



**BULLETIN**  
of the  
**South Carolina Academy of  
Science**  
Volume XCIV  
2022

Including the 94<sup>th</sup> Annual Meeting Program



*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 2022**

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President-Elect .....	(Position open)
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Edna Steele, SCJAS Treasurer .....	Converse University
Marlee Marsh, SCAS Treasurer .....	Columbia College
Eran Kilpatrick, Program Chair .....	University of South Carolina, Salkehatchie
John Kaup, Executive Director, SCJAS .....	Furman University
Tammy Cureton, SCJAS Program Director .....	Furman University
Don Jordan, Director, MESAS, AAAS/NAAS Rep, .....	University of South Carolina, Columbia
Michele Harmon, Electronic Journal .....	University of South Carolina, Aiken
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David Boucher .....	College of Charleston, 2022
Zhabiz Golkar .....	Voorhees College, 2022
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Sheryl Wiskur .....	University of South Carolina Columbia, 2022
Marlee Marsh .....	Columbia College, 2023
Eran Kilpatrick .....	University of South Carolina Salkehatchie, 2023
Breanne Swart .....	The Citadel, 2023
Brittany Baker .....	Francis Marion University, 2023
Christine Byrum .....	College of Charleston, 2023
Carole Oskertizian .....	University of South Carolina School of Medicine, 2023
Don Jordan .....	University of South Carolina Columbia, emeritus
Bill Pirkle .....	University of South Carolina Aiken, emeritus
Tom Reeves .....	Midlands Technical College, emeritus
David Stroup .....	Francis Marion, emeritus

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High School Research Awards .....	John Kaup, Brian Dominy, Bill Wabbersen
Membership .....	Don Jordan (interim)
Necrology .....	Pearl Fernandes
Patron Membership .....	(Position open)
State Science Fair Coordinator .....	Don Jordan (interim)
Teacher of the Year .....	Pearl Fernandes, Eran Kilpatrick, Don Jordan, Linda Sinclair, Will Case
Undergrad Research .....	Eran Kilpatrick, Kevin McWilliams
Website .....	Jeff Pike, Andrew Kail
Curator .....	Graham Duncan

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

**Publication information**

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## Welcome from the SCAS President

Dear Students, Teachers, Scientists, and Colleagues,

I am pleased to welcome you to the campus of the University of South Carolina Aiken and the 94th annual meeting of the South Carolina Academy of Science (SCAS).

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, we are hosting more than 300 students who will be presenting the results of their work across a multitude of STEM-related fields including Biology, Chemistry, Physics, Mathematics, Medicine, Exercise Science, Engineering, and others. We are also excited to have our plenary speaker, Dr. Vahid Majidi, the Director of the Savannah River National Lab. We are also honored to present the Governor's Awards for Excellence in Scientific Research and Scientific Awareness to the 2022 recipients, as well as a number of awards for teaching in STEM areas.

Preparations for this event required a significant amount of teamwork. I would like to thank the organizing committee as well as our sponsors and donors for their generous support. I would also like to thank the SCAS council for guidance and assistance throughout the year. I owe special thanks to our hosts at the University of South Carolina Aiken, especially the College of Sciences and Engineering and the Office of External Affairs. I am grateful to Drs. Eran Kilpatrick, Kevin Williams, and John Kaup for securing judges for the SCAS and SCJAS sessions; Dr. David Ferris for preparing our online program; and Drs. Edna Steele and Marlee Marsh for acting as Treasurer for SCJAS and SCAS, respectively. Lastly, I would 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.

Dr. Michele Harmon, University of South Carolina Aiken  
SCAS President

### The 2022 Meeting Organizing Committee:

Dr. Jeff Steinmetz, Francis Marion University and SCAS Past President

Dr. John Kaup, Furman University and SCJAS Director

Dr. April Heyward, SC EPSCoR Program Manager and SCAS Vice President

Dr. Zhabiz Golkar, Dean of the School of Science, Technology, Health and Human Services,  
Voorhees College





**SOUTH CAROLINA ACADEMY OF SCIENCE  
NINETY-FOURTH ANNUAL MEETING  
2022 SCHEDULE OF EVENTS**

<b>8:00 AM - 10:00 AM</b> <i>8:00 AM - 9:00 AM</i>	<b>SCAS Registration</b> <i>Continental Breakfast</i>	<b>Business and Education Building (B&amp;E)</b> <i>Humanities and Social Sciences (HSS)</i>
<b>8:30 AM – 11:15 AM</b>	<b>SCAS Oral Sessions</b>	<b>Business &amp; Education Building</b>
Session 1: Field Biology		<b>B&amp;E 131</b>
Session 2: Cellular and Molecular Biology		<b>B&amp;E 134</b>
Session 3: Biochemistry		<b>B&amp;E 135</b>
Session 4: Physics and Astronomy		<b>B&amp;E 136</b>
Session 5: Chemistry		<b>B&amp;E 138</b>
Session 6 & 7: Engineering and computer Science		<b>B&amp;E 140</b>
<b>10:00 AM – 12:00 PM</b>	<b>Poster Session</b> <i>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.)</i>	<b>B&amp;E Gymnasium</b>
<b>12:00 PM – 1:15 PM</b>	<b>Lunch</b> <i>Pick up lunch ticket with name badge. Boxed lunches available on the patio</i>	<b>Student Activities Center</b>
<b>1:30 PM– 2:45 PM</b>	<b>Plenary Session</b> “Savannah River National Laboratory: Research and Job Opportunities.” Vahid Majid, Ph.D Director for Savannah River National Laboratory  Jim Privett Service Award Presentation Governor’s Awards Presentations Teacher of the Year Award Presentations	<b>B&amp;E Gymnasium</b>
<b>3:00 PM-5:00 PM</b>	<b>Graduate Student Session</b>	<b>B&amp;E 140</b>

<b>SCAS Judges Conference Room</b> <i>Business and Education Building, Room 144</i>
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## SOUTH CAROLINA JUNIOR ACADEMY OF SCIENCE 2022 SCHEDULE OF EVENTS

<b>7:30 AM - 10:00 AM</b> <i>7:30 AM – 9:00 AM</i>	<b>SCJAS Registration</b> <i>Continental Breakfast</i>	Humanities & Social Science Bldg. (HSS)
<b>9:00 AM – 10:30 AM</b>	<b>SCJAS Oral Session I</b> <i>See session listing for details</i>	Business & Education (B&E) and Humanities & Social Sciences
<b>10:30 AM – 10:45 AM Break</b>		
<b>10:30 AM – 12:30 PM</b>	<b>SCAS Poster Session</b> Junior Academy members are encouraged to visit SCAS posters	Business & Education Building
<b>10:45 AM – 12:30 PM</b>	<b>SCJAS Oral Session II</b>	Business & Education Bldg. and Humanities & Social Sciences Bldg.
<b>12:00 PM – 1:15 PM</b>	<b>Lunch</b> <i>Boxed lunches are available, Lunch Tickets are in the SCJAS badge holder.</i>	Student Activities Center
<b>1:30 PM– 2:45 PM</b>	<b>Plenary Session</b> “Savannah River National Laboratory: Research and Job Opportunities.” Vahid Majid, Ph.D Director for Savannah River National Laboratory	<b>B&amp;E Gymnasium</b>
	Jim Privett Service Award Presentation Governor’s Awards Presentations Teacher of the Year Award Presentations	
<b>3:00 PM – 3:30 PM</b>	<b>SCJAS Awards Ceremony</b>	

<i><b>SCJAS Judges Conference Room</b>    Humanities &amp; Social Sciences, Room 107</i>
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# Vahid Majidi, Ph.D.

## Laboratory Director

## Savannah River National Laboratory

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### EDUCATION

Wayne State University, Ph.D., Chemistry

Eastern Michigan University, B.S. Chemistry

**POSITION** Dr. Vahid Majidi is the President of Battelle Savannah River Alliance, LLC (BSRA) and the Laboratory Director for Savannah River National Laboratory (SRNL).

**EXPERIENCE** As Savannah River National Laboratory (SRNL) Director, Vahid Majidi is responsible for the management, operation, and strategic direction of SRNL. Employing approximately 1,000 technical and support staff, SRNL conducts research and development for diverse federal agencies, providing practical, cost-effective solutions for the nation's environmental, nuclear security, energy and manufacturing challenges. As the United States Department of Energy's Environmental Management Laboratory, SRNL provides strategic scientific and technological direction and program support for the nation's \$6 billion per year legacy waste clean-up program.

Dr. Majidi is a former member of the senior executive service with direct reporting responsibilities to the U.S. Secretary of Defense, U.S. Director of National Intelligence, and the Director of the Federal Bureau of Investigation (FBI). He has more than 30 years of experience in the areas of chemistry, measurement science and technology, national and homeland security, science and technology policy, and nuclear nonproliferation.

Dr. Majidi previously served as the Deputy Assistant Secretary of Defense for Nuclear Matters, responsible for nuclear weapon surety and the acquisition and modernization of the nuclear weapons stockpile. From 2006-2012, Dr. Majidi served as Assistant Director for the FBI's Weapons of Mass Destruction (WMD) Directorate, responsible for coordinating and managing its equities, activities, and investigations involving WMD. In 2003, he was appointed Chief Science Advisor to the Department of Justice (DOJ) and was detailed to DOJ from Los Alamos National Laboratory (LANL), where he coordinated science and technology policy among DOJ component agencies and with state and local law enforcement entities. Dr. Majidi also served as the Chemistry Division Leader at LANL and was a tenured associate professor of chemistry at the University of Kentucky.

Dr. Majidi is the President of the Battelle Savannah River Alliance, LLC (BSRA). BSRA brings world class expertise in laboratory management, nuclear operations, national security, and scientific research to Savannah River National Laboratory.

**RECENT NOTEWORTHY** Vahid has received numerous awards including Laboratory Director of the Year, Small Business Award Program; Medal for Exceptional Civilian Service, Office of the Secretary of Defense; and the Presidential Rank Award, The White House; among many others.



The South Carolina Academy of Science gratefully recognizes  
**AVX Corporation, Nephron Pharmaceuticals 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. The South Carolina Research Authority (2015-Present), AVX Corporation, and Nephron Pharmaceuticals are this year's sponsors of the Governor's Awards.

Beginning in 1990, two of these awards were given annually to include an award for scientific discovery and/or an award for scientific awareness. In 2005 the Academy, in conjunction with the Governor's Office, initiated the sponsorship of a third award directed to a gifted young researcher (*only those individuals who have completed no more than 12 years beyond the Ph.D.*). The award is called the Governor's Young Scientist Award for Excellence in Scientific Research. 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.



# **2022 Governor's Award for Excellence in Scientific Awareness**

is awarded to

## **Dr. Bob Couch**

**Principal, Anderson Institute of Technology**

This award recognizes Dr. Bob Couch for his contribution in increasing scientific awareness among thousands of secondary school students across the State as well as nationally and internationally. He is respected for his innovation in education and his research accomplishments. He has led education reform in the State through his contribution to the passage of the Education Economic Development Act of 2005 to increase opportunities for students to pursue science-based careers.

Dr. Couch completed his Doctor of Education in the field of secondary and post-secondary administration and has served in administrative leadership roles in both secondary and higher education. His reputation as an innovator in education is reflected in the development of two model secondary technical centers that changed how students view and pursue careers in science, technology, engineering, and mathematics. His bold leadership has increased opportunities for females to engage career fields in medicine and engineering.

He recently completed course work and research at MIT in the field of artificial intelligence to be prepared to lead a statewide effort to develop career pathways connecting secondary and postsecondary education. In addition, he recently completed course work at Harvard regarding innovative approaches to how students learn to change instructional strategies and increase student achievement.

Dr. Couch received numerous awards for his innovative leadership and research. He received international recognition through his appointment to the US Department of Education to serve on the US and the country of Denmark delegation to align computer science standards among selected European countries and the US. One of his most enduring contributions was creating First Robotics competitions in 2005. Those competitions have engaged thousands of students throughout the state for the past seventeen years and have increased student interest in the fields of science, technology, engineering, and mathematics. One of his elementary teams won the 2022 South Carolina Championship in VEX Robotics and will compete in the World Competition in April 2022 in Fort Worth, Texas.

# **2022 Governor's Award for Excellence in Scientific Research**

is awarded to

## **Dr. S. Michael Angel**

**Department of Chemistry and Biochemistry  
University of South Carolina, Columbia**

This award recognizes Dr. S. Michael Angel's record of scientific research excellence as well as his many contributions to teaching and service. He is a highly respected scientist with an impressive record of research accomplishments. He has helped expand our state's research infrastructure and increase its visibility within the national and international scientific communities.

Dr. Angel received his Ph.D. from North Carolina State University in 1985. He accepted a faculty position at the University of South Carolina in 1993, where he now is a Carolina Trustee Professor and holds the Fred M. Weissman Palmetto Chair in Chemical Ecology.

Professor Angel has made significant scientific and research contributions as a world-leading spectroscopist and researcher in the development of in situ and remote sensing spectroscopic techniques for deep-ocean and planetary measurements. His research takes advanced laser-based sensors out of the lab and applies them to real-world measurements in extreme environments, such as the surface of Mars and the deep-ocean. Mike is a member of the science team for NASA's MARS 2020 Mission and was involved in the design of remote sensing instruments on the Perseverance Rover, which landed on Mars in February 2021. The Rover's remote Raman spectrometer is largely based on a design that Mike pioneered and was the first to describe in the literature. Dr. Angel has published more than one hundred and fifty peer-reviewed scientific publications in the areas of in-situ chemical sensors and remote laser spectroscopy.

Professor Angel is a Fellow of the Society of Applied Spectroscopy (SAS), and a Fellow of the American Association for the Advancement of Science (AAAS). The excellence of his research has been widely recognized by numerous national and international scientific awards including the prestigious Society of Applied Spectroscopy's (SAS) William F. Meggers Award, which he has won twice, and the SAS Lester W. Strock Award, among many others.

# **2022 Governor's Award for Excellence in Scientific Research at a Predominantly Undergraduate Institution**

is awarded to

**Dr. John E. Weinstein**

**Department of Biology**

**The Citadel**

This award recognizes Dr. John Weinstein's record of scientific research excellence as well as his many contributions to teaching and service. He is a highly respected scientist with an impressive record of research accomplishments. Through teaching and mentoring of students, he has expanded our state's STEM literacy and helped to increase the visibility of its research within the national and international scientific communities.

Dr. Weinstein received his Ph.D. from the University of South Carolina in 1991. He accepted a faculty position at The Citadel in 2000, where he has since also served in a variety of administrative roles including Department Chair, Associate Dean for Accreditation, and Interim Dean. While at The Citadel, Dr. Weinstein has established an impressive record of mentoring both undergraduate and graduate students in his research, many of whom have won presentation awards at local, national, and international conferences and have gone on to successful careers in environmental science.

Dr. Weinstein has made significant scientific and research contributions in the area of environmental toxicology pertaining to the interaction of natural and anthropogenic stressors on estuarine biota. He is best known for his landmark studies assessing sources, fate, and effects of plastic and microplastic pollution along the South Carolina coast. Dr. Weinstein has published over forty peer-reviewed articles and technical reports, and he and his students have provided over 140 presentations at scientific conferences. He has also delivered over twenty seminars to faculty and students at other institutions, local environmental groups, and members of the public.

Dr. Weinstein's research on microplastics, especially the discovery of microscopic tire particles in coastal waters, has gained both national and international attention. The national media, including National Geographic, NPR, and the National Resources Defense Council, have highlighted his research findings. Underscoring the international significance of Dr. Weinstein's research, he was recently invited to participate in hearings at the French Senate in Paris as the Parliamentary Office for Scientific and Technological Assessment were interested in learning more about his findings.

Dr. Weinstein has taken a leadership role in a student-centered regional scientific society, the Carolinas Regional Society of Environmental Toxicology and Chemistry. He currently serves on their Board of Directors. In the past, he has served as President, Vice President, and as the host and organizer of their annual meeting.

# **2022 Governor's Young Scientist Award for Excellence in Scientific Research**

is awarded to

**Dr. Jessica Larsen**

**Department of Chemical and Biomolecular Engineering  
Clemson University**

This award recognizes Dr. Jessica Larsen's record of scientific research excellence as well as his many contributions to teaching and service. 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. Larsen received her Ph.D. from Auburn University in 2017. She accepted a faculty position at Clemson University in 2017, where she is now a Dean's Assistant Professor.

Prof. Larsen has made significant scientific and research contributions in the area of polymeric materials for treatment and diagnosis of central nervous system disorders. She focuses on juvenile orphan diseases, which need increased research to deal with early patient mortality. Her laboratory has already published ten peer-reviewed articles and given over seventy research presentations. She maintains a laboratory with 5 doctoral and over 20 undergraduate researchers. She is passionate about providing research and scholarship opportunities for historically excluded populations.

Prof. Larsen has received prestigious awards for her mentorship of graduate and undergraduate students including the Phil and Mary Bradley Award for Mentoring in Creative Inquiry in 2020 and the Outstanding Faculty Woman Award in 2021. Recently, Prof. Larsen was selected to give TEDx talk focused on mentorship in the classroom and laboratory settings.

# **2022 Governor's Young Scientist Award for Excellence in Scientific Research**

is awarded to

**Dr. Julianne Flanagan**

**Department of Psychiatry and Behavioral Sciences  
Medical University of South Carolina**

This award recognizes Dr. Julianne Flanagan's record of scientific research excellence as well as her many contributions patient care, education, and professional service. She is a highly respected and creative 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. Flanagan completed her doctoral training at the University of Tennessee in 2011, postdoctoral fellowship at the Yale University School of Medicine, and began her faculty appointment at the Medical University of South Carolina in 2013.

Dr. Flanagan has made significant scientific and research contributions in the study of intimate partner violence (IPV), focusing on identifying behavioral and neurobiological mechanisms linking alcohol use and Post Traumatic Stress Disorder (PTSD) with IPV. She maintains a closely related line of research focused on developing novel treatments for populations at high risk for IPV, such as those with alcohol and drug use disorders and posttraumatic stress disorder. She is passionate about working with Veterans and military service members and conducts her research and clinical interventions among both individuals and couples. Dr. Flanagan has published over ninety peer-reviewed articles and has accumulated over one hundred national and international conference presentations. Dr. Flanagan's scholarly contributions have been recognized through a Visiting Professor Fellowship to Macquarie University in Sydney, Australia in 2014, and election to national leadership positions in the Association for Behavioral and Cognitive Therapies and the Research Society on Alcoholism. She has served on numerous scientific grant review panels for NIH and VA. She also provides consultation to the Department of Defense in the form of scientific and programmatic review in both the Military Operational Medicine Research Programs and Congressionally Directed Medical Research Programs. In addition to her scientific endeavors, she is an enthusiastic mentor to trainees and early career researchers through her role as Director of the NIAAA-sponsored Enhancing Diversity in Alcohol Research program at MUSC, the Charleston Consortium psychology internship program, federally funded pre- and postdoctoral fellowship programs at MUSC and the Charleston VAMC, and the American Psychological Association's Society for Couple and Family Psychology.

**2022 South Carolina Academy of Science  
Four-Year Institution Teacher of the Year**

**Dr. Adrienne Oxley**

Professor of Chemistry,  
Program Chair, Division of Health, Mathematics, & Sciences, Columbia College

Dr. Adrienne Oxley joined the Columbia College faculty in August 2008. She holds a BS in Biochemistry from Chatham University and a Ph.D. in Chemistry from the University of Pittsburgh. Dr. Oxley is a Professor of Chemistry and regularly teaches General Chemistry I and II, Biochemistry I and II and the non-majors chemistry course (Survey of Chemistry). During her time at Columbia College, Dr. Oxley has served as Faculty Chair, LA 201 Lead Teacher and is currently serving as the Principle Investigator for Columbia College's NIH funded SC INBRE grant, which provides research opportunities to undergraduate students.





**2022 SOUTH CAROLINA ACADEMY OF SCIENCE  
EXCELLENCE IN SECONDARY SCIENCE OR MATHEMATICS  
TEACHING**

is awarded to

**Paul Johnson**

Saluda High School



Paul Johnson has been teaching at Saluda High School for the past twenty-two years. Initially hired as an agriculture teacher, he soon transitioned to the biology classroom. He currently teaches Advanced Placement Biology, Biology I, and advises an independent research experience for students. Paul also teaches Biology 101 as an adjunct instructor at Midlands Technical College.

Paul graduated from North Carolina State University with a Bachelor's of Science in Horticulture and a minor in Botany. He also earned a Master's of Life Science in Biology from the University of Maryland. Since his early childhood in Belmont, North Carolina, Paul has enjoyed gardening, birdwatching, traveling, reading, cooking, and eating.

Paul estimates he has taught over 2500 students in his career. While providing many gray hairs and a few ulcers, Paul's students have also kept him enthused about teaching. He has had the honor of watching his students enter a variety of science-related fields including nursing, food science, marine biology, horticulture, farming, medical research, human pathology, psychology, and teaching. There have been a couple of lawyers and an up-and-coming music star, too.

Paul wants his students to excel in life as well as the study of life. He hopes his students will leave their time with him realizing how fearfully and wonderfully they and the rest of the world are made. If his students go further than they thought they could, he feels like he has been successful.

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	Charlotte Meares, 1997	Academic Magnet High
Major C. Rhodes, 1972	Spartanburg High School	Leone Rochelle, 1998	Spring Valley High
Troy Bridges, 1972	Spartanburg High	William C. Alexander, 1999	Gov. School for Science and Mathematics
Elizabeth Reagan, 1974	J. L. Mann High	Ginger R. Foley, 2000	Spring Valley High
Katherine J. Farnell, 1975	Spring Valley High	Annitra Jean Allman, 2001	Mullins High
William J. Hilton, Jr, 1976	Fort Mill High	Ruth S. Taylor, 2002	Mayo High
Margaret W. Cain, 1977	Sumter High	Patricia Ann Smith, 2003	Greer High
Carline Bowers, 1978	Spring Valley High	Randolph M. Brooks, 2004	Dreher High
Naomi Seifert, 1979	Spartanburg High	Maureen M. Albright, 2005	Lakewood High
Maxine Moore, 1980	Spartanburg High	Christopher D. White, 2006	Seneca High
Elizabeth Lashley, 1981	D.W. Daniels High	Michelle Sutton 2007	Spring Valley High
Lucretia Herr, 1982	Spring Valley High	Lisa Rose 2008	White Knoll High
Michael H. Farmer, 1983	Riverside High	K.L. Metzner-Roop 2009	Academic Magnet High
Glenda George, 1984	Richland Northeast High	Tonya Swalgren 2018	White Knoll High
Myra Halpin, 1985	Goose Creek High	Jennifer McLeod-Crady, 2019	Ridge View High
Jessica B. Creech, 1986	Hartsville High	Lindsey Rega 2020	Spring Valley High
Jane P. Ellis, 1987	Dixie High	Patrick Smallwood 2020	Center for Advanced Technologies
Linda D. Sinclair, 1988	Lexington High	Erin Drennon 2021	Hamilton Career & Technology Center
Johanna O. Killoy, 1989	Dreher High	Christopher White 2021	Seneca High
Wyatt Y. McDaniel, 1990	Spartanburg High		
Sonda F. Weiland, 1991	Fort Mill High		
John L. Kinard, 1992	Spartanburg High		
Larry Jones, 1993	R.C. Edward Jr. High		
Dianne H. Earle, 1994	Dorman High		
David Salter, 1995	Aiken High		
Richard Hager, 1996	Ridge View High		

## 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](http://www.scacademysci.org) (click on awards).

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

### Recipients

2013: Kimberly Klas, College of Charleston  
2013: Brett Hoover, College of Charleston  
2013: Brenna Norton-Baker, College of Charleston  
2015: McKenzie Perdue, USC Columbia  
2016: David Gilbert, USC Aiken  
2016: Alexander Abare, Clemson University  
2017: Neema Patel, USC Columbia  
2017: Reagen Welch, Southern Wesleyan University  
2018: Gillian Horn, Converse College  
2018: Lisette Payero, USC Aiken  
2019: Lisette Payero, USC Aiken

2020: Ricardo Hernandez, Presbyterian College  
2020: Matthew Blair, The Citadel  
2021: Melanie Howe, USC Aiken

**2022: Korinne M. Swanson,  
Coastal Carolina University.**

## TOPICAL SESSIONS SCAS

Saturday, April 2<sup>nd</sup> 2022

### **SESSION 1: FIELD BIOLOGY**

8:30 AM – 9:15 AM

Business and Education Building, Room 131

Moderator: C. Nathan Hancock, Judge: C. Nathan Hancock

- 8:30 AM THE EFFECTS OF CLIMATE AND NEST BOX SITE LOCATION ON EASTERN BLUEBIRD NESTING SUCCESS  
Emelie Alarcon and Michelle Vieyra, University of South Carolina Aiken
- 8:45 AM STRUCTURE OF SALT MARSH PLANT COMMUNITIES: POSSIBLE IMPACTS OF INCREASING SALINITY DUE TO RISING SEA LEVEL  
Mackenzie Jenkins and Jennifer Schafer, Winthrop University
- 9:00 AM OBSERVATIONS OF NON-NATIVE VASCULAR PLANT SPECIES IN THE EASTERN UNITED STATES, FROM SOUTH CAROLINA TO THE FLORIDA KEYS  
Richard Stalter, St. John's University

### **SESSION 2: CELLULAR AND MOLECULAR BIOLOGY**

8:30 AM – 10:00 AM

Business and Education Building, Room 134

Moderator: Shanieka Staley, Judges: Austin Worden, Shanieka Staley

- 8:30 AM A DEEPER UNDERSTANDING BETWEEN TRANSFORMING GROWTH FACTOR BETA AND ITS ROLE IN CARDIAC FIBROSIS AND MYXOMA  
Danielle Prisendorf and Mohamad Azhar, University of South Carolina School of Medicine
- 8:45 AM ACTIVE OPTICS HARDWARE: EXPERIMENTS FOR ADVANCED MEDICAL IMAGING  
Brianna Joyner and Joe Carson, College of Charleston
- 9:00 AM EXPOSURE TO SUBLETHAL CONCENTRATIONS OF GLYPHOSATE, 2,4-D, AND THEIR COMBINED FORMULATION INDUCES OXIDATIVE STRESS IN EISENIA FETIDA  
Kaitlin Brown, Heena Patel, and Edna Steele, Converse University
- 9:15 AM ANALYZING HIV-DEPENDENT EXPRESSION USING A FIREFLY LUCIFERASE REPORTER PLASMID  
Kaitlynn Cook and William Jackson, University of South Carolina Aiken
- 9:30 AM DESIGN AND CLONING OF TWO SHORT HAIRPIN RNAS TARGETED TO THE HIV-1 REGULATORY GENES TAT AND REV  
Meghann Williams and William Jackson, University of South Carolina Aiken
- 9:45 AM INDUCING CELL DEATH IN AN HIV-DEPENDENT EXPRESSION OF PRO-APOPTOTIC BAX USING A MANNER THROUGH BAX EXPRESSION  
Andrew Gregory, University of South Carolina Aiken

- 10:00 AM PROMISING ANTI-CARCINOGENIC EFFECTS OF MEDITERRANEAN HERBS AND SEED EXTRACTS ON BREAST CANCER CELLS  
Diana Ivankovic, Addison Powell, Maya Learmonth, and Gianna Derosa  
Anderson University

**SESSION 3: BIOCHEMISTRY**

**8:30 AM – 9:45 AM**

**Business and Education Building, Room 135**

Moderator: Bettie Obi-Johnson, Judges: Sheri Strickland, Bettie Obi-Johnson

- 8:30 AM AN INTRODUCTION TO MRNA VACCINES FOR NON-SCIENTISTS  
Rashawn Spann and David Boucher, College of Charleston
- 8:45 AM IDENTIFYING THE LOCATION OF ORF1 AND TPASE PROTEINS IN *ARABIDOPSIS*  
Tyneisha Bradley and C. Nathan Hancock, University of South Carolina Aiken
- 9:00 AM THE EFFECTS OF HUMAN BEHAVIOR ON *STAPHYLOCOCCUS* AND *ESCHERICHIA* BACTERIOPHAGE PRESENCE AT COASTAL CAROLINA UNIVERSITY  
Korinne Swanson and Paul Richardson, Coastal Carolina University
- 9:15 AM UNCOVERING THE REGULATORY REGIONS IN MINIATURE INVERTED REPEAT TRANSPOSABLE ELEMENTS  
David Weidner, Priscilla Redd, and Nathan Hanacock, University of South CAROLINA AIKEN
- 9:30 AM CONSTRUCTION OF EXPRESSION PLASMIDS CONTAINING ACTIVE-SITE MUTANTS OF 2,4'-DIHYDROXYACETOPHENONE DIOXYGENASE (DAD)  
Zephanae Liis, Gerard Rowe, and Kenneth Roberts, University of South Carolina Aiken

**SESSION 4: PHYSICS AND ASTRONOMY**

**8:30 AM – 9:45 AM**

**Business and Education Building, Room 136**

Moderator: Neil Miller, Judge: Neil Miller

- 8:30 AM GENERAL RELATIVISTIC MAGNETO-HYDRODYNAMIC SIMULATIONS OF ULTRA-LUMINOUS X-RAY OBJECTS  
Zachary Smith and Chris Fragile, College of Charleston
- 8:45 AM MODELING SOLAR RADIATION WITH RESPECT TO WATER VAPOR  
Evan Fish and Scott Curtis, The Citadel
- 9:00 AM OCULAR ABNORMALITY MODELING  
Josefino Lubang and Kaelyn Leake, The Citadel
- 9:15 AM THE BEHAVIOR AT POLYMER SHELL CASINGS COMPARED TO BRASS CASINGS WHEN EXPOSED TO HEAT  
Joshua Jones and Kaelynn Leake, The Citadel

9:30 AM USING MUSR TO FIND HYDROGEN LIKE DEFECTS IN TIN OXIDE  
Samuel Cathcart and Brittany Baker, Francis Marion University

**SESSION 5: CHEMISTRY**

**10:00 AM – 11:15 AM**

**Business and Education Building, Room 138**

Moderator: Sheri Strickland, Judges: Sheri Strickland, Bettie Obi-Johnson

10:00 AM 3,6-DIMETHOXYXANTHONE FROM 2,2',4,4'- TETRAHYDROXY-BENZOPHENONE VIA  
MICROWAVE-ASSISTED ANNULATION  
Faith Rosario, Sarah Knisely, and Robert Lww, Bob Jones University

10:15 AM CHARACTERIZING 3D ELECTROCHROMIC LBL SELF-ASSEMBLED POLYMER FILMS  
Alexander Stensland and Kaelyn Leake, The Citadel

10:30 AM IMPROVED SYNTHESIS AND PURIFICATION OF HYDROXYBUPROPION  
Michael Fruetel and Robert Lee, Bob Jones University

10:45 AM THE EFFECTS OF CBD OIL ON SYMPTOMS OF MILD STRESS IN RATS  
Julia Mewborn and Michelle Vieyra, University of South Carolina Aiken

11:00 AM VAPOR DEPOSITION SYNTHESIS OF SEMICONDUCTING MOLYBDENUM DISULFIDE  
Hudson Arce and Robert Lee, Bob Jones University

**SESSION 6: ENGINEERING AND COMPUTER SCIENCE I**

**8:30 AM – 9:45 AM**

**Business and Education Building, Room 140**

Moderator: Chandani Mitchell, Judge: Carol Jantzen

8:30 AM A CLEANING IN PLACE METHOD FOR CLEANING HEAT EXCHANGERS AT ROLLS-ROYCE  
Abigail Hulsey, Chloe Johnson, Salvador Guerra, and Bethany Fralick,  
University of South Carolina Aiken

8:45 AM CENTER OF GRAVITY DESIGN PACKAGING TEST EQUIPMENT  
Malik Fordham, Seth Leischner, Heather Thomas, and Bethany Fralick, University of South  
Carolina Aiken

9:00 AM LAYER BY LAYER DIPPING TO COUNTERACT WING ICING ON PLANES  
Luke Eafano and Kaelyn Leake, The Citadel

9:15 AM NOVATECH AUTOMATION, D3 SYSTEM, AND FLAVOR PLANT SIMULATION  
Breanna Scaffe, David Moldovan, and Bethany Fralick, University of South Carolina Aiken

9:30 AM PROPOSALS TO MODERNIZE THE DESIGN OF THE SHIELDED CANISTER TRANSPORTER  
Melvin Green III, Richard King, Tristan Harris, Shayn Price, and Bethany Fralick, University of  
South Carolina Aiken

**SESSION 7: ENGINEERING AND COMPUTER SCIENCE II**

**10:00 AM – 11:00 AM**

**Business and Education Building, Room 140**

Moderator: Chandani Mitchell, Judge: Joe Manna

- 10:00 AM SAVANNAH RIVER NUCLEAR SOLUTIONS HYDROSTATIC TESTING HAZARDS ANALYSIS  
Harrison Olszewski, Monica Ruffin, Daniel Willoner, Justin Acker and Bethany Fralick, University of South Carolina Aiken
- 10:15 AM SAVANNAH RIVER NUCLEAR SOLUTIONS SAFEGUARDS, SECURITIES & EMERGENCY SERVICES  
SOLUTIONS ENGINEERING - MOBILE TEST BED PROJECT  
Chase Marzullo, Jacob Rye, Jared Corbett, and Bethany Fralick, University of South Carolina Aiken
- 10:30 AM SAVANNAH RIVER TRITIUM ENTERPRISE SPARE PARTS DATABASING  
Nicholas Mitchell, Adrian Coleman, and Bethany Fralick, University of South Carolina Aiken
- 10:45 AM THERMAL DESIGN OF RADIOACTIVE MATERIAL PACKAGES  
John Pretorius, Hayden Barnett, Greyam Hayes, and Bethany Fralick, University of South Carolina Aiken

**SESSION 8: GRADUATE STUDENT ORAL PRESENTATIONS**

**3:00 PM – 5:00 PM**

**Business and Education Building, Room 140**

***CELLULAR BIOLOGY***

- 3:00 PM AHR EXPRESSION ON RORC-EXPRESSING IMMUNE CELLS IS ESSENTIAL FOR I3C-MEDIATED  
PROTECTION AGAINST COLITIS AND IL-22 PRODUCTION BY ILC3S  
Chandani Mitchell and Brandon Busbee, University of South Carolina School of Medicine
- 3:15 PM THE POTENTIAL OF EDTA AS A NON-INVASIVE TREATMENT OF CALCIFIC AORTIC VALVE  
DISEASE  
Henry Helms and Mohamad Azhar, University of South Carolina School of Medicine Columbia
- 3:30 PM THE MOLECULAR REGULATION OF ADSCS DURING TOROID FORMATION  
Austin Worden and Jay Potts, University of South Carolina School of Medicine Columbia
- 3:45 PM SMALL-DIAMETER ARTERY DECELLULARIZATION: EFFECTS OF ANIONIC DETERGENT  
CONCENTRATION AND TREATMENT DURATION ON PORCINE INTERNAL THORACIC ARTERIES  
Julia Hohn and Wayne Carver, University of South Carolina School of Medicine Columbia

***IMMUNOLOGY***

- 4:00 PM THE ROLE AND REGULATION OF BACTEROIDES ACIDIFACIENS DURING COLITIS  
Shanieka Staley, Mitzi Nagarkatti, Prakash Nagarkatti, and Philip Brandon Busbee, University of South Carolina School of Medicine Columbia



4:15 PM THE EFFECT OF MHC HETEROZYGOSITY ON IGA REPERTOIRE DIVERSITY  
Tori Peacock and Jason Kubinak, University of South Carolina School of Medicine Columbia

4:30 PM B-CELL-INTRINSIC MHCII SIGNALING PROMOTES MICROBIOTA DIVERSITY  
Mary Roland and Jason Kubinak, University of South Carolina School of Medicine Columbia

***MOLECULAR BIOLOGY***

4:45 PM THE REPRODUCTIVE MODE OF A MACROALGAE INVADER IN THE PAPA HANAUMOKU AKEA  
MARINE NATIONAL MONUMENT  
Taylor Williams and Heather Spalding, College of Charleston

## **POSTER SESSION SCAS**

**Business and Education Building, Gymnasium**

**10:00 AM - 12:00 PM**

*Poster set up 8-10 AM, must be on display by 10:00 AM*

*Authors must be present from 10-Noon for Judging*

### **FIELD BIOLOGY**

Judge: Pearl Fernandes

- 1 JUVENILE STRIPED BASS (*MORONE SAXATILIS*) MOVEMENT IN THE GREAT PEE DEE RIVER  
Robert Jackson and Jason Doll, Francis Marion University
- 2 DOWNSTREAM FROM MYRTLE BEACH, AN ANALYSIS OF WATER QUALITY AT WINYAH BAY  
Terra Pettit-Bacovin and Sheri Strickland, Converse University
- 3 ENVIRONMENTAL BACTERIOPHAGE DETECTION ON COASTAL CAROLINA UNIVERSITY CAMPUS  
Madison Gentilo and Paul Richardson, Coastal Carolina university
- 4 ESTABLISHING AND MONITORING AN EASTERN BLUEBIRD NESTING BOX TRAIL ON THE  
UNIVERSITY OF SOUTH CAROLINA AIKEN CAMPUS  
Jessica Frias, Samantha Amaker, David Negrete, and Michelle Vieyra,  
University of South Carolina Aiken
- 5 DIGITIZATION OF THE HERBARIUM COLLECTION AT THE UNIVERSITY OF SOUTH CAROLINA  
SALKEHATCHIE: CONTRIBUTING TO AN INTERNATIONAL DATABASE  
Zachery Wilson and Eran Kilpatrick, University of South Carolina Salkehatchie

### **BIOCHEMISTRY**

Judges: David Gardenghi, Taylor Williams

- 6 EVALUATING THE KINETICS 2,4'- DIHYDROXY-ACETOPHENONE DIOXYGENASE AND 2,4'-  
DIHYDROXYACETOPHENONE.  
Conner Martin and Kenneth Roberts, University of South Carolina Aiken
- 7 IDENTIFICATION OF AMYLOID BETA 42 PEPTIDES IN TRANSGENIC DROSOPHILA MELANOGASTER  
Michael Yan<sup>1</sup>, Sasha Bronovitskiy<sup>2</sup>, Dakota Castillo<sup>3</sup>, and Fang Lin<sup>3</sup>,  
<sup>1</sup>University of South Carolina, <sup>2</sup>Georgia Institute of Technology, <sup>3</sup>Coastal Carolina University
- 8 IDENTIFICATION OF SMALL REGULATORY RNA TRANSCRIPTS IN EXTRACELLULAR VESICLES FROM  
LACTIC ACID BACTERIA  
L. Brooke Busby, Klea Hoxha, Isabel Myers, Gabriela Perez Alvarado, and Brian Lee,  
Coastal Carolina University
- 9 INVESTIGATING PROTEIN MODIFICATION BY ITACONATE  
Shoba Swaminathan and Norma Frizzell, University of South Carolina School of Medicine
- 10 STUDYING THE TRANSPOSITION MECHANISM OF THE MJING MINIATURE INVERTED REPEAT  
TRANSPOSABLE ELEMENT IN YEAST  
Megan Collins and C. Nathan Hancock, University of South Carolina Aiken
- 11 USING YEAST TRANSPOSITION ASSAYS TO STUDY TRANSPOSITION MECHANISMS  
Pei-En Tu, David Weidner, and C. Nathan Hancock, University of South Carolina Aiken

- 12 DIAPHONIZATION: A PROTOCOL FOR CLEARING AND STAINING  
Rachel Smith, Andreas James, and Julian Smith, Winthrop University

### **CELLULAR BIOLOGY**

Judges: Chakia McClendon, Deepak Bhare

- 13 AUTOMATION OF SCORING COURTSHIP BEHAVIOR- STUDY OF LEARNING AND MEMORY IN *DROSOPHILA MELANOGASTER*  
Andres Castillo and Fang-Ju Lin, Coastal Carolina University
- 14 DETERMINING THE ROLE OF GOOSECOID IN CRANIOFACIAL DEVELOPMENT IN ZEBRAFISH  
Chasey Shabdue and April DeLaurier, University of South Carolina Aiken
- 15 EXPLORATION OF ZMYM2 FUNCTION UTILIZING A LOSS-OF-FUNCTION MODEL AND MRNA IN SITU HYBRIDIZATION IN ZEBRAFISH  
Madison Ackroyd and April DeLaurier, University of South Carolina Aiken
- 16 EXPLORING THE EFFECTS OF REDUCED FIG4 EXPRESSION ON AXONAL TRANSPORT AND MITOCHONDRIAL FUNCTION  
Jeremy Money and Jeff Twiss, University of South Carolina Columbia
- 17 THE EFFECT OF CHROMATIN STRUCTURE ON MPING TRANSPOSITION IN YEAST  
Jumanah Al-Soudi, C. Nathan Hancock and Priscilla Redd, University of South Carolina Aiken
- 18 THE EFFECTS OF TBX5A ON THE CRANIOFACIAL DEVELOPMENT OF ZEBRAFISH  
Jourdan Gruber and April DeLaurier, University of South Carolina Aiken
- 19 THYMOQUINONE AND FENRETINIDE IN COMBINATION EFFECTIVELY INHIBITED GROWTH OF HUMAN GLIOBLASTOMA T98G AND U87MG CELLS  
Amanda Manea, Nadia Al-Sammarraie, and Swapan Ray,  
University of South Carolina School of Medicine

### **MOLECULAR BIOLOGY**

Judges: Swapan Ray, Kaustubha Qanungo

- 20 ALU DIMORPHISM AT THE PV92 LOCUS OF CHROMOSOME 16 IS IN EQUILIBRIUM FOR UNIVERSITY STUDENT POPULATION  
Mackenzie Thackston, Alaina Urman, and James Brooks, Charleston Southern University
- 21 ANALYSIS OF THE SOYBEAN YELLOW LEAF MUTANT  
Tetandianocce Germany and C. Nathan Hancock, University of South Carolina Aiken
- 22 ASSESSING THE OPTIMAL EXPOSURE TIME AND CONCENTRATION LEVELS OF CIGARETTE SMOKE EXTRACT USING HUMAN AIRWAY EPITHELIAL CELLS  
Noelle Black and Chakia McClendon, Columbia College
- 23 CHARACTERIZING THE GENES AFFECTING MPING TRANSPOSITION IN YEAST  
Zara Lacera<sup>1</sup>, Jack Timmons<sup>2</sup>, Priscilla Redd<sup>1</sup>, and C. Nathan Hancock<sup>1</sup>,  
<sup>1</sup>University of South Carolina Aiken, <sup>2</sup>Emory University
- 24 DETERMINING IF THE BASES ADJACENT TO THE MPING ELEMENT IMPACT TRANSPOSITION  
Monica Colon-LaBorde and C. Nathan Hancock, University of South Carolina Aiken
- 25 IDENTIFICATION OF THE SOURCES OF BLOOD MEALS EATEN BY MOSQUITOES

- Olivia Shirley, Carson Mickey, Elody Bensch, and Paul Richardson, Coastal Carolina University
- 26 IDENTIFYING GENES THAT EFFECT MPING TRANSPOSITION IN YEAST  
Kaeleigh Seigler, David Weidner, and C. Nathan Hancock, University of South Carolina Aiken
- 27 INVESTIGATING THE ROLE OF RNA POLYMERASE V IN MPING EXCISION SITE REPAIR  
Kaili Renken and C. Nathan Hancock, University of South Carolina Aiken
- 29 EXPRESSION OF YOLK PROTEINS IN STOMOXYS CALCITRANS  
Lauren Hightower, Kaylee Thomson, and Mary Mills, University of South Carolina Aiken

### **EXERCISE AND SPORTS SCIENCE**

Judge: Mary Roland

- 30 IMPACT OF A MULTIPLE INGREDIENT SUPPLEMENT ON MUSCULAR PERFORMANCE  
Matt Helms and Andrew Hatchett, University of South Carolina Aiken
- 31 RELATIONSHIP BETWEEN ELECTROCARDIOGRAPHICALLY MEASURED HEART RATE AND CAFFEINE INTAKE  
Elizabeth Allen, Kimberly Zorn, and Christopher DeWitt, University of South Carolina Aiken
- 32 THE EFFECT OF GUIDED DIAPHRAGMATIC BREATH TRAINING ON SYMPTOMS ASSOCIATED WITH ANXIETY IN COLLEGE STUDENTS  
Michaela Caughman and Andrew Hatchett, University of South Carolina Aiken
- 33 THE EFFECT OF GUIDED DIAPHRAGMATIC BREATH TRAINING ON SYMPTOMS ASSOCIATED WITH DEPRESSION IN COLLEGE STUDENTS  
Sarah Powell and Andrew Hatchett, University of South Carolina Aiken

### **COMPUTER SCIENCE**

Judges: Holly Flynn, Lauren Hanna

- 34 3D TECHNOLOGY FOR TRAINING  
Paul Jones<sup>1</sup>, Wesley Hightower<sup>2</sup>, and Zhenheng Li<sup>1</sup>,  
<sup>1</sup>University of South Carolina Aiken, <sup>2</sup>Savannah River Remediation
- 36 CAPSTONE SEMINAR II HEALTH MANAGEMENT SYSTEM  
Adithya Pandiri, Brendon Esposito, Kyle Barker, Wilfredo Colon-Rios, and Zhenheng Li, University of South Carolina Aiken
- 37 COMPARISON OF DIMENSION REDUCTION METHODS ON HYPERSPECTRAL IMAGES  
Noah Wells and Todd Wittman, The Citadel
- 38 ELECTRONIC FLIGHT PLANNING SYSTEM  
Nicole Brazell, Matthew Jones, and Zhenheng Li, University of South Carolina Aiken
- 39 FEEDBACKS FOR REINFORCEMENT LEARNING IN ROBOTICS  
Jacob Kelley, Andrew Hunt, Destin Buck, and Zenheng Li, University of South Carolina Aiken
- 40 FLIGHT PLANNING SYSTEM USING JAVA  
Mara Washburn and Zhenheng Li, University of South Carolina Aiken

- 41 PROGRAMMABLE LOGIC CONTROLLER SYSTEM: ALTERNATIVE SETUP TESTING WITH CYBERSECURITY PENTESTING CAPACITY

Samuel Boyd<sup>1</sup>, Cody Collum<sup>1</sup>, and Mackenize Morris<sup>2</sup>

<sup>1</sup>University of South Carolina Aiken, <sup>2</sup>Dragos Inc.

- 42 SRNS ENVIRONMENTAL MONITORING

Austin Hartley<sup>1</sup>, Rakeem Jones<sup>1</sup>, Ryan Bodvake<sup>1</sup>, and Marcus Mcghee<sup>2</sup>

<sup>1</sup>University of South Carolina Aiken, <sup>2</sup>Savannah River Nuclear Solutions

- 43 VIRTUAL REALITY TUNNEL SIMULATION

Matthew Carter<sup>1</sup>, Aaron Henderson<sup>1</sup>, and Jean Plummer<sup>2</sup>

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

### **ENGINEERING**

Judge: Wenxia L

- 45 CONSOLIDATED CHAMBER DESIGN FOR OLFACTORY CONDITIONING ASSAYS WITH *DROSOPHILA MELANOGASTER*

Sasha Bronovitskiy<sup>1</sup>, Dakota Castillo<sup>1</sup>, Michael Yan<sup>2</sup>, and Fang Ju Lin<sup>1</sup>

<sup>1</sup>Coastal Carolina University, <sup>2</sup>University of South Carolina Columbia

- 46 NANOPARTICLE SIZE EFFECT ON STABILITY OF IONIC LIQUIDS (ILS) BASED NANOFLUIDS

Anna Hawcroft and Titan Paul, University of South Carolina Aiken

### **PHYSICS & ASTRONOMY**

Judge: Neil Miller

- 48 A SURVEY OF SUPERCONDUCTING INTERMETALLIC SYSTEMS FOR QUANTUM TECHNOLOGY APPLICATIONS

Allie Lindler and Kasra Sardashti, Clemson University

- 49 UNIVERSALITY IN NEAR-CRITICAL O<sub>2</sub>

David Dorf and Ana Oprisan, College of Charleston

- 50 WHERE ARE ALL THE LOW-LUMINOSITY SHAKURA-SUNYAEV DISKS?

Erika Hamilton and Chris Fragile, College of Charleston

- 51 ENGINEERING NIOBIUM-GERMANIUM INTERFACES FOR VOLTAGE-TUNABLE QUANTUM DEVICES

Junior Langa, Allie Lindler, and Kasra Sardashti, Clemson University

### **MATH**

Judge: Wenxia Li

- 52 STATISTICAL ANALYSIS OF THE EFFECT OF MUSIC ON HUMAN BRAIN ACTIVITIES

Eric Lilling and Bo Li, The Citadel

- 53 THE BEST WAY TO DEFEND AGAINST THE PATRIOTS PASSING OFFENCE

Mathew Daugomah and Li Zhang, The Citadel

**METEOROLOGY**

Judge: Wenxia Li

- 54 CHARACTERIZATION OF VOLCANIC AEROSOLS: USING AN AFM AND AN SEM TO IDENTIFY THE SURFACE MORPHOLOGY OF ASH  
William McLoud and Michael Larsen, College of Charleston

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

**NOTE: This list will be updated post-meeting with additional names!**

## SCAS JUDGES

**SCAS Judges Conference Room**

*Business and Education Building, Room 144*

Bettie Obi-Johnson  
Austin Worden  
Chakia McClendon  
Chandani Mitchell  
David Gardenghi  
Deepak Bhare  
Holly Flynn

Joseph Manna  
Kaustubha Qanungo  
Lauren Hanna  
Mary Roland  
Nathan Hancock  
Neil Miller  
Pearl Fernandes

Shanieka Staley  
Sheri Strickland  
Swapan Ray  
Taylor Williams  
Wenxia Li

## SCJAS JUDGES

**SCJAS Judges Conference Room**

*Humanities & Social Sciences, Room 107*

Ashely Allen  
Virginia Baker  
Betsy Booth  
David Boucher  
Tyler Brown  
Francis Burns  
Philip Brandon Busbee  
Christine Byrun  
Brian Dominy  
Heather Eddy  
David Ferris  
Annette Golonka  
Carmela Gottesman  
Jon Guy  
Julia Hahn  
Nader Hakin  
Chris Healy  
Henry Helms  
April Heyward  
Dan Kiernan  
Leah Kiernan  
Jason Kubinak

Bryan Lai  
Robert Lee  
Alex Kugler  
Kinsey Meggett  
Emma Merry  
Joseph Merry  
Justin Mogilski  
Carole Oskeritzian  
Michelle Petrie  
Lisa Pike  
Jay Potts  
Frank Provenzano  
Archana Saxena  
J. Henry Slone  
Jeff Steinmetz  
Muthanna Sultan  
Breeanne Swart  
Scott Tanner  
Charles Turick  
William Wabbersen



## **SCAS ABSTRACTS**

### **Alphabetical by author**

#### **EXPLORATION OF ZMYM2 FUNCTION UTILIZING A LOSS-OF-FUNCTION MODEL AND MRNA IN SITU HYBRIDIZATION IN ZEBRAFISH**

Madison Ackroyd and April DeLaurier  
University of South Carolina Aiken

This project explores the function of the *zmym2* gene in a zebrafish model. Previous work has implicated the gene in a human disorder called Potocki-Shaffer syndrome which impacts craniofacial developmental pathways that affect structures like the skull and jaw. We hypothesize that *Zmym2* is a component of the Potocki-Shaffer protein complex including Phf21a due to proximity and previous studies on other models. To determine the function of this gene in a vertebrate model, we utilized CRISPR-Cas9 in hopes of creating a frameshift mutation which would lead to excessive missense, most likely an early stop codon, and gene knock out. This would create a loss-of-function model that can be observed and tested for phenotypical abnormalities. We have identified a potential founder which has been crossed with a genotypically normal wild type (WT) zebrafish to create an F1 heterozygote/WT generation. Stable germline carriers of a potential mutant line will be used to generate homozygous mutants. To identify heterozygotes of the F1 generation, we are genotyping fish via fin clips using Hotshot lysis and a T7 PCR assay which identifies potentially mutant alleles. We are concurrently designing an antisense mRNA probe to identify patterns of expression of *zmym2* mRNA in developing zebrafish. We designed the probe by cloning a sequence of the 3' UTR of the *zmym2* gene into a plasmid. The in situ hybridization will indicate where in the body and when in development that *zmym2* gene is being expressed. This result will inform us which tissues may be impacted in mutants. Together, a knock-out model and tools to identify *Zmym2* expression in zebrafish will be a useful model to understand factors in the Phf21a complex.

#### **THE EFFECTS OF CLIMATE AND NEST BOX SITE LOCATION ON EASTERN BLUEBIRD NESTING SUCCESS**

Emelie Alarcon and Michelle Vieyra  
University of South Carolina Aiken

Eastern Bluebirds saw a 90% decline in population between 1920 and 1970 due to habitat loss and competition with the invasive House Sparrow. Efforts to provide Bluebirds with nesting boxes has helped to reestablish their populations throughout their native ranges. The South Carolina Bluebird Society has been setting up nesting box trails across the state and monitoring the number of eggs laid, hatched, and fledged since 2010. This project looked at the data collected since 2016 and compared the number of eggs laid, hatched, and fledged across several types of site location (forest, low grasses, near parking lots or roads, and wetlands) to see if success rate was correlated with site location. Weather patterns such as especially wet, dry, hot, or cold conditions were also looked at to determine if this had any influence on nesting success. Data analysis is ongoing at the time of this abstract.

#### **RELATIONSHIP BETWEEN ELECTROCARDIOGRAPHICALLY MEASURED HEART RATE AND CAFFEINE INTAKE**

Elizabeth Allen, Kimberly Zorn, and Christopher DeWitt  
University of South Carolina Aiken

The purpose of our study was to test the hypothesis that caffeine intake may lead to elevation of resting heart rate (rHR) in individuals who consume caffeine. In the University of South Carolina (USC) Aiken Exercise Testing Laboratory, we measured the resting HR by using an electrocardiogram (EKG) rhythm strip in 161 consenting subjects (39 males and 122 females). A rate-ruler was used by trained investigators

for accurate measurement. The skin surface was cleaned with isopropyl alcohol and the stratum corneum was removed with abrasion. Electrodes were placed on each subject and a rhythm strip was taken in a seated position. For all subjects, the mean rHR was 90 beats/min (range = 43-132 beats/min) and the mean caffeine intake was 249 mg/day (range = 0-1,230 mg/day). Twenty-seven subjects (17%) reported no caffeine intake. Both rHR and caffeine intake were higher in females compared to males. Normal sinus rhythm (NSR), HR 60-100 beats/min, was present in 108 subjects (67%). Sinus bradycardia, HR < 60 beats/min, was present in 7 subjects (4%). Sinus tachycardia, HR > 100, was present in 46 subjects (29%). Linear regression analysis was used to determine the Pearson correlation coefficient ( $r^2$ ) between the independent variable, caffeine intake, and the dependent variable, rHR. For all subjects, the  $r^2$  was 0.50, for males, the  $r^2$  was 0.51, and for females, the  $r^2$  was 0.47. We conclude that there is a moderate positive correlation between caffeine intake and rHR.

#### THE EFFECT OF CHROMATIN STRUCTURE ON MPING TRANSPOSITION IN YEAST

Jumanah Al-Soudi, C. Nathan Hancock and Priscilla Redd

University of South Carolina Aiken

Transposable elements are DNA sequences that can “jump” from one location in a genome to another. They create mutations and contribute to genomic evolution, so it is important that we understand the factors that control their activity. This project used mPing, a miniature inverted-repeat transposable element (MITE) that is naturally occurring and actively transposing in the rice genome. The goal is to determine how chromatin structure affects mPing transposition. We hypothesize that tightly packed chromatin structure will prevent the transposase proteins from binding the mPing element. Thus, we expect that open chromatin will produce higher transposition and closed chromatin will produce lower transposition. Previously, a yeast transposition assay was developed which measures mPing transposition from the ADE2 gene. We obtained yeast knockout lines missing the LDB7 and IES6 genes. LDB7 is known to affect nucleosome positioning, transcription regulation, and transcription elongation. IES6 is involved in the regulation of chromosome segregation, the maintenance of chromatin structure, and is associated with active transcription sites. Thus, we predict that the chromatin will be more closed in the LDB7 knockout, causing mPing to transpose less, and we predict that the chromatin in the IES6 knockout will also be more closed, causing mPing to transpose less. We prepared these lines for mPing transposition assays by inserting mmPing20 into the ADE2 gene and transforming with a plasmid for expression of the ORF1 and Transposase proteins needed for mobilization. Performing yeast transposition assays in these lines will indicate what effect chromatin structure changes have on mPing activity.

