarian tissues. Injecting prepubescent mice with doxorubicin, collecting, and imaging their ovarian tissues at various times after the injection was the basis for this research project. Prepubescent mice were used, so that the hormone levels that change during the menstrual cycle were all at similar levels. The follicles of control mice -- which contain the oocytes (eggs) in the ovaries -- have granulosa cells that nourish the egg, but in the experimental mice, many of the granulosa cells of their follicles underwent cell death, leaving an abnormal cavity in the follicle. Although the research is currently ongoing, conclusions that can be drawn so far are that this particular cancer drug, doxorubicin, can affect female fertility in the short-term, if not permanently. Hopefully, with the supporting results of this investigation, women will have increased knowledge about cancer treatments using DOX prior treatment to so that they can choose between treatment options.

THE EFFECT OF THE CITY WASTEWATER TREATMENT PLANT ON WATER IN THE COLUMBIA AREA

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This experiment aimed to discern the effect of the wastewater treatment plant in Columbia, South Carolina on fecal coliform and E. coli counts after and without precipitation. E. coli was tested as it is a fecal coliform that serves as an indicator species, noting the existence of pathogenic organisms. Sites in close proximity to the river and sites up and downstream from the plant on the Congaree river were sampled after precipitation and without precipitation. Samples were bagged and refrigerated. Then 3m petrifilm plates were inoculated with 1 ml of each sample, incubated for 24 hours at 42° +1° celsius, and then read using the colony counter app. The results suggest that non-precipitation trials yielded higher E. coli counts. The location with the highest number of E. coli was the Heathwood wetland R (right). These results contradict previous findings that suggest that CFUs (colony forming units) should be highest after precipitation. The results suggest that a number of factors could have influenced the high count of the wetland that day: animal feces, wastewater runoff from the Metropolitan Wastewater Plant, etc. The results of 0 colonies in the post-plant water may have resulted because of the lack of flowing river accessibility and rain rates, as high rain rates can flush pollutants from an area. This study had many possible sources of error, as the incubator temperature may have been too high at 42° + 1° and there was no way to control the amount of rain for the post-precipitation trials, among others.

HISTOLOGICAL ANALYSIS OF THE OSTEOARTHRITIC KNEE JOINT IN DHGPS TREATED WITH MSCS

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Osteoarthritis (OA) results in the degradation of the joint, affecting the articular cartilage, subchondral bone, and surrounding synovium. OA affects nearly 34% of the world's population. Currently, no cure for OA exists considering treatment options only provide palliative care; therefore, it is desirable to investigate other regenerative strategies to mitigate the progression of this debilitating disease. The study objective was to investigate the therapeutic efficacy of human amnion derived stem cells (hAMSC) and adipose derived stem cells (hADSC) when intra-articularly injected in Dunkin Hartley Guinea Pig (DHGP) knees. A therapeutic treatment was injected into the left knee and a saline group was injected into the right knee of the DHGPs. The treatment options included Hyaluronic Acid (HA), HA+hAMSC, and HA+hADSC. After three injections over the span of six months, the knees were harvested for analysis. Twenty-four samples were formalin fixed in 10% formic acid and decalcified in Immunocal solution. The samples were then embedded in paraffin wax for sectioning. The microarchitecture of the knee tissue was analyzed using a universal histological grading scale provided by OARSI, in which increasing score represents further degradation of articular cartilage and proteoglycan content. Immunohistochemistry (IHC) was also performed to examine macrophage infiltration of the synovium using a mouse anti-guinea pig primary antibody accompanied with an anti-mouse IgG secondary antibody. Histological results showed that treatment groups had significantly lower scores than with their corresponding saline controls, ultimately showing that treatment with mesenchymal stem cell (MSC) sources may help to mitigate the progression of OA.

THE EFFECTS OF ASCORBIC ACID AND MELATONIN ON WHITE DRUPELET DISORDER IN "APACHE" BLACKBERRIES

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White drupelet disorder (WDD) is observed during the developmental phases of blackberries (*Rubus L.* subgenus *Rubus Watson*), appearing as patches of white, commonly flaccid drupelets on the fruit. This disorder poses a significant economic problem to farmers, as affected fruits are unmarketable. Several factors have been described to have a potential role in causing WDD, such as excessive light and high humidity. However, the involvement of anthocyanins has yet to be studied. Two plant-regulators, ascorbic acid and melatonin, were applied to fruiting blackberry plants over three weeks, the fruits of which were collected and analyzed for WDD, pH, abscisic acid (ABA) concentration, and anthocyanin content. Neither ascorbic acid nor melatonin had an effect on the incidence of WDD or statistical differences in pH, ABA concentration, and anthocyanin content.

GEOMETRIC ANALYSIS OF ASYMMETRICAL FAULT SYNTHESIS FOR THREE-PHASE TRANSFORMER CONNECTIONS USING COMPUTER SIMULATION

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Within a simulated grid environment various voltage and frequency conditions were applied to a device under test (DUT) to examine its performance. By using the Line to Line and Line to Neutral Voltages and transformer relationship equations, a derivation for the grid side voltage required to induce both a single and double phase sag on the DUT was produced. A total of 18 derivations were produced and subsequently used in a MATLAB/SIMULINK simulation to observe trends that appear in each transformer connection and type of sag. Trends that appeared in the data collected include but are not limited to the Vrms and phase angle changes from LL to LN voltages. These trends support the concept of three phase balanced sag and other preliminary models. Additionally, these trends allow for the classification of the transformer connections under both single and double phase fault conditions. This work allows for a better understanding of three-phase transformer connections and the characteristics of faults across them.

IDENTIFICATION OF NOVEL COMPOUNDS THAT INHIBIT GROWTH OF *PSEUDOMONAS AERUGINOSA* BY TARGETING PENICILLIN-BINDING PROTEIN 3 (PBP3)

Daphne Dang
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My project will be addressing antimicrobial resistance in *Pseudomonas aeruginosa*, geared toward the hit-identification and structure-activity relationships. The targets of my investigation are the penicillin-binding proteins, and its purpose is to circumvent known resistance mechanisms. I will be using a model developed in the lab to select and screen potential inhibitors of penicillin-binding protein 3. Then, I will be characterizing the potency of these compounds through a series of biochemical and microbiological techniques such as SDS-PAGE and ITC. The purpose of this experiment is to identify novel compounds that could serve as enzyme inhibitors of *Pseudomonas aeruginosa* through targeting Pencillin Binding Proteins (PBPs) With three assays that include three different test compounds from the pyrrolidinedione class, I will discover that these compounds will inhibit *Pseudomonas aeruginosa*. DMSO will serve as our negative control as it does not inhibit *P. aeruginosa*. Tested compounds exhibit antimicrobial activity at high concentrations. Using a model developed in the lab, several potential inhibitors of PBP3 were selected and screened. The potency of tested compounds as PBP3 inhibitors is promising and show marginal antimicrobial activity against Pseudomonas aeruginosa reference strain PA14.

ANALYZING THE EFFECT OF ADDITIVES ON SOAP'S BASE PH VALUE

British Das
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In this experiment, the effect that additives have on the pH of soap is examined, to see if it makes a significant difference that could potentially harm skin. The purpose of the procedure was to determine if it would be useful for homemade soap manufacturers, soapers, and help them to make safe products since they don't have any regulations. It could be unhealthy for the skin to have pH imbalances, so it is important for soap makers to have some knowledge of the pH of soap. The hypothesis stated that additives could have a significant effect(more than +/-1) on the pH value of soaps. The experiment was formatted using the additives and soap bases as the independent variables, and the dependent variables being the pH value of the solution. Avocado oil, sesame oil, and high fructose corn syrup was used as the additives, and for the soap base, Sodium Hydroxide(NaOH) was combined with olive oil. The solution was poured into separate beakers, and then the pH value of the soap base in that separate beaker was recorded, and the pH value of the additives separate from the beaker was recorded. The solutions were mixed and the pH value was recorded. This process was repeated times, with all the same measurements. The results of this experiment supported the hypothesis. This concluded that additives combined with soap have a potential to be create greater than a +/- 1.0 pH change.

THE HEART RATE OF *DAPHNIA MAGNA* WHEN EXPOSED TO ETHANOL AND RESVERATROL DURING DEVELOPMENT

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Alcohol is a teratogen that can affect a person's development in the womb. Resveratrol, found in wine, has been shown to help with cardiovascular diseases. The purpose of this study was to see the effect that the amount of alcohol had on heart rate as the *Daphnia magna* developed and if resveratrol could normalize that difference. It was hypothesized that as the amount of ethanol exposure increases, heart rate would decrease, and if resveratrol was introduced, then the heart rate would resemble control levels. This was done using *Daphnia magna* because of their transparent body that allows observation of the heart. Thirty *D. magna* were split into 4 levels, two of which were administered resveratrol. They were exposed to the solution for a total of 2 days, with heart rate observed and measured at 1, 24, and 48 hour marks. A repeated measures ANOVA was conducted to see if there was any interaction between time and treatment, and no interaction was found. This prompted a one-way ANOVA to compare the heart rate between the treatment, $[F(4,303)=1.02,\ p=0.399]$. This shows that there is no significant difference between heart rates. A steady increase in heart rate, however, was seen as time went on, and the mean heart rate was lower in treatments that included resveratrol. This shows that heart rate increases when exposed to ethanol for a long period of time, such as nine months, and resveratrol can lower that heart rate.

GRAPHICAL ANALYSIS OF THE EFFECT OF FLOW RATE ON COMPLEX FLUIDS

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A complex fluid is a substance whose physical characteristics depend on the organization of microscopic structures, which can be modified by external forces. Almost every fluid within the human body is classified as a complex fluid. Blood and mucus, for example, are essential in ridding the body of pathogens and debris. Investigating how flow rate affects the response of different complex fluids is a critical factor in the understanding of biological functions. In this project we analyze a new class of models designed to couple microstructural components with macroscopic responses.

AMBIENT AIR QUALITY OF "BLUE COLLAR" AND "WHITE COLLAR" WORK ENVIRONMENT

Paul Davis
Spring Valley High School

Previous studies have shown air quality of environments can pose health risks if there are high concentrations of particulate matter(PM) and formaldehyde. The purpose of this experiment was to test PM and formaldehyde levels in traditional blue and white collar work environments. It was hypothesized that the blue collar work environments would have the highest PM concentration, and the white collar work environments would have the higher concentration of formaldehyde. White collar measurements were taken in a guidance office and an insurance office. Blue collar measurements were taken in a woodshop work environment, and an automotive work environment. Measurements were taken by an EG Air Air Quality Pollution Monitor. Blue collar work environments had the higher levels of PM, while the white collar work environments had the highest formaldehyde concentrations. It was concluded that there were some unsafe levels of PM present, which could lead to adverse health effects. However, there were not any unsafe readings of formaldehyde at the sites recorded. Two sample t-tests were also conducted and showed significant difference between blue and white collar, PM $(t(43)= 6.61,\ p< 0.001)$ and formaldehyde $(t(81)= 4.88,\ p< 0.001)$ concentrations. According to the study, one would find more PM in traditional blue collar work environments, and more formaldehyde in traditional white collar environments.

AN OPTIMAL INFORMATION-THEORETIC DESIGN OF MYOELECTRIC PROSTHETIC UNDER BPSK MODULATION

Sparsho De
Spring Valley High School

Myoelectric prosthetics are a relatively modern technology where hand movements are determined by electrical signals sent my muscles in the upper arm. While extremely promising, little progress has been made in the way of efficiency. The goal of this experiment was to determine whether Reed Solomon or Hadamard error correcting codes were more efficient at reducing errors caused during the functioning of a 20-state myoelectric prosthetic. It was hypothesized that Reed Solomon codes would perform better than Hadamard codes because of less excessive usage of checksum bits in a channel with relatively low noise. Each of the 20 states of the prosthetic were assigned a binary representation based on frequency using Huffman Compression. Mathematica was then used to simulate the effect errors had on the number of bits necessary for accurate transmission within the AWGN channel. Errors were given a binomial distribution, with variance related to entropy of the system and mean directly related to the bit error rate. Data is presented as mathematical truth, and there are no significance tests. It was determined that the hypothesis was correct. Reed Solomon codes were more efficient than Hadamard codes at all signal to noise ratios (SNR). Their efficiency, in comparison to the Hadamard codes, improved as SNR increased. The control also proved more efficient than Hadamard codes after SNR exceeded 0.4. In particular, if a crude myoelectric prosthetic were used, it would be prudent to use Reed Solomon codes rather than Hadamard codes are none at all.

CLONING THE DRM2 GENE IN ARABIDOPSIS THALIANA FOR FURTHER RESEARCH IN PLANT PATHOGENIC DEFENSE

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Genes have a variety of functions, the most important being the encoding of proteins. The proteins encoded by some of these genes silence others and stop them from functioning. In plants, specifically *Arabidopsis thaliana*, a process called DNA methylation turns off specific genes through the activity of a protein encoded by the DRM2 gene. However, the DRM2 gene could be attacked by a pathogen, which can allow the pathogen to bypass the natural cellular defenses. DRM2 needs to be cloned in order to gain more knowledge and understanding of its processes in *Arabidopsis thaliana*. By cloning the gene, we will be able to see how it interacts with other plant defense genes and with other pathogens themselves by inserting it into yeast and looking at the interactions between other proteins in the yeast before examining them inside of the plant. The DNA that was suspected to contain DRM2 was replicated through PCR, expressed in gel electrophoresis and then extracted from the agarose gel. The DNA was transformed into *E. coli*, and then plated for growth. The DNA plasmids were then extracted from the bacteria, replicated, and visualized once more. DRM2 was successfully cloned as shown by the final gel electrophoresis as the plasmids were at the target sequence length. Now that the gene is cloned, it will be used for further research in *Arabidopsis thaliana's* defense against pathogens by observing protein interactions in the yeast, and eventually transgenic *Arabidopsis thaliana* plants.

THE EFFECT OF WHEY AND PLANT PROTEIN POWDER ON THE TOTAL GROWTH OF WORMS

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The goal of the experiment was to see which protein caused the worm to grow to an overall larger mass. The hypothesis of the experiment was that the plant protein powder will make the worms grow at a faster rate compared to the whey protein powder. The experiment was started with putting dirt into buckets. The total mass in grams of each set of worms that was being testing was measured on the mass scale. Three worms were measured at a time on the mass scale. The sets of worms were placed into buckets that had dirt and water. For buckets one and two there was ten grams of whey protein and fruit scraps put into the container. For buckets three and four ten grams of plant based protein,and fruit scraps was added. For buckets five and six there was fruit scraps, water and dirt. At the end of one week, the mass of the worms was measured by putting the sets of worms on the mass scale. The mass of each set of worms was measured in grams. The average growth after being fed plant based protein was 1.085 grams. The average growth after being whey protein powder was 0.4 grams and the average growth after being fed fruit scraps was 0.36 grams. The conclusion of the experiment was that the plant protein powder made the worms grow at a faster rate.

AGE-RELATED CHANGES IN MYELINATION OF THE MOUSE AUDITORY NERVE

Robert Dullanty
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My research was to determine whether there was a correlation between myelination of the mouse auditory nerve and the age of the mouse. To do this, the myelin thickness, axon diameter, and g ratio (the ratio of the axon diameter with and without myelin) of axons in the auditory nerve of young and aged mice were measured. To find these measurements, the cochlea of mice from control groups in previous experiments were photographed under an electron microscope, and then these photographs were analyzed using an Image J plugin called G ratio. The results of this study indicate that the aged mice have more myelinated axons in their auditory nerve than young mice. Although, the current sample size is low. These results imply that demyelination is not the cause of presbycusis. They also provide several new questions to explore: What causes the increase in myelination, and what are the effects of this increase?

THE POTENTIAL EFFICACY OF TARGETED GOLD NANOPARTICLES IN THE MICRO-CT IMAGING OF LN229 HUMAN GLIOBLASTOMA CELLS

Rachel Eisenhart
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Human glioblastoma multiforme (GBM) is one of the most aggressive and lethal forms of brain cancer, with a patient survival rate of only 12 months post-diagnosis. Detection of GBM in humans is a challenge due the location and histopathology of the tumor and imaging is also a difficulty for the same reasons. Imaging GBM tumors using computer tomography (CT) is low cost and highly accessible, but samples must reach a minimum target density in order to be visible on the scan. Potentially, however, these challenges can be overcome utilizing AuNPs as a contrast agent. The aim of this research is to gauge the plausibility of using AuNPs as a contrast agent in LN229 GBM cells and using the available data on AuNPs and data collected from a 2D microscopic image of an LN229 sample. Although the research done was very preliminary, the calculations indicate that from a mathematical standpoint, achieving target density via AuNPs is more than possible.

DEVELOPING A PCR-BASED SNP GENOTYPING METHOD FOR THE TOMATO SELF-PRUNING GENE

Melinda Elser
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Tomato farmers often prefer determinate tomatoes, as they are easier to harvest because of their compact size and their limited fruit production. Unlike determinate tomatoes, indeterminate tomato plants are much larger and can keep growing tomatoes until the plants die. A single-nucleotide morphism (SNP) at the self-pruning gene can cause an amino acid change which affects whether the tomato is indeterminate or determinate. To molecularly distinguish between the two types of tomato growth patterns, I designed two reverse primers that only annealed to either determinate or indeterminate DNA. To test these primers, a gradient PCR process was used that starts at 65°C and decreases by 0.5 degrees for six rounds and 24 cycles. After success with the gradient PCR, an optimum annealing temperature of 62° was identified. To refine any false bands that may have appeared, a touchdown PCR was used. We were able to visually distinguish indeterminate from determinate DNA on an agarose gel. Bands appear on indeterminate DNA only when it has C-reverse primers and on determinate DNA when it has the T-reverse primers. Multiple DNA concentrations were also tested other than 10 ng/µl of DNA. We tested 5 and 20 ng/µl successfully. When breeders cross pollinate an indeterminate and determinate plant, they will be able to tell what the growth pattern will be before the plant grows to maturity. This is helpful to people who only want to grow certain growth patterns.

THE EFFECT OF ACIDIC LEMON, GINGER, PEPPERMINT, AND VINEGAR EXTRACTS ON THE RELATIVE RATE OF REPELLENCY OF *CULEX PIPIENS*

Christine Encarnacion
Spring Valley High School

Mosquito populations are increasing, allowing malaria and other diseases to affect more people around the world. Since these diseases are becoming a major epidemic, research has been conducted to find an effective repellent. The problem then is whether people can afford the high-end repellents researchers have created. This research, therefore, focuses on finding an affordable-yet-effective repellent to steer away mosquitoes. Cheaper, pharmaceutical extracts with a lower pH have been found to work in repelling mosquitoes (Giatropoulos et al., 2018). In this experiment, lemon, peppermint, ginger, and vinegar extracts were used and it was hypothesized that the lemon extract would be most effective in repelling mosquitoes since it had the lowest pH (pH of 2.3). This experiment placed 10 mosquitoes in a mosquito chamber and used lemon, peppermint, ginger, and vinegar to find each respective rate of repellency. There was a total of 25 trials with 5 test for each independent variable and the controlled group, test with no extracts. The lemon extract was concluded to have the highest rate of repellency at 96% and ginger extract had the lowest at 74%. An ANOVA test was performed for each repellent; $F(4,20)=115.18$, $p<0.001$ (lower than the alpha-value 0.05) to compare the controlled group with the lemon, peppermint, ginger, and vinegar extracts. A post-hoc Tukey test was also conducted to find the significant differences between each extract, which rejected the null hypothesis. Between the four repellents, the lemon extract had the highest rate of repellency.

SYNTHESIS OF NANOPARTICLES FOR BIOMEDICAL APPLICATIONS

John Estock
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Crystalline materials are largely used in a variety of applications such as catalysis, nuclear detection, lasers and even biomedical applications when prepared in the nanoscale. Optogenetics, involves using light to control neuronal firing. Scintillating nanoparticles that can be modified with targeting ligands to attach to a target opsin which can be activated by a low dose of X-ray radiation, eliminates the need for fiber optic waveguides or light emitting diodes implanted deep within the brain structure which reduces the probability of failure as the surgery used to implant the cables into the brain causing damage to brain tissue. In this study, Cerium doped Lutetium silicate nanoparticles are being developed using a facile core-shell coating procedure for this application. The nanoparticles were successfully synthesized in batches of greater sizes than previous experiments, previously only small scale batches were synthesized to understand the correct ratios of metals to obtain the correct properties. Future work on this project includes doping the nanoparticles with metals other than Cerium.

GENETICALLY MODIFYING RICE TO FIGHT IRON DEFICIENCIES

Rachel Faris
Center for Advanced Technical Studies

In an effort to eliminate or lessen the effects of iron deficiencies, there will be research on genetic modification of rice to contain a greater amount of iron that the human body can actively absorb. Iron deficiencies are the most common micronutrient deficiency in the world, especially among third world and developing countries, which is where this modified rice would be most applicable. The hypothesis is that if genetic modification of rice occurs, the body will be able to uptake more iron and be less prone to iron deficiencies. The plan is to research iron, rice varieties, said rice varieties' genomes, other potential plants that the iron gene(s) could come from and their genomes, methods of genetic modification down to exact steps and what all would be needed, and then if time and availability to resources permits, attempt the actual modification of rice. It is unlikely that the research will get to the actual genetic modification, but the project will at least get through all of the initial research needed to do so. However, if the research were to get to the point of genetic modification of rice, doing the process of modification is all that would happen, not researching the outcome as the best way to do so would be to grow the modified rice plant. Due to time constraints, there will not be a fast enough way to be able to test the modified plants, but hopefully that will be possible in later years.

ANALYZING THE ROLE OF THE GLYCOCALYX IN WHOLE-CELL MECHANICS USING ATOMIC FORCE MICROSCOPY

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The glycocalyx is a layer of proteoglycans, glycolipids, integral proteins, etc. surrounding all animal cells. This layer plays a role in almost every cellular process and function, from cell communication to maintaining a viable concentration gradient. While its physical presence and function has been studied, its role in cell mechanics has yet to be established. The hypothesis of this research is that the absence of the glycocalyx can have a detrimental effect on cell mechanics. In this study, the apparent elastic modulus of endothelial cells (HUVEC), breast cancer cells (MCF-7), and vascular smooth muscle cells (VSMCs) was measured using Atomic Force Microscopy (AFM) before and after their glycocalyces were degraded. Elastic modulus is the resistance of cells to displacement, and this was calculated by recording the force that the cells exhibited when indented by the AFM cantilever mechanism. Following the control measurement, an enzyme solution comprised of chondroitinase and heparatinase at a concentration of 0.2 U/mL. was applied to the cells in order to degrade their glycocalyces, and the cells were indented once more. The results from the AFM were interpreted with a MATLAB program to determine the cells' average apparent elastic modulus. The data showed that glycocalyx degradation decreased the elastic modulus measurement of all cell types by a range from 20-50% which confirmed the hypothesis. With this research, a more accurate model of the cell can be determined for future studies, as well as open doors for new solutions in tissue engineering and regenerative medicine.

THE EFFECT OF BIOCHAR AND *RHIZOBIUM LEGUMINOSARUM* ON THE GROWTH RATES OF *ERUCA SATIVA* AND SOIL NITRATE AND PHOSPHORUS LEVELS IN SUBOPTIMAL SOIL

Ridha Fatima
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Biochar's nutrient retention paired with rhizobacteria's nitrogen-fixation may improve the quality of soils throughout the US. This study's purpose was to test whether the combination of biochar and *Rhizobium leguminosarum* would lead to healthier soils and greater plant growth in poor soils. It was hypothesized that combined additions of biochar and *Rhizobium leguminosarum* in suboptimum soils would lead to greater soil nitrates and phosphorus and higher *Eruca sativa* growth rates than separate or no introductions. The experiment was first split into four groups, each with fifteen trials: Control, Biochar, Rhizobacteria, and Combined. Biochar or *Rhizobium leguminosarum* was added to each applicable trial, and *Eruca sativa* seeds were planted and stem lengths measured every other day over 16 days. Soil nitrates and phosphorus were tested before and after experimentation. The ANOVA[$F(3, 305)=9.92$, $p<0.001<a=0.05$] results showed significant differences between treatments. A Tukey test and boxplot revealed that Control and Biochar groups had longer stem lengths than Rhizobacteria or Combined, but no significant differences between Control versus Biochar or Rhizobacteria versus Combined. Survivorship curves exhibited lower death rates in the Biochar than Control. Overall, the data show that Biochar grew best, followed by Control, then Rhizobacteria and Combined. Soil nitrates were uniform between all groups, and phosphorus levels were highest in Biochar and Rhizobacteria. The results do not support the hypothesis, as the Combined group did not exhibit the highest growth rates or soil nutrients. However, they partially indicate biochar's remediation in poor soils.

THE MENTAL HEALTH OF TRANSGENDER YOUTH IN COMPARISON TO CISGENDER YOUTH

Mary Fern
Heathwood Hall Episcopal School

The problem that is being addressed in this study is the effect that being transgender has on mental health. Being transgender is not a choice. This study is set up to bring attention to that and the people who are inadvertently hurt by ignorance and hate. This project was executed anonymously through an online survey by way of Instagram. Fifteen responses were collected, nine men, three women, and three non-binary individuals. As the data was being processed there appeared to be a correlation

between the amount of dysphoria and the gender of the person answering the question. Non-binary people and women had, on average, less dysphoria when the men did. If transgender people are misgendered it then their mental health will severely decline. The hypothesis was supported with the data collected during the experiment.

NEONATAL OPIOID WITHDRAWAL CARE IN SOUTH CAROLINA: STANDARDS OF CARE IN SELECT HOSPITALS

Jenna Flake
South Carolina Governor's School for Science & Mathematics

Neonatal opioid withdrawal syndrome (NOWS) has become a rising issue in the nation in the past six years and has increased fivefold since 2012. NOWS is caused when pregnant mothers use opioids during the gestational period. Without any established protocol to be followed it is hard to make sure that babies diagnosed with NOWS are receiving the best line of treatment (Grim, K., Harrison, T. E., & Wilder, R. T. (2013)).The purpose of this study is to investigate what treatment methods and protocols hospitals use in the state of South Carolina. Six hospitals were chosen to participate in this study due to their association with TRANSFORM SC, a collaborative pediatric clinical trials network associated with the USC School of Medicine and Palmetto Health. A REDCap survey was created to capture information such as whether or not a protocol has been established and what pharmacological and non-pharmacological treatments are recommended at each hospital. Data collection is still ongoing but once complete, protocols and treatments will be compared in order to determine how South Carolina identifies and treats infants with NOWS. Future studies will expand participation to every hospital in the state with a neonatal population and then hopefully expand nationwide. This study is the first step to better understanding the most beneficial and effective treatment for NOWS in order to one day establish an evidence-based treatment protocol.

THE EFFECT OF LEARNING TO PLAY A MUSICAL INSTRUMENT ON CREATIVE ABILITY IN MIDDLE SCHOOL STUDENTS

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Through many previous studies, it has been found that practicing music, particularly playing an instrument, has significant positive effects on cognitive abilities, including working memory and processing speed. However, the effects of music training on creativity are uncertain from the current literature, likely because of the ambiguity of the term creativity. This research looks to determine whether or not the process of learning to play an instrument has any significant effect on creative ability in middle school students through a pre-test / post-test method, using a combination of the Wallach-Kogan (W-K) Creativity Test and the Guilford Alternative Uses Task. The tests will be administered surrounding a 6 week treatment period (band class). The population includes 270 students in grades 5-6 with a mean age of 11.2 years. 140 students are enrolled in band class, making up the treatment group, as they are learning to play instruments. 130 students are enrolled in general music, making up the control group, as they are not learning to play instruments. The results of a paired t-test and a Wilcoxon signed-rank test do not show any statistically significant results at the 25% significance level. The conclusion of the present research, therefore, is that a 6 week period of training on a new musical instrument does not have a significant effect on the creative ability of middle school students as measured by the W-K Creativity Test and Guilford Alternative Uses Task.

THE WALKABOUT

Kayla Frady
Center for Advanced Technical Studies

The goal of The WalkAbout is a full weight-bearing leg brace that is designed to replace crutches. It's design consists of five leg cuffs with foam in the interior for comfort, two aluminum rods and a plate for support, and Velcro and pins for stability. The purpose of the brace is to replace crutches in lower extremity injuries due to crutches causing nearly 70,000 falls and injuries every year while also causing some paralysis of the arms due to improper use. The WalkAbout will be successful if it completely takes weight off the injured leg and is easy to move around in.

REMOTE ISCHEMIC CONDITIONING (RIC) IMPROVES NEUROBEHAVIORAL OUTCOMES AND CEREBRAL BLOOD FLOW IN A MICE MODEL OF TRAUMATIC BRAIN INJURY

Abigail Fralick
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Traumatic Brain Injury (TBI) is a major health issue that causes death and disability in many patients worldwide. However, there are extremely limited treatment options. Remote limb Ischemic Conditioning (RIC) is the simple, inexpensive, and safe use of repetitive inflation of a blood pressure cuff on a limb to protect distant organs from ischemic injury. Previous research has shown RIC to be protective after experimental focal cerebral ischemia and stroke. The hypothesis of this research is that RIC is a safe and effective therapy to improve functional outcomes after TBI. A group of 12 adult male mice (strain C57) received a craniotomy and a 3mm impact to mimic a moderate TBI. The control group included four mice which underwent the same surgical procedures, but no impact. Of the 16 mice, eight received RIC-therapy, while eight received a sham-treatment. These methods were repeated once daily starting 1-hour post-TBI. The effect of RIC on Cerebral Blood Flow (CBF) was measured using laser speckled imaging 1-5 days after TBI. Behavioral tests were used to measure anxiety levels by tracking time spent in an open field. The results of the laser speckled imaging shows that RIC significantly improves CBF. Concurrently, Open Field

data shows that RIC treated mice have significantly lowers anxiety levels at 5-days post-TBI when compared to control mice. Therefore, it can be concluded that RIC is a cost effective, safe, effective treatment which improves outcomes in male mice post-TBI. The next step is to test this protocol in clinical trials.

POCKOY: WHAT SHELL RINGS CAN SAY ABOUT CULTURES OF THE PAST

Eugenia Fulcher
South Carolina Governor's School for Science & Mathematics

Shell rings are a subset of Native American Architecture that are not widely recognized. They represent a transition between migratory and sedentary cultures because they are early signs of permanent habitation, social structure, and large, interacting populations. Pockoy is a shell ring that was uncovered by Hurricane Matthew and coastal erosion. It was excavated in spring 2018 and is currently undergoing analysis. Study of one section reveals abundant faunal remains, as well as shell and bone tools and early evidence of pottery. The pottery was washed and sized according to DAACS standards. Periwinkles, cockles, and oyster were found en masse, as well as remains of fish, deer, turtle, crab, and sawfish. The whelks excavated showed evidence of use as axe heads and drills, as well as bone pins that could have been used to hold hair or clothing, or as part of a fish hook. The pottery found was either plain or decorated with a shell punctate method. Faunal and botanical remains have not been analyzed outside of shellfish. An unusual amount of shell beads were also found.

