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BULLETIN

of the

SOUTH CAROLINA ACADEMY OF SCIENCE

INCLUDING 2009 MEETING PROGRAM

VOLUME LXXI
2009

THE SOUTH CAROLINA ACADEMY OF SCIENCE
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of the

SOUTH CAROLINA ACADEMY OF SCIENCE

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

Its purposes are:

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

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

Contents

SCAS OFFICERS, COUNCIL MEMBERS ..... inside front cover
PURPOSE OF THE ACADEMY i
SCAS WEB SITE: 2
MEETING SCHEDULE 3
SPONSORS AND PATRONS 5
TEACHER OF THE YEAR 7
GOVERNOR'S AWARD 9
TOPICAL SESSIONS 14
- Bioengineering 14
- Bioinformatics 14
- Cancer Research Session 15
- Cell Biology/Microbiology 15
- Chemistry/Biochemistry 16
- Environmental Sciences 17
- Experimental Theraputics 18
- HPV Symposium 19
- Molecular Biology 19
- Nanoscience/Physics 20

JUNIOR ACADEMY OF SCIENCE ABSTRACTS 21
ACADEMY OF SCIENCE ABSTRACTS 84
ACADEMY OF SCIENCE ANNUAL REPORTS 152
SOUTH CAROLINA ACADEMY OF SCIENCE MEMBERS 153
PAST PRESIDENTS ..... inside back cover

New Logo

Did you notice the updated SCAS logo on the front cover of the 2009 Bulletin and on the SCAS website? The logo has been updated but reflects the continuity of the SCAS mission by merging aspects of old with a more modern look. The new design represents our "keeping up with the times" and the emerging trends in science. We hope you enjoy the look of the new symbol of the SC Academy of Science. We look forward to serving all our membership for many years to come!

SCAS Web Site:
www.scacadsci.org

The South Carolina Academy of Science maintains the www.scacadscience.org. The web site has been functioning since October of 1999.

The Website features include, but are not limited to: online registration for SCJAS & MESAS events, Journal access, links to NAAS website, and other documents for download, such as registration documents and information about the SCAS events and Science Fairs. Criteria and nomination forms for Teacher of the Year and the Governor's Award of Excellence in Science also are available for download.

Please visit the website often for updates on the many activities of the SC Academy of Science!

SCHEDULE, EIGHTY_SECOND ANNUAL MEETING
SOUTH CAROLINA ACADEMY OF SCIENCE
April 15, 2009
COLUMBIA METROPOLITAN CONVENTION CENTER
COLUMBIA, SOUTH CAROLINA

Thursday, March 20th

8:30 AM - 6:00 PM **SCAS Annual Meeting**

Topical Sessions	**Senior Academy**
Bioengineering	Lexington Bl
Bioinformatics	Lexington B
Cancer Research Session	Richland A
Cell Biology/Microbiology	Congaree B
Chemistry/Biochemistry	Congaree A
Environmental Sciences	Carolina B
Environmental Theraputics	Carolina A
HPV Symposium	Richland A
Molecular Biology	Congaree B
Nanoscience/Physics	Carolina Al

12:00 PM- 1:00 PM **Undergraduate Research Colloquium**
Organized by the SC Alliance for Minority Participation to introduce undergraduate students to active researchers and potential research mentors. Lunch provided Richland A

1:00 PM- 1:30 PM **Governor's Awards Ceremony** Lexington A

1:30 PM- 2:30 PM **Plenary Lectures** Lexington A.
"Advancing Stroke Care in South Carolina" Robert J. Adams, MD, Director South Carolina Center of Economic Excellence; Director MUSC Stroke Center

"Key Technology Requirements for Practical Human Simulators" John Schaefer, MD, Professor. Assistant Dean, Statewide Clinical Effectiveness Education, MUSC

2:45 PM- 3:30 PM **SCAS Business Meeting** Lexington A

2:45 PM – 4:00 PM **Poster Session** Richland B/C

4:00 PM- 6:00 PM **Workshop** Lexington A
The Entrepreneurial Scientist Presented by by SC Launch, SC Research Authority