#### VAPOR DEPOSITION SYNTHESIS OF SEMICONDUCTING MOLYBDENUM DISULFIDE

J. Hudson Arce<sup>1</sup>, Robert E. Lee, Sr.<sup>1</sup>, Prakash Parajuli<sup>2</sup>, Apparao Rao<sup>2</sup>

<sup>1</sup>Bob Jones University in collaboration, <sup>2</sup>Clemson University

Molybdenum disulfide (MoS<sub>2</sub>) has promising uses in the production of field-effect transistors (FET) for use in biosensing. The two-dimensional form of this material comes in two variants, metallic (T-MoS<sub>2</sub>) and semiconducting (H-MoS<sub>2</sub>), and only H-MoS<sub>2</sub> can be used for the FET. Based on previous success in synthesizing carbon nanotubes with the vapor deposition method, it was decided to attempt a similar method to synthesize the H-MoS<sub>2</sub>. Using two tube furnaces linked by a quartz tube, independent temperature control was achieved. A substrate with a molybdenum precursor solution was placed at the downstream end of the tube and sulfur powder was placed in the upstream furnace. High purity nitrogen gas was used to flow the heated sulfur vapor to the substrate to react with the molybdenum. The sample was analyzed using Raman spectroscopy to determine the type of MoS<sub>2</sub> present, and by comparing the sample spectrum with literature spectra, it was determined that H-MoS<sub>2</sub> was successfully produced.

## THERMAL DESIGN OF RADIOACTIVE PACKAGES

Hayden Barnett<sup>1</sup>, Greyam Hayes<sup>1</sup>, John Pretorius<sup>1</sup>, and Edward Ketusky<sup>2</sup>

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

This report will examine the importance of heat transfer within packages containing spent radioactive material. With the assistance and guidance of the Savannah River National Lab Packaging Group, this project will demonstrate the necessity of adapting the package design process in an attempt to limit the heat transfer that will occur given knowledge of the content characteristics of that particular package. The group has hypothesized that, given the material of the container and the content heat load, dimensions can be designed to carry specific heat loads and make the transportation and storage of radioactive materials safer.

## ASSESSING THE OPTIMAL EXPOSURE TIME AND CONCENTRATION LEVELS OF CIGARETTE SMOKE EXTRACT USING HUMAN AIRWAY EPITHELIAL CELLS

Noelle Black, Felicia Gorss and Chakia McClendon

Columbia College

According to 2018 SCDHEC statistics, lung cancer is the second most common cancer diagnosed in South Carolina and the leading cause of cancer death. Cigarette smoke extract (CSE) contains over 7,000 chemicals, and more than 250 of those chemicals are known to be carcinogenic. These carcinogens target and damage DNA that disrupts normal cellular biological functions including cell proliferation, cell survival and cell migration. Due to the complexity and heterogeneity of lung cancer, it is essential to understand its molecular pathology for more effective therapies. The goal of this study was to determine the optimal exposure time and concentration levels of CSE using BEAS-2B, human lung epithelial cells. A constructed apparatus was used to smoke 10 to 20 cigarettes (i.e., Marlboro and Reference 2R5F brands) simultaneously. BEAS-2B cells were exposed to CSE for 1hr, 2hr, 4hr and 24hr exposure time points at varied concentrations to establish suitable treatment conditions. Results showed that cigarette smoke extract may cause rapid change in pH levels of the respiratory tract, which can influence biochemical and physical composition of the lung cellular environment. Future studies will include lower CSE concentrations with longer time points, to mimic the exposure routine of a smoker and to ensure the viability of the cells.

## PROGRAMMABLE LOGIC CONTROLLER SYSTEM: ALTERNATIVE SETUP TESTING WITH CYBERSECURITY PENTESTING CAPACITY

Samuel Boyd<sup>1</sup>, Cody Collum<sup>1</sup>, and Mackenize Morris<sup>2</sup>

<sup>1</sup>University of South Carolina Aiken, <sup>2</sup>Dragos Inc.

PLC systems with I/O inputs are extremely important to industry and businesses that automate their programs for highest efficiency. Unfortunately, these systems have traditionally been expensive to develop and test effectively. These testing systems also are missing key testing capacities, even in more modern software. They lack flexibility, high fidelity graphics, physics engines, and pentesting capacities. This project sets out to solve these issues by modifying advancements in the gaming industry, which have better flexibility, graphics, physics engines, and cost efficiency, to create a PLC testing system. Furthermore, by integrating a video game's software, the information loop will include the necessary components to allow for system pentesting by red hat teams and other cybersecurity experts trying to understand the system. The game that was modified to provide these advancements is Satisfactory. This presentation will document the process of modifying Satisfactory to meet these needs and improve the standards of PLC testing quality and cybersecurity potential.

## IDENTIFYING THE LOCATION OF ORF1 AND TPASE PROTEINS IN *ARABIDOPSIS*

Tyneisha Bradley and C. Nathan Hancock  
University of South Carolina Aiken

Transposable elements are DNA sequences that can move around within the genome of an organism, which can cause mutations. This project focuses on understanding the mobilization of the transposable element mPing from rice. mPing is mobilized by the ORF1 and TPase proteins from the related Ping and Pong elements. Prior protein localization results in yeast showed ORF1 appearing in the nucleus while TPase was primarily found in the cytosol, potentially acting as a mechanism to regulate transposition frequency. The goal of this project is to perform protein localization of the ORF1 and TPase proteins in *Arabidopsis thaliana*, a model plant. The ORF1 gene was cloned into pEarleygate104, which adds the YFP protein onto the N-terminal of ORF1 (YFP:ORF1). Similarly, TPase was cloned into pEarleygate103 to add GFP to the C-terminal of TPase (TPase:GFP). Initial separate experiments with these proteins showed YFP:ORF1 in the nucleus and TPase:GFP in the cytoplasm. However, visualization of both the TPase:GFP and YFP:ORF fusion proteins together in the same plant was not possible due to crossover of fluorescence emission. To address this issue, we are developing a new TPase:CFP that is constructed from the pEarleygate102 plasmid. This will allow us to visualize TPase:CFP and YFP:ORF at the same time without any fluorescence crossover, providing a better understand of how these two proteins effect each other's localization within *Arabidopsis thaliana*.

## ELECTRONIC FLIGHT PLANNING SYSTEM

Nicole Brazell, Matthew Jones, and Zhenheng Li  
University of South Carolina Aiken

In this Electronic Flight Planning System, we replicated an actual flight planning system. A user is prompted to enter a departure airport, destination airport, and an airplane type to have a flight plan generated. The flight plan generated will include any fueling stops needed during the flight as well as reply with an error message if the flight is not able to be completed with the given information. For this specific project, we decided to use a database management system to help keep our airport, airplane, and beacon classes organized for this project. Our Mentor that provided the specifications for this project was Dr. Zhenheng Li from the University of South Carolina Aiken.

## CONSOLIDATED CHAMBER DESIGN FOR OLFACTORY CONDITIONING ASSAYS WITH *DROSOPHILA MELANOGASTER*

Sasha Bronovitskiy<sup>1</sup>, Dakota Castillo<sup>1</sup>, Michael Yan<sup>2</sup>, and Fang Ju Lin<sup>1</sup>

<sup>1</sup>Coastal Carolina University, <sup>2</sup>University of South Carolina Columbia

The olfactory conditioning assay is widely used in Alzheimers disease research to quantify learning and memory in *Drosophila melanogaster*. The assay tests ability to recall an aversive conditioned stimulus of scent paired with electrical shock when presented a choice between shock-associated and unrelated scents. The T-maze, a commonly used apparatus for olfactory conditioning assays, employs an elevator mechanism to transfer flies from the shock-delivering training chamber to the scent selection point. Because T-Mazes are not commercially available, individual laboratory configurations vary widely and experimental replication is limited. The T-Maze elevator mechanism is known to cause fly casualty, often reducing data sample size. Other existing variations of olfactory conditioning apparatuses use airflow or automated machinery to transfer flies in place of the elevator. These alternative methods are known to inflict stress on flies during transfer, potentially altering conditioning effectiveness. A new, single-chamber apparatus was designed to address these concerns. The design consolidates the training chamber and scent selection point into one space, eliminating the need for transfer. The chamber features an easily

removable, flexible copper printed circuit board which is powered off to convert the space to the non-shocking selection point. A multi-opening slider component provides controlled access to the chamber, streamlining fly insertion, training, testing, and removal. All structural elements are 3-D printed, allowing for simple reproduction and alteration as desired. In preliminary trials, the single-chamber design displayed both minimal fly casualty and promise in functioning as a suitable alternative for traditional olfactory conditioning apparatuses.

#### EXPOSURE TO SUBLETHAL CONCENTRATIONS OF GLYPHOSATE, 2,4-D, AND THEIR COMBINED FORMULATION INDUCES OXIDATIVE STRESS IN *EISENIA FETIDA*

Kaitlin Brown, Heena Patel, and Edna Steele  
Converse University

The effective and widely used herbicide components glyphosate and 2,4-dichlorophenoxyacetic acid (2,4-D) are used ubiquitously on genetically modified crops and utilized worldwide. Exposing non-target organisms to sublethal levels of glyphosate, 2,4-D and their combined formulations could increase ROS production or damage antioxidants and result in oxidative stress. Adult earthworms (*Eisenia fetida*) were exposed to artificial soil treated with sublethal herbicide concentrations (1x or 3x the recommended dose, individually and combined with each other) for 28 days. Weekly sample collections were analyzed of the antioxidant enzymes superoxide dismutase (SOD) and catalase (CAT), malondialdehyde (MDA), and glutathione (GSH). The results were analyzed using one-way ANOVA with  $p < 0.05$  (IBM SPSS 28), and modeled using linear regression (StatsModels. Version 0.9.0.). Compared with the control, the results of the SOD analysis initially showed Glyphosate and 2,4-D to be significantly different from the control. Across the days the SOD decreased slightly, but significantly for the control group while it increased significantly in the 2,4-D 3x and Combo 3x groups. The CAT activity showed a significant increase in glyphosate and 2,4-D groups only at day 14 when compared to the control. Overall, it appears that the CAT activity is generally not significantly affected by the treatments. The LPO analysis showed a significant increase in the MDA levels compared with the control, both initially, and across the days. Combo 1x and 3x also show some of these effects, to a lesser extent. This study may indicate that exposure to sublethal levels of glyphosate, 2,4-D, and their combined formulation is harmful to non-target organisms and could be potentially carcinogenic to humans.

#### IDENTIFICATION OF SMALL REGULATORY RNA TRANSCRIPTS IN EXTRACELLULAR VESICLES FROM LACTIC ACID BACTERIA

L. Brooke Busby, Klea Hoxha, Isabel Myers, Gabriela Perez Alvarado, and Brian Lee  
Coastal Carolina University

Extracellular Vesicles, also referred to as EVs, are spherical lipid membrane-bound vesicles produced by both Gram positive and Gram negative bacteria. These vesicles are secreted into the extracellular space and play important functions in cellular and host communication, elimination of competitors, virulence, detoxification of environmental stress, and nutrition sensing. They are often packed with proteins, enzymes, lipids, nucleic acids and other biomolecules. *Streptococcus thermophilus* is a lactic acid bacterium (LAB), inhabiting the human digestive tract, that has been shown to produce EVs. The bacterial flora are known to influence the host immune system, metabolism, and neurological processes, but little is known about the biochemical pathways involved. Since EVs are involved in host communication, they may play a key role in affecting the biochemical processes of the host. To study the content and potential effects of EVs, we have grown different LAB strains under anaerobic conditions, including *S. thermophilus*, *Lactobacillus acidophilus*, and *Lactobacillus bulgaricus*. Our goal is to isolate EVs from these LAB strains and identify small regulatory RNA (sRNA) molecules that mediate communication and biochemical effects on the host systems. As part of this study, we have begun to identify sRNA genes in LAB strains that may

mediate communication with other bacteria or the host. In *S. thermophilus*, we have focused on the AsdS sRNA transcript, that is 152 base pairs in length, and is involved in quorum sensing. This gene is conserved among other streptococcal species. In the human pathogen, *Streptococcus pyogenes*, a homologous sRNA, known as MarS, is associated with the regulation of virulence factors. Since *S. thermophilus* is a non-pathogenic species, the AsdS gene cannot be involved in virulence, but based on

#### VIRTUAL REALITY TUNNEL SIMULATION

Matthew Carter<sup>1</sup>, Aaron Henderson<sup>1</sup>, and Jean Plummer<sup>2</sup>

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Expanding technology has always provided humanity with the possibility of accomplishing tasks that previously would have been considered impossible. Moreover, Virtual Reality (VR) is a relatively new technology that has barely scratched the surface in terms of its potential application. Virtual Reality started as an interesting new gaming feature but has recently shown promise in many other sectors. Primarily, Virtual Reality will allow humans to explore and understand areas that are too dangerous to enter otherwise. For our project, we were given point cloud LiDAR data of a tunnel used at the Savannah River Site (SRS). This tunnel is used to exhaust chemical vapors from a process building and includes low levels of radiation and is therefore much too dangerous to be traversed by people. If people were to enter the tunnel, they would surely get chemical and radiation poisoning, and therefore the tunnel must be scanned with robotic crawlers and LiDAR sensors to understand the layout of the tunnel. The LiDAR sensor performs a laser scan of the tunnel and converts the tunnel surfaces into a series of 3-dimensional (3D) points called a point cloud which can be viewed in a digital format. Our group was tasked with creating a Virtual Reality application that would allow a user to virtually maneuver through the tunnel without running the risk of getting radiation poisoning. The aim of this paper will be to illustrate how we incorporated the point cloud LiDAR data that we were given to create the Virtual Reality tunnel application.

#### AUTOMATION OF SCORING COURTSHIP BEHAVIOR- STUDY OF LEARNING AND MEMORY IN *DROSOPHILA MELANOGASTER*

Andres Castillo and Fang-Ju Lin  
Coastal Carolina University

Alzheimers disease (AD) is a neurological disorder that affects millions of people annually. This disease is caused by aggregations of beta-amyloid plaques within the brain which are known for causing interference with nerve cells. One method of researching Alzheimer's disease is with the use of fruit flies, also known as *Drosophila melanogaster*. The topic of interest was observed by using the Gal4-UAS system to drive the expression of a human amyloid beta-42 gene in flies. The effects caused by the buildup of plaques can be observed by the short-term memory loss that is correlated with modified courtship behavior. To accurately track the courtship suppression due to rejection from mated females, specialized chambers were 3D printed, which optimized video quality as each trial was documented using a video recorder. Additionally, the use of Ctrax, a fly tracking software, was also optimized so that the video could be inputted into MATLAB running the Jaaba program, tracking the fly's trajectory as well as their courtship behavior. Using these trajectories and the courtship behavior, the observed memory loss was quantified as a courtship index (CI), which showed the relative amount of courtship that each pair of flies attempted. This data was compared to parental control to show the effect of the human amyloid beta gene on the short-term memory of courtship rejection.

## USING MUSR TO FIND HYDROGEN LIKE DEFECTS IN TIN OXIDE

Samuel Cathcart and Brittany Baker  
Francis Marion University

Muons are particles which were originally found in solar rays along with pions and other particles. These pions decay into muons. Muons can be spin polarized by shooting them at a target. In doing so, their spins become polarized due to conservation of linear and angular momentum. Once they are polarized, these muons can be implanted into a sample where their spins will interact with the local environment of the sample. This method of muon implanting was used to collect MuSR (muon spin relaxation) data of implanted muons in Tin Oxide. This data was analyzed to determine how many muon sites are within the Tin Oxide lattice and the charge of the muon site. In the future the barrier energy between sites and the ionization energy of the neutral Muonium can also be determined. This information can be compared with already published hydrogen modeling to determine the likely locations of the muon sites within the lattice.

## THE EFFECT OF GUIDED DIAPHRAGMATIC BREATH TRAINING ON SYMPTOMS ASSOCIATED WITH ANXIETY IN COLLEGE STUDENTS

Michaela Caughman and Andrew Hatchett  
University of South Carolina Aiken

Anxiety is an emotional disorder that increased specifically in college aged students worldwide. Anxiety disorders are the most common mental health concern in the United States. Over 40 million adults in the U.S. (19.1%) have an anxiety disorder. Meanwhile, approximately 7% of children aged 3-17 experience issues with anxiety each year. Most people develop symptoms before age 21. Research indicates that diaphragmatic breathing alleviates symptoms of anxiety. Diaphragmatic breathing increases levels carbon dioxide levels and involves engaging the stomach, abdominal muscles, diaphragm when breathing. Diaphragmatic breathing increases carbon dioxide levels in the blood and strengthens parasympathetic nervous system activity. Diaphragmatic breathing stimulates the parasympathetic nervous system, which reduces anxiety and depression levels. Fifteen college students will participate in five consecutive sessions of breath training focusing on diaphragmatic breathing. Participants will be asked to complete a brief questionnaire prior to each training session, engage in a guided breath training session, and complete a brief questionnaire after the training session. The questionnaire will record anthropomorphic information and symptoms of anxiety. Results and conclusions pending.

## STUDYING THE TRANSPOSITION MECHANISM OF THE MJING MINIATURE INVERTED REPEAT TRANSPOSABLE ELEMENT IN YEAST

Megan Collins and C. Nathan Hancock  
University of South Carolina Aiken

Transposable elements are segments of DNA that can jump in and out of the genome. This activity can cause genetic mutations that either harm or benefit the organism. The mJing miniature inverted repeat transposable element is mobilized by proteins encoded by the transposable element Jing. These elements are found in Japonica and Indica rice, however, mJing transposition has only been detected in Indica rice. Our lab studies a distantly related element, mPing, using a yeast transposition assay that only allows yeast to grow when transposition has occurred. From this we know that mPing uses a cut and paste mechanism catalyzed by the two proteins ORF1 and Transposase. We hypothesize that mJing transposition also requires two proteins, but the exact sequences were not identified in the original description of this element. We set out to develop a yeast transposition assay to further define the mJing transposition mechanism. We first designed ORF1 and Transposase expression clones by determining the consensus of



the proteins from three Jing elements and cloning them into pAG413 and pAG415. We also designed and made a plasmid that contains mJing inserted into the ADE2 gene. These plasmids will be transformed into yeast and transposition assays will be performed by plating liquid cultures onto galactose plates lacking adenine. By doing so, only cells with transposed mJing, expressing the ADE2 gene, will be able to grow into colonies. These colonies can then be analyzed by PCR and sequencing to verify if transposition is occurring in our assay.

#### DETERMINING IF THE BASES ADJACENT TO THE MPING ELEMENT IMPACT TRANSPOSITION

Monica Colon-LaBorde and C. Nathan Hancock

University of South Carolina Aiken

A transposable element is a segment of DNA that can move from one part of the genome to another. mPing is a small, transposable element that actively transposes in rice. Our laboratory studies the transposition mechanism of mPing because this element is currently altering the rice genome and is being developed into a gene tagging tool for plant gene discovery. The established method for measuring transposition of mPing in *Arabidopsis* uses a GFP reporter. The GFP reporter only allows expression of the fluorescent biomarker when mPing is mobilized. We are attempting to determine if the bases adjacent to the mPing element affect its transposition. The consensus sequence that normally flanks mPing is TTA:TAA. Experiments in yeast show that the element excises more when flanked by TTA:TAA and less when flanked by GGT:ACC. Our goal was to make constructs that would allow us to test the effect of these flanking sequences in *Arabidopsis*. Using methods including PCR and NEB Builder cloning, we created four different plasmids. Each different plasmid contains mPing or mmPing20 (a hyperactive version of mPing) with adjacent TTA:TAA or GGT:ACC sequences. We are inserting these constructs into *Arabidopsis* together with a construct that contains the ORF1 and Transposase genes needed for transposition. These plants will be tested for GFP expression to determine the transposition frequency of each construct. We predict that the elements with TTA:TAA will have higher rates of transposition, suggesting that the adjacent bases contribute to the transposition mechanism.

#### ANALYZING HIV-DEPENDENT EXPRESSION USING A FIREFLY LUCIFERASE REPORTER PLASMID

Kaitlynn Cook and William Jackson

University of South Carolina Aiken

Replication of the human immunodeficiency virus (HIV-1) requires the presence of two viral regulatory proteins, Tat and Rev, which are produced during the early phase of viral gene expression. Tat upregulates viral transcription through its association with the trans-activating response element (TAR). Transcription of all viral mRNAs is initiated at the TAR sequence, which is found downstream of the viral promoter/enhancer within the viral Long Terminal Repeat. The resulting Tat/TAR interaction results in efficient transcription of full-length mRNAs that are subsequently completely spliced to generate Tat and Rev mRNAs. Rev binds the Rev response element (RRE), a cis-acting RNA element located within viral glycoprotein coding sequence. Rev binding facilitates export of partially spliced and un-spliced viral mRNAs out of the nucleus triggering the switch from early to late gene expression. In the absence of Tat and Rev, HIV gene expression is inhibited by another cis-acting RNA element, termed the gag inhibitory sequence (INS). In this study, the HIV-1 promoter/enhancer (LTR), RRE, and INS elements were used to create a HIV-dependent expression plasmid to express the firefly luciferase reporter gene p(LIR)LucF.pA. HIV-dependent expression of the reporter was studied in a series of experiments in HEK293T cells, p(LIR)LucF.pA, pCMVR8.74 (a HIV-1 Tat and Rev expression plasmid), and pCMV-LucF, which constitutively expresses Firefly luciferase. In these experiments, cells transfected with p(LIR)LucF.pA, in the absence of Tat and Rev expressed low levels of luciferase, while cells transfected with increasing levels of pCMVR8.74 showed correspondingly higher levels of luciferase activity. These results indicate that luciferase

expression from p(LIR)LucF.pA is HIV-dependent. Current studies are underway to more completely characterize HIV-dependent expression using the p(LIR) plasmid.

#### THE BEST WAY TO DEFEND AGAINST THE PATRIOTS PASSING OFFENCE

Mathew Daugomah and Li Zhang

The Citadel

Operations Research will be used to estimate the most effective way to defend against the New England Patriots football team offense. Game Theory, a subset of Operation Research will be used to analyze data based off past offensive performance. A dataset of games will be used to make a playoff function of the three most used offensive formations used by the Patriots and the three defensive formations most used against the Patriots to analyze the best defense to be used against the Patriots passing offensive.

#### UNIVERSALITY IN NEAR-CRITICAL O<sub>2</sub>

David Dorf and Ana Oprisan

College of Charleston

Supercritical oxygen is a phase of O<sub>2</sub> that displays mixed properties found in liquids and gases. The experiment utilized the HYLDE magnetic levitation apparatus to take advantage of the paramagnetic properties of liquid oxygen to counteract the concentration gradient formed under the influence of gravity. Different wavelengths of light were sent through the oxygen samples in the apparatus to determine the isothermal compressibility, correlation time, and other material properties. A CCD detector collected light transmission data that was analyzed through software that used rectangular regions to section off various areas in the image frame. Material property values closely matched those found in previous investigations, however bluer light seemed to deviate from other results. This optical analysis technique could be applied to other materials with variable indexes of refraction without disturbing the temperature control of cryogenic samples.

#### LAYER BY LAYER DIPPING TO COUNTERACT WING ICING ON PLANES

Luke Eafano and Kaelyn Leake

The Citadel

Icing of the wings and leading edges of an aircraft is one of the most dangerous situations plaguing the modern day aviation world. This icing can lead to an increase in stall speed, excess weight and loss of coordinated flight. Modern day anti-icing measures include temporary sprays, heating elements in the structure of the plane, or bleed-air systems. However these solutions are expensive and not used in smaller non commercial planes such as prop planes. Layer by Layer dipping is a fabrication method to deposit nanometer thick layers of a polymer onto a surface. The goal of this research is to find a material that can be applied onto an aluminum wing creating a coating that prevents the conditions in which ice forms in flight and does not compromise the aerodynamic capabilities of the wing. This research has concluded that PEI+PCBS with PEI as the base layer sticks to aluminum and allows the creation of the bi-layers on an aluminum wing. Water was applied to the surface of PEI+PCBS on a glass slide and observed after the water began to freeze. Compared to a non-coated slide the coated slide exhibited hydrophobic properties and prevented ice formation. Therefore PCBS has shown to be hydrophobic and effectively prevents ice from sticking onto its surface. This research has demonstrated that it is possible in conjunction with modern day de-icing systems to serve as a replacement for some of the less effective, and expensive systems and can be used in aviation. Future research looks to test for aerodynamic properties of a coated wing.

## MODELING SOLAR RADIATION WITH RESPECT TO WATER VAPOR

Evan Fish, Kaelyn Leake, and Scott Curtis

The Citadel

Precipitable water vapor decrease solar radiation by blocking solar rays as they enter the Earth's atmosphere. This understanding can be used to develop a model that outputs solar radiation levels with respect to precipitable water vapor levels. This work aims to test the accuracy of a solar radiation model in different regions than originally designed and how it can be utilized specifically in the Lowcountry of South Carolina. Precipitable water vapor data was retrieved from satellites along with location and surface elevation for the respective data elements. A MATLAB program was created to process the satellite's data in conjunction with surface elevation, location of the sun in relation to the Earth, amount of daylight, the day of the year, and other constants. This program utilizes modeling equations and outputs given solar radiation at respective locations. The calculated solar radiation per day based upon water vapor values is compared with experimental data from The Citadel's weather station for accuracy. Currently results show the modeled solar radiation levels to be 90% higher than The Citadel's weather station recorded levels.

## CENTER OF GRAVITY DESIGN PACKAGING TEST EQUIPMENT

Malik Fordham, Seth Leischner, Heather Thomas, and Bethany Fralick

University of South Carolina Aiken

This report describes the importance of the center of gravity relating to radioactive packaging material. For this project, it is important to drop the packaging material in an orientation that conflicts maximum damage. This way, accidents can be prevented in the future and protect the condition of the sealed material. The work consists of research on Title 10 Code of Federal Regulations Part 71, research on different methods of testing, and subsequently building and testing a scaled prototype. Once the prototype has proven accuracy for this project, a larger test rig will be built to perform testing on heavier packages.

## ESTABLISHING AND MONITORING AN EASTERN BLUEBIRD NESTING BOX TRAIL ON THE UNIVERSITY OF SOUTH CAROLINA AIKEN CAMPUS

Jessica Frias, Samantha Amaker, David Negrete, and Michelle Vieyra

University of South Carolina Aiken

Eastern Bluebird populations drastically declined through much of the 20th century due to loss of habitat and competition from invasive species. Establishing nesting boxes for these birds to use has greatly increased their numbers in the last few decades. In collaboration with the South Carolina Bluebird Society, a nesting box trail consisting of 21 boxes has been established on the campus of the University of South Carolina Aiken. Eleven of these boxes have existed on campus for several years while ten of them are new. Nesting begins in late February and our team will be monitoring the number of eggs laid, the number of eggs hatched, the number of chicks that fledge, and any predation that occurs. We will also be collecting any eggs that do not hatch to determine if they were infertile, and if not, stage the unhatched embryo. Boxes have been placed in different types of locations including wooded, grassy, next to a parking lots, as well as in busy versus secluded areas to determine the optimal location for nesting success. We will be presenting data on early nesting activity and which of the new sites attracted nesting bluebirds this season.

#### IMPROVED SYNTHESIS AND PURIFICATION OF HYDROXYBUPROPION

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Hydroxybupropion is a CYP2B6 metabolite of bupropion, a medication used in the treatment of seasonal affective disorder and as a smoking cessation aid. The primary goal of this research is to improve the yield of a patent synthesis of hydroxybupropion while maximizing the purity of the product so that it will be research grade. The synthesis was completed in a one-step reaction between 2-bromo-3'-chloropropiophenone and 2-amino-2-methylpropanol. Conditions of the reflux were modified by adjusting the reaction temperature from 83°C to 35°C. The product was characterized using TLC, HPLC, GC-MS, IR, <sup>1</sup>H-NMR, and melting point. The optimization improved the yield to 93% hydroxybupropion with 91% purity. Column chromatography and recrystallizations were used to bring the purity up to 99.52%.

#### ENVIRONMENTAL BACTERIOPHAGE DETECTION ON COASTAL CAROLINA UNIVERSITY CAMPUS

Madison Gentilo and Paul Richardson

Coastal Carolina university

Bacteriophages are viruses that infect bacteria. These viruses can be found nearly anywhere in the environment and are the most abundant organism on Earth. The purpose of this study was to utilize bacteriophage as an environmental indicator of the presence of harmful bacteria in waterways on Coastal Carolina campus, as well as identify bacteriophage that could possibly be used to control bacterial blooms. 11 sites were designated for weekly sample collection, water samples were filtered and then amplified using strains E. coli B and E. coli K12. This was done to allow potential viruses in the sample to proliferate to detectable levels using microbial and molecular testing techniques. Plaque assays were used as a microbial screen for the presence of bacteriophage. Samples that tested positively using the microbial test were then run using PCR and gene specific primers to identify the viral families as well as further confirm the presence of the desired bacteriophage. The results of this study show the presence of bacteriophage on the Coastal Carolina campus as well as the identification of at least one of the desired viral families.

#### ANALYSIS OF THE SOYBEAN YELLOW LEAF MUTANT

Tetandianocee Germany and C. Nathan Hancock

University of South Carolina Aiken

Soybeans, *Glycine max*, are a highly versatile, important crop. Soybean growth is dependent on its ability to fix nitrogen, a process in which atmospheric nitrogen is converted into nitrogenous compounds available for the plant's consumption, within its nodules. A previous study discovered a mutant soybean, called Yellow Leaf, that exhibits yellow leaves, smaller stature, more fragile stem, and smaller root system with smaller nodules. This project focuses on determining the gene responsible for defective nodule development in the Yellow Leaf mutant. Genetic analysis indicates that the Yellow Leaf mutation is caused by a single recessive gene. Through sequence analysis we have identified 15 candidate genes that were mutated in the Yellow Leaf plants. We are narrowing the number of candidates by Illumina sequencing of PCR amplicons of the mutation sites in an F2 population segregating for the phenotype. Once the most likely candidate is identified, we will construct a gene editing plasmid, containing a GFP gene, an sgRNA, and Cas 9 gene to target the candidate sequence. The plasmid will then be used to perform a hairy root transformation, a process in which transgenic roots expressing the CRISPR-Cas 9 gene editing system will

be able to cut the target DNA sequence. If we have identified the correct gene, we expect to observe transformed roots with fewer, smaller nodules.

#### PROPOSALS TO MODERNIZE THE DESIGN OF THE SHIELDED CANISTER TRANSPORTER

Melvin Green III, Richard King, Tristan Harris, Shayn Price, and Bethany Fralick

University of South Carolina Aiken

This paper focuses on the modernization of the design of the Shielded Canister Transporter (SCT). Although the current SCT is operational, technological advancements since its development give the opportunity to design an updated model. Opportunities for improvement include updated video guidance systems, a remote operation system, utilization of electric motors to replace hydraulic drive and crane operations, and implementation of all-wheel steering and drive. Using system engineering practices, the design of the SCT is broken down into different functioning subsystems focused on the areas for improvement. Proposals for an alternative design will allow for the enhancement of the overall operation of the SCT.

#### INDUCING CELL DEATH IN AN HIV-DEPENDENT EXPRESSION OF PRO-APOPTOTIC BAX USING A MANNER THROUGH BAX EXPRESSION

Andrew Gregory

University of South Carolina Aiken

Since the start of the HIV pandemic in 1981, approximately 79 million people have become HIV-1 infected and 36 million have died from AIDS. HIV-1 attacks and destroys CD4-positive T helper lymphocytes, and it is the loss of these cells that leads to AIDS, the acquired immunodeficiency syndrome. While progression to AIDS can be greatly slowed, current drug therapy does not eliminate latent reservoirs of HIV-infected cells. Therefore, methods to target and eliminate these reservoirs are under intense investigation. HIV-dependent gene therapy offers a potential method to selectively eliminate these HIV-positive reservoirs. To test this hypothesis, we created the HIV-dependent plasmid, p(Bax)X.pA, which expresses the Bcl-2-associated X protein (Bax), a pro-apoptotic member of the Bcl-2 gene family. Bax expression in this plasmid is under transcriptional control of the three HIV regulatory elements: the viral promoter/enhancer, the Rev Response Element, and the Gag Inhibitory Sequence. The addition of these elements results in an inducible expression that is dependent upon the presence of two viral regulatory proteins Tat and Rev. HIV-dependent Bax expression was investigated in a cell culture model using HEK293T cells. For this, HEK293T cells were transfected with (1) pCMVBax, which constitutively expresses Bax, (2) p(LIR)Bax.pA alone; or (3) p(LIR)Bax.pA and pCMVR8.74, which expresses HIV Tat and Rev. Forty-eight hours post-transfection, cell viability was determined by trypan blue exclusion. Results showed that cells cotransfected with p(LIR)Bax.pA and pCMVR8.74 had higher levels of cell death compared to p(LIR)Bax.pA alone. These results suggest that Bax expression is HIV-dependent. Current studies are underway to directly measure levels of Bax expression and to investigate induction of apoptosis.

#### THE EFFECTS OF TBX5A ON THE CRANIOFACIAL DEVELOPMENT OF ZEBRAFISH

Jourdan Gruber and April DeLaurier

University of South Carolina Aiken

Tbx5 (TBOX-5) is a transcription factor for the T-box 5 protein which plays a role in heart and forelimb development. Humans with the dominant TBX5 mutation have a genetic condition called Holt-Oram syndrome. This syndrome causes cardiac system and anterior forelimb defects, specifically defects of the cardiac septa and immature forelimb growth (Steimle & Moscovitz, 2016). Previously, a zebrafish line was generated with a mutation in tbx5a (heartstrings mutant) (Garrity et al., 2002). This mutation causes fish

to lack pectoral fins and have progressive cardiac dysfunction which eventually leads to a non-functional cardiac system (Garrity et al., 2002). This line has a mutation in exon 8 where a C/T change causes a premature stop codon (Garrity et al., 2002). Craniofacial deficiencies resulting from *tbx5a* mutation have not been previously characterized, although larval zebrafish have abnormal jaw structures. The goal of my project is to a) characterize the skeletal phenotype in mutant fish compared to wild-type siblings at a range of embryonic and larval stages, and b) establish the stage in development where patterning goes awry.

#### WHERE ARE ALL THE LOW-LUMINOSITY SHAKURA-SUNYAEV DISKS?

Erika Hamilton and Chris Fragile  
College of Charleston

Black hole X-ray binaries, systems in which a black hole is in close orbit with and pulls material from a companion star, can usually only be observed whenever they go into outburst. During a typical outburst, the source will spend some amount of time in a soft state characterized by a blackbody spectrum peaking around 1keV, but only for a narrow range of luminosities. Based on available theory, there is no particular reason why this luminosity range should be so restricted. In my work, I use numerical simulations of black hole accretion extending over a wide range of luminosities to explore what may limit this range in nature. So far, I have been unable to find any discriminating characteristics that would explain why we do not see, in particular, low-luminosity, soft-state disks in Nature. In other words, I have been unable to establish any physical mechanism that would restrict soft-state accretion disks to the narrow range of luminosities observed.

#### SRNS ENVIRONMENTAL MONITORING

Austin Hartley<sup>1</sup>, Rakeem Jones<sup>1</sup>, Ryan Bodvake<sup>1</sup>, and Marcus Mcghee<sup>2</sup>

<sup>1</sup>University of South Carolina Aiken, <sup>2</sup>Savannah River Nuclear Solutions

One of the key missions of the Department of Energy's Savannah River Site is to complete the safe cleanup of the environmental legacy which was brought about by years of developing nuclear weapons and government-sponsored nuclear energy research. To support this mission, over ten thousand ground water and environmental samples are collected each year. This capstone will serve as a prototype project for a future development at Savannah River Nuclear Solutions (SRNS), where samples such as air, drinking water, soil, vegetation, and wildlife are collected to check for radionuclides and other chemicals from prior SRNS activities. The objective is to create a website that will allow for efficient insertion of sample data collected and the monitoring of their statuses as they go through testing. With a focus on a mobile-first design, the website will work seamlessly with portable devices to allow for on-site logging of sample data as the technician collects it. With this data, the website will be able to generate a report to summarize all the findings to be used in their annually released report. A login page will be implemented to allow only certain roles access to data they have clearance to modify/view. The website will be developed following the current industry standard of Agile Methodologies and stored in a centralized code repository GitHub. The technology used will be ASP.Net and SQL. The timeline to complete this task spans over the Fall and Spring Semester, ending in Spring 2022.

#### NANOPARTICLE SIZE EFFECT ON STABILITY OF IONIC LIQUIDS (ILS) BASED NANOFLUIDS

Anna Hawcroft and Titan Paul  
University of South Carolina Aiken

Ionic liquids (ILs) are considered as one of the potential heat transfer fluids (HTFs) for solar thermal applications where it comprised of base ILs and a small volume/weight percentage of nanoparticles.

Dispersion stability of IL-based nanofluids is one of the challenges for make it as a viable HTFs. This paper presents the stability of ionic liquid based nanofluids for different sizes of nanoparticles and different concentrations by using visual inspection. The IL-based nanofluids contain 1-Butyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide ([C4mim][NTf2]) and Al<sub>2</sub>O<sub>3</sub> nanoparticle with 0.5 wt% and 1 wt% concentrations. Nanoparticles sizes are: 10nm, 30nm, 60nm, and 90nm. The results demonstrated that the ionic liquid's stability generally decreases as nanoparticle size and concentration increases. Increased mixing time also improved sample's stability but only for samples at a 0.5 wt% concentration. The 10 nm nanoparticles, the smallest observed, proved to be the most stable over the longest period when mixed for 90 minutes and concentrated at 0.5%. The most consistent trend was observed in the samples containing 30 nm nanoparticles, which were the most unstable across all mixing times and concentrations.

#### IMPACT OF A MULTIPLE INGREDIENT SUPPLEMENT ON MUSCULAR PERFORMANCE

Matt Helms and Andrew Hatchett  
University of South Carolina Aiken

Purpose: To determine the influence of an enzyme hydrolyzed collagen based multiple ingredient supplement has on muscular performance. Methods: Eight healthy recreationally trained participants completed three data collection sessions (baseline, 10-days and 21-days). Each session consisted of the following assessments: body composition upper and lower body power, upper and lower body strength, upper body endurance and midline endurance. Measures from each session were compared to determine if a significant change in performance was observed. Results: After comparing the first data collection session to the last collection session there were statistically significant changes in several performance measures. Conclusion: The use of an enzyme hydrolyzed collagen based multiple ingredient supplement can positively influence muscular performance.

#### THE POTENTIAL OF EDTA AS A NON-INVASIVE TREATMENT OF CALCIFIC AORTIC VALVE DISEASE

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Calcific Aortic Valve Disease (CAVD) is a progressive heart disease that affects 25% of people older than 65 and 50% of people older than 85. These rates are expected to increase in the United States due to higher levels of obesity and diabetes, as well as an aging population. CAVD is the leading cause of valve replacement surgery. Annual healthcare costs for these valve replacements are currently estimated to be approximately 2 billion dollars. There are currently no medications approved by the FDA to treat CAVD. The chelating agent, EDTA, offers promising potential as a means of reversing the calcification in cardiac tissue. It can interrupt the divalent bonding of Ca<sup>2+</sup> which leads to a reduction in calcification of cardiac tissue. Delivery of EDTA must be done in a targeted manner to be considered as a viable treatment option. If EDTA is not delivered to the desired site of calcification using a vehicle such as nanoparticles used in this research, then the EDTA will begin reacting with calcium in the serum and lead to bone loss and hypocalcemia. Targeted delivery of EDTA to reduce calcification of the aortic valve will lead to improved valve and heart function, as well as a reduction in risky valve replacement and trans-catheter surgery.

#### EXPRESSION OF YOLK PROTEINS IN *STOMOXYS CALCITRANS*

Lauren Hightower, Kaylee Thomson, and Mary Mills  
University of South Carolina Aiken

*Stomoxys calcitrans*, stable flies, have created significant economical strain within the cattle industry due to the stable flies' need to blood feed. These repeated blood meals cause cattle to experience extreme distress and disease transmission, costing this industry millions annually. Stable flies must blood feed to

produce eggs, and this blood feeding induces the expression of yolk protein genes that regulate this process. However, there is knowledge gap in knowing what tissues within the fly express these yolk protein genes. If the tissues were identified, the egg development could be inhibited, reducing the population of this species. To determine the yolk protein gene expressing tissue(s), we dissected flies after blood feeding. The ovaries, midgut (gastrointestinal tract), fat body, and the remaining tissues were collected. RNA was extracted and synthesized into cDNA. RT-qPCR is utilized to determine gene expression across these tissues. We found that the ovaries express these yolk protein genes, providing insight into the regulation of egg development in stable flies. These data provide the foundation for new population control strategies against these pests.

#### SMALL-DIAMETER ARTERY DECELLULARIZATION: EFFECTS OF ANIONIC DETERGENT CONCENTRATION AND TREATMENT DURATION ON PORCINE INTERNAL THORACIC ARTERIES

Julia Hohn and Wayne Carver

University of South Carolina School of Medicine Columbia

Engineered replacement materials have tremendous potential for vascular applications where over 400,000 damaged and diseased blood vessels are replaced annually in the United States alone. Unlike large diameter blood vessels, which are effectively replaced by synthetic materials, prosthetic small-diameter vessels are prone to early failure, restenosis, and reintervention surgery. We investigated the differential response of varying 0% – 6% sodium dodecyl sulfate and sodium deoxycholate anionic detergent concentrations after 24 and 72 h in the presence of DNase using biochemical, histological, and biaxial mechanical analyses to optimize the decellularization process for xenogeneic vascular tissue sources, specifically the porcine internal thoracic artery (ITA). Detergent concentrations greater than 1% were successful at removing cytoplasmic and cell surface proteins but not DNA content after 24 h. A progressive increase in porosity and decrease in glycosaminoglycan (GAG) content was observed with detergent concentration. Augmented porosity was likely due to the removal of both cells and GAGs and could influence recellularization strategies. The treatment duration on the other hand, significantly improved decellularization by reducing DNA content to trace amounts after 72 h. Prolonged treatment times reduced laminin content and influenced the vessel's mechanical behavior in terms of altered circumferential stress and stretch while further increasing porosity. Collectively, DNase with 1% detergent for 72 h provided an effective and efficient decellularization strategy to be employed in the preparation of porcine ITAs as bypass graft scaffolding materials with minor biomechanical and histological penalties.

#### A CLEANING IN PLACE METHOD FOR CLEANING HEAT EXCHANGERS AT ROLLS-ROYCE

Abigail Hulsey, Chloe Johnson, Salvador Guerra, and Bethany Fralick

University of South Carolina Aiken

Rolls-Royce Power Systems produces three types of engines that utilize heat exchangers in the testing process. The manufacturing plant has four test cells that are used to test the efficiency and quality of the engines before being sent to a customer. A heat exchanger uses metal plates to transfer heat between the coolant circulating through the engine and tower water. Overtime waste builds up and if the heat exchanger continues to be used without proper cleaning heat will not transfer properly. Rolls-Royce needs to develop and implement an effective mobile cleaning in place method system for the heat exchangers. The team must order parts to build, verify the variable frequency drive (VFD), and other supporting materials in testing the cleaning in place method system for the heat exchangers.



## PROMISING ANTI-CARCINOGENIC EFFECTS OF MEDITERRANEAN HERBS AND SEED EXTRACTS ON BREAST CANCER CELLS

Diana Ivankovic, Addison Powell, Maya Learmonth, and Gianna DeRosa  
Anderson University

Studies in recent years have shown that cancerous cells interact with and respond to a multitude of natural substances. Researchers are continuing to experiment with the category of natural plant extracts to examine their cytotoxic effects and to ensure that noncancerous cells remain unharmed throughout the duration of treatment. This study investigates three different Mediterranean plant and seed extracts and assesses their effect on MCF-12 healthy breast tissue cell line and MCF-7 cancerous breast cell line. The extracts analyzed were thyme, flaxseeds, and marjoram oil. At a concentration of 1000 micrograms per ml, positive results were observed from the thyme and flaxseed extracts as a cytotoxic effect was displayed on nearly all the cancerous breast cells. With the marjoram oil extract at 500 micrograms per ml, we successfully observed cytotoxic effects on the cancerous breast cells that left the healthy breast tissue cells thriving and unharmed. We conclude that the marjoram oil extract had the most effective outcome on both the MCF-7 and MCF-12 breast cell lines.

## JUVENILE STRIPED BASS (*MORONE SAXATILIS*) MOVEMENT IN THE GREAT PEE DEE RIVER

Robert Jackson and Jason Doll  
Francis Marion University

Striped bass (*Morone saxatilis*) are potamodromous species native to South Carolina. A small population exists in the Great Pee Dee River and the South Carolina Department of Natural Resources (SCDNR) began supplemental stockings in 2019 to enhance this fishery. The objective of this study is to evaluate movement patterns of juvenile striped bass after they are stocked in the Great Pee Dee River. Twenty-eight juvenile striped bass were tagged with hydroacoustic tags prior to stocking into the Great Pee Dee River. All fish were held at the hatchery for one week for mortality observation prior to stocking. Juveniles were stocked in the Great Pee Dee River at Samworth Wildlife Management Area Landing and Dewitts Bluff Landing in December, 2020. Fish locations were recorded by the fixed receiver array managed by SCDNR. Twenty-three juveniles were recorded between 12/16/2020 and 11/03/2021 while 5 were never detected. All transmitted fish initially migrated to the lower Great Pee Dee River and Winyah Bay. During the spring, most individual fish stayed in Winyah Bay and the Sampit River. Four fish were still being detected by receivers during the fall in Winyah Bay, Sampit River and lower Great Pee Dee River. Results suggest that juvenile striped bass primarily inhabit the lower portions of the Great Pee Dee and Waccamaw River system near Winyah Bay. Future studies evaluating nursery habitat should occur in the lower portions of the Great Pee Dee and Waccamaw River system near Winyah Bay.

## STRUCTURE OF SALT MARSH PLANT COMMUNITIES: POSSIBLE IMPACTS OF INCREASING SALINITY DUE TO RISING SEA LEVEL

Mackenzie Jenkins and Jennifer Schafer  
Winthrop University

Sea level rise caused by global warming can lead to increased flooding and salt water encroachment in coastal habitats, increasing salinity concentrations. The objectives of our study were to assess variation in salt marsh plant community structure with distance from a tidal creek and investigate composition of the salt marsh-maritime forest ecotone seed bank and effects of salinity on germination. We established three 40 m transects in the salt marsh habitat on Horse Island in South Carolina and recorded percent cover of each species and height of the tallest *Spartina alterniflora* individual in 11 plots per transect. There was no change in percent cover of salt marsh species from 0 to 24 m from the tidal creek, but total percent

cover of salt marsh species and percent cover of *Spartina alterniflora* increased from 24 to 40 m along transects. *Juncus roemerianus*, *Salicornia virginica*, and *Borrchia frutescens* occurred only 36 to 40 m from the tidal creek, indicating pronounced zonation within the plant community. For the seed bank study, we collected four soil samples (5 cm deep) from each of 12 plots within the salt marsh-maritime forest ecotone. We watered soil samples with one of four salinity concentrations: 0, 6, 12, or 25 psu. No seeds germinated during the 8 weeks we applied salinity treatments. Our results suggest that the structure of salt marsh plant communities may change as sea level rises and salt concentrations increase inland, but the role of the soil seed bank in affecting community structure is unclear.

### 3D TECHNOLOGY FOR TRAINING

Paul Jones<sup>1</sup>, Wesley Hightower<sup>2</sup>, and Zhenheng Li<sup>1</sup>

<sup>1</sup>University of South Carolina Aiken, <sup>2</sup>Savannah River Remediation

Training is a crucial element for every level of an organization. Effective training leads to skilled employees, higher productivity, increased efficiency, better quality of work, and improved safety habits. Organizations are continuously searching for and developing improved training methods. An effective training program will keep the trainees engaged, leading to increased morale, and improved knowledge retention, while an ineffective training program is a waste of time and resources. Elements of 3D technology can be utilized in training to capture the interest of trainees and incentivize their continued learning.

Our organization is utilizing 3D technology to improve training procedures. Currently, we are 3D scanning our facilities/equipment. These 3D scans are excellent resources for training, engineering, maintenance, and emergency preparedness/response groups. Our group utilizes these 3D scans to create additional products for use in training procedures. Some of these products include/will include a 3D image viewing application, augmented reality training applications, environment/facility flythroughs, and the current end goal, VR training applications.

Continuous improvement is our primary goal. We especially want to promote/enable employee safety and increase job efficiency. 3D technology allows trainees to practice training procedures in a safe environment while reducing or eliminating the need for PPE. Additionally, these products enable engineering and maintenance groups to survey an environment/facility without having to travel to the location. Emergency preparedness/response groups can devise drills, escape routes, etc. without exposure to hazardous areas. Finally, these products are especially useful due to current COVID-19 protocols. They facilitate virtual training which minimizes exposure to the virus.

### THE BEHAVIOR AT POLYMER SHELL CASINGS COMPARED TO BRASS CASINGS WHEN EXPOSED TO HEAT

Joshua Jones and Kaelynn Leake

The Citadel

When a firearm gets too hot, it can have a critical malfunction. Traditional brass casings absorb some of the heat from the gunpowder explosion. Then they are ejected from the weapon. This process removes thermal energy from the system. New experimental polymer casings are made of nylon. Will nylon casings reduce or increase the rate of malfunctions in firearms due to heat? The two most important material properties involved in heating are specific heat and thermal conductivity. Specific heat is how much thermal energy a material needs to absorb to increase in temperature. Thermal conductivity is how well that energy is transferred to another material. We determined the specific heat of both materials by using the material to boil liquid nitrogen. The specific heat of brass is 0.445 J K/g and nylon is 2.342 J K/g. Nylon's higher specific heat means it takes more energy to increase the temperature than brass. Our measurement system for thermal conductivity does not yield comparable results, but does indicate nylon

is less conductive. Nylon's higher specific heat and lower thermal conductivity suggests that it will be absorbing energy from the gunpowder explosion, but not passing that energy on to the weapon through conduction. The combination of properties in nylon are improvements over brass in reducing malfunctions due to overheating.

#### ACTIVE OPTICS HARDWARE: EXPERIMENTS FOR ADVANCED MEDICAL IMAGING

Brianna Joyner and Joe Carson  
College of Charleston

Cervical cancer is one of the top diseases affecting women around the globe, with particularly high statistical deaths in underserved communities around the world. Shape-from-focus imaging, when combined with advanced data processing techniques, presents an opportunity to address this circumstance by enabling low-cost, simple-to-operate, 3D imaging to effectively screen for cervical precancers without the need for follow up lab work of collected samples, multiple patient visits, or expensive medical infrastructure. In an effort to advance this technique, we present an AI3DI (AI Driven 3D Imaging) test bed connected to Raspberry Pi (RPI) hardware hosting an RPI V2 Camera interface app with accompanying custom-built control software, which will allow automated collection of data with selectable parameters relating to shape from focus. The test bed connection to the RPI unit was established through the creation of a simple circuit using GPIO pins as switches for controlling movement of the test bed. The goal of testing revolves around the need for improved image statistics to further understand relevant shape-from-focus parameters and their relation to our calibration function. This will ultimately lead to more effective clinical use that will help women in underserved areas around the world.

#### FEEDBACKS FOR REINFORCEMENT LEARNING IN ROBOTICS

Jacob Kelley, Andrew Hunt, Destin Buck, and Zhenheng Li  
University of South Carolina Aiken

Artificial intelligence and machine learning is growing in popularity. These technologies are incredibly important in today's world, already having use cases such as suggesting words while writing an email, to Amazon's Astro robot for home monitoring, possibilities are growing almost seem limitless. Another rapidly growing technology is the Microcontroller, which is a small computer on a single chip. The most common type of Microcontroller is Arduino, which is commonly referred to as a tinkerer's dream due to it being extremely easy to learn and use, even with little to no experience in coding or system design. Arduino is also extremely useful for prototyping designs due to its easy-to-use nature. This project combines these two technologies, utilizing quadrupedal robots that are controlled by ESP32 Arduino boards with components such as servos as well as LiDAR sensors that are lightweight enough for battery operation, and eventually a Machine Learning Algorithm to control it. The objective of the project is to test the theory of utilizing a backpropagation method in conjunction with reinforcement learning to optimize the movement patterns of these robots. Data will be collected by the robot operation prior to designing the artificial intelligence model by assessing its base operation. This project may have several applications should it be successful, such as in unmanned exploration where human exploration is not possible or generally wherever the power consumption of a machine needs to be optimized.

#### CHARACTERIZING THE GENES AFFECTING MPING TRANSPOSITION IN YEAST

Zara Lacera<sup>1</sup>, Jack Timmons<sup>2</sup>, Priscilla Redd<sup>1</sup>, and C. Nathan Hancock<sup>1</sup>  
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Transposable elements (TEs) are segments of DNA that "jump" to different locations in an organism's genome. TEs are important because they can cause mutations which result in genetic diversity and

facilitate evolution. We study the transposition behavior of an active TE from rice called mPing. To identify genes that affect mPing transposition, we screened a yeast overexpression genomic library and found clones that altered transposition rates. By performing a growth curve, we eliminated clones with altered growth. Sequencing our top candidates allowed us to identify the genes present in each clone. From these results, we eliminated a clone from further study because it had no testable genes in the genomic region it contained. However, we found that the E27 clone contained the gene STB3, which could be responsible for its high transposition rate. We also became interested in the HCH1 gene from the 1B-F11 clone, which is a heat shock protein involved in protein folding. We made overexpression constructs and ordered yeast knockout strains for these genes to directly measure how they affect mPing transposition. Based on our screen, we anticipate that overexpression of these genes will increase transposition, while removing the genes will decrease transposition. Knowing the effects of these genes on transposition is important because it helps us understand how organisms regulate TE activity.

#### ENGINEERING NIOBIUM-GERMANIUM INTERFACES FOR VOLTAGE-TUNABLE QUANTUM DEVICES

Junior Langa, Allie Lindler, and Kasra Sardashti  
Clemson University

Voltage-tunable hybrid superconductor-semiconductor Josephson junctions have recently emerged as promising building blocks for low-loss frequency-tunable quantum devices such as qubits, couplers, and magnetic flux sensors. The realization of hybrid devices in group IV semiconductors such as Si and Ge is of particular interest due to higher scalability and low dielectric loss at microwave frequencies. However, inducing superconductivity in Si and Ge via proximity effect has been proven to be challenging so far because of large interfacial energy barriers and defect densities. Here, we utilize molecular beam epitaxy to engineer the energy bands at Nb-Ge interfaces. By creating a gradient in Nb:Ga ratio throughout the superconducting layers, we create smooth potential gradients at the interfaces. Various thermal cycling schemes under vacuum and in inert atmospheres are used for tuning the interface structures. Using high-resolution transmission electron microscopy we determine the competing secondary phases that may form in the stacks. This is complemented by cryogenic magneto-transport measurements on the resulting Nb/Ge heterostructures (as films and Josephson junctions) where critical physical parameters including the induced gap size, the critical magnetic field, and the normal coherence length for the proximitized phases are determined.

#### CONSTRUCTION OF EXPRESSION PLASMIDS CONTAINING ACTIVE-SITE MUTANTS OF 2,4'-DIHYDROXYACETOPHENONE DIOXYGENASE (DAD)

Zephanae Liis, Gerard Rowe, and Kenneth Roberts  
University of South Carolina Aiken

The non-heme iron-dependent enzyme, 2,4'-dihydroxyacetophenone dioxygenase (DAD), catalyzes the oxidative cleavage of the substrate, 2,4'-dihydroxyacetophenone (DHA), into 4-hydroxybenzoic acid (4HB) and formic acid in the presence of molecular oxygen.<sup>1-3</sup> DAD was originally isolated from the betaproteobacterial species *Alcaligenes sp.* 4HAP (aDAD)<sup>1</sup> and more recently as a close homolog from *Burkholderia sp.* AZ11 (bDAD; 81% sequence identity).<sup>2</sup> We have recently discovered that, although the chemistry of the reaction takes place on the alkyl portion of DAD, replacing the 4'-OH group with non-hydrogen-bonding moieties results in very poor substrates –  $k_{cat}/K_m$  decreases on average 7000-fold. Computational docking experiments have shown that the 4'-OH group of DHA is part of an extended hydrogen-bond network involving residues Ser-50, Trp-62, and Asp-64. We hypothesize that mutating these amino acids (S50A, W62F, D64N, or D64L) will result in a reduced ability of the enzyme to bind DHA by disrupting hydrogen-bonding. Herein, we show our current efforts to prepare these mutants for kinetic evaluation.