IMPLEMENTATION OF CYBERSECURITY WITHIN MARINE CORPS LAV-C2 SYSTEMS

Brianna Fuller
South Carolina Governor's School for Science & Mathematics

In today's world, nearly everything is connected to computers or the internet, so there is a necessity to make sure everything is secure. This is especially true within the military or government, where every system is important to protect both the lives of our soldiers and civilians. I was able to help with this endeavor by creating Risk Management Framework (RMF) documentation and Powershell scripts to aid in the increase of security within Marine Corps Light Armored Vehicles Command and Control (LAV-C2) systems. For the RMF documentation, we took existing records of necessary security levels and created new documents filled with security controls to be used from now on during the project, as well as a template for future changes or additions. In addition, we created Powershell scripts to aid in speeding up the testing phases of the project, which will increase the time available to develop new security advancements. Both the RMF documents and the Powershell scripts will help in future advancements and activities within the LAV-C2 project and will serve as a basis for if security researchers find something else that needs to be changed.

THE HISTORY OF LORDS PROPRIETORS' SEAL RECOVERED FROM NORTH CHARLESTON "DEAD HOUSE"

Randi Gamble
South Carolina Governor's School for Science & Mathematics

A Lords Proprietors' seal was found on a building called "Dead House" in North Charleston. The origin of the seal and the purpose of the Dead House is unknown, and many questions. This seal is significant because if the seal is from the Proprietors' period, then it could be the oldest artifact in the city of North Charleston. Historical research was performed, using property titles and the history of the Lords Proprietors through their founding documents and other online resources. In addition, chemical techniques were used to determine the composition of the building and seal. Through analysis of the documents and data, this project suggests that the "Dead House" was a gunpowder magazine built around the time of the Revolutionary War by Sir Edgerton Leigh, a loyalist. To display that the magazine was only for loyalists, he may have put the Lords Proprietors' seal on the building. Thus, the artifact may not be the oldest in North Charleston, but it is old enough to hold historical significance.

THE EFFECT OF A *EUCALYPTUS GLOBULUS* BIOLARVICIDE ON THE GROWTH RATE OF A NON-TARGET ORGANISM, *CHLORELLA VULGARIS*

Josephine Gardiner
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The purpose of this experiment was to test the potential effect on the environment a *Eucalyptus globulus* biolarvicide would create. This was done by testing it on a non-target organism, *Chlorella vulgaris*, which is essential to the ecosystem. It was hypothesized that as the concentration of the *Eucalyptus globulus* biolarvicide was increased, the growth rate of the *Chlorella vulgaris* would decrease. To test this hypothesis, Chlorella was added to 125 test tubes. The various concentrations of larvicide (1.24g/500mL, 0.62g/500mL, 0.31g/500mL, 0.17g/500mL, 0.00g/500mL) were poured into these test tubes. Then, a spectrophotometer was used to get a relative cell concentration value for each trial. Once this was completed, the algae was left for 72 hours, after which the concentration was measured again. The initial and final concentrations were compared to determine algae growth. The highest average growth was seen in the 0.31g/500mL group, and the lowest average in the 0.15g/500mL group. Additionally, an ANOVA gave a P-value of 0.314, which is greater than an alpha value of 0.05, indicating that there were little differences among treatment groups. The data suggests that the biolarvicide did not affect the growth of the algae, and that the slight differences in growth between treatment groups were due to random external factors. Therefore,

the concentrations of *Eucalyptus* used in this study could be used as a larvicide without harming *Chlorella vulgaris*, an algae which is essential to the food chain.

EFFECTS OF RIPARIAN VEGETATION AND LOCAL HABITAT QUALITY ON THE DIVERSITY AND ABUNDANCE OF FISH IN PIEDMONT STREAMS OF SOUTH CAROLINA

Joshua Geden and Grace Park
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Prior research on rural Piedmont streams in South Carolina suggests that watershed level land cover does not explain differences in fish diversity or abundance among different streams. However, observations at these sites suggest significant differences in the riparian zone over small spatial scales along the same stream. Due to the high mobility of fish, it is possible that they can choose more favorable stream reach habitats at this smaller spatial scale, explaining why fish abundance and diversity are poorly correlated with watershed level land cover. Therefore, the focus of our research has been to study the ways in which local riparian vegetation and local habitat quality impact fish populations in streams. We predict that higher density of riparian vegetation along the stream will correlate with a greater abundance and diversity of local fish populations. To test this hypothesis, we sampled each stream at two adjacent stream reaches with different riparian cover. Within each stream reach we measured channel geomorphology and instream canopy cover, collected fish and sediment, and characterized the riparian zone next to the stream by measuring percent ground cover, canopy cover, and the number of trees and shrubs above 4.5 feet at six random points. Our results show that Simpson's diversity is negatively correlated with percent ground cover and percent forest in the watershed. We also found that Simpson's diversity is positively correlated with percent grass and pasture in the watershed, average mean sediment size in phi, and entrenchment ratio.

INVESTIGATING THE MECHANICAL PROPERTIES AND FAILURE CHARACTERISTICS OF DENTAL ARCHWIRE

Austin Geer
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Ceramic braces are typically chosen by people who are looking to conceal the fact that they are wearing braces. Unfortunately, the metal archwires stand out in contrast to the ceramic brackets. Researchers have begun looking for an alternative to the metal archwires. Some possible alternatives include polymer, metal coated, and Optiflex archwires. The current study investigated the material properties of alternative dental archwire materials. Testing was performed on the selected materials to determine bending stiffness, ultimate tensile strength, toughness, and modulus of elasticity. The properties of the alternative archwire materials were compared to those of standard archwire materials tested under the same conditions including Titanium and Steel. In addition, electron microscopy was employed to reveal surface characteristics of these materials such as Silicone, Teflon, and Polytetrafluoroethylene. Coating the metals in silicone allowed for the force of the specimen to be absorbed, and for the specimen to still be held in place if fractured. The use of Teflon and Polytetrafluoroethylene gave a decrease in the speed in which our samples deformed. A particular coating was not found from this research, but it has brought about ideas for future research to achieve the overall goal.

THE EFFECT OF INFLUENCER'S GRADE LEVEL ON HIGH SCHOOL FRESHMAN MOVIE CHOICES

Robert Golden
Heathwood Hall Episcopal School

The purpose of this project was to find how many Freshman in high school's movie choices were influenced by other grade levels and which grade level had the most influence. This experiment was conducted by having four influencers, one from each grade fill out a form of their favorite movies.Then freshmen were asked to fill out a different form in which they started out with their own choices, and were then shown the influencers movies, increasing by lowest grade level of the influencer to the highest grade level, and were asked if they would like to make changes to their movie choices. Finally the amount of changes were measured to see which grade had the most influence. Upon analyzing the data the hypothesis was not supported by the data when Seniors caused the least amount of changes to the freshmen's choices. The results however did show the exact opposite that the closer the class of the influencer to the Freshman the more influence they had.

NOVEL APPROACH IN CREATING A BIMETALLIC METAL ORGANIC FRAMEWORK BY INCORPORATING RHODIUM INTO A COPPER BENZENE-1,3,5-TRICARBOXYLATE THIN FILM TO INCREASE CONDUCTIVITY

Vamsi Gorrepati
Spring Valley High School

Metal-Organic Frameworks are crystalline structures that consist of metal ion clusters in the center with organic ligands. These structures are incredibly porous and hold promise for increasing the conductivity of chemiresistive sensors for gasses and for improving the potential in photovoltaic cells. Modifying MOF's modular framework with bimetallics utilize semiconductive properties to increase the efficiency of electron transfer. In this experiment rhodium was used a second metal to be incorporated into a Cu3(BTC)2 MOF. Various temperatures and times were tested to optimize the amount of rhodium incorporated into the MOF. X-ray photoelectron spectroscopy (XPS) was used to calculate ratio of rhodium to copper which determined percent rhodium incorporated on the MOF. Through analysis of the inferential statistics on rhodium incorporated, it was shown that the treatments were significant ($F(2,4)=45.98$, $p=0.017$), however, time ($F(5,4)=0.71$, $p=0.681$) was not significant. A tukey test,

showed that treatments 2 and 3 were significantly different than the control (treatment 1) as $p<0.05$. Though treatment 2 had a higher average rhodium percentage than treatment 3, a tukey test showed that there was no significant difference between the 3-2 as $p=0.294$. Based on the experimentation rhodium was successfully able to be integrated into the MOF structure forming a bimetallic CuRhBTC MOF.

THE EFFECT OF PERMANENT, SEMI-PERMANENT, AND TEMPORARY DYES ON THE TENSILE STRENGTH OF HAIR

Briana Gray
Spring Valley High School

The use of hair dye is becoming more prominent because of new trends and concealing white hair in older people. It has been known that excessive amounts of hair dye can cause damage to the hair, leading to an abundance of breakage. Testing to see if multiple applications of a weaker hair dye is less damaging than one or few permanent applications can benefit users from damaging their hair so drastically. The distinction between the damages of different types of hair dyes was determined in this study. It was hypothesized that the semi-permanent hair dye group would have the greatest average tensile strength after the coloration processes. Samples with semi-permanent, permanent, and temporary dyes were applied and tested for their tensile strength after the dye application. An ANOVA test was run, showing that the four means were statistically significantly different with a $p<.00001$ at a confidence level of 95%, $\alpha = 0.05$. However, the hypothesis that the semi-permanent hair dye group would have the highest average tensile strength, was not supported.

THE EFFECT OF NITROGEN STARVATION OF CHLORELLA SP. ON THE MASS OF THE PROTEOBACTERIA *SHEWANELLA ONEIDENSIS*

Pranav Guntupalli
Spring Valley High school

The impending depletion of nonrenewable energy sources has resulted in worldwide research for more productive renewable resources. Biofuels are an emerging source of energy that utilize the carbohydrates of biomass such as algae and palm trees. Environmental stress, such as prolonged lack of nutrients, increase the higher lipid contents of algae, which result in a higher biofuel productivity. This research was aimed at improving the growth of *Chlorella* sp. for purposes of biofuel production through algal based fuel cells. It was hypothesized that if nitrogen starvation was performed on the *Chlorella* sp., the mass of *Shewanella oneidensis* would increase. This was tested by culturing the *Chlorella* sp. in nitrogen sufficient and nitrogen sufficient medium. The biomass of the algae produced was fed to the *Shewanella oneidensis*. The mass of the bacteria was measured with an electronic balance. A one-way ANOVA $F(2,42)=48.29$, $p<0.001$, followed by a post-hoc Tukey test, was conducted to determine if there was a significant difference between the nitrogen starved, the nitrogen sufficient, and the control treatments. The hypothesis was supported with the results since there was a significant difference between the control and nitrogen starved treatments, as it produced a larger mass of *Shewanella oneidensis* than both the nitrogen sufficient and control groups. No significant difference was found between the nitrogen sufficient and the control treatments. The results of this study can improve the methods in which algal-based microbial fuel cells are used, making the energy produced from them more efficient.

THE EFFECT OF YEAST STRAIN ON BREAD WEIGHT AND ACIDITY

Callie Haddock
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The purpose of this experiment was to determine if yeast strain affected bread qualities. This was done by preparing bread with four kinds of yeast: *Saccharomyces cerevisiae, Saccharomyces banavus, Saccharomyces uvaruium,* and *Saccharomyces boulardii*. It was hypothesized that bread containing *S. cerevisiae* would have the lowest weight and highest pH. To test this hypothesis, bread was prepared four times, each with a different yeast strain, with 30 trials for each. Dough proofed for four hours and was then baked. After baking for 15 minutes the bread was removed from the oven and rested for five minutes. After resting, the bread was removed from the tin and mass was measured. Each piece of bread was then individually blended with 100 mL of water and pH was recorded using an electronic pH meter. The hypothesis was partially disproven. The bread containing *S. banavus* had the lowest weight. The bread containing *S. cerevisiae* had the highest pH. An ANOVA of the mass data showed significant differences between the average mass of the bread trials, with a p-value less than 0.0005. Post-hoc testing showed significant differences between all but the bread masses containing *S. cerevisiae* and *S. uvaruium* with a p-value of 0.08501. An ANOVA of the pH data showed significant differences between the average bread pH with a p-value less than 0.0005. Post-hoc testing showed significant differences comparing each average to the others. Further testing is required to determine optimal yeast to use when baking bread.

THE TRACING OF MESOTHELIAL-DERIVED CELLS

Brent Hadley
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The mesothelium is a layer of cells that surround the heart and multiple other organs that shows WT1 gene expression. My lab worked with WT1-Cre mice in order to trace the lineage of cells that are seen in the mesothelium at different embryo stages. My experiment observed the location that these cells existed and at what stage they were present. This experiment is necessary

to ensure that experiments in the future and the past are authentic by verifying that the WT1-Cre expression can be considered specific in the heart at specific time points and areas. Knowing the location of this expression in earlier stages can also help to explain the effects that genetic modification can have on the body's functions. The WT1 gene will be present in areas such as the liver and kidney at all the stages of the embryos in my case, E14.5, and E16.5, with constrictions of WT1 Cre+ that are associated with Rosa. This experiment involved the sectioning and staining of Cre+ mice embryos. They then went through a staining process which allowed us to view the presence of the desired genetic sequence. Once observing the locations of these genetic sequences, we determined the validity of the WT1-Cre expression specificity at different stages of the embryo.

GUIDED LAMB WAVE NONDESTRUCTIVE EVALUATION FOR METALLIC STRUCTURE INTEGRITY INSPECTION

Adam Hakimji
South Carolina Governor's School for Science & Mathematics

Nondestructive evaluation (NDE), also referred to as NDT (testing) or NDI (inspection), can utilize multiple methods in order to inspect the specimen including: guided wave testing, leak testing, radiographic testing, and several others. In this study, we utilized guided Lamb waves in order to detect discontinuities or imperfections in metallic structures that may not be visible or easily accessible. Common uses for NDE include: airplanes, piping, and railway tracks. Airplanes are good candidates for NDE because they are constantly subjected to high pressures which cause materials to form small imperfections. Using NDE, engineers are able to fix small issues before they grow into potential life threatening risks. In order to test metallic structures an ACT (air-coupled transducer), SLDV (scanning laser Doppler vibrometer), and a function generator were used. The ACT would excite 120 KHz tone bursts and the SLDV would scan for the propagating waves. With the resulting wave forms from the SLDV we were able to accurately detect a surface mounted quartz and a crack in a 1mm thick aluminum plate as well as approximate the most effective incident angle and distance of the ACT.

THE EFFECT OF VARIOUS BARRIERS ON SOIL ERODIBLITY

William Hale
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Soil erosion is a natural occurrence that, while commonplace, causes structural damage, soil loss, and incurs significant costs in prevention. The widespread nature of erosion has lead to a variety of methods for controlling erosion using different materials. Erosion barriers have unique properties that make some more useful than others depending upon how one wants to tackle the erosion. Barriers like textiles focus on catching everything including the water. This is inefficient however as the water build up often leads to ponding or overtopping. Prevention barriers also require strong materials, are less biodegradable, often too tall for animals like amphibians to get over, and generally cost more to protect a given area. Other barriers like hay bales or synthetic barriers are porous, allowing water to travel through but not soil, preventing ponding. Porous Barriers can also be too porous allowing soil erosion as the water moves. These barriers, while highly biodegradable, can also have adverse effects on ecosystems around them. Hay bales introduce and foster the growth of non native plant species. The ideal barrier would use a biodegradable container, filled with organic material that does not foster growth of non-native plant life, while still preventing erosion as good as the prevention barriers. Pine-straw, a naturally acidic leaf that retards growth on itself, does not contain germinating materials that introduce new plant life, is biodegradable, compressible, readily available, and is a viable alternative. To test this a nylon contained pine-straw barrier was made and tested in comparison to other barriers.

CLONING OF CANDIDATE GENES FROM SEASHORE *PASPALLUM*

Marissa Haller
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Drought and salt stresses have a negative impact on agricultural production. There is promising research on the molecular mechanisms of plant tolerance to drought and salt exposure in model species. For example, Uddin et al. (2012) reported using a non-model plant species with a high tolerance to both stresses. In this study, five seashore *Paspallum* genes (m11, m23, m26, m28 and m31) were chosen that were responsive to salt and drought conditions. The full-length seashore *paspallum* cDNA was cloned to evaluate the genes' effectiveness in the model species *Arabidopsis*. This gene could then be transferred into economically important crops via *Agrobacterium*-mediated plant transformation for future analysis. Five and three prime ends of the candidate genes were cloned and sequenced using RACE PCR, and the cDNAs were cloned from these sequences. In the future, the genes will be delivered into *Agrobacterium* via electroporation and transformed into *Arabidopsis* using floral dip approach. The transgenic plants will be tested to see if the overexpression of the candidate genes will positively impact the plant's response to abiotic and biotic stresses such as drought and salt.

THE EFFECT OF ENROLLMENT IN A MIDDLE SCHOOL MAGNET PROGRAM AND A STUDENT'S PERCEIVED STRESS AND AMOUNT OF SLEEP

Taylor Hamilton-Hankins
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Over the past few years, sleep deprivation and worsened physical and mental health in adolescents has become a common and alarming issue. With intensifying pressures to do well in school, academic magnet programs have garnered attention for their accelerated learning and curriculum. Though these programs are known for producing students better acclimated to certain

fields, it is often believed that academic strain on these students sometimes interferes with the two earlier stated factors. The purpose of this study was to determine if the effect of enrollment in a magnet program heightened perceived stress and/or contributed to lack of sleep. It was hypothesized that students in a middle school magnet program would on average get fewer hours of sleep and have higher scores for perceived stress than non-magnet students. To measure the sleep variable, students in grades 6-8 used a google form to record the amount of sleep received the night before. These students also completed a children's perceived stress scale questionnaire weekly in order to gauge stress levels. This procedure continued over the span of four weeks. The results for magnet and non-magnet students were compared for the 7th and 8th grades. A one-way ANOVA test was run to determine the effect of the program on sleep and perceived stress levels. It was concluded that the amount of sleep ($F(4,1421)=12.83$, $p<0.001$) was lower, while perceived stress levels ($F(4,198)=5.87$, $p<0.001$) were higher for magnet students than non-magnet students.

THE EFFECT OF ACID RAIN ON PLANT GROWTH

Nadine Hanna
Heathwood Hall Episcopal School

The purpose of this research was to test the effect that acid rain had on the growth of plants. With the use of Wisconsin Fast Plants(plants that take only 40 days for full growth) in four groups of 24 treated with the different pHs of sulfuric acid such as 4.2, 4.6, 5.6, and 7 in the time-span of the first 11 days of growth, measurements of the growth such as the height and amount of leaves of each plant were taken and put into graphs and data sets to observe the growth rate and effect of the plants. It was noticed that the plant groups with the pH's of 4.2 and 4.6, of higher acidity grew at a faster rate than the plants of lower acidity with the pHs of 5.6 and 7. Although plants bend in the direction of light, the plants of higher acidity bent more than the plants of lower acidity. Another effect noticed about the plants was the fact that the leaves of the highly acidic plants became frail and damaged into a grey color, whereas the leaves of the plants with the pHs of 5.6 and 7 were perfectly green and healthy. More plants in the highly acidic plant group died than in the lower acidic plant group. The conclusion came to be that acid rain didn't stunt the growth of the highly acidic plants, it really just affected the plants over time.

ANALYSIS OF THE IMPLEMENTATION OF BIOMATERIALS IN THE SURGICAL SCREW

Olivia Hardy
Center for Advanced Technical Studies

Earlier this year, I had a surgical screw placed in my left medial epicondyle. Although this did fix my broken bone, I began to experience mechanical pain and the screw started to feel foreign in my body which lead to discomfort. This led me to wonder if there was a way to have a screw that dissipated into the body after a certain period of time, secreting beneficial minerals into the bone emitting its biomaterial into the body, releasing nutrients, et cetera. I began my research through determining which biomaterials would be best fit and have certain qualities similar to bone such as tensile strength. This is why I narrowed down my materials to Collagen and Chitosan. I have made a three-dimensional mold using a surgical orthopedic screw and are in the process of filling this mold with an Acetic Acid and Chitosan solution. After I make Collagen and Chitosan screws, I will observe their rate or dissolving. My expected outcomes for this project are to analyze the rate of dissociation and reaction to bone Chitosan and Collagen has when placed into a bone-like substance, or polyurethane foam.

USING CONVOLUTIONAL NEURAL NETWORKS FOR THE AUTOMATED SCORING OF THE BENDER-GESTALT TEST II

Caitlin Harrington and William Ramsey
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This research was done as a way to simplify and improve the efficiency of the grading system of a widely used psychological test called the Bender-Gestalt test. The current hand-scored system of grading is subjective and inefficient, so we decided to come up with a way to use artificial intelligence to improve it. First, we created a data set of drawings from the test that we could use to train a network on. Then we created code for a convolutional neural network, which is used in image processing/ identification software, and fed it our data set. After it trained on the data, it came back with a 99% accuracy rating, meaning our project was highly successful. The next step would be to gain access to real data from the testing company and if our code is successful there too, we could sell our code to the company.

UNDERWATER CAMERA

Jacob Harrison
Center for Advanced Technical Studies

The purpose of this project is to raise awareness about the negative effects of ocean pollution. Currently, the only long term imaging system used to track the Pacific ocean "Garbage Patches" are satellites. If a camera is created that can follow the current path of the "garbage patch", more will be known about what is happening with ocean pollutants. The camera will send a picture to an attached device (phone, tablet or computer) every minute. These photos will show what is under the surface. Much like an iceberg, what's under the surface is much larger than what's above it. Marine biologist could use the data gathered to further experiment on ways to reduce ocean pollutants. The plan is to be able to supply constant power to a GoPro Hero 5. The camera will be powered via solar panel or Thermo Electric Generator. If the camera is powered via solar, the panel will

have to be created to withstand the salt water of the ocean. If powered via TEG, a heated side will be necessary. Both forms of power have many pro's and con's.

DETERMINING THE RELATIONSHIP BETWEEN AMOUNT OF BIOMASS, NUTRIENTS, AND SOIL GRAIN SIZE TO STRENGTH IN BIO-CEMENTED SIMULANT MARTIAN SOIL

Frankie Hawkesworth and Olivia Hilferty
South Carolina Governor's School for Science & Mathematics

NASA is looking into using biocementation to develop a method of creating the strongest possible cement on mars using Martian soil. Biocementation is a process of creating a biocement using naturally occurring microorganisms which, in the presence of urea and calcium carbonate, create a strong glue-like bind. The purpose of this research is to use simulant Martian soil in the biocementation process to develop the method which produces the strongest columns. This method will allow NASA to build structures directly on Mars in the 2030 Mars mission. The fairly new topic of Microbiologically induced calcium carbonate precipitation (MICP) and biocementation will hopefully be perfected enough to create an strong enough biocement. This project is a beginning to determine the combinations of soil grain size, amount of nutrients, and amount of biomass that creates the strongest columns. For this study, 27 combinations of the different variables were established with three columns made for each combination. The simulant Martian soil was separated in columns and biomass of urea and calcium carbonate (which activates the precipitation to create the glue) were pumped though repeatedly. Corresponding data helped to determined that the strongest columns were created with medium soil size, average nutrients, and large amounts of biomass. The uneven distribution of the biomass resulted in weaker columns because the area of the column with the least biomass became a weak spot to break first. These results will be used to continue the research for the strongest variables in biocementation using simulant Martian soil.

TIO2 NANOSTRUCTURES OBTAINED BY ANODIZATION FOR BIOMEDICAL APPLICATIONS

Doyle Hayden and Leighton O'Dell
South Carolina Governor's School for Science & Mathematics

Titanium and titanium alloy materials are commonly used in dental, orthopedic and craniofacial surgery. The primary reason that TI is widely used is its biocompatibility such as corrosion resistance and ability to withstand the harsh conditions within the human body. This study investigated the effects of anodization duration and voltage on the geometry of vertically oriented titanium dioxide (TiO2) nanotubes (NTs). In addition, the growth mechanism of vertically aligned TiO2 NTs was examined. The NTs were primarily grown in fluoride-based electrolyte solution, however the mechanism of formation of NTs in fluoride free solution as well as the effect of electrolyte pH on NT geometry was also be investigated. These TiO2 NTs have potential biomedical applications for orthopedic implants and drug delivery due to their semi-conductive nature, osseointegration, and antibacterial properties. Characterization of the TiO2 NTs was performed via scanning electron microscopy (SEM), x-ray diffraction (XRD) and Energy Dispersive Spectroscopy (EDX).

EFFECT OF MAGNESIUM IONS ON THIAMINE PYROPHOSPHATE'S (TPP) ABILITY TO STABILIZE THE CLOSED STATE OF THE TPP RIBOSWITCH

Elijah Hayes
South Carolina Governor's School for Science & Mathematics

Riboswitches are genetic switches in messenger RNA that regulate gene expression through mechanisms. These include ribosome binding site sequestration and premature transcription termination, in response to the presence of metabolites such as thiamine pyrophosphate (TPP). There is strong experimental evidence for a distinct energy landscape as the TPP Riboswitch folds and binds the TPP, and that magnesium plays an important role in the TPP-riboswitch interaction. However, the quantitative role played by the magnesium ion in stabilizing the riboswitch's closing pathway confirmation remains unknown. To quantify the role of magnesium in the TPP riboswitch operation, we performed single-molecule optical tweezer experiments to measure the folding and unfolding energy landscape in the presence of varying concentrations of magnesium. We made heterobifunctional DNA handles using PCR amplification that we will attach to the 5' and 3' ends the riboswitch. We ligated the handles with a linking DNA oligo and gel purified the product. By tethering one end of the ligated DNA handle to the coverslip and the other to a 1 μm diameter bead in the optical trap, we measured the stretching force-displacement curves of the DNA handles in the optical tweezer and found that the beads were becoming attached to multiple strands of DNA at once. In the future, we will be able to understand the effects of magnesium concentration on the riboswitch binding and following pathways, as well as the role of the TPP Riboswitch in gene regulation.

SOULAR 365: THE SUSTAINABLE PURIFICATION OF UNSANITARY WATER IN LESS DEVELOPED COUNTRIES

Laney Hayes
Chapin High School

Limited access to clean drinking water in less developed regions poses serious health issues for individuals without water sanitation services. Despite advances that provide ways to eliminate microorganisms from polluted water sources, 2.1 billion individuals lack access to safe drinking water services, meaning they are forced to acquire their own sources of hydration without regulations on water pollution and quality (WHO, 2017). A prevalent waterborne disease derived from this conundrum is

diarrhea, claiming the lives of 2,195 children around the world each day (Center for Disease Control and Prevention, 2015). A probable cause of this issue limited resource availability, as electrical power sources as well as necessary economic advances are not present in the least developed of countries. This experimental study investigates the ability of a cost-effective and sustainably-powered ultraviolet radiation water purification system to reduce populations of E. coli bacteria related to diarrheal illness in less developed countries. Turbidity will be employed as an explanatory variable in order to account for discrepancies of UV-C wave penetration in water with high particulate density, and an inferential statistics T-test will be used to assess if the degree of bacterial reduction is significant when compared to the original concentration of E. coli in the sample. The results of this study revealed a statistically significant reduction in Escherichia coli, supporting the potential of an inexpensive and sustainable water purification system to reduce waterborne illness in the less developed world.

STUDYING THE TRANSPORT RATE OF RHODAMINE 123 BY P-GLYCOPROTEIN

Esha Hegde
South Carolina Governor's School for Science & Mathematics

Alzheimer's disease is an illness that has taken hold of the lives of over 3 million Americans. This neurodegenerative disease causes affected individuals to experience a cognitive decline, and a lack of memory retention. The buildup of amyloid- ß protein in neuronal cells is a likely cause of Alzheimer's. While most research experiments concerning Alzheimer's disease focus on the more aggressive stages of the illness, the goal of this research was to increase the transport rate of amyloid- ß proteins out of the brain cells using P-glycoprotein. A buffered mixture of P-glycoprotein, ATP, and the fluorescent tag Rhodamine 123 was combined in a cuvette and analyzed by fluorometry. The goal was to find the ideal concentration of these substrates to maximize the stability of P-gp and ultimately increase the transport of amyloid- ß proteins out of brain cells. Unexpectedly a lower concentration of ATP (3.75 mm), with a constant concentration of Rhodamine 123, was most effective.

THE EFFECT OF GENDER ON PURCHASING HABITS AMONG ADOLESCENTS

Isabelle Herndon
Heathwood Hall Episcopal School

The purpose of this study was to determine the effect of the Pogonomyrmex ant species on chemical properties of Harvest Organic soil. There were four different levels of chemical elements being tested in the soil: nitrogen, phosphorus, potassium and pH. Hypothesis one states "if the Pogonomyrmex ant species live in Harvest Organic soil for a designated amount of time, then the ants will change the nutrient level (N, P, K, pH) in the soil." Hypothesis two states "if the Pogonomyrmex ant species live in Harvest Organic soil for a designated amount of time, then the ants will change the pH level in the soil." The null hypothesis states that there will be no change in the chemical properties of the soil after the Pogonomyrmex ant species have lived there. The Pogonomyrmex ants lived in a controlled environment for two weeks with Harvest Organic soil as the soil being tested. There were 20 ants per aquarium; there was 1000 mL of soil to ensure that each trial would contain an equal amount. The Harvest Organic soil will be tested around every three/four days. This experiment was run eight separate times. An inferential and descriptive statistical test was completed to test the mean and percent change of the data. All inferential analysis suggested that there was a statistically significant change in the different chemical levels of soil. Phosphorus had the highest percent change and potassium had the lowest. The mean for each trial was taken, then the overall mean for nitrogen, phosphorus, potassium and pH was gathered so that each variable had one mean. Therefore, the results supported the hypotheses. In conclusion the Pogonomyrmex ant species positively changed the differing chemical properties of the Harvest Organic soil.

OPTIMIZING THE USE OF HYDROTHERMAL CARBONIZATION IN LIVESTOCK DISPOSAL

Daniel Hilbourn
South Carolina Governor's School for Science & Mathematics

Improper disposal of livestock carcasses is one of the leading causes of antibiotic resistance. This is due to antibiotic resistant bacteria or plasmid DNA left behind after disposal. These carcasses can be sanitized, but not without great cost to farms. This study was carried out to optimize the cost effectiveness of one sanitation process, Hydrothermal Carbonization (HTC). Particularly, its effectiveness on Poultry. HTC was carried out at the USDA Agricultural Research Service located in Florence, SC. The optimization concerned minimizing temperature by compensating for it with a higher pressure. To test this, chicken bone and tissue were immersed in water and a Phosphate-Buffered Saline solution, respectively. They were then inoculated with E. coli. They were then put through HTC at 150°C and 200°C for 30 min, 60 min, and 240 min. This was done for both kinds of sample (Bone and Tissue). After HTC, the samples were tested for any lingering bacteria and Plasmid DNA. To test for bacteria, 4 LB Agar plates were inoculated with unfiltered liquid from each sample, with 2 at 10^0 dilution, and 2 at 101 dilution. To test for Plasmid DNA, three parts of each sample (Unfiltered Liquid, Filtered Liquid, Solid material) had DNA extraction performed on them, and that DNA was subsequently run through both the PCR process and Bioanalysis. No experimental runs were found to have any bacteria or DNA after being put through the HTC reactor. This study concluded that 150°C at 30 minutes was enough to ensure DNA denaturation.