Dr. John L. Safko

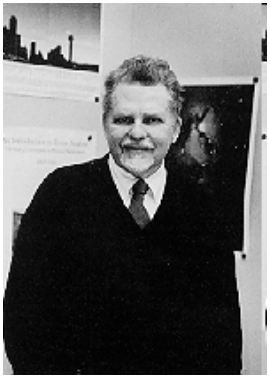
Thank You, for Decades of Service to the South Carolina Academy of Science

Dr. John Safko, Distinguished Professor Emeritus at the University of South Carolina retired as the SCAS Treasurer in 2008. John Safko served as the South Carolina Academy of Science Treasurer, Long-Range Planning Committee member, Council Member, AAAS representative, and many other roles through decades of exemplary service.

Please join us in wishing John the very best in his well-earned retirement.

The SCAS Officers and Council Members

Unfortunately, John didn't leave many pictures of himself behind!



Please join the South Carolina Academy of Sciences in thanking our Meeting and Award sponsors:

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www.michelin-us.com

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

(TEACHERS OF THE YEAR)

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

South Carolina Academy of Science 2008 Award for Excellence in Secondary Science or Mathematics Teaching is Presented to:

KATHARINE LEE METZNER-ROOP

Teacher of Honors Marine Science
and Honors Physical Science
Academic Magnet High School
Charleston, SC

Ms. Metzner-Roop received a BS degree in Marine Science from College of Charleston in 1990 and a Masters degree in Marine Science from the University of Charleston in 1993. She also holds Advanced Placement certification. She was selected Teacher of the Year at Academic High School in 2004 and SCJAS Sponsor of the Year in 2005.

Ms. Metzner-Roop's creativity is evidenced throughout her teaching, and her students are engaged in meaningful inquiry-based labs on a regular basis. Activities which stimulate the interest of young people in science include bringing her students to SCJAS workshops and competitions. She practices with the challenge bowl teams and reviews the students' research papers and presentations. Her students compete and win in the Low Country Science Fair and the International Science and Engineering Fair as well as the Junior Science and Humanities Symposium. She and her students are involved in the Noisette Creek Research Project in which they monitor the health of the water and soil around the marsh creek that runs through the school campus. As a result, her students were invited to present their Noisette Creek research in Washington DC and lobby for environmental protection before the President's Cabinet, the Senate, House of Representatives, and world renowned scientists.

Ms. Metzner-Roop believes that teaching is the most important job because we guide the next generation and help determine the future of our world. She says that "I love being a teacher and I cannot imagine doing anything else." Colleagues point out that she is a dedicated teacher who truly loves her school and works tirelessly on providing students with relevant and fun activities.

It is therefore appropriate that this wonderful teacher be recognized by the SCAS for her innovation and effectiveness in the classroom, her dedicated service to school and community, and her ability to impart to her students an understanding of science as a way of knowing about the world. Ms. Katharine Metzner–Roop is hereby named the 2008 Awardee for Excellence in Science Discovery.

Linda D. Sinclair Chairman, Selection Committee

Governor's Award for Excellence in Science 2009

The award was established in 1985 by the Drug Science Foundation to honor specifically an individual or team within the state whose achievements and contributions to science in South Carolina merit special recognition and to promote wider awareness of the quality and extent of scientific activity in South Carolina. Since 1989 the award, named the "Governor's Award for Excellence in Science", has been under the joint sponsorship of the Governor's office and the South Carolina Academy of Science. In 1993 these groups were joined by the Dewees Development Corporation and Harbor Watch of Charleston. In 2000 **Roche Carolina Inc**. took the lead, in 2004 **MeadWestvaco** joined and in 2005 **Michelin North America** joined in sponsorship of the Governor's Awards.

Beginning in 1990, two of these awards were given annually with one being for scientific discovery and the other for scientific awareness. In 2005 the Academy, in conjunction with the Governor's Office, initiated the sponsorship of a third award directed to a gifted young researcher (***only those individuals who have completed no more than 12 years beyond the Ph.D***.). The award is called the Governor's Young Scientist Award for Excellence in Scientific Research and was sponsored by Michelin North America. The awards consist of an honorarium of $1,000 and a handsomely framed certificate which is presented to the recipient 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.