## STATISTICAL ANALYSIS OF THE EFFECT OF MUSIC ON HUMAN BRAIN ACTIVITIES

Eric Lilling and Bo Li  
The Citadel

Electroencephalography (EEG) data is a measure of the electrical activity in a human brain. It can be recorded using a special headset containing electrodes that are placed around the skull, and interpreted by a computer using a brain computer interface (BCI). Many people have been trying to understand how the human brain responds to certain stimuli, such as music, in order to develop meaningful applications from this data. In this report, we study how music affects human brain activities based on EEG test data. A pilot study based on a convenient sample shows that the mean signal peaks responding to music is moderately significantly higher than that of the control group at significance level 0.1. We collect a "random" sample and study the effect of music by comparing the treatments versus a control group based on the Bonferroni method.

## A SURVEY OF SUPERCONDUCTING INTERMETALLIC SYSTEMS FOR QUANTUM TECHNOLOGY APPLICATIONS

Allie Lindler and Kasra Sardashti  
Clemson University

In recent years, superconducting circuits have gained prominence as leading platforms for the development of quantum information processors and high-sensitivity quantum sensors. These circuits are comprised of low-dissipation superconducting elements that can create and transfer fragile quantum states with high fidelities. More complex devices with higher characteristic impedance ( $Z_S$ ) have recently been considered given the need for improvement of resilience to the charge fluctuations in microwave quantum circuits (e.g., Fluxonium qubits) as well as hybrid optical-microwave systems (e.g., coherent transducers for quantum networks). The main source of such impedance in a dissipationless superconducting material is the inertia of the Cooper pairs manifested as kinetic inductance ( $L_k$ ), which is often very small for Al and Nb thin-films. So far, the focus has been mostly on materials such as NbN and NbTiN. These are mainly considered due to the ease of their deposition process via magnetron sputtering. Here, we conduct a survey of another class of materials; intermetallic A15 superconductors also known for high critical temperatures and magnetic fields. Through a comprehensive study of the published data on Nb<sub>3</sub>X and V<sub>3</sub>X (X = Si, Ge, Ga, Ir) compounds, we mapped the dependence of superconducting characteristic parameters (i.e., critical temperature, critical magnetic field, kinetic inductance, etc.) on composition and structure of the materials in bulk crystal and thin-film states. Our findings warrant a revisitation of experimental investigations of A15-based superconducting circuits for quantum technology applications.

## OCULAR ABNORMALITY MODELING

Josefino Lubang and Kaelyn Leake  
The Citadel

Over the course of the human lifespan, our eyes slowly degenerate due to hereditary diseases, old age, or health complications affecting eyesight. Depending on the severity of the issue, eyesight can be corrected with corrective lenses or in extreme cases medical procedures such as Lasik eye surgery. This project replicated these abnormalities to observe and understand what is happening within the eye by manipulating different lens sizes and varying distances. Different lens sizes were representations of each abnormality. A picture was captured from a camera after the lens moved farther from or closer to the light source. The image captured from the camera was analyzed in MATLAB. A linear graph that

represented the image's light intensity across the image indicated a sharp intensity peak when in focused and a widened peak when out of focus. A peak from an unfocused image had a max increase in size of 45% compared to the focused peak.

#### THYMOQUINONE AND FENRETINIDE IN COMBINATION EFFECTIVELY INHIBITED GROWTH OF HUMAN GLIOBLASTOMA T98G AND U87MG CELLS

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University of South Carolina School of Medicine

Background and significance: Glioblastoma is the most malignant brain tumor in humans with an average survival time of 14 months after diagnosis. It is a heterogenous tumor that originates predominantly from abnormal and immature astroglial cells. Autophagy in a tumor is a cellular mechanism for bulk degradation of defective components and damaged organelles to generate building blocks that promote cell survival. Activation of telomerase in a tumor yields infinite cell proliferation without cell differentiation. Glioblastoma is frequently characterized by activation of both autophagy and telomerase, which act in tandem to promote tumor growth and resistance to conventional treatment comprised of single agents. Significance of our study would be in revelation that combination of thymoquinone (autophagy inhibitor) and fenretinide (telomerase inhibitor) would be more effective than either treatment alone.

Methods: We employed two human glioblastoma cell lines, T98G (telomerase positive) and U87MG (telomerase negative), under starvation or serum-free culture media to induce autophagy. The MTT assay was used to assess quantity of cell proliferation following treatments with different doses of thymoquinone and fenretinide alone and in combination for two days. Acridine orange staining was used to assess inhibition of autophagy and Shandon Kwik-Diff staining kit was used to assess induction of apoptosis in response to treatments.

Our results indicated that thymoquinone and fenretinide in combination acted in dose-dependent manner and more effectively than either single treatment in both glioblastoma cells. In conclusion, these two compounds act as a novel combination therapy to inhibit growth of human glioblastoma cells.

#### EVALUATING THE KINETICS 2,4'- DIHYDROXY-ACETOPHENONE DIOXYGENASE AND 2,4'-DIHYDROXYACETOPHENONE.

Conner Martin and Kenneth Roberts  
University of South Carolina Aiken

In this research, I am looking at the kinetics behind the reaction of 2,4'-dihydroxyacetophenone dioxygenase (DAD) and 2,4'-dihydroxyacetophenone (DHA). In the first 60 to 90 s of the reaction, the kinetics curve seems to relax into a slower, linear rate. This is the interest of the research, to understand this curve more by examining different methods and evaluating the effect they have on the curve. The methods include changing the buffer in which the reaction takes place, using stopped-flow for rapid-mixing, and using different concentrations and volumes of enzyme and substrate.

#### SAVANNAH RIVER NUCLEAR SOLUTIONS SAFEGUARDS, SECURITIES & EMERGENCY SERVICES SOLUTIONS ENGINEERING - MOBILE TEST BED PROJECT

Chase Marzullo, Jacob Rye, Jared Corbett, and Bethany Fralick  
University of South Carolina Aiken

At the Savannah River Site (SRS), the protection of government assets is a critical role that the Safeguards, Securities & Emergency Services Solutions (SS&ESS) Engineering team is responsible for. In order to carry out the engineering process in the protection of government assets, there are several documents that must be completed. One way that high-security sites like SRS protect their assets is through the use of

perimeter intrusion detection and assessment systems (PIDAS). One of the main purposes of this project is to conceptualize and design a mobile testing apparatus for PIDAS systems at SRS, which will give SRS the ability to test and approve detection devices on site, rather than sending devices to other Department of Energy sites. Moving forward, the SS&ESS Engineering Team have developed goals and benchmarks for the capstone group during the Spring semester for ENCP A499 Capstone Design II. Procuring and deploying a mobile test unit for SS&ESS would not only streamline the intrusion detection system (IDS) testing process, but it will also be more productive and allow for more time to perform other job tasks on site.

#### CHARACTERIZATION OF VOLCANIC AEROSOLS: USING AN AFM AND AN SEM TO IDENTIFY THE SURFACE MORPHOLOGY OF ASH

William McCloud and Michael Larsen  
College of Charleston

The Mount Pinatubo and Pacaya volcanic eruptions (which occurred in 1991 and 2010, respectively) were catastrophic events that sent large amounts of aerosols into the Earth's atmosphere. Aerosols like these can act as ice and cloud condensation nuclei, cause respiratory problems, and affect our planet's global radiation budget. Samples from both eruptions were collected to examine the morphology of the volcanic ash aerosols to help make potential insights on the climate and ocean biogeochemical cycles that volcanic eruptions can influence.

Here, we characterize the surface morphology of the volcanic ash as a first step in determining their role in biological, geological, chemical, and atmospheric processes. To do this, AFM (atomic force microscope) and SEM (scanning electron microscope) images of the ash samples were taken. These images were then analyzed using standard image processing techniques to identify significant surface features and to examine roughness and size differences between the particulates generated during these eruptions. SEM images reveal distinct differences in the particle size distributions (for example, the Pacaya sample has a broader distribution of particle sizes and a much larger average size compared to the Pinatubo ash). Following methods introduced in previous studies, AFM images are used to calculate quantitative measures of surface roughness. These quantitative analysis techniques are used to assess the morphological features of the ash and compare the surface roughness of ash to other atmospheric particulates.

#### THE EFFECTS OF CBD OIL ON SYMPTOMS OF MILD STRESS IN RATS

Julia Mewborn and Michelle Vieyra  
University of South Carolina Aiken

CBD oil has gained in popularity as a treatment for a wide range of problems from pain, to anxiety, to sleep disturbances. Sales of CBD oil are projected to hit 20 billion dollars by 2024 yet there are few studies that show effectiveness in treating the mild everyday problems the vast majority of people purchase it for. In our study, rats were given CBD oil to see if it helps to lessen some of the symptoms of mild stress seen in rodents. After a two week period of mild stress induced by loud noises, cage switching, and altered light cycles, these rats will be tested using a light/ dark box and an elevated plus maze to see if they show more explorative behaviors, a sign of less reaction to stress. Their urinary cortisol (a stress hormone) levels will also be tested. The rats given the CBD oil are expected to show more exploratory behaviors and have lower cortisol levels compared to control rats given coconut oil. Testing will conclude in mid March.

AHR EXPRESSION ON RORC-EXPRESSING IMMUNE CELLS IS ESSENTIAL FOR I3C-MEDIATED PROTECTION  
AGAINST COLITIS AND IL-22 PRODUCTION BY ILC3S

Chandani Mitchell and Brandon Busbee  
University of South Carolina School of Medicine

The number of people who suffer from an inflammatory bowel disease (IBD) called colitis has constantly been on the rise. Some of the symptoms of colitis include abdominal pains, bloody stool, and ulcers in the lining of the abdomen that leave the patient with a negative quality of life. Few treatments offer alleviation of these symptom without additional negative side effects. However, in our lab we previously reported the ability of indole-3-carbinol (I3C), a natural plant product and an aryl hydrocarbon receptor (AhR) ligand, to alleviate symptoms of colitis and prevent gut microbial dysbiosis through innate lymphoid type 3 (ILC3) cells in an interleukin-22 (IL-22) dependent manner. In this study, we produced AhR knockout mice in rorc-expressing immune cells and induced colitis in them using 3% dextran sodium sulfate (DSS). Our results showed that the mice with an AhR deficiency in rorc-expressing cells (AR mice) lost the expected efficacy effects of I3C treatment during colitis. Additionally, they had a higher disease score as well as inflammation in the colon. Flow cytometry analysis showed that AR mice lost the ability to increase IL-22 via ILC3s suggesting that the AhR/ILC3/IL-22 axis is essential for I3C-mediated protection against colitis. AR mice also lost the ability to reduce colitis-associated microbes in the gut, therefore, these data collectively show that AhR expression in ILC3 play a critical role in I3C-mediated prevention of colitis and microbial dysbiosis attributed to the disease. Studies were supported in part by NIH grants P20GM103641, P01AT003961, R01AI123947, R01 ES030144, and R01AI129788.

SAVANNAH RIVER TRITIUM ENTERPRISE SPARE PARTS DATABASING

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This report is a display of the endeavor to produce a centralized, real-time, accessible database regarding spare parts that are critical to engineering and maintenance operations for Savannah River Tritium Enterprise. Currently, there are several data storage locations that require specific expertise to navigate, and this software does not contain a complete list of spare parts and their information. The goal was established by performing a stakeholder analysis to provide insight into the voice of the customer. Adhering to the lean six sigma problem solving tool known as the A-3 Framework, an orderly procedure was established from the project's inception to a completion plan. Once the root cause (lack of a centralized database) was determined, the solution approach was to develop an improved process. Employing this process, a database model was designed. Future work includes testing the improved model, discussing results with the customer, and briefing Tritium Process Control on the model.

EXPLORING THE EFFECTS OF REDUCED FIG4 EXPRESSION ON AXONAL TRANSPORT AND  
MITOCHONDRIAL FUNCTION

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Charcot-Marie-Tooth type 4J (CMT4J) Syndrome is a rare neurodegenerative disease caused by a partial loss-of-function mutation in the Fig4 gene. Also known as Sac3, Fig4 encodes a lipid phosphatase responsible for endosome maturation and degradative sorting. Reduction of Fig4 expression has shown deficits in late endosome formation, membrane homeostasis, and vesicle-based transport along axons. Nonetheless, the molecular mechanisms of CMT4J disease pathogenesis through Fig4 mutation remain to be elucidated. To explore this, we conducted a compartment-specific proteomic and transcriptomic analysis of embryonic cortical and adult sensory neurons from Fig4 deficient mice. Ingenuity Pathway



Analysis (IPA) of the transcriptomes and proteomes revealed a downregulation of the oxidative phosphorylation and Ca<sup>2+</sup> signaling pathways, suggesting mitochondrial dysfunction. Functional analyses of axonal mitochondria were performed and showed a sharp decline in membrane potential, both in neurons from Fig4 knockout mice and upon depletion of Fig4 from wildtype neurons using siRNA. This mitochondrial depolarization was further exacerbated by glycolysis inhibition, while overall numbers of mitochondria remained unchanged. Recent work has shown that some mRNAs can be transported into axons by tethering to endosomes. Interestingly, RTddPCR showed a decrease in several mRNAs for nuclear-encoded mitochondrial proteins (e.g., COX4 and ATP5) in the axonal compartment of sensory neurons in culture and the axoplasm of the sciatic nerve in vivo of Fig4 deficient mice. Taken together, these data point to a selective attenuation of axonal mitochondrial function with Fig4 deficiency that is likely caused by decreased replenishment of nuclear-encoded mitochondrial proteins from a decline in endosome-based axonal mRNA transport.

SAVANNAH RIVER NUCLEAR SOLUTIONS HYDROSTATIC TESTING HAZARDS ANALYSIS  
Harrison Olszewski, Monica Ruffin, Daniel Willoner, Justin Acker and Bethany Fralick  
University of South Carolina Aiken

This study investigates the potential hazards accompanying the hydrostatic testing of firefighting appliances and seeks to mitigate these hazards. The Savannah River Site, part of the US Department of Energy Industrial Complex, is managed and operated by Savannah River Nuclear Solutions (SRNS). The National Fire Protection Association (NFPA) is an international regulatory body which creates codes related to fire hazards. SRNS has partnered with the University of South Carolina Aiken's engineering program to develop a system which meets the NFPA's requirements for hydrostatically testing all fire hose appliances at 300 pounds per square inch (psi) while visually inspecting the appliance for leaks as required in NFPA 1962. The chief safety concern is that the energy in the appliance and pump during testing will, in the event of a failure, result in dangerous water jets and/or high velocity solid fragments harming personnel conducting the test. Thus, this study examines the energy involved during testing. The NFPA does not specify the flowrate of the pump used to pressurize the appliance. Therefore, this study analyzes two systems which are identical except for the flowrate of the pump pressurizing the system. The results of this research will lead to the design of the procedure and device to be used in mitigating hazards during hydrostatic testing of fire hose appliances.

CAPSTONE SEMINAR II HEALTH MANAGEMENT SYSTEM  
Adithya Pandiri, Brendon Esposito, Kyle Barker, Wilfredo Colon-Rios, and Zhenheng Li  
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Doctors all around the world tend to treat countless patients every year, and as such it can be hard to keep up with every patient and their individual needs and appointments. Because of this, there is a need for a way to maintain organization to ensure each patient is being tended to on time and their needs are being documented. Fortunately, doctors do not work alone, so they can receive help in keeping track of everything courtesy of a helping hand from their nurses. However, even nurses can only do so much. To alleviate the monumental worldwide workload needed to keep everything running properly, a database can be created to document the necessary information. This paper seeks to explore this created database, its real-world influences that went into creating the database.

## THE EFFECT OF MHC HETEROZYGOSITY ON IGA REPERTOIRE DIVERSITY

Tori Peacock and Jason Kubinak

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Major histocompatibility complex (MHC) molecules present peptide antigens to T-cells and are the most polymorphic loci in vertebrates. Heterozygosity at MHC loci is thought to promote MHC allelic diversity by enhancing the diversity of antigens that can elicit an immune response. In the context of B lymphocytes, which both present peptide antigens to T-cells and secrete antigen-specific effector molecules (antibodies), MHC heterozygosity should therefore enhance diversity in antibody repertoires. To test this, we contrasted aspects of B-cell selection between MHC homozygote and heterozygote mice. Germinal centers (GCs) are micro-environments within lymph nodes where MHC plays a role in the process of B-cell selection. Preliminary data indicates that MHC heterozygosity is associated with differences in localization of B-cells within GC micro-environments. Specifically, B-cells are found in higher abundance within the light zone of GCs (the site of T-cell-mediated positive selection of GC B-cells) in MHC heterozygotes compared to homozygotes suggesting that MHC heterozygosity may enhance T-cell-mediated positive selection of B-cells during GC responses. Additionally, MHC heterozygote mice show enhanced binding of immunoglobulin A (IgA) antibodies to SI-resident bacteria. Future work will compare IgA repertoire diversity and the diversity of commensal bacterial species bound by IgA in the SI of MHC heterozygote and homozygote mice. We hypothesize that enhanced positive selection in MHC heterozygotes increases IgA repertoire diversity and consequently the diversity of microbes that can be targeted by IgA. Results from these studies represent the first empirical test of the prediction that MHC heterozygosity enhances functional diversity of B lymphocyte responses.

## DOWNSTREAM FROM MYRTLE BEACH, AN ANALYSIS OF WATER QUALITY AT WINYAH BAY

Terra Pettit-Bacovin and Sheri Strickland

Converse University

Impaired water bodies have negative impacts on the health of dependent ecosystems. The downstream effects of human density in Myrtle Beach on the Waccamaw River and Winyah Bay may have long lasting consequences if left unaddressed. The recent Title 303(d) listings of several locations across Winyah Bay for various pollutants highlights the need for continuous evaluation of water quality. Samples from the Waccamaw River, and Winyah Bay with respect to the Hobcaw Barony Preserve were analyzed over the course of the summer. The physical and chemical parameters of water temperature, pH, dissolved oxygen, conductivity, and bacteria levels were evaluated for each sampling event as supplemental data. Water temperatures increased by 23.8 % (from 25°C to 31° C) over the summer months, and dissolved oxygen decreased by 40.3 % (from a site average of 5.08 ppm to 3.03 ppm). The primary parameter of interest was the concentration of total phosphorous in the samples. The Ascorbic Acid method and Malachite Green method were utilized in determining the concentration of phosphorus in water samples. Total phosphorus levels determined by the Ascorbic Acid method increased by 45.4 % (from 0.0778 ppm to 0.1133 ppm). The Malachite Green method suggested an increase of 124.7 % in total phosphorus (from 0.0445 ppm to 0.1000 ppm). Each method detected phosphorus at varying levels but both illustrated a trend of increasing concentrations through the months of May-August for each testing site. The data overall represents the need for continuous monitoring of these waterbodies and a concerted effort to abate further impairment.

## THE EFFECT OF GUIDED DIAPHRAGMATIC BREATH TRAINING ON SYMPTOMS ASSOCIATED WITH DEPRESSION IN COLLEGE STUDENTS

Sarah Powell and Andrew Hatchett  
University of South Carolina Aiken

Mental health poses significant problems for many college students worldwide. Depression is one of the most common psychological conditions experienced by college students. Approximately 10 years ago, a survey indicated a 4.6% increase in the number of students diagnosed with these disorders shifting from 10.3% to 14.9%. In recent years, depression has peaked at 35%. Research indicates the effects of diaphragmatic breathing on alleviating symptoms of depression. Diaphragmatic breathing increases carbon dioxide levels in the blood and strengthens parasympathetic nervous system activity. This breath training stimulates the parasympathetic nervous system, which reduces depression levels. There is research that indicates the influence of breath training on symptoms associated with depression in college students. Fifteen college students will participate in five consecutive sessions of breath training focusing on diaphragmatic breathing. Participants will be asked to complete a brief questionnaire prior to each training session, engage in a guided breath training session, and complete a brief questionnaire after the training session. The questionnaire will record anthropomorphic information and symptoms of depression. Results and Conclusion pending.

## THERMAL DESIGN OF RADIOACTIVE MATERIAL PACKAGES

John Pretorius, Hayden Barnett, Greyam Hayes, and Bethany Fralick  
University of South Carolina Aiken

This report will examine the importance of heat transfer within packages containing spent radioactive material. With the assistance and guidance of the Savannah River National Lab Packaging Group, this project will demonstrate the necessity of adapting the package design process in an attempt to limit the heat transfer that will occur given knowledge of the content characteristics of that particular package. The group has hypothesized that, given the material of the container and the content heat load, dimensions can be designed to carry specific heat loads and make the transportation and storage of radioactive materials safer.

## A DEEPER UNDERSTANDING BETWEEN TRANSFORMING GROWTH FACTOR BETA AND ITS ROLE IN CARDIAC FIBROSIS AND MYXOMA

Danielle Prisendorf, Mrinmay Chakrabarti, and Mohamad Azhar  
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This project aims to uncover the role of transforming growth factor beta-1 (TGFB) in the propagation of cardiac hypertrophy, fibrosis and myxoma (cardiac tumor). The TGFB superfamily includes TGFB, Activins, and Bone Morphogenic Proteins (BMPs), all which play immense roles in pattern formation, differentiation, and proliferation. TGFB specifically is a useful tool in understanding the pathogenesis of cardiovascular disease through studying the pathways of ligands and receptors, as well as three different isoforms of TGFB (TGFB-1, -2, -3). Although playing various roles biologically, all three have been discovered to activate cardiac fibroblasts and induce cardiac hypertrophy, specifically in the left atrium and left ventricle. This project focuses on genotypically transgenic mouse models, with constitutively activated form of TGFB1 selectively overexpressed in adult cardiomyocytes. Through crossing Tgfb1 overexpressor mice with tamoxifen-inducible adult cardiomyocyte-specific alpha-Myosin Heavy Chain Cre recombinase transgenic (MerCreMer) mice, the adult double transgenic (Tgfb1Tg;MerCreMer) mice were able to be created and were intraperitoneally-injected with 5 daily doses of the tamoxifen. This created a perpetually overexpressed an activated form of TGFB1 in the cardiac muscle cells. The effect of TGFB1

overexpression was able to be observed via histological analysis, echocardiographic methods, immunohistochemical methods, and protein extraction. In summary, it was discovered that: 1) fibrosis is accompanied by progressive loss of cardiac muscle cells in a phenomenon called “replacement fibrosis,” and 2) cardiac myxoma formation and fibrosis in the left atrium is stimulated upon TGFb1 overactivation, with increased fibrosis and hypertrophy in the left ventricle.

#### INVESTIGATING THE ROLE OF RNA POLYMERASE V IN MPING EXCISION SITE REPAIR

Kaili Renken and C. Nathan Hancock

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Recent studies indicate that RNA plays a role in Eukaryotic DNA repair. The plant specific RNA Polymerase V (PolV) is mostly known for its role in gene silencing through the RNA-directed DNA methylation pathway, but it has also been proposed to aid in repair of double stranded DNA breaks (DSBs). Excision of DNA transposons creates DSBs, but little is known about PolV's role in repair of these sites. The transposable element, mPing, is an active miniature inverted transposable element derived from the autonomous Ping element that can be induced to transpose in Arabidopsis. The purpose of this project is to test if the PolV protein is required for mPing excision site repair. We measured mPing transposition by screening for GFP (green fluorescence protein) expression from an mPing:GFP reporter. GFP is only expressed when mPing excision has occurred and the resulting DSB is repaired. To answer this question, we tested four Arabidopsis mutants with altered methylation: ddm1-2, pol4, polV, and met1. We transformed each with a T-DNA construct that contains the mPing:GFP reporter and the gene constructs needed for mPing mobilization. We then used fluorescence microscopy to screen the transgenic plants for GFP and performed an excision site analysis. The results suggested that plants missing RNA PolV show less GFP expression and plants missing RNA Polymerase IV, Ddm1, and Met1 proteins have normal mPing transposition and DNA repair. PCR analysis of polV plants suggests that PolV is not required for mPing excision, but the excision sites are repaired less precisely.

#### B-CELL-INTRINSIC MHCII SIGNALING PROMOTES MICROBIOTA DIVERSITY

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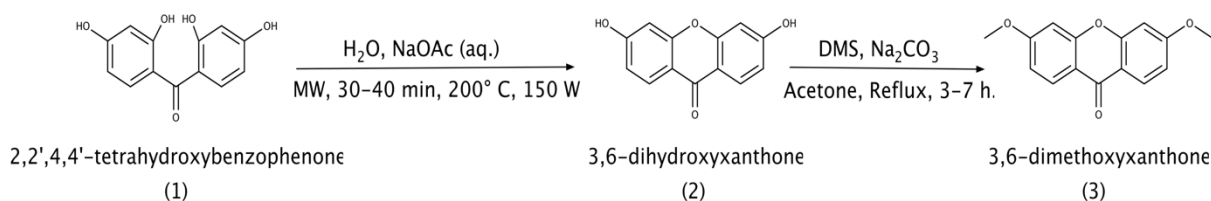
T-cell-dependent (TD) antibody responses generated against the microbiota (mainly immunoglobulin A (IgA)) are primarily produced within gut Peyer's patches (PPs). Within these sites, the expression of major histocompatibility complex class II (MHCII) molecules on B cells is thought to be necessary for the development of germinal center (GC) reactions in lymphoid follicles. However, this assumption has not been adequately addressed, and its relevance to the generation of anti-commensal IgA and the management of microbiota composition has not been described. Here, we use a RAG1<sup>-/-</sup> adoptive transfer model where RAG1<sup>-/-</sup> mice are either reconstituted with naive CD4<sup>+</sup> T cells and MHCII<sup>+</sup> B cells or naive CD4<sup>+</sup> T cells and MHCII<sup>-</sup> B cells to address these gaps in our knowledge. Results from these experiments demonstrate that B-cell-intrinsic MHCII signaling is a strict requirement for the development of GC responses. Consequently, we show that B-cell-intrinsic MHCII signaling promotes the generation of high-affinity, anti-commensal IgA responses in the gut that is associated with increased species richness within the small intestinal microbial community. Collectively, our data suggest that B-cell-intrinsic MHCII signaling is crucial for the generation of high-affinity anti-commensal IgA responses generated against the gut microbiota, and that this response favors a more diverse bacterial community.

### 3,6-DIMETHOXYXANTHONE FROM 2,2',4,4'-TETRAHYDROXY-BENZOPHENONE VIA MICROWAVE-ASSISTED ANNULATION

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<sup>1</sup>Bob Jones University, <sup>2</sup>Cayman Chemical Corporation

Xanthenes are tricyclic aromatic compounds that have multiple pharmacological uses due to their anti-tumor, antioxidant, anti-inflammatory, anti-bacterial, and potentially chemopreventive properties. The purpose of this research was to complete a two-step synthesis of 3,6-dimethoxyxanthone (3) from 2,2',4,4'-tetrahydroxybenzophenone (1) via microwave-assisted (200°C, 30-40 min., 150 W) sodium acetate-catalyzed annulation. 3,6-dihydroxyxanthone (2) was methylated to (3) using dimethyl sulfate (DMS) and sodium carbonate in acetone reflux. The average yield for products (2) and (3) were calculated to be 93% (99% initial purity) and 94% (initial 90% purity), respectively. Characterization was accomplished using <sup>1</sup>H NMR, FTIR, melting point, TLC, HPLC, and GCMS. The product obtained from this research will contribute to future research, such as synthesizing dyes like fluorescein and its derivatives.



Reaction Scheme

### NOVATECH AUTOMATION, D3 SYSTEM, AND FLAVOR PLANT SIMULATION

Breanna Scaffa, David Moldovan, and Bethany Fralick

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This project devises an automated simulation of the control systems for a flavor plant with the objective of visually aiding as a learning mechanism for D3 programming novices. D3 is a distributed control system with software, hardware, and networks. It allows for visualization, processes information, equipment status, and system status. Accommodations for high-definition graphics were achieved using D3 edit features to satisfy new industry frame standards of sixteen by nine and meet new code for display through transparency of background blended with active arraying functions. Conducting existing archives to ensure communicating between the process control module and individual face plates, sated with D3 coding, grant a call and response sequence of events to ensue. D3 architect feature coordinates the procedure, which is monitored through the process of building, or running, all individual plates pertaining to the flavor plant allowing fluent transaction of the network communication with the process control module, the display control module, and the operator console module. This work serves as a template automation program for D3 operating customers and possesses versatility in being used for training due to the programs simplistic conceptual process of managing functions for a desired outcome.

### IDENTIFYING GENES THAT EFFECT MPING TRANSPOSITION IN YEAST

Kaeleigh Seigler, David Weidner, and C. Nathan Hancock

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Transposable elements are DNA sequences that excise and re-insert randomly throughout the genome, creating mutations and altering the genome size. Researching the mechanisms controlling their movement is important because of the large impact they have on genome evolution. mPing is a miniature transposable element from rice that uses transposase proteins to catalyze its movement. mPing is unique in that it is much more active in comparison to other transposable elements in the rice genome, resulting

in altered expression of some genes. A yeast transposition assay was previously developed to study mPing's transposition mechanism. The goal of this project is to identify which *Saccharomyces cerevisiae* (Baker's yeast) genes affect mPing transposition. To achieve this, approximately 700 yeast genomic library clones were screened for the ability to alter mPing transposition. Eight clones were identified as being potential candidates because they showed interesting levels of mPing transposition. We performed a growth curve to determine if the clones affected the yeast growth rate. Genomic clones that were found to have normal growth rates were retested in transposition assays to verify their effect on transposition. Sequencing was performed on the genomic clones that were shown to be significantly different than the control to determine which genes are present.

#### DETERMINING THE ROLE OF GOOSECOID IN CRANIOFACIAL DEVELOPMENT IN ZEBRAFISH

Chasey Shabdue and April DeLaurier  
University of South Carolina Aiken

Previously, the Riley lab at Texas A&M University generated a zebrafish mutant for the homeobox gene goosecoid (*gsc*) that affects the neurons of the statoacoustic ganglion (SAG), which innervate the inner ear. Other observations suggest that loss of *gsc* affects craniofacial development, although this was not studied in detail in the original study. In humans, short stature, auditory canal atresia, mandibular hypoplasia, and skeletal abnormalities (SAMS) are reported due to loss of GSC. In mice, GSC is detected in the brain and in postotic cranial neural crest cells and the frontonasal prominence of the first branchial arch and cleft indicating a potential role in first branchial arch (jaw) development. Our hypothesis is that *gsc* is required for development of the early head and/or first pharyngeal arch skeleton in zebrafish and is a model for understanding the role of GSC in human craniofacial development. In a preliminary analysis, we performed skeletal analysis (stained by Alizarin Red and Alcian Blue) and determined that defects are present in the first pharyngeal arch skeleton, particularly in the Meckel's cartilage. We plan on performing developmental series of mRNA in-situ hybridizations (ISH), a powerful technique for localizing specific nucleic acid targets within fixed tissues and cells. Currently our results show a range of severity of defects from normal patterning to severe loss of midline structures. The findings of this study will help elucidate the action of *gsc* in zebrafish craniofacial development, which may facilitate understanding of human craniofacial disorders associated with midline defects.

#### IDENTIFICATION OF THE SOURCES OF BLOOD MEALS EATEN BY MOSQUITOES

Olivia Shirley, Carson Mickey, Elody Bensch, and Paul Richardson  
Coastal Carolina University

Mosquitos are known to spread diseases throughout communities, including viruses, referred to as arboviruses. In 2017, DHEC reported 158 incidents of arboviruses in South Carolina, including Eastern Equine Encephalitis, West Nile, Dengue Fever, and Zika virus. The infections rate was up from the year before when 124 incidents of arboviruses were reported. Monitoring these infected mosquitoes can be a valuable asset for proper health protection in our community. Understanding what the mosquitoes are feeding on can help us better monitor the zoonosis threats that our community faces. A series of primers have been developed that target unique sequences in the cytochrome b gene in mammals, reptiles and amphibians, and birds, as well as sequences in the gene for human hemoglobin. With these primers, we were able to detect one or more possible blood meals that the mosquito had fed from. Thus, this project wants to determine what the mosquitoes in our area are feeding on to better understand the zoonosis threat to our community. Over this past year, our goal was mainly to identify whether the mosquito specimen had fed on human blood or blood that came from something other than a human, or in some cases, whether it had fed on both a human and something else. This data can then be combined with our

future goal of developing techniques to detect arboviruses in the mosquitoes and identifying the bloodmeal source of those diseases.

#### GENERAL RELATIVISTIC MAGNETO-HYDRODYNAMIC SIMULATIONS OF ULTRA-LUMINOUS X-RAY OBJECTS

Zachary Smith and Chris Fragile  
College of Charleston

Ultra luminous X-ray sources (ULXs) can be broadly described as astronomical systems whose luminosities are greater than the Eddington limit for a stellar-mass compact object (black hole or neutron star). This poses a number of questions: How can these objects reach and surpass their Eddington limit? What does super-Eddington accretion look like? To explore these questions, I use the general relativistic radiative magneto-hydrodynamic astrophysics code Cosmos++ to perform numerical experiments on hyper-accreting compact objects. One important result of our work so far is the discovery of strong outflows in my simulations; excess material is being rejected by the compact object and pushed away in the form of winds. I have also found that the brightness of these objects depends sensitively on the angle from which they are viewed. I hope to soon use my results to help interpret observational data of ULXs.

#### DIAPHONIZATION: A PROTOCOL FOR CLEARING AND STAINING

Rachel Smith, Andreas James, and Julian Smith  
Winthrop University

Diaphonization, known as clearing and staining, is a technique of skeletal preservation that was first developed in 1897. This process turns the soft tissues of animals transparent and employs the use of stains to highlight bones and cartilaginous structures with identifying colors. The product is an accurate model of vertebrate anatomy. Diaphonization is performed by removing the viscera and skin from small deceased vertebrates and exposing them to chemicals such as KOH, trypsin, formaldehyde, ethyl alcohol, thymal, and glycerin, as well as Alcian blue and Alizarin red stains. The carcass is dehydrated and stained, and preserved in a glycerin solution. This process is time consuming and can easily take a month to complete, however, with further research, the time frame could be reduced down to a week. Diaphonization is a fairly simple procedure that would benefit undergraduate students interested in studying anatomy in depth. The separate staining of both the cartilage and bone of a specimen allows for precise visualization of anatomical structures in real time. This technique would aid and benefit students as a hands on approach and would give proper practice to dissection, chemical dilution, and staining alongside recognizing anatomy. It is the purpose of this study to further develop this technique in order to cut the time it takes to complete, solidify a proper and simple procedure that students can demo during laboratory sessions, and provide new skeletal models that can be utilized in a learning environment.

#### AN INTRODUCTION TO MRNA VACCINES FOR NON-SCIENTISTS

Rashawn Spann and David Boucher  
College of Charleston

mRNA Vaccines represent a novel medical technology that has exciting potential within the health sector. However, due to their seemingly recent development, there exists much misunderstanding about how mRNA vaccines work within the body, especially when compared to normal vaccines. The goal of this talk is to present mRNA vaccines and other scientific works to a non-technical audience, absent of specialized jargon and technical vocabulary. Providing clear scientific knowledge to the general public represents an important aspect of being a scientist and is vital in order for the public to make informed decisions about how to utilize, fund, and support science and its future.

THE ROLE AND REGULATION OF BACTEROIDES ACIDIFACIENS DURING COLITIS  
Shanieka Staley, Mitzi Nagarkatti, Prakash Nagarkatti, and Philip Brandon Busbee  
University of South Carolina School of Medicine Columbia

Colitis is an inflammatory bowel disease (IBD) characterized by chronic inflammation of the colon with significant disease-associated alterations in the gut microbiome, a term known as microbial dysbiosis. IBDs, such as colitis, are becoming more prevalent in industrialized areas, impacting over 1.6 million Americans. Our lab has previously shown that in mouse models of colitis, *Bacteroides acidifaciens* significantly increases in abundance during disease, and can be regulated by interleukin-22 (IL-22), a cytokine involved in gut homeostasis. *B. acidifaciens* are obligately anaerobic, non-sporing, non-motile, gram-negative rods. This bacterium can degrade protective mucus in the colon and has properties linked to inflammation, such as enhancing immunoglobulin A (IgA) responses and producing short-chain fatty acid (SCFA) acetic acid. This study investigates the effects of the overgrowth of *B. acidifaciens* in a colitis-induced mice and its ability to potentially induce or enhance colitis symptoms. Colitis was induced by using the dextran sulfate sodium (DSS) model. Results showed compared to disease controls or low dosage with *B. acidifaciens*, mice inoculated with a high dose of *B. acidifaciens* by oral gavage, but not intrarectal route, had more severe colitis symptoms. The mice inoculated with the high dose bacterium lost over 20% of their initial body weight, their colons were shorter, and their colons displayed ulcers, redness, and mucosal crystallization. These results showed that during overgrowth, *B. acidifaciens* significantly exacerbated the symptoms of DSS-induced colitis.

OBSERVATIONS OF NON-NATIVE VASCULAR PLANT SPECIES IN THE EASTERN UNITED STATES, FROM  
SOUTH CAROLINA TO THE FLORIDA KEYS  
Richard Stalter  
St. John's University

This study, based on 16 floristic inventories including 14 by Stalter, compares the non-native vascular plant species at city, state, national parks, and research preserves from South Carolina to the Florida Keys. This presentation includes 16 study sites, their coordinates, and date of study, investigator, number and percent of non-native taxa. Sites with high human activity e.g., Garden Key, Florida, 42.4% and Fort Sumter, South Carolina, 34.6% have a high percent of non-native vascular plant species. Sites with no human habitation or little visitation, e.g., Turtle Island, South Carolina, 5.9% and Little Torch Key, Florida, 4.0% have a low percent of non-native taxa. Non-native taxa have increased at the “protected” abandoned rice fields, Georgetown, South Carolina, 3.3% in 1971 to 5.5% in 2021, although human activity and impact at the abandoned rice fields are minimal. The deliberate and/or accidental introduction of non-native vascular plant species such as Brazilian Pepper (*Schinus terebinthifolia*), Callery Pear (*Pyrus calleryana*), Kudzu (*Pueraria montana*), Multiflora rose (*Rosa multiflora*), Water Hyacinth (*Eichhornia crassipes*), and others pose a threat to native taxa.

CHARACTERIZING 3D ELECTROCHROMIC LBL SELF-ASSEMBLED POLYMER FILMS  
Alexander Stensland and Kaelyn Leake  
The Citadel

Electrochromic polymer films are rapidly becoming more understood and are increasingly applicable in meeting the needs of military and commercial industries. Electrochromic devices show a reversible color change upon a charge being applied through the electrochromic material by application of a voltage. The devices in this study were composed of bilayers of poly(3,4-ethylenedioxythiophene): polystyrenesulfonate and polyallylamine hydrochloride on indium tin oxide substrates. The films were



fabricated and patterned through a novel layer-by-layer process. This process uses a laser during dipping to create a pattern on the substrate. Devices fabricated from these polymers are characterized using a UV-Vis spectroscopy to confirm layer binding is present on the sample. UV-Vis spectroscopy also aids in measuring the difference in light absorbance for an active area of 1mm blocks generated by the laser patterning. A max increase was found of 0.03 between 450 and 500 nanometers which corresponds to the spectrum expected for PEDOT:PSS. Characterizing patterned electrochromic samples gives promise to future applications in both military and commercial industries.

#### INVESTIGATING PROTEIN MODIFICATION BY ITACONATE

Shoba Swaminathan and Norma Frizzell  
University of South Carolina School of Medicine

During inflammation, immune cells undergo metabolic changes to regulate the immune response; a field known as "immunometabolism". Recently the metabolite itaconate has been shown to drive an anti-inflammatory response to help resolve inflammation. Accumulated itaconate can react irreversibly with protein cysteine residues and was recently termed protein dicarboxypropylation. While most studies have examined itaconate reactivity in peripheral macrophages, I examined the role of itaconate in microglia as they play a prominent role in the brain's immune response. Highly aggressively proliferating immortalized (HAPI) microglia maintain key characteristics of microglial cells, including the metabolic response to lipopolysaccharide (LPS), which made them an excellent model for this study.

This project utilized proteomic strategies to identify new targets of itaconate modification in activated immune cells. Proteins from HAPI microglia were exposed to LPS, exogenous itaconate, or were untreated. For protein identification, I performed polyacrylamide gel electrophoresis, stained the gel with Coomassie Blue, and excised a series of protein bands. I reduced and alkylated the proteins prior to digestion with trypsin and concentrated the peptides. Liquid chromatography-mass spectrometry was performed with the UofSC mass spectrometry center. I analyzed the peptide mass spectra generated using Mascot software to identify the proteins present in the excised band, and to identify specific sites of itaconate modification. I have identified calreticulin and beta tubulin as novel itaconate modified proteins in microglia. This study is the first to characterize itaconate-derived protein modification in microglia, and further functional analyses of the effect of this modification on these protein targets is planned.

#### THE EFFECTS OF HUMAN BEHAVIOR ON *STAPHYLOCOCCUS* AND *ESCHERICHIA* BACTERIOPHAGE PRESENCE AT COASTAL CAROLINA UNIVERSITY

Korinne Swanson and Paul Richardson  
Coastal Carolina University

Annually, more than 2.8 million antibiotic resistant bacterial infections are diagnosed in the United States, according to the CDC. This global health threat has meant that the exploration of innovative treatments for antibiotic resistant infections, such as bacteriophages, are vital to ensuring community health. Bacteriophages are viruses which can lyse and kill their host, bacteria. The isolation and characterization of bacteriophage will, hopefully, allow for the natural sourcing of bacteriophage, to be used against antibiotic resistant bacterial infections like Methicillin Resistant *Staphylococcus Aureus* (MRSA). At Coastal Carolina University the *Staphylococcus* and *Escherichia* bacteriophage population on students and faculty is monitored annually. Amidst the COVID-19 pandemic (2020-21), annual monitoring indicated an absence of phage presence on humans. In 2021-22, as COVID-19 restrictions diminish, participant behavior and bacteriophage presence were studied to understand the drastic shift in bacteriophage population from 2020-21. Participants provided a postauricular and nasal swab sample, along with a completed survey regarding perceived stress levels and hygiene habits. Each sample was subjected to microbial and molecular tests to determine potential bacteriophage presence. The purposes

of this study were to isolate and characterize *Staphylococcus* and *Escherichia* bacteriophages and to determine possible correlations between pertinent participant behavior (face mask wearing, hygiene, perceived stress levels) and the bacteriophage presence.

#### ALU DIMORPHISM AT THE PV92 LOCUS OF CHROMOSOME 16 IS IN EQUILIBRIUM FOR UNIVERSITY STUDENT POPULATION

Mackenzie Thackston, Alaina Urman, and James Brooks  
Charleston Southern University

*Alu* is a retrotransposable element, which refers to its ability to be copied and move from one region of DNA to another DNA region. At the PV92 locus of chromosome 16, *Alu* is a 300 bp dimorphic insert that can either be present or absent. It does not encode a protein product and has lost the ability to transpose. It is specific to humans, and differences in genotype and allele frequencies between human populations are an important tool in understanding evolution. In this research, data was obtained and analyzed from 269 students at Charleston Southern University (CSU) belonging to four different races: Asian, Black, Hispanic or Latino, and White. Standard molecular biology procedures were used to isolate DNA from epithelial cheek cells, detect *Alu* inserts using polymerase chain reaction (PCR), and determine genotypes by gel electrophoresis. Statistical analyzes were performed using Microsoft Excel, and chi square and Hardy-Weinberg equations were used to test for goodness of fit and equilibrium, respectively. The results were separated by genotypes: homozygous present, heterozygous, or homozygous absent. Homozygous absent was the most common genotype. Results were further separated into categories of gender and race. No significant genotype differences were found between male and female or between Black and White students. Nevertheless, there were significant differences between all other race combinations. Hardy-Weinberg calculations indicate that mutations, natural selection, nonrandom mating, genetic drift, and gene flow are negligible, and the overall student population at CSU is in equilibrium.

#### USING YEAST TRANSPOSITION ASSAYS TO STUDY TRANSPOSITION MECHANISMS

Pei-En Tu, David Weidner, and C. Nathan Hancock  
University of South Carolina Aiken

Transposition is the ability of transposable elements to change position in the genome, a process in which they are removed from one site and inserted into a second. Understanding the mechanism of transposition is essential because most eukaryotic genomes are partially composed of transposable elements. Also, it provides a clue into how transposable elements interact with their hosts, helping us understand more about genome evolution. Transposable elements such as mPing and mPong are the deletion derivatives of Ping and Pong elements. These elements are mobilized by the ORF1 and Transposase (TPase) proteins. Expressing these proteins in yeast can induce the transposition of these elements from the ADE2 gene, allowing us to measure transposition frequency. A previous study by the Hancock lab showed that removing a repeat sequence from the N-terminal of the ORF1 protein (1 REP) resulted in higher mPing transposition rates. Our study aims to determine whether the 1REP also produces higher mPong transposition. To achieve this, we transformed yeast containing either genomic mPing or mPong with ORF1 SC1 1REP expression plasmids as well as the normal ORF1 plasmid as a control. We will then perform transposition assays to determine whether transposition rate is different between the two ORF1 proteins. Determining if the effect is specific to mPing will help us to find out whether the presence of the repeat in ORF1 is a regulatory mechanism to prevent excessive transposition.

## FLIGHT PLANNING SYSTEM USING JAVA

Mara Washburn and Zhenheng Li  
University of South Carolina Aiken

This paper details the development of a multi-class, object-oriented flight planning program following professional software engineering processes to create a project that is accurate, efficient, and robust. The Flight Planning System accepts a user's starting airport, desired destination, and aircraft preference and then determines an optimal flight path depending on location of airports and navigational beacons, as well as the capabilities of the designated aircraft. The program is written in Java and utilizes information accessed from three different databases of aircrafts, airports, and navigational beacons. Although not intended for actual navigational purposes, calculations for the distance of each flight are based on the Haversine formula for distance using geographical coordinates and the program provides realistic estimates of heading, distance, and travel time.

## UNCOVERING THE REGULATORY REGIONS IN MINIATURE INVERTED REPEAT TRANSPOSABLE ELEMENTS

David Weidner, Priscilla Redd, and Nathan Hanacock  
University of South Carolina Aiken

Identifying the mechanisms that control mobilization of DNA transposable elements is key to understanding genome evolution. Plant genomes are especially rich in Miniature Inverted Repeat Transposable Elements (MITES). These nonautonomous elements are mobilized in trans by proteins produced by their related autonomous elements. mPing, an extremely abundant and active MITE from rice, was used to establish a yeast transposition assay that measures mobilization frequency. We have identified the regulatory regions of mPing and the closely related synthetic mPong MITE by systematically mutating 20 bp segments. We hypothesized that some internal regions are involved in the interaction of the MITES with the mobilizing proteins ORF1 and Transposase. We predicted that altering regions that promote interaction with these proteins would decrease transposition. Conversely, we predicted that changing regions that normally inhibit transposition complex formation would result in higher activity. For both MITES, the yeast transposition assay identified multiple regions that promote and inhibit transposition. The presence of inhibiting regions supports a model in which transposable elements limit their activity to prevent host damage and detection by host regulatory mechanisms. To further verify the effect of these regulatory regions we created chimeric elements of mPing and mPong. We observed that the transposition frequencies of these elements corresponded to the combination of inhibiting and promoting sequences present. This suggests that the capacity of a specific MITE to exhibit hyperactive transposition is determined by the regulatory sequences inherited from the parent autonomous element.

## COMPARISON OF DIMENSION REDUCTION METHODS ON HYPERSPECTRAL IMAGES

Noah Wells and Todd Wittman  
The Citadel

Hyperspectral imaging is a recent imaging technique that allows for the capture of hundreds of bands of light, as opposed to the three bands found in traditional RGB images. Thus, Hyperspectral images contain more useful information than standard images which often makes hyperspectral image analysis a long and resource intensive task. Due to the immense amount of data in hyperspectral images, the application of dimension reduction methods is helpful for reducing the data to a manageable size. However, there are many dimension reduction algorithms and there is debate among image analysts about the most effective algorithm. This project evaluates a variety of image dimension reduction techniques on hyperspectral images in order to increase efficiency and accuracy of classification. Results show that most methods perform at similar efficiencies overall. With no significant differences between the efficiency for

each method, minimum noise fraction is the recommended method due to its speed and relative efficiency. Additionally, linear discriminant analysis is not recommended due to its lackluster performance relative to the other tested methods.

#### DESIGN AND CLONING OF TWO SHORT HAIRPIN RNAs TARGETED TO THE HIV-1 REGULATORY GENES TAT AND REV

Meghann Williams and William Jackson  
University of South Carolina Aiken

The human immunodeficiency virus (HIV-1) attacks CD4-positive T Helper lymphocytes which play a central role in inducing immune responses to infection. Because there is no cure for HIV infection, research continues to seek potential ways to reduce/inhibit viral infection. The activation of cellular RNA interference pathway, using small interfering RNAs (siRNA) offers a potentially powerful way to silence genes expressed by HIV-1. Two of these genes are the trans-activator or transcription (Tat) and the regulator of virion protein expression (Rev). Together these two proteins control viral replication by regulating viral genes and controlling virus replication. In this project a shRNA targeted to sites within each of these genes (Tat exon 1 and Rev exon 2) were designed, synthesized, and cloned into the RNA Polymerase I expression plasmid, pH1.Stuffer. For this, a small interfering RNA target site was identified within the Tat and Rev sequences of the HIV-1 NL43 genomic clone. Each site consisted of 19 nucleotides and were located within Tat exon 1 at nucleotides 5834-5853 and Rev exon 2, located at nucleotides 8403-8422. A short hairpin RNAs (shRNA) was designed by linking the 19 nucleotide target sites to its complementary sequence using a nine nucleotide hairpin sequence (TTCAAGAGA). Each shRNA was then converted to DNA and a complementary sequence was added to form a dsDNA (DshRNA). To aid in cloning, HindIII and BglII sites were added to Revsh8403, and BglII and XbaI sites were added to Tatsh5834. Each DshRNA was synthesized and cloned into the RNA Polymerase I expression plasmid pH1.Stuffer forming pH1.Revsh8403 and pH1.Tatsh5834. Current work is underway to test the expression and silencing activity of each shRNA.

#### THE REPRODUCTIVE MODE OF A MACROALGAE INVADER IN THE PAPAHAUUMOKUAKEA MARINE NATIONAL MONUMENT

Taylor Williams and Heather Spalding  
College of Charleston

The Northwestern Hawaiian Islands are a 1,931 km chain of remote and nearly pristine atolls within the Papahānaumokuākea Marine National Monument (PMNM). The first invasive macroalga in PMNM was recently discovered at Manawai (Pearl and Hermes Atoll). *Chondria tumulosa* is a mat-forming, red macroalga found in high abundance across Manawai's shallow subtidal reefs. It was first recorded in low abundance in 2015, but by 2019 formed large mats that smothered native corals and algae, reducing diversity and abundance of reef organisms on the scale of thousands of m<sup>2</sup>. We hypothesize that the rapid establishment of *C. tumulosa* is aided by its capacity for asexual reproduction via vegetative fragmentation, a phenomenon that has been shown in other macroalgal invasions. Collections were made at Manawai to determine its prevailing reproductive mode. Only 19% of thalli were visibly reproductive at the time of collection as tetrasporophytes, there were no male or female gametophytes observed. Preliminary analyses on six thalli at 12 microsatellite loci revealed four unique, multilocus genotypes. One genotype was encountered four times, suggesting some degree of vegetative fragmentation, while the other three genotypes were unique. The reproductive system is critically important as it plays a central role in the partitioning of genetic diversity. As we fully analyze these data, we will incorporate an understanding of the *C. tumulosa* reproductive system into best management practices for the PMNM.

and provide more information about the eco-evolutionary implications of haploid-diploid life cycles on invasion success.

DIGITIZATION OF THE HERBARIUM COLLECTION AT THE UNIVERSITY OF SOUTH CAROLINA  
SALKEHATCHIE: CONTRIBUTING TO AN INTERNATIONAL DATABASE

Zachery Wilson and Eran Kilpatrick  
University of South Carolina Salkehatchie

An herbarium is a collection of dried plant specimens that are mounted and systematically arranged for scientific study. Herbarium specimens provide a means of tracking past and present trends of plant species with conservation status, determining ecological integrity and providing data to guide land management decisions. The USC Salkehatchie Herbarium (SALK) was founded in 2013 and is part of the SouthEast Regional Network of Expertise and Collections (SERNEC), a consortium of 233 herbaria across 14 states in the southeastern USA. The SERNEC mission is to acquire plant specimen images and metadata from one of the most botanically diverse regions in North America to help facilitate scientific research and public interest. During 2021, funding from the Palmetto Undergraduate Research Experience (PURE) and Workplace Opportunity for Rural Communities (WORC) programs was used to prepare, catalog, and image SALK specimens collected from 2018 - 2019. Dried and pressed plant specimens were mounted on standard herbarium sheets along with an accompanying locality label, barcode, and herbarium seal. Skeletal data for each specimen was then entered into the (SERNEC) database. Specimens were imaged using a Canon EOS 5D digital camera with a 50mm macro lens in combination with an imaging station. After proofing each image with Microsoft Digital Photo Professional, the Adobe Lightroom application was used to compress the raw (CR2) image to JPEG format. Images were then uploaded to the Cyperduck Library, a web-based cloud, then paired with their appropriate skeletal record in SERNEC through final digitization by barcode entry and synchronization. Over 150 specimens were processed from May – August 2021 bringing the overall SALK collection total to 1131 specimen records representing 603 vascular plant species. The SALK collection, with a concentration of specimens from the Middle Atlantic and Southern Coastal Plain of southwestern South Carolina, is publicly available in SERNEC and published in the Global Biodiversity Information Facility (GBIF), an international data network.

THE MOLECULAR REGULATION OF ADSCS DURING TOROID FORMATION

Austin Worden and Jay Potts  
University of South Carolina School of Medicine Columbia

The use of three-dimensional (3D) culture systems (hydrogels) and adipose-derived stem cells (ADSCs) in regenerative medicine has allowed for early-stage investigation and modeling of the mechanisms in diseases, treatments, targets, etc. without having to involve a specimen. ADSCs, specifically, are utilized due to their ability to differentiate into mesodermal, endodermal, and ectodermal cell-specific lineages. The innate programming of stem cells during embryonic development that drive them to a specific location for structural differentiation can be replicated during a process, termed toroid formation, where the cells are cultured on top of a hydrogel. These migrating toroidal cells are long, thin and looks like the spokes of a wheel as they move towards the center of the gel to form a ring-like structure. Toroid formation appears to be a near universal process with the exception being cancer cell lines we have tried (<4). Interestingly, when cells are cultured inside of the hydrogel, there is a contraction of the gel, but no toroid is formed. Our lab discovered that the CXCL12-CXCR4/7 pathway, the pathway implicated in numerous diseases including cancer and HIV, was upregulated during toroid formation and downregulated for mixed-in gels. By thoroughly dissecting this signaling pathway, our data pinpointed six key targets that significantly delayed, but did not eliminate, toroid formation. My work will define the underlying signaling pathways that regulate ADSC directed migration used during embryonic development

and establish toroid formation as a novel 3D model for high throughout investigation of diverse in vivo molecular mechanisms.