OPTIMIZATION OF 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. And once the dual rotor design is found. It needs to be optimized. The purpose of the experiment is to find the optimal blade size ratio, as well as design of the blade itself. However before either of those could be achieved, since the hub rods will be spinning in opposite directions, testing had to be done to compensate for the criteria of the rotation of the system. The procedure involves choosing counter rotating, and non counter rotating blades. Then the blades are tested to see which set outputs the most power, in a given time period of 30 min over a set of 6 trials. Thus finding that the counter rotating blades were more effective for increasing the efficiency of the dual rotor system. These implications can be applied to blade design/material and size ratio to to improve the efficiency of the dual rotor turbine. Future work involving a single piece hub and blade assembly, with different materials is still to be done.

THE EFFECT OF THE GAMIFICATION OF SOFTWARE ON THE AMOUNT OF USER ENGAGEMENT IN SOCIAL MEDIA SOFTWARE IN HUMANS

Ethan Ho
Spring Valley High School

One growing addiction that has many effects on the world is the addiction to social media. This addiction exists in many people and comes with many dangers. The purpose of this study was to identify a way to reduce the amount of time spent on social media, more specifically if people are informed of the amount of time they spend on social media,could this affect the amount of time they will spend on social media. It was hypothesized that an intervention would cause the amount of time social media users spend on social media to decrease. The participants, all sophomores, were pulled from two sophomore classes and the amount of time spent was measured in hours. A one sample t-test ($t(29) = -0.1$, $p = 0.919$) was run to identify the significance of the difference in hours spent before and after the intervention. According to the results, the hypothesis was not supported. The p-value from the t-test is greater than the alpha value ($\alpha = 0.05$) meaning that the data were insignificant. Also, the study shows that gamified changes to software does not always produce an increase in user engagement.

THE USE OF GRAVITY TO POWER A UV LIGHT PURIFICATION SYSTEM

Jacob Ho
Spring Valley High school

1,000,000 people die each year due to a lack of clean water (Water.org). As technology advances, novel and more efficient ways of creating more clean water should be pursued. One universally available, easily accessible, and heavily underused energy source is gravity. The goal of this research was to determine if gravity could provide sufficient energy to sterilize water by remodeling Shell's GravityLight. It was believed that the resulting device would be able to produce 200 milliliters of sterilized water in 7 minutes. The device was created by repurposing the GravityLight to power a UVC-LED. A stock of E. coli contaminated water was created to test and water sterility was measured using the membrane filtration method. It was found that around 25.1333% of the bacteria were killed off by the prototype. A t-test of the data was performed with an alpha value of 0.05. There was no significant difference between the number of colony forming units before and after sterilization, $p= 0.76$ In conclusion, the current state of the prototype is ineffective and further improvements and testing need to be done on this method of sterilization.

AN EXPLORATORY ANALYSIS OF COUNTERFEIT BUYERS

William Hobbs
South Carolina Governor's School for Science & Mathematics

This study examines the similarities among preferences of people who buy counterfeit goods, specifically comparing consumers in Charleston, SC to Shanghai, China. This survey measured consumer's sociodemographic information, as well as their willingness to buy (WTB) any of twenty categories of counterfeit goods. It was hypothesized that two clusters would emerge from the Charleston data and another two from the Shanghai data, and that for the clusters for both data sets would be somewhat similar in terms of goods and the Willingness to Buy that comprised them. This hypothesis, to a degree, proved to be correct. Two research sub-groups were asked to analyze the data and agree upon what the clusters meant. Charleston respondents were divided into two clusters called "Image-Driven Counterfeit Buyers" and "Utility-Driven Counterfeit Buyers." The two clusters of Shanghai data were called "Counterfeit-Inclined Buyers" and "Counterfeit-Disinclined Buyers." STATA calculated logistic coefficients for each sociodemographic variable and how it affected a respondent's likelihood to be placed in one cluster over another. None of these coefficients for the Charleston data were shown to be significant at the 5% level. For the Shanghai clusters, females were more likely to be placed in the "Counterfeit-Disinclined Buyers" cluster; and that a higher consumer personal emphasis on Brand Status made that consumer more likely to be placed in the "Counterfeit-Inclined Buyers" cluster. Both of these findings were significant at the 5% level.

DISCERNING HOW CATALYST SUPPORT INFLUENCES THE PRODUCTS IN AQUEOUS PHASE GLYCEROL PROCESSING

Benjamin Hodges
South Carolina Governor's School for Science & Mathematics

In the production of biodiesel, aqueous glycerol is a byproduct that can be converted into useful chemicals and fuels. Catalysis, which involves lowering activation energy, drives this reaction. Catalysts are composed of metal, specifically platinum in our reaction due to its efficiency in C-C bond breakage, and support which may vary but is composed of metal oxides. The objective of this research is to understand fundamental aspects about the catalysis of glycerol conversion, specifically how alumina and silica supports affect the way that platinum catalysts function for this reaction. Specifically, we aim to monitor the functions of these catalysts by using them to create liquid products from glycerol via the aqueous phase processing (APP) reaction. In APP, glycerol is converted into gaseous products, such as H_2, and liquid products, such as ethanol, in the upflow fixed bed reactor. Specifically, aqueous glycerol is pumped through the reactor along with pressurized inert gases, and the glycerol is converted to the previously listed products, among others. Liquid phase samples are collected at the reactor outlet, and they are analyzed using a gas chromatograph/mass spectrometer (GC/MS) which looks for the propylene glycol, acetol, ethylene glycol, ethanol, and methanol. Eventually, this product analysis will lead to better understanding of how supports influence the product distributions in the APP of glycerol, which will facilitate the design of new catalysts with optimized supports. In addition to performing analysis, we are writing standard operating procedures for the upflow fixed bed reactor and GC/MS, which will assist future researchers.

THE COMPARISON OF SUNSCREEN, MOISTURIZER, AND FOUNDATION WITH THE SAME SPF AND ITS RELATIVE REFLECTION OF UV RADIATION.

Sydney Hook
Spring Valley High School

The comparison of sunscreen, moisturizer, and foundation with the same SPF and its relative reflection of UV radiation. Sydney Hook Spring Valley High School, Columbia, SC Dale Soblo, Teacher, Spring Valley High School The purpose of this research was to show if pigmented cosmetics with SPF can protect skin from UV rays in the same way that a sunscreen does. It was expected that if the amount of UV rays were measured coming through a sunscreen, a tinted moisturizer, and a foundation of the same SPF, the three products would have the same relative reflection due to having the same SPF and ingredients for sun protection. This was conducted by spreading sunscreen, tinted moisturizer, and foundation of SPF 25 onto glass plates, placing them under a UV light for 2 minutes, and then measuring the UVA and UVB values coming through each plate with the different products. These methods were repeated for 30 trials, with random control trials throughout. After collecting the data, it was found that the sunscreen was most varied in its values for both UVA and UVB, as well as having the highest averages for both. The moisturizer had the lowest average for UVA and the foundation had the lowest average for UVB. An ANOVA ($F(7,184)=1340.31$, $p<0.001$) test was also conducted and showed that there was a significant difference for UVA and UVB values of the cosmetics, sunscreen, and control. However, the following Tukey test allowed the conclusion that there was no significant difference between the UVA and UVB values of the sunscreen, foundation, and moisturizer. Therefore, the hypothesis was supported and for short term use, cosmetics protect to the same degree as sunscreen.

THE ACCURACY OF DIFFERENT BLOOD GLUCOSE METERS IN RELATION TO THE TRUE BLOOD GLUCOSE LEVEL

Asher Huddlestun
Spring Valley High School

Around 371 million people have diabetes worldwide, meaning that diabetes has reached epidemic proportions. Diabetics, who either have trouble or cannot produce a blood glucose regulating hormone called insulin, check their blood sugars on devices called Blood Sugar Meters (BGMs). The purpose of this study was to measure the accuracy of several commonly used BGMs in relation to the true blood glucose. It was hypothesised that if the OneTouch Verio IQ has a margin of error less than or equal to 5% in relation to the true blood glucose, then it will be the most accurate of the meters tested. The fake blood glucose solution was evenly mixed to ensure an equal dispersion of sugar per gallon (mg/dl), then the solution was put into a meters test strips and the meter calculated what it registered. This was then compared to the true blood glucose and repeated for each meter. An ANOVA test ($F(3,116)=96.02$, $p<0.001$) was run on the data with alpha equal to 0.05. It was concluded that there was no significant difference between the Accu Chek Guide and the Nova Max Plus and between the OneTouch Verio IQ and the OneTouch Verio Flex. The hypothesis that the OneTouch Verio IQ would be the most accurate meter of the meters tested was rejected. Future research will have to test the difference between more types of meters and between Continuous Glucose Monitors (CGMs).

REDUCED-GRAPHENE OXIDE SEMI-PERMANENT HAIR DYE: DURABILITY AND TOXICITY

Charlotte Hughes
Heathwood Hall Episcopal School

Because many conventional hair dyes contain supposed carcinogens, toxicants, and skin irritants, a reduced-graphene oxide (r-GO) hair dye, was explored as an alternative to conventional dyes. This dye has even been found to decrease static electricity and conduct heat. It was hypothesized that r-GO would exhibit insignificant environmental toxicity and be significantly more

durable than conventional hair dye. Graphene oxide and r-GO were produced by the methods cited in literature. To examine the toxicity of r-GO, a 48 hour r-GO acute aquatic toxicity assay was conducted using 150 Daphnia magna. The r-GO concentrations in the Daphnia magna acute toxicity assay were found to include significantly more fatalities than the control solutions. This fails to support the hypothesis that r-GO would exhibit insignificant aquatic toxicity, though further studies are needed because the r-GO solutions were significantly more acidic than the control. To examine the durability of r-GO, UV-Vis spectroscopy was used to measure the wavelengths and absorptions of the r-GO hair dye on 80 human hair samples after successive washes. While the 5.00 wt% r-GO dye was found to be the most effective r-GO dye (using ANOVA; $\alpha = 0.05$), the control dye was significantly more durable than any r-GO dye, which failed to support the hypothesis. For future studies, the use of mass spectroscopy to control purity and a wider range of concentrations is suggested. Potential implications of this dye include helping people regulate their body temperature in extreme conditions and creating technology interfacing with the body.

PREDICTOR VARIABLES OF PRIMARY PRESIDENTIAL PARTISAN ELECTIONS IN THE U.S.

Joseph Humphries
Chapin High School

General elections have been able to be predicted with relatively high accuracy due to a party split between the final candidates. However, this is not the case in a primary election as each candidate is usually of the same party. The only factors which have been found to relatively correlate with primary results are polling results and endorsements for each candidate. Current models which factor polling and endorsements typically predict primary elections with only 57% accuracy, while current models which only factor polling predict primary elections with about 43% accuracy (Silver, 2016). This research sought to find other variables which may be used to predict primary presidential elections with greater accuracy than these current models. A sample of voting-age participants was surveyed and asked about various demographics, and they were required to vote for a primary candidate from the 2016 presidential election from either the Democratic or Republican Party. Their demographic data was compared to the demographic data of the candidates which they voted for, and a chi-squared goodness-of-fit test was used to determine whether there was a correlation between the demographics of voters and the demographics of the candidates which they vote for. The results showed that voters were most likely to vote for candidates with close proximity in age and of a similar race, while other demographics did not provide statistically significant results.

A SIMULATION OF POTENTIAL ECONOMIC LOSS DUE TO LEGAL IMMIGRATION CRACKDOWNS

Jareer Imran
Spring Valley High School

The economic benefits that legal immigrants to the United States provide remains ambiguous. With recent changes in government encouraging the reduction of immigrants into the United States, it has become pertinent that this subject be studied in more depth.The purpose of this study was to examine whether legal immigrants provide a substantial net benefit to the United States economy, with the intention that the results of the study be used as an objective argument during immigration policy debates. It was hypothesized that there would be a substantial net increase in economic productivity provided by immigrants, and that a reduction in the number of immigrants entering the country would conversely lead to a reduction in economic productivity. To carry out this experiment, a model was adapted from previous studies to fit the purpose of this study. The model then simulated how changes in labor input from immigrants affected overall productivity. The simulation was modeled over the course of fifteen years, with the number of immigrants entering the United States simulated to be five percent less than those entering the previous year. These values were then analyzed using descriptive statistical methods, where it was noted that an average of $68,706,017 was lost annually due to the reduction. Over the course of the fifteen year simulation, it was projected that nearly a billions dollars was lost. These results indicate a substantial contribution of immigrants to the United States economy.

THE EFFECT OF ORGANICALLY GROWN BANANAS ON THE LIFESPAN OF *DROSOPHILA MELANOGASTER*

Morgan Iseman
Heathwood Hall Episcopal School

The purpose of this study is to determine the relationship between organic bananas and lifespan of *Drosophila Melanogaster* 9(fruit fly). It was hypothesised that if different fruit flies eat organic and non-organic bananas, then the fruit flies that eat organic bananas will live longer. Each test consisted of one vial culture with 10g of mashed organic banana as the lone food source, with a vial net for the flies to rest on. The vial was then sealed with a foam plug. Their were 25 flies in the vial for test one and 10 flies in each vial culture for test 2 and 3. The only difference in the control group was a non-organic banana was used in place of the organic banana. The amount of dead flies in each vial was recorded once daily for for 19 days. There was no clear difference in lifespan which may indicate that lifespan of *Drosophila Melanogaster* is not directly related to organic bananas.

THE EFFECT OF COMPOSITE FACES ON PERCIEVED ATTRACTIVENESS

Taahera Islam
Spring Valley High School

This study researched the influence of viewing composite faces made up of different ethnicities upon perceived attractiveness. It was hypothesized that ethnic differences and composite faces have an effect on the way individuals perceive attractiveness from faces. Hypotheses included that composite faces would be considered more attractive than individual faces, composite faces made up of more ethnicities would be considered more attractive, and subjects would choose a person of the same ethnicity as most attractive. Experimentation was performed with 190 subjects through the use of a survey; subjects were requested to complete a Google Forms survey where they were initially asked questions about ethnic and attraction preferences. In the questions following, they were then asked to rank several series of faces from least attractive to most attractive. For each question, around ten faces were illustrated, every question corresponding to five different ethnicity composites. The ethnicities included Caucasian, African-American, Asian: Indian Sub-Continent, Asian: Far-Eastern, and Hispanic. A two-sample t-test [$T(1882)=12.00$, $p=<0.001$] analyzing composite and individual faces illustrated that composite faces were viewed as more attractive than individual faces. A one-way ANOVA [$F(940,944)=23.77$, $p=<0.001$] analyzing composite faces of different ethnicities illustrated that the composite face that was considered the most attractive was the five-ethnicity composite face. A one-sample t-test [$T(189)=0.62$, $p=0.533$] analyzing the difference in ethnicity data illustrated that, overall, the data were not significant, yet results indicated that one's own ethnicity was preferred as opposed to a different ethnicity.

THE EFFECT OF RADIOFREQUENCY ELECTROMAGNETIC RADIATION (RF-EMR) OF AN LTE 1900 MHZ MOBILE PHONE ON THE REPRODUCTION IN THE P AND F1 GENERATIONS IN *DROSOPHILA MELANOGASTER*

Fatima Jatoi
Spring Valley High School

Mobile phones have become a major aspect in today's society. People are constantly on their mobile devices and thus, are being exposed to radiofrequency electromagnetic radiation (RF-EMR). In past studies, RF-EMR has been shown to cause various health effects and some suggest it may negatively impact reproduction, but this has not yet been ascertained. As such, the purpose of this study was to test the effects of a RF-EMR from an LTE 1900 MHz mobile phone on the reproduction of the P and F1 generations of *Drosophila melanogaster*. It was hypothesized that the groups of *D.melanogaster* that are exposed to radiation would produce less offspring than the control group. The experiment was conducted using two groups of *Drosophila melanogaster*, one exposed to mobile phone radiation prior to breeding and a control group. After two weeks of breeding, the number of offspring produced by each group was counted. The offspring of the experimental group and control group were then separately bred. After two weeks, the offspring of each group were counted. The t-test conducted of the data showed that the hypothesis was not supported, $t(5)=1.086006, p>0.05$, however another t-test was completed between the parental and F1 experimental groups,$t(6)=4.02107, p<0.05$. The results of this test implies that since the lack of radiation in the F1 generation caused an increase in offspring compared to the experimental parental generation, then exposure to cell phone radiation may decrease reproduction in *D.melanogaster*.

IDENTIFYING THE IDEAL GROWTH CONDITIONS OF WHEAT CROPS IN THE PEE DEE USING GENOME WIDE ASSOCIATION STUDIES.

Jeffrey Jiang
South Carolina Governor's School for Science & Mathematics

The climate is shifting as the years go by, and we need to find or create species of wheat that can adapt to the new climate. These new species also need to be able to maintain yield the same as well. The research that was conducted at the Pee Dee Research Center for Research and Education made strides in that direction. We found how strongly correlated the different traits, like weed growth and lodging, for yield were to the plants, and those traits were then correlated to previous data to find out how accurate they were compared to the data from previous years. In the field, spikes were collected manually using clippers, and different machines, like the thresher and the seed counter, were used to separate the wheat grains from the spike. Different forms of data collected include grains per spike and the weight of a hundred grains of wheat, as well as the weight of five heads of grain from each plot. These data were then analyzed through GAPIT, and multiple plots were created to visualize how strong the correlation was between each trait and hundred grain weight. In conclusion, the study conducted gave insight into the different traits that were important to how wheat crops grew. Examples of these traits include overall healthiness of the plant, the presence of lodging and the pressure of weeds. In the future, commercial farms can use this new information to regulate the crops and determine ideal species to grow in different conditions.

THE EFFECTS OF URBANIZATION ON AMPHIBIAN AND REPTILE POPULATIONS IN THE PIEDMONT AREA

Catlyn Johnson
South Carolina Governor's School for Science & Mathematics

Reptiles and amphibian populations are in decline due to habitat loss and degradation, pollution, and many other factors that can be related back to urbanization. Studying the types of urbanization factors that affect the reptile and amphibian populations can lead to more effective and efficient conservation plans. We collected various data, such as length, weight, growth rings (for eastern box turtles), and GPS coordinates, on different species of reptiles and amphibians through terrestrial surveys. To take

data on stream salamanders, we made leaf litter bags that consisted of mesh, wet leaf litter, and a natural weight to create an attractive refuge for the salamanders. We flipped the rocks within five meters on either side of the bags we planted and caught the salamanders with a handheld mesh net before placing them into a bucket to be identified and photographed as needed before we released them back into the stream. We also used telemetry to consistently find the locations of box turtles. We did this data gathering at about fifteen different sites ranging from heavily urbanized to heavily forested. We predict that the species abundance will be lower in the more urbanized sites than in the less urbanized sites in the next several years. Once we identify the urbanization factors that have the most negative effects on amphibian and reptile population, we can find a better method of conservation.

BACKYARD BULGARI: AVAILABILITY AS A FACTOR IN CONSUMER WILLINGNESS TO BUY COUNTERFEIT GOODS

William Joseph
South Carolina Governor's School for Science & Mathematics

This study analyzes the effect availability of counterfeits has on a consumer's willingness to buy different counterfeit goods. This was done through a survey distributed in Shanghai, China and Charleston, South Carolina in which respondents gave their perception as to how available counterfeits goods were to them and if they were willing to buy twenty different counterfeits. These items range from automotive parts to watches and can be divided into "status piece" and "non-status piece" items, with status piece items including clothes, handbags, wallets, jewelry, and similar goods. With significance, we found contrasting results in the Shanghai and Charleston surveys. As Shanghai respondents perceived counterfeit items to be more available, they were less willing to buy "status piece" counterfeits. As Charleston respondents perceived counterfeit items to be more available, they were more willing to buy counterfeit items across the board. This disparity can be attributed to Shanghainese respondents living in a more "image" focused environment where your appearance and the brands you wear have a large weight. As Shanghainese respondents perceived their environment as increasingly saturated with counterfeits, they perceived a greater risk in wearing them and were more interested in the personal benefits of wearing non-counterfeit luxury items. Charlestonian respondents were more interested in the convenience of purchasing counterfeits as well as their lower price and therefore were more willing to buy counterfeit items as they perceived them to be more available.

EXPLORING AUTONOMOUS VEHICLE SYSTEMS USING RACECAR MODELS

Derrick Joyce
South Carolina Governor's School for Science & Mathematics

Vehicular autonomy is a growing field that is expected to revolutionize travel in the near future. This is evident in the growing popularity of the self-driving cars engineered by companies such as Waymo and Tesla. This research was conducted to analyze the various systems that operate to make a car's mobility fully autonomous. Alongside programming autonomous software, a heavy emphasis was placed on software testing. Software testing is an essential part of any engineering design process because it is important to test the algorithms before they are released in the outside world. This research utilized MIT's RACECAR platform which is a small scale model of an autonomous car. A combination of control systems, image processing, and motion planning allowed the RACECAR to detect obstacles and make self-directed decisions on how to maneuver accordingly. After implementing these systems, the RACECAR was able to autonomously drive through a final obstacle course that tested its ability to fully recognize colors, follow lines on the ground, and follow the general flow of the course. Once fully developed, these autonomous systems will transform the travel industry as they will be further innovated and used in more vehicle types such as planes, rovers, and trains.

THE EFFECT OF SUCRALOSE CONCENTRATION ON MORTALITY OF *DAPHNIA MAGNA*

Andrew Juhn
Spring Valley High School

The artificial sweetener sucralose is able to pass through both the human body and sewage treatment facilities, making its way into the waterstream, and could be a potential threat to aquatic life. *Daphnia magna*, commonly known as the water flea, is an extremely common freshwater crustacean that plays a crucial role in the aquatic ecosystem, grazing on phytoplankton. The purpose of this experiment was to study the effects of hyperconcentrated amounts of sucralose on the mortality of *Daphnia magna* in order to see the impact of sucralose on the aquatic population. It was hypothesized that if the amount of sucralose in the water increased, then the mortality rates would increase. 150 *Daphnia* were set in 30 different observation bowls, with 5 in each bowl. There were three trials done, a control, a 100 µg trial, and a 1,000 mg trial. Each trial had 10 bowls. A One Way ANOVA ($F(2.25)= 2.64$, $p = 0.091$) was performed, which indicated that there was no significant difference between the treatments. The hypothesis was not supported and sucralose concentration did not have an impact on the mortality of *Daphnia magna*.

SILENCING CYTOCHROME P51 GENE WITH DSRNA TO COMBAT PEACH FUNGAL PATHOGENS

Virginia Kenan
South Carolina Governor's School for Science & Mathematics

California, South Carolina, and Georgia are large peach producers worldwide. They face adversity with fungal peach pathogens Armilaria mellea and Botrytis cinerea. These fungi cause millions of dollars in crop loss annually. A. mellea causes root rot. B.

cinerea attacks developed fruit and reduces shelf-life. The current prevention method is chemical fungicides which are expensive, harmful to the environment, and ineffective. In hopes of creating a better fungicide, we focused on the Cytochrome p51 gene in A. mellea that controls cell wall synthesis. If the gene were silenced, it would prevent the fungus from being able to grow. Genomic DNA containing Cyp51 was replicated by PCR and used to create double stranded RNA (dsRNA). Previous studies indicate dsRNA can be absorbed topically into the fungal cells creating RNA interference and reducing gene expression. The dsRNA was applied to PDA media and plated with live fungal cells. After 20 days of cultivation, the radial growth was measured and compared to the radial growth of the control, which was plated with water. dsRNA treatment did slightly reduce the radial growth of the fungus and silence the Cyp51 gene. This experiment will be replicated with increased sample size and a new variety of concentrations. It will also be repeated with B. cinerea and target it's DCL genes, which control methylation in a cell. The use of dsRNA as a fungicide in the future may provide more efficient, eco-friendly, and fungus specific methods of fungal control.

THE EFFECT OF *CHAENOMELES SPECIOSA* (DRI) ON THE RESPONSE TO THERMOTAXIS IN *CAENORHABDITIS ELEGANS* EXPOSED TO ETHANOL DURING DEVELOPMENT

Deiveek Kerai
Spring Valley High School

Fetal alcohol syndrome (FAS) is a disorder that results from the consumption of alcohol by pregnant women. Certain substances such as DRIs 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 *Chaenomeles Speciosa* (DRI) against FAS modeled by *C. elegans*. It was hypothesized that highest amount of *Chaenomeles Speciosa* would allow for the highest percentage of C. elegans in the coldest section of the thermotaxis gradient. For experimentation, 50 square petri dishes, divided into 4 sections, were seeded with *C. elegans*. During this time, 30 microliters of ethanol and varying amounts of treatment was added. After 72 hours, 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 30 minutes. 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. The p-value for the percentage and treatment showed statistically insignificant results with $p=0.987$. A two-way ANOVA was conducted at $\alpha=0.01$.The p-value for the percentage and section number showed statistically significant results for that with it being 0.000026. Regardless, flowering quince appeared to be an effective treatment in combating FAS.

ANALYSIS OF DFT PROGRAMS VASP AND CP2K USED FOR MODELING ADSORPTION, CATALYSIS, AND ADVANCED MATERIAL PROPERTIES

Noah Klimkowski Arango
South Carolina Governor's School for Science & Mathematics

My assignment for research is to compare the commercial program the Getman group is currently using for their calculations, VASP, against an open-source program that can perform the same calculations, CP2K. Both programs model systems of atoms by solving Kohn-Sahm equations using the density functional theory. The Getman group uses VASP to model the adsorption of various molecular compounds to bulk platinum and other catalysts. The purpose of modelling these systems is to explore the nature of catalysis to determine how molecules could be catalyzed with reduced content of precious metals such as platinum. My research is to convert the VASP input files into CP2K input files and analyze the two programs in terms of processing speed, memory usage, and ease of use. VASP models atoms using plane wave basis sets while CP2K uses atomic orbital basis sets. In order to compare the effectiveness of the programs, a job has to be run using both programs while recording memory usage and processing speed on the Palmetto Cluster. Preliminary testing of CP2K shows that CP2K uses less memory per job and converges faster than VASP.

SHAKEY WAKEY: A PORTABLE INNOVATION TO WAKE THE DEAF, HEARING IMPAIRED, ELDERLY, AND CHILDREN

Kelsey Krusen
Center for Advanced Technical Studies

Shakey Wakey is a portable biomedical innovation, to wake the deaf, hearing impaired, elderly, and children to smoke detectors. The purpose of this project is to wake people to smoke detectors via a pillow that will vibrate. This project is important because 3,515 people die each year from residential fires. In order to make the project successful, a raspberry pi (a mini-computer) was programmed to recognize the frequency of smoke detectors. Once the pi recognizes the frequency via a miniature microphone it was programmed to turn on a vibrating pad to wake the user. It is to be expected that the device will wake people to the frequency within 5 seconds to help the user safely escape the fire. The next phase of the project is to develop an app to connect to the shakey wakey and call 911 when set off.

EVALUATING THE STRENGTH AND DURATION OF REVERBERATION AND ITS INFLUENCE ON SPEECH INTELLIGIBILITY

Caitlin Kunchur
Dutch Fork High School

Verbal communication plays a key role in education and its efficacy depends fundamentally on the acoustics of a classroom. The room needs to have a strong reverberation to amplify the speaker's voice and a short reverberation decay time to avoid loss of clarity. Therefore, developing quantitative methods to evaluate a room's acoustics is valuable. This project studied and developed techniques for measuring reverberant sound intensity and decay time as a way of comparing the acoustics of various rooms. Additionally, blind listening tests were conducted on human subjects to determine the correlation between the acoustical environment and speech intelligibility. Three rooms with different acoustics were compared. The first experiment studied how reverberation affected the inverse-square relationship between sound intensity and distance. This provided a measure of the absorption of each room. The second experiment measured the duration of reverberation using oscilloscope and audio recording softwares. These experiments showed what conditions provided strong reverberation along with a short reverberation decay time. The final experiment conducted blind listening tests on human subjects to determine their ability to distinguish different phonemes of speech. This experiment confirmed the expectation that the right kind of reverberation, strong but short, is most beneficial for clearly understanding speech. The results of this project are highly relevant to the designs of classrooms and impact the ability of students to effectively understand an instructor.

THE EFFECT OF TAI CHI AND JAZZ MUSIC ON THE MEMORY OF MIDDLE SCHOOL STUDENTS

Maryah Lance
Spring Valley High School

Tai chi and jazz music are believed to increases the memory of students (Lehmann, et al 2017).. Doing tai chi before doing an assignment allows students to wake up their body and mind. Playing jazz background music during the assignment allows students to focus on the assignment and not the other actions and sounds going on around them. Most teachers start the lesson right away when class starts. Some students may be wide awake, while other students are still fatigued. It was hypothesized that if a teacher requires the class to do tai chi, then the scores of those students would improve. Three groups were made with 3 classes per a group. The three groups were tai chi, jazz music, control. The tai chi group did tai chi at the beginning of class and then played a memory game three times. The jazz group played the memory game three times while jazz music was playing in the background. The control group started the memory game at the beginning of class with no tai chi or music. All scores were recorded by the student in a form that was sent to them by the teacher.

THE EFFECT OF EXCESS 2-AMINOETHANESULFONIC ACID ON LOCOMOTION IN PLANARIA

Crawford Latham
Spring Valley High School

Taurine is an amino acid derivative that occurs naturally within the human body and is attributed to a wide range of functions. It can function as a calcium channel blocker, neurotransmitter, neuromodulator, and organic osmolyte. Taurine is being taken in by humans in larger amounts today than ever before by way of energy drinks and dietary vitamin supplements. There is almost no research on the negative effects of high concentrations of taurine. The purpose of this research was to learn more about the negative effects of taurine in high concentrations, targeting its function as a calcium channel blocker. It was hypothesized that high concentrations of taurine would impair locomotive function because of taurine's role as a calcium channel blocker. There were two experimental groups and one control group. The control group were planaria in plain spring water put through the same chemotaxis and phototaxis tests to determine a baseline for comparing the test groups too. The test groups, each containing thirty planaria, were put in solutions of taurine with concentrations of 500 µm/L and 750 µm/L. These test groups were put through the same chemotaxis and phototaxis tests. When ANOVAs were used to analyze the data both groups showed significance at α=0.01. These statistics, as well as all of the descriptive trends supported the hypothesis. This is sufficient evidence to suggest taurine negatively impacted the locomotive function of the planaria for the chemotaxis and phototaxis tests.</p>

CHARACTERIZATION OF GOLD NANOPARTICLE ENCAPSULATED POLYMERSOMES FOR BRAIN IMAGING

Anais Lawson and Kayleigh Kelly
South Carolina Governor's School for Science & Mathematics

Presently, the method for Computer Tomography (CT) scanning is ingesting radioactive heavy metals that are visible on these scans. CT scanning is used to image different parts of the body with contrast dyes, including the brain. This project uses biocompatible polymersomes to carry gold nanoparticles to the brain. The intention is to cross the blood-brain barrier (BBB) with the gold nanoparticle-encapsulated polymersomes. Polymersomes are self-assembled amphipathic nanoparticles that can be used as a vesicle to encapsulate other nanoparticles, such as gold nanoparticles. To create the polymersomes, a synthetic polymer, polyethylene glycol-b-polylactic acid (PEG-PLA) was dissolved in dimethyl sulfoxide (DMSO) and injected into 2% D-mannitol solution. The polymersome sizes were determined to be 176.6 ± 10.1 nm using dynamic light scattering. To complete the process, the polymersomes are slowly frozen at -20℃ and -80℃ and lyophilized between 15-18 hours. The polymersomes had a 17.7% encapsulation efficiency with the Near Infrared dye (NIR), which was verified using Ultraviolet-Visible (UV/Vis)

spectroscopy. The gold nanoparticles were loaded into the polymersomes using the NIR dye loading procedure. Then the absorption of the gold nanoparticle-loaded polymersomes was measured at a wavelength of 515-525 nm, yielding an encapsulation efficiency of approximately 72.5%. After encapsulation, the polymersomes are guided to the brain once injected into the body. Upon reaching the brain, the gold nanoparticles can serve as targeting ligands or contrast agents. In the future, procedures for encapsulating other metallic nanoparticles can be carried out to be more easily read by CT and Magnetic Resonance Imaging (MRI) scans.