Dr. Don M. Jordan
Center for Science Education
College of Arts and Sciences
Sumwalt Room 323
University of South Carolina
Columbia SC 29208
Email: Jordan@gwm.sc.edu

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The South Carolina Academy of Science gratefully recognizes the contribution of

Roche Carolina, MeadWestvaco, and **Michelin North America**

for their support of the

Governor's Award for Excellence in Science

1985-1988 Drug Science Foundation Award for Excellence in Science

1989-Present Governor's Award for Excellence in Science

PAST RECIPIENTS

James R. Durig, 1985 ..... University of South Carolina
Howard F. Harrison, 1986. ..... CR Seeds, Hartsville, South Carolina
F. John Vemberg, 1987. ..... University of South Carolina
Danyl D. DesMarteau, 1988. ..... Clemson University
Harry S. Margollus, 1988. ..... Medical University of South Carolina
Lon B. Knight, Jr., 1989. ..... Furman University
Paul D.Ellis, 1990. ..... University of South Carolina
William J. Padgett, 1990. ..... University of South Carolina
James A. Marshall, 1991. ..... University of South Carolina
Rudolph E. Mancke, 1991. ..... SC Educational Television Network
Makio Ogawa, 1992. ..... Medical University of South Carolina
Larry Joe McCumber, 1992. ..... Francis Marion University
Yakir Aharonov, 1993. ..... University of South Carolina
William F. Junkin, III, 1993. ..... Erskine College
Donald D. Clayton, 1994. ..... Clemson University
R. Bruce Dunlap, 1994. ..... University of South Carolina
Frank Avignone, 1995. ..... University of South Carolina
Daniel Antion, 1995. ..... University of South Carolina
Elizabeth Martin, 1996. ..... College of Charleston
Maria G. Buse, 1996. ..... Medical University of South Carolina
John H. Dawson, 1997. ..... University of South Carolina
Sarah F. Stallings, 1997. ..... Winthrop University
Joseph Manson, 1998. ..... Clemson University
George E. Temple, 1998. ..... Medical University of South Carolina
Michael Farmer, 1999. ..... Greenville Technical College
Roy Edward Wuthier, 1999. ..... University of South Carolina
Thomas Borg, 2000. ..... South Carolina School of Medicine
Louis Terracio, 2000. ..... South Carolina School of Medicine
Elaine L. Craft, 2000 ..... State Center for Excellence
Kenneth Marcus, 2001. ..... University of South Carolina Aiken
Jeffrey M. Priest, 2001 ..... University of South Carolina Aiken
Roger R. Markwald, 2002. ..... Medical University of South Carolina
William T.Pennington, 2002. ..... Clemson University
Richard D. Adams,, 2003 ..... University of South Carolina Columbia
Charles Beam, 2003. ..... College of Charleston
John W. Baynes, 2004. ..... University of South Carolina Columbia
David J. Stroup, 2004. ..... Francis Marion University
Frank Berger, 2005 ..... University of South Carolina Columbia
Thomas Reeves, 2005 ..... Midlands Technical College
Ya-Ping Sun, 2005 ..... Clemson University
Gabriel Virella, 2005 ..... Medical University of South Carolina
Omar Bagasra, 2006, ... Claflin University
Rebecca Bullard-Dillard, 2006 ..... Claflin University
Karen Burg, 2006 ..... Clemson University
Yusuf Hannun, 2006 ..... Medical University of South Carolina
Stacey Franklin Jones, 2007 ..... Benedict College
Varavut Limpasuvan, 2007 ..... Coastal Carolina University
Daniel Reger 2007 ..... University of South Carolina
Don Jordan 2008 ..... University of South Carolina
Donna Chen 2008 ..... University of South Carolina
Terry Tritt 2008 ..... Clemson University