#### IDENTIFICATION OF AMYLOID BETA 42 PEPTIDES IN TRANSGENIC *DROSOPHILA MELANOGASTER*

Michael Yan<sup>1</sup>, Sasha Bronovitskiy<sup>2</sup>, Dakota Castillo<sup>3</sup>, and Fang Lin<sup>3</sup>

<sup>1</sup>University of South Carolina, <sup>2</sup>Georgia Institute of Technology, <sup>3</sup>Coastal Carolina University

Alzheimer's, which will be frequently referred as AD, is characterized by two main neuropathological features: senile plaques and neurofibrillary tangles. In this study we used a transgenic line of fruit fly *Drosophila* that expresses human amyloid beta protein as our model system. Our focus was directed to the senile plaques, more specifically, amyloid beta peptides, amyloid beta-42, that make up their composition, as it is one of the main indicators of Alzheimer's development in the brain. The goal being to correctly identify and visualize the presence of amyloid peptides in our models and being able to correctly process them utilizing different protocols/methods to gain a further understanding of the neurological degeneration between our control and our experimental groups. Using *Drosophila melanogaster* as a model organism, our experimental groups were administered with human amyloid beta-42 transgene to allow for the development of AD in our subjects. We collected fly head samples from different time frames to visualize and identify how AD develops pathologically. In this study, both control and experimental AD models were subjected to immunohistochemical staining with H&E / immunostaining /fluorescence staining. In addition, western blot analysis was performed to identify the amyloid beta protein aggregates. Result from the immune-histochemistry and Western blot analysis verified the presence of amyloid beta peptides in *Drosophila melanogaster* line that carries the transgene. The presence of peptide aggregates is only in the AD samples and not in the ELAV control groups. In addition, we noted a more disorganized brain morphology in AD flies under H&E staining, suggesting the onset of neurodegeneration.

**END**

SC Academy of Science Abstracts  
(Sr. Academy)



**SOUTH CAROLINA JUNIOR ACADEMY OF SCIENCE  
2022 SCHEDULE OF EVENTS**

<b>7:30 AM - 10:00 AM</b> <i>7:30 AM – 9:00 AM</i>	<b>SCJAS Registration</b> <i>Continental Breakfast</i>	Humanities & Social Science Bldg. (HSS)
<b>9:00 AM – 10:30 AM</b>	<b>SCJAS Oral Session I</b> <i>See session listing for details</i>	Business & Education (B&E) and Humanities & Social Sciences
<b>10:30 AM – 10:45 AM Break</b>		
<b>10:30 AM – 12:30 PM</b>	<b>SCAS Poster Session</b> Junior Academy members are encouraged to visit SCAS posters	Business & Education Building
<b>10:45 AM – 12:30 PM</b>	<b>SCJAS Oral Session II</b>	Business & Education Bldg. and Humanities & Social Sciences Bldg.
<b>12:00 PM – 1:15 PM</b>	<b>Lunch</b> <i>Boxed lunches are available, Lunch Tickets are in the SCJAS badge holder.</i>	Student Activities Center
<b>1:30 PM– 2:45 PM</b>	<b>Plenary Session</b> “Savannah River National Laboratory: Research and Job Opportunities.” Vahid Majid, Ph.D Director for Savanah River National Laboratory	<b>B&amp;E Gymnasium</b>
	Presentation of Governor’s Awards Presentation Teacher of the Year Award Presentation	
<b>3:00 PM – 3:30 PM</b>	<b>SCJAS Awards Ceremony</b>	

<b>SCJAS Judges Conference Room</b> Humanities & Social Sciences, Room 107
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# SCJAS PRESENTER TIME & LOCATION

By last name of first author

<b>Presenter</b>	<b>Time</b>	<b>Room</b>
Able, Katelyn	11:45 AM	HSS 109
Agarwal, Sahil	11:30 AM	HSS 214
Alan, Ella	11:30 AM	HSS 202
Alan, Ella	12:00 PM	HSS 203
Amick, Lillian	11:00 AM	HSS 215
Anand, Jiya	11:45 AM	HSS 107
Ante, Leilani	11:30 AM	HSS 113
Ariyo, Toluwanimi	10:00 AM	HSS 209
Ashton, Anna Gray	9:30 AM	HSS 113
Ashton, Anna Gray	10:15 AM	HSS 202
Aull, Carsin	10:15 AM	B&E 234
Avula, Harsha	12:00 PM	HSS 103
Aycock, Brantley	12:00 PM	HSS 206
Aycock, Carson	11:30 AM	HSS 111
Azhar, Mustafa	9:45 AM	HSS 107
Babinec, Stephanie	11:30 AM	HSS 205
Bedford, Andrew	11:45 AM	HSS 113
Benjamin, Bethany	9:30 AM	B&E 237
Berry, Tomiah	10:00 AM	HSS 205
Blackmon, Hope	10:00 AM	HSS 214
Blake, Christopher	10:45 AM	HSS 111
Bodepudi, Sathvik	9:30 AM	HSS 107
Breedlove, Chloe	10:45 AM	HSS 103
Brent, John	11:15 AM	HSS 209
Brizek, Addison	9:45 AM	B&E 234
Brock, Liana	10:45 AM	HSS 210
Brown, Lydia	9:15 AM	HSS 111
Bruss, Nathaniel	9:45 AM	HSS 202
Campanella, Silas	9:00 AM	HSS 214
Carson, Hannah	10:15 AM	B&E 235
Cawley, Daniela	11:45 AM	HSS 203
Chada, Srihith	10:45 AM	B&E 234
Chattha, Aleena	11:45 AM	HSS 215
Chauhan, Sanjeev	9:30 AM	HSS 209
Chigoba, Everlast	11:00 AM	HSS 214
Clark, Caleb	9:15 AM	HSS 214
Clements, Adam	11:30 AM	HSS 209
Clontz, Brodee	10:00 AM	HSS 202
Comose, PJ	9:30 AM	HSS 111
Corley, Maggie	11:30 AM	HSS 109
Coyle-Vega, Xavious	11:00 AM	HSS 116
Creech, Nyaveia	9:45 AM	HSS 205

<b>Presenter</b>	<b>Time</b>	<b>Room</b>
Crosby, Berkeley	11:15 AM	HSS 109
Daise, Cheyenne	9:00 AM	HSS 206
Day, Camille	<b>10:15 AM</b>	<b>HSS 209</b>
Davidson, William	9:15 AM	HSS 215
Delarosa, Timotheo	10:00 AM	HSS 111
Delgado, Olivia	10:00 AM	HSS 203
Desai, Parth	11:15 AM	HSS 107
Divekar, Sanvi	9:15 AM	B&E 234
Doughty, David	10:15 AM	B&E 237
Dowey, Jackson	9:30 AM	B&E 235
Dozier, Rachel	11:30 AM	HSS 210
Driscoll, Aidan	11:00 AM	HSS 209
Edwards, William	9:45 AM	HSS 111
Evans, Tanner	11:15 AM	B&E 234
Field, Isabelle	10:00 AM	HSS 109
Fontenot, Moira	11:00 AM	HSS 202
Fontenot, Moira	12:00 PM	HSS 210
Funk, Sullivan	11:00 AM	HSS 103
Galaída, Stephen	11:45 AM	HSS 210
Gambaloza, Geraldo	10:00 AM	HSS 103
Ganesh Babu, Shrihan	9:30 AM	HSS 109
Ganesh Babu, Shyam	9:00 AM	HSS 109
Gill, Hunar	11:15 AM	HSS 215
Gillam, Alyssa	10:15 AM	HSS 107
Godwin, Eva	9:00 AM	HSS 202
Griffin, Ganis	10:00 AM	HSS 215
Gummere, Mathew	9:00 AM	HSS 205
Guntupalli, Nidhi	11:30 AM	HSS 107
Hagerty, Jasmine	10:00 AM	HSS 113
Han, Madison	11:30 AM	HSS 116
Harris, Jayden	9:45 AM	HSS 103
Hazel, Logan	9:15 AM	HSS 205
Hill, Charlton	12:00 PM	HSS 107
Hipple, Isabelle	10:00 AM	HSS 107
Hix, Haley	12:15 PM	HSS 113
Holstein, Thomas	11:15 AM	HSS 103
Horman, William	10:15 AM	HSS 116
Jackson, Steven	10:15 AM	HSS 103
Jenkins, Asah	10:00 AM	HSS 206
Jenkins, Lillian	9:45 AM	HSS 206
Johnson, Tishyra	10:45 AM	HSS 113
Jones, Makenzie	11:30 AM	HSS 203



# SCJAS PRESENTER TIME & LOCATION

By last name of first author

<b>Presenter</b>	<b>Time</b>	<b>Room</b>
Kapoor, Ria	10:15 AM	HSS 113
Kelly, Ace	11:15 AM	HSS 210
Kelly, Logan	11:45 AM	HSS 205
Kerai, Heiyaani	9:15 AM	B&E 237
Khan, Doonya	9:15 AM	HSS 116
Kim, John	11:00 AM	B&E 234
Kim, Mia	9:45 AM	HSS 203
Kim, Mia	9:15 AM	HSS 202
Klauk, Venture	12:00 PM	HSS 113
Kong, Justin	9:00 AM	B&E 235
Lanahan, Elise	9:30 AM	HSS 202
Latham, Kylie	9:45 AM	B&E 237
Lawton, Chandler	10:45 AM	HSS 107
Leadbitter, Ryan	9:30 AM	HSS 206
Lee, Abbey	11:30 AM	HSS 103
Lee, Jisoo	9:00 AM	B&E 237
LeGrand, Daniel	11:00 AM	HSS 111
Lesesne, Hollings	10:00 AM	B&E 237
Marin-Dings, Marshall	10:00 AM	HSS 116
Massalon, Jackson	9:15 AM	HSS 103
Mathis, Isabella	9:00 AM	HSS 103
May, Andrew	11:45 AM	HSS 206
McFadden, Nadira	11:15 AM	HSS 214
McGaughey, Fred	10:00 AM	B&E 234
McGriff, Maegan	11:00 AM	B&E 237
McGriff, Robert	11:45 AM	HSS 103
Mckelvey, Cali	9:30 AM	HSS 215
Mei, Angela	9:30 AM	HSS 203
Miro, Ryon	11:45 AM	HSS 111
Morgan, Reese	10:45 AM	B&E 237
Morton, Joshua	9:15 AM	HSS 203
Murugesan, Neya	11:15 AM	HSS 116
Nance, Jonathan	11:15 AM	HSS 113
Nasriddinov, Firdavs	11:15 AM	HSS 202
Nasriddinov, Firdavs	9:45 AM	HSS 209
Nelakuditi, Satvik	10:45 AM	HSS 206
Olson, Parker	10:45 AM	HSS 109
O'Neal, J'Den	9:45 AM	HSS 215
Ortiz, Maureen	11:00 AM	HSS 113
Othersen, Ansley	9:45 AM	HSS 116
Ottich, Carolina	9:00 AM	HSS 111
Papaletsos, Michael	9:30 AM	B&E 234
Pasala, Meghan	11:15 AM	B&E 235
Patel, Jay	10:45 AM	HSS 116

<b>Presenter</b>	<b>Time</b>	<b>Room</b>
Patel, Shivani	11:30 AM	HSS 215
Patterson, Jordan	11:00 AM	B&E 235
Pelia, Harmanpreet	9:00 AM	HSS 203
Phelps, Ava	11:00 AM	HSS 107
Phillips, Caleb	9:15 AM	B&E 235
Pieters, Jeremy	9:30 AM	HSS 103
Prime, Zaire	9:30 AM	HSS 116
Rancu, Isabel	10:45 AM	HSS 209
Ravindran, Joseph	11:15 AM	HSS 111
Rebmann, Cainan	9:00 AM	HSS 215
Ries, Lillian	11:30 AM	B&E 234
Rychener, Carlynn	10:15 AM	HSS 215
Saracila, Ian	9:00 AM	HSS 116
Saravanan, Kevin	11:15 AM	HSS 206
Sellers, Nathan	9:45 AM	HSS 109
Sen, Adeep	9:45 AM	B&E 235
Senthil, Mritika	11:30 AM	HSS 206
Shissias, Hunter	11:30 AM	B&E 235
Slaubaugh, Marina	10:00 AM	B&E 235
Sunilkumar, Gowri	12:00 PM	HSS 215
Swick, Robert	9:15 AM	HSS 109
Taine, Irairie	11:15 AM	HSS 203
Tang, Cathy	9:15 AM	HSS 206
Taylor, Alexander	9:30 AM	HSS 205
Thibodeau, Tobyn	9:45 AM	HSS 113
Thomas, Sandra	11:00 AM	HSS 206
Thumsi, Siddharth	10:15 AM	HSS 206
Tutich, Holden	10:15 AM	HSS 109
Umberger, Branner	9:30 AM	HSS 214
Valluri, Kartik	11:45 AM	HSS 214
Walsh, Daisy	9:45 AM	HSS 214
Ward, Natalie	10:45 AM	B&E 235
Ward, William	10:15 AM	HSS 214
Warren, Aiden	11:00 AM	HSS 109
Washington, James	10:45 AM	HSS 214
Washington, Zanaia	10:15 AM	HSS 111
Weiss, Sara "Kate"	10:45 AM	HSS 205
Wood, Eamon	11:00 AM	HSS 205
Wuori, Amelia	11:15 AM	B&E 237
Yadav, Shashwat	10:45 AM	HSS 215
Yu, Lyn	11:15 AM	HSS 205
Zhang, Lily	12:00 PM	HSS 214
Ziegler, Alaska	9:00 AM	B&E 234

## **SCJAS 2022 ANNUAL MEETING ORAL PRESENTATIONS**

April 2<sup>nd</sup> 2022

### **BEHAVIORAL SCIENCE I / NON-MENTORED**

**9:00 AM – 11:45 AM**

**Business and Education Building, Room 234**

- 9:00 AM HALLUCINATIONS! PREVENT AND PREPARE YOUR MENTAL HEALTH  
Alaska Ziegler, Center for Advanced Technical Studies
- 9:15 AM THE EFFECT OF BILINGUALISM ON SOCIAL ANXIETY IN ADOLESCENTS  
Sanvi Divekar, Spring Valley High School
- 9:30 AM THE EFFECT OF PLAYING "THE CLIMATE TRAIL" ON HIGH SCHOOL STUDENTS' PERSPECTIVES  
OF CLIMATE CHANGE  
Michael Papaletsos, Spring Valley High School
- 9:45 AM COLOR PERCEPTION IN OPPOSITE GENDERS  
Addison Brizek, Chapin High School
- 10:00 AM SELF-WORTH'S AFFECT ON PARTICIPATION IN AFTERSCHOOL PROGRAMS  
Fred McGaughey, Chapin High School
- 10:15 AM STUDENT COMFORT IN THE CLASSROOM AND ITS IMPAC  
Carsin Aull, Chapin High School
- 10:45 AM THE EFFECT OF COVID-19 ON THE NUMBER OF IN-PERSON VOLUNTEERS VERSUS CASH  
DONORS  
Srihith Chada, Spring Valley High School
- 11:00 AM THE EFFECT OF GRAPHICAL VERSUS TEXTUAL DISPLAY OF INFORMATION ONLINE ON THE  
PERCEPTION OF CREDIBILITY  
John Kim, Spring Valley High School
- 11:15 AM THE EFFECTS OF EMPLOYMENT ON THE POLITICAL ALIGNMENT OF SOUTH CAROLINA HIGH  
SCHOOL STUDENTS  
Tanner Evans, Spring Valley High School
- 11:30 AM THE RELATIONSHIP BETWEEN SOCIAL MEDIA AND PARENTAL INFLUENCE ON HIGH SCHOOL  
STUDENTS' ATTITUDE TOWARD RECEIVING THE COVID-19 VACCINE  
Lillian Ries, Spring Valley High School

## **BEHAVIORAL SCIENCE II / NON-MENTORED**

**9:00 AM – 11:45 AM**

**Business and Education Building, Room 235**

- 9:00 AM THE EFFECT OF INTRINSIC AND EXTRINSIC MOTIVATIONAL FACTORS ON VOLUNTEER PARTICIPATION FOR DISTRIBUTED COMPUTING PROJECT FOLDING@HOME  
Justin Kong, Spring Valley High School
- 9:15 AM THE CORRELATION BETWEEN A TEENAGER'S TRUST IN INFORMATION SOURCES AND CREDIBILITY OF SOURCES  
Caleb Phillips, Spring Valley High School
- 9:30 AM THE EFFECT OF EXPLICIT VERSUS IMPLICIT TRUST IN THE GOVERNMENT ON THE NUMBER OF COVID-19 PRECAUTIONS TAKEN  
Jackson Dowey, Spring Valley High School
- 9:45 AM THE EFFECT OF CLIMATE CHANGE ON MENTAL HEALTH IN TEENAGERS  
Adeep Sen, Spring Valley High School
- 10:00 AM THE EFFECT OF PRE PERFORMANCE RITUALS ON ADOLESCENTS' ACADEMIC PERFORMANCE  
Marina Slaubaugh, Spring Valley High School
- 10:15 AM EMOTIONAL INTELLIGENCE AND GPA  
Hannah Carson, Chapin High School
- 10:45 AM TOXIC TIKTOK  
Natalie Ward, Chapin High School
- 11:00 AM ON THE TOPIC OF MENTAL HEALTH: STIGMATIZATION AND IT'S SOLUTION  
Jordan Patterson, Center for Advanced Technical Studies
- 11:15 AM THE MODIFICATION OF JURY INSTRUCTIONS TO IMPROVE JUROR VERDICTS AND CONFESSION RECOGNITIONS IN A CRIMINAL TRIAL  
Meghan Pasala, Spring Valley High School
- 11:30 AM THE RELATIONSHIP BETWEEN SOCIOECONOMIC STATUS AND STUDENT PANDEMIC EXPERIENCE  
Hunter Shissias, Spring Valley High School

### **BEHAVIORAL SCIENCE III / NON-MENTORED**

**9:00 AM – 11:30 AM**

**Business and Education Building, Room 237**

- 9:00 AM THE EFFECT OF INTRINSIC AND EXTRINSIC MOTIVATION ON STUDENT SUCCESS IN A MAGNET PROGRAM  
Jisoo Lee, Spring Valley High School
- 9:15 AM THE EFFECT OF TEMPERAMENTAL PERSONALITIES ON EMOTIONAL INTELLIGENCE  
Heiyaani Kerai, Spring Valley High School
- 9:30 AM THE APPLICATION OF THE EYEWITNESS POST-IDENTIFICATION FEEDBACK EFFECT IN A LEARNING ENVIRONMENT  
Bethany Benjamin, Spring Valley High School
- 9:45 AM HYPERSEXUALIZATION, VIOLENCE, AND DESENSITIZATION  
Kylie Latham, Chapin High School
- 10:00 AM IMPACT OF TIME SPENT ON HOMEWORK ON ANXIETY RATES  
Hollings Lesesne, Chapin High School
- 10:15 AM THE EFFECT OF AVATAR CHARACTERISTICS AND VOICE EXPRESSION ON ONLINE GAMING ENVIRONMENTS  
David Doughty, Spring Valley High School
- 10:45 AM THE EFFECT OF FIRST LANGUAGE ON EMOTIONAL UNDERSTANDING OF ELEMENTARY SCHOOL STUDENTS  
Reese Morgan, Spring Valley High School
- 11:00 AM THE EFFECT OF MAGNET PROGRAM PARTICIPATION ON THE ACADEMIC PROGRESS OF HIGH SCHOOL STUDENTS DURING EMERGENCY REMOTE LEARNING DUE TO COVID-19  
Maegan McGriff, Spring Valley High School
- 11:15 AM THE RELATIONSHIP BETWEEN RIGHT WING AUTHORITARIANISM, SOCIAL DOMINANCE ORIENTATION, AND PERCEPTION OF QUEER INEQUALITY IN THE UNITED STATES  
Amelia Wuori, Spring Valley High School

## **CONSUMER SCIENCE / NON-MENTORED**

**9:00 AM – 12:15 PM**

**Humanities & Social Sciences Building, Room 103**

- 9:00 AM THE DEVELOPMENT OF AN ACUPRESSURE WATCH BAND TO TREAT ANXIETY  
Isabella Mathis, Center for Advanced Technical Studies
- 9:15 AM USING SOLAR PHOTOVOLTAIC ENERGY TO POWER A PORTABLE BLUETOOTH SPEAKER  
DEVICE  
Jackson Massalon, Center for Advanced Technical Studies
- 9:30 AM ELECTRICITY-GENERATING FITNESS WEIGHT SET  
Jeremy Pieters, Center for Advanced Technical Studies
- 9:45 AM ENERGY VAMPIRES: HOW TO ELIMINATE THEM AND BECOME ENERGY EFFICIENT  
Jayden Harris, Center for Advanced Technical Studies
- 10:00 AM FEELS LIKE PLASTIC, LOOKS LIKE PLASTIC, BUT IS IT BETTER THAN PLASTIC?  
Geraldo Gambaloza, Center for Advanced Technical Studies
- 10:15 AM POWERING MOBILE PHONES WITH A SKATEBOARD  
Steven Jackson, Center for Advanced Technical Studies
- 10:45 AM THE BIOMETRIC BOLTER: A FINGERPRINT PROTECTED PILL BOTTLE  
Chloe Breedlove, Center for Advanced Technical Studies
- 11:00 AM USING PIEZOELECTRIC PLATES IN SHOES  
Sullivan Funk, Center for Advanced Technical Studies
- 11:15 AM EFFECT OF COVID-19 ON SMALL BUSINESSES IN CHAPIN SOUTH CAROLINA  
Thomas Holstein, Chapin High School
- 11:30 AM THE EFFECT OF FACE MASK ORIENTATION ON PARTICLE FILTRATION  
Abbey Lee, Spring Valley High School
- 11:45 AM THE EFFECT OF PRIOR KNOWLEDGE ON HIGH SCHOOL STUDENTS' PERCEPTION AND  
ACCEPTANCE OF ARTIFICIAL INTELLIGENCE  
Robert McGriff, Spring Valley High School
- 12:00 PM THE EFFECT OF THE LEACHATE FROM FEMININE HYGIENE PRODUCTS ON THE SURVIVAL OF  
*DAPHNIA MAGNA*  
Harsha Avula, Spring Valley High School

### **ZOOLOGY / MENTORED**

**9:30 AM – 10:15 AM**

**Humanities & Social Sciences Building, Room 107**

- 9:30 AM EFFECTS OF MICROPLASTICS ON CORAL BLEACHING  
Sathvik Bodepudi and Haya Kidwai, South Carolina Governor's School for Science and Mathematics
- 9:45 AM EFFECT OF UV LIGHT ON ZEBRAFISH EMBRYONIC DEVELOPMENT  
Mustafa Azhar, CrossRoads Intermediate School
- 10:00 AM SPERM PRECEDENCE IN GENETICALLY DIFFERENTIATED POPULATIONS OF *DROSOPHILA MELANOGASTER*  
Isabelle Hipple, South Carolina Governor's School for Science and Mathematics
- 10:15 AM PREDICTING HARMFUL ALGAL BLOOMS WITH WATER QUALITY PARAMETERS  
Alyssa Gillam and William Ostergaard,  
South Carolina Governor's School for Science and Mathematics

### **ZOOLOGY & BOTANY / NON-MENTORED**

**10:45 AM – 12:15 PM**

**Humanities & Social Sciences Building, Room 107**

- 10:45 AM THE EFFECT OF CANNABIDOIL AND CAFFEINE ON THE HEART RATE OF *DAPHNIA MAGNA*  
Chandler Lawton, Spring Valley High School
- 11:00 AM THE EFFECTIVENESS OF LITHIUM CHLORIDE IN ELICITING A TASTE AVERSION RESPONSE IN *BLAPTICA DUBIA*  
Ava Phelps, Spring Valley High School
- 11:15 AM TWO-DIMENSIONAL NONLINEAR CATEGORIZATION BY *CAENORHABDITIS ELEGANS*  
Parth Desai, Spring Valley High School
- 11:30 AM CO-APPLICATION OF BIOCHAR AND UREA ON THE NITROGEN UPTAKE OF *BRASSICA RAPA*  
Nidhi Guntupalli, Spring Valley High School
- 11:45 AM THE EFFECT OF FACEMASK LEACHATE ON THE GROWTH OF *PHASEOLUS VULGARIS*  
Jiya Anand, Spring Valley High School
- 12:00 PM THE EFFECT OF ROOT TEMPERATURE ON THE ROOT LENGTH OF AEROPONICALLY GROWN MUSCARI  
Charlton Hill, Spring Valley High School

## **ENGINEERING I / NON-MENTORED**

**9:00 AM – 12:00 PM**

**Humanities & Social Sciences Building, Room 109**

- 9:00 AM FURTHER DEVELOPING A MERGED ASPIRATION THROMBECTOMY DEVICE AND ROTATIONAL ATHERECTOMY DEVICE FOR EFFICACIOUS INDIVIDUAL OR JOINT REMOVAL OF THROMBI AND PLAQUE  
Shyam Ganesh Babu, Spring Valley High School
- 9:15 AM THE EFFECT OF ARTIFICIAL SUBSTANCES ON THE INCREASING SPIN RATE IN MAJOR LEAGUE BASEBALL  
Robert Swick, Spring Valley High School
- 9:30 AM THE EFFECT OF A PNEUMATIC CYLINDER-BASED SOLAR TRACKING SYSTEM ON THE ELECTRICITY PRODUCTION OF A PHOTOVOLTAIC PANEL  
Shrihan Ganesh Babu, Spring Valley High School
- 9:45 AM MOVE-A-SHELF  
Nathan Sellers and Phillip Chapman, Center for Advanced Technical Studies
- 10:00 AM SEEING THE BIGGER PICTURE: DEVELOPING VISION FIELD EXPANDING GLASSES FOR RETINITIS PIGMENTOSA PATIENTS  
Isabelle Field, Center for Advanced Technical Studies
- 10:15 AM THE DANGEROUS ROOF  
Holden Tutich and Seth Trocheset, Center for Advanced Technical Studies
- 10:45 AM USING SOLAR PHOTOVOLTAIC POWER FOR REMOTE VEHICLES  
Parker Olson, Center for Advanced Technical Studies
- 11:00 AM WHEELS OF FORTUNE  
Aiden Warren, Mia Loudon, and Tristen Singletary, Center for Advanced Technical Studies
- 11:15 AM THE DEVELOPMENT OF A NEW VENTRICULOPERITONEAL SHUNT  
Berkeley Crosby, Center for Advanced Technical Studies
- 11:30 AM CREATING A NEW SYNTHETIC CARILAGE FOR OSTEOARTHRITIS  
Maggie Corley, Center for Advanced Technical Studies
- 11:45 AM IMPROVEMENT OF THE SNACKEES TRAVEL SNACK AND DRINK CUP  
Katelyn Able, Center for Advanced Technical Studies

## **ENGINEERING II / NON-MENTORED**

**9:00 AM – 12:00 PM**

**Humanities & Social Sciences Building, Room 111**

- 9:00 AM    A WAY TO HAVE A SWEET NIGHT: AN INVENTIVE PILLOW THAT'LL HELP YOU SLEEP  
Carolina Ottich, Center for Advanced Technical Studies
- 9:15 AM    DON'T CRY, PHOTOSYNTHESIZE ; USE A SOLAR POWERED KNEE BRACE  
Lydia Brown, Center for Advanced Technical Studies
- 9:30 AM    INVESTIGATION INTO ENERGY STORAGE FROM EXCESS RENEWABLE RESOURCES  
PJ Comose, Center for Advanced Technical Studies
- 9:45 AM    SAFE STOVE  
William Edwards, Marcellus Lewis, and Walker Bolin, Center for Advanced Technical Studies
- 10:00 AM    STRONG ARM: FISHING DEVICE FOR PEOPLE WITH LOW TO MODERATE STRENGTH DEFICITS  
Timotheo Delarosa, Center for Advanced Technical Studies
- 10:15 AM    THE LACI BRACE: A MORE COMFORTABLE AND AFFORDABLE BRACE FOR CHILDREN WITH  
WALKING DISABILITIES  
Zanaia Washington, Center for Advanced Technical Studies
- 10:45 AM    WHAT THE DOG DOIN'  
Christopher Blake and Nicholas Brewer, Center for Advanced Technical Studies
- 11:00 AM    WHERE'S MY REMOTE?  
Daniel LeGrand and Thomas Moore, Center for Advanced Technical Studies
- 11:15 AM    THE DESIGN AND COMPARISON OF VOLTAGE PRODUCTION IN NOVEL TRIBOELECTRIC  
NANOGENERATORS  
Joseph Ravindran, Spring Valley High School
- 11:30 AM    THE EFFECT OF FRISBEE GLOVE MATERIAL ON IMPACT REDUCTION IN ULTIMATE FRISBEE  
Carson Aycock, Spring Valley High School
- 11:45 AM    A COMPARISON OF ROBOTIC HAND THUMB DESIGNS  
Ryon Miro, Spring Valley High School



### **ENGINEERING III / MENTORED**

**9:30 AM – 10:30 AM**

**Humanities & Social Sciences Building, Room 113**

- 9:30 AM DEVELOPMENT OF HYDROXYPROPYL CELLULOSE AND POLYDIMETHYLSILOXANE PRESSURE SENSORS  
Anna Gray Ashton and Eva Godwin,  
South Carolina Governor's School for Science and Mathematics
- 9:45 AM COMPUTATIONAL MODELING OF GRAPHENE GRAIN BOUNDARIES  
Tobyn Thibodeau, South Carolina Governor's School for Science and Mathematics
- 10:00 AM AUTONOMOUS UNDERWATER VEHICLE IMAGE PROCESSING AND CONTROL  
Jasmine Hagerty, South Carolina Governor's School for Science and Mathematics
- 10:15 AM THE PRODUCTION CYCLE OF KETAMINE HYDROCHLORIDE INJECTION IN A PHARMACEUTICALS CORPORATION: FROM RAW MATERIAL TO COMMERCIAL PRODUCT WITH A FOCUS ON CHEMICAL LABORATORY PROCESSES  
Ria Kapoor and Yashvi Patel, South Carolina Governor's School for Science and Mathematics

### **ENGINEERING IV / NON-MENTORED**

**10:45 AM – 12:30 PM**

**Humanities & Social Sciences Building, Room 113**

- 10:45 AM CLOUD STAPS: DEVELOPMENT OF A BACKPACK TO SOLVE BACK PAIN  
Tishyra Johnson, Center for Advanced Technical Studies
- 11:00 AM IMPROVEMENT OF SHIN SPLINT COMPRESSION SLEEVE  
Maureen Ortiz, Center for Advanced Technical Studies
- 11:15 AM LAPTEG  
Jonathan Nance, Center for Advanced Technical Studies
- 11:30 AM SEASONAL KNEE SLEEVE: THERMOELECTRIC COOLER AND PHOTOVOLTAIC CELL ACTIVATING HOT AND COLD  
Leilani Ante, Center for Advanced Technical Studies
- 11:45 AM TEMPERATURE REGULATION IN HEAVY PERFORMANCE UNIFORMS  
Andrew Bedford and Kaden Van Leuven, Center for Advanced Technical Studies
- 12:00 PM THE WINDING INNOVATION: IMPORVING COMMERCIAL WIND TURBINES BY CHANNELING WIND  
Venture Klauk, Center for Advanced Technical Studies
- 12:15 PM WHAT'S THE DEAL WITH WATER  
Haley Hix, Ashley Cripps, and Matthew Doty, Center for Advanced Technical Studies

## **MICROBIOLOGY / NON-MENTORED**

**9:00 AM – 11:45 PM**

**Humanities & Social Sciences Building, Room 116**

- 9:00 AM A STUDY OF THE ANTI-BACTERIAL PROPERTIES OF 3D-PRINTED WATER FILTERS ON THE GROWTH OF E. COLI  
Ian Saracila, Spring Valley High School
- 9:15 AM DESIGNING A LITTER BOX THAT NEUTRALIZES TOXOPLASMA GONDII: A PARASITE THAT CAUSES TOXOPLASMOSIS IN HUMANS  
Doonya Khan, Center for Advanced Technical Studies
- 9:30 AM OBSERVING THE EFFECTS OF EPINEPHRINE AND CORTISOL ON DIGESTIVE HEALTH  
Zaire Prime, Center for Advanced Technical Studies
- 9:45 AM HOW JET DRYERS OR NOT DRYING HANDS IMPACT BACTERIA  
Ansley Othersen, Chapin High School
- 10:00 AM ABSORBABLE SUTURES THAT STERILIZE AND MITIGATE SURGICAL WOUNDS  
Marshall Marin-Dings, Center for Advanced Technical Studies
- 10:15 AM ASPERGILLUS NIGER GROWTH ON TYPES OF COMMON DRYWALL MATERIALS  
William Horman, Spring Valley High School
- 10:45 AM HOW DOES THE CONCENTRATION OF SUGAR AFFECT THE POWER OUTPUT OF A MICROBIAL FUEL CELL  
Jay Patel, Spring Valley High School
- 11:00 AM THE EFFECT OF HIGHLY CONCENTRATED CANNABIDIOL ON STAPHYLOCOCCUS EPIDERMIDIS  
Xavious Coyle-Vega, Spring Valley High School
- 11:15 AM THE EFFECT OF TURMERIC EXTRACT ON THE GROWTH OF ESCHERICHIA COLI B  
Neya Murugesan, Spring Valley High School
- 11:30 AM THE PHYTOREMEDIATION OF ESCHERICHIA COLI IN CONTAMINATED WATER BY *LEMNA MINOR*, *SALVINIA MINIMA*, AND *AZOLLA CAROLINIANA*  
Madison Han, Spring Valley High School

## **CHEMISTRY & BIOCHEMISTRY / NON-MENTORED**

**9:00 AM – 11:45 AM**

**Humanities & Social Sciences Building, Room 202**

- 9:00 AM ANALYZATION OF 3,4,5-TRIFLUOROPHENOL USING MICROWAVE SPECTROSCOPY  
Eva Godwin and Liana Brock, South Carolina Governor's School for Science and Mathematics
- 9:15 AM INFLUENCE OF SURFACE WATER DISPLACEMENT ON SOLVATION THERMODYNAMICS  
Mia Kim, South Carolina Governor's School for Science and Mathematics
- 9:30 AM NANOBIOHYBRIDS: COMBINING THE CATALYTIC ACTIVITY OF METALLIC NANOPARTICLES  
AND ALKALINE PHOSPHATASE  
Elise Lanahan, South Carolina Governor's School for Science and Mathematics
- 9:45 AM MEASURING THE MICROWAVE SPECTRUM OF 3,4-DIFLUOROPHENOL  
Nathaniel Bruss and Akhil Devarapali,  
South Carolina Governor's School for Science and Mathematics
- 10:00 AM MICROWAVE SPECTRUM OF 2,3,5,6 TETRAFLUOROPHENOL  
Brodee Clontz and Aidan Atance,  
South Carolina Governor's School for Science and Mathematics
- 10:15 AM DETERMINING THE SHAPE OF 2-FLUOROPHENYL ACETYLENE USING MICROWAVE  
SPECTROSCOPY  
Anna Gray Ashton and Daniela Cawley,  
South Carolina Governor's School for Science and Mathematics
- 11:00 AM THE PROPOSAL OF A DOPAMINE REUPTAKE INHIBITING TOXIN  
Moiria Fontenot, South Carolina Governor's School for Science and Mathematics
- 11:15 AM MODIFYING THE MOLECULAR STRUCTURE OF RITALIN TO EXTEND ITS DURATION OF ACTION  
Firdavs Nasriddinov and Avery Fields, South Carolina Governor's School for Science and  
Mathematics
- 11:30 AM OPTIMIZATION OF A COMPLEMENT COMPONENT 5 INHIBITOR WITH HYDROPHOBIC  
CLUSTER MODIFICATION  
Ella Alan, South Carolina Governor's School for Science and Mathematics

**PHYSIOLOGY, MICROBIOLOGY, CELL & MOLECULAR BIO. / MENTORED**

**9:00 AM – 12:15 PM**

**Humanities & Social Sciences Building, Room 203**

- 9:00 AM TRANSCRANIAL DIRECT CURRENT STIMULATION: PRE-CLINICAL  
Harmanpreet Pelia, Academic Magnet High School
- 9:15 AM CORRELATION AND INQUIRY BETWEEN CRITICALLY ILL CORONAVIRUS PATIENTS AND  
SECONDARY INFECTIONS  
Joshua Morton, Chapin High School
- 9:30 AM MOJOINT: A SOFTWARE FOR MOTION VISUALIZATION AND ANALYSIS  
Angela Mei, Academic Magnet High School
- 9:45 AM MODIFICATION OF LOVASTATIN TO EXPAND SELECTIVITY TO MMP-9 FOR THE TREATMENT  
OF FRAGILE X SYNDROME  
Mia Kim, South Carolina Governor's School for Science and Mathematics
- 10:00 AM GENOMIC AND ECOLOGICAL ANALYSIS OF BACTERIA IN AN OCEANIC OXYGEN MINIMUM  
ZONE AND THEIR ROLES IN NITROUS OXIDE PRODUCTION AND CONSUMPTION  
Olivia Delgado and Mason Nisbet,  
South Carolina Governor's School for Science and Mathematics
- 11:15 AM THE EFFECT OF MUTATIONS IN THE GENES OF DIACYLGLYCEROL KINASE THETA AND  
PHOSPHOLIPID PHOSPHATE 7 PROTEINS ON THE PROGRESSION OF PORT WINE STAIN  
Irairie Taine, Spring Valley High School
- 11:30 AM INVESTIGATING THE ROLE OF PLASTICITY RELATED GENE-2 IN CHICK RETINAL GROWTH  
CONE RESPONSE TO LYSOPHOSPHATIDIC ACID  
Makenzie Jones, South Carolina Governor's School for Science and Mathematics
- 11:45 AM PRODUCTION AND PURIFICATION OF LANTHIPEPTIDE NATURAL PRODUCTS  
Daniela Cawley and Scout Hamrick,  
South Carolina Governor's School for Science and Mathematics
- 12:00 PM CLONING AND EXPRESSION OF METALLOTHIONEIN GENES FROM *S. CEREVISIAE* AND *A.*  
*FUMIGATUS*  
Ella Alan and Dixie Collins, South Carolina Governor's School for Science and Mathematics

**PHYSIOLOGY & HEALTH / NON-MENTORED**

**9:00 AM – 12:00 PM**

**Humanities & Social Sciences Building, Room 205**

- 9:00 AM    *PRESENTATION WITHDRAWN*
- 9:15 AM    COLD SORE COVERAGE: HERP-BE-GONE  
Logan Hazel, Center for Advanced Technical Studies
- 9:30 AM    MUSCLE GROUP EXERCISE CODEX  
Alexander Taylor, Center for Advanced Technical Studies
- 9:45 AM    STDS: TEENAGE AWARENESS OF A STIGMATIZED DISEASE  
Nyaveia Creech, Center for Advanced Technical Studies
- 10:00 AM    ALLEVIATING SYMPTOMS OF DEPRESSION BY INCREASING LEVELS OF SEROTONIN  
Tomiah Berry, Center for Advanced Technical Studies
- 10:45 AM    THE EFFECT OF LENGTH OF MIXED SPORTS TRAINING AND LENGTH OF DANCE TRAINING ON  
PROPRIOCEPTIVE BALANCE ABILITY IN HEALTHY TEENS AND ADULTS  
Sara "Kate" Weiss, Spring Valley High School
- 11:00 AM    THE EFFECTS OF A TEAR GAS LAUNCHER ON THE LOWER ABDOMEN OF THE HUMAN BODY  
Eamon Wood, Spring Valley High School
- 11:15 AM    THE EFFECTS OF THE AMOUNT OF SHORT-TERM EXERCISE ON THE DIAPHRAGMATIC  
BREATHING RATE OVER WIND INSTRUMENTS.  
Lyn Yu, Spring Valley High School
- 11:30 AM    THE ROLE OF TIMING OF DIM ARTIFICIAL LIGHT AT NIGHT (DALAN) ON THE WEIGHT OF MUS  
MUSCULUS  
Stephanie Babinec, Spring Valley High School
- 11:45 AM    A COMPARISON OF GAMING PLATFORM EXERCISE VERSUS TRADITIONAL EXERCISE  
Logan Kelly, Spring Valley High School

**COMPUTER SCIENCE, CHEMISTRY, BIOCHEMISTRY, & PHYSICS / NON-MENTORED**

**9:00 AM – 12:15 PM**

**Humanities & Social Sciences Building, Room 206**

- 9:00 AM NO BLOOD NEEDED: NEW WAY TO DETECT IRON DEFICIENCY ANEMIA  
Cheyenne Daise, Center for Advanced Technical Studies
- 9:15 AM ADVANCING SUSTAINABLE ANTIFUNGAL COATINGS BY ECO-FRIENDLY CHEMICAL CURING  
OF NATURAL SEED OILS  
Cathy Tang, Spring Valley High School
- 9:30 AM EXPLORING THE EFFECTIVE SYNTHESIS OF SYNTHETIC POLYMER COMPOSITES THROUGH  
SOLUTION MIXING OF MULTI-WALLED CARBON NANOTUBES AND EPOXY HARDENER INTO  
THE POLYMER MATRIX  
Ryan Leadbitter, Spring Valley High School
- 9:45 AM AN APP TO ASSIST IN EATING DISORDER RECOVERY- REWIRING YOUR BRAIN  
Lillian Jenkins, Center for Advanced Technical Studies
- 10:00 AM DEVELOPMENT OF CARDIOVASCULAR PLAQUE BLASTER  
Asah Jenkins, Center for Advanced Technical Studies
- 10:15 AM A STUDY ON THE SECURITY OF DATA TRANSMISSION OF HOUSEHOLD INTERNET-BASED  
DEVICES  
Siddharth Thumsi, Spring Valley High School
- 10:45 AM DESIGN OF A PROGRAM FOR AUTOMATIC DETECTION OF STROKE-INDUCED APHASIA  
Satvik Nelakuditi, Spring Valley High School
- 11:00 AM EVALUATION OF WEB ACCESSIBILITY OF HEALTHCARE INFORMATION SITES  
Sandra Thomas, Spring Valley High School
- 11:15 AM THE COMPARISON OF DATABASE MANAGEMENT SYSTEMS ON THE SPEED OF ANALYSIS BY  
ARTIFICIAL INTELLIGENCE  
Kavin Saravanan, Spring Valley High School
- 11:30 AM DATA-DRIVEN APPROACHES TO GRAVITATIONAL WAVE POLARIZATIONS OF COLLIDING BLUE  
STRAGGLERS  
Mritika Senthil, South Carolina Governor's School for Science and Mathematics
- 11:45 AM A COMPARISON OF THE TRACTION GENERATED BY DIFFERENT TRACK SPIKE MODELS  
Andrew May, Spring Valley High School
- 12:00 PM THE EFFECT OF A LATEX, SYNTHETIC, AND MONDO TRACK ON THE ACCELERATION OF A  
RUNNING SHOE ON THE TRACK  
Brantley Aycock, Spring Valley High School

### **COMPUTER SCIENCE, PHYSICS, & MATH / MENTORED**

**9:30 AM – 11:45 AM**

**Humanities & Social Sciences Building, Room 209**

- 9:30 AM RESBENCH: AN ANALYSIS OF DEEP LEARNING FRAMEWORKS FOR IMAGE CLASSIFICATION  
Sanjeev Chauhan and Benjamin Chauhan,  
South Carolina Governor's School for Science and Mathematics
- 9:45 AM IMPROVING THE EFFICIENCY OF BACKPROJECTION AND VEHICLE DETECTION IN SYNTHETIC  
APERTURE RADAR IMAGES  
Firdavs Nasriddinov, South Carolina Governor's School for Science and Mathematics
- 10:00 AM TUMOR CELL DETECTION IN SINGLE-CELL DNA SEQUENCING DATA  
Toluwanimi Ariyo, Ridge View High School
- 10:15 AM SYNCHRONIZATION OF SWARM ROBOTS USING PULSE COUPLED OSCILLATORS  
CAMILLE DAY AND JAMES WHITE,  
South Carolina Governor's School for Science and Mathematics
- 10:30 AM: *BREAK*
- 10:45 AM DETERMINATION OF THE THERMOELECTRIC FIGURE OF MERIT THROUGH THE MAXIMUM  
TEMPERATURE DEPRESSION USING THE PELTIER COOLING EFFECT  
Isabel Rancu, South Carolina Governor's School for Science and Mathematics
- 11:00 AM ULTRA-SMALL TO ULTRA-LARGE SCALES  
Aidan Driscoll, South Carolina Governor's School for Science and Mathematics
- 11:15 AM USING MULTIPHASE SIMULATIONS TO DETERMINE THE NATURE OF SELF CLEANING  
SURFACES  
John Brent, South Carolina Governor's School for Science and Mathematics
- 11:30 AM FORMALIZING CONWAY'S LITTLE THEOREM IN LEAN  
Adam Clements, Christian Long, and Case Morton-Lill,  
South Carolina Governor's School for Science and Mathematics

### **PSYCHOLOGY & SOCIOLOGY / MENTORED**

**10:15 AM – 12:15 PM**

**Humanities & Social Sciences Building, Room 210**

- 10:45 AM CREATING AND VALIDATING STIMULI TO STUDY MISOPHONIA  
Liana Brock and Natalie Peart,  
South Carolina Governor's School for Science and Mathematics
- 11:15 AM YOUTH, GENDER, AND PUBLIC LEISURE SPACES  
Ace Kelly, South Carolina Governor's School for Science and Mathematics

- 11:30 AM    **BUTTONS, BOTTLES, AND BOWLS: A LOOK INSIDE POSTBELLUM LIFE ON HUME PLANTATION**  
Rachel Dozier and Hannah Dozier,  
South Carolina Governor's School for Science and Mathematics
- 11:45 AM    **METEORS, MEGACORPERATIONS, AND MURDER**  
Stephen Galaida, Harrison Walker, and Nathan Stolzenfeld,  
South Carolina Governor's School for Science and Mathematics
- 12:00 PM    **THE IMPACT OF A UNIVERSITY'S PRESENCE ON NEIGHBORHOOD WALKABILITY**  
Moiria Fontenot, South Carolina Governor's School for Science and Mathematics

**ENVIRONMENTAL SCIENCE I / NON-MENTORED**

**9:00 AM – 12:15 PM**

**Humanities & Social Sciences Building, Room 214**

- 9:00 AM    **REDUCTION OF CARBON EMISSIONS FROM CONVENTIONAL OVENS/GRILLS UTILIZING PYROLYSIS**  
Silas Campanella, Center for Advanced Technical Studies
- 9:15 AM    **DEVELOPING A HYBRID RENEWABLE GEOTHERMAL HEATING AND COOLING HOME SYSTEM**  
Caleb Clark, Center for Advanced Technical Studies
- 9:30 AM    **DOES WAVELENGTH AFFECT SOLAR PHOTOVOLTAIC EFFICIENCY?**  
Branner Umberger, Center for Advanced Technical Studies
- 9:45 AM    **OPTIMIZING SOLAR PHOTOVOLTAIC ELECTRICITY**  
Daisy Walsh, Center for Advanced Technical Studies
- 10:00 AM    **GROWING HYDROPONIC PLANTS UTILIZING BRINE FROM DESALINATION**  
Hope Blackmon, Center for Advanced Technical Studies
- 10:15 AM    **A COMPARISON OF CITY AND WELL WATER QUALITY IN CHAPIN, SOUTH CAROLINA**  
William Ward, Chapin High School
- 10:45 AM    **THE EFFECT CLIMATE CHANGE TEMPERATURES HAVE ON DENDRODRILUS RUBIDUS**  
James Washington, Spring Valley High School
- 11:00 AM    **THE EFFECT OF ELODEA CANADENSIS ON FLUORIDE LEVELS IN DRINKING WATER**  
Everlast Chigoba, Spring Valley High School
- 11:15 AM    **THE EFFECT OF MAGNESIUM CITRATE ON THE REPRODUCTION RATE OF DAPHNIA MAGNA**  
Nadira McFadden, Spring Valley High School
- 11:30 AM    **THE EFFECT OF POTASSIUM CHLORIDE ON AMMONIA PRODUCTION OF RHODOSPIRILLUM RUBRUM**  
Sahil Agarwal, Spring Valley High School



- 11:45 AM THE EFFECT OF SPIRULINA MAJOR AND OSCILLATORIA ON REDUCING THE ACIDITY OF FRESHWATER CONTAINING ANTIBACTERIAL LIQUID AND BAR SOAPS  
Kartik Valluri, Spring Valley High School
- 12:00 PM THE INDIVIDUAL AND COMBINED EFFECTS OF MICROPLASTICS AND ACETAMINOPHEN ON THE HEART RATE AND SURVIVAL OF DAPHNIA MAGNA  
Lily Zhang, Spring Valley High School

### **ENVIRONMENTAL SCIENCE II / NON-MENTORED**

**9:00 AM – 12:15 PM**

**Humanities & Social Sciences Building, Room 215**

- 9:00 AM A KID FRIENDLY SOLUTION FOR CHILDREN AND ADULTS WITH RESPIRATORY RISKS IN SCHOOLS  
Cainan Rebmann, Center for Advanced Technical Studies
- 9:15 AM DOES WATER QUALITY IN SOUTH CAROLINA HIGH SCHOOLS PASS EPA STANDARDS?  
William Davidson, Center for Advanced Technical Studies
- 9:30 AM ECOFRIENDLY SOAP USING GLYCERIN  
Cali Mckelvey, Center for Advanced Technical Studies
- 9:45 AM REDUCING WASTED FOOD THROUGH IMPROVING COMPOSTING TECHNIQUES  
J'Den O'Neal, Center for Advanced Technical Studies
- 10:00 AM USING PORTABLE WATER TURBINES TO GENERATE ELECTRICITY FROM RIVERS AND STREAMS TO POWER SMALL ELECTRONICS  
Ganis Griffin, Center for Advanced Technical Studies
- 10:15 AM THE EFFECTS OF LIGHT POLLUTION ON THE NESTING BEHAVIORS OF TURTLES  
Carlynn Rychener, Chapin High School
- 10:45 AM THE EFFECT OF A MIXTURE OF MAGNESIUM OXIDE AND TITANIUM DIOXIDE NANOPARTICLES ON SOIL HEALTH AND THE GROWTH OF VIGNA RADIATA  
Shashwat Yadav, Spring Valley High School
- 11:00 AM THE EFFECT OF LOW SALINITY LEVELS ON THE HATCHING OF ARTEMIA SALINA AND ARTEMIA FRANCISCANA  
Lillian Amick, Spring Valley High School
- 11:15 AM THE EFFECT OF NYQUIL ON THE RATE OF PHOTOSYNTHESIS OF ELODEA CANADENSIS  
Hunar Gill, Spring Valley High School
- 11:30 AM THE EFFECT OF RESVERATROL ON THE BIOLUMINESCENCE OF PYROCYSTIS FUSIFORMIS AND PYROCYSTIS LUNULA  
Shivani Patel, Spring Valley High School

11:45 AM THE EFFECTS OF RICE BRAN OIL AS A REPELLENT FOR MOSQUITOES COMPARED TO  
MINERAL OIL AND EFFECTIVE NATURAL REPELLENTS  
Aleena Chattha, Spring Valley High School

12:00 PM THE PRESENCE OF SULFATES IN SHAMPOOS ON THE FROND GROWTH OF LEMNA MINOR  
Gowri Sunilkumar, Spring Valley High School

**END**  
**SCJAS SESSION LISTING**

## SCJAS ABSTRACTS

(Listed alphabetically by first author's last name)

### IMPROVEMENT OF THE SNACKEES TRAVEL SNACK AND DRINK CUP

Katelyn Able

Center for Advanced Technical Studies

A new and improved travel snack and drink cup for toddlers. This cup benefited both children and parents featuring a twistable auto-sealed lid. wanted to design a cup for toddlers can enjoy their snacks and drink in one cup and parents can feel comfortable giving their child a sippy cup. While doing her research she discovered that traditional sippy cups for toddlers promote tooth decay because most toddlers drink sugary juices throughout the day and the sugar can cling to their teeth causing tooth decay. Her hypothesis stated, If traditional sippy cups promote tooth decay in toddlers, then why do parents still give sippy cups to their children. eliminated this problem through the design of her lid. used a 3-D print machine where her 3rd prototype was made. reached goals of a designed cup eliminated tooth decay through sippy cups while maintaining a sleek and light design. Overall, her cup was a success in decreasing tooth decay in toddlers while having a snack and drinkable cup for toddlers.

### THE EFFECT OF POTASSIUM CHLORIDE ON AMMONIA PRODUCTION OF *RHODOSPIRILLUM RUBRUM*

Sahil Agarwal

Spring Valley High School

With the increasing problem of saline soil infertility, the availability of nitrogen found in this infertile soil has become a heavily researched topic. Nitrogen fixing properties are found in a wide range of bacteria. The purpose of this experiment was to evaluate whether the bacteria *Rhodospirillum rubrum* is an effective bacterium for aiding plants in extreme saline conditions. The hypothesis was stated that if the potassium chloride concentration was increased, then the *Rhodospirillum rubrum*'s nitrogenase properties would produce less ammonia because of similar inhibition properties found in other nitrogenase bacteria in the family. Three 500 ml sterile nutrient broths were prepared. 20 ml of broth was placed in 30 test tubes for the control group. In the high saline mixture, 7.2 grams of potassium chloride was added to the 600 ml of nutrient broth preceding the transfer of broth to the test tubes. The *Rhodospirillum rubrum* was then placed into the vials and was cultivated for 5 days. It was found that data was inconclusive and that no difference between each variable could be determined. It was however concluded that in both experimental and control groups >500 ppm of ammonia was found in a test tube filled with 20 ml of broth.

### CLONING AND EXPRESSION OF METALLOTHIONEIN GENES FROM *SACCHAROMYCES CEREVISIAE* AND *ASPERGILLUS FUMIGATUS*

Ella Alan and Dixie Collins

South Carolina Governor's School for Science and Mathematics

Transition metals, such as copper, are key components of biological systems. Because of their special properties, they are required for the function of proteins that perform essential cellular processes. However, having excess metals in the cell can also be toxic to cell growth. Metallothioneins (MT) are proteins that can help relieve this toxicity by binding to excess metals in the cell. The metallothioneins being studied are copper metallothioneins: Cup1 and Crs5 from *Saccharomyces cerevisiae*, and CmtA from *Aspergillus fumigatus*. The genes for these proteins are expressed only when their promoters are activated. To study the impact of high gene expression on cell survival, the constitutive TEF1 promoter is

used. The TEF1 promoter can be used to constantly overexpress the genes that correlate to metallothionein production. The goal was to construct a plasmid that uses the TEF1 promoter to drive MT gene expression so that it can be used for future growth experiments. Plasmids with the MT genes, CUP1, CRS5, and CMTA, were created by genetic engineering including steps such as subcloning, polymerase chain reactions, the use of restriction enzyme digestion, and Gibson Assembly. The resulting plasmids included both the TEF1 promoter and a metallothionein gene to be studied. An ultimate goal that can be explored in further research is to determine how high expression of these MT proteins impacts cells survival under high and low Cu conditions, which might occur during infection.

#### OPTIMIZATION OF A COMPLEMENT COMPONENT 5 INHIBITOR WITH HYDROPHOBIC CLUSTER MODIFICATION

Ella Alan

South Carolina Governor's School for Science and Mathematics

The complement system is an important part of the immune system that functions to induce a series of inflammatory reactions to enhance the abilities of antibodies. The protein complement component 5 (C5) is a validated drug target within the complement pathway. The effects of dysregulation of the complement pathway contributes to the clinical symptoms of many conditions, including myasthenia gravis and endometriosis, and C5 inhibitors have proved effective in treating these effects. Currently, many inhibitors are large molecules intravenously administered; small molecule inhibitors are currently being developed. M. Zhang et. al. discovered that 1-phenyl-3-(1-phenylethyl) urea derivatives act as small molecule inhibitors of the complement system; this structure was further modified by K. Jendza et. al. Jendza et. al was also able to suggest the molecular mechanisms by which the compound inhibited C5. The molecule's lipophilic side chain rests within a hydrophobic pocket within C5; the researchers concluded that there exists a need for the lipophilic side chain to properly fill this space. The goal of this research was to extend this side chain and thus optimize how it fits within the hydrophobic pocket of C5. Three main modifications were made: extension of the terminal carbons with methyl groups, the use of fatty acid mimicking structures, and the addition of ringed structures. The computational software AutoDock VINA was used to compare binding affinities between different iterations of the drug; it was found that the addition of ringed extensions gave the best binding affinities.