THE EFFECT OF L-THEANINE AND VITAMIN B12 IN C. ELEGANS EXPOSED TO A NEONICOTINOID PESTICIDE ENVIRONMENT

Christian Lee
Spring Valley High School

Bee colony collapse disorder has been on the radar of scientists for many years because the bee population continues to decrease year after year with no obvious reason for the decline. Scientists have speculated for these causes and have come up with one main culprit: neonicotinoid pesticides. Neonicotinoid pesticides cause neurological functions to fail and in high dosages, cause death. Their chemical structure is similar to nicotine which are known harmful substances to all living species. These pesticides are introduced to the system by farmers spraying them onto the flowers that the bees land on to start their pollination process. To mimic these effects, C. elegans were used as model species to exhibit the effects of the pesticide and hopefully be the recipient of chemical treatments. To best show the effects of the pesticide and the treatments, the mortality rate of the C. elegans was recorded. It was hypothesized that the control group of just pesticide-exposed C. elegans would have the highest mortality rate while the L-theanine treatment group would have the lowest mortality rate. The results indicated that the control group had the highest chance of surviving at around 27% while the vitamin B-12 had a low chance of surviving at around 8%. The hypothesis was not supported because the L-theanine group had a mere 12% of survival. Based on the results, the treatments actually harmed the nematodes and the control group displayed the highest survival rate. A one-way ANOVA was conducted at a confidence level of $\alpha=0.01$ to test the significance of the survival rate between the three groups demonstrated that the data was significant at $p< .001$.

HEATED PORTABLE MUSCLE ROLLER FOR SHIN PAIN

Eliza Leslie
Chapin High School

The high impact of each step when running was the inspiration behind this project as it is the cause of the rise in prevalence of shin pain. Through this engineering project a heated muscle roller with a portable charging box will be created in order to benefit those that experience shin pain. If a track athlete uses a heated portable muscle roller prior to each practice, then their shin pain will be relieved. The muscle roller portion of this product, will relax contracted muscles, improving blood and lymphatic circulation, and stimulating the stretch reflex in muscles. The heated portion of this product will apply direct, but comfortable heat to relax and release tensions in the muscles, to help prevent the shins pains to occur during exercise. What motivated this product were the track athletes that experience this excruciating shin pain, so instead of them alleviating this pain in two steps, they are able to utilize a single instrument that combines the two steps into one. This product will be completed by creating three different prototypes with each having different forms of muscle rollers and individual heating sources. These three products will be evaluated based on whether or not the product provided a comfortable massage and heat therapy that helped to alleviate shin pain prior to practice. What is expected is that this product will support the individuals desire to relieve shin pain.</p>

HOW MUCH DO TEACHERS REALLY KNOW ABOUT FOOD ALLERGIES?

Shelby Lewis
Center for Advanced Technical Studies

The purpose of my study is to test South Carolina teachers' knowledge of food allergies. My personal experience with having a peanut allergy prompted me to select food allergies as my area of interest for my research project. I have compiled a selection of questions about food allergies for teachers across the state to answer in a survey that is completely voluntary and anonymous. The questions will cover topics about the teacher's teaching career, food allergy training, and how to handle a food allergy reaction. My hypothesis is that Pre-K and elementary level teachers will be overall more proficient in their knowledge of food allergies. A single question will be considered proficient if 60% or more of all teachers that have taken the survey answer it correctly. At the end of my study, I hope that teachers will feel more comfortable handling food allergies at school and that students with food allergies will feel more safe at school.

APPLICATIONS OF MACHINE LEARNING ALGORITHMS IN LIDAR-BASED AUTONOMOUS VEHICLES

Daniel Li
South Carolina Governor's School for Science & Mathematics

Vehicle manufacturers such as Toyota and Ford plan to develop mostly-autonomous vehicles within the next decade. To ensure the utmost safety for all that share the road, the autonomous driving algorithms must be accurate. The goal of this research was to develop an accurate machine learning algorithm able to navigate paths using infrared laser data from Light Detection

and Ranging, LiDAR for short, and to test its capability to learn from various training data. Automation was implemented in a remote-controlled car which consisted of various sensors including LiDAR, camera, and inertial measurement unit. Cardboard boxes were used to construct tracks for testing the control-based driving algorithm and gathering data for training the neural network. Trained neural networks suggest that diverse data consisting of both human driving and control-based driving provides the best training for machine learning.

THE EFFECT OF POLYSTYRENE MICROPLASTICS ON THE HEART RATE IN DAPHNIA MAGNA

Matthew Li
Spring Valley High School

Large amounts of plastics are created and sloughed into the environment, causing global environmental problems, especially in freshwater ecosystems. Polystyrene microplastics are one of the commonly found microplastics in freshwater ecosystems, and they have caused harm to aquatic organisms. However, scientists do not fully understand the full effects of these microplastics when ingested. The purpose of this project was to acquire a greater understanding of how polystyrene can affect aquatic organisms, specifically the heart rate of Daphnia magna. It was hypothesized that the D. magnas' heart rate would decrease when higher amounts of polystyrene microplastics are added in the water. Daphnia magna were placed into glass bowls that contained 175 mL of spring water and each bowl contained 30 D. magna. Daphnia food was added into one bowl and the rest of the bowls contained the polystyrene microplastics. The levels of microplastics were calculated by using dimensional analysis from the ratio of polystyrene microplastics to freshwater ecosystems. After experimentation, a one way ANOVA and a Tukey test was done to see if the data was significant. The heart rates were calculated and the tests showed that the heart rates were significantly different; $F(2.26)=9.0443$, $p<0.05$. The tukey test showed that there were significant differences between the control versus 26.25mg of microplastics, control versus 43.75mg of microplastics, and 8.75mg of microplastics vs. 43.75mg of microplastics. This shows that polystyrene microplastics have a significant effect on the average heart rate of Daphnia magna.

OPTIMIZATION OF POLYSTYRENE DECOMPOSITION USING MEALWORMS

Caylin Lomoriello
Center for Advanced Technical Studies

The problem with polystyrene is the fact that the material cannot be recycled or thrown away in landfills due to the complex molecular structure of polystyrene, so there is a constant buildup in landfills and recycling centers each year. Mealworms have been scientifically proven to safely digest polystyrene through a bacterium inside the guts called *Exiguobacterium* sp.. If mealworms can digest polystyrene, then is there another type of material that mealworms could possibly digest? Polystyrene materials like packaging peanuts, polystyrene cups, food containers, etc. have a recycling number 6 symbol on the bottom of all materials along with the PS letters below. Trials containing different kinds of polystyrene like coolers, architect polystyrene, and polystyrene cups have successfully been eaten by the mealworms in the trials from this project. The trials have proven that mealworms can eat multiple types of polystyrene like XPS, EPS, and regular polystyrene. The findings could be used in landfills by dumping a mass of mealworms into the landfills to eat on the polystyrene to help lower the amount thrown away annually. For future work, there will be different tests being run like testing the amount of Carbon dioxide being released by the mealworms eating the polystyrene, seeing if growing a plant with the amount of Carbon dioxide being released is possible, etc.

DEVELOPING A PORTABLE THERMAL ELECTRIC BATTERY

Michael Lopez
Center for Advanced Technical Studies

Batteries are harmful to the environment, releasing harmful chemicals that can endanger plants and animals. A thermal electric battery is a non-toxic battery that is portable and can be used at anytime to generate portable electricity. If the thermal electric battery works properly when using a Zippo™ hand warmer or Hothands™ hand warmer, then it will be able to produce enough electricity to charge a phone or even power a small light. The prototype battery is tested by using a constructed plastic box that has multiple thermal electric generators (TEGs) secured in the walls so that the hot side is able to heat up by having a Zippo and Hot Hands and the battery is hooked up in a series circuit to bring the voltage output higher. The battery is tested by using a Spark device through the graphing of the average DC voltage output over time. The voltage output is around .3 to .5 volts over a 24hr period. In conclusion, the battery cannot generate enough voltage to power a phone or small light at this point in the prototype development. More TEGs must implemented into the design in order to increase voltage significantly. In future work, there will be additional prototypes that are able to produce even higher voltages and then the battery will begin to shrink into a small battery that can be transported easily.

MODELING CELLULAR MOVEMENT INSIDE COLLAGEN GELS

John Lu and Travid Pence
South Carolina Governor's School for Science & Mathematics

Our goal was to explain why human cells, when sprinkled onto a collagen gel, formed a torus after one day and a sphere a day later. The chemical properties of the cells and collagen gel can't be used because of the large size of the gels. A new approach was taken by analyzing the physical forces instead of the chemical properties. We hypothesized that we could model the formation of these geometric shapes because the collagen gel contains so many intermolecular forces that it affects cellular

movement. To model the collagen gel, we created a three-dimensional phantom lattice with a coordination number of six. We ran millions of random walks along the connections of the phantom lattice, each of which represented a unique polymer chain configuration. We then took the gradient of an energy equation to derive a force equation that models the individual bending and stretching forces of each polymer chain. Through this research project, we also hoped to gain insight as to why cancer cells don't move similarly to regular cells. When cancerous human cells instead of noncancerous cells are used, no recognizable shape was formed. By understanding why regular human cells form a torus and then a sphere, we hoped to gain insight as to why cancerous cells move differently than noncancerous cells.

THE EFFECT OF DECREASED LOAD ON THE TEMPOROMANDIBULAR JOINT IN WILD TYPE AND ADAMTS5 DEFICIENT MICE

Alura Luck
South Carolina Governor's School for Science & Mathematics

WEED DIVERSITY DECREASES PEST ABUNDANCE WITHOUT YIELD LOSS

Melina Madden
South Carolina Governor's School for Science & Mathematics

Farmers spend much of their time and money managing weeds because they compete with crops but weeds also provide ecosystem services on farms. They introduce plant diversity in a crop monoculture and are important habitats for beneficial insects, providing alternative food resources and refuge from weather and predation. In this experiment we measured effects of weed diversity on the density of predators in eggplant crops and on biological control of pests and weed seeds. We manipulated weed density in 10 small plots, performed weed surveys, and sampled pest and predator communities with pitfall traps, visual surveys, and vacuum collection. We measured biological control of weed seeds and insect prey as well and collected eggplant yield data to measure potential costs of weed tolerance. In weedy plots we found more predators, fewer pests, and observed higher rates of consumption of seeds than in weed-free plots. However, pupae consumption between the two treatments were not statistically different. Importantly, there was no yield cost to weed tolerance in our system. While weeds do not always lead to reduced crop production, the biodiversity they provide can encourage pest control services in agroecosystems.

OPTIMIZING BACTERIAL CELLULOSE PAPER PRODUCTION FOR FOLDING ORIGAMI

Michael Madden
South Carolina Governor's School for Science & Mathematics

Origami, the art of folding 3D structures from paper, has experienced a new wave in interest in the engineering world. Using origami allows for more intricate and complex forms that can be carbonized to make materials useful in other fields. Our research aimed to create origami structures by manufacturing and folding a paper-like film made from bacterial cellulose. After growing the cellulose from a culture, we had to find a way to dry it so that it folded well. We cut pieces of the cellulose and then used a food dehydrator at different settings to find which created the idea origami paper. We looked at whether the paper was uniform, the number of defects it had, and how easy it was to fold. Our results expressed that drying at a temperature below or at 95°F and drying for at least 3 hours made higher quality paper that was easy to fold. Finding a way to dry the cellulose will help the process of manufacturing and folding easier and eventually able to be reproduced in factories.

EFFECTS OF STRESS (HYPOXIA) ON PRO-INFLAMMATORY CYTOKINE PRODUCTION FROM ASTROCYTES

Michael Mai
South Carolina Governor's School for Science & Mathematics

Our research dealt with astrocytes in the human optic nerve head and studying their production of pro-inflammatory cytokines under hypoxic conditions. Retinal ganglion cells, neurons of the eye, die during the progression of glaucoma. Our lab believes that hypoxia in astrocytes from the optic nerve head contribute to retinal ganglion cell death via upregulation of pro-inflammatory cytokines. In the experiment, astrocytes from various human donors were incubated for 24 hours under normoxia and hypoxia. After 24 hours, immunocytochemistry was performed on the cells to view TNF-α, HIF-1α, and IL-1ß production under a confocal microscope. Cells were stained with anti-rabbit primary and secondary antibodies at a dilution of 1:100 and 1:200, respectively. Our results showed that production of pro-inflammatory cytokines was enhanced, but the increase in production was not drastic. TNF-α and IL-1ß were upregulated by a reasonable amount. It was hypothesized that, because cytokines are secretory in nature, the cytokines could have been released into the media the cells were in. Because of this, the next direction for the lab is to investigate the media for the presence of the cytokines. These results support our lab's hypothesis that pro-inflammatory cytokines produced from astrocytes are upregulated in hypoxic conditions, similar to glaucoma. Understanding more about how glaucoma progresses would lead to better treatment in the near future.

A NEW ESTIMATE OF MARINE ICE UNDER AMERY ICE SHELF

Madeleine Maylath
Chapin High School

Accreted marine ice is present under Antarctica's Amery Ice Shelf (AIS). This study provides a new estimate of accreted marine ice thickness under the outer AIS using IPR measurements for ice thickness and elevation collected jointly by China, Australia, and the US during the 2016-2017 and 2017- 2018 austral summers. The hypothesis was that distribution and properties of the marine ice layer can be defined using IPR measurements of the meteoric-marine ice interface and signal ocean forcing beneath the ice. Conditions at the ice-ocean interface, including presence of marine ice, make AIS a compelling analog for Jupiter's moon, Europa. This study estimates the distribution of marine ice by applying the hydrostatic equation. The orthometric height is compared to the height calculated by the hydrostatic equation using the ice thickness from IPR data and the modeled densities of meteoric ice and sea water. The difference between the orthometric height and IPR-derived height, the hydrostatic height anomaly, was calculated. Where the hydrostatic height anomaly was 0-30 m, marine ice was likely present. Where marine ice is present, a derived equation that accounted for presence of marine ice was used to re-estimate the total ice thickness. The difference between the IPR-derived thickness and the revised total ice thickness gives an estimate of the thickness of marine ice. A map of marine ice was successfully created. The estimate indicated accretion mainly at the front of the ice shelf, which was consistent with the ice pump mechanism hypothesized to be occurring below AIS.

FINDING A BALANCE: A STUDY OF EATING DISORDERS IN FEMALE COMPETITIVE GYMNASTS

Tessa McArthur
Chapin High School

This research project investigates the relationship between participation in competitive gymnastics and the risk of eating disorders. The purpose is to determine if competitive gymnasts are at an increased risk of developing an eating disorder due to the potential subjectiveness and judging aspect of the sport. Since early eating disorder intervention is healthier and easier, subjects include 11-14 year old female adolescents who participate in either recreational or competitive gymnastics. They were administered a modified version of the Children's Eating Attitudes Test-26 (ChEAT-26) in which level of participation in gymnastics and knowledge of healthy eating habits were also evaluated. The data was analyzed using a series of Analysis of Variance (ANOVA) tests to assess if there was a significant difference in test results between competitive and non-competitive gymnasts. Results indicated that level of participation does not affect the prevalence of disordered eating.

THE EFFECT OF EXTRACURRICULAR ACTIVITIES ON THE EMOTIONAL EXHAUSTION, DEPERSONALIZATION, AND SENSE OF PERSONAL ACCOMPLISHMENT (BURNOUT) OF ACADEMICALLY HIGH-ACHIEVING ADOLESCENTS

Jane McCallum
Spring Valley High School

In recent years, depression has become an increasingly concerning topic of discussion in public high school. Less discussed is burnout, which is often mistaken for depression. The syndromes are not necessarily mutually exclusive, but they are treated differently. It is possible that teenagers experience burnout due to constant participation in clubs and community service activities they believe necessary to gain entry into competitive colleges. It was hypothesized that adolescents participating in sports will have lower burnout scores than others because better health likely leads to less burnout. It was also hypothesized that, due to competing priorities, adolescents participating in more weekly extracurricular activity hours would have higher burnout scores. In order to test the hypotheses, Richland School District 2 students were sent a survey asking about their extra-curricular activities. The adolescents then filled out the Maslach Burnout Inventory, which interpreted their burnout on a numerical scale. Results were tabulated and compared. An ANOVA showed no difference in burnout between students in any of the extracurricular time commitment categories $F(5,120)=0.184$, $p>0.05$. Likewise, a 2 sample Z test revealed no difference between sport participants ($M=60.1$, $SD=19.4$) and non-participants($M=59.5$, $SD=17.7$), $z=0.186$, $p>0.05$. Therefore, neither of the hypotheses were supported. While extracurricular activities do not decrease burnout, neither do they increase it, thus they should remain a part of of a well rounded education.

AN INVESTIGATION OF THE ROLE OF NEURAMINIDASE IN LUPUS NEPHRITIS

Caitlin McDade
South Carolina Governor's School for Science & Mathematics

Lupus Nephritis is an autoimmune disease that results in the deterioration of one's kidneys. The origins of Lupus Nephritis have been traced to an excess of pro-inflammatory cytokines and chemokines in Mesangial Cells. As the origins of Lupus Nephritis in these cells have not yet been explored in-depth, the objective of our research was to determine whether Neuraminidase mediated a specific cytokine known as IP-10. IP-10 demonstrated similar characteristics to another chemokine called IL-6 in the way it responded to varying levels of Neuraminidase. As IL-6 was found to be directly mediated by NEU, we hypothesized that NEU would also directly mediate IP-10. Using RT-PCRs and ELISAs, to measure the resulting level of mRNA and protein levels of IP-10 respectively, we measured to see if there was a correlation between increasing and decreasing Neuraminidase stimulation in Mesangial Cells and the resulting IP-10 mRNA and protein levels. Our results found that IP-10 does not directly mediate NEU though, as when OP, a neuraminidase inhibitor, was added to Mesangial Cells, IP-10 levels did not always decrease, but when stimulated with excess neuraminidase, they did increase.

MAKING CYBER SECURITY MORE ACCESSIBLE TO STUDENTS

Johnathan McDowell
South Carolina Governor's School for Science & Mathematics

Cyber security is a field that is becoming more and more important. Yet many universities do not put much focus on teaching this subject to students. This is especially true in liberal arts schools. By creating easier to understand and enjoyable course work in this subject universities could help their students became stronger in their cybersecurity knowledge. Through online courses and labs that allow students to actually test what they learned in a real world simulation students will get a better understanding of the world around them.

ENABLING DATA COLLECTION FOR GAIT ANALYSIS USING FLOOR VIBRATIONS

Lani McGuire
South Carolina Governor's School for Science & Mathematics

As humans walk on structures, we interact with it by sending vibrations through it. The structure reacts based on the way that the human affects it and vice versa. As they walk, they send a certain type of vibrations into the floor. Those vibrations would be different if that same person was to run across the floor. One of the research tracks of the Structural Dynamics and Intelligent Infrastructure (SDII) Lab is to study the differences between the vibrations, and to find a way to differentiate between the vibrations caused by humans on structures: people running, walking, and falling. To do that, a controlled environment must be created to measure the vibrations and include the relevant metadata to describe the acceleration records. In addition, the usable life of the data will be short. A National Instruments data acquisition system is used to collect the data and a python code must be developed to collect and document the data. The code is to ask questions before the experiment and store the parameters, then collect the data through the data acquisition system, and then save them all into one file. It will not only make collecting and storing the data faster and easier, but it will allow for results to be shared easily with others. The code was published and can still be edited by people online, but it has accomplished its primary goal.

AN AUTOMATED HARDENING AND SECURITY MONITORING PROGRAM FOR LINUX

Brendan McManamon
South Carolina Governor's School for Science & Mathematics

Linux malware tripled from 2015 to 2016 and has only continued to grow, particularly with the rise of botnets. A substantial fraction of malware exhibits similar behavior once installed, some of which can be clearly monitored, eventually leading to removal. Many initial exploitations come from easily-closed security gaps such as default credentials on exposed services or a lack of protection against brute-force attacks. The Python program that I developed is a text-based systems administration tool for Ubuntu Linux that fixes these common security issues while continuously monitoring for signs of intrusion. These security measures include: securely configuring critical services, stopping any unlisted services, setting strong password policies, checking users for easily decrypted passwords, deleting unauthorized users, checking the permissions of essential files, monitoring modifications of important listed directories and files, and verifying the integrity of system tools. The software was developed modularly, with almost every function independent of the others. The program uses the Bash shell and its various utilities extensively. The approach was primarily based on automatically implementing security measures using industry standards, blue-team competitions, reports, and papers as a guide. The program can be a useful open-source tool for any user, and it is another part of the growing security software solutions for Linux. Almost every function uses input text files, so no modifications to the source code are necessary in order to configure the program. While currently targeted towards Ubuntu Linux, it can be quickly adapted to other distributions of Linux.

ENVIRONMENTAL CONDITIONS ON RED DRUPELET INCIDENCE

Mackenzie Meadows
South Carolina Governor's School for Science & Mathematics

Blackberry growers and packers have long realized the difficulty of preserving the black pigment of fruit when preparing for consumers. Red drupelet reversion is when fully mature black drupelets return to a red, burgundy color after harvest. Reversion occurs between the time of fruit harvest and consumer purchase, causing it to one of the most difficult postharvest problems to control. The relative humidity (RH) and temperature at time of harvest in addition to direction of rows in relation to the sun could all be variables that affect this reversion of color. In this experiment, two cultivars 'Arapaho' and 'Natchez' were picked at two different times (7:30 AM and 10:00 AM) from two different sides (east or west), and then immediately delivered into cold storage. The fruit was taken out of storage at one-week and two-week periods, where the number of red drupelets was then counted and recorded for each berry. Sensors that recorded relative humidity and temperature every 30 minutes were set up around the berry perimeter. We found that red drupelet reversion was lower in 'Navaho' compared to the 'Arapaho' cultivar. We also found that in warmer weather, fewer red drupelets are present on the berries and reversion was most common when RH was between 80% and 60%. Warmer weather and increased hours of sunlight also appear to decrease the incidence of reversion on west-facing rows. With additional studies and confirmation of our results, pickers may be able to use this information to harvest higher yield of desirable fruit.

INCREASING THE COMFORT OF SCOLIOSIS BRACES

Muskaan Mehta
Center for Advanced Technical Studies

The purpose of this experiment is to increase the comfort of scoliosis braces. In scoliosis braces, sweat accumulates around the waist of the user, and it creates discomfort for the user. The sweat absorbency of 3 materials placed inside of a brace will be compared. The 3 materials are cotton, linen, and Silipos gel pads. One 4-inch square of the material will be placed on both sides of the waist of a mannequin. Before using the material, it will be weighed. On the mannequin, artificial perspiration will be placed on the waist area, the material will be placed on top of the artificial perspiration, and the mannequin will be placed in a room with a humidifier turned on. This will be so that the mannequin can simulate real-life conditions as accurately as possible. The humidifier will release steam in the room for approximately 8 hours. After the 8 hours are complete, the weight of the material will be taken once again. The difference in the weights before and after the period of 8 hours will determine how much sweat was absorbed. The prediction is that the Silipos gel pads will absorb the most sweat because they are medically produced for the purpose of relieving any discomfort or pain.

SHINING LIGHT ON THE ISSUE OF HARMFUL MICROORGANISMS

Emily Melton
Center for Advanced Technical Studies

The project Shining Light on the Issue of Harmful Microorganism is being developed to create a prototype of a UV-C light lamp. Potentially deadly microorganism are on the rise in public medical facilities such as doctors offices. Research on UV-C light has be found to eradicate microorganisms which could potentially solve this issue in public medical facilities. The goal of this project is to create a prototype of a UV-C light lamp that will reach all surfaces of rooms used to check patients in public medical facilities. A five head floor lamp and UV-C light bulbs will be used to create the first prototype of the lamp. A trial will then be completed to test the lamp by creating a simulation of a medical facility room. E.Coli will be spread around the simulation and then a test cycle will be run. After the cycle is run the surfaces the light was targeting will be swabbed to determine if the E.Coli was eradicated. Multiple trials will be completed to determine adjustment that will need to be made to the prototype to ensure all surfaces are being exposed to the light rays. The results will be determined by the amount of E.Coli eradicated. In the future the goal is to create a final prototype of a design of a lamp that can be stationary in public medical facility rooms and will reach all surfaces of the room.

ANALYZING DEHYDRATION IN HIGH SCHOOL ATHLETES

Jack Mensch
Center for Advanced Technical Studies

High school athletes are often dehydrated when practicing or playing their respective sports, this causes them to suffer from cramps, fatigue, and headaches which limits their ability to perform well in their sport. In an effort to prevent deyhdration, I will test athletes from my school district using a bio-electricscale. I am going to be comparing different sports as well as male and female results to see which sport and gender has the most hydrated athletes. Also, I will be giving the participants of the study a survey to see how hydrated they think they are and I will see if they have misconceptions about their true hydration levels. From this research I hope to be able to draw conclusions about student athlete hydration level and help prevent dehydration in the future.

THE EFFECT OF HEATHWOOD'S RUNOFF AND WATER QUALITY ON THE GILLS CREEK WATERSHED

Jackson Meriwether
Heathwood Hall Episcopal School

The purpose of this project was to test the water quality including the PH level, DO level, and the water temperature at heathwood hall, and compare it to Gills Creek measurements at bluff road made by the City of Columbia. The Independent Variable: Location of the measurements taken. Dependent Variable: The correlation or lack there of between the two data sets. The procedure involved collecting a sample from the heathwood pond and the runoff up the heathwood pond measuring the temperature there and then measuring the DO and PH levels once it had been brought back. After reviewing and analyzing the data and comparing the results to the hypothesis,

THE EFFECT OF THE *POGONOMYRMEX* ANT SPECIES ON CHEMICAL PROPERTIES IN HARVEST ORGANIC SOIL

Olivia Merritt
Heathwood Hall Episcopal School

The purpose of this study was to determine the effect of the *Pogonomyrmex* ant species on chemical properties of Harvest Organic soil. There were four different levels of chemical elements being tested in the soil: nitrogen, phosphorus, potassium and pH. Hypothesis one states "if the *Pogonomyrmex* ant species live in Harvest Organic soil for a designated amount of time, then the ants will change the nutrient level (N, P, K, pH) in the soil." Hypothesis two states "if the *Pogonomyrmex* ant species live in Harvest Organic soil for a designated amount of time, then the ants will change the pH level in the soil." The null hypothesis states that there will be no change in the chemical properties of the soil after the Pogonomyrmex ant species have lived there.

The *Pogonomyrmex* ants lived in a controlled environment for two weeks with Harvest Organic soil as the soil being tested. There were 20 ants per aquarium; there was 1000 mL of soil to ensure that each trial would contain an equal amount. The Harvest Organic soil will be tested around every three/four days. This experiment was run eight separate times. An inferential and descriptive statistical test was completed to test the mean and percent change of the data. All inferential analysis suggested that there was a statistically significant change in the different chemical levels of soil. Phosphorus had the highest percent change and potassium had the lowest. The mean for each trial was taken, then the overall mean for nitrogen, phosphorus, potassium and pH was gathered so that each variable had one mean. Therefore, the results supported the hypotheses. In conclusion the *Pogonomyrmex* ant species positively changed the differing chemical properties of the Harvest Organic soil.

THE EFFECT OF SENSORY IMPLEMENTATIONS ON INFORMATION RETAINED FROM VIRTUAL REALITY MEDIA

Andrew Miller
Spring Valley High School

This paper examines the addition of sensory implementations into virtual reality (VR) applications and their effect on the educational value of that application. The purpose of this experiment was to test how sensory implementations affect information retention and to find which sensory implementation are most beneficial to information retention. A group of 20 participants utilized 4 different apps over the course of this experiment to learn about a subject. They were then assessed using a short, 6 question follow-up quiz that included questions about the subject. Later on, the participants were sent a post-experimentation survey to measure the quality of their experience. It was believed that if trimodal (audio, visual, and haptic) feedback was implemented, the user's sense of presence within the virtual reality space would be the highest and the students would produce higher results on the post-assessment. Also, if asked which implementation increased their educational experience most, more participants would respond "visual".

THE EFFECT OF THE LUNAR CYCLE ON THE FEMALE REPRODUCTIVE SYSTEM

Brooklyn Moore
Heathwood Hall Episcopal School

The purpose of this experiment was to determine how the lunar cycle affects the female reproductive system. It was hypothesized that when the lunar cycle is in the full moon phase, there will be a higher percentage of people experiencing ovulation, higher aggression levels, and less sleep. In contrast, during the new moon phase, more people will record that they experienced menstruation, lower sexual desire levels, and a happier mood. After getting Human Consent Forms read and signed by a parent or guardian, 26 Heathwood Hall Upper School students (boys and girls of varying grades ranging from 9-12) completed forms regarding their reproductive system and everyday life, such as if they were menstruating or ovulating that day, as well as their sleep hours, sex drive level, and mood, among others. These forms were completed for four days on and/or surrounding the new and full moons for 4 trials (two new moons and two full moons). Each form was then separated by sex and moon phase and analyzed. It was concluded that during the new moon, more subjects recorded they had experienced menstruation. Additionally, during the full moon, more subjects experienced ovulation, higher sexual desire levels, and increased volatile aggression levels and sleep hours. A relationship between sleep hours and mood was identified, considering that when each gender experienced less sleep, they recorded a more negative mood. This project rejected the null hypothesis that there is no relationship between the lunar cycle and the female reproductive system.