2008 Governor's Award for Excellence in Science Awareness

The 2008 Governor's Award for Science Awareness is awarded to

Dr. Don M. Jordan
University of South Carolina

Dr. Jordan has tirelessly worked to increase science awareness in South Carolina for many years, both as a faculty member at USC and as an outstanding member of the SCAS. Dr. Jordan's accomplishments as a leader in science education and awareness are too many for to be listed in full here. He is the USC Science & Engineering Fair Director; SCAS Discovery Fair Founder and Director; Middle/Elementary School Academy of Science Founder and Executive Director; Founder & Coordinator of the nationally recognized South Carolina Certified Metric Specialist program; Chief Trustee and Author of the S.C. Academy of Science Trust Fund; primary author of the National Metric Education Standards; director of seven correspondence courses for USC; faculty advisor to the Alpha Tau Omega fraternity at USC, (was the 2007 Faculty Advisor of the year at USC); Eastern Director of the United States Metric Association. Dr. Jordan is coordinator for the U.S. metric transition efforts with the National Institute of Standards and Technology. Dr. Jordan served as President of the National Association of Academies of Science (NAAS) in 1992-93, and continues to serve on the Board of NAAS as the Council person to AAAS, and as Editor of the National News Letter for NAAS.

Honors and Awards:

Dr. Jordan was a finalist for the Distinguished Teacher Award for 1998. In addition, he was the winner of the Distinguished Researcher and Scholarship Award by the College for 1996. Dr. Jordan was elected President of the South Carolina Academy of Science, and, in February 1993, he was elected a Fellow of the American Association for the Advancement of Science (AAAS). He received the Helms Award of Excellence from the S. C. Science Council; the S. C. Hall of Science and Technology; the Michener Award of Excellence from the South Carolina Academy of Science. In March of 2000, he received The Order of the Silver Crescent from the Governor of South Carolina, which is an award for dedication, commitment and leadership by an individual in the state.

2008 Governor's Award for Excellence in Scientific Research

The 2008 Governor's Award for Excellence in Science Research is awarded to

Dr. Donna Chen
University of South Carolina

Dr. Donna Chen is recognized for her pioneering work in the field of nanoparticle chemistry, in which she has rapidly emerged as a young leader at the national and international level. Dr. Chen was one of five speakers sponsored to present at the Young Chemists Workshop, organized by the Chair of the Nobel Prize Committee in Gothenburg, Sweden, in 2003, and has received numerous invitations to speak at many prestigious conferences in her field. In 2004, the National Academy of Science recognized Dr. Chen as one of the top 60 young scientists in the nation. In her five years at USC, Dr. Chen secured over $ 1.7 million in funding for her research program, and played a key role in a successful $ 2 million Catalyst Nanoscale Interdisciplinary Research Team grant application to the National Science Foundation. Dr. Chen is widely recognized as an outstanding teacher, in the classroom and in the laboratory, has trained numerous postdoctoral fellows, graduate and undergraduate students, and maintains a very active research group. She was recently promoted to Associate Professor with tenure at USC, with outstanding reviews.

2008 Governor's Award for Excellence in Scientific Research

The 2008 Governor's Award for Excellence in Science Research is awarded to

Dr. Terry M. Tritt
Clemson University

Dr. Terry M. Tritt has a superb record of accomplishments as a scientist and a mentor in South Carolina. He has authored over 150 publications in refereed journals, 10 review articles, and has edited seven books. He has trained 8 Ph.D.'s and 3 MS students in the past five years, and directs an active laboratory with ten graduate students, three postdoctoral fellows and several undergraduate students. Dr. Tritt has to his credit over $ 10M in competitive extramural funding for his laboratory, currently supported by a prestigious and very competitive DOE Center of Excellence for Novel Materials grant, just renewed until 2010. Dr. Tritt is an internationally recognized leader of his field of thermoelectric materials. His accomplishments are too many to be listed, but have been very effectively summed up by a comment made by one of his reviewers: "Professor Tritt has taken a sleepy little materials program at Clemson University and transformed it into a comprehensive thermoelectric materials program for South Carolina that has earned both national and international recognition for its excellence". Dr. Tritt's contributions to thermoelectric materials science, notably the discovery of high performance thermoelectric compounds in various classes of materials, have far reaching potential for their applicability to efficient energy utilization, "green energy", and the preservation of the environment.