#### THE EFFECT OF LOW SALINITY LEVELS ON THE HATCHING OF *ARTEMIA SALINA* AND *ARTEMIA FRANCISCANA*

Lillian Amick

Spring Valley High School

*Artemia* serve many purposes within hypersaline environments in which they are found; therefore, it is important to understand their susceptibility to environmental factors. Global warming is an increasingly large issue affecting sea levels, temperatures, and salt concentrations in aquatic environments. The purpose of this experiment was to determine whether *Artemia salina* or *Artemia franciscana* hatch more readily in water with lower salinities. It was hypothesized *salina* would have a lower number of nauplii in low salinity environments compared to *franciscana*, and that both species would fare better in water with a salinity of 30 ppt compared to water at 10 ppt due to regional differences. *Artemia* cysts were placed in containers with salinities at 30 or 10 ppt. After 24 hours, representative samples from each container were placed under a microscope and the number of nauplii counted. Four individual t-tests were performed to evaluate the relationship between *Artemia* species and salinity level. It was found *Artemia salina* in 10/30 ppt and both species hatched in 30 ppt had statistically similar hatch rates, ( $t(30) = -1.10$ ,  $p > 0.05$ ,  $t(30) = 0.19$ ,  $p > 0.05$ ) and the null hypothesis failed to be rejected. Additionally, *franciscana* in 10/30 ppt and both species in 10 ppt had statistically different hatch rates, ( $t(30) = -5.66$ ,  $p < 0.05$ ,  $t(30) = 7.45$ ,

$p < 0.05$ ), and the null hypothesis was rejected. *Artemia salina* hatched more readily at 10 ppt, and both species had higher hatch rates at 30 ppt.

#### THE EFFECT OF FACEMASK LEACHATE ON THE GROWTH OF *PHASEOLUS VULGARIS*

Jiya Anand  
Spring Valley High School

The purpose of this study was to measure the effect of leachate extracted from different facemasks on the growth of *Phaseolus vulgaris* (common bean) plants. Due to the COVID-19 Pandemic, an increase in facemask usage is causing an increase in pollution due to masks. There is a lack of study on how the chemicals found in leachate from masks will impact the environment. It was hypothesized that masks would hinder the growth of the bean plants. It was also predicted that the facemasks with dyes would impact plant growth greater than the facemasks without dyes due to the heavy metal content in many reactive dyes. 112 bean plants were split into four groups, no-mask, disposable mask, cloth mask and n-95 mask. They were split into groups of no-mask, disposable mask, cloth mask, and n-95 mask. The plants were grown for nine days and plant height was recorded. A One-Way ANOVA and a Tukey test were run to check for correlation between the facemask leachates and plant height. The data collected is not statistically significant enough to support this hypothesis.

#### SEASONAL KNEE SLEEVE: THERMOELECTRIC COOLER AND PHOTOVOLTAIC CELL ACTIVATING HOT AND COLD

Leilani Ante  
Center for Advanced Technical Studies

Different groups of people such as first responders, construction workers, and other citizens experience pain in their knees every year. With researching and observing if a thermoelectric cooler and a photovoltaic cell will activate hot and cold, it is important to recognize how these inventions that relate to climates can be used. The innovation that will be created is known as a seasonal knee sleeve that will contain both of these temperatures. With research and observation, there is a realization of how a seasonal knee sleeve can have value and have the capability to change people's lives. The impact and importance include decreasing pain in the knees, soreness during seasonal changes, and inflammation by thermotherapy and cryotherapy. Although these therapy methods reduce the pain they also enhance emotional changes such as relaxation and comfortability. The problem develops by having a desire to research a way to involve electricity and an environmental resource to activate the power that will be used for others' benefits. By constructing a seasonal knee sleeve the engineering goals involve getting the right fabric that is stretchy and fire-retardant, using a multimeter to measure the voltage of the photovoltaic cell, and using an ohmmeter to measure electrical resistance.

The expectations should be of the photovoltaic cell being able to successfully take in sunlight and send off power to the conductive wires to create electricity at an appropriate temperature and meeting the expectation that the thermoelectric cooler is able to conduct electricity and successfully create a cooler temperature.

#### TUMOR CELL DETECTION IN SINGLE-CELL DNA SEQUENCING DATA

Toluwanimi Ariyo  
Ridge View High School

Single-cell DNA sequencing (scDNA-seq) helps researchers study the evolutionary process of cancer. It is a process used to examine individual cells, describe intra-tumor heterogeneity, and reconstruct the

evolutionary history of a tumor. Coverage is the number of reads at a given position in the genome. The depth of high-coverage scDNA-seq allows for analysis of point mutations while it is difficult to make these inferences within ultra-low coverage scDNA-seq. However, due to the uniformity of coverage, ultra-low coverage scDNA-seq is ideal for copy number calling [6]. This study aims to develop a computational method, utilizing features computed from ultra-low coverage scDNA-seq, to detect tumor cells and assist in future efforts of identifying technical errors. Data was pre-processed using Principal Component Analysis (PCA). A machine learning algorithm was implemented to detect tumor cells in this latent, dimensionally reduced space for two patients (patients S0 and S1) with breast cancer sequenced using 10x genomics. The training set (patient S0) had an accuracy of 98% for tumor cell detection. The testing set (patient S1) had an accuracy of 99% for tumor cell detection. This demonstrates that these features are useful for accurately detecting tumor cells in ultra-low coverage scDNA-seq data. Spatial heterogeneity of tumor clones was observed, revealing correlations with cell type and sections. Doublet analysis revealed doublets concentrated between clusters, providing evidence that this feature may be useful for future detection of technical errors. Future studies will focus on improving the computational method for doublet detection and optimization of the tumor cell detection algorithm.

#### DEVELOPMENT OF HYDROXYPROPYL CELLULOSE AND POLYDIMETHYLSILOXANE PRESSURE SENSORS

Anna Gray Ashton and Eva Godwin

South Carolina Governor's School for Science and Mathematics

Hydroxypropyl cellulose (HPC) is a derivative of cellulose which, when mixed with water, will enter a liquid crystalline state. Liquid crystals (LCs) are materials with both conventional liquid and solid crystal behaviors. HPC in its LC state is responsive to pressure due to its helical structure. When the helix is compressed, the HPC will reflect shorter wavelengths of light, causing a blue-shift. The concentration of HPC and water must be in a specific range in order to exhibit this property, so when water evaporates, HPC becomes colorless. By encapsulating our HPC-water mixture inside a PDMS silicone film, we were able to prevent the water from evaporating and designed a functional pressure sensor. Further research with these sensors would likely include determining which wavelengths of light correspond with different amounts of pressure. Once that is determined, these sensors can be used for industrial and biomedical applications in the place of more expensive pressure sensing devices.

#### DETERMINING THE SHAPE OF 2-FLUOROPHENYL ACETYLENE USING MICROWAVE SPECTROSCOPY

Anna Gray Ashton and Daniela Cawley

South Carolina Governor's School for Science and Mathematics

Microwave spectroscopy is a tool used to analyze the rotational spectra of chemicals to determine the shape of a molecule. This is useful because a molecule's shape determines its function. We measured the microwave spectrum of 2-Fluorophenyl Acetylene (2FPA) using a chirped-pulse Fourier transform microwave spectrometer. We sprayed 2FPA into the spectrometer which measured the rotational frequencies using microwaves with a frequency range of 8,000-18,000 MHz and averaged the data 10,000 times. We also used Gaussian 03W software to predict the rotation constants and the distortion constants of 2FPA. We used the SPCAT/SPFIT software programs to compare the patterns of the spectra from the Gaussian prediction and the data gathered using the spectrometer. We assigned 76 lines in the spectra and determined the rotational constants to be the following:  $A=2949.419100(92)$  MHz,  $B=1495.780700(63)$  MHz,  $C=992.230260(36)$  MHz and the distortion constants to be the following:  $DJ=0.00003700(72)$  MHz,  $DeJK=0.0005440(26)$  MHz,  $DK=0.0004070(50)$  MHz,  $dj=0.00001130(36)$  MHz,  $dk=0.0003160(39)$  MHz. From these constants we can determine the shape of the molecule.

## STUDENT COMFORT IN THE CLASSROOM AND ITS IMPAC

Carsin Aull  
Chapin High School

The research in the following paper has been conducted to study the effects of student-teacher relationships and its impact on students asking for help. This research was collected to gather a better understanding of why students may not ask for help. Data was collected through a survey given out to randomly selected students in a high school. All of the participants were from all grade levels from one school in a suburban culture. In this study a total of 62 students at the highschool of study from grades 9th to 12th participated in this study. The participants were given scores of 1-50 determining their relationship level with their teachers. That score was then compared to the students' answers of how often they ask for help from teachers. The data was put in a basic type of correlational method in order to determine the significance of this relationship. The analysis showed that there was not a significant correlation between the two variables. The R value found was .437 meaning the significance of this relationship is very weak. While conducting this research, there may be factors that have altered this result. The researchers' original hypothesis that better student-teacher relationships would lead to higher rates of students asking for help was proven to be incorrect. This suggests that student-teacher relationships have no impact on the students when it comes to reaching out for help. However, this study might influence further research into the impact of Covid-19 on student comfort inside of the classroom.

## THE EFFECT OF THE LEACHATE FROM FEMININE HYGIENE PRODUCTS ON THE SURVIVAL OF *DAPHNIA MAGNA*

Harsha Avula  
Spring Valley High School

The purpose of this experiment was to determine the effect of leachate from different brands of feminine hygiene products on the survival of *Daphnia magna*. The hypothesis was that if the brand of feminine hygiene product contains fragrance, then less *Daphnia magna* will survive than if exposed to fragrance-free brands of feminine hygiene leachate. The experiment used tampons of different brands: three scented and four unscented. The six brands used were Tampax Pearl (unscented and scented), Lola (unscented), Kortex (scented), Equate (unscented), O.B. (unscented), and Playtex Sport (scented). The leachate is created with three tampons from each brand and placed into a beaker with 250 milliliters of distilled water. The tampons were left in the solution for 24 hours. The study tested *D. magna* exposed to the different brands of leachate along with a control group of *Daphnia magna* exposed to no leachate. The results showed that the Tampax Pearl Scented had a higher number of deaths than the Tampax Pearl Unscented. The average mortality of the *Daphnia magna* exposed to the fragranced brands of leachate was higher than the *Daphnia magna* exposed to fragrance-free leachates. This study shows that the *D. magna* exposed to feminine hygiene products with fragrances had a higher number of deaths than those that were exposed to fragrance-free feminine hygiene products. The data collected was analyzed using a Chi Square Test of Independence. There was no statistical significance found  $\chi^2=2.95$ ,  $df=28$ ,  $p=1$  between the mortality/survival of the organisms.

## THE EFFECT OF A LATEX, SYNTHETIC, AND MONDO TRACK ON THE ACCELERATION OF A RUNNING SHOE ON THE TRACK

Brantley Aycock  
Spring Valley High School

Since the 1860s, athletes in the United States have been running on athletic tracks. Numerous advancements have been made to athletic tracks as a result of modern technology ("Tracks Through the

Years,” 2012). A well-designed running track is important to give athletes the best opportunity to perform well. The purpose of this study was to determine which track type, out of polyurethane, latex, and mondo, is the most effective for racing by finding the acceleration of a shoe pulled along the track. It was hypothesized that the mondo track would result in the greatest acceleration, and the latex track would result in the least acceleration because the mondo track has the greatest amount of grooves to create friction while the latex track has the least. To find the acceleration of the shoe, it was dragged at a constant rate along each track type while hooked to a Go Direct Force Sensor to find the force needed to start the shoe moving. This force value was then used to calculate the friction coefficient between the shoe and the track as well as the acceleration of the shoe. A One-way ANOVA test found that there was a significant difference between the acceleration with which the shoe moved on the track for each track type,  $F(2, 87)=211.41$   $p=0.00$ . It was additionally found that the average friction coefficient was greatest on the mondo track ( $\mu_s=0.668$ ) and smallest on the latex track ( $\mu_s=0.531$ ), supporting the hypothesis.

#### THE EFFECT OF FRISBEE GLOVE MATERIAL ON IMPACT REDUCTION IN ULTIMATE FRISBEE

Carson Aycock  
Spring Valley High School

The basis of the study was the issue of hand bruising in ultimate frisbee. Ultimate frisbee is a non-contact sport, but there is a great force applied on the hands when catching a disc that can lead to bruising, discomfort, and pain. The purpose of this study was to determine the most effective ultimate frisbee glove to prevent and lessen hand bruising when catching or blocking a disc. Possible solutions to this issue should be explored. The simplest way to study this was by determining which pair of ultimate frisbee gloves would be the best at lessening hand bruising. It was hypothesized that if frisbee glove materials were experimented on in a drop test, then the Friction Warm gloves would have the best force reduction qualities because of the extra inner fleece lining as well as having synthetic leather with a synthetic rubber compound to decrease impact force. In order to test the gloves, a rough estimate of frisbee throw velocity had to be determined using a camera and grid system. From there, a drop test was performed to determine which frisbee glove has the best impact force reduction qualities. It was found that the FD-SPORT gloves had the highest force reduction percentage of 15.7%. Although this was found, the results were not statistically significant between the means of the groups. Therefore, the null hypothesis failed to be rejected. The experiment did not provide sufficient evidence to conclude that frisbee gloves had a significant effect on impact force.

#### EFFECT OF TGFβ2 GENE DELETION ON THE RIGHT HEART CHAMBER

Aamina Azhar  
Dutch Fork High School

Congenital heart defects (CHD) are problems with the heart's structure that are present at birth. In more severe forms of CHDs, heart chambers may be poorly formed. CHDs are the most common cause of infant death due to birth defects. Most causes of CHDs are unknown. CHDs are related to known genetic conditions. For example, mutation in Transforming Growth Factor Beta-2 (TGFB2) gene is found in many babies born with a CHD. How the deletion of the Tgfb2 gene in the heart muscle affects the size of the heart chambers remains unknown. The purpose of my science project was to measure the size of heart chambers when the Tgfb2 gene is genetically mutated or deleted (i.e., knocked out) in mice. I used already cut thin (7  $\mu$ m) sections of the heart belonging to normal or wildtype (Tgfb2+/+) embryos and Tgfb2 knockout (Tgfb2-/-) embryos. Then I used microscope images from 3 mice from each group and a computer software (Zeiss AxioVision) to outline the right and left chambers, the right and left chamber wall thickness, and the right and left lumen (space filled with blood) to find out their areas. I averaged out all the numbers and it led me to a conclusion that when a Tgfb2 gene is knocked out the right heart



chamber becomes smaller. My future experiment is to make a 3D reconstruction of the heart using a computer software (AMIRA), so that I can measure the volume of each ventricle to further confirm my findings.

#### EFFECT OF UV LIGHT ON ZEBRAFISH EMBRYONIC DEVELOPMENT

Mustafa Azhar

CrossRoads Intermediate School

Zebrafish (*Danio rerio*) is a vertebrate fish that is used a lot in scientific research to study embryonic development and birth defects. They are that are easy to study because of their transparency and high development rate. The hypothesis of this project is that if I expose the zebrafish embryo to an abnormal amount of ultraviolet (UV) light, the embryonic development of zebrafish will be defective. The question is, "How will changing the exposure to UV light (manipulated variable) affect the development of the zebrafish embryos?" Different variables include the amount of UV light (independent variable), embryonic development (dependent variable), and water, methylene blue, *Danio rerio*, temperature, and tank environment (controlled variables). First, the zebrafish tank was set up. The zebrafish were bred, and their eggs were collected. Then the zebrafish embryos were exposed to UV light for different time intervals and their embryonic development was observed under the microscope. In all experiments, more than three embryos were used. The results showed that the increased UV exposure decreased the embryo survival rate. Embryos that were exposed to the UV light for a longer duration looked short, hunched, and they did not hatch. Finally, longer UV light exposure also resulted in an abnormal heart development. In conclusion, the UV light is harmful for embryonic development. In the future, I will study the effect of UV light on the zebrafish embryonic heart development and heart rate in the adult zebrafish.

#### THE ROLE OF TIMING OF DIM ARTIFICIAL LIGHT AT NIGHT (DALAN) ON THE WEIGHT OF *MUS MUSCULUS*

Stephanie Babinec

Spring Valley High School

Light pollution at night is a growing issue in many suburban and urban settings, commonly referred to as artificial light at night (ALAN). Many studies have been conducted as to how the intensity or wavelength of this lighting can disrupt the circadian rhythm but none have evaluated how the timing of this light could affect it. It is hypothesized that those that chronically experience dim artificial light at night (dALAN) after biological day will lead to a more pronounced disruption in the metabolic system and therefore will cause an increased level of weight gain. Mice were used as test subjects and were split into four groups: 1) 12 light, 12 dark (L:N); 2) 12 light, 4 dim, 8 off (L:D:N); 3) 12 light, 4 off, 4 dim, 4 off (L:N:D:N); and 4) 12 light, 8 off, 4 dim (L:N:D). The weight of these mice was tracked weekly to obtain the necessary data. These data were then analyzed for percent body weight increase and an ANOVA was run, obtaining a p-value of 0.000053. A Scheffe test was then run, finding a significant difference between L:N and L:D:N, L:N and L:N:D, and L:D:N and L:N:D:N. These results support that chronic dALAN exposure can lead to increased percent body weight changes. Future studies can further examine the possibilities as to why this is.

#### EATING DISORDERS IN HIGH SCHOOL EQUESTRIAN ATHLETES

Abby Bauknight

Chapin High School

In recent years, the prevalence of eating disorders among female athletes has significantly increased. This is evidenced by the National Eating Disorder Association's research where it was concluded that over one third of NCAA D1 female athletes have reported a negative relationship in regards to eating (NEDA, 2021). A gap in this research that can be filled is specifically focusing on a certain female dominated sport, such

as equestrian. There is a gap in similar research when it comes to the age group of athletes and there is a lack of research that predominantly focuses on high school equestrian athletes. This study was conducted by modifying the Eating Attitudes Test (EAT-26) and posting the test online for junior members of the equestrian community, who compete in either the equitation or the hunter divisions, to complete. It was hypothesized that if riders compete in the equitation then they will have a higher score on the EAT-26 test than riders that compete in the hunters due to the different judging standards of each division. The results were analyzed comparing scores of equitation riders (judged on rider) and hunter riders (judged on horse) with a two sample t-test. The results of the two sample t-test yielded a p-value of 0.000 which suggests that the conclusions of the hypothesis were highly significant. A further gap that could be addressed with future research could be comparing junior equitation riders to adult equitation riders.

#### TEMPERATURE REGULATION IN HEAVY PERFORMANCE UNIFORMS

Andrew Bedford and Kaden Van Leuven  
Center for Advanced Technical Studies

Every year (especially during the summer months), performing in a heavy uniform such as a mascot suit poses a significant health risk to the wearer, which includes heat exhaustion and heatstroke. There indeed have been cases of death under harsh circumstances. Creating an efficient way to keep the wearer cool during their time in the suit is imperative to their safety and well-being. We are going to design a device that will cool down the wearer of such a uniform. The device will consist of a silicone-copper tubing system with a heat exchanging system to remove heat energy from the circulated water. The heat exchanging system will consist of a section of copper tubing submerged in a separate ice water bank. When the water in the tubes is circulated by a small water pump, heat energy will be transferred from the circulated water to the ice water bank via the copper tubing. The water will then return to the silicon tubing which will be in contact with the wearer's skin. This system will all be confined to a small bag that can be worn on a person's back.

#### THE APPLICATION OF THE EYEWITNESS POST-IDENTIFICATION FEEDBACK EFFECT IN A LEARNING ENVIRONMENT

Bethany Benjamin  
Spring Valley High School

Post identification feedback effect is known in courtrooms as one of the main causes of unreliability and malleability in eyewitness testimonies. When eyewitnesses are given nonconfirming but possibly misleading feedback, it can have an impact on the eyewitnesses confidence and likeliness to be correct or incorrect again. This research sought to examine if post identification feedback effect (PIFE) also occurs in a learning environment. Participants were split into three treatment groups, then each read the same earth-science passage and were asked to answer questions pertaining to the material. Depending on which treatment group a participant was in, they then received positive feedback, no feedback, or negative feedback, regardless of the correctness of their answers. It was hypothesized that students who received positive feedback would score their psychological needs higher than the other two groups. The participants then ranked their feelings of motivation and other psychological needs in their learning environment. Data was analyzed through central tendency and one-way ANOVA tests of each psychological ranking, and it was concluded that the data was not statistically significant, as the ANOVA null hypotheses failed to be rejected for every psychological need. Most participants rated their psychological needs at about a 3 or 4 on a 5-point Likert scale, regardless of which type of feedback they received. The hypothesis was not supported, and it was concluded that there was not a significant difference between the feedback groups and influence on student's psychological needs.

## ALLEVIATING SYMPTOMS OF DEPRESSION BY INCREASING LEVELS OF SEROTONIN

Tomiah Berry

Center for Advanced Technical Studies

This project will help those who struggle with depression or even have symptoms of depression but haven't been medically diagnosed. It is important because oftentimes, people who are depressed will resort to coping mechanisms that are not healthy or can cause severe damage to the body such as drugs or alcohol. The problem is that people who struggle with symptoms of depression, have lower levels of serotonin, and everyone doesn't have access to purchase antidepressants and some simply don't want to take antidepressants. If people who have low levels of serotonin experience symptoms of depression then, increasing levels of serotonin will alleviate symptoms of depression. Non-medication ways to increase serotonin levels consist of dieting, exercising, and getting an adequate amount of sunlight. The independent variable in this project is the different ways to boost serotonin, the dependent variable is the amount of serotonin that would be increased and the constants would be the amount of time these actions to boost serotonin levels are performed. The expected outcome of this project is to be successful in alleviating symptoms of depression by boosting serotonin levels. If this proves to be successful, people can incorporate these activities into their everyday lives to maintain healthy levels of serotonin and ultimately be happier. Alleviating symptoms of depression by increasing serotonin will keep individuals from causing harm to themselves.

## GROWING HYDROPONIC PLANTS UTILIZING BRINE FROM DESALINATION

Hope Blackmon

Center for Advanced Technical Studies

Desalination facilities are located all around the globe turning ocean water into fresh water for consumer use. When the filtering process is complete, a substance called brine is leftover -- only to be dumped back into its original location. By doing this, oxygen levels deplete for marine life as well as raising the salinity levels. If brine is used in a hydroponic system in place of fertilizer, then the lettuce plants grown will increase in width. A hydroponic system will be built in place to grow romaine lettuce, rather than growing from ground soil. Two rows will be used, each with 5 drilled holes for each lettuce to be planted; row one will be the constant, and row two will be the experimental. In the experimental row, five of the 10 planted lettuce will be implemented with 1% brine mixture. Both of the rows will have the constants of being filled with 9.5 L of water and having the same amount of GH Flora Grow supplements on medium feed. The results of the lettuce rang true - the experimental lettuce grew more widthwise, and was a deeper color of green. Growth rate was not up to par compared to the control group, but was still healthy and growing nonetheless. Concluding the results from over a week of sprouting, the trial was successful. The brine lettuce flourished alongside the control lettuce, having comparable length differences. David Jiménez-Arias, an archeologist at the Spanish National Research Council, conducted research with his team on utilizing recycled brine into fertilizer as a proficient commodity. Growing tomatoes in a hydroponic system, he found that the recycled solution cost less than commercial subsistence, and found richness in calcium, magnesium, and potassium. The tomatoes only grew 60% from the original amount, but consumers preferred the brine tomatoes because it developed a deeper shade of red and was sweeter in taste. The next step of the project will be to use different plant seeds (such as basil or kale), and to increase the brine intake from 1% to 1.5%.

WHAT THE DOG DOIN'  
Christopher Blake and Nicholas Brewer  
Center for Advanced Technical Studies

According to Canine Behavioral Services Inc., “most” pets, primarily dogs, ignore human boundaries. It takes time as well as an owner who is home and willing to reinforce and train dogs to set boundaries. For the purpose of keeping personal commodities safe and to retain privacy, we are looking to create a device designed to solve such a problem since most pet owners have jobs and must leave their pet unattended. Dogs don’t always respond to verbal commands, “especially just at the beginning of the training process,” supported by claims according to the American Kennel Club. Throughout this process, people often find it difficult and tedious to teach dogs certain behaviors as new boundaries are set. As situations become more and more difficult, such methods, such as shock collars and scents that are used to deter dogs, are used. However effective they are, they also come across as harmful to a pet’s mental and physical development in which I believe is more important.

EFFECTS OF MICROPLASTICS ON CORAL BLEACHING  
Sathvik Bodepudi and Haya Kidwai  
South Carolina Governor's School for Science and Mathematics

When water temperature rises, corals undergo a process called coral bleaching, where they kick out endosymbionts. However, we believe the existence of microplastics in the ocean might be speeding up this process because of normal corals' tendency to consume similar sized microplastic particles, which decreases their nutritional intake. We utilized *Exaiptasia diaphana*, sea anemones under the same genus as corals, as they’re easier to manipulate and replicate in a lab setting. Since no one has tested if microplastics have an accelerating effect on the bleaching process, we decided to test our hypothesis; if *Artemia nauplii* (brine shrimp) contaminated with microplastics were fed to anemones, the bleaching process would be induced and more likely to occur. We observed the bleaching process of two anemones over the duration of a week to determine needed temperature increments. We set up four groups of anemones, two control groups in high and low temperature, and two microplastic-fed groups in high and low temperatures. The high temperature microplastic group sustained the most visible bleaching. No strong correlation between microplastics and bleaching was apparent in our data, but we identified possible sources of error. These include the malfunctioning of the tissue homogenizer, incubator, and personal error. Although the data doesn’t entirely support our hypothesis, there is a strong association between bleaching susceptibility and microplastics, increasing chances of reproducing the experiment. The correlation gives us another clear example of the detrimental effects of plastic pollution in oceans and another motive to preserve coral reefs for future generations.

THE BIOMETRIC BOLTER: A FINGERPRINT PROTECTED PILL BOTTLE  
Chloe Breedlove  
Center for Advanced Technical Studies

My project is to engineer and create a Pill bottle that is locked by the biometrics of the caretaker's fingerprint so that the Patient can’t misuse the opioids or prescription in the bottle. This invention is important for the confirmation, and support of the idea that the patient doesn’t have the option or ability to misuse or abuse their medications. This would benefit the family members of the patient, the doctors of the patient, the caretakers and more, through the gratification of knowing that the individual is in safe hands. My product is similar to The Pill Popper, an automated pill dispenser with biometric access control. It verifies a patient’s fingerprint and dispenses medication based on a prescribed schedule, set by an authorized pharmacist or physician. This is quite similar to my product idea, although they are both

different through the idea that mine would be for the Caretakers print, and not on a schedule, so that the patient couldn't trick the dispenser into giving more than prescribed, or at wrong times, etc. I plan to do this project through experimental trials of the engineering mechanics behind it. And use Trial and Error for the lock, the bottle opening, etc. I expect to create a durable bottle large enough to contain the medication, with a secure lid and lock that is controlled by the Caretakers fingerprint. I plan to analyze my project through how tough and durable it is, and whether or not the lock is truly secure. I will know when I'm successful when my bottle can be roughhoused, dropped, thrown, etc. and stay unbroken, and still locked, while the lid still works for it's same purpose.

#### USING MULTIPHASE SIMULATIONS TO DETERMINE THE NATURE OF SELF CLEANING SURFACES

John Brent

South Carolina Governor's School for Science and Mathematics

Throughout the world, there have been countless studies on natural hydrophobic surfaces (examples of which include lotus leaves, bird feathers, and rose petals) in attempts to mimic their self-cleaning properties. Despite these studies, nobody could say for certain how the droplets went from the highly adhesive Wenzel state to the far less adhesive Cassie-Baxter state. To solve this conundrum, we used a many-body dissipative particle dynamics (mDPD) simulation to visualize the coalescence of two water droplets in both the Cassie-Baxter state and the Wenzel state. What we found was the droplets in the Cassie-Baxter state made enough energy in their coalescence to jump off the surface, and the droplets in the Wenzel state, though they couldn't jump off the surface, were able to transition into the Cassie-Baxter state. This information could be used to better create self-cleaning surfaces, as we now know the process by which they work.

#### COLOR PERCEPTION IN OPPOSITE GENDERS

Addison Brizek

Chapin High School

The purpose of this study is to explore gender preference in color in relation to brightness. This study uses three primary colors of red, yellow, and blue with four different shade options to select from. The project uses high school students from a targeted area and the data is collected in a survey format. The results were analyzed by a series of tests and categorizing to fit the selections to the individual and their gender categorization. In a real- world point of view the research was derived from a gap in marketing and the production of products. With the increase in technology and social media usage in today's modern time, the results of this research can be applied to business and how to advertise to the select group of teenagers and their gender appeal. With the discovery of preference in color, businesses can craft an advertisement that will make teenagers more likely to stop their scrolling and look more into the product.

#### CREATING AND VALIDATING STIMULI TO STUDY MISOPHONIA

Liana Brock and Natalie Peart

South Carolina Governor's School for Science and Mathematics

Misophonia is an impulsive, unpleasant reaction to specific sounds and is categorized under OCD. People with Misophonia experience a sensation akin to physical pain when triggered. Common triggers include nose, mouth, and throat sounds such as sniffing, chewing, and coughing. Misophonia disrupts the daily lives of those suffering from it, so studying it is essential. Our objective was to develop and validate a set of stimuli that can be used in further research of Misophonia. We identified triggers found in various research papers. We created a list of aversive and non-aversive audiovisual stimuli and made videos out of all of the stimuli on our list. Aversive and non-aversive stimuli are different from Misophonia triggers

because they are generally pleasant or unpleasant whether you have Misophonia or not. The aversive and non-aversive stimuli will be used as controls in future Misophonia experiments. We generated 182 stimuli with 96 aversive/ non-aversive stimuli and 86 Misophonia-triggering stimuli. We validated the stimuli across four behavioral experiments where participants rated the stimuli on aversiveness, valance, and arousal. If most participants agreed that a certain stimulus was aversive, then we consider that stimuli validated. The experiments are currently collecting data. The final stimuli set will be used in future misophonia studies to help better understand the disorder and hopefully find a treatment for this debilitating disorder.

#### DON'T CRY, PHOTOSYNTHESIZE; USE A SOLAR POWERED KNEE BRACE

Lydia Brown

Center for Advanced Technical Studies

The abstract is to build a solar-powered knee brace that has the ability to do cooling and compression that's made especially for an mpfl distal realignment patellofemoral surgery. (realignment and stabilization of the knee cap and tibia ) . This is important because anyone who has had this type of surgery or will have to have it in the future won't be in as much pain after the surgery process and also can help better them in the long run. This will impact anyone who buys this product who needs a specialized knee brace for this type of surgery or anyone who is going to have this surgery in the near future. My motivation for this personally is to make others who are dealing with, have dealt with or will deal with this type of surgery more comfortable with as far as the brace goes, help them by making a better brace design itself and make something that absorbs the pain/its shocking sensation also I want to have everything completed so I can graduate. The problem with this surgery is it causes a lot of pain and also gives off a shocking like sensation that hurts and is painful to the point where people grab their knee just out of reflex. With my knee brace, I hope to help with that because It relieves the stress/pain the patient feels throughout the surgery and helps with the post-surgery effects ergo the shocking sensation that they feel afterwards. My Hypothesis is that I can make a solar-powered knee brace made especially for an mpfl distal realignment, patellofemoral surgery and to surgery that can be somewhat comfortable, non-time consuming and be 1 brace that does the functions of all the three regular braces you go through combined ( the braces are an immobiliser, j brace and compression sleeve ). My study is different because whereas other braces are made non specifically for one thing this one is made especially for an mpfl distal realignment patellofemoral surgery to better help the patient and his/her recovery process. As for the problems I hope to solve, I hope to, solve the stabilization problem and also help absorb the shocking feeling that occurs after this surgery. I chose these methods/ this idea/project because it is convenient, environmentally friendly and also becoming more common as years go by. The materials I used are Spandex, neoprene, velcro strips, donjoy web tech brace, sharpies, needles and thread, stencils, solar panel, sewing machine(s) and other people as models and surveyors.

#### MEASURING THE MICROWAVE SPECTRUM OF 3,4-DIFLUOROPHENOL

Nathaniel Bruss and Akhil Devarapali

South Carolina Governor's School for Science and Mathematics

This study measured the microwave spectrum of the chemical 3,4-difluorophenol in order to determine the structure of the molecule. The microwave spectrum of 3,4-difluorophenol was measured in the range of 8-18 GHz using a chirped microwave pulse. 10,000 averages were taken for each frequency range. Density functional theory calculations were performed using Gaussian 03W in order to obtain the predicted rotational spectra of the compound. Gaussian yielded three rotational constants, A, B, and C for 3,4-difluorophenol, whose values are 3071.31 MHz, 1301.36 MHz, and 914.84 MHz, respectively. These values measure the chemical's resistance to rotational motion. The distortion constants, which measure

the flexibility of the chemical, were also computed. For the analysis of the spectrum the software programs SPCAT and SPFIT were used to determine rotational constants from the experimental data. This study was able to successfully analyze the experimental values of A, B and C whose values are 3079.42, 1307.43, and 917.84 MHz, respectively, as well as the distortion constants of the chemical. The overall RMS error of the predicted values and measured values is 0.000654 MHz.

#### REDUCTION OF CARBON EMISSIONS FROM CONVENTIONAL OVENS/GRILLS UTILIZING PYROLYSIS

Silas Campanella

Center for Advanced Technical Studies

The purpose of this research project is to show that common grills produce too much carbon dioxide and little heat power compared to the pyrolysis oven. The hypothesis of this project will be that pyrolysis ovens can outperform common grills in power and CO<sub>2</sub> emissions. Methods used in this research project were that all four ovens were burned at the same time as they reached the apex of their burn. As they reached this, an infrared thermometer was used to get the celsius and a carbon dioxide monitor was used to get the carbon dioxide readings of each oven and compare each piece of data. The results show some pyrolysis ovens are cleaner than common grills, but all pyrolysis ovens are more powerful than common grills. The data shows that we can use pyrolysis ovens instead of common grills and pursue a new, cleaner way of cooking and heating up homes. The conclusion shows that the hypothesis is supported that they are outperforming, but some pyrolysis ovens aren't as clean compared to others, but they do show this can help us move to a greener way of cooking. The implications show we can change the old ways and implement new ways that are cleaner and safer for our future generations and the environment. Future work of this research project will include all three pyrolysis ovens and directly compare them to the Common grill and compare each pyrolysis oven to one another to see which one is the best.

#### EMOTIONAL INTELLIGENCE AND GPA

Hannah Carson

Chapin High School

With the expansion of the Coronavirus in the past few years, many schools have switched to online or a hybrid between online and in-person learning. This has caused grades to drop drastically on a nationwide level. To exemplify this, The New York Times stated, "In Houston, about half of high school students got at least one F in the fall 2020 semester, compared with 35 percent the year before. In Dallas, five high schools had more than a quarter of students failing two or more courses this spring, up from just one school two years ago. And in Chicago, a recent story by WBEZ described teachers at high-poverty high schools agonizing about whether to fail students"(Taylor, Nierenberg, 2021). This study looks at the relationship between emotional intelligence, the ability to analyze nonverbal cues, and grade point average (GPA). I conducted the survey to find a solution to the drastically dropping GPAs of high school students across the nation. If emotional intelligence is a determining factor in raising GPA, schools could implement programs to elevate students' emotional intelligence and therefore their grades.

#### PRODUCTION AND PURIFICATION OF LANTHIPEPTIDE NATURAL PRODUCTS

Daniela Cawley and Scout Hamrick

South Carolina Governor's School for Science and Mathematics

Lanthipeptides are a subclass of ribosomally synthesized and post translationally modified peptides (RiPPs) that exhibit promising biological activity. Because lanthipeptides are peptides in nature, we can use protein purification methods to extract and purify them. To construct our proteins, we used a variety of distinct molecular biology techniques, including plasmid extraction, gel electrophoresis, PCR

(Polymerase Chain Reaction), Gibson Assembly, Restriction Digestion, and eventually, Protein Purification. Plasmids are small, circular genetic material within bacteria that code for proteins, so we started by isolating them and performing PCR to target and amplify a specific segment. We then used a technique called Gibson Assembly to take the segment and recombine it with other gene sequences. To verify that our constructs were correct, we used a method called restriction digestion where we cut the plasmid into specific sized pieces, which could then be analyzed using gel electrophoresis. The pattern of the fragment on the gel indicated whether or not the plasmid contained the expected size insert. Then, by inserting the new strand into competent cells (cells ready to uptake genetic material), our protein could be synthesized. Our proteins contained a histidine tag, which allowed us to isolate them by using affinity chromatography. Once purified, they can be used for further in vitro discoveries.

#### THE EFFECT OF COVID-19 ON THE NUMBER OF IN-PERSON VOLUNTEERS VERSUS CASH DONORS

Srihith Chada  
Spring Valley High School

COVID-19 has been devastating the world since March 2020. Health-care workers and front-line workers have been stretched thin by the needs of the general public. The purpose of this study was to evaluate the effect of COVID-19 on in-person volunteering compared to cash donations. It was hypothesized that as a result of COVID-19, in-person volunteering would decrease and cash donations would increase because people would feel more inclined to donate than to volunteer in person to reduce the risk of contracting the virus. The agencies of Goodwill, United Way Association of South Carolina, and Feed My Sheep Movement and Ministry were contacted and asked for the number of people weekly that volunteered and donated money from the weeks of February 2020 to August 2020. The hypothesis was confirmed based on the information received showing that people did indeed volunteer less and donate more, and outcomes of the linear regression test showed a relevant connection between the number of in-person volunteers and cash donors,  $F(1, 28) = 84.3$ ,  $p < .001$ ,  $R\text{-squared} = .75$ ,  $R\text{-squared adjusted} = .74$ ,  $B = 1.82$ . According to a Pearson  $r$  correlation test, there was a strong association between the two variables,  $r(28) = -0.83$ ,  $p < .001$ . This means that during COVID-19, when the number of in-person volunteers decreased, the number of cash donors increased. This further supports the need for non-profit organizations and volunteering agencies to do more to promote community service during the coronavirus, especially in the wake of an increase of cases.

#### THE EFFECTS OF RICE BRAN OIL AS A REPELLENT FOR MOSQUITOES COMPARED TO MINERAL OIL AND EFFECTIVE NATURAL REPELLENTS

Aleena Chattha  
Spring Valley High School

Mosquitoes that spread viruses are called vector mosquitoes and can be extremely dangerous to humans, but bites from other mosquitoes can also lead to side effects such as itching, irritation, or swelling. Rice bran oil has not yet been tested as a repellent, but it possesses very similar properties to mustard seed oil, which has been proven to have insect-repelling tendencies by previous studies (Mukesh et al., 2014). Discovering novel repellents is necessary because of recent studies that have been conducted regarding the resurgence of mosquito-borne diseases like arboviruses and malaria (Dahmana & Mediannikov, 2020). The purpose of this study was to determine the ability of rice bran oil as a mosquito repellent. The mosquito-repelling abilities of various essential oils that have been proven to be effective in preventing mosquito contact were compared with rice bran oil and mineral oil. It was hypothesized that rice bran oil would have significantly less mosquito landings than the odorless oil, as rice bran oil has a similar composition to mustard seed oil, an effective mosquito repellent. The number of mosquito landings in each oil was counted, as a significant number of mosquito landings would classify a compound as an



ineffective repellent. A one-way ANOVA was conducted and found a significant difference between at least one pair of means, with  $F(4,70)=86.78$ ,  $p<0.001$ , and a Tukey test showed a significant difference between the rice bran and mineral oil. Rice bran oil acted as an effective repellent in the experiment.

#### RESBENCH: AN ANALYSIS OF DEEP LEARNING FRAMEWORKS FOR IMAGE CLASSIFICATION

Sanjeev Chauhan and Benjamin Chauhan

South Carolina Governor's School for Science and Mathematics

Deep learning frameworks are of particular note, as they have been shown to drastically alter the performance of Deep Learning while training, as well as the final result of the training, despite the theoretically identical math being done while training. This study expands upon the works of “DLBench: a comprehensive experimental evaluation of deep learning frameworks” by Radwa Elshawy, Abdul Wahab, Ahmed Barnawi & Sherif Sakr through testing only ResNet50v1.5 with the frameworks TensorFlow, PyTorch, and MxNet, without changing the architecture. This gives us less variation between framework tests, as the DLBench study used different architectures as well as different databases when testing, leaving the reason for changes in performance up to multiple indistinguishable factors. Our study performed tests using 2 Tesla V100 GPUs from Nvidia, and was evaluated with each framework on 2 datasets: CIFAR100 and ImageNet.

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#### THE EFFECT OF *ELODEA CANADENSIS* ON FLUORIDE LEVELS IN DRINKING WATER

Everlast Chigoba

Spring Valley High School

Fluoride in water at certain levels can be dangerous to human health. The purpose of this experiment was to test if the plant, *Elodea canadensis*, would be an effective method of filtration for fluoride. It was hypothesized that if *Elodea canadensis* was used to filter water, levels of fluoride in water will decrease due to herbaceous plants being effective in water filtration. Thirty *Elodea* plants were separated into three different test groups with different levels of fluoride dissolved in water. The groups were as follows: Group 1, 2g of fluoride, Group 2, 7g of fluoride, and the third, a control group containing no fluoride at all. The concentration (ppm) of the fluoride was measured over a period of 120 hours. Data collected over the period ultimately showed inconsistent results with the observed fluoride concentration numbers fluctuating greatly. It would be important that this experimentation be replicated due to the potential negative effect that fluoride concentrations in water can have on people. Data analysis would involve comparing mean, median, min, max, interquartile range, quartiles 1-3, and the median. As well as the use

of a two-way ANOVA to compare the mean values in each group. Data tables will be presented along with appropriate graphs to show trends.

#### DEVELOPING A HYBRID RENEWABLE GEOTHERMAL HEATING AND COOLING HOME SYSTEM

Caleb Clark

Center for Advanced Technical Studies

This study is being made to see if combining a solar panel and a geothermal system make them more efficient. If I combine a solar panel and a geothermal system then these two systems will help each other to become more efficient. The geothermal system will be powered by the solar panel. There will be tubes behind the solar panel to collect its heat and transfer said heat to the geothermal system. It is possible to use the cooling part of the geothermal system to cool down the solar panel. Results have shown that these two systems work well together. The data that has been collected from the test shows that a geothermal system can be powered just fine using solar. In the future it is planned to maybe add other clean energy systems to this hybrid system. In conclusion, a geothermal heating/cooling system pairs nicely with a solar panel. And not just by powering the whole thing using solar, it is also possible to use the geothermal system to collect heat from the solar panel and use said heat.

#### FORMALIZING CONWAY'S LITTLE THEOREM IN LEAN

Adam Clements and Christian Long

South Carolina Governor's School for Science and Mathematics

LEAN is an interactive proof assistant program that is headed by Project Xena. It uses mathlib, an online, crowdsourced mathematical library containing thousands of formalized theorems and lemmas. LEAN helps users formulate proofs by offering lemmas and theorems, using tactics, and highlighting the goal of the proof. Our goals for the month-long research project were to learn about higher math, learn how to formalize math, learn how to program with LEAN, and formalize a proof to be added to the public mathlib. We spent the first half of the project learning about formal math and how to use LEAN. In the second half of the project, we decided to try to formalize Conway's little theorem in LEAN. It proves that a certain quality of triangles is exclusive to equilateral triangles: the ratio between two sides and two angles of a triangle being a rational number. We chose to formalize O.A.S. Karamzadeh's proof of Conway's Little Theorem. First, we proved that the cosine of double angles is rational. Then we used properties of a Euclidean domain to try to prove that cosine has a finite number of rational outputs, and that they are periodical. Unfortunately, we didn't have enough time to finish the formalization.

#### MICROWAVE SPECTRUM OF 2,3,5,6 TETRAFLUOROPHENOL

Brodee Clontz and Aidan Atance

South Carolina Governor's School for Science and Mathematics

We measured the microwave spectrum of 2,3,5,6 tetrafluorophenol for the first time. Microwave spectroscopy is used to determine a molecule's rotation, and then constants that then show us a molecule's shape. We measured rotational frequencies from 8000 to 18000 MHz to determine those constants. We performed 10,000 averages on the oscilloscope that we then had to analyze to show us the constants and prime numbers. Before we measured our chemical, we used Gaussian 03W to provide us with calculations to give us a base prediction as to what the constants would look like. Analysis of results is ongoing.

## INVESTIGATION INTO ENERGY STORAGE FROM EXCESS RENEWABLE RESOURCES

PJ Comose

Center for Advanced Technical Studies

The project will determine how successful Thermal Energy Storage systems are at storing heat for a certain period of time. The hypothesis for this project is that the change in materials used in the prototypes will not have an effect on how successful the system is at storing heat. The project will use thermal energy storage mediums such as gravel, sand, and water as well as others. It will then be determined which is the best to use and if applicable attempt pumped thermal storage. The project will then be tested to see how well energy can be stored and then used to power various appropriate devices. This is important because in the real world thermal energy storage is an important area of the clean energy industry and it can always be improved and applied in new circumstances. Data will show how successful the system is at storing heat for a certain period of time. The project will be successful by constructing prototypes to see which one is the best at preserving high temperatures, comparing the results between the substances tested. Future work on the project includes constructing multiple prototypes with the goal that each one will be better at storing thermal energy than the last one. Other future works include being able to generate electricity, and using it to power devices.

## CREATING A NEW SYNTHETIC CARILAGE FOR OSTEOARTHRITIS

Maggie Corley

Center for Advanced Technical Studies

Synthetic cartilage will benefit those with osteoarthritis. Osteoarthritis, a common type of arthritis affecting 32.5 million adults in the US, occurs when cartilage wears down over time. The cartilage protects the ends of bones from rubbing against each other, which can be extremely painful and damaging to the bones. A synthetic cartilage can be inserted into a joint to prevent the bones from rubbing against each other, helping relieve pain and avoiding the deterioration of the epiphysis. Currently, the only synthetic cartilage available is for use in the metatarsophalangeal joint. The goal of this new synthetic cartilage is to create a synthetic cartilage that can be used in multiple joints, since osteoarthritis most commonly affects joints in your hands, knees, hips and spine. Through research on the effectiveness of preexisting synthetic cartilages, the most effective material for the cartilage will be determined. Most of the project is research based due to the creation and testing of synthetic cartilage not being ethical. The main criteria for the synthetic cartilage is it being adaptable for use in multiple joints, being long lasting, and having a low rejection rate. A synthetic cartilage that can be adapted to use in multiple joints will help many people diagnosed with osteoarthritis, relieving immense pain and preventing deterioration.

## THE EFFECT OF HIGHLY CONCENTRATED CANNABIDIOL ON *STAPHYLOCOCCUS EPIDERMIDIS*

Xavious Coyle-Vega

Spring Valley High School

With the continued use of marijuana all across the world where many people are starting to research and learn more about the health benefits and other aspects that the components inside of this psychoactive plant can give more insight into the chemicals inside the plant should be looked into. Cannabidiol (CBD) is one of the two main components inside marijuana, which is the focus of this research. CBD is being continually researched as markets for the component have grown exponentially in the past few years. To find the effectiveness of specifically highly concentrated Cannabidiol, however, the research conducted will go over how the component affects skin-infection causing bacteria. *Staphylococcus epidermidis* is a bacteria that has been problematic in causing infections especially in situations where the inside of the body is exposed during surgery. Testing on this bacteria to see if the Cannabidiol's antibacterial properties

in a highly concentrated state can help with getting rid of problematic bacteria would be an immense help in finding more ways to fight antibiotic resistance and also allow Cannabidiol to be implemented into the medical scene more. Using three test groups with two being different amounts of highly concentrated Cannabidiol and one control group a test was performed. *Staphylococcus epidermidis* is put into a medium broth with the water-soluble Cannabidiol and then a test was performed to find the absorbance compared between the three groups. The hypothesis was disproven with a statistical p-value of  $>0.05$ . Outliers that occurred in the data may have been caused by unknown factors, but the correlation between the addition of Cannabidiol into *Staphylococcus epidermidis* may be that Cannabidiol even of high concentration does not affect that species of bacteria in a noticeable manner.

#### STDs: TEENAGE AWARENESS OF A STIGMATIZED DISEASE

Nyaveia Creech

Center for Advanced Technical Studies

Teenagers all over the country are beginning to have sexual relations more often. Regardless if you think this is an issue or not, there is something bigger at stake, and that is the health of the teenagers in our state. Starting at the time of adolescents will undoubtedly improve STD rates across the state. The target audience of this research assignment are of course teens, but enlightening other age groups to this issue will also improve rates. Bringing light to this issue will help teens learn the steps of protecting themselves. STDs aren't something that you can just ignore, if left untreated they can cause serious health complications. The hypothesis is that teenagers have little to no awareness about STDs. Materials and methods used are surveys, online groups, communication with doctors that specialize in this field. The independent variables are going to be the different age groups that will be researched. The data will be quantified using different graphs and statistics. The dependent variable is the awareness of the disease and to promote abstinence. The expectations of this project is that teens in South Carolina will indeed have had STDs or know someone who has had one. The goal of this research project and STD prevention is to decrease the generality of STDs by interrupting their spread, minimize the length of infection and prevent the forming of complications in those infected.

#### THE DEVELOPMENT OF A NEW VENTRICULOPERITONEAL SHUNT

Berkeley Crosby

Center for Advanced Technical Studies

Hydrocephalus is a build up of fluid in the brain. This condition affects about 1 million Americans, mostly affecting children. If Hydrocephalus is not treated as soon as possible via a Ventriculoperitoneal Shunt, it is fatal. Approximately 50% of affected patients die before three years of age and about 80% die before reaching adulthood. Currently, the shunts being used are failing from various causes. These can include obstruction, infection, pseudocyst, bowel perforation, and hardware malfunction. My goal is to create and revise a ventriculoperitoneal shunt that is longer lasting and can withstand multiple types of bacteria. By creating a shunt out of celluloid instead of silicone, my shunt should last longer. I will also add a mesh filter and have the shunt drain into the bladder instead of the stomach. Having the shunt drain into the bladder will eliminate the possibility of infection in the digestive tract and will allow for the direct excretion of the excess fluid.

## NO BLOOD NEEDED: NEW WAY TO DETECT IRON DEFICIENCY ANEMIA

Cheyenne Daise

Center for Advanced Technical Studies

The goal of this project is to develop a non-invasive procedure able to measure Iron Deficiency without the use of blood. This project will allow many who are afraid of needles the option to try something which will not involve needles. This innovation will be inexpensive and convenient for many patients, while saving lives by limiting the exposure to many blood infections that can occur through normal iron blood tests. This detector will be used daily and checked whenever the patient feels the need to since it will be applied to watches. This is important because many people are afraid of needles and are not willing to get yearly iron checks due to this fear. This will be an option for those who find needles uncomfortable. The creation of this project involved programming and developing an app that enabled sensors to be applied to detect the level of iron. The program will then be able to be used and downloaded on smart watches.

## DOES WATER QUALITY IN SOUTH CAROLINA HIGH SCHOOLS PASS EPA STANDARDS?

William Davidson

Center for Advanced Technical Studies

The purpose of this project is to test the water quality of High Schools in District 5 (Chapin, Irmo, Springhill, CATE, Dutchfork). It is recommended that the average person drinks between 2.7 to 3.7 liters of water a day. With a regular school day being 7 hours long, it is almost impossible to not use school water fountains. Bad test results will indicate that change may be needed to plumbing, water sources, or water fountains. The main purpose and motivation for this project is to protect the health of students and to ensure the safety of clean drinking water. Each water sample will be tested on 5 different metrics: nitrate, pH, temperature, lead, conductivity, and TDS. The tests are significant and unique, because the tests will be done at multiple water fountains and at different times of the week. The results will indicate if water quality is impacted by old water fountains, and will help to further understand if the water quality is at a safe level. This project is very important, because compromising water quality in schools can impact the health of thousands of people, including students and teachers.

## SYNCHRONIZATION OF SWARM ROBOTS USING PULSE COUPLED OSCILLATORS

Camille Day and James White

South Carolina Governor's School for Science and Mathematics

Our research was focused on a new and upcoming model called Pulse Coupled Oscillators or PCOs. As the swarm robotics field grows, PCOs are being considered as an efficient and decentralized way to synchronize robot headings while also sending minimal data over networks. Oscillators are models that spin, and when they complete a rotation they send a pulse to the other oscillators, where an algorithm will be run to determine what the oscillator needs to change its phase value to. During our research we explored two methods: the Mirollo Strogatz algorithm and the Phase Response function (PRF) method, both of which were coded based on research papers. We then used Raspberry Pis' as our PCOs and ran the code on three of them at a time. Our research showed that the PRF method was quicker than the Mirollo-Strogatz algorithm, but was way less reliable as there was a chance that they would never synchronize at all, on the other hand the Mirollo-Strogatz method was slower but would always synchronize. These results are what our mentor Timothy Anglea found as well, from there he used machine learning to combine and maximize the two methods and made one that was both fast and reliable. In the future, PCO algorithms and machine learning will continue to be combined and studied in order to further the control of swarm robots.

## STRONG ARM: FISHING DEVICE FOR PEOPLE WITH LOW TO MODERATE STRENGTH DEFICITS

Timotheo Delarosa  
Center for Advanced Technical Studies

After finding out about the healing waters program I became interested in how disabled people fished. I googled it and found that there was a very limited selection of devices that aided in fishing. The selected audience I chose was people with low to moderate strength loss in their arms and hands. The product while influences many people including people who fish already and people who want to fish but have been scared there disability will stop them from performing properly. The goal of the project was just to make fishing a little easier for some people. The way of achieving this was a use of a brace and glove that would be fitted with your fishing pole of choice. The Brace assisted in holding the rod and the glove assisted in gripping the reel handles on the rod. The main point that we wanted to be hit was comfort, safety, and practicality. With a mix of felt and plastic, the brace will be built and magnets, as well as an underlined type glove, will make the glove. A very easy and simple safety mechanism will be used on the brace to assure the safety of the user. In conclusion, an assistive device will be made to improve the lives of those with disabilities who want to fish.

## GENOMIC AND ECOLOGICAL ANALYSIS OF BACTERIA IN AN OCEANIC OXYGEN MINIMUM ZONE AND THEIR ROLES IN NITROUS OXIDE PRODUCTION AND CONSUMPTION

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Nitrous Oxide (N<sub>2</sub>O) is a potent greenhouse gas that has harmful neurological effects and causes global warming. Microorganisms that live at anoxic depths have specific metagenomes (MAGs) that enable them to survive without oxygen and contribute to the global N<sub>2</sub>O budget by either producing or consuming N<sub>2</sub>O. We hypothesized that the MAGs we analyzed would have a positive correlation with the production and consumption of N<sub>2</sub>O. Samples were collected from three different stations in the North Pacific oxygen minimum zone (OMZ), ranging from 0-900 meters. DNA was also extracted from the samples and sent for shotgun metagenome sequencing; MAGs were reconstructed and annotated using Kyoto Encyclopedia for Genes and Genomes (KEGG). After compiling the sample's data into figures, we found that ammonium and nitrite concentration peaks correspond with each other. We also found that the microbe's abundances increase dramatically at the anoxic-oxic interface. However, the p-values determined from the linear regression between the percent reads of the microbe and the production/consumption rate showed no significant correlation between the MAGs and N<sub>2</sub>O consumption/production. This suggests that other microbes play a more direct role in controlling N<sub>2</sub>O dynamics than the Actinobacteriota and Roseibacillus we investigated. Ultimately, metatranscriptomic studies should continue to investigate the overall activity of the Actinobacteriota and Roseibacillus MAGs, as well as the genes involved in N<sub>2</sub>O consumption and production, in order to pinpoint the primary source of these N<sub>2</sub>O rates, so that the global N<sub>2</sub>O budget can decrease, preventing further ecological and neurological damage.