THE EFFECT OF *LEUCOBRYUM GLAUCUM* ON THE GROWTH OF BRASSICA RAPA AND SOIL COMPOSITION

Sydni Moore
Spring Valley High School

Determining if mosses have a positive effect on plant growth can provide a cheaper and more efficient way of fertilizing plants. Synthetic fertilizers raise problems because of their inability to have nutrients readily available because they take longer than natural fertilizers to deposit into the soil. While natural fertilizers can be used, they offer low levels of nutrients and natural compost can take a long time to develop enough to use. This leads mass agricultural growers to look for cheaper and more efficient ways of fertilizing plants. It was hypothesized that the plants grown with moss around them and in the soil will grow faster and develop better than the plants without the moss. Different levels of *Leucobryum glaucum* were tested in a low, 20% by volume, and high, 40% by volume, concentration. The low concentration was made by taking 1200mL of soil and replacing 240mL with *Leucobryum glaucum*. The high concentration was made by taking 1200ml of soil and replacing 480mL with *Leucobryum glaucum*. The plants were then allowed to grow for 3 weeks and the growth in cm was measured once a week. An ANOVA test for the final week, ($F(2,87)=1.78$, $p=.174$), showed that there was no significant difference between the treatments of 20% moss, 40% moss, and control.

THE EFFECT OF SOAPS WITH AND WITHOUT TRICLOSAN ON THE HEALTH OF *PENICILLIUM ITALICUM*

Michael Moran, Alexander Roberts, and Ryan Shelley
Heathwood Hall Episcopal School

Our intent is to research the effect of soaps with and without triclosan on the health of *Penicillium Italicum*. *Penicillium Italicum* is a fungus harmful mainly to citrus plants. Throughout our experiment, we used the following materials: 60 petri dishes, three 500mL bottles of agar, an incubator, a fridge, Colony Counter (a smartphone app), Ajax Antibacterial soap, Dawn

Soap, an incubator, sterile swabs, and three tubes of living *Penicillium Italicum*. Google Sheets was used for data analysis. First, we filled all petri dishes with enough agar to cover the bottom, which translates to close to a millimeter. The two groups with soap were mixed with 1 part soap to 25 parts agar. From there, we divided the 60 dishes into the three separate groups of 20. The control group was introduced to the fungus with nothing added beyond the agar. The second and third groups both had soaps mixed into their agar and cultivated. Next, data was collected over the course of three days after it had been determined that the fungus had grown to a point where detection was possible. "Detection" relates to the Colony Counter app suggested by the head of science at our school that uses photos of petri dishes to identify colonies of fungi and bacteria.

THE EFFECT OF SOUND AND FOOD ON THE INTELLECT AND RESULTANT BEHAVIOR OF WILD SQUIRRELS.

William Morris
Heathwood Hall Episcopal School

In this experiment, the effect of sound and food on the training and the intelligence of wild squirrels was tested upon. The purpose of this research project was to support Pavlov's Theory of classical conditioning and to find if it was possible to train wild squirrels using sound and food. Pavlov has already proved it possible to train animals that are accustomed to human contact, but this experiment did not support that it is possible to train animals that are not used to human contact. It was hypothesized that if the squirrels can relate the sound on the phone to the food, then the squirrels will rush down to the platform after the sound is played. There was a board set up on a tree in the researcher's backyard. Food was put on the board everyday for 10 days. Whenever the food was put on the board, a sound was played. If the squirrels related the sound to the food then the would've thought that the sound means food. On the last day of experimentation, just the sound is played. If the squirrels come to look for food on the board, then the experiment would've been a success. In this experiment, the squirrels found the food and ate it, but never related the food to the sound.

EFFECT OF DIFFERENT PERSONAL LISTENING DEVICES ON SOUND PRESSURE MEASURED AT THE TYMPANIC MEMBRANE

Andrew Mott
Spring Valley High School

Permanent hearing loss due to the unsafe use of personal listening devices (PLDs), such as earbuds and headphones, has become increasingly common. The purpose of this experiment was to discover which type of PLD produces the safest listening experience. Accordingly, sound intensity generated at the tympanic membrane of an anatomically correct ear by the three most common types of PLDs (earbuds, closed-back headphones, and open-backed headphones) was measured. It is hypothesized that open-backed headphones will exert fewer decibels on the tympanic membrane than closed back headphones or earbuds and closed back headphones will exert less pressure on the tympanic membrane than the earbuds when a normalized input is used. Each PLD was put through a series of tests, including 10-second pure tones intervals, and a real-world test of the song "Bohemian Rhapsody". The data were analyzed with descriptive and inferential statistics. The analysis displayed that the mean dB level for the earbuds was higher than both headphones. The one-way ANOVA revealed a significant difference in sound output of the different PLDs as the p-value of < 0.001 is less than the alpha value of 0.05, allowing the null hypothesis of no difference to be rejected. The Tukey test revealed that the earbuds were significantly different from both headphones. The earbuds were 11% and 13% louder at the tympanic membrane than the closed and open back headphones respectively, whereas the headphones were not different from each other. These findings suggest that both headphones provide a safer listening experience than earbuds.

THE INCIDENCE OF DEEP VEIN THROMBOSIS AMONG VARYING TRAUMA PATIENT POPULATIONS IN COLUMBIA, SC

Amanda Murray
Chapin High School

Deep vein thrombosis is a condition which proves fatal in over 100,000 cases of hospitalized patients each year, most of which occur due to inappropriate prophylaxis administration upon arrival at the hospital, especially in trauma patients. The goal of this study is to analyze the incidence of DVT among trauma patients of different genders, ages, ethnicities, body mass indexes (BMI), and injury severity scores (ISS), and the incidence of these occurrences due to insufficient prophylaxis administration through a retrospective review in order to more appropriately administer initial prophylaxis based on an individual's specific risk rates. The delineated records of trauma patients who developed DVT going back at least two years will be obtained through Palmetto Health Richland's Extended Learner Program, and the records will only contain information prevalent to this study, not any patient-identifying information. The records are sorted using the hospital's record registry system based on the five stratifications of patient populations, and a chi-square and Pearson's correlation analysis is conducted to show significant associations and correlations between each variable and DVT. From there, records are analyzed to show how many patients received appropriate prophylaxis, and final conclusions are drawn. The outcome of this study is that patient populations of males, African Americans, those with a BMI of thirty or greater will have a significantly heightened risk of DVT than other patient populations, and these results have the potential to streamline initial DVT prophylaxis administration for incoming trauma patients based on physical patient features.

THE EFFECT OF HYDROGEN PEROXIDE (6%), HUMIC ACID (6%), AND DECAYING *HORDEUM VULGARE* ON *PYROCYSTIS FUSIFORMIS* GROWTH AND BIOLUMINESCENCE

Connor Myrick
Spring Valley High School

Algae are producers for many ecosystems, providing nutrients and energy necessary for an environment. Harmful algal blooms (HABs) wreak havoc on environments and recently, the frequency of HABs has increased. Blooms of *Pyrocystis fusiformis*, a type of bioluminescent algae, can quickly become toxic, affecting tourism and aquatic environments. The purpose of this experiment was to narrow down properties that allow *Hordeum vulgare* to inhibit algae growth, without affecting *P. fusiformis* bioluminescence. It was hypothesized that the combination of chemicals from barley would prove most effective at inhibiting algal growth. It was also hypothesized that the use of hydrogen peroxide would cause *Pyrocystis fusiformis* to bioluminesce most frequently. The algae was exposed to 3 mL of hydrogen peroxide, humic acid, and barley extract for twenty-one days. Then, frequency of bioluminescence (FoB) was observed and growth was recorded by dry massing the algae. The hypothesis claiming that hydrogen peroxide would result in the largest number of bioluminescent occurrences, was supported, $F(3, 116)=216.8311$, $p<0.00001$. The second hypothesis predicting that barley extract would suspend algal growth the most was not supported. Nevertheless, the null hypothesis could be rejected, $F(3, 116)=107.4650$, $p<0.00001$, as no statistical difference was found between the trials. While all the independent variables suspended algal growth, hydrogen peroxide did not significantly alter the frequency of bioluminescence in *Pyrocystis fusiformis*. The components and mechanics of hydrogen peroxide should be studied further in order to develop a beneficial method to suspend algal growth.

CONCEPTUALIZATION OF LACT IN CONJUNCTION WITH EGCG FOR CELL-TARGETING APOPTOSIS WITHIN *C. ELEGANS* UTILIZED AS A RAPIDLY PROLIFERATING CANCER MODEL FOR TUMORIGENESIS PREVENTION/SUPPRESSION

Abhijith Nair
Spring Valley High School

Approximately 1 in every 4 deaths in the United States are due to cancer. In accordance with the vast negatives present with the diagnosis of cancer, financial issues arise as well. In fact, some estimate basic chemotherapy to be as high as $65,000 over a month long period. Recent studies have introduced LACT within malarial prophylaxis to be used in a synergistic combination with cancer. Since both artemisinin and EGCG have anticancer and cell-targeting properties, their use may prove beneficial in the prevention/treatment of cancer. This project focuses on such anticarcinogenic and antiproliferative characteristics: specifically the synergy between these two drugs and how they could allow cell-targeting of artemisinin to stay intact while LACT driven functions of EGCG are still effective. These characteristics have been seen in the previous study utilizing an MIC concentration. This previously established synergistic MIC is used on *C. elegans*, which are dyed using a DAPI fluorescence assay and tested at specified wavelengths to assess apoptotic and nonviable cells. The combination would introduce a cost-effective treatment which may induce more apoptosis than current chemotherapy, thus decreasing the typical hardships in cancer treatment today. After experimentation, it was shown that because $t(14)=1.7613$, $p<alpha(0.05)$ in all three tests, there is sufficient evidence to suggest that the MIC created a significantly lower cell viability overall, however apoptosis was increased at an indefinitely higher rate. This supports the concept of LACT in a practical application, thus implying that antiproliferative results were achieved.

THE EFFECT OF SODIUM FLUORIDE, TURMERIC, AMPICILLIN, AND XYLITOL EXPOSED TO SODIUM LAURYL SULFATE ON THE INHIBITION OF *STREPTOCOCCUS MUTANS* BIOFILMS

Anika Nair
Spring Valley High School

Bacterial infections are a common problem in the field of dentistry. Bacteria exists as plaque and can form biofilms on the surface of teeth. Many recent dental diseases have rooted from the development of tooth biofilms. Finding a beneficial solution to inhibit the growth of these biofilms would reduce the risk of acquiring such diseases. The purpose of this experiment was to find the most effective treatment product which could successfully inhibit the most *Streptococcus mutans* biofilms. Knowing this would help others in the field of dentistry to incorporate such products in their daily practices in order to inhibit tooth biofilms and reduce the risk of dental diseases. It was hypothesized that if *Streptococcus mutans* were exposed to sodium lauryl sulfate and ampicillin, then the bacterial biofilms would absorb the most of this treatment, thus inhibiting their growth. *Streptococcus mutans* were grown in test tubes with different treatments added to them. The biofilms were then stained with crystal violet in order to detect the absorbance of the products on the biofilms. A one-way ANOVA test was run to test a difference in the means, and displayed a statistical difference between the means at $\alpha = 0.05$, $(F(4,143)=7.95957)$, $p<0.05$ when $p<0.00001$. A post-hoc Tukey test showed that the sodium lauryl sulfate and ampicillin treatment had a significantly higher absorbance mean compared to the other treatment means. Thus the hypothesis that using sodium lauryl sulfate and ampicillin in order to inhibit the highest amount of *Streptococcus mutans* biofilms was supported. It was concluded that using ampicillin and sodium lauryl sulfate in order to inhibit tooth biofilms is effective and could potentially be used in dental practices to reduce the development of dental diseases.

THE EFFECT OF *RHIZOPUS STOLONIFER*, *SORDARIA FIMICOLA* AND *COPRINUS CINEREUS* ON THE DECOMPOSITION RATES OF NEWSPAPER

Rachael Nall
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During the decomposition process, fungi takes over the decomposer community which is described as being a high involvement of fungi on the material. Species of fungi are primary decomposers in ecosystems because they can produce a variety of enzymes. Fungi also influences the decomposition of organic carbon, deposition of recalcitrant carbon, and transformations of nitrogen and phosphorus. The distribution of soil fungi gene in *Ascomycota* and *Basidiomycota* revealed that decomposition is a long-term process for transformation of plant polymers. Different types of fungi can allow for different rates of decomposition of materials. Some of the different fungal groups include Zygomycete, Ascomycete, and Basidiomycete. Bacteria and fungi are most abundant in the decomposition process. *Ascomycota* and *Basidiomycota* fungi groups contain the cbhI gene which is important in the decomposition process. The different microbial communities are based on DNA and RNA. Some fungal groups were located in the RNA functions and some fungal groups had decreased appearances on the DNA fungal group. The fungal groups with the cbhI gene are more significant in the decomposition process. In this experiment, *Rhizopus stolonifer*, *Sordaria fimicola* and *Coprinus cinereus* were used to measure decomposition rates of newspaper. *Rhizopus stolonifer* and *Sordaria fimicola* help recycle organic materials in food webs which make them important decomposers. The different fungi are being used to test the decomposition rates of newspaper.

GRAPHENE DEVICE FABRICATION AND CHARACTERIZATION

Jacob Nalley
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Graphene is a two-dimensional material consisting of a single layer of carbon atoms arranged in a hexagonal lattice. Graphene has some unique properties, as it is stronger than steel, it shows a high conductivity of heat and shows high carrier mobility(highest recorded mobility is 200,000 cm^2/Vs), and it only absorbs 2% of light that passes through it. Single layer graphene was grown on copper in this research as it has been found to produce higher quality graphene than any other material tested. After the growth occurred, a wet-based transferring technique was used to transfer the graphene from the copper foil onto a SiO_2/Si substrate. The transferring technique included the use of Ammonium persulfate to etch away the copper and a PMMA(Polymethyl methacrylate) layer as the sacrificial film. Indium dots were pressed on four corners of graphene working as electrodes for graphene characterization by a Hall effect measurement system. We also observed the graphene's sensing performance to NH_3 gas. The graphene's changing properties were measured with the Hall effect measurement system and presented in the report.

RISK ASSESSMENT OF CARDIOVASCULAR DISEASE AMONG VARYING DEMOGRAPHIC AND SOCIOECONOMIC POPULATIONS

Haley Nazario Ramos
Center for Advanced Technical Studies

The objective of this study is to gauge the risk assessment of varying demographic and socioeconomic populations and to promote efforts to make accessibility to educational and medical resources more available to the public. To achieve this, a risk assessment created for the National Health Service cardiovascular awareness programme will be supplemented to various communities and will test the participants' knowledge of cardiovascular disease (CVD). The Spearman Rho and Pearson Correlation statistical procedure will be used to identify the strength of the association between the participants economic and ethnic background in regards to their CVD perceived risk. The implications of this project would be to stimulate concerted efforts to increase awareness of CVD. Future work would focus on shifting risk profiles of CVD patients as well as conducting more studies on diverse populations to accommodate their risks for cardiovascular disease. Following the analysis of the 155 profiles, the Pearson correlation value was regarded with a moderate linear correlation within the economic lens. Additionally, the average profiles sustain the hypothesis with African Americans scoring a lowers perceived risk profile of perceived benefits and healthy eating intentions with the relatively lower averages of 2.872 and 3.198 respectively. The resulting data shows potential trends for a stronger correlation to occur within the economic and demographic lenses. The next steps of this project are to increase the sample size as well as diversify population representation to further validate the data.

THE EFFECT OF GREEN TEA POLYPHENOLS ON THE FORAGING BEHAVIOR, REPRODUCTION AND MASS OF *DROSOPHILA MELANOGASTER*

Jordan Nealey
Spring Valley High School

Green tea polyphenols (GTP) are a specific antioxidant phytochemical found in green tea. Antioxidants are beneficial to health by preventing illnesses and diseases from taking over the body. GTP has been found to have both positive and negative effects in *Drosophila melanogaster*. Over 34% of GTP consumption comes from green tea (Fukushima et al., 2009). The purpose was to determine if green tea polyphenols have long term positive or negative effects on the foraging behavior, reproduction and mass of *Drosophila melanogaster*. The higher the concentration of GTP, the poorer nutritional food choices the *Drosophila melanogaster* would make. *Drosophila melanogaster* that are exposed to higher dosages would most likely go to the sugar. Also, the higher the concentrations, the lower the mass would be and the lower the fertility. The amount of *Drosophila melanogaster*

they reproduced would decrease. A choice chamber was created giving the *Drosophila melanogaster* a choice between banana and sugar, all flies in each culture jar were counted for reproduction, and 100 flies were selected at random and massed individually. Two ANOVA tests [F (16.79) =17, p < .001] and [F (12.23) =12, p < .001] showed significance between GTP and mass of flies for both generations. There were drastic differences in reproduction of flies between GTP groups in both generations. Chi squares also showed differences between foraging behavior for both generations depending on GTP concentration. The hypotheses were overall supported.

THE EFFECT OF DEVELOPMENTAL NUTRITION WITH *PUERARIA MONTANA* EXPOSURE ON ETHANOL ADDICTION IN *DROSOPHILA MELANOGASTER*

Dawn Nguyen
Spring Valley High School

Pueraria montana is a Chinese weed that can provide affordable treatment towards alcohol use disorders. Kudzu, the common name of the weed, can decrease the mortality rates, prevalence, and unhealthy choices associated with alcohol addiction. Therefore, an experiment has been conducted to study the correlation between environmental factors and ethanol consumption with influence of kudzu in order to increase cures available for alcoholism. The purpose of this experiment was to see if equal access to kudzu but different food accessibility and nutritional value impacted recovery from ethanol addiction. It was hypothesized that the *Drosophila melanogaster* raised in a rich nutritional environment would consume the most ethanol. In order to test this hypothesis, the experiment began by raising the fruit flies in three developmental environments with a 5% kudzu concentration. When the model organisms matured, a 5% ethanol and 5% sucrose concentration was given using a capillary feeding (CAFE) assay. This allowed the ethanol consumption to be measured and studied between each developmental treatment over two weeks. An average consumption rate of microliters per day was calculated and recorded. Each treatment had extremely low consumption values. While the poor consumption rates were the highest, the rich consumption rates were the lowest. An ANOVA test [$F(2,3) = 0.500$, $p = 0.649$] was conducted to analyze whether the developmental environments impacted alcohol consumption. When compared at alpha = 0.05, the data was not significant. As a result, nutritional treatments with early kudzu exposure did not influence ethanol addiction.

AN INVESTIGATION INTO HOW WELL INDIVIDUALS FROM THE Z GENERATION ARE ABLE TO IDENTIFY THE DIFFERENCE BETWEEN RACISM AND STEREOTYPES IN DIFFERENT SCENARIOS.

Nam Nguyen
Spring Valley High School

The current American population has been observed to quickly claim and take offense to racism, even if the situation doesn't actually contain racism. This results in many false-claims, diluting the meaning of racism. As false-claims of racism spreads, people aren't going to focus on solving actual racism, as they'll be too busy focusing on the scenarios that aren't racist. The research conducted looks at exactly how well people from Generation Z (people born in the year 1995-2012) are actually able to identify racist scenarios. Generation Z was chosen specifically because it is the generation that will have the biggest impact in the near future. The experiment took the form of a survey, in which the participants were asked preliminary questions about their views on racism and stereotyping. Then, they were given a number of scenarios and asked to identify whether the scenarios were an example of racism or stereotyping. Based on previous observations, the claim of the experiment was that more people from Generation Z would claim racial stereotyping as racism, than they would claim racism as racial stereotyping. A t-test was done to see significance between the amount of times participants incorrectly labeled the scenarios The results from the t-test shows that the amount of times participants incorrectly labeled racial stereotyping ($M = 5.75$, $SD = 6.932$) was statistically about the same as the amount of times participants incorrectly labeled racism ($M = 8.01$, $SD = 6.664$), $t = 0.2304$, $p = 0.05$. The hypothesis was not supported as neither scenarios were incorrectly labeled more than the other.

MEASURING CHANGES IN SURFACE MAGNETISM USING THE PLANAR HALL EFFECT

Nghia Nguyen
South Carolina Governor's School for Science & Mathematics

Prior research has shown that the application of solvents can change the magnetic properties of thin film metals. For example, solvents can reduce the coercivity of thin film metals and change gold from a diamagnetic to a paramagnetic metal. However, this effect is not yet understood. My research focused on the use of Hall bars to measure these changes in surface magnetism. Our research group at the University of South Carolina wanted to study this phenomenon, so we used the planar Hall effect to observe coercivity in thin film metals. Hall bars are created using photolithography and thermal evaporated metal in the presence of a magnetic field. These Hall bars use the planar Hall effect (PHE) to produce two voltage peaks in an externally applied, alternating magnetic field. The separation of the two PHE peaks are dependent on the coercivity of the metal. The objective is to collect data on magnetic field and Hall voltage and compare it to the data after application of solvents. A change in coercivity would therefore indicate changes in the in-plane magnetic field. However, only preliminary data was taken. Therefore, no decisive conclusions can be made. If successful, this research can expand our knowledge of magnetic properties of metals and be controlled for applications in computer engineering, such as computer memory and logic gates.

TILTED ACCRETION DISK'S PRECESSION AND THE EFFECTS ON RELATIVISTIC JETS

Tri Nguyen
South Carolina Governor's School for Science & Mathematics

This paper presents the results of our efforts to simulate precession of accretion disks in a tilted system using the cubed sphere grid. The main reason for this research is the effects of the precession on the relativistic jets. Due to the nature of these jets, they suppress star formation at high power and induce star formation at low power. This eventually leads to the evolution of the entire universe as these jets have been found throughout the universe. The research used Cosmos ++, a code developed by Dr. Fragile and collaborators for astrophysical simulations. The cubed sphere grid was also used instead of the spherical polar grid. While spherical polar is more widely used, variables became broken at the poles along with the timestep being extremely small. The cubed sphere grid allows for uniform zones throughout the surface of the grid. However, getting magnetic field to work at the boundaries of the grid's blocks have been difficult, rendering the jets unusable for our simulations. The problem is still being investigated to hopefully integrate magnetic field or a new grid will have to be used.

THE OPIOID CRISIS IN CORRELATION WITH WISDOM TEETH REMOVAL SURGERY

Ashley Noller
Center for Advanced Technical Studies

The goal of this research is to analyze the correlation between wisdom teeth removal surgeries and the overprescription of opioids. The issue of overprescription of opioid drugs is becoming more prominent in America as the number of addictions and overdoses contines to rise. Another issue that can been seen is that people do not know how or where to safely return medications so they are not being returned. Results are expected to show that medications for wisdom teeth surgeries are being over prescribed and people do not know how to properly dispose of the drugs. A survey will be used to search for a correlation between these variables.

THE EFFECT OF PROLONGED EXPOSURE OF COPPER SULFATE IN GERMICIDE ON THE GROWTH OF MICROBES

Johannamarie Nwanagu
Heathwood Hall Episcopal School

The purpose of this experiment is to see if $CuSO_4$ in a cleaning product could continuously limit the growth on a surface after a period of time for use in a medical setting. If $CuSO_4$ is added into a hospital grade germicide, then the number of bacterial colonies after 8 hours will be less than a surface cleaned with germicide without $CuSO_4$. Four solutions with varying concentrations of $CuSO_4$ were used to clean a masked off portion of a school desk. The portion of the desk that was cleaned was swabbed eight hours later and used to inoculate 1 mL of luria broth. The broth was then incubated overnight then spread onto petri dishes and incubated overnight. The resulting colonies of bacteria were counted using the phone application ColonyCounter. After running a single factor ANOVA test the results found are statistically insignificant and do not support or refute the hypothesis because the results are inconclusive.

THE EFFECT OF LED, UV, AND FLUORESCENT LIGHT ON *LACTUCA SATIVA* IN A HYDROPONIC SYSTEM

Serena Parmar
Heathwood Hall Episcopal School

Hydroponics has revolutionized the world of agriculture. Its advancement has led to the successful growth of plants without soil. Many studies have compared plants grown hydroponically to plants grown traditionally in soil. This study was conducted to observe the effect of LED, UV, and fluorescent light on the growth rate of Lactuca sativa, compared to a control group grown under natural sunlight. It was hypothesized that plants grown under natural sunlight would have a higher growth rate than plants grown under other lighting. During this experiment, plants were grown in hydroponic systems under respective lighting for 4 weeks. Their height and number of leaves were measured three times a week and both the average height and average number of leaves were tested in single factor ANOVA tests. The statistically significant data was further analyzed in post hoc testing. The results obtained for average height under various lighting groups was not statistically significant in contrast to the data for average number of leaves which was statistically significant. After further analyzation, it was concluded that the plants grown under UV light had a significantly lower number of leaves than the plants in other groups. The null hypothesis that if lettuce is exposed to UV, LED, fluorescent, or sunlight, then there will be no variation between the different lighting groups was rejected.

THE ROLE OF CD73 IN REGULATING PRO-INFLAMMATORY INTERLEUKIN IL-6 VIA NF-KAPPA B DURING *PORPHYROMONAS GINGIVALIS* INFECTION

Chetna Patel
South Carolina Governor's School for Science & Mathematics

THE EFFECTS OF ACETYLSALICYLIC ACID AND METHYLTHIONINIUM CHLORIDE (MTC) ON MORTALITY OF *CAENORHABDITIS ELEGANS* WITH THE CL2006 STRAIN

Jay Patel
spring Valley High School

Alzheimer's disease (AD), the most common form of dementia, is a neurodegenerative disorder of the brain that leads to memory loss. AD affects 5.3 million Americans and is the sixth leading cause of death in the United States. The purpose of this experiment was to test the efficiency of theorized tau and amyloid beta inhibitors on slowing down the effects of AD and to better understand the relationship between amyloid beta inhibitors and tau inhibitors. It was hypothesized that the group treated with acetylsalicylic acid and the group treated with MTC and acetylsalicylic acid would be the most effective in slowing down the neurodegeneration. *C. elegans* with the CL2006 strain was used to mimic AD. Before experimentation, 20 petri dishes were divided into quarters and cultured with *C. elegans*. Then, different treatments were added to the petri dishes. After five days, three areas from each trial were randomly chosen to calculate the average mortality rate. Percentages were the most ideal way to record the data because of the different amounts of *C. elegans* in each petri dish. An ANOVA test was conducted at an alpha value of 0.05. The p value was <0.001 which means there was statistical significance. A Tukey test was also conducted. There were honest statistical significance between the control and the group treated with MTC, the control and the group treated with MTC and acetylsalicylic acid, and the group treated with acetylsalicylic acid and the group treated with MTC and acetylsalicylic acid. The group treated with MTC and acetylsalicylic acid was the most effective at reducing the mortality rate of the *C. elegans*.

THE EFFECT OF ETHANOL, N-ACETYL CYSTEINE, VITAMIN C, AND GLUTATHIONE ON BEHAVIOR AND HEALTH IN *C. ELEGANS* EXPOSED TO ACRYLAMIDE

Khushi Patel
Spring Valley High School

Over the past decades, the western diet has seen a rise in the number of fried food items that are consumed. This process of cooking can lead to the production of acrylamide, large amounts of which have been linked to multiple cancers, neurological problems, and fetal abnormalities (Kumar et al., 2018). The purpose of this experiment was to look at different types of therapies that could lessen the effects of acrylamide poisoning in *C. elegans*. It was hypothesized that if different therapies were added to *C. elegans* exposed to acrylamide, then glutathione would prove to be most successful. In this experiment, petri plates of agar and acrylamide were prepared with C. elegans. Additional petri dishes were prepared with therapies. The first set of plates, which had acrylamide present in them, were chunked into the respective plates of therapies. A data collection was conducted after one week where the number of nematode eggs, living nematodes, dead nematodes, and a phototaxis response were recorded. A One-Way ANOVA [$F(3, 116)= 46.471$, $p<0.001$] conducted on the number of dead nematodes resulted in a p-value less than 0.001. When compared to an -value of 0.05, this data was statistically significant. A One-Way ANOVA [$F(3, 116)= 106.703$, $p<0.001$] conducted on the phototaxis response data resulted in a p-value less than 0.001. When compared to an α-value of 0.05, this data was statistically significant.

THE EFFECT OF BROMINE, HARDNESS, CYANURIC ACID, AND PH ON TAP WATER

London Patel
Heathwood Hall Episcopal School

The purpose of this experiment was to compare different states' tap water with respect to pH, bromine, cyanuric acid and hardness. Free Chlorine, Iron, Copper, Lead, Nitrate, Nitrite, Total Chlorine, Fluoride, Lead, Carbonate, and Total Alkalinity data will be included if statistically nominal. The hypothesis for this experiment is that northeastern states will have better water quality due to the increased amount of total rainfall compared to southern states. The procedure for this experiment included immersing the water test strips into the solution of water from each state. After two to three weeks, another trial for all of the states were conducted. The first trial's data showed a constant pH of 6 throughout the country; Cyanuric Acid levels were high in Atlanta, Georgia; Charlotte North Carolina; and Key West, Florida. Regions located in the south, such as Charlotte, North Carolina; Atlanta, Georgia; Key West Florida; and Dallas, Texas all contained high Copper levels. Philadelphia, Pennsylvania; Bangor, Maine; and Key West, Florida contained high amounts of Nitrate, with only Key West, Florida having a high amount of Nitrite. Even when St. Louis, Missouri had a hardness level of 120, all of the other regions contained hardness levels from 25 to 50. In conclusion, states in the southeastern region of the United States have worse water than northern states. Key West, Florida showed to have the worst water in all of the tested regions.

SYNTHESIS OF CORANNULENE-BASED COVALENT ORGANIC FRAMEWORKS (COFS)

Nishi Patel
South Carolina Governor's School for Science & Mathematics

My research is the development and synthesis of different forms of both corannulene and fullerene molecules. These molecules are organic compounds composed of carbon and hydrogen bonds, which are strategically created through various chemical reaction. Each process has multiple steps each creating different intermediates, ultimately leading to the final products. Each step is unique, with the reagents added, to the temperature needed for the reaction to occur. However, most reactions need to be done under nitrogen, as any interaction with oxygen may result in a large combustion. We are currently experimentally testing corannulene and fullerene to see its potential uses for the future. The current tests are showing progress towards the

ultimate goal, as there has been a positive reaction to light. This can ultimately lead to corannulene and fullerene being used as cells for storing energy, hydrogen cells, and solar cells, and even creating more efficient lithium ion cells.

THE EFFECT OF AN ALTERNATIVE BLOOD MEAL SOURCE FROM GLYCINE MAX ROOT NODULES ON THE EGGS LAID AND SUCCESSFUL LARVAL BIRTH OF *CULEX PIPIENS*

Parth Patel
Spring Valley High School

Mosquito-transmitted diseases have led to a vast increase in attempts to find a sustainable method to reduce the vector's population. The purpose of this experiment was to use leghemoglobin, a heme protein formed in nitrogen-fixing nodules, to reduce mosquito reproduction and offspring. It was hypothesized that leghemoglobin would lead to fewer eggs laid by the mosquitoes and the percentage of larvae that surface from the eggs would be lower since the structure of leghemoglobin contains less protein and iron, two essential nutrients for making eggs. Leghemoglobin was isolated from Glycine max root nodules that were dried in a desiccator and ground to a powder. Both protein powders were dissolved and given in two specific concentrations to ten mosquitoes in an even gender ratio. Eggs were counted after two days, and two additional days were given for the larvae to emerge. The larvae were then counted by displacing them from the water. The leghemoglobin resulted in less eggs and larvae compared to hemoglobin. A two-way ANOVA was run to study the significance of the blood meal and concentration on the number of eggs and percentage of larval emergence. The Bonferroni test conducted for egg production at α=0.05 resulted in a p-value of <0.001. The egg production results were deemed significant, whereas, the results for successful larvae ended up being insignificant. It was found that the mosquitoes were able to adjust to the meal, creating a lower quantity of eggs, but still providing enough nutrients for a successful hatch.

CHEMICAL MODIFICATION OF TOBACCO MOSAIC VIRUS (TMV) NANOPARTICLES

Ronak Patel
South Carolina Governor's School for Science & Mathematics

Tobacco has an ill reputation from negatively impacting health in the form of cigarettes. Smoking has been directly linked to lung cancer which, according to the American Lung Association, will cause an estimated 154,050 Americans to die in 2018, accounting for approximately 25 percent of all cancer deaths. Tobacco is the cause of the deadly disease, however, the research aims to use tobacco to develop medicine. Specifically, the research focuses on using a virus from tobacco plant. Plant viral nanoparticles (VNP) are a promising type of nanocarrier that is degradable, can be chemically and genetically modified, and safe for human use. VNPs are used to display cancerous cell antigens. Tobacco mosaic virus (TMV) is a commonly used rod-shaped plant virus that is 300nm in length. Its viral capsid contains 2130 identical coat proteins assembled in a helical structure. This project produced a mutant of TMV that contains solvent exposed lysine residues (TMV-EPMK) through modification with cell targeting motifs. EPMK is the amino acid sequence code associated with the TMV mutant. E is glutamate, P is proline, M is methionine, and K is lysine. TMV samples were propagated with tobacco plants. A TMV sample was then isolated and purified through centrifugation. Afterwards, a bioconjugation was performed with TMV and diazonium salt to produce TMV-EPMK. This process was confirmed with Matrix-Assisted Laser Desorption/Ionization Time-of-Flight (MALDI-TOF) mass spectrometry, an analytical technique that measures the mass-to-charge ratios of samples. Future research would involve attaching folic acid to TMV-EPMK in order to target cancer cells.

COMPARATIVE STUDY OF THE EFFECTS OF SCREEN TIME ON ADOLESCENTS AND ADULTS

Sachin Patel
Marion High School

The purpose of the experiment—the effects of screen time—is to allow individuals to have a better appreciation of how technology affects us every day intentionally and unintentionally. Technology, meaning anything that can reduce human effort, has surrounded us for more than centuries. In this experiment, the data was collected from 400 students on how they utilize technology throughout their day. A broad approach that was aimed to reach was to find out whether students would prefer talking through various messaging systems rather than one-to-one conversations. The students' results are then compared with those of the adults. This will establish parameters on how the technology affects people from different generations and walks of life. Furthermore, blue light, which is a type of light that is emitted from technology, has the ability to penetrate through the eyes' natural filters. Blue Light can affect people negatively if the technology is being overused at night. After reading this report, one will have a better understanding of the effects of technology on their relationships and on their health.</p>

THE ANTIBACTERIAL EFFECT OF COTTON INFUSED WITH COLLOIDAL SILVER AND COTTON INFUSED WITH COLLOIDAL COPPER ON NON-VIRULENT STRAINS OF *E. COLI* OVER SHORT PERIODS OF TIME

Yash Patel
Spring Valley High School

In recent years there has been a rise in hospital acquired infections which are very prevalent because they consist of multidrug resistant bacteria, and biofilms. The purpose of this study was to see if silver and copper nanoparticles are effective against household bacteria, such as E. coli K-12. It was hypothesised that the silver colloid would perform better then both the copper colloid and the Lysol disinfectant. It was further hypothesised that the copper colloid would perform better than the Lysol

disinfectant. Cheesecloth was used to simulate the wiping effect that would occur if it were to be used as a antibacterial spray. The cheesecloth, saturated with either colloidal copper, colloidal silver, or Lysol disinfectant, was used as Kirby-Bauer Disks to conduct a Kirby-Bauer Disk Diffusion Test. The zone of inhibition area per centimeter squared of cheesecloth was used to conduct an ANOVA test, at alpha equal to 0.05. The ANOVA test showed, [$F(2,86)=0.42$, $p=0.662$], that there was no significant difference between the zones of inhibition per area of cheesecloth for lysol, copper colloid, and silver colloid. The result of this study showed that colloidal copper and colloidal silver should not be primarily used for household bacteria such as E. coli K-12 because they perform at the same level as regular disinfectants, such as Lysol.

THE EFFECTS OF NATURAL BIOACCUMULATOR AND HYPERACCUMULATOR BIOCHARS FOR SOIL PHYTOREMEDIATION AND COMPOUND SUSTAINABILITY OF NITROGEN, PHOSPHORUS, POTASSIUM, AND PH BY *LEPIDIUM SATIVUM*

Ronit Pathak
Spring Valley High School

In opposition to artificial phytoremediation techniques, plant-based composts have arisen in efforts to combat heavy metal detoxification in garden soil. This experiment aimed to remodel hyperaccumulating and bioaccumulating plant species in combination with pine chips in efforts to successfully retain traces of N, P, K, and pH in soil. It was hypothesized that if compounded *Lactuca sativa* is added to pine chips, soil phytoremediation rates and compound levels of N, P, K, and pH within the soil of *Lepidium sativum* would be sustained at their healthiest levels. Thirty pre-grown hyperaccumulator and bioaccumulator plants, *Brassica oleracea* and *Lactuca sativa*, were massed with pine chips, baked in an oven at 115 ℃ for 1.5 hours, and then grilled for 20 minutes. After application to soil pots, LusterLeaf kits were obtained and capsule tests were run to determine changes in K, N, P, and pH. The hypothesis was partially supported as the bioaccumulator biochar had the highest averages in oz./100 square feet for K and pH, the hyperaccumulator biochar group for P, and the control group for N. Each of the experimental groups were modeled by time plots, where P hyperaccumulator biochar ($p=0.0097<\alpha=0.05$), N control ($p=0.001<\alpha=0.05$), K bioaccumulator biochar ($p=0.007<\alpha=0.05$), and pH bioaccumulator biochar averages = 7.05. It can be concluded that although common soil is best for nitrogen sustainability, hyperaccumulator and bioaccumulator biochars are best suited for optimal potassium, phosphorus, and pH retention in soil.

2,2',3,5',6-PENTACHLOROBIPHENYL (PCB-95) INDUCED TOXICITY ON EARLY DEVELOPMENT OF ZEBRAFISH (DANIO RERIO)

Victoria Paul
South Carolina Governor's School for Science & Mathematics

Polychlorinated Biphenyls (PCBs) are toxic chemicals that are of public and wildlife health concern because of their persistence and bio-accumulative properties. Out of 209 different congeners of PCBs, PCB -95 was used in the current study. This study serves to show that exposure to PCB-95 causes brain cell necrosis, which is one mechanism for the PCB-95 toxicity. Zebrafish (Danio rerio) embryos at 2 cell stage with intact chorion were exposed to different PCB-95 concentrations (0.25ppm, 0.5ppm,0.75ppm, 1 ppm) with two controls (E2 solution and a DMSO solution). After exposure, the embryos were incubated for 7 days. At day 7, brains were sectioned and stained with toluidine blue. Higher brain cell necrosis was observed in the treated group compared to the controls. Further, necrosis increased in the treated groups in a dose dependent manner. Together with, survival rates, morphological deformations and brain necrosis, we confirm PCB -95 exerts toxic effects on early development of an organism. The results of the present study can be coupled with molecular and other toxicological assays to reveal the possible toxic mechanisms of PCB -95 on neurogenesis of an organism.

THE IMPACT OF GRAVITY ON THE HABITABILITY AND STRUCTURE OF LIFE ON TRAPPIST-1E

Frazier Peluso
Heathwood Hall Episcopal School

In this paper, we assess the possible environmental conditions on Trappist-1e, as well as the structure of life if any organisms exist on the planet. Through the analyzation of previous data, we have determined that Trappist-1e is most likely a water-dominated world, and if habitable, would possibly contain a large number of aquatic organisms within its oceans. We assumed an Earth-like atmosphere for the planet, as well as implementing different climate models to assess the planet's habitability. The planet has shown itself to be a remarkable candidate for habitable exoplanets, with it being in both the conservative HZ (habitable zone) as well as the tidal HZ, giving it enough heat to contain water on its surface, regardless of atmospheric pressure (however, we assumed an atmosphere of 1 bar for planet e). Furthermore, the planet shows signs of containing a magnetosphere similar to that of Earth, giving the planet protection against the UV fluxuations from the planet's host star, Trappist-1. Life on the planet would most likely be a majority of aquatic organisms, with a similar ecosystem to that of Earth. However, due to pressures presented by a mass ocean, most aquatic lifeforms would most likely be in equilibrium with the environment in order to adjust to a great deal of pressure, much like deep-sea organisms on Earth.

AN ANALYSIS ON THE POTENTIAL EFFECT OF CLIMATIC CONDITIONS ON CORN AND PEANUT PRODUCTION IN THE COASTAL REGIONS OF SOUTH CAROLINA

Jayra Penaloza
Spring Valley High School

Climate change is a change in global or regional climate patterns. The increased levels of atmospheric CO_2 produced by the excess burning of fossil fuels and the ensuing greenhouse effect contribute to this. Agricultural productions are heavily altered by changes in climate as crops are dependent on climatic conditions to germinate and grow. The agricultural sector, helps sustain life and accounts for about 9% of SC's economy (SCDA, n.d.). Thus it is important to understand the relationship between climatic factors and agricultural production. Experimentation began by collecting data from the USDA: NASS, US Climate Data, and the NOAA: NCEI. The data was then categorized and analyzed through a Pearson correlation, a numerical representation of the explored relationship. An ANOVA was added to significant relationships to ensure a difference in climate or crop outcome. The hypothesis was that if temperature and total liquid content are tested for a correlation to the changes in corn and peanut production over the span of 4 years in the coastal regions of SC, then the coastal zone would contain the highest correlation for temperature and corn. At α=0.05 the hypothesis was not supported. The outer coastal plain held a significant relationship for the lb/ac of peanuts to the TLC and temperature with p=0.022 and 0.013, respectively. County wise Colleton, Bamberg, Horry, and Dorchester held at least one significant relationship. This means that the crops were adversely affected by increased precipitation at the local scale, except for Dorchester county.

COMPARING THE EFFECT OF TGFB ON EXTRACELLULAR MATRIX GENE EXPRESSION IN WHOLE SKIN AND DERMAL FIBROBLASTS

Michael Pennell
South Carolina Governor's School for Science & Mathematics

Scleroderma, or Systemic Sclerosis (SSc), is a connective tissue disease that causes hardening / tightening of the skin and connective tissues. Scleroderma has a 50% 10-year mortality rate and fibrosis is responsible for 45% of deaths in the developed world. One of the staples of Scleroderma, fibrosis, is a leading cause of death worldwide but there are currently no FDA-approved agents capable of stopping or reversing fibrosis. When treating samples of whole skin and isolated skin fibroblasts with TGFß(Transforming Growth Factor Beta), isolating RNA, synthesizing mRNA, then running quantitative real time polymerase chain reaction (qRTPCR), the increase in the strands of Collagen 1A1, Collagen 1A2, and Fibronectin in the extracellular matrix was expected to be greater. The induced response of the Collagen 1A1, Collagen 1A2, and Fibronectin in the extracellular matrix by TGFß did have a similar trend of increasing in whole skin tissue and in primary skin fibroblasts. In the future, different concentrations of TGFß should be tested in human skin to identify a concentration that generates a consistent response. The variability of the response in human skin from different individuals reflects susceptibility for developing fibrosis and/or different kinetics of response.

AN ANALYSIS OF THE ECONOMIC, ENVIRONMENTAL, AND ETHICAL BENEFITS OF REPROCESSING SINGLE USE MEDICAL DEVICES

Niko Petersen
South Carolina Governor's School for Science & Mathematics

Since the 1970s, hospitals around the world, particularly in the United States, Canada and Europe, have employed the practice of reprocessing medical devices intended for single use. Single use devices (SUDs) include blood pressure cuffs, deep vein thrombosis compression sleeves, harmonic scalpels, endoscopic trocars, balloon inflation devices, and many more. However, as these devices became less expensive to fabricate, they became more economically viable to dispose of after one use. In recent years, companies like Stryker and Johnson & Johnson have expanded the reprocessing market. These corporations have proven that third party reprocessing can save hospitals millions of dollars in costs, as well as divert millions of pounds of biohazardous waste from landfills and create a more sustainable medical market. The market is still in its early stages, so there is a lot more room for it to grow from its $1.64B global market share. This poster will delve into the Economic, Environmental, and Ethical benefits from reprocessing single use medical devices for all parties involved: the third party reprocessor, the hospital, the patient, the sterilization company, and the insurance company.

THE EFFECT OF EARTHWORMS ON SOIL PH

Pete Peterson
Heathwood Hall Episcopal School

In this experiment, the purpose was to see if there was correlation between earthworms and soil pH. Two containers of soil were put on a porch outside and every week from October 27, 2018 to December 15th, 2018, the pH of that soil was checked. Each week, however, several increasing amounts of earthworms were added to both containers. At the end of the 7 weeks, a combined 36 worms were in both containers. Around week 2 for one container and week 4 for the other container, the pH shifted to 8.0 on the scale from the 7.5 it started out on. While it is possible that this shift could be due to the earthworms, poor experimental design let other factors interfere with seeing if the earthworms exclusively affected the pH. Another issue that disallows a statement about whether the earthworms affect the pH or not is that the two containers, despite being in the same location, shifted at two different times.

THE EXPRESSION OF GLYCINE RECEPTOR TYPE 4A (GLR4A) IN MAMMALIAN CELLS

Jean Pinto
South Carolina Governor's School for Science & Mathematics

Kidney diseases damage the kidney's ability to filter blood which can lead to chronic symptoms that can deteriorate to kidney failure and then possibly death. One-in-six people who suffer from a kidney disease, suffer from kidney disease focal segmental glomerulosclerosis (FSGS), the goal in this study is to better understand some of the mechanisms underlying it. This specific area is very novel as the mutation of glycine receptor type 4a (GLR4a) was just recently discovered to contribute to FSGS and the amount of research done on glycine receptors in the kidneys is very scarce. Procedures carried out in this investigation included: multiplying bacterial cells with DNA that carried the targeted gene, isolating the DNA, quantifying the DNA, and assuring its purity before then inserting the DNA into mammalian cells and visualizing the proteins in cells using confocal microscopy. After visualization of the proteins it was evident that protein was structured and clustered in the cytoplasm of the mutant-type (cells with the targeted mutant gene) and more concentrated than the wild-type, while contrasting with the control-type cells in which protein was evenly distributed throughout the cell. This data would need to be further verified with more visualizations, but it does indicate that the mutant-type of GLR4a has an effect on the distribution of protein within the cell and further research could extend off of the findings of this research to find future solutions.

THE EFFECT OF GLYPHOSATE TOLERANT SOYBEANS ON THE PH, NITROGEN, AND PHOSPHORUS LEVELS OF THE SOIL

Andrew Polson
Spring Valley High School

Genetically modified plants (GM) can have both positive and negative effects on the environment. The purpose of this study was to see how GM plants affect their surrounding environments versus Non GM plants. Soil qualities like pH, N, and P were tested to show whether GM plants affect specific soil nutrients. It was hypothesized that the soil of the GM soybeans would have the same pH, N, and P levels as the soil of conventional soybeans. About 35 mm from the top of the soil, 30 GM soybeans and 30 conventional soybeans were planted in separate plastic pots. After 45 days soil samples were taken near the roots of the plants. Soil test kits were used to determine the specific qualities of the soil. The conventional soybeans ($M=6.742$, $SD=0.362$) and glyphosate tolerant soybeans ($M=6.708$, $SD=0.474$) did not differ significantly on the pH levels of soil, $t(54)=0.31$, $p=0.756$, but the conventional soybeans ($M=50.667$, $SD=29.117$) reported higher nitrogen levels in soil than the glyphosate tolerant soybeans ($M=27.667$, $SD=14.547$), $t(42)=3.87$, $p<0.001$. Like the pH tests, the conventional soybeans ($M=15.383$, $SD=4.063$) and the glyphosate tolerant soybeans ($M=14.933$, $SD=3.629$) did not differ significantly on the phosphorus levels in soil, $t(57)=0.45$, $p=0.653$. GM plants do not have negative effects on soil pH, N, or P levels.

THE EFFECT OF FIASMA ON IL-6 SECRETION AND EXPRESSION STIMULATED BY LPS AND PALMITIC ACID IN RAW 264.7 MACROPHAGES

Audrey Pope
South Carolina Governor's School for Science & Mathematics

Increased concentrations of palmitic acid (PA) and lipopolysaccharides (LPS) within the human body increase the likelihood for individuals to develop periodontitis. These substances appear in greater quantities in patients with diabetes and other metabolic syndromes. The purpose of this study was to discover the most potent inhibitor of IL-6 expression out of four different antidepressants known to be FIASMAs: amitriptyline (AMI), fluoxetine hydrochloride (FH), sertraline hydrochloride (SH), and paroxetine hydrochloride hemihydrate (PH). By culturing RAW264.7 mouse macrophages and running Enzyme-linked immunosorbent assays (ELISA) the expression of IL-6 can be quantified and analyzed. By using an antibody-antigen-antibody sandwich model, only the excess IL-6 was detected by the spectrometer indicating the potential damage that would be done to a human subject. The four FIASMAs were tested against LPS alone, PA alone, and LPS and PA together, the aim was to show the symbiotic relationship that the two substances have resulting in such serious cases of periodontitis. After analyzing the results, SH was the antidepressant with the greatest amount of inhibition. This will be a useful discovery to prescribe to diabetic patients, not to cure their diabetes associated periodontitis, but to decrease the severity of it or prevent it from becoming more severe.

THE EFFECT OF CLOTHING ON TEST TAKING ABILITIES.

Pamela Ann Pope
Heathwood Hall Episcopal School

The purpose of this experimental research project is to determine if the type of clothing being worn has a correlation to test taking abilities. The investigation started out by reading Predictably Irrational and then researching questions to use on the test that the subjects would take. The researcher then wrote down the questions and created the test. Next the researcher printed out the tests and created consent forms. The researcher gave the consent forms to the subjects that would be taking the test and then received the consent forms back. The researcher then told the subjects what to wear (fancy or casual clothing). Then she had the subjects come into a room, and they were handed a test. They had no time limit when taking the test. The subjects turned in the test, and the researcher then corrected their tests. Then, the researcher had the same test subjects take the test again but in a different outfit than what they wore the first time. The researcher repeated the same steps that were

done before. The researcher then looked at the correlation between the test results regarding fancy and casual clothing. The researcher repeated the experiment with different people in each group for a total of three trials. Lastly, the researcher thanked the subjects that participated in the experiment. The results concluded that there was no correlation between fancy and casual clothing. In conclusion, when taking tests, it does not matter what people wear; people will get the same test results.

ANALYSIS OF THE CYSTEINE DESULFURASE MECHANISM USED BY THE PLP BOUND PROTEIN SUFS

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Iron homeostasis is crucial to overall cellular health. To keep iron levels in the cell stable, organisms have developed methods to regulate iron due to its toxicity at high concentrations. One of these is the creation of iron – sulfur (Fe – S) clusters. In E. coli, the Suf Pathway contributes to the biogenesis of these clusters. The Suf pathway is primarily used under oxidative stress, which is when the cell has an elevated concentration of hydrogen peroxide, or under conditions of iron starvation. The key proteins of the Suf pathway targeted in this research are SufS and SufE. SufS functions in conjunction with SufE to catalyze the removal of sulfur from L – Cysteine to create a "protein bound persulfide." Studying these two proteins gives greater insight to the effectiveness and role of the Suf pathway in E. coli cells. The removal of sulfur from L – Cysteine is dependent on pyridoxal 5'–phosphate (PLP), a coenzyme that is bound to SufS. To determine the amount of PLP bound per SufS monomer, a PLP quantification was run, with the PLP concentration being approximately equal to the SufS concentration. A Cysteine – Desulfurase Assay was used to test the desulfurase activity of SufS in the presence and absence of SufE. It was found that SufS and SufE had greater desulfurase activity when compared with SufS alone. Finally, stopped-flow spectroscopy was used to analyze the kinetics of the SufS cysteine desulfurase activity.

THE EFFECTS OF MECHANICAL LOAD ON CARDIOMYOCYTES

Albert Rancu
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Research in bioengineering has provided promising returns in the field of cardiac cell biology and the continued understanding of diseases such as cardiomyopathies and high blood pressure. Our research aims to study the effects of mechanical load on the organization of myocytes and the effect of the mechanical load in conjunction with electrical stimulation on the formation of the cell's contraction-excitation complex. This system mimics the cardiac muscles in the heart by exerting an in vivo-like cyclic stretch and the results will offer a new understanding of the pathological mechanisms of mechanical overloading to the scientific and medical community, allowing new procedures and treatments that will help patient health. The cells were placed in elastic PDMS chambers that promote in vivo-like cell alignment. A cell stretcher was created to hold four such chambers. A carbon bar was placed within the stretcher to provide electrical triggering to one or two selected cell chambers. This was to study the effects of mechanical load on the chambers and the effect of both mechanical stretch and electrical stimulation upon the cells. The one side of the stretcher was attached to a gear system powered by a step motor. The motor was operated through an Arduino Nano processor. The processor was programmed with three different types of stretch, while the electrical stimulation was held constant. The mechanical load provided to the chambers was varied between constant, cyclic, and piecewise.

THE EFFECT OF ASYMMETRIC DOMINANCE ON IDEOLOGICAL PERSUASION IN VOTING-AGE PARTICIPANTS THROUGH NEWS ARTICLES

Pallavi Rao
Spring Valley High School

A theory to explain the psychology of decision-making is the asymmetric dominance theory, or decoy theory, which asserts that if a choice set contains two options that are equally attractive - the introduction of a third option, X, that is completely dominated by only one option will cause one to choose the option that dominates X. The purpose of this study was to explore how the decoy theory can be applied in a political context and study the factors that influence ideological shifts. In this study, the decoy theory was applied to news articles concerning net neutrality. It was hypothesized that if a participant is in the left-1 group, then they would be more willing to allow researchers to reinstate net neutrality. If a participant is in the left-2 group, then there would not be a significant difference in choice compared to the control. If presented with a "decoy" article that is dominated by one article in both attributes, then the decoy effect would be present. The articles varied in factuality and political alignment (right-leaning or left-leaning). A pre-screening was completed by participants from Prolific to judge factuality and political alignment. In the experimental surveys, participants were presented with low or high-quality articles from various sources. After reading the articles, the willingness to allow net neutrality to be reinstated was solicited. The binary logistic regression results at an α=0.05 displayed a negative correlation between participation in the left-1 group and reinstating net neutrality, but a positive correlation for the other two groups. There was a significant difference in proportions only between the left-1 and left-2 groups. The decoy effect and left-1 hypotheses were rejected, but the left-2 hypotheses was supported. It was concluded that there were external factors that affected the left-1 and left-2 group responses, perhaps due to the persuasiveness of the high-quality right-aligned article.

THE IMPACT OF TIMING OF INCREASED SALINITY ON THE DEVELOPMENTAL AND GROWTH RATES OF *ANAXYRUS TERRESTRIS* TADPOLES

Ashlyn Reining
South Carolina Governor's School for Science & Mathematics

THE EFFECT OF VARYING OXYGEN LEVELS ON *LITHOBATES CATESBEIANUS*

Myles Roberts
Heathwood Hall Episcopal School

This experiment is on the effect of different levels of oxygen on the growth rate and size of Bullfrog tadpoles. This research could be used to help create solutions for creating a larger food supply by trying to replicate this on an animal we use for food, lowering the price of that food and making it easier for less fortunate people to get a source of food. I hypothesize that the shrimp exposed to the most oxygen will grow to the largest size and have the highest growth rate. My null hypothesis is that the varying levels of oxygen will have no effect on overall growth and growth. My alternate hypothesis is that the shrimp exposed to no extra oxygen will grow to larger sizes than the ones exposed to extra oxygen. This will be accomplished by starting with 33 tadpoles, which have been in water with normal oxygen levels. They will be raised in these conditions and will be measured every other day for 11 days. The independent variable is the oxygen levels, which will be changed by spraying boost 95% oxygen into the water. The dependant variable is the size of the tadpoles which I hypothesize will be dependant on the amount of oxygen in the water. The data was analyzed and it was discovered that an increase in oxygen caused the tadpoles to become smaller and less healthy than those raised in water with regular oxygenation.

THE EFFECT OF PUBLIC AND PRIVATE SCHOOLING ON TEENAGE BOYS TOXIC MASCULINITY

M Roney and Austin Tuller
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The purpose of conducting this social experiment was to discover if the environment in which high school boys spend most of their time impacts their toxic masculinity. The researchers hypothesized that the private school boys would have a higher concentration of toxic masculinity. The experimenters created an anonymous quiz (on google forms) with 13 questions, including possible situations the teenage boy may experience which may indeed indicate whether he has toxic masculinity or not. Once having permission from each of the boys, the researchers emailed out an anonymous quiz to 10 public school boys and 10 private school boys. The researchers appreciate that this is probably too small of a sample to be statistically significant, but it is felt that the results are meaningful and provide a basic understanding of the issue. After receiving all of the boy's results, the researchers concluded that overall, the public school boys had a higher level of toxic masculinity. In certain circumstances private school boys did indeed show more toxic masculinity compared to the public school boys, however, the majority of the results indicated that public school boys exhibited more toxic masculinity more often. In conclusion, the researcher's hypothesis was refuted. The data shows that public school boys have more toxic traits than boys who attend private school.

THE EFFECT OF CHLORINE AND BROMINE ON THE AMOUNT OF BACTERIA ON THE SKIN OF RAW POULTRY PRODUCTS

Jimmy Ruskell
Heathwood Hall Episcopal School

The purpose of this project is to measure the ability of different antimicrobials to eliminate or reduce the amount of bacterial colonies in relation to the amount of bacterial colonies on untreated chicken. The Center for Disease Control reported that, between 1998 and 2008, the annual amount of food borne illnesses in humans caused by bacteria on poultry was 653,622. Two of the most common ways that chicken is protected against bacteria is by washing the chicken in chlorine or bromine. The researcher wanted to test the effectiveness of these methods. The two different treatments, chlorine and bromine, were tested on raw chicken by submerging small amounts of the chicken skin into them. The chicken was placed into the treatments for one minute, then soaked in water. The water was then swabbed onto petri dishes and placed into an incubator for two days. The petri dishes were then scanned using an app called Colony Counter to count how many bacterial colonies were present in each petri dish. The average number of bacterial colonies for the petri dishes that were not treated with anything was 54.833. The bromine trials had almost double the control, with 104.02 bacterial colonies. The chlorine trials had over triple the amount with 164.18 bacterial colonies. The results suggest that bacterial colonies are more likely to grow when subjugated to antimicrobials, but this result was most likely produced due to an error, either procedural or technological.

COMPARISON OF TWO IMAGE ENHANCEMENT TECHNIQUES: HISTOGRAM EQUALIZATION AND GAMMA METHOD

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Two image enhancement methods are compared: histogram equalization (HE) method and gamma or power law method. Intensity transformations are among the simplest of all image processing techniques. In HE method, pixels of the image occupy the entire range of possible intensity levels, which results in high contrast. In gamma method, fractional values of gamma map a narrow range of dark input values into a wider range of output values. We claimed that the rate of success for HE method is

greater than that from the gamma method. Using the p-value we failed to reject the null hypothesis at significance level (Î±) = .05, suggesting there is no sufficient evidence to support the claim that the rate of success for HE method is greater than that from the gamma method.

THE EFFECTS OF TEMOZOLOMIDE ANALOG (TMZ-A) ON LN229 AND U87 GLIOBLASTOMA CELL LINES

Paula Salazar
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Glioblastoma is the most common and deadly type of brain cancer. A common drug used to treat glioblastoma is Temozolomide (TMZ), but it is known to have detrimental side effects. The purpose of this research is to determine if a modified version of TMZ (TMZ-A—TMZ with an added carboxylic acid) will have the same cell death efficacy as unmodified TMZ. Two glioblastoma cell lines, U87 and LN229, were treated with various concentrations of TMZ and TMZ-A [0-100 µM] up to 48 or 72 hours. The results indicate that TMZ-A was more effective in causing cell death with concentrations of 100 µM in either 48 or 72-hour periods as compared to TMZ in U87 cell lines. The results of TMZ-A on the LN229 cell line indicated significant (>90%) cell death with concentrations of 1 µM and 100 µM of treatment up to 48 hours, and concentrations ranging from 10-100 µM of treatment up to 72 hours. Due to time constraint effect of TMZ on the LN229 cell line could not be achieved. These are preliminary results. Therefore, these experiments need to be repeated due to discrepancies in the protocol. In the future, it would be valuable to the repeat the research with other cell lines, at various time periods, and with more TMZ analogs, in order to optimize the drug's efficacy.

THE EFFECT OF *BACILLUS CEREUS* VERSUS BIOCHAR IN THE ABILITY TO DECREASE CHLOROTHALONIL AND INCREASE RHIZOBIUM BACTERIA IN SOILS

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Chlorothalonil is the world's second most used fungicide, but it is associated with numerous environmental hazards, including the inhibition of beneficial soil microbes, such as *Rhizobium*, and it can cause various health risks. This research was aimed to determine which biodegradation treatment, biochar or Bacillus cereus, would be capable of degrading chlorothalonil and result in the increase of *Rhizobia*, which assists in plant growth and soil condition. It was hypothesized that the plants treated with biochar would show more root nodules compared to the plants treated with *Bacillus cereus*. Pea plant seeds were divided into three groups of 20, which were then assigned to different treatment groups, which would then be contaminated with 0.35 ml of Daconil, a popular fungicide that uses chlorothalonil as its main ingredient. The absence of root nodules after experimentation lead to the collection of the root mass and the number of leaves. Both variables were statistically analyzed with a one way ANOVA at the alpha=0.05 level. There was no statistical significance between the root masses, but there was with the number of leaves; ($F(2,57)= 5.56$, $p=0.006$). A Tukey test determined that significant differences were between the control versus the *Bacillus cereus* treatment and in the *Bacillus cereus* treatment versus the biochar treatment. It was concluded that neither treatment was able to successfully increase the amount of *Rhizobium*, but when comparing the dependent variables, it was assumed that biochar had the most effect on soil health.