## TWO-DIMENSIONAL NONLINEAR CATEGORIZATION BY *CAENORHABDITIS ELEGANS*

Parth Desai  
Spring Valley High School

*Caenorhabditis elegans* have been utilized to study the nervous system for decades. However, the computational prowess of the neural network of the microorganism is not fully understood. This experiment tested whether *C. elegans* are capable of learning two-dimensional categories that are linearly as well as non-linearly separable. It was hypothesized that *C. elegans* would be able to learn both linearly and nonlinearly separable classes. This was tested by using two dimensions of potassium chloride (KCl)

and color, whose presence/absence was associated with the presence/absence of food (*E. Coli*). *C. elegans* were trained to learn one of three relations: AND and OR (both linear) and XOR (nonlinear). After training, learning was then tested by examining the movement of *C. elegans* in separate dishes. In a separate experiment, the reverse associations (absence/presence of food) representing the same functions were also trained and tested. The results showed that *C. elegans* can learn these positive and negative associations for both linear and nonlinear cases. This advances our understanding in two ways. First, it shows that the microorganism can learn two-dimensional problems, i.e., simultaneously considering two variables to determine behavior. Secondly, it shows for the first time, that their neural networks possess sufficient computational complexity to learn nonlinear boundaries. This will put them in a different class of organisms, capable of solving more complex problems than previously realized. For the AND Gate, X-squared = 83.42,  $p < 0.001$ . For the OR Gate 100/300 test, x-squared = 73.657,  $p < 0.001$ . For the NAND Gate 1.1454,  $p = 0.28445$ . For the NOR Gate, 9.79,  $p = 0.001755$ . For the XOR Gate, 49.278,  $p < 0.001$ .

#### THE EFFECT OF BILINGUALISM ON SOCIAL ANXIETY IN ADOLESCENTS

Sanvi Divekar

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Bilingualism, fluency in more than one language, has become more widespread as cultural diversity and globalization expands. It is not a widely-known or accepted fact but research has indicated that there may be negative effects of bilingualism. The purpose of the study was to determine if bilingualism has an effect on social anxiety in adolescents. It was hypothesized that bilinguals may be more likely to experience social anxiety because of their increased susceptibility to adverse emotions. Levels of social anxiety were determined by using the social interaction anxiety survey (SIAS). First, a human consent form was completed; the participant's lingual status was selected before starting the actual questionnaire. For this study, conversational fluency in more than one language was the minimum criteria for a participant to be defined as bilingual. A chi-square and z-test were performed. Statistically significant results were found for both tests. The chi-square inferential test revealed that lingual status does have an effect on social anxiety in adolescents,  $X^2(4, N=80)=9.6$ ,  $p=9.49$ . The z-test found that there was a statistically significant difference between the two lingual group's sample means ( $z=3.05$ ,  $p=1.96$ , two-tailed). The results suggested that monolingual adolescents had a higher correlation with social anxiety than bilingual adolescents. By identifying which groups are at a higher risk for social anxiety, psychologists and educators can try to implement preventive measures and recommend external support if needed.

#### THE EFFECT OF AVATAR CHARACTERISTICS AND VOICE EXPRESSION ON ONLINE GAMING ENVIRONMENTS

David Doughty

Spring Valley High School

As cases of online gaming toxicity continue to rise, the social well-being among players of online video games is impacted negatively. As such, a method to ensure that players remain socially safe in online gaming environments must be devised to slow the progression of social toxicity and negativity among players. Previous research suggests that many cases of harassment and toxicity online, such as hate speech, are often caused by the absence of anonymity. A player may express themselves in online scenarios by using avatars, which can reflect certain racial features, as well as by using voice chatting functions. This suggests that as anonymity increases in the individual, the less prone the person is to toxicity online. The purpose of this study was to identify the relationship between anonymity and online toxicity, and the extent to which anonymity could decrease the number of negative comments from other players. Teens and young adults were surveyed regarding their positive and negative experiences with others online, as well as taking part in an experiment where three levels of anonymity (no avatar with

voice, no voice with avatar, no expression) were used in League of Legends online matches. A chi-square test of independence revealed that there was no statistically significant difference ( $p > 0.05$ ) between the type of anonymity used and the number of negative comments received,  $\chi^2 (4, N=68) = 1.14$ ,  $p = .888$ .

#### THE EFFECT OF EXPLICIT VERSUS IMPLICIT TRUST IN THE GOVERNMENT ON THE NUMBER OF COVID-19 PRECAUTIONS TAKEN

Jackson Dowey  
Spring Valley High School

Much research has been done into the factors that impact whether people will take precautions against the Covid-19 virus. Among these factors is the level of trust someone has in the government. Previous research has shown that people seem to display varying levels of trust in the government depending on the kind of test they take. Implicit trust is found through tests that look for trust without directly asking the participants while explicit trust is found through asking the participants about their trust outright. This study aimed to find out whether the type of trust that someone holds in the United States government affects the amount of Covid-19 precautions they take. It was hypothesized that there would be a relationship between type of trust and number of Covid-19 precautions taken. By surveying teachers and social media users for their implicit and explicit trust as well as the number of Covid-19 precautions they take, the study found that there is a correlation between the two variables. The data was analyzed using a Chi-square test for dependence. In doing so, it was found that the p-value of 0.5649 was higher than the alpha value of 0.05, thereby showing that there was not sufficient evidence to suggest that the type of trust someone has in the government and how many Covid-19 precautions they take are dependent.

#### BUTTONS, BOTTLES, AND BOWLS: A LOOK INSIDE POSTBELLUM LIFE ON HUME PLANTATION

Rachel Dozier and Hannah Dozier  
South Carolina Governor's School for Science and Mathematics

The purpose of our research was to identify and catalog the artifacts excavated in 2011 from Hume Plantation, situated on Cat Island near Georgetown, SC. We began determining age of the artifacts through studying the glass, using its bubbles and coloration to indicate what time period they were from. We then moved on to look at buttons and ceramic objects to determine a more precise time period for the artifacts, while also looking at the bigger picture to see into the lives of the people who lived there. From the existence of bubbles and the colors of the glass pieces, we could tell that most artifacts were from the Reconstruction era (1865-1877). We continued with the other artifacts to see what period they would fall into as well. This research is important because it can change the way we think about artifacts and the people who used them. For example, if we assume artifacts were used during the Antebellum era, then we get a different story about the people than we would if we thought they were from the Reconstruction era. The lives of enslaved people were much different from the lives of newly freed people. Our purpose was to look into the artifacts and not just see the date of the artifacts, but to also see the lives of the people who owned and used these items.

#### ULTRA-SMALL TO ULTRA-LARGE SCALES

Aidan Driscoll  
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How high and low can the fundamental measures, such as temperature and size, of the universe go? What can we figure out from these measures? While these questions aren't necessarily new, they are important in understanding the known universe. To answer these questions, scales of size and temperature were created to test the limits of the known universe. By creating these scales, it was easier to point out the



uniquity of objects in our universe and how they correlate their size to their known temperature. To conduct this experiment, the lowest and highest sizes/temperatures of the known universe were found and put on separate scales. To interpret these scales and their importance, they were compared between each other to find interesting correlations. For example, Betelgeuse, a star that is much larger than the sun, has a lower surface temperature. Generally, stars that are larger than the sun were said to be hotter, but by doing this research, it is seen that that is not necessarily the case. Betelgeuse is still significantly brighter than the sun, but that is because light is actually correlated with size and temperature! By creating two simple scales, one can find out things about our universe that are not easily determined just by looking around. In conclusion, the limits of size and temperature allow us to figure out properties of our known universe, fulfilling the purpose of this experiment. By using fundamental scales, one can determine the properties of the known universe.

#### SAFE STOVE

William Edwards and Marcellus Lewis, Walker Bolin  
Center for Advanced Technical Studies

The majority of house and commercial fires occur in the kitchen, and the majority of these fires are caused by cooking equipment. Namely stove tops and heating surfaces. The goal of project safestove is to stop fires on electric stove tops. This is because most stove fires are caused by negligence and/or the fire makes accessing the stove impossible without injury. Safestove will have features already present in many high end cooking appliances. However, these appliances are either only realistically applicable in a commercial setting and cost more than the average person is willing to spend on cooking equipment. The safestove will have similar safety features but will be adaptable to most household kitchens and electrical stoves. The safestove will use an arduino and sensors to be able to detect a fire and turn off the stove autonomously. It will also be able to be paired with already existing, more significant countermeasures.

#### THE EFFECTS OF EMPLOYMENT ON THE POLITICAL ALIGNMENT OF SOUTH CAROLINA HIGH SCHOOL STUDENTS

Tanner Evans  
Spring Valley High School

Political alignment refers to an individual's position on the political alignment chart. The political alignment chart is a method of evaluating a person's political ideologies based on the left-leaning versus right-leaning and libertarian versus authoritarian tendencies found in their political ideologies. Political alignment is typically cultivated via the events an individual experiences and the actions and words of those around them. This experiment sought to determine if there is a possible relation between employment and political alignment. It was hypothesized that participants would typically be more libertarian-right-leaning during and post-employment than they would be if they had never been employed because libertarians, the party of the individual, typically support individual worker's rights, as would an individual worker. In order to determine if the hypothesis was supported, 60 high school students were asked to complete a specially prepared political alignment test that was evaluated based on the Likert scale. The Likert scale provided quantifiable values to be used to determine the participants' position on the political alignment chart. Each question had five possible answers, ranging from one to five based on how greatly a participant agreed with the statement posed by the question. The value of one was negative 10, while five was positive ten. The values in between shifted by multiples of five. The resulting data did not support the hypothesis as the employed or previously employed students were not significantly more libertarian-leaning than unemployed students. Therefore, the idea that employment status may affect political alignment was not supported.

## SEEING THE BIGGER PICTURE: DEVELOPING VISION FIELD EXPANDING GLASSES FOR RETINITIS PIGMENTOSA PATIENTS

Isabelle Field  
Center for Advanced Technical Studies

Creating vision field expanding glasses that will benefit people living with mild to moderate retinitis pigmentosa. Retinitis Pigmentosa (RP) is a degenerative eye disease affecting roughly 1 in every 4000 Americans that progressively causes the dystrophy of rod cells on the periphery of the retina. RP will typically cause legal blindness by age 40. This project is based on experimentation using different lens, prism, and mirror techniques in order to create a pair of glasses that will expand the field of vision without restricting central vision. This product is tested by enlisting the help of students at the Center for Advanced Technical Studies. The product is tested via simulation glasses and peripheral vision tests. The simulation glasses will help people understand what it is like to live with the disease and will allow the testing of vision field expanding glasses on people with peripheral vision. If the field of vision is expanded by the glasses, the results are successful.

## THE IMPACT OF A UNIVERSITY'S PRESENCE ON NEIGHBORHOOD WALKABILITY

Moira Fontenot  
South Carolina Governor's School for Science and Mathematics

Neighborhood walkability is the general quality of amenities within a neighborhood, such as the presence of sidewalks and facilities like grocery stores. Walkability has been shown to be linked to the health outcomes of residents, with higher walkability allowing for better outcomes. This study was conducted to examine how much a university may affect this through using resources that could otherwise be used to create consistent positive walkability throughout the city. For this research, three universities and their surrounding areas were chosen based on being urban, suburban, or rural: Tulane University in New Orleans; The University of Notre Dame in South Bend; and Cornell University in Ithaca respectively. Within each, two additional neighborhoods were chosen, one diverse neighborhood and one homogenous minority neighborhood. Since research could not be conducted in-person, Google Earth and its street view function were used to assess walkability, which was itself assessed using the Delaware Walkability Assessment Tool (which rated walkability on a scale of 1 to 6 with 1 being the best and 6 being the worst). This research found that both the urban and suburban areas had more inconsistency, with the university having the highest walkability and the minority neighborhood having the lowest. However, in Ithaca the results were more consistent and the minority neighborhood had the highest score. These results, sans Ithaca, seem to support the idea that universities use up resources in an area. With these in mind, universities may need to work with their surrounding neighborhoods for equitable resources.

## THE PROPOSAL OF A DOPAMINE REUPTAKE INHIBITING TOXIN

Moira Fontenot  
South Carolina Governor's School for Science and Mathematics

This research explored the design of a toxin that could bind well to a dopamine reuptake inhibitor to stimulate addiction. This acts as proof of concept that small changes to a toxin's structure can lead to additional biological activity. This was primarily performed through the use of Avogadro and PyRx, with the former being used to create molecules and the latter simulating binding strength to a dopamine transport macromolecule. Multiple molecules were created for testing, each based on anatoxin-a, a toxic substance, and desipramine, a dopamine reuptake inhibitor. Variations included being bound together by a shared nitrogen, attaching desipramine's carbon rings to anatoxin-a's, and adding a ketone with a carbon and an oxygen as a means of attachment. After all five docking calculations were done, the fused

molecule where anatoxin-a and desipramine were bound by a shared nitrogen bond the best, revealing a binding energy of -9.6 kcal/mol in PyRx. Other results were close, off by a few tenths of a kcal/mol, overall the fused molecule worked the most for what was needed. It is unclear how feasible this molecule would be in a practical setting. It is unknown if it could be synthesized, it is also unknown if the added desipramine could offset anatoxin-a's deadliness enough to allow room for addiction, or potentially offsetting the toxic effects completely to create a new therapeutical molecule. Experimental testing would be needed to assess the activity of the newly created molecule and determine its toxicity, addiction potential, or therapeutic potential.

#### BINDING LUMATEPERONE WITH CUCURBIT[8]URIL TO IMPROVE DRUG BIOAVAILABILITY

Guadalupe Frias and Joshua Keable

South Carolina Governor's School for Science and Mathematics

The purpose of this study is to improve the bioavailability of the atypical antipsychotic, lumateperone, which is currently used to treat schizophrenia. Lumateperone has a bioavailability of 4.4%. Increasing the bioavailability would allow the drug to be administered in lower doses, reducing production cost and side-effects of the drug. We determined that the best method for improving the bioavailability of lumateperone is to pair it with a drug carrier, which is a host molecule that potentially protects the molecule from first-pass metabolism and aids in the release of the compound into systemic circulation. We selected a handful of drug carriers, and performed docking calculations with the ligand, lumateperone. Cucurbit[8]uril (CB8) had the highest binding affinity, so we continued to run more tests on the drug carrier. Molecular dynamics simulations showed an increase in polar interactions with water from -20.2 kcal/mol for the ligand to -57.2 kcal/mol for the ligand-host system. Nonpolar interactions with water increased from -29.4 kcal/mol for the ligand to -65.6 kcal/mol for the ligand-host system. Pairing lumateperone with CB8 yielded a significant enhancement of the molecule's polar and nonpolar interactions with water. The molecular dynamics simulations also demonstrated the stability of the host-ligand dynamics. The favorable molecular dynamics energies along with the promising stability of the host-ligand system suggests that pairing lumateperone with CB8 improves the solubility, and therefore the bioavailability, of the drug.

#### ENHANCING THE MECHANICAL PROPERTIES OF THE CARTILAGE SCAFFOLD FOR CARTILAGE REPAIR

Guadalupe Frias and Hannah Hodge

South Carolina Governor's School for Science and Mathematics

Many people suffer from cartilage defects, but there is no suitable way of solving this problem. The main reason people have so many problems is because cartilage cannot heal itself the way skin and bone can. A well investigated solution to this problem is the cartilage scaffold. Our research focused on a type of scaffold that is inserted into the defect area and allows stem cells to come in and turn into healthy cartilage. The problem this scaffold faces is the lacking mechanical properties. The base of the scaffold comes from the nucleus pulposus of the ox tail. The scaffold then must be decellularized since it contains ox cells. When the scaffold is decellularized, it loses some GAG, which is important to the mechanical properties. To help stop the loss, the GAG in the scaffold can be crosslinked. The two tests we assessed compares crosslinked scaffolds and scaffolds that have not been crosslinked. The first test checked the amount of GAG left in the scaffold after decellularization. This showed that crosslinking does keep GAG in the scaffold. The second test assessed the stiffness of the scaffolds. The scaffolds that were crosslinked were not as stiff as the scaffolds that were not crosslinked. The second test is not reliable and will have to be redone for a longer amount of time. The results of the tests shows that decellularization could be an extremely important factor in improving the mechanical properties of the cartilage scaffold.

## USING PIEZOELECTRIC PLATES IN SHOES

Sullivan Funk

Center for Advanced Technical Studies

This project is using piezoelectric plates to generate electricity from walking or playing sports. This is important because there are more than 7 billion people who walk and more than 75% of those people have access to mobile devices. The project is similar to some of the other ones out there because it uses piezo plates to charge an object. The project consists of shoe soles to house the piezo elements, piezo sensors to generate mechanical electricity, solder/soldering iron to piece the elements together, a digital multimeter to measure voltage produced, and a portable battery to contain electricity produced. The project will be successful if the device being charged actually charges using only the power available from the shoe circuit itself. I expect that my piezo setup will generate the required amount of electricity to charge a typical mobile device like a cell phone. I will analyze my project by finding the amount of electricity generated by a pair of shoes and matching that to common portable electronic devices. Research proves that the project is possible. This is an ongoing project that will continue until the end of the academic school year.

## METEORS, MEGACORPERATIONS, AND MURDER

Stephen Galaida and Harrison Walker

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This research centered on the discussion of ethical dilemmas in matters of astrobiology and space exploration. Due to the significant lack of legal precedent or ethical thought on matters in space, it is necessary to foster discussion to better handle potential situations that may arise. With wealthy individuals having plans in outer space, and discovery of extraterrestrial life expected soon, this is particularly pressing. The research consisted of reading prior discussions or writing in these areas, drafting cases and peer-reviewing with other research partners, and testing some outcomes through surveys. Employing these methods, three separate case studies were produced regarding issues of planetary value, outer-space labor relations, and legality versus ethicality when establishing space regulations. These case studies are designed to create discussion and discourse in an academic setting, and to bring the respective issues to light before real problems arise. Through the creation of these case studies insights were gained in terms of teaching perspectives, the basis or ethics as a whole, and the urgency of space ethics as an area of discussion. There is a wide variety of potential dilemmas regarding this issue, and this research only covers a small portion of space ethics.

## FEELS LIKE PLASTIC, LOOKS LIKE PLASTIC, BUT IS IT BETTER THAN PLASTIC?

Geraldo Gambaloza

Center for Advanced Technical Studies

Plastics are harmful to the environment and also to the human body. The null hypothesis is that both plastic and bio spoons don't have a difference. The alternate is that the bio spoons can exceed the plastic utensil during testing. GreenWorks, HaloGreen, EcoFriendly bio spoons, and Comfy traditional plastic spoons were through different kinds of trials. Boiling is where the spoons were trying to survive inside the boiling water for one hour. A survey tests people asked which spoon utensils are preferable but doesn't know what kind of spoon is being used. Composting is where the spoons are inside the composter. Spoons are getting water once a week and placed on a heating pad. Boiling test every spoon survived in the boiling water. HaloGreen bio spoon is the favorite, while the EcoFriendly is the least favorite spoon. GreenWorks and Ecofriendly bio spoon show a sign of decomposition. People like the HaloGreen bio spoons because of the round scoop, Ecofriendly bio has the least because it's deep. The bio spoons can replace the plastic

based on these results. These results are important to support the alternate hypothesis. Make a bio spoon, and there is a plant seed inside.

FURTHER DEVELOPING A MERGED ASPIRATION THROMBECTOMY DEVICE AND ROTATIONAL  
ATHERECTOMY DEVICE FOR EFFICACIOUS INDIVIDUAL OR JOINT REMOVAL OF THROMBI AND PLAQUE

Shyam Ganesh Babu  
Spring Valley High School

Endovascular occlusive diseases are among the leading causes of death around the world. Specifically, thrombosis is responsible for 1 in 4 people dying worldwide. Atherosclerosis is the cause of over 50% of deaths in westernized society. The purpose of this research was to improve on existing atherectomy and thrombectomy technology by producing a novel device that can conduct an atherectomy or thrombectomy independently or simultaneously. The goal of this research was to design, construct, and test an efficacious and safe joint rotational atherectomy and aspiration thrombectomy device. The device was designed using 3D models and constructed using balsa wood, metal tubes, DC-motors, 3D-printed parts, wires, batteries, and surgical tubes. To test the device, a mock aspiration thrombectomy and rotational atherectomy were performed in a model blood vessel using model blood clots and plaque, respectively. The joint device was successful and increased the lumen diameter of blood vessels obstructed with blood clots or plaque.

THE EFFECT OF A PNEUMATIC CYLINDER-BASED SOLAR TRACKING SYSTEM ON THE ELECTRICITY  
PRODUCTION OF A PHOTOVOLTAIC PANEL

Shrihan Ganesh Babu  
Spring Valley High School

With global warming increasing exponentially, renewable energy sources have never been more important. Solar energy has held a promising future, however, the low efficiency of solar cells has limited popularity. Implementing a solar tracking system is one way to optimize electricity production. The ideal solar tracker is not yet marketed because of the lack of reliability or inefficient energy production. The purpose of this paper was to construct an electricity-free solar tracking system that produces an increase in average voltage levels over a fixed solar panel. It was hypothesized that when an efficient solar tracking system was created, the average voltage production of the solar panel would increase when compared to a fixed solar panel because the tracker would keep the panel perpendicular to the sun at all times. The final solar tracker design implemented a pneumatic cylinder and microcontroller to create a single-axis chronological tracker. The tracker was tested with a light moved around the panel. The results of the solar tracker indicated an average 31% increase in voltage levels when compared to a fixed panel, which is consistent with other dual-axis solar trackers. Data were statistically analyzed with an unpaired z-test using a 95% confidence interval. The mean increase in voltage was determined statistically significant, as the p-value of 0.0072 was less than the  $\alpha$ -value of 0.05. Therefore, it was found that the proposed pneumatic cylinder solar tracker is a viable, electricity-free alternative to conventional solar tracking systems.

COMPUTATIONAL MODELING OF GRAPHENE GRAIN BOUNDARIES

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South Carolina Governor's School for Science and Mathematics

Graphene is such an important material for a variety of reasons, it's the only man-made 2D object, Its stronger than steel, and lighter than aluminum. In the world of Mechanical engineering, Graphene is quite a hot topic. Dr. Enrique Martinez introduced us to a lot of research about Graphene, so much so that we

realized how important it is. Knowing how important it is, these factors led us to want to do our own research. Using hardware (Palmetto) and software (LAMMPS) provided by Clemson, we were able to run simulations to test the true strengths of Graphene. We put sheets of graphene (one with defects, and one without) under various degrees of stress and this is what we found. After putting the sheets under various levels of stress and temperature, we found that a perfect sheet of graphene would break under about 300k bars of stress and 3000 K. A sheet with two defects in opposite corners, however, would break under much less stress, at about 125k bars and 3000 K. Overall, these results further the notion that graphene is insanely strong and has so many practical uses. Think about lightweight wings on an airplane that would reduce fuel, and likewise reduce emissions. Reasons like this are why graphene is the future, and why we need to keep testing it.

#### THE EFFECT OF NYQUIL ON THE RATE OF PHOTOSYNTHESIS OF *ELODEA CANADENSIS*

Hunar Gill

Spring Valley High School

COVID-19 has increased the use of cold medicines to alleviate symptoms. As more people consume medications, the pharmaceuticals build up in the environment due to improper disposal practices and negatively impact organisms. The purpose of this study is to determine if *Elodea canadensis*, a common aquatic plant, is affected by pharmaceuticals in Nyquil. The experiment consists of three groups of Elodea planted into three different sections of an aquarium tank, each receiving different doses of Nyquil every other day. Each tank's dissolved oxygen (mg/L) and pH levels were measured for ten continuous days to determine the effect of the drugs on the plant health. The hypothesis for this experiment predicted that the Elodea plants exposed to Nyquil would have a lower dissolved oxygen and pH concentration which would indicate decreased photosynthesis and therefore, a decline in plant health. The results show that there was a decrease in oxygen and pH in both experimental groups. These findings supported the hypothesis, confirming that pharmaceutical pollution is a threat to living organisms unless society begins to dispose of drugs and medicines more safely.

#### PREDICTING HARMFUL ALGAL BLOOMS WITH WATER QUALITY PARAMETERS

Alyssa Gillam and William Ostergaard

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Algae, single-celled autotrophs, are essential organisms in freshwater ecosystems. However, when a body of water becomes eutrophic, or has excess nutrients, a harmful algal bloom (HAB) may occur. This research project aims to collect and analyze water quality parameters to predict HABs. We collected samples from Lakes Murray and Wateree for analysis. Lake Wateree was chosen for sampling because it is currently undergoing a harmful algal bloom. Lake Murray was chosen more as a long-term study project and because the lake is heavily used for recreational purposes. The sample water was collected by a Niskin bottle lowered to a specific depth, based on data we received from a multiparameter sonde. The samples were analyzed via filtering for phytoplankton concentrations and by a membrane inlet mass spectrometer (MIMS) for the concentrations of dissolved gasses, especially nitrogen and oxygen, to determine the productivity of microorganisms in the water. Data collected from the sonde was run through MIMS and corrected in a separate Excel file. After that we could form graphs based on the data collected. These graphs show the change in excess nitrogen at different depths and days. This allows us to see how the lake changes over months and years. If we had more time to conduct this research, we would have looked further at data from Lake Murray, since we observed a gradual increase in biogenic N<sub>2</sub> in the anoxic bottom water over the summer. We observed a more oxic environment, and generally, denitrification is present in anoxic environments.

## ANALYZATION OF 3,4,5-TRIFLUOROPHENOL USING MICROWAVE SPECTROSCOPY

Eva Godwin and Liana Brock

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We researched the shape of 3,4,5-trifluorophenol through rotational spectroscopy. Experiments in microwave spectroscopy on this specific molecule have not been done before. We tested our microwave spectrometer with acetone first (a substance with a known rotational spectrum) and made sure that its known spectrum fit the spectrum that we recorded on our own. Then we calculated the shape of 3, 4, 5-trifluorophenol using computer software. We used a chirped-pulse Fourier transform microwave spectrometer to measure the microwave spectrum of the molecule. After that, we compared the calculated spectrum with our experimental spectrum and matched the calculated spectrum to transition lines that were observed to determine the experimental rotational constants. Using the data that we collected, we were able to get a precise and accurate measurement of the shape of 3,4,5-trifluorophenol. This shape is related to how it interacts with other molecules in its environment.

## USING PORTABLE WATER TURBINES TO GENERATE ELECTRICITY FROM RIVERS AND STREAMS TO POWER SMALL ELECTRONICS

Ganis Griffin

Center for Advanced Technical Studies

Large numbers of people in the United States have access to rivers and streams, but have no ability to use this natural energy to their advantage. This Project will be capturing the energy from flowing water in rivers and transforming it into usable energy to power small electronics. This project includes a trolling motor that is used to simulate the flow of a river and a flow meter that accurately measures flow rate in meters per second. The trolling motor is used to run simulated tests in the lab that are similar to the flow rates collected in the rivers. The flow meter is used to measure flow rates in the lab, but in the rivers to ensure the lab simulation is as close to real as possible. The results for this project were recorded in the lab using a trolling motor, Spark data collection unit, flow meter and 12v bulb turbine and results recorded in the rivers using the flow meter and Spark data collection unit. The data recorded to date support the alternate hypothesis for this project. The project has successfully produced sufficient amounts of electricity to power electronics through the simulation of flow rates collected from local rivers. These findings this project produced make it known that portable hydropower from rivers will produce enough electricity to power small electronics. This project will be bringing portable turbines to these rivers used in the project and powering small electronics.

## WEIGHT CUTS IN WRESTLING: HYDRATION AND MENTAL HEALTH

Mathew Gummere

Chapin High School

The purpose of this experiment was to determine if there was a preexisting correlation between hydration and mental health indicators in high school male wrestlers who were intentionally losing weight. In order to determine this, wrestlers took the Youth Mental Health Test created by the organization Mental Health America and reported their hydration as measured by a bioelectrical impedance scale. This data was then compiled into graphs and analyzed using a linear regression equation. It was determined that a correlation between hydration and indicators of mental health was present, and thus that high school athletes should avoid dehydration to intentionally lose weight. This conclusion was supported by the effects on physical health which were previously well-documented, and this newfound correlation which showed that dehydration is associated with indicators of poor mental health.

## CO-APPLICATION OF BIOCHAR AND UREA ON THE NITROGEN UPTAKE OF BRASSICA RAPA

Nidhi Guntupalli  
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With the growing use of nitrogen fertilizers, there has been a concern for if the fertilizers were doing more harm than good. Nitrogen and water pollution have developed into prominent issues in the environment's health, as they can lead to low-quality water and eutrophication. This study focuses on the amount of nitrogen plants use, therefore, determining how much nitrogen is being used indirectly, through runoff and other pollutants, using biochar and urea. It was hypothesized that the application of biochar and urea would result in a higher nitrogen efficiency, meaning that a majority of the nitrogen available to the plants is used as intended - by the plants. The nitrogen usage was conducted by measuring the nitrogen before and after plant growth, in the soil and calculating the difference. The nitrogen levels were determined using a nitrogen test kit and a color change chart. For this experiment, a one-way ANOVA test was used,  $[F(3, 52)=21.36, p<0.05]$ , which determined that a significant difference was present between the data. Furthermore, the post hoc Tukey test was used to determine which difference was significant in the datasets. Four differences were significant, Biochar vs. Urea, Biochar vs. Biochar + Urea, Biochar vs. Control, and Biochar + Urea vs. Control. These results showed that the hypothesis was supported, as the nitrogen usage was highest in the Biochar + Urea group, compared to the other groups. These results concluded that the application of both biochar and urea allowed for more efficient use of the nitrogen available to plants. The results of this study would further improve the methods and practice used to sustainably farm and use fertilizers.

## AUTONOMOUS UNDERWATER VEHICLE IMAGE PROCESSING AND CONTROL

Jasmine Hagerty  
South Carolina Governor's School for Science and Mathematics

Despite making up 75 percent of the earth's surface, only 5 percent of the ocean has been explored. Autonomous Underwater Vehicles (AUVs) are valuable tools that help us expand our knowledge of the ocean as well as the Earth as a whole. While coding an undersea robot for autonomous control is far from new, the challenge presented to us encompassed the basics of how AUVs operate in the real world. The challenge combined image processing, vehicle control, and mission reconstruction in order to aid the AUV in successfully navigating an underwater field of red and green buoys, similar to those used by the US Coast Guard. Our team worked remotely due to Covid-19 and our code was uploaded and tested on AUVs in the MIT pool. The AUV was able to successfully navigate one out of four buoys, but due to time constraints there was no time for further tweaking of the code to make the AUV run more smoothly. Despite all this, the AUV was successful in all areas of image processing and control similar to how AUVs navigate the ocean in real missions.

## THE PHYTOREMEDIATION OF *ESCHERICHIA COLI* IN CONTAMINATED WATER BY *LEMNA MINOR*, *SALVINIA MINIMA*, AND *AZOLLA CAROLINIANA*

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Pathogenic strains of *Escherichia coli* can cause potentially fatal diseases like hemorrhagic colitis. Phytoremediation is the process in which plants remove contaminants like *E. coli* from the environment. *Lemna minor*, *Salvinia minima*, and *Azolla caroliniana* are three aquatic plant species that have been tested in previous phytoremediation research, but their abilities to expunge *E. coli* from water have not been directly compared. The purpose of this study was to test and compare the abilities of *L. minor*, *S. minima*, and *A. caroliniana* to reduce *E. coli* concentration in contaminated water. It was hypothesized



that aquatic plants would decrease the concentration of *E. coli* in water due to the antimicrobial flavonoids they produce, and *L. minor* would kill more bacteria than *S. minima* and *A. caroliniana* because of its fast growth rate and extensive roots. Plants were placed in fertilizer solution, and *E. coli* was added to each sample. Initial and final concentrations (CFU/mL) of *E. coli* in the samples were determined after a serial dilution. *L. minor*, *S. minima*, and *A. caroliniana* resulted in a 97.890%, 90.292%, and 99.063% decrease in *E. coli* concentration, respectively. A Kruskal-Wallis test found that results were statistically significant,  $H(3) = 51.413$ ,  $p < .001$ , and Dunn's pairwise tests found significant differences between *L. minor* vs. control, *S. minima* vs. control, and *A. caroliniana* vs. control. The results of the present study suggest that *L. minor*, *S. minima*, and *A. caroliniana* are equally effective at remediating *E. coli*-contaminated water.

#### ENERGY VAMPIRES: HOW TO ELIMINATE THEM AND BECOME ENERGY EFFICIENT

Jayden Harris

Center for Advanced Technical Studies

For this project, the kWh of various electrical household devices will be measured through the use of a device known as a KILL-A-WATT, and proposing solutions to making or using the device more efficiently. The goal of this project is to raise consumer awareness of energy vampire devices and eliminate them to reduce utility cost. It is best that this knowledge is given out to the average middle class person so that they can lower their electricity costs and use the majority of their funds for different purposes.

#### COLD SORE COVERAGE: HERP-BE-GONE

Logan Hazel

Center for Advanced Technical Studies

Cold sores are a type of infection that occurs around the lip and nose area. With Cold Sore Coverage: Herp-be-gone, the idea was to create a medication that heals and covers cold sores. Those that have to deal with the HSV-1 virus and its symptoms would want to invest in this product. This product will cover the harsh blisters that come along within them, as well as, heal the sores and allow them to disappear at a faster rate. Significantly enough, cold sores affect 80% of Americans. As well as 9 out of 10 Americans have the HSV-1 virus within their bloodstream. For this project, Cosmetic tubes will be needed, as well as a liquid bandage, Kur cold sore medication, tower 28 make-up tint, and special effects makeup. For the ranking criteria of this project, it needs to have its healing aspects, its coverage aspect, and its stick aspect. The most effective way to handle this project would be to test the coverage mechanism. There will be 3 sores based on a 1-5 ranking of their coverage. In the final stages of this project, the sore with the most coverage will determine the amount of ingredients in the product.

#### THE EFFECT OF ROOT TEMPERATURE ON THE ROOT LENGTH OF AEROPONICALLY GROWN *MUSCARI*

Charlton Hill

Spring Valley High School

Farming is an essential way of gathering food for humanity, and has been altered over the years thanks to technology. Throughout the past couple of decades, different methods of farming have been created, such as hydroponics and aeroponics. Aeroponics is the process of misting the roots of the bulb, seed, bud, etc., in order to give the plant the nutrients it needs to grow. The purpose of this experiment was to determine the best root temperature range in which to grow plants aeroponically. It was hypothesized that the bulbs with the highest root temperature would have the longest root length based on the fact that plants tend to thrive in slightly higher temperatures than 21°C. Three aeroponic devices with water temperature settings of 13, 21, and 31 degrees Celsius were used to allow the *Muscari* bulb to remain suspended in the air while still receiving necessary nutrients from the mist. The two temperature groups,

21°C and 31°C, were shown to support the hypothesis that the bulbs with the highest root temperature would have the longest root length [ $F(2,9) = 9.1$ ,  $p=.00015$ ] and [ $F(2,9) = 6.7$ ,  $p=.0015$ ]. The group held at a temperature of 13°C did not show a significant difference in growth [ $F(2,9) = .752$ ,  $p=.47$ ]. Therefore, the bulbs grown in colder temperatures had a more negative impact on the root growth, and the warmer and neutral temperatures had a more positive impact on the growth.

#### SPERM PRECEDENCE IN GENETICALLY DIFFERENTIATED POPULATIONS OF *DROSOPHILA MELANOGASTER*

Isabelle Hipple

South Carolina Governor's School for Science and Mathematics

Sperm precedence is a mechanism in many organisms, including *Drosophila melanogaster*, by which sperm of one male is more likely to fertilize eggs than sperm of another male. Because the relative fitness of a male will be determined by the success of his sperm in competition with another male, selection can shape competitive interactions between males that occur within the female reproductive tract. While this type of conspecific sperm precedence is well established in different species of *Drosophila*, it is unclear to what extent this occurs between populations of the same species. In this experiment, we used two genetically differentiated long-term laboratory populations (IV and LHM), to ask two questions: 1) Do males from different genetic backgrounds show differences in reproductive success when mated to females? 2) Do males from different genetic backgrounds show differences in sperm competition outcomes? To answer these questions, we mated IV female and IV male pairs, as well as IV female and LHM male pairs. Some IV females were mated in sequence, first with an IV male, and then with an LHM and vice versa. The average number of offspring produced by females were then compared. Despite it being well established in *Drosophila* that second males father the majority of offspring (Price 1997), LHM males sired significantly less offspring than their IV counterparts regardless of mating order. While the reason for this reduced reproductive success is not entirely known, this research is important in understanding the process of genetic differentiation and ultimately how speciation occurs.

#### WHAT'S THE DEAL WITH WATER

Haley Hix and Ashley Cripps, Matthew Doty

Center for Advanced Technical Studies

Affordable natural disaster kits and water filters are not economically efficient or accessible to those who are in need of it, we want to create an affordable kit with a specially designed water filter to help provide clean water to those in water crisis. This problem is important to solve because large-scale natural disasters around the world are affecting people every day. According to the EPA clean water is essential to our health, communities, and economies. Natural disasters on average affect over 100 million people per year globally so this is clearly an issue that can still be worked on.

#### EFFECT OF COVID-19 ON SMALL BUSINESSES IN CHAPIN SOUTH CAROLINA

Thomas Holstein

Chapin High School

As COVID-19 has affected the United States within the past few years, many businesses have been affected indefinitely. The purpose of this project is to explore the affects of COVID-19 on different small businesses in Chapin, South Carolina. These small businesses range from dentistry to restaurants to grocery stores and many more. This is because all of these businesses have had different environments that they had to react to when COVID-19 started. Thus, it will provide an overall view of the community as a whole and how COVID-19 has affected these small businesses.

## ASPERGILLUS NIGER GROWTH ON TYPES OF COMMON DRYWALL MATERIALS

William Horman  
Spring Valley High School

Families around the world suffer from the effects of mold growth in the home every year. Mold is responsible for causing health issues such as headaches, coughing, wheezing, and watery eyes. Additionally, mold can aggravate asthma, lung cancer, or pneumonia. Mold spores are most commonly found growing on drywall surfaces. The purpose of this project is to find a reliable drywall material that can combat the growth of mold in the everyday household. To test how different types of drywall stand up to mold growth, thirty samples of each drywall material were cut into 9 square inches. These squares will then be placed into trays and the *Aspergillus niger* added to the surfaces of the drywall pieces. A colony counter will be used to record the measurements in square centimeters. It was hypothesized that the Purple XP drywall would prove to be most resistant to mold growth. The results support the hypothesis as the Purple XP showed the least number of square centimeters of mold growth. An average of 1.013 square centimeters of mold grew on the High Strength drywall. An average of 0.519 square centimeters grew on the Purple XP drywall and an average of 0.573 square centimeters grew on the MgO Board. Using the ANOVA one-way test the p-value of the High Strength drywall is determined to be 0.711. The p-value for the Purple XP is 0.810 and the p-value for the MgO Board is 0.955. These p-values exceed an alpha value of 0.05, showing that the results are not statistically significant.

## POWERING MOBILE PHONES WITH A SKATEBOARD

Steven Jackson  
Center for Advanced Technical Studies

With cell phone usage becoming more and more popular, the demand for powering these devices is also increasing. A skateboard that is able to charge a portable phone charger while riding it is another way to power the seemingly endless demand for electricity. The hypothesis is that if an electric generator created from pre-existing parts is used on a skateboard, then it will generate enough electricity to sufficiently charge a portable phone charger. Prototypes will be created and tested. The flaws of the prototypes have been fixed, and will continue to be fixed, until a prototype is created which is able to successfully charge the portable phone charger. The electrical generator is providing enough power to charge the portable charger, although it has not actually charged it yet. The voltage produced ranges from 37 to 80 volts, which would be sufficient to charge the portable charger. As of now, the hypothesis cannot be accepted or rejected, since the portable charge has not been implemented to any prototype yet. The future work that needs to be done is to create prototypes with the portable charger that will be able to power the portable charger.

## DEVELOPMENT OF CARDIOVASCULAR PLAQUE BLASTER

Asah Jenkins  
Center for Advanced Technical Studies

The mission of this engineering innovation is to reduce the amount of Atherosclerosis in CAD by breaking it down faster where it can flush out the body. With the liquid Blaster, it will benefit patients who have rapid increase and substantial plaque build-up, the top targeted patients would be, anyone the Ages 65+, Postmenopausal women, and Obese Individuals. It is of great importance to treat CAD because if left untreated the condition can lead to other Heart issues such as Cardiogenic shock which can lead to a severe heart attack that can cause death. Heart Diseases such as CAD are the number 1 leading Cause of death in the U.S said the CDC due to the fact heart disease that causes atherosclerosis can vary and morph into several types of other heart conditions. With the liquid supplement, the goal or main purpose is to just

slow down how much plaque is building and to break down larger portions the study of this innovation will be different from other products already out due to its liquid base quality and ingredients used for the artery as well for the fact the plaque was hand made and dried vs finding a heart to actually test on. The natural selection with a portion of acids and enzymes method was chosen to keep the nonartificial aspect of the liquid and to have an effective breakdown process in the artery in the research process results found that products like sunflower oil any natural plant product, seeds etc help plaque break down. the innovation will see results when over the course of 3-5 trials, less and less atherosclerosis shows up in the tube that is used to represent the artery. This innovation is not to cure the disease but to lessen the chances of risk increases.

#### AN APP TO ASSIST IN EATING DISORDER RECOVERY- REWIRING YOUR BRAIN

Lillian Jenkins

Center for Advanced Technical Studies

This project is targeted towards teens who struggle with eating disorders, specifically anorexia, as such disorders can result in a variety of health defects from malnourishment to death. Treatment options for those with eating disorders are both limited and expensive, making them inaccessible to many. Many teens struggle with eating disorders and find themselves with a lack of time or resources to pursue recovery. The creation of this app will allow for a more accessible way for people to begin their self-guided journey to recovery. Developed using X-Code software, the app will utilize positive reinforcement to gradually alter the user's mindset towards food, as eating disorders generally stem from negative self image or consistent negative associations with food. The psychological component of eating disorders is what makes recovery so difficult, as many patients find it difficult to change their approach to food due to an extended negative relationship with it. This project will likely allow patients to begin the transition to a more positive and healthy relationship with food, as it is evaluated on whether it is positive and encourages healthy thoughts and habits. This project will allow for those with a more limited range of recovery options the opportunity for a greater chance of recovery and the improvement of their health.

#### CLOUD STAPS: DEVELOPMENT OF A BACKPACK TO SOLVE BACK PAIN

Tishyra Johnson

Center for Advanced Technical Studies

The problem with backpacks today is that they are not supportive nor comfortable to carry around for 8 hours. Students complain about back pain due to lack of support in material in backpacks and how much they have to carry for school everyday. The creation of this backpack is to be stylish, affordable, and most of all comfortable for students that carry a lot of school supplies that makes backpacks heavier. This project is to benefit anyone that may experience back pain with backpacks especially students. This project is one of a kind as there were no similar projects to it. With this project, the materials will be an original backpack, add memory foam to the shoulder straps, and air in the back part of the backpack, hoping this will make shoulder and back pain decrease. To see if the design worked, there will be a few testes to take the survey provided with levels mild, moderate, or servere on how bad they experience back pain from original backpacks then after the designed backpack has been worn for two weeks, they will take the same survey again in hopes they choose the option that says "no pain". If there were somebody that did experience pain, their opinion would be asked and revision(s) will be made.

## INVESTIGATING THE ROLE OF PLASTICITY RELATED GENE-2 IN CHICK RETINAL GROWTH CONE RESPONSE TO LYSOPHOSPHATIDIC ACID

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Lysophosphatidic acid, or LPA, is believed to be a major repelling chemical cue in the process of Axon Guidance in the formation of the visual system in Utero. In the visual system, Axon Guidance is necessary for the formation of the Optic Nerve. Plasticity-Related Gene's or PRG's, are a family of possible LPA-interacting proteins. There are 5 known PRG genes, PRG-1 through PRG-5. These are believed to play a role in Retinal Growth Cone collapse during Axon Guidance. PRG-2's role in Retinal Growth Cone collapse when exposed to LPA was studied through using a CRISPR system to mutate Chick Embryo Retinal Ganglion Cells (RGCs). It is believed that through this process, growth cone collapse could be prevented through the mutation of PRG-2. Following RGC mutation, Chick Retina was harvested through dissection. Mutated RGC's were then exposed to LPA and growth cone collapse was recorded. This research is ongoing, and results have yet to be produced. Previous studies suggest that PRG-1, PRG-3, and PRG-5 may be involved in axon retraction but are not solely responsible for it. It is expected that mutating PRG-2 will prevent LPA from inhibiting axon outgrowth. If this is proven true, this information could be further researched. It could then possibly be applied in a clinical setting in cases where the Optic Nerve is damaged or develops incorrectly.

## THE PRODUCTION CYCLE OF KETAMINE HYDROCHLORIDE INJECTION IN A PHARMACEUTICALS CORPORATION: FROM RAW MATERIAL TO COMMERCIAL PRODUCT WITH A FOCUS ON CHEMICAL LABORATORY PROCESSES

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Behind the bottle of pills at the store or the anesthetic used during surgery is a web of materials and processes. As a pharmaceuticals corporation, Nephron manages all areas of drug development--procurement, formulation, packaging. We conducted an in-depth examination of this development process using Ketamine Hydrochloride, a Schedule III controlled substance, to explore each step of product development. To understand production operations of Ketamine Hydrochloride, we interviewed experts, made observations, conducted chemical testing, read SOPs and studied monographs by USP. We identified specifics of each phase of the cycle. Phase I focuses on preparing formulation components. Phase II includes processes which ensure quality. Phase III involves producing the commercial product and post-release testing and verification. Finally, we performed lab tests to explore how drugs are tested from specific acceptance criteria. We focused on extractables testing, or chemicals from the packaging that have potential to break down and diffuse throughout the drug, therefore affecting the product. In our extractables assessment, we followed two procedures to compare the negative control to the extraction solution: buffering capacity, which uses a pH titration to neutralize the pH of each samples, and nonvolatile residue, which uses a steam bath to evaporate the water, and recorded the weights of residue left. Through these examinations and lab tests, we were able to study the process of drug creation and see how things that may seem trivial are actually important in ensuring the safety and quality of a drug you might see at the pharmacy.

## OPTIMIZING WAREHOUSE DISTRIBUTION BY RANDOM SAMPLING USING CENSUS DATA

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Businesses and governments need optimal locations for new buildings and services. The goal of this study was to model warehouse (any building or service local) distribution and use that model to study the relationship between warehouse distribution and population distribution. Warehouse distribution was modeled using Census tract and block data. To calculate the best location for a set of warehouses in a given geographic area, a random sampling optimization algorithm was run to improve the average distance a person would have to travel to their nearest warehouse. The qualities of many states and countries' warehouse distribution were studied by running the optimization algorithm with varied parameters. The U.S. national warehouse distribution was analyzed by performing the algorithm for varied sets of 1-2000 warehouses and plotting the relationship between warehouse count and the average distance a consumer would have to travel. The U.S. distribution was compared with San Francisco, Tennessee, Australia, and South Africa distributions to study the relationship between a population distribution's shape and its warehouse count vs. minimum average distance distribution. The wider a population is dispersed the closer the exponent of the warehouse count vs. minimum average distance trendline is to 2, while the exponent is closer to 1 for more one-dimensional, linear population distributions. Using this algorithm to understand the relationship between optimal business and service locations and population distribution could lead to better urban planning and less service deserts.

## YOUTH, GENDER, AND PUBLIC LEISURE SPACES

Ace Kelly

South Carolina Governor's School for Science and Mathematics

Research has shown that public leisure spaces are highly beneficial for communities and people, but numerous populations lack access to them. Though research has discussed ethnic, race, and socioeconomic barriers that impact access to public leisure spaces, minimal research has been done on identifying the barriers affecting youth of different genders. This study examines how youth's gender impacts their use of public leisure spaces. Nine interviews were conducted with cisfemale, gender queer, and cismale youth. Participants were asked about their free-time activities, comfort, and recommendations to improve feelings of safety in public leisure areas. Interviews were recorded, and the audio files were transcribed. The transcriptions were coded to identify similarities and themes. Findings showed that cisgender women tended to be more cautious and fearful than their cismale counterparts, with genderqueer people falling between them in most differences. For example, genderqueer youth tended to have a mix of fears from both the cismale and cisfemale perspectives. Study limitations included having a small number of participants and using a convenience sampling to identify potential participants. As views of gender and equality change, it is necessary to examine gender's impact on public leisure spaces for youth. Cities can also continue to make sure that public leisure spaces are accessible to all.

## A COMPARISON OF GAMING PLATFORM EXERCISE VERSUS TRADITIONAL EXERCISE

Logan Kelly

Spring Valley High School

<p>The purpose of this experiment was to compare exercise intensity between two video game platforms. Many teenagers enjoy technology and can possibly utilize these platforms to exercise. It was hypothesized that if teenagers exercised with the Nintendo Wii compared to the Oculus, then participants would have higher heart rates while playing the game which directly relates to more calories burned. Thirty high school students played video games using virtual reality headsets (Oculus), the Wii console and a control

group performed running as their physical activity. Heart rate data was collected from each activity and was analyzed and compared. calories burned was calculated using the weight of participants and the metabolic equivalent of the activity. The major finding was that the average percent change in heart rate was 26.40, while the Wii had 17.04 . Along with the Oculus having a higher average calorie burn of 182.55 than the Wii having an average calorie burn of 121.87. Overall, if using a digital platform to perform physical activity, using the Oculus to do so would be the better option.</p>

#### THE EFFECT OF TEMPERAMENTAL PERSONALITIES ON EMOTIONAL INTELLIGENCE

Heiyaani Kerai

Spring Valley High School

Emotional intelligence is one's ability to understand their emotions as well as use it to understand the emotions of others. This study discusses how temperaments can affect emotional intelligence using the temperament theory. The temperament theory consists of four different types of temperaments: sanguine, choleric, melancholic, and phlegmatic. The purpose of this research was to determine the correlation between temperaments and emotional intelligence. It was hypothesized that the sanguine temperament would have the highest emotional intelligence because those with the sanguine temperament tend to be more outgoing and sociable, which helps them better understand others emotions. To test this, a survey was conducted in which there were two parts. The first part tested the independent variable, the different types of temperaments, and the second part tested the emotional intelligence using the Schutte Self Report Emotional Intelligence Test. The test was a self report test in which subjects had to evaluate if they agreed or disagreed to situations using a scale of 1 to 5, 1 being strongly agree and 5 being strongly disagree. After the data was collected, the results from both parts were compared. To determine if the data was statistically significant, a Chi-squared test was used. According to the test, the results are statistically insignificant ( $p > 0.05$ ). Nevertheless, the temperament with the highest emotional intelligence are those with the phlegmatic temperament. Although the hypothesized stated that the sanguine temperament would have the highest emotional intelligence, those with this temperament are outgoing and extroverts, they tend to get distracted and have poor concentration causing them to have a lower emotional intelligence than phlegmatic. According to the temperament theory, the phlegmatic are emotionally stable causing them to have a high emotional intelligence.

#### DESIGNING A LITTER BOX THAT NEUTRALIZES *TOXOPLASMA GONDII*: A PARASITE THAT CAUSES TOXOPLASMOSIS IN HUMANS

Doonya Khan

Center for Advanced Technical Studies

Pregnant women are unaware of the possibility of their cats carrying a parasite known as *Toxoplasma gondii*. This parasite can have effects on the health of their fetuses because the parasite causes Toxoplasmosis, an infection that can be passed on congenitally, increasing the risk of being born with abnormalities. Since there are no vaccines made for human or cat use at the moment, the creation of a litter box that neutralizes the parasite will decrease the risk of pregnant women from getting infected. This litter box is self-cleaning and contains UV light attached to three sides of the hood of the litter box. Self-cleaning litter boxes contain sensors that detect no movement which allows the litter to be moved around. The UV lights have the same sensors as the self-cleaning litter boxes allowing them to turn on for an interval of time. If *T. gondii* samples are mixed with salt and cat litter, UV light can be used for different intervals of time to test for the inactivation of the parasite. To test the inactivation, samples were observed underneath a microscope. When the litter box was designed, the ranked criteria was based on the affordability, odor control, neutralizing effectiveness, and safety of the litter box. One similar product

is the LitterZap which only uses UV light, however, its position in one location doesn't cover the entire litter box. Pregnant women who clean litter boxes often have complications that can be limited with the use of this new innovative litter box.

#### INFLUENCE OF SURFACE WATER DISPLACEMENT ON SOLVATION THERMODYNAMICS

Mia Kim

South Carolina Governor's School for Science and Mathematics

Many chemical reactions are carried out in an aqueous solution, as it is much more energy efficient. The aqueous media affects both the reaction thermodynamics and the surface chemistry. This is called Aqueous Phase Reforming (APR). APR transforms oxygenated hydrocarbons from biorefinery into hydrogen and/or light alkanes while remaining in the aqueous phase. APR is also commonly used in biorefinery, the process that transforms biomass products into energy or other valuable products in order to reduce fossil fuel dependency. My specific project analyzed the solvation thermodynamics of several adsorbed molecules, such as acetone, carbon monoxide, and hexanedione, with Molecular Dynamic (MD) simulations and Free Energy Perturbation (FEP) calculations. There were three goals of the project: (1) Visualize and identify the quantity of water molecules displaced by each adsorbate with MD simulations, (2) Calculate the free energy of each adsorbate using (FEP) calculations, and (3) estimate the impact water displacement has on solvation thermodynamics. Understanding the impact of both the APR process and surface water displacement will ultimately lead to a better understanding in the development of catalytic materials in biorefinery, a step closer to fossil fuel independence.

#### THE EFFECT OF GRAPHICAL VERSUS TEXTUAL DISPLAY OF INFORMATION ONLINE ON THE PERCEPTION OF CREDIBILITY

John Kim

Spring Valley High School

In today's society much of the information that spreads comes from online sources, such as news or social media platforms. In such sources the information inside can be difficult to understand, which can be the result of different formats of information including graphs, videos, or text. The purpose of this study was to better understand how the format of information changes the understanding of high school students about various topics. The second purpose of this study was to figure out if high school students are able to predict if a source is credible by looking at information in different formats. It was hypothesized that high school students would be able to tell the difference between untrustworthy sources and trustworthy sources. This is because most high school students have enough common sense to know if something is fake. A likely outcome of this experiment is that graphs would be easier to understand compared to other formats. Using a google form as the base, three surveys, which included graphs, texts, and videos, were created and sent to the three groups. The results showed that there was not enough evidence to support a difference in the perception of credibility based on the format of information  $\chi^2 (1, N = 41) = 1.377, p = .502338$ . In addition, the different formats of how information was presented did change the students' understanding of the information  $\chi^2 (1, N = 41) = 7.0916, p = .028846$ . These results indicate that students most easily understand information presented in a video format.



## MODIFICATION OF LOVASTATIN TO EXPAND SELECTIVITY TO MMP-9 FOR THE TREATMENT OF FRAGILE X SYNDROME

Mia Kim

South Carolina Governor's School for Science and Mathematics

Fragile X syndrome (FXS) is an X-linked dominant disorder caused by the amplification of the CGG triple at the 5' end of the fragile X mental retardation 1 gene (FMR-1). The most common non-physical symptoms of FXS include developmental delays and hyperactive behaviors, both of which can be associated with autism spectrum disorder (ASD) and attention deficit hyperactivity disorder (ADHD). Over the past several decades, there has been growing interest in the development of drugs to treat FXS. However, due to its primary cause being an error in DNA replication, it is difficult to treat. As such, several pharmaceuticals have been developed to target potential proteins that are downstream of the FMR-1 gene and assist with the production of the fragile X mental retardation protein (FMRP). Two of these such proteins are ERK and MMP-9. In this work, lovastatin, a drug that inhibits ERK activity, was modified to increase its binding affinity to ERK and MMP-9 in an attempt to further relieve effects of the syndrome through two biological mechanisms. The addition of polar functional groups to lovastatin showed marked improvement in binding to the two proteins, showing promising results for a new pharmaceutical treatment of FXS.

## THE WINDING INNOVATION: IMPORVING COMMERCIAL WIND TURBINES BY CHANNELING WIND

Venture Klauk

Center for Advanced Technical Studies

Wind turbines have very limited geographical application and this project hopes to solve that issue. If this project can place a cone in front of a wind turbine then the turbine will perform more efficiently. Making the cone has been done by using very specific cuts of foam. These cuts have been used to combine each other and create a cone. This cone will then act as a template for a metal prototype. The prototype has performed better than placing the turbine directly in front of a wind source. This data showed that this could be improved further. This project has already proven to be a success. This project also has the potential to be better. This has the potential to extend the range of wind turbine use. This result will only happen if work is continued on this project which will be done.