ETHNICITY AND ASSOCIATION TO COSMETIC SURGERY AND BODY DYSMORPHIC DISORDER IN HIGH-SCHOOLED FEMALES

Monica Sanchez
Chapin High School

The trend of teenagers obtaining cosmetic procedures is rapidly increasing. According to the American Society of Plastic Surgeons, in the United States alone, approximately 229,000 cosmetic procedures were performed on patients aged 13 to 19 in 2017. Cosmetic procedures are defined as "surgical and nonsurgical procedures that enhance and reshape structures of the body to improve appearance and confidence." On the other hand, Body Dysmorphic Disorder is a mental disorder that involves a repetitive thinking about one or more perceived defects or flaws in one's self appearance. According to the Anxiety and Depression Association of America, BDD affects 1.7% to 2.4% of the general population--about 1 in 50 people. A common symptom of BDD includes constantly seeking frequent cosmetic procedures with little satisfaction. This study investigates whether there is a significance in association among BDD and a desire for cosmetic procedures among high school females. Additionally, ethnicity will be used as an explanatory variable in examining whether there is an association or correlation to a desire for cosmetic procedures. A chi-squared statistic test is used in order to find significance among ethnicity and desire for cosmetic surgery as well as an association between ethnicity and BDD. The outcome showed that Black/African American and Hispanic females are identified with an increased desire for cosmetic procedures and the most identified and affected by BDD. The implications of this study could reveal that it is necessary to increase awareness of the effects of BDD on teenage girls in schools.

HEME OXYGENASE 1 AS A CYTOTOXIC TARGET FOR A NOVEL ISOFLAVONE, ME-344

Richard Sandvoss
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ME-344 is an anticancer drug in phase-1 clinical trials that inhibits mitochondrial oxidative phosphorylation, making it a candidate treatment for cancer stem cells. Researchers must determine ME-344's mechanism of action (MOA) to ensure the safety and effectiveness of ME-344 treatment. Previous research suggests heme-oxygenase 1(HO-1) is ME-344's cytotoxic target. This research was conducted to verify that result. HO-1 was knocked down in five cell lines, with a sixth used as a nontarget. Next, an MTT assay was performed to construct a viability curve and extrapolate the IC50 values for each cell line. Finally, a western blot was then performed on an SDS-PAGE run on proteins harvested from two groups of cell lysates: a control group and an experimental group treated with the respective IC50 of each cell line. The MTT assays showed the IC50s of the HO-1 knockdown cell lines were 5-10 times lower than the nontarget. The western blot for the control groups showed HO-1 expression in the knockdown cell lines was 47%-82% lower than the nontarget. There were no western blot results for the experimental groups because not enough protein was collected from the lysates. The change in the cytotoxic profile in the HO-1 knockdown cell lines compared to the nontarget indicates HO-1 is a target of ME-344. Fewer steps remain undetermined in ME-344's MOA. Determining these will enable clinicians to conduct safer treatments and to test ME-344 in conjunction with other treatments.

THE EFFECT OF WIND SPEED ON VOLTAGE GENERATED; USING AN RC AIRCRAFT'S PROPELLER AS A GENERATOR

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This experiment was designed to test the amount of voltage generated by a propeller in varying wind speed, in an attempt to reduce the likelihood of remote control aircraft crashes resulting from loss of battery power. First, a wind tunnel was constructed out of cardboard. Next, an RC aircraft motor was placed inside the testing chamber on a stand. Wind was generated using three box fans and a leaf blower, and the wind speed was measured using an anemometer. The motor was started by a 9 volt battery, then disconnected and hooked up to an electrical multimeter. The data was recorded into data tables. The experiment was conducted three times with both the leaf blower and box fans, and three times without the leaf blower to have variations in wind speed. A separate test was performed with the motor connected to a 1 farad capacitor. An attempt was made to run the motor off of the voltage stored in the capacitor. Results showed that the motor would not turn below a certain wind speed, and, more volts are generated at a higher wind speed. When the motor was connected to the capacitor, it wasn't able to make a single rotation. In conclusion, the windmilling propeller driven motor generated current and voltage; however the current likely will not produce a sufficient amount of power to be practical to power RC aircraft

VISUALIZING NANOPARTICLES IN THE FUNGAL PATHOGEN, *ASPERGILLUS FLAVUS*

Jenny Schaffer
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The fungus, *Aspergillus flavus*, is a pathogenic fungus known for producing aflatoxin. Aflatoxin in A. flavus affects crops, livestock, and people, causing things like aspergillosis and liver cancer in people. Aspergillosis mainly affects organisms with immune deficiencies when they breath in the *A. flavus* spores. Previous reports indicated that aflatoxin production can be prevented by silver nanoparticles, but the mechanism of action is unknown. In this study we demonstrate that silver nanoparticles are internalized by *A. flavus* cells. A Leica confocal laser scanning microscope was used to obtain images of the fungal samples with silver nanoparticles. We overlaid 20X differential interference contrast imaging of the *A. flavus* that had been exposed to silver nanoparticles. These images showed that the nanoparticles entered the fungal cells. A series of time lapse photos showed the nanoparticles moved inside the cells. We proposed that the nanoparticles enter the cells through endocytosis and localize to the vesicles which are the site of aflatoxin production. These results suggest potential mechanisms of action for reduction of aflatoxin production via silver nanoparticles, which could lead to new ways to prevent the negative impacts on crops, livestock, and people.

TESTING THE CORRELATION BETWEEN THE MUSIC LISTENED TO IN CHILDHOOD AND ADOLESCENT PERSONALITY/BEHAVIOR

Adam Schiferl
Chapin High School

The goal of this correlational study is to test the relationship between the music listened to in childhood (sub 11 years old) and personality of an adolescent. A survey is used to gather information on an individual's music listening habits as a child and a short measure of personality is also assessed. Two online surveys, the Short Test of Musical Preference (STOMP) created by Jason Rentfrow and Samuel Gosling, and the Five Factor Model of Personality (FFM) created by Robert McCrae and Paul Costa are merged together to create the custom survey used in this study. The surveys have scales that condense the questions of the survey into more manageable data. The music survey takes 23 genres and condenses it down to four dimensions, where the personality assessment takes 15 statements and condenses it down to five factors of personality. A Pearson's test of correlation was conducted for each music dimension and five factor personality traits. The result is that there is a correlation between more heavy genres of music and negative personality traits, and vice versa. The implication of this research is that parents can avoid

having their child listen to heavier genres of music at a young age, to avoid negative personality traits at a later age as an adolescent.

NIO-MC DUAL-PHASE MEMBRANES FOR CO2 CAPTURE FROM SIMULATED FLUE GAS

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CO2 capture membranes are a critical technology for the slow and halt of the issue of global warming, which is partly due to the large amount of CO2 emissions from coal-burning power plants in the form of flue gas. The current leading technology is an amine scrubbing membrane which, however effective, is far too costly and inefficient to be used commercially on a wide scale. My purpose in research this summer was in optimizing a prototype of a Mixed Electron Carbonate-Ion Capture membrane which is cost efficient and highly effective. The MECC is a semipermeable, dual-phase, self-forming membrane that combines the electron conducting properties of Ni at high temperatures with the ability of Molten-Carbonate to conduct CO32- to process CO2 and O2 while blocking other gasses from penetrating the membrane. A Micro-GC tester was used to obtain results from 5 different ratios of MC which were used to fill a porous NiO matrix and then tested for flux density of N2, O2, and CO2 to determine the ratio for best performance. Through both long term testing at 850°C and testing at various temperatures from 600°C to 850°C, yielded flux densities that indicated that a 54Li:46Na was the most optimal for the membrane.

ATRX MUTATIONS IN IDH1-MUTATED MICE NEURAL STEM CELLS

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The WHO altered their diagnostic methods for central nervous system tumors. These diagnostic methods now include both histologic analysis of the tumor cells and determination of genetic mutations present. IDH1-mutations in astrocytoma lead to the production of 2-hydroxyglutarate, which inhibits proteins that are important in cellular metabolism. When the metabolism is abnormal, cells can divide too quickly and form tumors. An accurate mouse model of neural cells with the IDH1 mutations does not yet exist for therapeutic research. We hypothesized that coupling IDH1 mutations with the two other characteristic mutations in astrocytoma—p53 and ATRX—would create a functional dependency and improved model. p53 is known primarily as a tumor suppressor gene that causes cell cycle arrest when there is DNA damage. ATRX mutation is important to development, and mutations can cause either mental retardation or cancer, but its specific function remains unknown. ATRX mutations were inserted into mice neural stem cells, and the cellular functions and rate of division were monitored with ATRX, p53, and IDH1 mutations were combined. Western Blot and Immunofluorescence were used to measure protein levels and efficacy of the induction. ATRX was shown to have a positive effect on the levels of proliferation in IDH1 and p53 mutated cells. This is the first sign of cancerous behavior, and thus suggests that there is a sequence that the mutations arise in astrocytoma. This research can be used to better understand the function of these lesser known mutations and improve the mouse models used for clinical studies.

FACTORS OF RISK STATUS AND PERSISTENCE OF UNDERGRADUATE STUDENTS AT THE UNIVERSITY OF SOUTH CAROLINA LANCASTER

John Shaheen
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The failure of students to finish their post-secondary education has plagued universities for years, with solutions at the university level being at a premium. This research project aimed to assist university administration in taking the proper actions to maintain high levels of retention within their student body. Particularly, this project focused on the retention of the student demographic found mostly at the University of South Carolina Lancaster, a group consisting primarily of working-class whites. This project used scholarly literature found on both Google Scholar and the EBSCOhost database, which was conducted among university students in the pursuit of commonalities in the motivations of departing students. These studies often featured first-hand accounts from students, detailing why they had chosen to leave their universities and what factors had motivated their choice to do so. This study points towards parental education, developmental education, and university-student relations as being the foremost factors in determining persistence. Additionally, the information contained within the studies highlights the characteristics of at-risk students, allowing proper actions to be taken to ensure they are given the necessary tools to ensure their own success. The commonalities highlighted by source analysis within this project will assist educators in establishing an academic environment which promotes student persistence and future success.

THE EFFECT OF DIFFERENT METHODS OF MEMORY

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In this experiment, the purpose was to determine the effect of different methods of memory. It was hypothesized that if the three different methods of memorization were used, then rote memorization would be most effective for primarily auditory learners, while the story and loci methods would be most effective for visual learners. Three methods in particular were examined: loci, rote, and story. To carry out this experiment, four different lists, with various objects, places, and ideas, were produced. Three lists were made, one for rote, one for story, and one for loci, as well as a fourth for the subject's preferred

method, the control group. There were then human consent forms sent out, to each test subject. Once returned, the experimentation began. One subject was tested at a time. The person would memorize one list at a time, for however long the subject preferred, and then waited approximately two minutes before taking the test. This process was repeated five times, with five different test subjects. Once the trials were completed the data was collected and analyzed. After research, it was determined that there was not a direct correlation between the type of learner the subject was, and the amount of information the subject remembered. What did seem to affect the amount of information the subjects remembered was simply the method of memory. The amount of information remembered was higher when using the loci, and story methods, rather than the rote method.

THE IMPACT OF DAMPER PROPERTIES ON THE AMPLITUDE AND FREQUENCY OF BLUFF BODY BEHAVIORS UNDER VORTEX-INDUCED VIBRATION FOR MARITIME ENGINES

Sirawit Shimpalee
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Vortex Induced Vibrations (VIV) are a phenomenon where the fluid flow causes oscillations against an object called a bluff body by vortex shedding. This phenomenon has recently been studied as a source of renewable energy. The purpose of this study was to test the feasibility of a direct VIV powered maritime propulsion system. It was hypothesized that testing conditions would allow for operation of the proposed mechanical propulsion system and that the combination of the largest bluff body with the lowest damping would achieve the highest amplitude in its vibration. A structure was created to support the bluff body and damper. The bluff bodies consisted of four designs and were suspended by eight types of dampers. The combinations were then exposed to fluid flow at eight different velocities. Results were analyzed by investigating the relationship of velocity against amplitude and frequency. Regressions were also done for statistical analysis. The 2.75 cm bluff body with the 4.35 cm damper achieved the highest amplitude at 1.6 m/s. However, the regressions determined that the data was not statistically significant, and the independent variables did not correlate with the dependent variables (p>$\blacksquare$), although these tests did not account for the lock-in region of VIV. In addition, results show that all combinations did not achieve the ability to make a direct drive engine feasible. However, the results demonstrate that it is possible to create a VIV power generator for the propulsion system.

UTILIZING BIG DATA TO UNDERSTAND PUBLIC PERCEPTION IN NECESSARY POLICY CHANGES BEFORE AND AFTER A MASS SHOOTING

Elizabeth Shytle
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From May 25, 2015 to May 25, 2018, there were 1,296 mass shootings in the United States. This research attempted to evaluate public support for gun regulation before and after major mass shootings. It was hypothesized that there would be a higher percentage of Tweets opposing gun control 1 week before each mass shooting, and a higher percentage of Tweets supporting gun control 72 hours following each mass shooting. The researcher used "Big Data" to account for outliers and skewing points by analyzing 250 Tweets that occurred one week before each major mass shooting, 72 hours following the mass shooting, and 2 weeks after the shooting, for a total of 750 per shooting. The Tweets were restricted to include at least one of the following hashtags: #secondamendment, #neveragain, #shooting, #NRA, #guncontrol, #gunviolence, and #2A. The Tweets were categorized as pro-gun control, anti-gun control, or neutral, defined by operational definitions. It was found that at $\alpha = 0.01$, there was a significant decrease in the anti-gun control Tweets and an increase in the pro-gun control Tweets posted 72 hours following a shooting compared to 1 week prior, with p-values < 0.00001. There was a significant increase in anti-gun control Tweets and decrease in pro-gun control Tweets 2 weeks after the shooting compared to 72 hours after the shooting, showing a regression towards the baseline, with p-values < 0.00001. Therefore, people were more vocal about stricter gun control after a mass shooting than before, but regressed back within 2 weeks.

A NOVEL APPROACH IN CREATING A BIOINSECTICIDAL REPELLENT USING *CYMBOPOGON, LAVANDULA*, AND *ROSMARINUS OFFICINALIS* ESSENTIAL OILS (EOS) WITH AN ATTRACTIVE SUGAR BAIT

Aisha Siddique
Spring Valley High School

With the emerging of insecticide resistance among mosquitoes, diseases such as malaria, West Nile virus, Dengue fever, and chikungunya have remained a prevalent issue globally. The purpose of this research project was to identify whether or not an essential oil (EO) enhanced the toxicity of the oil towards *Culex quinquefasciatus*. It was hypothesized that citronella would repel the most amount of *Culex quinquefasciatus*. There were 90 mosquitoes in four groups: control, citronella (*Cymbopogon*) experimental, lavender (*Lavandula*) experimental, and rosemary (*Rosmarinus officinalis*) experimental. Once the mosquitoes emerged from their pupae stage, two cotton pads (one with a sugar bait and one with the EO drops and bait) were placed on opposite sides of the cage. A concentration of the essential oil and the bait was created using 10, 20, and 30 EO drops and applied on a cotton pad with a 10% sucrose solution. Results were measured by observing how many were attracted to the EO bait in comparison to the sugar bait alone. A one-way ANOVA between the three essential oils and the numbers of drops applied on the sugar bait was tested, showing that all citronella, lavender, and rosemary EOs were significantly different from one another based on all the number of drops applied to the sugar baits. To compare the EOs to each other, a Tukey post-hoc took place. The hypothesis was not supported because rosemary showed a significant difference between the other two EOs, meaning that the rosemary EO was able to repel the most mosquitoes.

MULTI-LAYER WOUND DRESSING THROUGH SOLUTION BLOW SPINNING

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This research was aimed towards determining the best base materials to incorporate in the development of solution blow-spun nanofibers for multi-layer wound dressing sensing applications. To determine which materials would be most applicable for a multi-layer wound dressing sensor, multiple fibers of varying poly(lactic acid), and multi-walled carbon nanotube (MWCNT) composite concentrations were created. Subsequently, each fiber was tested for its average diameter, conductivity rate, surface tension, as well as its composition of elements. A four-point probe system was utilized to measure conductivity, a Hitachi S-4800 Field Emission Scanning Electron Microscope was used to test the fiber diameter, and a variable pressure SEM S3400 was employed to capture the elemental composition of each fiber. The surface tension of each polymer and solvent system used was collected via the droplet method. SEM images of spun fibers exhibited durable fiber morphology and diameter size that correlated positively with MCWNT and polymer concentrations. Moreover, surface tension analysis showed how an increase in polymer concentration displayed higher tension values. The highest conductivity rate observed occurred when 10% MWCNT of 4% PLA was mixed, in which surface conductivity values were as high as 522 S/cm, which allows an accurate measurement of the resistance, and thus concentration, of bacteria.

THE EFFECT OF TEMPERATURE ON THE REACTION TIME OF VINEGAR AND BAKING SODA

Ellie Singerling
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The purpose of this study was to investigate if the temperature of vinegar had any effect on the time it took for its reaction to stop, when mixed with baking soda. It was hypothesized that the temperature of the vinegar will cause a change in reaction time, specifically colder temperatures causing a slower reaction time, while hotter resulted in a faster time. Four different temperatures of vinegar were tested, based off of the room temperature vinegar: -2℃ (50° below room temperature) 12℃ (25° below room temperature) 40℃ (25° above room temperature), and 52℃ (50° room temperature). The heated or cooled vinegar was poured into the baking soda, and when put together, was timed until the reaction completely stopped without being touched or tampered with. The results supported past experiments; the vinegar with higher temperatures had a significantly faster reaction time, while the vinegar that was cooled, or had a lower temperature, took much longer to fully react with the baking soda.

EFFECTS OF SPEECH RATE ON SELF-MONITORING AND LEXICAL ERROR FREQUENCY IN MOTHERS WITH THE FMR1 PREMUTATION

Caroline Sizemore
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The FMR1 premutation occurs in 1:151 women. Women with the FMR1 premutation show very subtle signs of slight executive dysfunction, disproving the preceding belief that these individuals were only silent carriers. For this project, 32 women with the FMR1 premutation were given the "Network Production Task." Each participant was shown 8 different networks of colored images and pictures with lines connecting them and asked asked to describe the path a red dot took within each network, being as descriptive as possible. Each network was shown twice, once at a slow speed of 27 seconds and once at a fast speed of 18 seconds. Errors were later coded into 14 different categories. This part of the project focused on the 7 lexical error categories. Based off of our statistical analysis, the superordinate and coordinate lexical errors were significantly more frequent in the fast condition. The phonemic errors also appeared to be significantly more frequent in the fast trial than the slow trial, though occurring at a low frequency. Future studies should include comparison with a control group so that we can make conclusions regarding whether the language production features observed in this sample of Fragile X carriers were atypical.

EVALUATION OF PLATELET ACTIVATION AND ADHESION ON TEFLON® GRAFTS

Lillian Slaughter
South Carolina Governor's School for Science & Mathematics

Cardiovascular diseases greatly affect the world today, with over 610,000 cases in the United States each year. These diseases can be alleviated with implants such as stents and grafts. However, there are many problems that may occur, such as platelet activation, adhesion, and aggregation. While platelet aggregation normally is beneficial in injury, adhesion to vascular implants can lead to thrombosis, the formation of blood clots. Blood clots may then travel to the brain, lungs, or heart, bursting and therefore causing serious injury and/or death. This project was done to evaluate platelet activation and adhesion on vascular grafts made of Teflon®, coated with PGMA (Polyglycidyl methacrylate) and HSA (Human Serum Albumin). We first cut the grafts into 2.5 cm diameter circles, then sterilized them using the plasma treater, coated them, and then sterilized using the ethylene oxide gas chamber. We then collected porcine blood and centrifuged to obtain our platelets. We transferred the platelets to a separate container, centrifuged them again to remove any non-platelet cells, suspended the platelets, and incubated them. We put the platelets in a twelve-well plate containing six graft samples and six collagen wells (the positive control), as well as buffer solutions. We then performed an LDH assay and found that there was a significant difference in absorbance levels between the collagen and grafts, meaning the platelets adhered to the samples. We also performed an ELISA test and found that there was minimal platelet activation, telling us that HSA did not affect platelet adhesion very much.

THE EFFECT OF MINDFULNESS ON SHORT-TERM MEMORY IN TEENAGERS

Christina Smith
Heathwood Hall Episcopal School

The purpose of this experiment is to compare the effect of mindfulness with respect to short-term memory capacity. Each subject was met twice. The first time they were given a list of twelve words which were randomly gathered online. Studying the words and stopping when they chose, fifteen seconds later the subject wrote down every word they remembered from the list, assessing the subject's free recall accuracy. At the second meeting, the subject participated in a mindfulness exercise, "Fading Tones." A chime was rung twice, with the subject listening until the tone faded. The process was repeated, then data was recorded, comparing the individual subject's first test to their second test to get rid of any outliers, which are trials 17-20, for more accurate results. The results showed that through the procedure used, the number of words remembered by subjects, the dependent variable, has no relationship to the independent variable, the tones of the chime, since the dependent variable is volatile throughout trials. This lack of a relationship indicates that the hypothesis, which is "if the memory tests are taken, then the test results taken with two complete tones of the chime beforehand will be better than the test results with no complete tones of the chime," was not supported by the data. The null hypothesis, which is "if the memory tests are taken, there will be no difference in how well the memory tests are completed with or without mindfulness practice," was supported by the data.

SOFTWARE DEVELOPMENT FOR HIGH-SPEED AUTONOMOUS GROUND VEHICLES

Hollis Smith
South Carolina Governor's School for Science & Mathematics

Self-driving cars are of great interest in computer science and artificial intelligence due to their speed, efficiency, and affordability. Despite the attention, no one has been able to find the "perfect" solution: the implementation of completely predictable and reliable autonomous transportation. This research serves as an introduction to filling that gap by achieving total autonomy on a smaller scale through programming the Massachusetts Institute of Technology's RACECAR (Rapid Autonomous Complex Environment Competing Ackermann-steering Robot), creating a safe and robust autonomous ground vehicle that will serve as an example for autonomy on passenger-carrying cars. Python, the advanced control systems on the car, ROS (Robot Operating System), and OpenCV were the main tools utilized to enable the car to drive on its own. My team created an autonomous race car capable of following walls, detecting and avoiding obstacles, and changing paths based on visual perception of its environment. These components were combined into a state machine that implemented different controllers and commands based on detection of AR (augmented reality) tags. The car proved able to navigate autonomously through a complex, dynamic course both safely and quickly. Autonomy was achieved, and, in the future, the implemented tactics can be translated to a passenger-carrying car to fulfill the ultimate goal of autonomous research: fully driverless transportation.

EFFECTS OF THE HPV VACCINE GARDASIL 9 ON NATURAL KILLER CELL LIGAND EXPRESSION ON TUMOR CELLS

Hunter Smith
South Carolina Governor's School for Science & Mathematics

RECYCLING HABITS OF STUDENTS AT CHAPIN HIGH SCHOOL

Kathryn Smith
Chapin High School

In 2016, more than thirty-three million tons of plastic waste was produced in the United States, and as a result, Americans have contributed to environmental issues like ocean acidification and increased global temperatures. By improving the recycling habits of the fifteen million high school students in the United States, the increasing carbon footprint produced by Americans could potentially be reduced. The goal of this study is to determine the extent to which increased education concerning recyclables along with an increased presence of recycling containers within a school setting will impact the recycling habits of students. This study initially establishes the typical recycling habits of the students at the school of investigation, and later imposes two treatments onto the participating students. As a part of the first treatment, additional recycling bins were placed at the school in order to determine their impact on the students' recycling behavior. Next, the students received additional instruction on the recycling practices of Chapin High School. As a result of the increased presence of recycling bins at the school and the increased level of instruction concerning recyclables, the recycling habits of the students remained unchanged.

THE POTENTIAL CORRELATION BETWEEN SOIL PH AND COLOR VIBRANCY OF YELLOW CHRYSANTHEMUM BLOOMS, *DENDRANTHEMA GRANDIFLORA*

Savannah Smith
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The purpose of this experiment is to determine whether or not the pH of a soil has an effect on the color vibrancy of select plants growing in that soil. The null hypothesis claims that the soil pH will have no effect on the color vibrancy of yellow chrysanthemums. The hypothesis states that yellow chrysanthemums will experience a color change when grown in soils of

different pH. Photographs were taken at specific time intervals, and were then downloaded into Adobe Lightroom and analyzed. The photographs were cropped and set to the white balance using a digital gray card. The computer cursor was placed on the most common or middle shade of yellow, and the amount of red, green, and blue pixels in that specific spot were recorded. This was done for each photograph. Those normalized RGB values were then translated into an HEX number, and the color was produced in Google Docs to generate color swatches. Google Docs uses HEX numbers while Adobe Lightroom uses an RGB scale. Upon producing the average color for each time frame by converting RGB percentages to an HEX scale number, it was concluded that a difference in soil pH does result in a variation of petal shades in yellow chrysanthemum blossoms.

THE EFFECT OF MONOPOLY GROUP AND IMPROVEMENT LEVEL ON THE RETURN ON INVESTMENT OF MONOPOLY PROPERTIES

Andrew Sobel
Heathwood Hall Episcopal School

The purpose of this experiment was to determine the return on investment (ROI) for Monopoly properties with respect to the property's improvement level (i.e. the number of houses/hotel) & the monopoly to which the property belonged. It was hypothesized that if a property was located farther clockwise from GO & had a greater improvement level, then its return on investment would be greater. The two independent variables were the improvement level and the property's monopoly; the dependent variable is the return on investment. A total of 6 trials, each for a different improvement level (e.g. 2 Houses), were run using a Java code that simulated a four player game of Monopoly. Whole monopolies were randomly assigned to each of the four players, and property ownership remained constant throughout the experiment. The hypothesis was not fully supported as it was determined that no houses or hotels resulted in the lowest median ROI, while 1 Hotel resulted in the greatest median ROI. It was additionally concluded that the monopoly to which the property belonged had less of an effect on that property's ROI than originally anticipated.

THE EFFECTS OF THE PESTICIDES IMIDACLOPRID, ATRAZINE, AND ROUNDUP ON *DAPHNIA MAGNA* HEART RATE

Afaf soliman
Spring Valley High School

The purpose of this study was to see the effect of pesticides on aquatic organisms. It was hypothesized that the pesticide that would have the largest effect on *Daphnia magna* heart rate was atrazine and the pesticide that would have the least effect was imidacloprid. When conducting this experiment, there were three different pesticides (imidacloprid, atrazine, and roundup) that were each used twice in different dilutions of the recommended solution. For each pesticide, there were 15 *Daphnia* that were tested for each dilution. These *Daphnia* were all fed everyday. Once the solution was made and the *Daphnia* were put in their petri dishes, for 4 days straight, the *Daphnia's* heart rates were observed through a microscope and recorded, mortality was also recorded. It was found that for both dilutions of the Roundup treatment, most *Daphnia* died by the second or third day. *Daphnia* died the most in both dilutions of the Roundup treatment due to its toxicity. The Roundup had the largest affect ($F(6, 48)=69.92$, $p<0.001$) on *Daphnia* heart rates and atrazine had the least effect on *Daphnia* heart rates. As each treatment got less diluted, more *Daphnia* died. Based on the one way ANOVA (figure 6), the treatments in order of lowest to highest heart rates are roundup (1/10 of the solution recommended by the manufacturer), imidacloprid (1/10), atrazine (1/10), atrazine (1/100), imidacloprid (1/100), and lastly roundup (1/100).

NANOCOMPOSITE CONDUCTIVE FIBERS VIA SOLUTION BLOW SPINNING FOR REAL-TIME WOUND SENSING

Gavin Stafford
South Carolina Governor's School for Science & Mathematics

The research objective was to see if Solution Blow Spinning (SBS) could fabricate fibers from a polymer solution that could be used to create a conductive smart wound dressing for diabetic foot ulcers. This dressing would be able to detect the amount of bacteria in the wound through changes in the resistivity of the dressing. This research is necessary to provide a cheap and effective solution for the autonomous detection of chronic, non-healing ulcers. Each fiber was then tested for its average fiber diameter, conductivity, surface tension, as well as composition of its elements. Fiber conductivity was analyzed via four-point probe testing. A Hitachi S-400 Field Emission Scanning Electron Microscope (SEM) was used to test the fiber diameter and the composition of each sample was examined using a variable pressure SEM S3400. To create these fibers, Poly (lactic acid), chloroform/dichloromethane solutions were created. Then the solutions were solution blow spun to create fibers using a pressurized inert gas, nitrogen. SEM images showed consistent non-woven fiber morphology and diameter size that decreased with increasing and decreasing multi-walled carbon nanotube (MWCNT) and polymer concentration, respectively. Moreover, surface tension analysis showed how an increase in polymer concentration displayed higher tension values. When 10% MWCNT of 4% PLA was mixed with chloroform, surface conductivity values were as high as 1390 S/cm. Which would allow accurate detection of bacteria concentration in foot ulcers.

EVALUATING PHYSICAL COMPETENCE AWARENESS IN FEMALES

Kennedy Stodden
Center for Advanced Technical Studies

This study investigated and evaluated the self conceptions and self perceptions of females, specifically 12-14 year olds, both before and after being tested for their actual physical competence. This research is aimed to confirm and potentially understand why it has been theorized that females will consistently underestimate their physical competence. To do this I gave the girls surveys to be completed both before and after I had tested them for their physical competence values. I then evaluated the data based on how they thought that they would score compared to how they actually scored in response to all of the tests that I gave them. Hypothetically my data would confirm that females in this age range will underestimate their physical competence consistently which equates to an inability to form accurate comparisons in relation to physical abilities.

CD8+ T-CELLS HAVE A BIPHASIC ROLE DURING POST-MYOCARDIAL INFARCTION CARDIAC REMODELING

Reed Studer
South Carolina Governor's School for Science & Mathematics

In the past, people did not believe that adaptive immunity was a major component of the post-myocardial infarction wound healing process. This was because the cells that are involved in the process of adaptive immunity were found in such small amounts around the infarct region. Recent studies have shown that when people have increased levels of these CD8+ T-cells, there is a decrease in survival rates post-myocardial infarction. It is not completely known why these elevated levels lead to such an impairment of the healing process. My goal for this summer is to access the inflammatory component of the wound healing process by performing immunohistochemistry. I will also analyze echocardiography data which will indicate changes in cardiac function after heart attack. We hypothesized that CD8+ T-cells control the inflammation that occurs, and this leads to the decrease in both survival rates and cardiac function. To test this, the left anterior descending coronary artery is closed to simulate the lack of blood flow during a heart attack. Two different kinds of mice were used: the C57Bl6/J (WT) mice and a mutant that does not express the CD8+ on the surface of the inflammatory T-cells. Staining for the white blood cells, neutrophils and macrophages, were performed to assess changes in inflammation when CD8+ T-cells are not present. Echocardiography which evaluates the pumping action of the heart was also performed to assess differences in cardiac function between mouse strains.

CAN BONE MARROW TRANSPLANTS CURE ALLERGIES?

Taylor Sullivan
Center for Advanced Technical Studies

The purpose of the research project is to see if there is a correlation between bone marrow transplants and the development or loss of allergies. The motivation for this project is my dad who received an autologous bone marrow transplant for Multiple Myeloma. He was allergic to bees before the procedure, and about 2 years after the transplant, he was stung by a bee and had no allergic reaction. The plan is to create a survey and send it out into certain Facebook groups such as one called Car-T, which is a study to cure multiple myeloma, as well as Facebook groups for leukemia and lymphoma. The survey will also be given to doctors to give to patients that have received bone marrow transplants. There is no data so far but when the survey is sent out, some will be collected. The goal is to see if there is a correlation between the loss or development of allergies after bone marrow transplants to see if this is a more common occurrence than people know of.