## THE EFFECT OF INTRINSIC AND EXTRINSIC MOTIVATIONAL FACTORS ON VOLUNTEER PARTICIPATION FOR DISTRIBUTED COMPUTING PROJECT FOLDING@HOME

Justin Kong

Spring Valley High School

Folding@Home (F@H) is a distributed computing project that volunteers run to process simulation-based data packets of viral proteins of diseases such as SARS-CoV-2 and Alzheimer's. The initiative has gained significant traction over the course of the pandemic due to its contribution in treatment method research and drug testing. However, persisting issues of retention rate and initial participant attraction have not been addressed. Therefore, the purpose of this study was to determine the general motivational factors for non-volunteer young adult participation in F@H. It was hypothesized that participants would hold greater extrinsically-motivated values with the distribution of the likert scale scores in relation to time spent running the software being statistically significant. A survey-questionnaire was sent to a random sampling of Spring Valley High School students and MechanicalTurk users (18 to 21). Participants were given the choice to run the software for any amount of time, and were asked to respond to intrinsic and extrinsic motivational assessment likert questions (Krebs, 2010). A two sample chi-square test of analysis was performed on the data sets for intrinsic motivation ( $\chi^2(16, N = 160) = 32.509, p < 0.05$ ) and extrinsic motivation ( $\chi^2(16, N = 185) = 56.091, p < 0.001$ ). The results indicated that the average likert scale scores

for intrinsic motivation were greater than that of extrinsic motivation, with the distribution of scores being statistically significant. Furthermore, the study showed that a significant demographic of technology consumers held greater personal values for a scientifically-contributive program, which should be researched more extensively in the future.

#### NANOBIOHYBRIDS: COMBINING THE CATALYTIC ACTIVITY OF METALLIC NANOPARTICLES AND ALKALINE PHOSPHATASE

Elise Lanahan

South Carolina Governor's School for Science and Mathematics

Nanobiohybrids are created by blending functional nanomaterials and living systems. Recent work has provided substantial evidence related to advantages of combining proteins with metallic nanoparticles. The objective is to develop a nanobiohybrid combining Alkaline Phosphatase (ALP) and metallic nanoparticles. The hypothesis is that a hybrid would promote a two-step catalytic transformation and do it more efficiently than individual components. The affinity between different sized copper metallic nanoparticles (from 1 Å (angstroms) to 20 Å) and ALP was calculated using the entire ALP and the top & bottom halves of the protein separately. The affinity decreases from approximately -2 for the 1 Å copper metallic nanoparticles (as the ligand) to approx. -32 for the 20 Å ligand. The protein-ligand complex is more stable regardless the area of the protein the ligand docked on when the ligand is larger. The effects of multiple ligands at a time on one protein were also measured using 9 Å ligands. Despite additional ligands, affinity values stayed fairly consistent. Secondly, catalytic activity of copper nanoparticles with para-Nitrophenyl Phosphate was examined by looking at absorbance of dilutions of p-NPP (with a buffer) with and without copper nanoparticles added. Copper metallic nanoparticles were effective in acting as a domino catalyst by speeding up the reaction of p-NPP to p-AP. This was measured using a spectrophotometer at 400 nm. This research demonstrates that ALP could be effective and is more stable as it grows larger. Additional research could measure catalytic activity of ALP and copper nanoparticles when combined.

#### HYPERSEXUALIZATION, VIOLENCE, AND DESENSITIZATION

Kylie Latham

Chapin High School

Previous research has suggested that violent (79%) and overly sexualized games (21%) are the most common types of video games on the market today (Dill, et al.). This paper examines how violent and hypersexualized games affect desensitization in males. Due to these games dominating the video game market, it is important to explore the potential mental/emotional (desensitization) risks of prolonged exposure to these video games. Specifically in males aged 13-18, in a South Carolina High School. Data was collected from 14 randomized homeroom classes (n=73) ensuring data from all ages (13-18). From October 31, 2021 to December 1, 2021, data was collected from the classes via a 3-part Google Form. After all forms were completed, 2 interviews were conducted on January 13, 2022. To examine results comparing violent/ hypersexualized video gameplay and desensitization in males who play them, a chi-square analysis was conducted, then placed into two separate graphs containing the "mean score" (mentioned in results). Both graphs revealed that exposure to these games did not have a significant effect on desensitization rates. However, the interviews contradicted all data collected. The interviews conducted showed that there is in fact a positive correlation between contrast exposure to violent and/or hypersexualized video games and desensitization in males 13-18. Implications of such game-play could negatively affect how males react in real-life scenarios, this is examined in the Form via scenario-based questions. Future research could be conducted to examine how the brain evolves after continuous exposure to these types of video games.

## THE EFFECT OF CANNABIDOIL AND CAFFEINE ON THE HEART RATE OF *DAPHNIA MAGNA*

Chandler Lawton  
Spring Valley High School

With anxiety on the rise in teens and young adults, there is a trend towards the use of holistic medicine. Holistic medicine focuses on the healing of the mind, body, and spirit. Holistic medicine frequently uses products that contain Cannabidiol Oil (CBD). CBD oil is derived from either hemp or marijuana. This oil contains little to no Tetrahydrocannabinol (THC), a crystalline compound, and the main ingredient in cannabis that simulates a “high” feeling in the body. *Daphnia magna* is used as a model organ to test the effect on the human heart. In hopes to test the effectiveness of CBD Oil, the *Daphnia* were exposed to a caffeine stock solution, to mimic a common symptom of anxiety, an increase in heart rate, and exposure to a diluted CBD oil solution to test the effect of the CBD oil. In order to accurately test this process, *Daphnia*'s heart rate was collected and recorded. A t-test was used to determine the significance of the results. Comparing the two groups' data shows ( $t = 12.98$  and  $p = 0.0001$ ,  $\alpha 0.05$ ). It is hypothesized that the caffeine solution will increase the heart rate whereas the CBD solution will decrease the heart rate. This hypothesis was supported since the results showed that  $p < 0.05$ .

## EXPLORING THE EFFECTIVE SYNTHESIS OF SYNTHETIC POLYMER COMPOSITES THROUGH SOLUTION MIXING OF MULTI-WALLED CARBON NANOTUBES AND EPOXY HARDENER INTO THE POLYMER MATRIX

Ryan Leadbitter  
Spring Valley High School

Carbon nanotubes are widely used and studied for their excellent mechanical properties based on their high tensile strengths and elastic modulus. Epoxy has been found to be an effective reinforcing agent for carbon nanotubes. The purpose of this study was to determine how nanocomposites synthesized using solution mixing of carbon nanotubes and epoxy resin can be produced with optimal mechanical properties in order to gain further understanding of the optimal manufacturing of carbon nanotube-polymer composites to reach even greater industrial potential and make further progress into becoming a ubiquitously used material. It was hypothesized that composites containing epoxy resin and hardener would have superior mechanical properties compared to those produced only with carbon nanotubes. A solution casting method of producing carbon nanotube-polymer composites was used. CNT powder was dispersed in a solution containing polyvinyl alcohol, using a magnetic stirrer. The solution containing the dispersed nanotubes was then placed into a drying oven to cure the composite film. While quantitative data was not able to be collected, observation of the samples showed variance within the test groups and great differences between groups, but no significant conclusions could be reached from the data available. Therefore, the data was insufficient to support or reject the hypothesis that the epoxy group would yield composites with greater tensile strength. Further understanding of the optimal manufacturing of CNT-polymer composites will allow these composites to achieve even greater industrial potential and make further progress into becoming a ubiquitous material.

## THE EFFECT OF FACE MASK ORIENTATION ON PARTICLE FILTRATION

Abbey Lee  
Spring Valley High School

Face masks have been a prevalent topic since COVID-19 appeared, with different forms of face masks becoming popular. Contradictory information on the internet, such as wearing masks inside-out if healthy and wearing masks traditionally if unhealthy, has caused confusion on how to wear masks properly. The purpose of this study was to determine how particle filtration is affected by mask orientation. It was

hypothesized that inside-out surgical masks would allow more respiratory particles through than standard-worn surgical masks. It was also hypothesized that gaiter and cotton masks would block the same amount of particles when worn traditionally and inside-out. An airbrush passed particles of a red food coloring solution through each side of a mask onto a paper. Then, the percentage of paper covered by particles, which corresponded to the particles not filtered by the mask, was found. A one-way ANOVA ( $F(0.0178, 0.0001) = 125.9816, p < .0001$ ) found at least one difference between masks and a post-hoc Tukey-Kramer test found that both methods of wearing surgical masks did not differ from each other, wearing cotton masks traditionally and inside-out did not differ from each other, and that both methods of wearing gaiter masks differed from each other. The test results did not support that standard surgical masks would allow fewer respiratory particles through than inside-out surgical masks. It also supported that both methods of wearing gaiter masks, as well as both methods of wearing cotton masks, would let the same number of respiratory particles through.

#### THE EFFECT OF INTRINSIC AND EXTRINSIC MOTIVATION ON STUDENT SUCCESS IN A MAGNET PROGRAM

Jisoo Lee  
Spring Valley High School

Students may be motivated to join a magnet, or a specialized academic program, in secondary school for various reasons. Whether students are intrinsically or extrinsically motivated to join their magnet can be essential for understanding and predicting their success in the program. The purpose of this study was to examine how the type of motivation of magnet students was associated with their perceived learning, academic achievement, and satisfaction. It was hypothesized that students who were intrinsically motivated would have greater perceived learning, academic achievement, and satisfaction than students who were extrinsically motivated due to the potentially harmful effects of extrinsic motivation observed in various studies. Students in the Discovery and Explorations magnet programs at Spring Valley High School were asked to complete a survey to test this hypothesis, and three chi-square tests of independence were conducted to analyze the significance of the data. Results showed that the type of motivation was independent of perceived learning,  $\chi^2(1, N = 90) = 1.56, p = .211$ , and academic achievement,  $\chi^2(1, N = 82) = 0.09, p = .767$ . However, type of motivation was significantly correlated with satisfaction,  $\chi^2(1, N = 83) = 4.63, p = .031$ . These findings suggest that students who are intrinsically motivated to join their magnet programs are more likely to be highly satisfied with their academic experience than extrinsically motivated students are.

#### WHERE'S MY REMOTE?

Daniel LeGrand and Thomas Moore  
Center for Advanced Technical Studies

With our project we will be designing, constructing, and testing a device designed to locate a misplaced item. This invention has been designed for use on remotes but can be used on any item the locator will fit on. The device is intended to be used to lower the amount of time taken to find lost items, mainly being targeted towards lost television remotes. The device is going to be activated via an app on a cellphone which causes the remote locator to emit an audible beep so that the pursuer can be directed towards the remote or other lost object. The device can be connected to via Bluetooth or wifi with a cellphone, tablet, or other applicable device. The unit Price of each Locator is intended to be composed of common and inexpensive but effective components to make it cost effective and able to compete with alternate products.

## IMPACT OF TIME SPENT ON HOMEWORK ON ANXIETY RATES

Hollings Lesesne  
Chapin High School

This research acknowledges established methods of measuring anxiety for AP social studies students using questionnaires in a high school in South Carolina. Previous studies found an estimated 31.9 percent of adolescents have an anxiety disorder. Out of the adolescents who have anxiety, 8.3 percent had severe problems/anxiety. Anxiety is defined as a disorder made up of features such as excessive fear and related behavioral disturbances. Based on previous studies homework could be a factor that heightens anxiety. High anxiety rates can cause rapid heart rate, palpitations, and chest pain. It can also lead to long-term effects such as depression, sadness, and anger. Additionally, the Advanced Placement program is focused heavily on this research because it is a prestigious class offered to high school students as an opportunity to experience college with a similar amount of homework involved with college courses. This research aims to determine if the hours of homework given in AP social studies classes contribute to high anxiety amongst high school students. The study will involve students taking a survey that asks them quantitative and free-response questions about their amount of homework and amount of anxiety for their AP social studies classes. The gap focuses on high school students. Correlation between these two variables will be calculated using a Linear Regression T-test which found the p-value 0.0006, indicating that there is significant evidence to directly support a relationship between the two variables. Concluding that homework is a possible factor for anxiety in students.

## ABSORBABLE SUTURES THAT STERILIZE AND MITIGATE SURGICAL WOUNDS

Marshall Marin-Dings  
Center for Advanced Technical Studies

I am testing to see if surgical wounds can be sterilized and soothed while healing. I believe this is important because of the possibility of lives being saved and this benefits anyone undergoing surgery. My project will be similar to other experiments done with polydioxanone sutures except for the difference of my attempt to use capillary action in my tests. I plan on infecting porcine skin and designing my own drip-coating process for the sutures using pennsaid and possibly moisturizer. I plan on discovering ways to disperse the medication throughout the wound and thus creating my product. I will analyze it by observing how effectively it killed the staphylococcus aureus as planned.

## USING SOLAR PHOTOVOLTAIC ENERGY TO POWER A PORTABLE BLUETOOTH SPEAKER DEVICE

Jackson Massalon  
Center for Advanced Technical Studies

Over the past couple years, sustainable energy devices have become more advanced and accessible, but sometimes unable to compete with the more mainstream small appliances and electronic devices. This project is going to close the gap between these two different types of appliances, a speaker powered by solar PV cells that can compete with the most mainstream speakers. In order to compare to best-selling speakers today, intensive focus will be on making this speaker portable, have a reliable battery life, and deliver great sound quality. Since a custom body is being created, the wiring setup will also be handmade. Preliminary tests have proven enough to show promise of making a high-quality solar speaker reality. After two prototypes, a final design has been reached and moving towards a 3D printed design is imminent. Upon the assembly of the final product, more extensive testing will be conducted to ensure maximum quality and performance.

## THE DEVELOPMENT OF AN ACUPRESSURE WATCH BAND TO TREAT ANXIETY

Isabella Mathis

Center for Advanced Technical Studies

The development of an Acupressure Watch Band will help people who have anxiety. This will help improve people who have anxiety and do not want to wear the bracelets that are specifically targeted for anxiety. This is significant because over 20% of the United States has anxiety. The goal for this project is to make an apple watch band that uses acupressure to target the pressure points on the wrist that reduce anxiety. The bracelet needs to be comfortable and also functional. This also needs to blend in and not be noticeable so that people will actually wear this product. This study is different because it is placing the acupressure beads in an Apple watch band instead of the typical bracelet. These bracelets are thick and do not blend in, so this product will blend in since it will look like you are just wearing an Apple watch band. In order to make this bracelet, the acupressure beads will be glued to the middle of the watch and then will be given to people to test it. The materials in this experiment will be apple watch bands, acupressure beads, and glue. The dependent variable will be the amount of anxiety that people experience and the independent variable will be the addition of acupressure beads to the Apple watch band. The results will hopefully show that acupressure can decrease anxiety and that the Apple watch band would want to be used by many people. This Apple watch band will decrease anxiety.

## A COMPARISON OF THE TRACTION GENERATED BY DIFFERENT TRACK SPIKE MODELS

Andrew May

Spring Valley High School

Track runners are often confronted with the issue of deciding which track spike model to use for peak performance. Many athletes are forced to guess what spikes to use, or wear the model included with their spike shoes, typically, pyramid spikes. The purpose of this study was to determine which model of track spike, pyramid, needle, or Christmas tree, has the most traction. It was hypothesized that Christmas tree spikes would have the most traction due to the rigid design. Each spike model was attached to identical wooden blocks and then forced into a Mondo track surface. The wooden blocks were then pulled using a force gauge, and the force required to dislodge the spikes was recorded. Each type of track spike was tested thirty times. A one way analysis of variance test was used to assess the significance of the results. The Christmas tree spikes required the most force to dislodge from the track, an average of 53.153N, indicating that it has the most traction,  $F(2, 27) = 63.80$ ,  $p < 0.0001$ . A Tukey Post Hoc Test concluded that the difference in the force required to dislodge the different track spike models was significant,  $CD = 2.16$ . The Christmas tree required the most force, needle spikes required the second most amount of force, and pyramid spikes required the least amount of force.

## THE EFFECT OF MAGNESIUM CITRATE ON THE REPRODUCTION RATE OF DAPHNIA MAGNA

Nadira McFadden

Spring Valley High School

Daphnia magna, also known as the water flea, are often used as model organisms for experimentation. Magnesium is a beneficial element to humans due to the minerals and vitamins included in the supplements used. The purpose of this experiment was to determine if the addition of magnesium citrate was beneficial to the reproduction rate of D. magna. It was hypothesized that Mg citrate would increase the number of offspring produced due to the beneficial properties of magnesium to humans. After emptying the magnesium capsules into spring water, the D. magna were added and observed for 11 days. After experimentation was completed, it was concluded that magnesium citrate does not positively affect the reproduction rate of D. magna, and too much magnesium is deadly to the D. magna.

## SELF-WORTH'S AFFECT ON PARTICIPATION IN AFTERSCHOOL PROGRAMS

Fred McGaughey  
Chapin High School

Self-worth, a mental factor affecting motivation, has been seen to be especially important to students. There has been extensive research relating to this self-worth within high school students, particularly how the sources of this self-worth come from a self-worth contingency or group. These self-worth contingencies determine what a person may do in order to keep a stable self-worth level. For example, a person whose self-worth is contingent on Virtue would volunteer in order to keep their self-worth level stable. Despite this extensive research, there has not been research on how a high school student's self-worth can affect their interest in growing their academics further through academic based after school clubs. This research paper aims to target this gap between how self-worth affects academic based club participation. It is hypothesized that there will be a positive correlation between a student's self-worth and their likelihood to join an academic based club, meaning that it is hypothesized that a student's self-worth contingency will affect their likelihood of joining an academic based after school club. A survey has been given by random homeroom classes in a South Carolina high school, asking students questions that would help the researcher see if there is any correlation between participation in academic clubs and a student's self worth. Overall 66 students were surveyed. All 6 self-worth contingencies have students who were within them, and there was a variety of those willing and not willing to participate in academic based afterschool clubs.

## THE EFFECT OF MAGNET PROGRAM PARTICIPATION ON THE ACADEMIC PROGRESS OF HIGH SCHOOL STUDENTS DURING EMERGENCY REMOTE LEARNING DUE TO COVID-19

Maegan McGriff  
Spring Valley High School

The Northwestern Education Association (NWEA) concluded that students' academic performance declined significantly during emergency remote learning due to school closures in 2020 during the COVID-19 pandemic (Hoofman & Secord 2021, May 19). The purpose of this study was to determine whether freshmen high school students in magnet programs and students not in magnet programs experienced different academic declines. It was hypothesized that magnet students would have a lesser academic decline than nonmagnet students due to the programs' rigor. Freshmen completed an online questionnaire about their emergency remote learning experiences. The average score for responses to questions relating to emergency remote learning having a positive effect ( $M=2.49$ ) was further from the strongly agreed score, 4, than responses for a negative effect ( $M=2.60$ ). Math and Reading Measures of Academic Progress (MAP) test scores of freshmen in honors and college preparatory courses from Fall 2019 and Fall 2021 were compared to those of freshmen students in magnet programs using a paired t-test. Comparing the mean difference between the reading scores showed a statistically significant difference between magnet 2019-2021 mean reading scores and nonmagnet 2019-2021 mean reading scores ( $t=-7.26$ ,  $p<.001$ ). However, there was no statistically significant difference in math scores ( $t=-.881$ ,  $p=.381$ ). It can be concluded that magnet programs do not significantly impact the academic decline of high school freshmen. This is significant because it means declines in academic performance are related to factors other than participation in a magnet program.

## THE EFFECT OF PRIOR KNOWLEDGE ON HIGH SCHOOL STUDENTS' PERCEPTION AND ACCEPTANCE OF ARTIFICIAL INTELLIGENCE

Robert McGriff  
Spring Valley High School

Current trends indicate that artificial intelligence (AI) is taking the world's economy into its own hands. High school students are important consumers of AI technology and will be the workforce of the future. The purpose of this research was to determine how prior knowledge of AI technologies affect high school students' perceptions and acceptance of AI. Students were asked via an online survey about their knowledge and use of AI technology or devices. They were then asked to watch a video about AI and asked some additional questions about the technology to measure any change. The data were analyzed and compared the actual frequency of responses to the hypothesis that a student's perception and acceptance of AI will be negatively correlated the more knowledgeable the student becomes of AI capabilities. Overall, 63.2% of respondents believed they were well-informed on the capabilities of AI; and generally, 76% thought AI was beneficial to society. The data did not show any significant association between the participant's prior knowledge and overall consumer perception and acceptance of AI. However, the data did show that increased knowledge of AI capabilities made some students wary about the use of their personal data. Students agreed with sharing personal data with their parents, but most disagreed with sharing personal data with third parties. This is significant because policymakers must understand the impact of AI on society to formulate laws and social policies that effectively protect it.

## ECOFRIENDLY SOAP USING GLYCERIN

Cali Mckelvey  
Center for Advanced Technical Studies

The goal of this project is to make soap from the glycerol produced from biodiesel. During this process 20mL-30mL of glycerin from three different funnels are being recorded from the process of transesterification. Once the glycerin is collected the process of making the soap is begun. For the first portion a beaker is placed on a digital scale to record grams. First 152g is put into a beaker and 58.85g of lye NaOH is added. After 220g of tallow, 100g of castor oil, and 80g of coconut oil is added into a pot, all oils are melted. Then the mixture is blended with a hand blender until trace. Next in a separate beaker 60g of glycerin is added to 150g of alcohol. Once mixed together it will be added to the soap mixture and mixed with a hand blender once more and quickly covering it. While the soap mixture is cooking add 45g of sugar into 90g of distilled water after warming it up. Once the solution has hardened in the mold completely it is tested for pH. The soap trials so far have been around 10.2-10.3 while the soap itself is at the level of hardness that is expected and completely opaque. While the pH is higher than the average pH for soap, the consistency is accurate. In the future tests for cleansing and condition will be taken.

## MOJOINT: A SOFTWARE FOR MOTION VISUALIZATION AND ANALYSIS

Angela Mei  
Academic Magnet High School

Musculoskeletal disorders (MSD) affect about 1.7 billion people worldwide. As most MSD cases are associated with the abnormal motion of joints, motion assessment of the joints provides a powerful tool for the prediction, diagnosis, and treatment of MSDs. However, the present-day diagnosis methods use medical imaging (e.g., MRI), which can only provide static and limited dynamic images. A compelling solution to this challenge is to combine medical imaging with marker-based motion tracking techniques to capture joint motion in an anatomically precise manner. However, the current lack of user-friendly, open-source software that coordinates the data from medical imaging and motion tracking systems limits



the clinical application of this approach. In this manuscript, we developed a software (MoJoint) that integrate the geometry files generated from medical imaging and the motion data from a marker-based motion tracking system to accurately calculate the joint motion and perform kinematic analyses. To make the musculoskeletal kinematic analysis readily available to researchers and clinicians, we developed a graphic user interface (GUI). After completing the first stable version of the software, we used it to assess mandibular kinematics, which is crucial to further understand the cause of highly prevalent temporomandibular joint disorders (TMDs) (affecting ~5-12% of the population) and disparities in TMD risk (including by occlusal class and race). We data showed that Class II subjects and Caucasians have the highest amount of mandibular translation and rotation in lateral movements, consistent with their high prevalence of TMD. The findings of this project as well as the fact that our researchers mastered this software with less than half an hour of learning showed that our software has huge potential for improving the prediction, diagnosis, and treatment of MSDs.

#### A COMPARISON OF ROBOTIC HAND THUMB DESIGNS

Ryon Miro

Spring Valley High School

The ever-growing world of robotic prosthetics encompasses many different areas of the human body, and one paramount area is the development of hands. Prosthetic hands are all different in their modeling approach but have similar design, with the exception of the carpometacarpal joint of thumbs. The thumbs from these designs thus have the potential for differing movement capabilities and ease. The purpose of this study was to test the effectiveness of differing degrees of mechanical freedom on a prosthetic hand's ability to perform simple tasks. It was hypothesized that the hand possessing more degrees of mechanical freedom would outperform the more simple hand design, on the assumption that the additional degrees of freedom better enable movement. The hand designs were sourced from the internet, and then created using a 3D printer. These hands were then evaluated by a series of success-based grip and motion tests to determine the effectiveness of degrees of freedom. The t-test showed that there was a significant difference between the motion of the hands,  $t(180) = 2.95$ ,  $SEM = 0.23$ ,  $t = 1.6535$ ,  $p < 0.01$ . The results of this experiment show that additional degrees of freedom in a thumb do not enable a prosthetic hand with increased practical dexterity.

#### THE EFFECT OF FIRST LANGUAGE ON EMOTIONAL UNDERSTANDING OF ELEMENTARY SCHOOL STUDENTS

Reese Morgan

Spring Valley High School

In the United States there are many children who do not speak English. With this barrier for these students there creates a gap in the classroom between non-English speakers and the rest of the class. The purpose of this study was to understand the difference in emotional intelligence between Spanish speaking and English-speaking groups. . It was hypothesized that the emotional intelligence score would be higher for Spanish speaking students than the English speaking students. An emotional intelligence survey was administered to test the hypothesis of a higher emotional quotient score in Spanish speaking students. The students were scored on a scale of 15-60, then a one-way ANOVA was performed on the three groups, English as a first language, Spanish as a first language, or another language as a first language. There was no significant difference in emotional intelligence of the three groups ( $F(2,43) = 0.4$ ,  $p = .6$ ). These findings suggest that the difference in first language does not impact human empathy.

## CORRELATION AND INQUIRY BETWEEN CRITICALLY ILL CORONAVIRUS PATIENTS AND SECONDARY INFECTIONS

Joshua Morton  
Chapin High School

Coronavirus, also known as COVID-19, has come to be a massively widespread pandemic. While it is still considered a debate to where the virus originated from, it has become a major issue for civilians and medical officials at risk of exposure. Literature suggests the virus inflames and damages the walls of the air sacs within the lungs ultimately causing respiratory malfunction. Because of this, it has been hypothesized that a large percentage of the critically ill Covid-19 patients are in fact induced with respiratory complications. As the body attempts to fight off the virus, the lungs become exponentially more susceptible to damage. Eventually, fluid will fill the lungs. Common results of the fluid are the use of respiratory assists including the ventilator, increasing risk of infection within the lungs causing further complications for patients. Superimposed Bacterial Pneumonia, an acute pneumonia resulting from a bacterial infection is caused by outside stimulus including the Coronavirus. While bacterial infections can be resolved by antibiotics, viruses cannot and unnecessary treatment can make symptoms worse. As a result, bacterial pneumonia coincides with viral responses causing complications. The purpose of my research would be to analyze the specific data of bacterial infections in the respiratory tract (Bacterial/Coronavirus Pneumonia) at Lexington Medical Center connected to the critically ill coronavirus patients to ultimately illustrate the true morbidity of secondary infectious diseases. By specifically following these factors, the experiment conducted, will highlight the usefulness and necessity of antibiotic treatments within viral contractions to change medical practices in the future of medicine.

## THE EFFECT OF TURMERIC EXTRACT ON THE GROWTH OF *ESCHERICHIA COLI* B

Neya Murugesan  
Spring Valley High School

Common pathogens known to cause infections include *Streptococcus*, *Staphylococcus*, and *E. coli*. Many studies have been conducted on the antimicrobial resistance properties of *Curcuma longa*, or turmeric, against pathogens. The purpose of this study was to determine if using a milk and turmeric extract to make a solution would affect the growth of *E. coli* B. It was hypothesized that increasing the concentration of turmeric extract would inhibit the growth of *E. coli* B. Four solutions were created, one being the control. 30 disks were soaked in each solution and placed in the center of each quadrant for 30 agar plates. The plates were incubated for 24 hours. This resulted in no formation of a zone of inhibition for any of the 30 plates. It was determined that the primary cause of the data error was most likely because the turmeric extract did not completely dissolve in the whole milk. This meant that the solution's concentration would be significantly lower than it had been, altering the performance of the turmeric extract. Further study is necessary to determine the potential of *Curcuma longa* on antibiotic resistance.

## LAPTEG

Jonathan Nance  
Center for Advanced Technical Studies

This project focuses on harnessing waste heat from laptops. The background theory is to discover the best placement for a thermoelectric generator (TEG) in a laptop. In order to do this, the backplate of an old laptop had to be removed and valid TEG placements had to be found. The only usable location was on top of a small green plate. More valid locations have yet to be determined. This green plate produced very little voltage and the output changed minimally. Results from this series of experiments include temperature data, voltage data, and current data. For as many trials as applicable, maximum points,

minimum points, and mean points were collected. Actions to place TEGs in other discovered places are ongoing. Two more placements so far seem valid. Future work for this topic includes using different models of laptops, finding ones with more usable empty space, and finding more efficient TEGs to recover more lost heat.

#### MODIFYING THE MOLECULAR STRUCTURE OF RITALIN TO EXTEND ITS DURATION OF ACTION

Firdavs Nasriddinov and Avery Fields  
South Carolina Governor's School for Science and Mathematics

Ritalin is an effective medicine used to treat Attention Deficit Hyperactivity Disorder (ADHD). Ritalin, also known as methylphenidate, held the stage for the most used and widespread medication for ADHD, until others like Dexedrine, Adderall, and Focalin were developed. Ritalin's flaw is a short duration of action—approximately 3.5 hours. This lends to frequent redosing, which is inconvenient and can lead to issues with missed doses. Ritalin's duration of action is affected by its metabolism in its targeted enzyme, Human Hepatic Carboxylesterase 1 (hHCE-1). Our research goal was to modify the chemical structure of Ritalin to increase its duration of action. The short duration of action can be attributed to how quickly the Ester group of Ritalin gets cleaved by amino acids in hHCE-1's active site. To approach this, we designed different modifications of Ritalin in Avogadro (a molecule editor program) to add a modification that would act as a shield to protect the Ester from getting cleaved, increasing the duration of action. The various modified Ritalin structures were docked in PyRx (a Virtual Screening Tool for drug design). There, we could observe the orientation of the modified drug in hHCE-1's active site. In the end, we concluded that replacing the Ester's R group with a tert-butyl functional group was most effective in altering the orientation of the Ritalin in hHCE-1's active site to protect the Ester. However, this cannot be experimentally tested with our resources, so our results would have to be verified by organic chemists to ensure the molecule can be synthesized and is effective.

#### IMPROVING THE EFFICIENCY OF BACKPROJECTION AND VEHICLE DETECTION IN SYNTHETIC APERTURE RADAR IMAGES

Firdavs Nasriddinov  
South Carolina Governor's School for Science and Mathematics

In the modern world, militaries use radars to form images instead of optical images to compensate for the many cons of optical imaging through the use of Synthetic Aperture Radar. SAR works by collecting data over a region of interest and using this data to form an image through an algorithm called backprojection. My research at MIT Beaver Works Summer Institute was to work on methods to make communication with radars and backprojection more efficient. We did this by using interpolation to form more points on a graph of signal amplitudes gathered by the radar. We also used multithreading to utilize a heavier load of a computer's CPU to make the code run faster. We implemented many error catches on the command and control code that helped prevent any errors that could occur when collecting data from the radar. My team developed a command and control code that was very close to entirely error-free. Our backprojection code was the fastest out of the other teams and on par with the instructor. We learned that interpolation and multithreading are very important in improving code and making it faster. Our first implementation of the code took over 45 minutes for a high-resolution image of 1200x1200 pixels over 200 scans. In our final implementation, it took less than 9 seconds to do the same.

## SYRINGE PUMP EXTRUDER FOR 3D PRINTING OF HIGHLY ELASTIC NATURAL-BASED BIOGELS

Irtija Nazim and Andrew Hill

South Carolina Governor's School for Science and Mathematics

3D printing is primarily done using filaments such as PLA and other plastics. The purpose of our research was to restructure a 3D printer to print with biogels and to create a new biogel for the printer to utilize. We restructured the 3D printer by designing and assembling a syringe pump system that would extrude the biogel by compressing a syringe using a stepper motor and vertical press system. These parts were designed using CAD then printed with our 3D printer and altered using machinery. We attached this syringe pump to our printer and connected the stepper motor to the printer's original filament feed system wiring. During this process, we created and tested different biogel mixtures of guar gum and kappa carrageenan to find an optimal solution. Guar gum is positively charged and carrageenan is negatively charged, allowing for strong bonds in the biogel. These biogels were made with pure water and mixed using magnetic stirrers and a vortex. Salt, a negatively charged substance, was added to break down bonds that were too strong. The optimal biogel was 0.4 concentration with 0.05g of salt. The project was ultimately successful as the printer can print biogels into accurate and rigid forms. These results can be used for future endeavors to print more functioning bodies such as organ tissues and medicinal sheaths with soft matter and other biological forms.

## DESIGN OF A PROGRAM FOR AUTOMATIC DETECTION OF STROKE-INDUCED APHASIA

Satvik Nelakuditi

Spring Valley High School

It is critical for people experiencing stroke symptoms to be admitted to the hospital immediately to receive proper treatment. One way to ensure timely treatment is to automate the detection of aphasia, a symptom of stroke. The goal of this project was to develop a machine learning system based on Support Vector Machines (SVM) for detecting aphasia using features extracted from speech transcripts. The system was coded in Python using the scikit-learn library. The system was trained and tested with a dataset from the C-STAR Aphasia Lab, consisting of speech transcripts of responses for three different prompts (requiring the patients to describe a scenario) from 80 participants with differing levels of aphasia and without aphasia. The average aphasia detection accuracy of the system was 85-88% when only responses for each individual prompt were considered, while the accuracy of the system went up to 95% when the responses of all the prompts together were used. The inaccuracy is mainly due to false positives, which decreased significantly with all prompts combined. While these results are based on responses to prompts in a clinical setting as opposed to daily living, they show promise towards the creation of automatic at-home aphasia detection systems.

## USING SOLAR PHOTOVOLTAIC POWER FOR REMOTE VEHICLES

Parker Olson

Center for Advanced Technical Studies

Cars produce a lot of pollution and this project is planned to help reduce the emissions done by cars. This project is working on having an RC car run on solar power and eventually working on other, larger vehicles run on solar power, most likely going into an electric Go Kart provided from the CATE center sometime in the future. This will most likely be successful but trials of the RC car haven't started yet. One of the methods done in this project was to measure the power usage of the RC which was done by running the RC car and measuring the power being produced when the RC car was running and comparing that to the power the batteries that were being used to run the RC car was producing when the RC car wasn't running. Another method done was to measure the power that the solar panels were producing in order to

determine the amount needed to power the RC car. Those trials for the solar panels were done by measuring the power that was being produced by the solar panels in 30 minute increments. A future method to be done is measuring the power being produced by the solar panels while running the RC car in 30 minute increments similar to the ones done for the solar panel trials. So far there has been collected data from the first two methods that were earlier described and it is looking very promising for the project. So far the data that has been collected from the RC car trials has been used to determine the amount of power needed to run the car for the solar panels. This will most likely prove the hypothesis correct due to the data found in the trials but the solar powered RC car hasn't been built yet so time will tell.

#### REDUCING WASTED FOOD THROUGH IMPROVING COMPOSTING TECHNIQUES

J'Den O'Neal

Center for Advanced Technical Studies

Americans waste more food than any other country in the world with roughly thirty to forty percent of food waste being directly linked to the entire U.S food supply. What doesn't help this problem is there is a large depletion of topsoil in the Corn Belt located in the midwestern region of the United States. If more Americans begin composting then we can fight the depletion of topsoil by incorporating easy compost rotating techniques. To test the simplicity of the experiment three two-gallon buckets were used in conjunction with compost safe ingredients including leaves, coffee grounds, waste potatoes, and distilled water. During the experiment each bin had its own requirements of how it shall be rotated, Bin 1 being the only bin that did not encounter rotation whereas Bin 2 had a much more vigorous rotation schedule, and Bin 3 was only lightly rotated. Next, heat, pH, and humidity were regularly measured, later followed by tracking the soil moisture to help measure the decomposition rate of each bin. Moreover, Bin 2 encountered the highest peak of humidity whereas Bin 1 had the lowest humidity values. Bin 3 had the highest average temperature with 38.77° being the highest average. During the peak of the experiment Bin 2 started to grow invertebrates such as fungi and earthworms; the increased humidity levels and consistent medial heat levels allowed for Bin 2 to support smaller forms of life which aided in the decomposition of the fresh organic matter. Bin 1 did not have optimal results because it had the lowest average of heat and did not produce significant values of humidity. Bin 1 and Bin 3 had identical values of pH with 7.9 being the common value between the two bins, but Bin 2 had the highest value holding an average of 8.2. This helps support the hypothesis that if more Americans begin composting then we can fight the depletion of topsoil by incorporating easy compost rotating techniques. What is upcoming in this experiment is building a tumbling device that can hold the two gallon buckets and be self rotating rather than using manual rotation. Using the same recipe is intended for all future experiments but also using a compost accelerator solution to help increase the decomposition rate of each bucket. Lastly, measuring volume is going to be a new unit used to show the effectiveness of each compost bucket; this will help to prove how crucial rotating is when composting.

#### IMPROVEMENT OF SHIN SPLINT COMPRESSION SLEEVE

Maureen Ortiz

Center for Advanced Technical Studies

A compression sleeve was created and improved so that it is adjustable and also consists of breathable material. The compression sleeve can help athletes with shin splints, specifically for active runners. This is important because many people wear compression sleeves that do not fit them properly and those that are adjustable only consist of a thicker material which makes exercising difficult. After all, it retains heat. Many athletes acquire lower leg issues such as shin splints and make it difficult for them to continue in their sport or physical activity due to the pain. Compression sleeves have been shown to increase blood flow in the lower legs and thus promote healing and mitigating the pain in the shins. The improved sleeve

is different because it combines two components; a breathable material and adjustability. The improved compression sleeve consisted of a thin, elastic, athletic material and an adjustability factor such as elastic laces. To determine that the improved sleeve was successful, it was determined that the sleeve was comfortable, adjustable, alleviates heat retention, mitigates pain/relieves pressure, is cost-efficient, and fashionable. The adjustability and breathability components added to the sleeve improved the compression sleeve by making it better for athletes to wear a sleeve specific to them.

#### HOW JET DRYERS OR NOT DRYING HANDS IMPACT BACTERIA

Ansley Othersen  
Chapin High School

Due to the increasing spread of the Covid-19 pandemic it has become even more imperative that precautions be taken to prevent the spread of viruses. One simple measure that can be taken is widespread, effective hand washing. However guidelines for hand washing often do not contain a recommendation for a specific method of hand drying despite many studies showing that drying methods can influence the spread of bacteria. This study expands on prior research by examining if the use of a jet air dryer leaves more bacteria on hands than undried hands, and assumes that the drying method's impact on bacteria is comparable to the method's impact on viruses. Students at a South Carolina high school were given guidelines for washing hands and then after using their assigned drying method their hands were swabbed. This sample was transferred to an agar plate and after a week in an incubator, bacteria colony counts were manually counted and recorded. When this data was imputed into a two sample T-test, after the removal of a major outlier, the p-value was .085, meaning that the results were statistically insignificant. However, three plates evaporated or melted during their time in the incubator. Thus further research is needed to conclude whether this experiment's results were due to undercoverage since the p value is close to being less than .05.

#### A WAY TO HAVE A SWEET NIGHT: AN INVENTIVE PILLOW THAT'LL HELP YOU SLEEP

Carolina Ottich  
Center for Advanced Technical Studies

Carolina made a pillow that helped the user fall asleep faster and sleep better at night, it aided people who normally took a longer time to sleep or those who just had sleeping problems. This project solely concentrated on breathing patterns by making the pillow inflate and deflate using Pranayama techniques which are based on inhale-exhale ratios and breath retention, the user breathed in and out following the pillows' breathing exercise. Since you allowed yourself to practice deep breathing exercises, your heart rate was slowed, blood pressure was decreased, reduced stress response, and made it easier to drift off to sleep (Jerath, 2006). The pillow is long and when placed on the body and in between knees, there was something that kept the body aligned, it took pressure off of your hips and therefore helped the body relax (Savy, 2016). There was a survey that was sent to 150 people who had issues falling asleep and asked them a number of questions. These questions will consist of: "Do you think the pillow will help you sleep better and will you use it", the group was asked for their opinion on the pillow. Another was conducted survey to check if it helped one sleep better, and it double-checked if all the suggestions were considered.

## THE EFFECT OF PLAYING "THE CLIMATE TRAIL" ON HIGH SCHOOL STUDENTS' PERSPECTIVES OF CLIMATE CHANGE

Michael Papaletsos  
Spring Valley High School

Increasing awareness and information on climate change is among the most important things society can do to avoid a critical crisis in the future. One method of spreading information is through interactive video games. This research project investigated the efficacy of the use of video games to spread information. It was hypothesized that after playing the selected educational game, the participants would give answers on a questionnaire that would suggest a mindset more in favor of acting against climate change due to an increase in knowledge of climate change. For the experiment, high school students were brought to a school computer lab and were instructed to fill out a questionnaire before and after playing the designated video game for roughly 30 minutes. The results of this experiment were analyzed using a paired t-test and it was determined that there was a significant difference between the pre and post-game answers, indicating that the game was an effective means of sharing information on climate change. This research project serves to show the importance of interactive activities in teaching and shaping one's understanding of a subject.

## THE MODIFICATION OF JURY INSTRUCTIONS TO IMPROVE JUROR VERDICTS AND CONFESSION RECOGNITIONS IN A CRIMINAL TRIAL

Meghan Pasala  
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False confessions are one of the leading causes of wrongful convictions in the American legal system (Jones et al., 2021). Jury instructions have been identified as an effective judicial safeguard in an effort to prevent wrongful convictions and allow jurors to better comprehend confession evidence in the courtroom. The purpose of this study was to determine whether the modification of standard jury instructions would have an effect on juror verdicts, confession identifications, and overall juror decision-making. It was hypothesized that participants given modified jury instructions would have the highest correct verdict determinations and confession recognitions with both the coerced and voluntary trial transcripts. Participants were recruited through Amazon Mechanical Turk, and they were randomly assigned into experimental groups. Participants read a trial transcript and completed a questionnaire. Descriptive statistics were determined, and logistic regression tests were conducted to determine statistical significance. The type of trial transcript had a significant main effect on both verdict determinations, Wald  $\chi^2$  (1, N=180) = 17.544,  $p < 0.001$  and confession identifications, Wald  $\chi^2$  (1, N=180) = 24.765,  $p < 0.001$ . The results demonstrated that participants who were given modified jury instructions had the highest percentages of correct verdict determinations and correct confession identifications compared to participants who were given standard instructions or no instructions. It was also determined that participants given modified instructions were more aware of factors such as interrogation coercion. Further research should be conducted to maximize the potential of jury instructions and other safeguards in criminal trials.

## THE EFFECT OF RESVERATROL ON THE BIOLUMINESCENCE OF *PYROCYSTIS FUSIFORMIS* AND *PYROCYSTIS LUNULA*

Shivani Patel  
Spring Valley High School

Harmful algal blooms (HABs), formed by toxic phytoplankton like dinoflagellates, cause adverse health and environmental issues that kill people and animals. Resveratrol is a nutrient commonly found in red

wine with anti-inflammatory properties that help prevent certain illnesses, such as cardiovascular disease. While some studies have tested how resveratrol works symbiotically with certain aquatic animals, none have researched its effect on protists like dinoflagellates. The purpose of this study was to determine the effects of resveratrol on *Pyrocystis fusiformis* and *Pyrocystis lunula*, two bioluminescent dinoflagellate species. It was hypothesized that a higher concentration (2.3 mg/L) of resveratrol would result in more bioluminescence after 72 hours than the lower concentration (1.1 mg/L). A higher bioluminescence rate indicates a disturbance within their environment, leading to a period of low reproduction as conditions are unfavorable for growth. 3 mL of *P. fusiformis* and *P. lunula* were transferred to Petri dishes, and 2 mL of a resveratrol concentration was added. Bioluminescence was measured at 24, 48, and 72 hours using spectrophotometry. A one-way ANOVA found that time did not influence bioluminescence while one concentration of resveratrol (0, 1.1, and 2.3 mg/L) did ( $F(2, 285) = 109.81, p < .001$ ); therefore, a post hoc Tukey test was conducted, which determined that 2.3 mg/L was statistically significant. The results of this experiment suggest that a 2.3 mg/L resveratrol concentration can effectively lower the bioluminescence of *P. fusiformis* and *P. lunula* regardless of the time, meaning that resveratrol has the potential to decrease HABs.

#### EXAMINING THE STRUCTURAL DIFFERENCES IN DIFFERENT CANNIBINOIDS AND HOW THEY INTERACT WITH RECEPTORS IN THE BRAIN

Yashvi Patel

South Carolina Governor's School for Science and Mathematics

There are both natural cannabinoids (Delta-8 and Delta-9 THC) that bind to the cannabinoid CB1 and CB2 receptors, as well as synthetic cannabinoids (WIN55-212,2, JWH-018, and Provaloline). How these molecules affect the brain depends on which receptor they bind to more strongly: CB1 has more psychoactive effects, whereas CB2 has more medicinal effects. The goal of this study was to examine the structure and binding energy of each cannabinoid upon binding to each receptor. The differences in structure between the molecules was analyzed to understand differences in binding. This was done using AutoDock Vina, a computational docking software where the ligand (cannabinoid) simulates binding to the macromolecule (receptor) and records the binding site and affinities. Through the fixed docking methodology, I obtained results that contradicted experimentally determined data about how well the cannabinoids bind to each of the receptors. Flexible docking was then performed, in which the receptors adapt flexibly to the ligands, but this further contradicted background information. The synthetic cannabinoids should be stronger binders to the CB1 receptor, but docking showed the ligands bound more strongly to the CB2 receptor. I hypothesized that the CB2 receptor file from the PDB was biased to have a more open binding site than CB1 structure from the PDB. Looking at the Poseview images from some of the stronger binding ligands, I was able to identify what characteristics in the structures of each of the compounds led to the changes in strength of binding between each receptor. and the ligand.

#### HOW DOES THE CONCENTRATION OF SUGAR AFFECT THE POWER OUTPUT OF A MICROBIAL FUEL CELL

Jay Patel

Spring Valley High School

The recent threat of climate change and the rising demands for electricity around the world has prompted research into Microbial fuel cells (Logan, 2006). Microbial fuel cells are a promising technology that can potentially avoid this crisis. Microbial fuels cells (MFCs) are fuel cells that collect electrons from bacteria in order to produce electricity (Logan, 2006). However, the expansion of MFC technology is slow due to many limitations such as its low power output and the lack of understanding of MFCs and bacteria's relationship with them (Xu, 2015). The purpose of this experiment was to test how the concentration of sucrose within a microbial fuel cell's soil affects its power output. In the experiment, 3 microbial fuel cells



all contained different concentrations of sucrose within it's soil. The wattage of each MFC was tested over the course of a week. It was hypothesized that the microbial fuel cell with the highest concentration of sugar within it's soil will have the greatest wattage compared to the microbial fuel cells with a lower concentration of sugar in it. The results from the experiments show that the MFC with no sugar had the highest mean wattage of 245.714 while the MFC with 200 grams of sugar had the lowest mean wattage of 111.714. According to the ANOVA chart, the p-value 0.0004 is much lower than the critical value 0.5. The null hypothesis can be rejected due to the fact that the p-value is less than the critical value and that the p-value is very close to 0 (the closer the p-value is to 0, the higher chance there is that the data is significant). The degrees of freedom is equal to 41, which is very high. Since higher degrees of freedom usually mean there is a larger sample size, a higher degree of freedom means more power to reject the null hypothesis.

In conclusion, it is plausible to say that when the amount of sugar within the soil of a Microbial fuel cell is increased, the resulting power output of that MFC decreases. With the help of microbial fuel cells and the addition of sugar, renewable energy can be made without harming the environment in any shape or form (Ochoa, 2016).

## ON THE TOPIC OF MENTAL HEALTH: STIGMATIZATION AND IT'S SOLUTION

Jordan Patterson

Center for Advanced Technical Studies

The primary objective of this project was to find correlations between demographics and beliefs towards the mentally ill. The secondary objective is to educate people on mental illnesses, such as depression and anxiety. The issue of mental illness in this country should be a concern for everyone given how the past couple of years have seen such a mass loss of life and a great change in how we live. The motivation for this project are my own issues with mental health as well as my parent's openness about theirs, which has encouraged me to pursue a project that could help people.

The main problem is misinformation surrounding mental illnesses which leads to stigmatization. This project was different from previous studies as this study's results will directly indicate which diseases need the most coverage on the website which would help fight misinformation. The hypothesis for this study is that depression and anxiety will be the most understood mental illnesses and will be the least stigmatized. The study was conducted using an online survey because this allowed for ease of distribution and would guarantee anonymity for the participant, thus not violating HIPAA. The independent variables are the people answering the survey, the dependent are the opinions on what mental illnesses are the most dangerous/stigmatized, and the constants are the questions asked. I hope to find which mental illnesses are the most stigmatized and that the website is adequate in helping people. This project helps educate people on mental illnesses.

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## CREATING AND VALIDATING STIMULI TO STUDY MISOPHONIA TRIGGERS

Natalie Peart

South Carolina Governor's School for Science and Mathematics

Misophonia is a condition characterized by an intense, uncontrollable hatred or fear of certain trigger sounds. Common triggers include breathing, chewing, eating, sneezing, and coughing, making it difficult for those who suffer to endure everyday life with their loved ones. This study focused on those trigger sounds as well as other common aversive and non-aversive sounds and aimed to recreate them. By generating videos of these stimuli and making an experiment to validate them, we created the tools needed for future research. Using previous misophonia research, we made a list of common triggers, aversive, and non-aversive sounds, and then created a checklist to make sure all our videos were of equal quality. These qualifications included a continuous, recognizable sound and video, audio and visual match, landscape orientation, 4:3 ratio, and a file size under 1mb. The stimuli were then split into four batches and made into four experiments. Three had 16 aversive and 16 non-aversive stimuli each, and the fourth with all of the trigger stimuli. Each trial within the experiments contained either an audio, video, or audiovisual clip of each stimulus followed by a valence/arousal grid and an aversiveness scale with values ranging from negative nine to positive nine. Three out of the four experiments are currently collecting data and expected to be completed mid-to-late September. The final set of validated stimuli can be used in fMRI studies on the neuroscientific basis of misophonia, and research of future treatment.

## TRANSCRANIAL DIRECT CURRENT STIMULATION: PRE-CLINICAL

Harmanpreet Pelia

Academic Magnet High School

In the United States, brain and nervous system tumors affect about 30 out of 100,000 adults. Brain tumors are dangerous because they can put pressure on healthy parts of the brain or spread into those areas. Brain tumors often are cancerous or become cancerous. Problems mainly occur when they block the flow of fluid around the brain, which can lead to an increase in pressure inside the skull.

With current methods of encountering brain tumors such as radiation therapy the drawbacks can be dire if not fatal. A new treatment regarding low-cost, portable (battery-operated), painless, and low-intensity non-invasive transcranial direct current stimulation (tDCS) is not FDA-approved however it could be critical in providing an alternate and efficient method to hinder the drastic effects of brain tumors. Without a thorough study and pre-clinical data, we are not able to assess its viability for the future. By actively facilitating tDCS with a brain tumor investigated initiated drug (BTIID) with 30-60 minute treatments, we can assume that it will affect cellular composition and the root of the immunosuppressive tumor environment. The study exhibited without the BTIID it significantly decreased the protein levels of urokinase-type plasminogen activator receptor (uPAR) as well as phosphorylation of Akt and upregulates Bax expression. This shows its viability for the future of suppressing brain tumors and hopefully give evidence to lead to its access and FDA-approval.

## THE EFFECTIVENESS OF LITHIUM CHLORIDE IN ELICITING A TASTE AVERSION

RESPONSE IN *BLAPTICA DUBIA*

Ava Phelps

Spring Valley High School

Despite taste-aversion being a well-established concept in the field of psychology, little is known about the prevalence of the quality in invertebrates. Taste-aversions protect organisms from toxins through associations between tastes and sickening agents. The purpose of this study was to determine whether LiCl evokes a food aversion in *Blaptica dubia*, a species of cockroach, and to establish whether or not the

invertebrates possess the capacity to demonstrate taste aversion. It was hypothesized that if the roaches were injected with a LiCl solution following exposure to a novel food, then the amount of food consumed upon the second exposure would decrease due to an association between adverse symptoms of LiCl and the novel food. The insects were exposed to novel food, and the amount consumed was recorded. After the remaining food was collected, the insects in the experimental group were injected with a LiCl solution. 24 hours later, the *Blaptica dubia* were again exposed to the food, and the mass was recorded. The results of a paired t-test, with an alpha value of 0.05, suggest that there were no significant differences between the mass of food eaten by the test group,  $t(4)=0.078$ ,  $p=0.942$ , and control group,  $t(4)=-0.318$ ,  $p=0.771$ . Thus, it was concluded that there is not sufficient evidence to suggest that there is a difference between the mass of the food consumed by the *Blaptica dubia* exposed to the LiCl and those not exposed to the LiCl.

#### THE CORRELATION BETWEEN A TEENAGER'S TRUST IN INFORMATION SOURCES AND CREDIBILITY OF SOURCES

Caleb Phillips  
Spring Valley High School

The spread of misinformation is prevalent on the internet, particularly with teenagers, who use it more than other age groups, and has repeatedly caused issues regarding the information that people accept as fact. In addition, many people believe that they do filter out misinformation, but it is unknown how effective these methods are. Knowing if there is a correlation between a teenager's trust in information and the credibility of sources is important to finding the source of misinformation. The purpose of the study is to determine what the correlation between trust and credibility for information sources among teenagers is, and therefore to know if teenagers generally know how to filter out misinformation. If the mean of the scores amongst trust and credibility are rated on a scale of 1-10, then the value will likely differ by 3 due to information generally being moderately reliable, but teenager's trust likely being a bit higher than the accuracy of the information. In order to determine the correlation, a survey was conducted in order to determine student's trust in sources, while an independent research study was conducted to determine the credibility of sources. The study resulted in the average value of accuracy of information being higher than that of reliability of information, with the hypothesis not being supported due to the p-value being less than 0.001. This shows that the spread of misinformation is generally not found within the people who believe that they are filtering out misinformation, which rejects the initial hypothesis.

#### ELECTRICITY-GENERATING FITNESS WEIGHT SET

Jeremy Pieters  
Center for Advanced Technical Studies

The goal of this project is to create a weight set that generates electricity. This addresses two problems in the US today. One being obesity, and the other being carbon emissions. Creating a new piece of exercise equipment will address obesity because it will give people a motive to go work out, and it will address carbon emissions by being another way to generate electricity in a clean way. This will be done by using a belt generator and a piezoelectric generator. The belt generator will be connected to a wheel on the pulley system, and the piezoelectric generator, which is a device that generates electricity by creating electrical charges from mechanical pressure, will be placed under the weights. So far, the piezoelectric generator has been placed under the weights, and voltage output has been collected from under 10, 25, and 45 pounds of weight. Under 10 lbs, there was an average of .83 volts per rep, 25 lbs, 1.87 volts per rep, and 45 lbs, 2.03 volts per rep. These results are not bad, but they can be substantially improved. Soon, the belt generator will be assembled, connected to the weight set, and data will be gathered from it. In

conclusion, an electricity-generating weight set has the potential to be the best piece of exercise equipment for the purpose of generating electricity, by combining two different methods of electricity generation.

#### OBSERVING THE EFFECTS OF EPINEPHRINE AND CORTISOL ON DIGESTIVE HEALTH

Zaire Prime

Center for Advanced Technical Studies

Stress levels in people has increased, especially with the onset of a global pandemic. 84% of adults in America reported feelings of prolonged stress in February of 2021 (APA: U.S. Adults Report Highest Stress Level Since Early Days of the COVID-19 Pandemic, 2021). One of the major effects that prolonged stress has on the body is harming digestive health. This project aims to better understand the mechanism through which stress affects digestive health by determining if it inhibits growth of commensal bacteria in the gut or the ability of the bacteria to ferment carbohydrates. Gut microbiota play a role in maintaining digestive health by producing necessary vitamins, aiding in digestion, and preventing pathogenic bacteria from growing in the digestive tract (Role of the Normal Gut Microbiota, 2015). This project aims to grow E. coli, a bacteria that is commonly found in the human gut, in the presence of the stress hormones cortisol and epinephrine to determine if colony growth is inhibited by the presence of the chemical.