UNDERSTANDING THE LANGUAGE OF FEMALE FMR1 PREMUTATION CARRIERS

CarNya Sutton
South Carolina Governor's School for Science & Mathematics

The genotype of Fragile X Mental retardation- 1 (FMR1) premutation carriers are well known however, studies concerning their phenotype are scarce. The premutation is the result of a trinucleotide expansion, CGG with repeats ranging from 55 to 200. Language is an important part of fragile X because it effects how the carriers communicate and causes them stress and anxiety when they are unable to communicate satisfactorily. This research focuses on understanding the effect that time pressure has on non-lexical language errors and disfluencies on female premutation carriers, thought to stem from problems from the conceptual and auditory loop in the brain. It also examines the correlation between the errors made in the different loops. The 32 women who were involved in the experiment completed a network production task. There were 16 trials set to two different speeds, fast (18 seconds) and slow (27 seconds). Non-lexical language errors from the task were coded for. The results showed time pressure produces subtle perseverative and syntactic language impairment in female FMR1 premutation carriers, but there was not a definite correlation between the language errors in this study. This work help identifies the carriers before they have their children (women typically find out they are carriers through their children) and lessen the stress and other symptoms that comes with carrying the premutation. If the language imparities in these females are well known, tasks for jobs and school could be done more efficiently by them.

INJECTION OF GOLD NANOPARTICLES INTO PVDF + DMSO SOLUTION

Julian Taliaferro
South Carolina Governor's School for Science & Mathematics

In our lab, we investigated polyvinylidene difluoride (PVDF), a non-reactive plastic polymer that is a specialty plastic used in many practical cases. For example, it can be used in sheets, tubing, and films. The plastic can be spun out into a fiber using an electromagnetic spinner. The spinner uses an electric field to draw out the PVDF solution into a string. When the plastic is spun into a fiber the plastic becomes piezoelectric, which means that it can create a voltage when mechanical stress is applied. Our research attempted to put gold nanoparticles into the PVDF fiber, since the gold may capture optical energy when pulses of light fall on the fibers. Since the gold is in aqueous solution, we investigated how different concentrations of water react with PVDF and how the gold shows up in the resulting fibers. Overall, the goal is to create a plastic PVDF material than can harness mechanical and optical energy.

FORENSIC ARCHAEOLOGY: UTILIZATION OF RESOURCES AND STRATEGIES IN OR FOR THE ACCURATE IDENTIFCATION OF SKELETAL REMAINS

Brooks Taylor
South Carolina Governor's School for Science & Mathematics

There are many clues surrounding the death of unknown persons left behind by time. This summer, Sean Taylor, along with the South Carolina Department of Natural Resources and myself, excavated the site of death of an individual discovered on the coast of the Georgetown County Area, recovering local artifacts within close proximity of the remains such as scraps of preserved clothing and porcelain buttons. This research set out to contrast the analysis of the remains of the individual and the corresponding recovered artifacts against the historical records of natural incidents and missing persons of the presumed time of death. This was done in order to offer an educated guess about the identity of the person in question. Experts such as forensic anthropologists, the Richland County coroner, local police officers, and textile analysts were involved in these efforts.

SYNTHESIS OF GRAPHENE USING CHEMICAL VAPOR DEPOSITION

Tyler Taylor
South Carolina Governor's School for Science & Mathematics

Graphene is an allotrope of carbon in the form of a plane of sp2-bonded atoms with a molecular bond strength of 0.142 nm. Because of its extraordinary electrical, thermal, and chemical properties, graphene is a very useful material and has many applications. Some of the applications include car interior, construction materials, and antimicrobial materials such as microchips, solar panels, and ballistic transistors. Graphene's use is currently limited, because it is expensive to produce and difficult to mass produce. Developing new optimal conditions will make synthesizing and mass-producing graphene easier and more cost efficient has been a topic of much research and was the objective of this project. The method used to optimize the growth of graphene was thermal chemical vapor deposition. The surface of the copper foil was cleaned with hydrogen fluoride and made more optimal for 2 hours with argon and hydrogen at 1050˚C. The graphene seeds were grown with Methane and Hydrogen at 1050˚C and cooled with Hydrogen or Methane. The graphene was transferred to silicon wafers and the polymer PMMA, later removed with acetone, was used to support it. Copper etching with Iron (III) chloride was used to rid any remaining copper. The graphene was rinsed in distilled water and transferred to a silicon dioxide bath. The synthesized graphene was observed using Raman Spectroscopy, Optical Microscopy, and X-ray Photoelectron Spectroscopy. The results observed showed that the graphene was successfully synthesized, but the optimal conditions in which to grow the graphene were not conclusive.

THE EFFECT OF DIFFERENT EXTRACTION METHODS OF ANTHOCYANINS IN PETUNIA ×ATKINSIANA PLANTS ON THE PERFORMANCE OF DYE-SENSITIZED SOLAR CELLS

Sahil Thakkar
Spring Valley High School

The increase in pollution and the use of nonrenewable resources in producing electricity has caused the environment to be in danger. The use of dye-sensitized solar cells may help this situation. The purpose of this experiment was to see which solvent extraction of anthocyanin would produce the highest voltage on the dye-sensitized solar cell. It was hypothesized that ethanol would produce the greatest voltage compared to citric acid and distilled water. The experiment was conducted by extracting anthocyanins from Petunia ×atkinsiana plants using the solvents. Then the extraction was used to make a dye-sensitized solar cell. Lastly, a multimeter was used to determine the voltages of each cell from each solvent. Ethanol had the largest voltage compared to citric acid and distilled water. An ANOVA showed that the data were significant; $F(2,87)=4775.80$, $P<0.001$. The Tukey tests determined that there were significant differences between ethanol versus citric acid and distilled water, and there were significant differences between citric acid versus distilled water. Therefore, ethanol was the best solvent to make dye-sensitized solar cells since it had the greatest voltage.

WASTEWATER FILTRATION OF *ALOCASIA CALIFORNIA*

Courtney Tharp
Chapin High School

Wastewater treatment is the process in which domestic wastewater is filtered and processed to reduce the excess amounts of nutrients that are present from organic waste residue. The current systems generally employ the use of an electric oxidation tank, which facilitates the growth of bacteria in order to digest the nutrients such as phosphate and nitrate. Recent studies have revealed that water plants can be used to uptake nutrients through their roots and therefore filter and treat the water in a more sustainable way. This experiment follows the ability of *Alocasia californa* to filter two 10 gallon tubs of wastewater in 1 month. To measure this, water quality probes took the levels of nitrate, phosphate, ammonia, dissolved oxygen, and pH of two control tubs with no plants and two tubs with plants suspended in the water. After the systems were placed in a greenhouse and allowed to cycle, the water quality standards were measured again. Analysis of these differences revealed that although the plants were successful in lowering the amount of nutrients that roots can uptake, the p-values are not significant enough to claim that the plants can completely take over as a source of wastewater treatment. However, a larger number of trials to draw results from or an improved system could result in more significant results.

EFFECTS OF SILVER NANOPARTICLES ON MICE HEALTH

Justin Thomas
South Carolina Governor's School for Science & Mathematics

Silver Nanoparticles are one of the most commonly used nanotechnologies, and they are put into many different consumer products. Currently, there is more literature regarding the utilization, characterization, and impact of AgNPs in comparison to other engineered nanomaterials. However, the adverse risk effects associated with exposure to AgNPs is still partly unknown. The aim of this project is to further investigate the risk of AgNPs regarding their toxicity in mammalian cells within the reproductive system, liver, spleen, kidney, and heart of female mice. 21 day old, CD1 mice were injected with or without AgNPs solution at a dosage of 0.2 mg/kg per day for seven days. After the period of injections, tissue samples were taken from the mice and placed into slides to be examined under a microscope. The histology of the tissues from the treatment group, when compared to that of the control group, did not show any signs of adverse effects from the AgNPs. This implies that exposure to AgNPs does not cause any adverse effects when the duration of exposure remains relatively short.

THE CORRELATION BETWEEN THE FLAVOR OF A VAPE LIQUID AND THE KETONES PRODUCED

Caroline Tinch
Heathwood Hall Episcopal School

The purpose of this experiment was to determine which flavors of vape liquid, when heated and vaporized, contained the highest amount of ketones. It was hypothesized that the liquids with creamy or buttery flavors would contain higher amounts of ketones because these flavors are often artificially produced with Diacetyl, a ketone that is been connected with lung disease. Nine different flavors of vape liquid and one unflavored vape liquid base (control) were heated and vaporized. The vapor was collected using an erlenmeyer flask and a bunsen burner. Rubber tubing was attached to the flask, and the other end of the tubing was inserted into a graduated cylinder, which was upside down in a water bath. The graduated cylinder was water-filled so the rate of gas collection could be measured. When the liquid was vaporized, the vapor was collected in the graduated cylinder , where it was mixed with water to create a solution, which was then tested for ketones using ketone test strips. Each flavor of vape liquid tested negative for ketones, which showed that ketones were not directly present in any of the vape liquid flavors. These results rejected the hypothesis, but confirmed the null hypothesis.

INVESTIGATING NON-COVALENT INTERACTIONS VIA SYNTHETIC MOLECULAR DEVICES

Brian Torreon
South Carolina Governor's School for Science & Mathematics

How would our world change if we could sharpen our knowledge on the atomic scale? Molecular machines and devices, a research area recognized in the 2016 Nobel Prize in Chemistry, holds great promise in advancing our understanding and harness of molecular processes. Imagine the improvements in medicine, technology, engineering and other branches of science that could come about with breakthroughs on the molecular level. Aromatic Interactions (AI's) are one of the most important non-covalent interactions, and they are ubiquitous in many applications in chemistry, biology, and material science. However, AI's are among the most difficult non-covalent interactions to study due to their weak interaction energies and complex solvent natures. Experimental studies of AI's via molecular machines not only provide first-hand practical knowledge on these important non-covalent interactions but also provide valuable experimental data for benchmarking future calculations. This project focuses on two types of molecular devices: balances and rotors. Molecular Balances and rotors can help accurately analyze molecular interactions in both ground state and transition state as well as catalysis, which in turn will help us better understand numerous thermodynamic and kinetic processes at the molecular level.

THE EFFECT OF WOOD TYPE ON XYLEM PORE SIZE DEGENERATION

Paulina Trifonova
Spring Valley High School

The demand for clean water in third world countries and after natural disasters is a pressing societal issue. While systems for water purification exist, they are often too expensive or inaccessible to benefit the areas that require them the most. Xylem filtration aims to solve this problem by using a ubiquitous resource to create an accessible low cost filter. Xylem cross sections have been found to be effective in filtering out most contaminants, including viruses and bacteria. Studies have found that they stop allowing water to pass through after moderate use, rendering that cross section useless. The purpose of this experiment was to determine whether oak (*Quercus*) or maple (*Acer*) wood has a lower rate of xylem pore size degeneration and whether wood type affects the durability of a xylem filter. It was hypothesized that oak would perform better than maple because oak's xylem pores are dispersed throughout the cross section while maple's xylem pores are clustered in the center. In this experiment, cross sections were gathered and the rate of pore size degradation was calculated over 10 trials using a light microscope. A linear regression showed that maple's rate of degradation was significant($\alpha=0.05>p=0.004$), while oak's was not. This supported the initial hypothesis. It can be concluded that oak is more practical for xylem filtration than maple.</p>

THE EFFECT OF THE BRAND OF FEMININE HYGIENE PRODUCTS ON THE NUMBER OF CHEMICALS ABSORBED INTO A SOLUTION

Logan Trull
Heathwood Hall Episcopal School

The purpose of this investigation was to determine the levels of chemicals absorbed into an aqueous solution from different feminine product brands. The hypothesis was that if the brand of feminine hygiene product is changed, then the amount of added chemicals absorbed into the solution would also change. The experimenter tested four tampons from varying brands including one scented. The types gathered included: Tampax Pearl Scented/Unscented (both with flow size regular), Safe & Soft (Unscented, flow size regular), and Playtex Sport (Unscented, flow size regular). An aqueous solution with a viscosity near 0.6922 mPa.s was created by heating water to a temperature near 37 Degrees Celsius. After, five tampons from each of the four tampon brands were inserted into the solution and soaked for 8 hours. The testing strips were inserted into the solutions (after removing tampons) and the researcher reviewed the color changes to determine the levels of absorbed chemicals. The regular water at the temperature was tested as well, without tampons. The results recognized the Tampax Pearl Scented provided a harder water than Tampax Pearl Unscented. The evidence implies that the fragrance applied to the Tampax Pearl Scented tampons was the cause. The average total alkalinity levels of the different brands were higher than the controlled water meaning the contaminant must have been absorbed into the water from the tampons. The pH of all tested were shown in the analysis to be normal, and the free chlorine and total chlorine were shown to be inconclusive.

THE EFFECT OF A MOTORIZED GIMBAL ON LOCAL ACCELEROMETER-BASED POSITION TRACKING

DuBose Tuller
Heathwood Hall Episcopal School

The purpose of this experiment was to investigate the accuracy of a position-calculating device by finding the average difference in distance between what is measured by a camera from above and what is calculated by an accelerometer/gyroscope attached to a motorized gimbal. A drone acted as the aerial camera used to check the system's accuracy. Position tracking accuracy was determined between two groups: one with the motorized gimbal system turned on, and one with it turned off. Neither setup was able to effectively determine its own position, but the group with the motorized gimbal was able to do it statistically significantly better.

IMPACT OF ALTERNATIVE METHODS OF MENSTRUAL HEALTH MANAGEMENT ON YOUNG WOMEN

Eden Turek
Center for Advanced Technical Studies

The goal of this research is to analyze the impact of alternative forms of menstrual health management in young women, particularly girls age 14 to 18. Normalizing non-prevalent menstrual health management options in the younger population directly contributes to improved quality of life and menstrual product satisfaction. Additionally, the implications of the study could be applied to the broader spectrum of international women's health. If the participants are given the menstrual cup to use for 4 months, then they will prefer it to their traditional method of menstrual health management. By supplying the participants with menstrual cups and surveying them along with the control, who report on their use of more traditional products such as tampons and sanitary pads, analysis of general satisfactory trends over time is able to be conducted. It is expected that at the end of the 4 month research period, those in the experimental group will prefer the menstrual cup over the traditional methods, and in turn will have an improved quality of life along with a better understanding of their physiology due to the more intimate, non-disposable nature of the menstrual cup. This is Phase I of a II Phase project, in the future this project could be implemented on a more global scale, and further analyze the correlation of socio-economic class, race, age, and other factors in menstrual product satisfaction.

THE EFFECT OF WHITE VINEGAR, HYDROGEN PEROXIDE, AND SODIUM TETRABORATE ON *MICROCYSTIS AERUGINOSA* POPULATIONS' CYANOTOXIN AMOUNTS

Sachet Urs
Spring Valley High School

Cyanobacterial blooms are a major ecological problem that have disastrous effects worldwide. Recently, industry and global climate are becoming factors of decimated ecosystems and heavy economic losses. Vinegar, hydrogen peroxide, and sodium tetraborate are all compounds that have been shown to have some relative effect on either algae or cyanobacteria. This project focused on determining the effect of various, possible solutions on cyanobacterial cyanotoxin expulsion. It was hypothesized that the hydrogen peroxide would be the most effective at reducing the cyanotoxin amounts. A set of 40 dishes were split so that there were 10 dishes per treatment, with an extra 10 for the control group. Each dish was filled with distilled water and cyanobacteria, as well as its respective solution. The cyanobacterial residue was vacuumed, filtered, and weighed in order to find the dry weight of the cyanotoxins. The process was repeated once a day for an entire week. The hypothesis claiming that hydrogen peroxide would be the most effective was rejected, $F(3,16)=0.39$, $p=0.76$. There was no statistical difference found between trials. The solutions of hydrogen peroxide, sodium tetraborate, and white vinegar should be studied more before in order to find a more feasible method to reducing cyanotoxin expulsion.

EFFECTS OF GREENSPACE EXPOSURE ON STRESS AND MOOD OF COLLEGE STUDENTS

Zayden Van Vleet
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Stress, anxiety, and depression are growing issues among college students. Recent research suggests that stress may be a factor causing these mental health conditions, and that if this stress were to be treated, depression and anxiety may be positively affected. Greenspace is one way to treat this stress. Although a number of studies conclude that greenspace reduces stress and improves mood, there is little to no specificity as to what type of greenery accomplishes this task best. It is hypothesized that outdoor exposure to greenspace reduces stress and improves mood the most out of four methods tested in this experiment. The 80 participants who took part in this study were given a non-invasive blood pressure test and a BRUMS-32 mood assessment. They were then exposed to the type of greenspace to which they had randomly been assigned. The four groups tested were a poster, live, potted plants, a green, outdoor area, and a control with no greenery or vegetation. After 10 minute exposure, participants took the blood pressure test and mood assessment again. Results are being analyzed and will be available before January 2019. It is expected that all groups with exposure to green space will have some improvement in stress levels and mood. However, it is expected that outdoor exposure will have the highest level of improvement. The results of this study have implications in the medical field, offices, and schools, as well as how the administration of such treat the stress of their patients, workers, and students respectively.

THE EFFECT OF PHOTOSHOP ON THE ABILITY TO DIFFERENTIATE BETWEEN ORIGINAL, SEMI-EDITED, AND MILDLY EDITED PHOTOS IN HIGH SCHOOL STUDENTS

Kayleigh VanAlstine
Spring Valley High School

With the introduction of digital technology, the forgery of digital images has become a recurring issue for the public. The purpose of this experiment was to conclude the percentage of people who are able to differentiate between original and edited images. It was hypothesized that as the validity of images decrease, the average amount of participants who are able to correctly differentiate between the original and edited images would decrease. Sixty different images were captured, then edited with the software, Adobe Photoshop CC. Three Google Forms were created for testing, with twenty images on each form. All three types of images were evenly distributed to each form. Participants were collected and randomly assigned an order for testing. The forms were then distributed to each group and data was collected. There was a significant difference in the mean of the original group and the semi-edited and mildly-edited groups. A One-Way ANOVA was run with an alpha value of 0.05 for the three levels. The resulting p value was found to be < 0.01. The results concluded that the data collected was significant. A Tukey test was then performed for each level of editing (original, semi-edited, and mildly-edited). The results concluded that there was a significant difference between the original and the other two groups, but there was no significant difference between the semi-edited and mildly-edited image groups. This experiment shows that the majority of the population is unable to tell the difference between original and edited images.

STORM DRAIN HYDROELECTRIC GENERATOR

David Wamai
Center for Advanced Technical Studies

The focus of this research study is the the renewable energy field of hydroelectric generation. The main focus is to design and fabricate a hydroelectric generator that can fit on the inside of a storm drain, taking advantage of the running flow of water in the gap during mild rainfall or heavy storms. The entire purpose of the device is to provide electricity to a household body in the event of a power outage during natural disasters involving precipitation. The inspiration for this project idea was observing the amount of homes without power during rainstorms in certain areas of South Carolina, even though most power lines are underground and not suspended up in the air where they remain vulnerable to falling branches and debris. The design of the device will consist of two designs, one will be a portable model and the other will be a permanent attachment model. The portable

model will have 2-3 hydroelectric rotors each connected to a energy storage device that is all supported by a telescopic pole that will meet the two ends of the gap of the storm drain. This model is designed to be removed, stored, and reinstalled when needed, be an anticipated storm or heavy rainfall. The permanent attachment model will sit directly inside of the drain and catch any falling water running down the side of it. It will be connected to the wall by screws and cement glue.

MEASUREMENT OF SMOOTHNESS OF REACH IN PATIENTS WITH PARKINSON'S DISEASE

Haakim Waraich
South Carolina Governor's School for Science & Mathematics

The primary objective in this study was to explore the smoothness of reach in patients with Parkinson's disease. Parkinson's disease is known to affect movement and we wanted to explore how the disease potentially affects reach. This is significant because a decrease in the ability to reach also decreases the quality of life in the patient. We designed a reaching task using a virtual reality system. Two Parkinson's patients performed the task before and after deep brain stimulation along with a healthy subject. Our data suggests that healthy patients have a smoother reach than Parkinson's patients. We also found data that suggested that deep brain stimulation improves the smoothness of reach in patients with Parkinson's disease. Our sample sizes are small which does affect our accuracy. Our results show that patients with Parkinson's disease do have a less smooth reaching movement compared to healthy patients. The results also show that stimulation manages to improve the reach.

THE EFFECTS OF THE BOAT'S HULL DESIGN ON SPEED AND MANEUVERABILITY

Preston White
Spring Valley High School

The lack of speed and maneuverability of boat hulls are one of the possible reasons why thousands of cargo ships are at lost at sea. This investigation's purpose was to find the best hull for cargo ships, in respect to speed. It was hypothesized that the flat bottom hull would do the best in terms of stability and round hull would do the best in terms of speed. The three most common hulls, round, flat, and V, were tested. Three model boats of the same mass were used during experimentation. First, displacement was tested by putting each model in a small water tank, and measuring how much the boat sunk naturally. The round boat displaced 1603 ml of water, which was the highest compared to any other boat hull. Then, each model was put into a bathtub with the rope connected to the boat that was hanging on a hook with a weight on it. Then, the boat was pulled back to the end of the bathtub and released. The weight brought the boat to the other side of the tub. The ANOVA [$F(2,57)=49.82, p<0.001$] result indicated that the null hypothesis was rejected. The Tukey test results indicated that there was a significant difference between the round hull and all others. The flat hull did best in terms of speed and maneuverability. The other hulls failed to hold cargo since water got into the models.

THE EFFECT OF SOCCER HEADGEAR ON THE FORCE OF A COLLISON BETWEEN TWO HEADS

Tyler White
Spring Valley High School

Soccer is the most played sport in the world, with over 256 million people 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 this experiment was to determine if expanded polypropylene would be a viable material to protect the brain from head to head contact. It was hypothesized that the modified soccer headgear would significantly reduce the amount of force on the head. A dummy was used to simulate the human head, and a force sensitive resistor measure the force the receiving head incurred. A One-Way ANOVA ($a=0.05(F\ 3,30)= 2.49$, $p<0.05$) showed that the prototype did not significantly reduce force on the head from the already available headgear.

THE EFFECT OF AUTHORITARIAN, AUTHORITATIVE, AND PERMISSIVE PARENTING STYLES ON SELF-IMAGE IN MALE AND FEMALE HIGH SCHOOL TEENS

Mark Wild
Spring Valley High School

In psychology, the three parenting styles are the authoritarian style, in which parents impose rules and expect obedience without discussion, the permissive style, in which parents submit to what their children want, and the authoritative style, in which parents act assertive and responsible but are open to explanation and discussion. These parenting styles can greatly affect child development. Self-image is the view or conception one has of oneself and also has substantial effects on progression of children, especially teens. This experiment was conducted to look into how different parenting styles can influence the development of teens, also incorporating how this relates to gender. It was hypothesized that if the effect of different parenting styles is compared on the self-images of male and female high school students, then it will be found that the authoritative parenting style produces the highest scores on the self-image test, for both males and females. This experiment was completed by sending out a survey that included questions to determined the parenting style of the parents of the participants and a self-image test to receive a score. Groups were made based off of gender and parenting style, and data was analyzed. It was found

that the authoritative parenting style led to significantly higher self-image scores and the authoritarian parenting style led to significantly lower self-image scores that the other groups in both males and females. The permissive parenting style showed averages in between these two. This makes the authoritative style ideal to follow in relation to self-image.

THE EFFECT OF MENTAL IMAGERY ON BASKETBALL SHOTS

Hugh Willcox
Heathwood Hall Episcopal School

The subjects were asked to shoot 10 free throws to establish a base indicator for each subject. The average number of succesful shots made for a base was 4.667 shots. Subjects then either watched a video of a person making four free throws in a row, or a video of a person missing free throws. After watching the video of someone making four free throws in a row, the average number of shots made out of ten was 5.267. After watching the video of someone miss free throws, the average shots made out of ten was 4.267. There were uncontrolled variables such as weather and if the subject was sick that day. The results were too close to definitively conclude a difference in said results. The conclusion of the experiment was that there was not enough significance in the results to say that there was a difference when showing the videos. The point of the experiment was to show evidence that mental imagery worked, but the results showed that there was no significant evidence that it does.

THE EFFECT OF WHEEL TYPE ON THE SPEED OF A MOBILE ROBOT

Alyssa Williams
Spring Valley High School

In continuation with the previous year's experiment, the purpose of this experiment was to determine which base type produced the most efficient robot when tested on their speed. The previous project tested the base types' performance in alignment and traction. It was found in the previous test that the straight drive bases with omnidirectional wheels or combination wheels performed the best overall in tests of alignment and traction. It was hypothesized that there would be a significant difference in the mean distances traveled between all bases. It was also hypothesized that the straight drive base with combination wheels would perform with the greatest overall speed. The speed of the base was tested by allowing the bases to autonomously follow a previously delineated path for three seconds and recording the distance traveled in meters. The results were analyzed using a Welch's test and they revealed a significant difference between the means, $F(2, 87)= 414.12$, $p<0.01$, supporting the first hypothesis. It was found that the base with a straight drive and omnidirectional wheels had the highest mean distance traveled, against the second hypothesis. These findings are significant because they suggest that robots with a straight drive and omnidirectional wheels perform the best for tasks requiring high linear accuracy, traction, and speed. The findings of this experiment are relevant because they may influence future robot designs.

USING SANGER SEQUENCING TO DIAGNOSE A PATIENT WITH BMD

Kenneth Winterfeldt
South Carolina Governor's School for Science & Mathematics

Deletions in the gene that codes for the protein Dystrophin can cause muscular dystrophy. Symptoms of muscular dystrophy include muscle weakness and progressive muscle degeneration. The number of base pairs that are deleted and the location of the deletion can affect the severity of symptoms. This information can help predict the expected symptoms of the affected individual. The goal of this research was to determine the location of the ends of a specific deletion for a patient at Self Regional Healthcare. A method of determining the size and location of a genomic deletion is to sequence the DNA around the deletion and compare this to the wild-type or a normal sequence. Sequencing will reveal exactly which base pairs are deleted. The genomic location of the ends were 31845773-31915152, which means that the deletion was 69,379bp in size. The deletion was in frame. This means that an altered version of dystrophin can be produced which means that the patient can expect less severe symptoms than others that are affected. This information can help doctors determine possible treatments and assist physicians in predicting the severity of symptoms for this patient.

THE EFFECT OF LATTICE AND HONEYCOMB STRUCTURE ON THE SHOCK ABSORPTION CAPABILITY OF MODEL CRASH BARRIERS

Simon Wyatt
Spring Valley High School

The purpose of the experiment was to create a 3D printed structure for a model crash barrier that would be effective at absorbing impacts. The hypothesis was if the shock absorption capabilities of a crash barrier were tested, then the honeycomb and lattice structures will absorb more newtons of force than the control. To set up the experiment a force plate was placed on the ground and a protective piece of cardboard was placed on top of that. The structures (3D printed and made of flexible filament) were placed on top of the the cardboard and a meter stick was taped to a desk so that from the top of the barrier to the weight it was one meter. The hypothesis was partially supported ($F(2,251) = 15.1$, $p< 0.001$) with the lattice having a lower average than the control and being statistically significant . However, even though the honeycomb had a lower average than the control, it was not statistically significant which rejects that part of the hypothesis. From this it can be concluded that the lattice structure helps to absorb impact in a significant way when compared to a control block and a honeycomb structure made of the same material.

DEVELOPING A ARTIFICIAL NEURAL NETWORK TO ASSESS CARTILAGE HEALTHINESS

Jonathan Ye
Academic Magnet High School

Osteoarthritis, otherwise known as degenerative joint disease, is an incredibly common disease that affects over 10% of men and 18% of women over 60 years of age. Though the exact cause of osteoarthritis is unknown, the loss of cartilage and chronic joint pain are common features of OA. Currently, disease modifiable treatments are not available. One hurdle of developing an effective treatment for OA is that physicians are unable to assess the cartilage healthiness of patients. Recent studies suggest that two-photon laser scanning auto-fluorescence microscopy have the ability to image chondrocyte viability of articular cartilage without dye labeling. As the chondrocyte is the only cell type in articular cartilage to maintain the tissue, the chondrocyte viability is incredibly important in monitoring disease progression and the effects of treatment. However, the current two-photon imaging method relies on manual cell classification and counting, which is time consuming and not practical for real-time measurement. To solve this problem, in this study, a machine learning algorithm, a type of artificial intelligence, is proposed to automate the process of live cell identification for measuring the chondrocyte viability through the use of the neural network toolbox provided by Matlab (MathWorks). After training the algorithm with 150 cell images, it had a success rate of over 80% in recognizing live/dead cells, which can be further improved with a larger amount of training images. This result has demonstrated that, combined with the development of the imaging tool, the machine learning is a very promising approach towards the assessment of cartilage health in vivo.

THE EFFECT OF GOVERNMENT ASSISTED HEALTHCARE AND SELF PROVIDED INSURANCE ON PATIENT SATISFACTION IN SOUTH CAROLINA

Sera Zell
Spring Valley High School

Poverty plagues and overwhelming amount of people in America and leaves many helpless in terms of health, education and their overall well being. This fact lead to the creation of the government health insurance programs to help lower income Americans maintain their health. Though government health insurance is very beneficial to those in need, it is widely controversial with almost a 50% acceptance rate. The purpose of this experiment is to see if the insurance type (government or self provided) plays a part in patient satisfaction in South Carolina. Due to the previous voting patterns and overall political stance of the state, it is hypothesized that patients using government insurance will have a lower satisfaction rate than patients using self provided insurance. To test this, a survey was created in order to test the satisfaction of patients. They were then given to people with various incomes and data was recorded from this. With the data in hand a X2 analysis was run. The hypothesis was rejected for all questions at =0.05. In conclusion, the data could not sufficiently support that a difference in treatment between those using government health care and those using self provided health insurance.

USING A MACHINE LEARNING ALGORITHM TO DETECT BASAL CELL CARCINOMA IN MICROSCOPE SLIDES OF MOHS EXCISIONS

Luke Zhang
Spring Valley High School

It has been estimated that approximately 20% of Americans will develop some form of skin cancer in their lifetime; over 80% of these cases will be basal cell carcinoma. The process of detecting and locating basal cell carcinoma in microscope slides of Mohs excisions is time-consuming for Mohs surgeons, and operations can take hours to complete. Machine learning is a new field of artificial intelligence that has started to see growth in the field of medicine over the past few years. This experiment was conducted in order to study how accurately a supervised machine learning program would be able to detect the presence of basal cell carcinoma in microscope slides of Mohs excisions. It was hypothesized that the algorithm, after training, would be able to detect examples of basal cell carcinoma at an accuracy rate of 95% or higher. There were 1660 slides in total, with 1490 being used for the training period and the final 170 for testing. The final model was trained for 5 hours and had an average precision of 0.995. The precision and recall values were both 0.976 at a score threshold of 0.5.

END

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