#### DETERMINATION OF THE THERMOELECTRIC FIGURE OF MERIT THROUGH THE MAXIMUM TEMPERATURE DEPRESSION USING THE Peltier COOLING EFFECT

Isabel Rancu

South Carolina Governor's School for Science and Mathematics

In the last 30 years of thermoelectric research, many scientists determined thermoelectric efficiency of a material using many different methods. However, by using an alternative physical phenomenon (Peltier cooling), the figure of merit can be determined with minimal energy loss and error. The use of Peltier cooling is a novel method, and this research used a developed segmented model to determine the figure of merit using a Bismuth telluride-Constantan thermocouple to oversee a temperature gradient directly proportional to the figure of merit. In this research, an established mathematical calculation was conducted to have an expected value for a maximum temperature difference. From there, the team was able to use a newly developed segmented model containing elements of both the semiconductor and metal; current was run through the model, and a temperature gradient was observed as a result of the Peltier cooling effect. Matlab code was used to generate a system of equations designed to numerically label the maximum temperature difference. In comparison to the expected maximum 12 degrees K, a value of 10.7 degrees K was obtained from the segmented value. Although slightly lower, it was expected not to be exactly 12 due to radiation loss. Future work in this research includes redoing the calculations taking into consideration radiation loss within the model. Research in using an alternative method will help manufacturing in fields such as engineering or refrigeration design. This method, once refined, provides a much more efficient way of determining the figure of merit in thermoelectric materials.

#### THE DESIGN AND COMPARISON OF VOLTAGE PRODUCTION IN NOVEL TRIBOELECTRIC NANOGENERATORS

Joseph Ravindran

Spring Valley High School

Electricity, as old as it is, is still difficult for many regions of the world to attain. Research on accessible and efficient devices such as triboelectric nanogenerators (TENGs) tackle this issue as they can be made

from the simplest of materials while remaining affordable. The purpose of the experiment was to evaluate the differences in millivolt (mV) outputs of three TENG types: contact separation, lateral sliding, and single electrode mode. It was hypothesized that contact separation mode would perform the best because it had the most direct electron diffusion. The prototypes were restricted to a 30.1 cm by 30.4 cm by 6.0 cm area to imitate the area of one floor tile with a TENG circuit. The single electrode TENG had the lowest mean output of 1.6 mV. The lateral sliding mode performed considerably better, with a mean output of 2.5 mV, and the contact separation TENG performed the best, with a mean output of 3.2 mV. A one way analysis showed that the TENG's outputs were significant,  $F(2,87) = 188.92$ ,  $p < .0001$ . Post hoc analysis using a Tukey test showed the single electrode mode TENG ( $M = 1.6$ ,  $SD = 0.11$ ) was significantly different from the contact separation mode ( $M = 3.2$ ,  $SD = 0.40$ ) and lateral sliding mode ( $M = 2.5$ ,  $SD = 0.25$ ), but the contact separation mode TENG and lateral sliding mode TENG did not differ notably. Overall, the TENGs are low output devices but have a promising future due to their compactness and affordability.

#### A KID FRIENDLY SOLUTION FOR CHILDREN AND ADULTS WITH RESPIRATORY RISKS IN SCHOOLS

Cainan Rebmann

Center for Advanced Technical Studies

The number of individuals who have suffered from health disorders that were related to air quality has increased exponentially every year. The project was focused on students and teachers who had conditions such as asthma, cystic fibrosis, and allergies that affected their health when exposed to pollutants. The motivation for the project was inspired by the onset of the COVID 19 pandemic which put individuals in these groups at greater risk because of their condition. Additional motivation came from the exorbitant nature of preexisting solutions which were found to be expensive and costly to maintain, with filters and electricity being major contributors to price. The goal of the project was to create a cost-effective and energy-efficient air purifier that functioned unnoticed in a classroom setting while also being eco-friendly, this differed from other purifiers because it made an effective solution by balancing cost and functionality. The project was tested by finding the air quality of a given room by monitoring its initial air quality readings and then comparing readings after a given time while the air purifier was active. Filters were also tested to examine the level of pollutants that were collected by the filter when the air purifier was active, which ensured that the system was working properly. Surveys were conducted to make sure that the system maintained an adequate noise level and remained discrete while active. To conclude, the project was designed to improve air quality in classrooms, while also being as effective but cheaper than similar designs.

#### THE RELATIONSHIP BETWEEN SOCIAL MEDIA AND PARENTAL INFLUENCE ON HIGH SCHOOL STUDENTS' ATTITUDE TOWARD RECEIVING THE COVID-19 VACCINE

Lillian Ries

Spring Valley High School

With the emergence of COVID-19, the safety of the COVID-19 vaccine, in particular, has become highly debatable. Influences on vaccine opinions come from various outside sources, social media and parental influence being primary contributors. The content consumed and ideas formed by students regarding the current pandemic may cause those students to view the effects of COVID-19 from different perspectives. The purpose of this project was to analyze how two factors-social media and parental guidance-influence students' personal opinions about vaccination. This understanding of external influences and their effect on a younger audience may ultimately contribute to the health of later generations. It was hypothesized that as the role of parental influence on a student decreased and social media use increased, the students' urgency to receive the COVID-19 vaccine would increase. Additionally, it was hypothesized that after reading a given educational source students who are more influenced by social media would have more

urgency to be vaccinated compared to students influenced more by their parents. Through the use of an online survey, students were asked to rate their hesitancy and urgency in percentage form along with a ranked, Likert-based scale before and after reading the provided material. They were asked to evaluate where they receive the majority of their information, from parents or social media. It was found that the educational material had a significant effect on both hesitancy;  $t(81)=-3.9$ ,  $p<0.0001$  and urgency;  $t(81)=-44.1$ ,  $p<0.0001$  towards receiving the COVID-19 vaccination.

#### THE EFFECTS OF LIGHT POLLUTION ON THE NESTING BEHAVIORS OF TURTLES

Carlynn Rychener  
Chapin High School

Previous research has suggested that artificial light pollution negatively impacts sea turtles', specifically loggerhead (*C. Caretta*), nest distribution. However, current research has not explored how light pollution impacts false crawls, which can lead to the loss of turtle eggs. Due to the loggerhead sea turtle's declining population, it is important to explore the risks that threaten the species. Specifically on South Carolina beaches, loggerhead sea turtles are the most prominent nesting species. From May 1 to October 31, 2021, nesting data of sea turtles, all of which were loggerheads, were collected on Kiawah Island, South Carolina by the Kiawah Island Turtle Patrol. This data was retrieved from the South Carolina Department of Natural Resources in January of 2022. In November 2021, light values were collected by the researcher using a Unihedron Sky Quality Meter-L (SQM-L) every 0.1 mile increment for approximately 6.8 miles of Kiawah Island. The beach was broken down into 68 zones. For every zone, a light value was recorded and a corresponding amount of nests and amount of false crawls that occurred in that zone were recorded. To examine the impact of artificial light pollution on multiple aspects of loggerhead nesting, multiple linear regression analyses were conducted. Both statistical analyses produced insignificant results with a p-value of 0.934 for false crawl distribution and a p-value of 0.058 for nest distribution. Therefore, a relationship cannot be determined between either variables. This could suggest the effectiveness of lighting regulations currently implemented on Kiawah Island.

#### A STUDY OF THE ANTI-BACTERIAL PROPERTIES OF 3D-PRINTED WATER FILTERS ON THE GROWTH OF *E. COLI*

Ian Saracila  
Spring Valley High School

Bacterial growth in water, especially the antimicrobial-resistant (AMR) bacteria, is highly undesired in commonly used sources (wells, faucets, schools drinking fountains). For people having a compromised immune system, the effects can be even life threatening. The purpose of this study was to see if the hypothesis of using various designs of 3D printing water filters could inhibit, or even stop, the growth of bacteria such as *E. coli*. The research was conducted by comparing the growth of *E. coli* in 6 different samples of filter designs to see which type of filter had the largest impact on bacterial growth. *E. coli* was cultured and put in broth for growth. At the end, spectrophotometric analysis was performed on each sample to measure the bacterial growth.

The results of this study showed that the optical density mean absorbance (at 600 nm) for the five 3D-printed samples with pattern was on average 1.58 AU, while the absorbance for the flat/blank pieces from the same material was 1.68 AU demonstrating that, on-average, the 3D-printed samples had less bacterial growth as hypothesized. To analyze the data, to calculate the significance and the standard error, formulas from MS Excel were used. Considering that the annual spent on cleaning products is around \$46 billion (Center, n.d.) the result of this study offers a possible alternative to avoid using toxic chemicals to

treat the water we drink by using specially designed patterns on 3D-printed water filters to inhibit or even stop bacterial growth.

#### THE COMPARISON OF DATABASE MANAGEMENT SYSTEMS ON THE SPEED OF ANALYSIS BY ARTIFICIAL INTELLIGENCE

Kavin Saravanan  
Spring Valley High School

Artificial Intelligence (AI) is a common program of mathematical sequences that can conduct the calculations as if it were a human brain. Over the years, lots of attention has been focused on the development of AI due to its significance in society today. Due to the large amounts of data needed to be handled, lots of AI use database management systems (DBMS) to hold the information. The purpose of this study was to explore the effect of DBMS on AI and to determine which DBMS produce a quicker response time. It was hypothesized that PostgreSQL would show a faster response time due to it being a structured database designed to hold raw data. In order to conduct the experiment, VSCode, a source code editor based on Microsoft VSCode was used after retrieving the AI, ImageAI. Pictures were then stored in the DBMS and analyzed and the response time of the program was recorded at the end of the script in seconds. A one-way ANOVA test and a Tukey Post HOC test were conducted and produced an F-value of 5.969123767994860 and a p-value of 0.00372172430607. The Tukey test displayed that there was a significant difference between PostgreSQL and MySQL and between MySQL and MongoDB. Therefore, it was concluded that PostgreSQL and MongoDB are similar in their capacity to hold raw data such as binary and blob data. And that PostgreSQL and MongoDB excel in storing images compared to MySQL.

#### MOVE-A-SHELF

Nathan Sellers and Phillip Chapman  
Center for Advanced Technical Studies

Culinary workers like Chef Duggan, the main chef at the Center for Advanced Technical Studies, say that they have a hard time with shelving in their storage rooms. Every time a shelf needs to move a shelf or be removed to fit items stored on the shelf system, someone must disassemble multiple shelves or the entire system to adjust the height of just one shelf. Shelving problems has impacted most culinary workers which makes up about 12.1 million workers according to DataUSA.io.

#### THE EFFECT OF CLIMATE CHANGE ON MENTAL HEALTH IN TEENAGERS

Adeep Sen  
Spring Valley High School

The effect of climate change on mental health has been observable in cultures and populations deeply rooted in their environments, but is now becoming increasingly visible in the general population as well (Pikhala 2020). The effect of climate change on the mental health of teenagers has not been well observed, previous research has indicated that the media and narratives surrounding climate change can be damaging to both mental health and detrimental to environmental advocacy groups (McKinley 2008). The purpose of the study was to observe negative effects of climate change on the mental health of teenagers, and compare effects to positive climate action taken by participants. It was hypothesized that students who take positive climate action are more negatively affected by climate change, as mental health effects such as anxiety prompt evasive action (Stanley 2021). This study used a likert scale survey asking respondents to rate the degree to which they experience various negative emotions as a result of climate change and evaluate the positive climate action they take. The respondents were sorted into

groups of those who believe they help the environment, and those who do not, and the effect of climate change on mental health was compared between the two groups. The 11 participants who take positive climate action ( $M=-0.5$ ,  $SD=6.27$ ) compared to the 20 who do not take positive climate action ( $M=5.636$ ,  $SD=5.278$ ) were more negatively affected by climate change  $t(29)=5.6398$ ,  $p=2.898$ .

#### DATA-DRIVEN APPROACHES TO GRAVITATIONAL WAVE POLARIZATIONS OF COLLIDING BLUE STRAGGLERS

Mritika Senthil  
GSSM/ Fort Mill High School

Blue stragglers are main sequence stars that appear bluer and more luminous than stars at their corresponding main sequence turnoff points. They possess indefinite origins, with suppositions based on circumstantial evidence. It is assumed that these bodies are formed as the single product of binary star collisions. Due to the intangibility of gravitational waves, these emissions receive inattention during interactional studies. However, understanding such properties would expand insight on associated formative distinctions. This research characterizes the linearly polarized components of a collision instigating blue stragglers. JavaScript code processed datasets from the NASA Open Data Portal. These contained such values during differing times for four simulated collisions. One trial was chosen to represent the studied interactivity due to conditional similarities. The 18,654 data points per trial were arbitrarily distributed; thus, the initial results of each study were implemented in graphs of polarization values vs time. R code used an autoregressive integrated moving average model to fulfill functional discrepancies. The Minitab software acquired the values from prior methods, creating plots for the principal simulation. Fourier transforms converted their domains to frequency and the graphs were divided by similar waveforms. For each region, cosinor regression models produced fit line equations. These would allow the prediction of polarization values during times of standard simulations. While physical studies of gravitational waves are onerous, their statistically-driven models can be computationally manipulated. The only required equipment is a laptop with inexpensive softwares. Hence, the process for acquiring developmental data would increase efficiency with certain envisaged frameworks.

#### THE RELATIONSHIP BETWEEN SOCIOECONOMIC STATUS AND STUDENT PANDEMIC EXPERIENCE

Hunter Shissias  
Spring Valley High School

<p>The purpose of this study was to examine the pandemic experience of adolescents from varying socioeconomic backgrounds. It was hypothesized that students from higher socioeconomic backgrounds would report a more positive pandemic experience (lower score), while students from lower socioeconomic backgrounds would report a more negative experience (higher score). Student responses were collected via Google Forms, and compiled into a spreadsheet, revealing that while the upper class respondent reported the best experience, working class students, on average, reported better experiences than their middle class counterparts, placing the middle class as the most unhappy strata in the experiment. As a secondary investigation, the highest education level of any parent was recorded, and compared with the same responses. These revealed that the highest education levels did not equate to the best pandemic experience.</p>



## THE EFFECT OF PRE PERFORMANCE RITUALS ON ADOLESCENTS' ACADEMIC PERFORMANCE

Marina Slaubaugh  
Spring Valley High School

This research sought to investigate the correlation between pre-performance rituals and academic performance in adolescents. Previous research and anecdotal evidence have shown connections between the two variables, however not much research has been done in an academic setting. Pre-performance rituals are used by many people, even well-known athletes and other public figures. Their stress-relieving qualities can both calm whomever is using them and provide a sense of control. Stress can negatively impact the mind and body, especially those of students. Studies have shown that higher stress levels in students hinder academic performance so it is important to reduce this stress. It was hypothesized that if students perform a stress-relieving ritual, their scores on a logical reasoning test would improve. Over the span of three weeks, students were given a logical reasoning test three separate times; one time without a ritual and two times with a ritual. Their answers were graded on a scale out of ten, each question equal to one point. The average of the participants' scores increased from 2.8 without the ritual to 3.1 with the ritual. However, upon completing a two-tailed paired t-test, it was concluded that the results were not statistically significant ( $p < 0.05$ ,  $p = 0.41$ ). There is not sufficient evidence to reject the null hypothesis. These results suggest that pre-performance rituals may not impact academic performance, however their stress-relieving properties could still be utilized in a psychological manner.

## THE PRESENCE OF SULFATES IN SHAMPOOS ON THE FROND GROWTH OF *LEMNA MINOR*

Gowri Sunilkumar  
Spring Valley High School

Sulfates are added to many shampoos to create a false sense of extra cleaning when washing hair. However, the sulfates can have adverse effects on aquatic biota. This research was intended to determine a shampoo that would not cause harm out of 4 popular consumer brands. It was hypothesized that the Head & Shoulders shampoo will cause the least amount of growth in the frond number, or leaf number, in *Lemna minor*. This is because of the abrasive substances in the product that would not stimulate plant growth. Shampoos are considered as surfactants, which are known to have toxic effects on environments (Fatima et al., 2014). Ten mL of each shampoo was mixed with 9 mL of water to create 10% solutions. The *Lemna minor* plants were placed in each group, which was each shampoo brand, in a way that there were 15 fronds in each Petri dish. The hypothesis was supported due to the fronds in the Head & Shoulders solutions having the least amount of growth. A one-way ANOVA test showed that there was a significant difference between the means, due to the p-value of  $< 0.001$  being less than the alpha value of 0.05. Overall, the research demonstrates how common consumer products, such as shampoos, can impact aquatic environments.

## DEVELOPMENT OF MOLECULE TO REPLACE MONOCLONAL ANTIBODIES USED FOR THE PREVENTION OF ABDOMINAL FISTULAS

Marah Susko  
South Carolina Governor's School for Science and Mathematics

Crohn's disease, a form of Chronic Inflammatory Bowel disease, primarily affects the lining of the digestive tract and is highly complex. The current hypothesis is that it is autoimmune-related, and treatment mainly pertains to controlling symptoms. One common symptom is intestinal fistulas caused by ulcers or sores tunneling through the abdomen and areas surrounding the anus/rectum. Currently fistulas are treated using surgery. The only preventative medications for abdominal fistulas are intravenous injections of monoclonal antibodies targeting inflammation through the TNF- $\alpha$  cytokine. The problem with these

monoclonal antibodies is they must be administered intravenously every eight weeks. This is not always a viable option. My goal was to create an orally viable medication which can target TNF- $\alpha$ . I chose curcumin as a lead molecule and used molecular editing software Avogadro to create modifications to the drug lead molecule. I knew I needed a lead molecule to work off as orally viable medication must consist of small molecules. Thus, I chose curcumin as a drug lead, as it is what causes the anti-inflammatory properties in turmeric through binding to the TNF- $\alpha$  cytokine. I made six modifications to the original structure of curcumin, then further combining the modification to create several more. Modification 05 produced the best results. The change in Modification 05 is the change of an ethyl group to a trifluoro ethyl group; I replaced the hydrogens in this group with fluorine. Future experimentation will be needed to determine whether the novel molecule prevents fistulas, specificity to TNF- $\alpha$ , and adverse effects.

#### THE EFFECT OF ARTIFICIAL SUBSTANCES ON THE INCREASING SPIN RATE IN MAJOR LEAGUE BASEBALL

Robert Swick

Spring Valley High School

In Major League Baseball (MLB) there is currently a crisis with Spider Tack usage. Per the MLB guidelines it is prohibited for the usage of any substance except for pitching rosin to be applied to the baseball (Castrovince, 2021). These substances each have different effects on the baseball, but the most prominent effect is on the spin rate of the baseball. Increased spin rate on the baseball increases the movement and overall speed of the pitch dramatically. During the 2021 baseball season, there have been reports on the effects of spider tack such as the article written by Ari Alexander Putting Spider Tack and other MLB Substances to the Test. But there is no actual comparison involved. The purpose of this study is to test the different widely used substances such as Spider Tack, pine tar, and pitching rosin to determine if there was a statistical difference between the substances. It was hypothesized that out of all of the substances that were tested (pine tar, Spider Tack, and rosin) pine tar will be the substance that will have the most effect on the baseball's spin rate. This is due to the fact that it is the most widely used substance as well as the fact that it provides the most "stick" to the baseball. To test this research hypothesis a mechanical design was made. This Mechanism holds a baseball still so that it would be able to be dragged over silicone skin replicant in order to find the friction force required to pull the baseball. After testing was completed a one way ANOVA was used to determine that with a p value of less than .00005 the data was statistically significant. Using a Tukey test, it was determined that Spider tack was the most effective between the groups.

#### THE EFFECT OF MUTATIONS IN THE GENES OF DIACYLGLYCEROL KINASE THETA AND PHOSPHOLIPID PHOSPHATE 7 PROTEINS ON THE PROGRESSION OF PORT WINE STAIN

Irairie Taine

Spring Valley High School

Port wine stain (PWS) is a skin disease that appears in three to five out of every 1000 births. The mutation of the GNAQ gene at (c.548G>A; p.R183Q) is known to be a leading factor behind the development of PWS. Currently, the sub-factors causing PWS remain unclear. Mutations of the DGKQ protein at (c.653G>A; p. C218Y) and the PLPP7 protein at (c.634A>C, p.Lys212Gln) are suspected as potential cofactors. The purpose of this study was to confirm whether the somatic mutations of both genes were present in the skin tissues of subjects with PWS. It was hypothesized that if mutations occurred in the genes coding for DGKQ and PLPP7 proteins, then the disease would progressively worsen due to the growth of abnormal blood vessels. The DNA from 42 skin samples was extracted, a PCR was run, an NGS library was constructed, and the samples were sequenced. The results demonstrated that the DGKQ mutation occurs in 19.0% of PWS patients with an average mutation frequency of 1.741%, The PLPP7 mutation occurs in 14.3% of PWS patients with an average mutation frequency of 2.989%. The data was

analyzed statistically using a t-test. The results suggest that the mutations are a secondary factor to the development of PWS in a subpopulation of patients. Positive DGKQ and PLPP7 mutations occurred in macular and hypertrophic lesions but not in nodular lesions, suggesting the mutations are contributing factors to the initial stages of the disease.

ADVANCING SUSTAINABLE ANTIFUNGAL COATINGS BY ECO-FRIENDLY CHEMICAL CURING  
of Natural Seed Oils  
Cathy Tang  
Spring Valley High School

Protective green coatings are advantageous because they are eco-friendly and sustainable. With stringent environmental regulations, there has been a growing interest in utilizing renewable natural resources as candidates for manufacturing eco-friendly coatings (Hermens et al., 2020). On the other hand, there is a societal and economical need for anti-microorganism materials that can act as protective coatings against mold growth on commonly used surfaces including wood (Maduka *et al.*, 2019). The purpose of this study was to advance current protective coatings through a combination of mixed oils. The oils were placed under direct sunlight to form cured films on maple wood. The curing chemistry and its effect on chemical resistance, water resistance and thermal stability were characterized and evaluated by FTIR, <sup>13</sup>C NMR, solvent immersion, water contact angle and thermogravimetric analysis. It was hypothesized that the unsaturation in the oil chemical compositions would impact their curing ability and fungal inhibition. The oil-coated samples were placed on agar petri dishes that were spread with White-rot fungi. The diameters of growth inhibition for each sample were measured over six days using an Agar diffusion assay. The results from a two-way ANOVA with replication method showed that the seed oils had a significant effect ( $F(6, 588) = 203.0904$ ;  $p < 0.001$ ), and a post-hoc Tukey test showed significant differences in pairwise comparisons between different oil coatings. By mixing with a small fraction of tung oil, both linseed and soybean oils showed curing rates at least two times faster than individual oils and demonstrated much better inhibition of growth against fungi. This class of green natural seed oil coatings could be beneficial both economically and socially, given their high abundance, low cost, and environmental friendliness.

MUSCLE GROUP EXERCISE CODEX  
Alexander Taylor  
Center for Advanced Technical Studies

This project is intended to serve as a handheld codex of effective exercises for each individual muscle group. The codex is intended to inform the reader in a quick and tangible method. The simplicity allows it to be held on the reader so it may be used at any time. This codex will serve useful to those looking to improve a certain part of their body or to become stronger through a safer, more natural method. The exercises used are mostly aimed for being resourceless by default. However, minor 3 pound hand weights can be added if the reader wishes to do so. The exercises placed into the codex are intended to be capable of versatile use throughout many settings in the readers life.

EVALUATION OF WEB ACCESSIBILITY OF HEALTHCARE INFORMATION SITES  
Sandra Thomas  
Spring Valley High School

Making the web accessible for the disabled or impaired community is vital to making sure they are open to equivalent information (Friedman & Bryen, 2008). Healthcare websites are some of the most important sites that disabled people would need access to. Healthcare information websites are a way for patients to get details on certain symptoms or conditions urgently. Although this is not an ideal way to get advice

on one's health, accessing these sites directly on their phone might be the most efficient way to quickly know what to do for minor health issues that might not require travelling to a doctor. Disabled or impaired people benefit greatly from these types of sites as they would often need access to health information (Inderscience, 2011). The purpose of this study was to determine the popular healthcare sites that meet web accessibility guidelines and which of these guidelines are being missed the most in these healthcare information sites. The hypothesis that was constructed for this study was that the guidelines in the category of factors that would make the website "understandable" would be missed the most. This is because these types of accessibility guidelines are often not considered. To conduct this research, the database, WAVE (WAVE Web Accessibility Evaluation Tool, n.d.) was used in order to score the websites on web accessibility and find the specific guidelines that were missed. A one-way ANOVA determined that the results turned out to be statistically significant at  $p < 0.05$  [ $F(13, 686) = 10.111, p = 0$ ]. The details most often missed were "Very low contrast", "Broken ARIA reference", and "Missing alternative text." The factor that web designers should consider to improve accessibility of their healthcare information sites should be the contrast of their sites.

#### A STUDY ON THE SECURITY OF DATA TRANSMISSION OF HOUSEHOLD INTERNET-BASED DEVICES

Siddharth Thumasi  
Spring Valley High School

This study focused on the security of data transmitted using Wi-Fi. Wi-Fi based IoT devices are starting to gain more popularity. IoT devices have been expected to grow at a large rate, with some estimating a growth of 37% from 2017 to 2025 (Figliolia, 2020). The great increase, aided by the deployment of 5G cellular networks, has warranted concern for privacy and data security. This study aims to gauge the security in data transmission of household Wi-Fi devices. If various Wi-Fi based devices are tested for proper data transmission, none of the devices will have major vulnerabilities. This was based on the information about most devices having basic encryption capabilities (Lazzez, 2013). The research was conducted by performing an ARP poisoning attack on the Wi-Fi devices and intercepting packets from the devices. It was found that the VoIP phone system lacked encryption, allowing sensitive data to be captured. This research could be extended to multiple other IoT devices.

#### THE DANGEROUS ROOF Holden Tutich and Seth Trocheset Center for Advanced Technical Studies

Our Project aims to tackle the problem of fall injuries related to cleaning roofs and gutter systems. According to the American Academy of Orthopedic Surgeons around 500,000 people are treated for ladder-related injuries. The CDC states that over 150,000 people need medical treatment due to roofing accidents every year. The CDC also says that 97% of all roofing and ladder accidents happen at home. Suggesting homeowners are at a much higher risk of getting injured when on a ladder or roof cleaning debris. The solution we have developed utilizes a remote controlled vehicle. To build this vehicle we are using VEX motors, mecanum wheels, and other VEX parts to assemble the core. Specialized tools will either be 3-D printed or fabricated. These tools that the vehicle will be equipped with are specifically designed for cleaning gutters and sweeping roofs. It will be put on the roof using an adjustable pole with a hook system. Once placed on a roof it will be able to drive around and remove 80 percent of debris with the operator safely on the ground.

## DOES WAVELENGTH AFFECT SOLAR PHOTOVOLTAIC EFFICIENCY?

Branner Umberger  
Center for Advanced Technical Studies

Solar panels are one of many ways to cleanly produce energy. If the light filter is Ultraviolet (UV) bandpass then the photovoltaic (PV) panel will produce more energy because UV is on the higher end of the spectrum. In the experiment the IR filter was tested first with a control panel directly next to it and 5 tests were conducted. Then all the color filters (Blue, Green and Blue) were tested 5 times for each. And lastly, the UV filter was tested 5 times. The orange color filter is the closest to the control, followed by the blue, and then the green filter. It appears that a wave length between 600 nm to 700 nm is the best for the panel. According to these results the higher the wavelength gets over 700 nm the lower the voltage gets. The same thing happens when the wavelength gets below 600 nm. One filter that could be tested is one that limits the wavelength to only the 600 nm to 700 nm range.

## THE EFFECT OF *SPIRULINA MAJOR* AND *OSCILLATORIA* ON REDUCING THE ACIDITY OF FRESHWATER CONTAINING ANTIBACTERIAL LIQUID AND BAR SOAPS

Kartik Valluri  
Spring Valley High School

Personal care products are major pollutants in freshwater environments that are often difficult to mediate due to their fluid-like properties. Hand and bar soaps often cause the most pollution in freshwater environments due to their pH level, which often jeopardizes the livelihood of surrounding wildlife. With the prospect of algae such as *Spirulina major* and *Oscillatoria* as potential viable sources of bioremediation, the toxic pH level and effect of hand and bar soaps can possibly be reduced. The purpose of the research is to test the effectiveness of *Spirulina major* and *Oscillatoria* in reducing the pH level of personal care products (PPCPs) in freshwater environments. The hypothesis is that the algae *Spirulina* and *Oscillatoria* will reduce the pH level of a Dial Gold Antibacterial Bar Soap and Clorox Antibacterial Liquid Hand Soap mixture by 2 pH levels given that algae has been effective in reducing the pH level of personal care products in marine environments. The method of the research included four groups, two of which belonged to *Spirulina* and *Oscillatoria*, and the other two as control groups. Both algae were separated into 20 mg samples, and the pH level of all samples were recorded every day for ten days and averaged for each day. The research finds that both the *Spirulina major* and *Oscillatoria* groups became more acidic through an 19.9% and 48.83% increase in pH, respectively. The results of the research suggest that the algae did not aid in reducing the pH level of the PPCPs.

## OPTIMIZING SOLAR PHOTOVOLTAIC ELECTRICITY

Daisy Walsh  
Center for Advanced Technical Studies

Solar Panels are not as effective as theoretically possible. If different types of solar panels are tested in different conditions, then different voltage outputs will be observed. The solar panels (Monocrystalline, Polycrystalline, and Thin film) were first tested inside with a heating lamp as a constant. Next, the solar panels were tested outside with different temperatures and sunlight presented. The panels were then tested on a makeshift roof with racks to hold the solar panels up. These racks will be changed in height to analyze if this difference will affect the voltage. The Naturally the more sun that is presented to the panels, the higher the panels voltage. Although, unexpectedly, The heating lamp made a higher voltage than the actual sun. So far, the polycrystalline is giving a higher percentage of voltage than the other two panels. Meaning different solar panels, in different weather conditions, will have different voltage outputs.

Polycrystalline the highest, and Monocrystalline the lowest. The different tests planned for this experiment are as follows: more lift tests, testing different tiled roofs, and more weather conditions.

TOXIC TIKTOK  
Natalie Ward  
Chapin High School

My study examines the question, to what extent does liking TikTok videos that contain toxic body image content (possibly trigger an eating disorder or body dysmorphia) on the foryoupage affect the amount of toxic body image content seen on one's foryoupage? TikTok has been known for showing its viewers videos with content that can lead to eating disorders and/or body dysphoria. Seeing videos that contain this type of content can cause users to attempt to change their bodies to fit this unrealistic standard. Users often go about this in an unhealthy way such as restrictive eating and over-exercise, which can be harmful to the body. My study looks into how interacting with the for you page in different ways affect what type of videos TikTok shows its users. I did this by performing three different types of tests. For each test, I liked the videos based on a different code to see if liking videos that contained toxic content led to more toxic content seen, and even if a user liked the content that was not considered toxic would the amount of toxic content increased.

A COMPARISON OF CITY AND WELL WATER QUALITY IN CHAPIN, SOUTH CAROLINA  
William Ward  
Chapin High School

This study will cover the impact of drinking water's source on the water quality of that source, these sources being, well and city water. There is a fierce debate between which source is safer. In less developed areas, and less developed countries of the world, city water is far safer than well water. However, Chapin, SC is in a well developed area of the world. When it comes to developed areas of the world, well water is safer than well water in less developed areas. This is due to scientific innovations with well pipes. Meanwhile city water is treated and monitored by an organization, oftentimes healthy amounts of minerals are added to this water to make it healthier, such as fluoride. So if well water is safer in well developed areas and city water is always safe then which is better in well developed areas, leading the question to be asked: To what extent is the water quality of drinking water impacted by its source (well or city) in Chapin, SC.

WHEELS OF FORTUNE  
Aiden Warren, Mia Loudon, and Tristen Singletary  
Center for Advanced Technical Studies

A major safety concern in recent years is the amount of injuries resulting from road accidents. While many of these accidents occur between motorized and non-motorized vehicles, an alarming amount occur due to poor road conditions such as loose gravel or potholes. Over half of all traffic fatalities occur with cyclists and non-automotive vehicles. In the US, this amounts to 19,000 deaths. The purpose of our project was to combat this amount by developing a wheel that is capable of changing configurations depending on the environment in which it is placed. We achieved this by 3D designing a wheel that utilized components including a rotary union, long balloon, and syringe to create the inflation device. When tested, the wheel showed a clear difference between its tread configurations (this will be achieved by inflating and deflating the wheel); the wheel's increased surface area created greater stability as well as less irregularities from gravel at the end of testing.

## THE EFFECT CLIMATE CHANGE TEMPERATURES HAVE ON *DENDRODRILUS RUBIDUS*

James Washington  
Spring Valley High School

Climate change has greatly affected many animals and ecosystems in the world today. Due to its effects, many species of animals and plants are facing extinction. Decomposers are known to be a very important group of animals in an ecosystem. This experiment tested the effect of increasing temperature on earthworms. The experiment used temperatures recorded from the South Carolina Department of Natural Resources to test on the earthworms. Earthworms were placed into three plastic terrariums made from juice jugs and placed in incubators. To record the number of earthworms that were alive, water was poured into the terrarium enough to flush the worms up to the surface of the soil. The soil was then disturbed and the worms were counted and recorded on a data table. The results were inconclusive as all the worms placed in the incubator perished after one day. The worms may have died for many reasons, but one major one is that they were not able to survive the temperatures and died as a result.

## THE LACI BRACE: A MORE COMFORTABLE AND AFFORDABLE BRACE FOR CHILDREN WITH WALKING DISABILITIES

Zanaia Washington  
Center for Advanced Technical Studies

The target audience are children that have walking disabilities and also low income families. This is important because the original ankle-foot orthosis is not comfortable for the children and the ankle-foot orthosis can be very expensive and some families can't afford it. My motivation to make this brace is my little cousin, Laci 5. She has Spina Bifida and she had to wear an ankle-foot orthosis to make her legs stronger and to help her get a more normal walk. The original ankle-foot orthosis do not really have a padding to protect the foot from the brace. The problem I am trying to solve, the ankle-foot orthosis isn't really affordable for the working class and it is not comfortable for the children with the walking disabilities. The material I am using is thermoplastic beads to make the shape of the brace, velcro to keep the foot inside the so the foot wouldn't slip out the brace when walking, rivet nuts to connect the bottom and top of the brace so the child wearing the brace would have mobility when walking, and elastic band to it can help the brace snap back when walking.

## THE EFFECT OF LENGTH OF MIXED SPORTS TRAINING AND LENGTH OF DANCE TRAINING ON PROPRIOCEPTIVE BALANCE ABILITY IN HEALTHY TEENS AND ADULTS

Sara "Kate" Weiss  
Spring Valley High School

One of the systems of the body that affects equilibrium and balance ability is proprioception. Proprioception is the body's awareness of position and movement through sensory receptors throughout the nervous system (New World Encyclopedia, 2008). The purpose of the study is to investigate the relationship between athletic training and dance training on proprioceptive balance ability. It was hypothesized that athletes who trained longer would have a better proprioceptive balance ability than those who trained for less time, and dancers who trained for a longer time would have better proprioception. This is because, in athletic training, there are specific drills done to improve performance through the training of minute movements to contribute overall. Technique training for ballet extends this by specifically focusing on limb movement and balance through barre training that focuses on small parts of the body at a time. Participants filled out a training form, then participated in two balance tests. For the dance training analysis, the differences between means of the four groups proved to be statistically insignificant for the sports training analysis,  $F(3, 39) = 0.8239$ ,  $p = 0.739$  and statistically

insignificant for the dance training analysis,  $F(3, 39) = 0.4229$ ,  $p = 0.489$ . From the data, it can be concluded that both the length of sports training and length of dance training has no significant effect on proprioception as determined by a modified Romberg balance test in plantar flexion.

#### THE EFFECTS OF A TEAR GAS LAUNCHER ON THE LOWER ABDOMEN OF THE HUMAN BODY

Eamon Wood

Spring Valley High School

<p>During protests all over the world, people were injured and even killed in what were supposed to be peaceful demonstrations by law enforcement using “less-than lethal” crowd control weapons. In Iraq, ten young men got tear gas canisters lodged in their skulls during protests. They all died within three days of being admitted to the hospital due to extreme brain damage (Hoz, 2020). The purpose of this study was to prove that a tear gas launcher can severely injure people and should not be used in crowd control by testing the same forces on the lower abdomen of the human body. The hypothesis in this study was that a force of 40 newtons from a tear gas launcher can prove fatal. This is because a gas canister has been shown to go to greater depth in other parts of the body. To test this hypothesis, an air cannon was used to simulate a tear gas launcher, and ballistics gelatin was used to simulate the human body. The cannon was tested at 20, 30, and 40 Newtons of force. The data showed that this weapon can indeed kill at 30 and 40 Newtons. This is assuming that any victims do not have immediate access to medical care. In terms of inferential statistics, the alternative hypothesis that the means of the collected data would be different, had failed to be rejected. The data from this study has shown that tear gas launchers should not be used during protests for risk of life.

#### THE RELATIONSHIP BETWEEN RIGHT WING AUTHORITARIANISM, SOCIAL DOMINANCE ORIENTATION, AND PERCEPTION OF QUEER INEQUALITY IN THE UNITED STATES

Amelia Wuori

Spring Valley High School

<p>In past research, right wing authoritarianism has been linked to an inability to recognize hierarchical structures at large and a common feature of right wing governments is discrimination against LGBTQ people. The purpose of this research was to determine if right wing authoritarianism is specifically related to an inability to recognize inequality faced by LGBTQ people in the United States. It was hypothesized that different beliefs associated with right wing authoritarianism, namely conservatism, traditionalism, and authoritarianism, would be associated with a lesser perception of inequality. It was also hypothesized that social dominance orientation would be similarly negatively correlated. A survey was sent out and responses were collected from participants who were asked about their tendency to agree with beliefs related to right wing authoritarianism and social dominance orientation and their ability to recognize inequality based on gender identity. Scores were determined using a Likert scale, numerical values were assigned to scores which were analyzed via linear regression. The regression revealed no statistically significant correlation between SDO or RWA and POI. The data failed to reject the null hypothesis and thus the hypothesis was not supported.</p>

#### THE EFFECT OF A MIXTURE OF MAGNESIUM OXIDE AND TITANIUM DIOXIDE NANOPARTICLES ON SOIL HEALTH AND THE GROWTH OF *VIGNA RADIATA*

Shashwat Yadav

Spring Valley High School

The usage of nanoparticles, especially metal-based nanoparticles, is growing in various fields. As usage increases, environmental exposure grows as well. This study aims to examine the impact that a NP



(nanoparticle) system of TiO<sub>2</sub> and MgO has on the environment by studying its effects on *Vigna radiata*, more commonly known as mung beans. It was hypothesized that the NP system would cause plant height to decrease, soil pH to decrease, and soil salinity to increase. In this experiment 90 plants were grown for three weeks. The plants were divided into three groups, a control group, a group receiving 0.25 g of each NP, and a group receiving 0.5 g per NP. A measurement of plant height and soil pH was taken each week and a final measurement of soil salinity was taken at the end of the experimental period. It was found, after doing one-way ANOVA calculations and a Tukey HSD test, that there was a statistically significant decrease in plant height, an increase in soil pH, and no difference in soil salinity. This study shows that NP systems can have drastically different effects than when exposure to a single NP occurs. Ti-based NPs have been shown to increase plant height, but in this experiment, the overall impact led to a decrease in plant height. Overall, this study found that the NP system, based on the factors measured in this experiment, has an overall negative impact on the environment.

#### THE EFFECTS OF THE AMOUNT OF SHORT-TERM EXERCISE ON THE DIAPHRAGMATIC BREATHING RATE OVER WIND INSTRUMENTS.

Lyn Yu  
Spring Valley High School

A strong diaphragm is significant to wind musicians because it provides a steady airstream while they are playing their instruments. In order to strengthen the diaphragm, musicians use various methods to build up their endurance. One such method is by exercising because as a person's breathing rate increases, the lungs and diaphragm are constantly being used. Because of this, the person's diaphragm expands, allowing for longer sustainments of breath and longer endurance. This raises the question of how the effects of short-term exercise can affect the diaphragmatic breathing rate over wind instruments for wind musicians. The purpose of this was to help rising and professional musicians improve their endurance in a faster way. It was hypothesized that as the amount of cardio exercise increases, there would be an increase in breath sustainability because the exercises allow the diaphragms to expand and circulate the respiratory system. To determine this, human participants were gathered for three trials: no exercise, five minutes of exercise, and 10 minutes of exercise. Each participant had to perform cardio exercises; a breath builder was utilized to measure the amount of time they could sustain the ball in the air. An ANOVA test was used because the experiment had more than two treatments in the experiment. The results demonstrated that  $F(2, 5.07) = 0.0081$ ,  $p < 0.05$ . This reveals that the null hypothesis was rejected because the data was significant. The results demonstrated that short-term exercise does not affect the time of breath sustainability.

#### THE INDIVIDUAL AND COMBINED EFFECTS OF MICROPLASTICS AND ACETAMINOPHEN ON THE HEART RATE AND SURVIVAL OF *DAPHNIA MAGNA*

Lily Zhang  
Spring Valley High School

Microplastics (MPs) are a form of plastic pollution created by plastics breaking down into microscopic pieces. Due to their size they are often ingested by marine organisms and can build up inside the tissue and organs of their bodies. The purpose of this study was to explore the combined and individual effects of acetaminophen (APAP) and MPs on *Daphnia magna*. It was hypothesized that the solution containing both APAP and MPs would have significant effects on the heart rate and survival of the *Daphnia magna* due to the ability of the MPs to carry more of the APAP into the tissue of the *Daphnia*. The *Daphnia* were exposed to four solutions containing spring water and varying presences of APAP and MPs. After five days, the heart rates of the living *Daphnia* were counted using a microscope and handheld counter, and the number of surviving *Daphnia* was recorded. The two solutions containing APAP had no surviving *Daphnia*.

(100% mortality) excluding outliers, and the control and MPs solutions had 17% and 20% mortality, respectively. A two sample t-test assuming unequal variances was conducted on the heart rates of the control and MPs groups; there was insufficient evidence to support a meaningful difference between the treatment groups. The null hypothesis could not be rejected ( $t(22) = 1.58$ ,  $p = 0.13$ ), indicating that the microplastics had no effect on the heart rate or mortality of the fleas. Acetaminophen had a significant effect on the survival of the *Daphnia* with 100% mortality in both solutions.

#### HALLUCINATIONS! PREVENT AND PREPARE YOUR MENTAL HEALTH

Alaska Ziegler

Center for Advanced Technical Studies

The Illusion Packet can benefit people with schizophrenia and other conditions producing hallucinations, such as lack of sleep or high stress levels. It is important to calm a person and help them realize that the hallucination/s is not real, because it can prevent stress and future hallucinations from happening. motivation for doing this project comes from dealing with struggles with hallucinations. Illusion Packet is significant because it is a project that helps manage disruptive symptoms for individuals who experience hallucinations by calming them down and lowering their stress with coping mechanisms. The goal is for The Illusion Packet to help calm an individual during and/or after a hallucination, preventing the triggering of another visual disturbance with accompanying undesired emotions. There are no physical products similar to this product, but there is therapy/ counseling, vitamins, and medications made to prevent and help hallucinations. Materials needed are chains and clips, mini photo album books, sticker printer/ rolls, and website and survey. This project is expected to find positive survey results

**END**

**SC Junior Academy of Science Abstracts**

# Metric Week South Carolina

Metric Week in South Carolina is coordinated with National Metric Week which occurs during the week each year that contains October 10. This week is used because the metric system is a decimal system based on 10s.

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With help from the State Department of Education, the **South Carolina Academy of Science** and University of South Carolina, Center for Science Education, copies of this proclamation are emailed to all school principals in the State, and to all sponsors of both the South Carolina Junior Academy of Science (SCJAS), the South Carolina Middle and Elementary School Academy of Science (MESAS), and the Leading Teachers for the Department of Defense South Carolina Junior Science and Humanities Symposium for use in Metric Week activities and promotions. Our nation has partially (more than 40%) adopted the Metric System, and its usage continues to increase as awareness grows.

Metric Proclamation is emailed to **all** schools in South Carolina, public, private, chartered and home schools and includes year around activities developed by the staff of the Center for Science Education for students and teachers to use. This project is also coordinate with the **National Institute of Science &Technology (NIST).**

## SC Metric Week October 10 – 16, 2021

**You will find printable documents for this year's metric week here on the SCAS Web.**

## The 2022 Metric Week in South Carolina

### SC Metric Week October 9 – 15, 2022

## South Carolina Academy of Science Online Contest

This contest challenges students with fun math and science questions. All schools that have a grade 4, 5, 6, 7, or 8 can participate.

In 2022, we will publish the online contest and email it to all schools in South Carolina in late March. The online contest must be completed no later than 11:59 p.m. **Monday, April 25, 2022.**

There are two online contests:

E contest for grades 4 – 6

M Contest for grades 6 – 8.

(A sixth grader can enter E or M but not both.)

Each school that participates will have at least one winner, and each student that enters the contest will be recognized with a participation certificate given by their sponsoring school.

After the contest deadline, we will select winners in the four categories: School, Region, State, and Grand and produce **Honors Certificates** for each student winner. We will mail the Honors Certificates to the principal of the school to present to the winning student at a school assembly.

Winners will be announced on the Center for Science Education website. In addition, results will be published in the South Carolina Academy of Science Newsletter in the May/June/July issue.

For more information contact:

Dr. Don Jordan

**Email (Best Contact):** djordan@sc.edu

**Office Phone:** (803) 777-7007

**Mailing address:**

Dr. Don Jordan / Director SCAS Online Contest

Science Education Center / College of Arts & Sciences

Coker Life Science Building, CLS 108 / 715 Sumter Street, c/o Biology Department / 4th Floor  
CLS, USC, Columbia SC, 29208

## 2022 Contest Documents

The following documents are provided for the 2022 online contest.

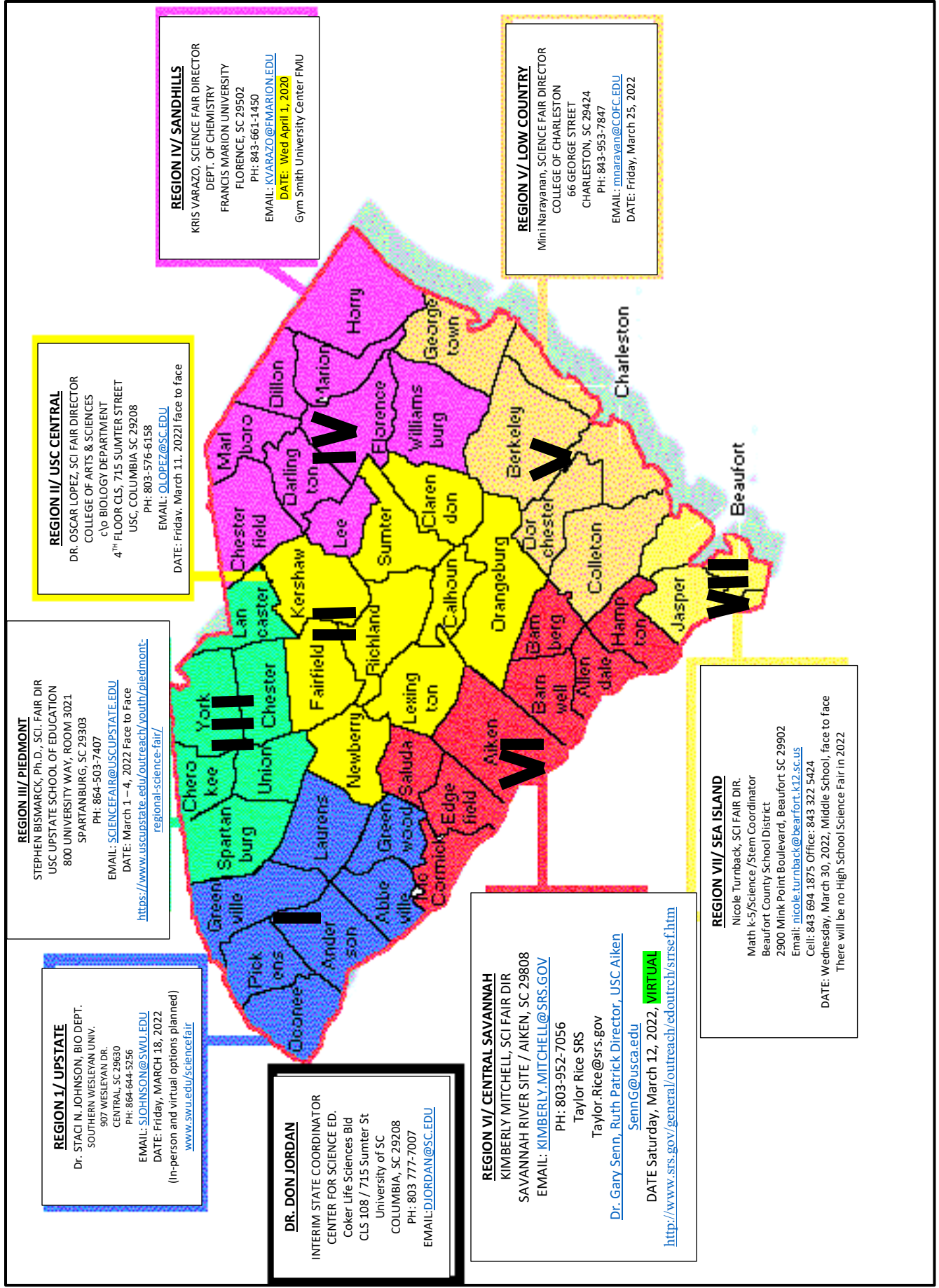
[Sponsor Verification](#)

[Rules for 2022 Online Contest](#)

[Certificate of Participation](#)

[How to Pay Contest Entry Fees](#)

# SC REGIONS SCIENCE FAIR MAP 2021 2022



**REGION 1 / UPSTATE**  
 Dr. STACI N. JOHNSON, BIO DEPT.  
 SOUTHERN WESLEYAN UNIV.  
 CENTRAL, SC 29630  
 PH: 864-644-5256  
 EMAIL: [SJOHNSON@SWU.EDU](mailto:SJOHNSON@SWU.EDU)  
 DATE: Friday, MARCH 18, 2022  
 (In-person and virtual options planned)  
[www.swu.edu/sciencefair](http://www.swu.edu/sciencefair)

**REGION III / PIEDMONT**  
 STEPHEN BISMARCK, Ph.D., SCI. FAIR DIR  
 USC UPSTATE SCHOOL OF EDUCATION  
 800 UNIVERSITY WAY, ROOM 3021  
 SPARTANBURG, SC 29303  
 PH: 864-503-7407  
 EMAIL: [SCIENCEFAIR@USCUPSTATE.EDU](mailto:SCIENCEFAIR@USCUPSTATE.EDU)  
 DATE: March 1-4, 2022 Face to Face  
<https://www.uscupstate.edu/outreach/youth/piedmont-regional-science-fair/>

**REGION II / USC CENTRAL**  
 DR. OSCAR LOPEZ, SCI FAIR DIRECTOR  
 COLLEGE OF ARTS & SCIENCES  
 C/O BIOLOGY DEPARTMENT  
 4TH FLOOR CLS, 715 SUMTER STREET  
 USC, COLUMBIA SC 29208  
 PH: 803-576-6158  
 EMAIL: [OLOPEZ@SC.EDU](mailto:OLOPEZ@SC.EDU)  
 DATE: Friday, March 11, 2022 face to face

**DR. DON JORDAN**  
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**REGION VI / CENTRAL SAVANNAH**  
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 PH: 803-952-7056  
 Taylor Rice SRS  
 Taylor.Rice@srs.gov  
 Dr. Gary Senn, Ruth Patrick Director, USC Aiken  
[SennG@usca.edu](mailto:SennG@usca.edu)  
 DATE Saturday, March 12, 2022, **VIRTUAL**  
<http://www.srs.gov/general/outreach/edoutreach/srsef.htm>

**REGION VII / SEA ISLAND**  
 Nicole Turnback, SCI FAIR DIR.  
 Math K-5/Science /Stem Coordinator  
 Beaufort County School District  
 2900 Mink Point Boulevard, Beaufort SC 29902  
 Email: [nicole.turnback@beaufort.k12.sc.us](mailto:nicole.turnback@beaufort.k12.sc.us)  
 Cell: 843 694 1875 Office: 843 322 5424  
 DATE: Wednesday, March 30, 2022, Middle School, face to face  
 There will be no High School Science Fair in 2022

**REGION V / LOW COUNTRY**  
 Mini Narayanan, SCIENCE FAIR DIRECTOR  
 COLLEGE OF CHARLESTON  
 66 GEORGE STREET  
 CHARLESTON, SC 29424  
 PH: 843-953-7847  
 EMAIL: [mnarayan@COFC.EDU](mailto:mnarayan@COFC.EDU)  
 DATE: Friday, March 25, 2022

**REGION IV / SANDHILLS**  
 KRIS VARAZO, SCIENCE FAIR DIRECTOR  
 DEPT. OF CHEMISTRY  
 FRANCIS MARION UNIVERSITY  
 FLORENCE, SC 29502  
 PH: 843-661-1450  
 EMAIL: [KVARAZO@FMARION.EDU](mailto:KVARAZO@FMARION.EDU)  
 DATE: Wed April 1, 2020  
 Gym Smith University Center FMU

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Leonard C Keifer, Gaithersburg MD

W Frank Kinard, College of Charleston, Chemistry and Biochemistry, Charleston, SC

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H.E. Scheiblich

W. Edwin Sharp

John Spooner

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Dewitt Stone, Jr.

Robert (Bob) Stutts

James Zimmerman

Hans Conrad Zur Loye, USC Columbia, Columbia SC.

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1925	F.H.H. Calhoun	1962	J.C. Loftin	1999	Leonard E. Lundquist
1926	A.C. Moore	1963	W.C. Worthington Jr.	2000	Jane P. Ellis
1927	W.E. Hoy, Jr	1964	C.S.Patterson	2001	Valgene Dunham
1928	S.A. Ives	1965	F.B. Tutwiler	2002	William Pirkle
1929	Stephen Taber	1966	R.H. Gadsden	2003	Dwight Camper
1930	R.N. Brackett	1967	J.W. Morris	2004	David J. Stroup
1931	C.A. Haskew	1968	W.T. Batson	2005	James Privett
1932	Dudley Jones	1969	T.R. Adkins, Jr.	2006	Thomas Reeves
1933	A.W. Blizzard	1970	Maggie T. Pennington	2007	Hans-Conrad zur Loye
1934	Roe E. Remington	1971	John W. Michener	2008	J. David Gangemi
1935	Franklin Sherman	1972	John Freeman	2009	Lucia Pirisi-Creek
1936	A.C.Caron	1973	Jacqueline E. Jacobs	2010	Justin K. Wyatt
1937	J.E. Mills	1974	Averett S. Tombes	2011	Judith Salley
1938	G.G. Naudain	1975	William A. Parker	2012	Robin Brigmon
1939	E.B. Chamberlain	1976	Donald G. Kubler	2013	Pearl Fernandes
1940	J.R. Sampey, Jr	1977	Oswald F. Schuette	2014	Laurie Fladd
1941-44	SCAS inactive (WWII)	1978	Gilbert W. Fairbanks	2015	John Kaup
1945	F.W. Kinard	1979	George P. Sawyer	2016	Heather Evans-Anderson
1946	Belma D. Matthews	1980	Daniel J. Antion	2017	Kevin McWilliams
1947	G.H. Collins	1981	Donna Richter	2018	Heather Evans-Anderson
1948	J.T. Penney	1982	Jack Turner	2019	Kevin McWilliams
1949	Martin D. Young	1983	Gerald Cowley	2020	Jeffery A. Steinmetz
1950	G. Robert Lunz	1984	Charles F. Beam, Jr.	2021	Jeffery A. Steinmetz
1951	Alex B. Stump	1985	Robert C. Nerbun, Jr.	2022	Jeffery A. Steinmetz
1952	Robert H. Coleman	1986	De Witt B. Stone, Jr.		
1953	J.E. Copenhaver	1987	E.F. Thompson, Jr.		
1954	Elsie Taber	1988	Manuel Keepler		
1955	G.M. Armstrong	1989	Lisle Mitchell		
1956	I.S.H. Metcalf	1990	Gordon Sproul		
1957	H.W. Davis	1991	Sharon Hahs		
1958	H.W. Freeman	1992	Joseph Cicero		
1959	J.C. Aull, Jr.	1993	Don Jordan		
1960	J.G. Dinwiddie	1994	William Pirkle		
		1995	Mike Farmer		
		1996	John C. Inman		
		1997	Daniel J. Antion		





# **2023 MEETING**

**DATE & LOCATION: TBA**

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