TOPICAL SESSIONS

Bioengineering
Presiding: Melissa Moss, Francisco Gonzalez
Lexington B

2:45-3:00 pm ACTIVATION OF ENDOTHELIUM IN AD BRAIN INVOLVES SOLUBLE AGGREGATES OF THE AMYLOID-BETA PROTEIN
Author: Melissa A. Moss

3:00-3:15 pm BIODEGRADABLE SCAR-INHIBITING IMPLANTS FOR GUIDED SPINAL CORD REGENERATION
Author: Angel E. Mercado

3:15-3:30 pm FLUID FLOW REGULATES ECM EXPRESSION AND DEPOSITION DURING CARDIAC VALVE DEVELOPMENT
Author: Hong Tan

3:30-3:45 pm AGE EFFECTS ON ARTERIAL AXIAL STIFFNESS IN WILD TYPE AND DIABETIC MICE
Author: Ying Wang

3:45-4:00 pm INTRACELLULAR DELIVERY AND CONTROLLED RELEASE OF TREHALOSE USING A THERMALLY RESPONSIVE NANOCAPSULE
Author: Wujie Zhang

Bioinformatics
Presiding: Agnes Ayme-Southgate
Lexington B

4:00-4:15 pm ANALYSIS OF BIOLOGICALLY REALISTIC PREFRONTAL CORTEX PYRAMIDAL CELL MODEL
Author: Fletcher Moore

4:30-4:45 pm BIOINFORMATICS OF INSECT MUSCLE PROTEOMES: EVOLUTION AND FUNCTIONAL ANALYSIS
Author: Agnes Ayme-Southgate

4:45-5:00 pm COMPUTATIONAL METHODS FOR DIFFERENTIAL PROFILING OF TRIACYLGLYCEROLS IN EDIBLE OILS USING LC-MS TRIACYLGLYCEROLS IN EDIBLE OILS USING LC-MS
Author: Maggie Broadwater

5:00-5:15 pm MIM: A SPECIES INDEPENDENT APPROACH FOR DISTINGUISHING CODING AND NON-CODING DNA SEQUENCES IN BACTERIA
Author: Achraf EL Allali

Cancer Research Session
Presiding: Marj Pena
Richland A

2:45-3:00pm THE EFFECT OF OBESITY ON THE INCIDENCE OF BREAST CANCER
Author: Diana Ivankovic, Ph.D.

3:00-3:15pm A STEP FORWARD : PHER2 BIOMARKER DISCOVERED FOR THE PROLACTIN RECEPTOR ANTAGONIST G129R
Author: Victoria Herold

3:15-3:30pm THE EFFECTS OF ZINC ACCUMULATION ON BREAST CANCER
Author: Sharne' Morrow

3:30-3:45pm VIRAL CANCER PATHOGENESIS: REGULATION OF THE MICROENVIRONMENT BY AN ONCOGENIC HERPESVIRUS
Author: Chris Parsons

3:45-4:00pm EFFECTS OF 17BETA-ESTRADIOL AND TAMOXIFEN ON MCF-7 HUMAN BREAST CANCER CELLS
Author: Samir Raychoudhury

4:00-4:15pm INTERACTION OF EXOGENOUS AND ENDOGENOUS VIRUSES IN HEAD AND NECK CARCINOMA
Author: Semyon Rubinchik

4:15-4:30pm EXPRESSION AND ACTIVITY OF GAMMA-AMINOBUTYRIC ACID RECEPTOR (SUBTYPE A) IN HUMAN BREAST CANCER
Author: Donna Sellers

4:30-4:45pm ELUCIDATING THE EFFECTS OF CHRONIC INFLAMMATION ON TUMORIGENESIS IN MIN MICE
Author: Margeaux Wetendorf

Cell Biology/Microbiology
Presiding: Omar Bagasra
Congaree B

8:30-8:45 AM INTEGRATING RESEARCH PROJECTS INTO UNDERGRADUATE LABORATORY COURSES
Author: Christina Eddy

8:45-9:00 am REDUCTION OF BACTERIA ON SPINACH, LETTUCE, AND SURFACES IN FOOD SERVICE AREAS USING EO WATER
Author: Jane Guentzel

9:00-9:15 am PROJECTIN AND MYOFIBRIL ASSEMBLY IN DROSOPHILA MUSCLES
Author: Cynthia Oliva

9:15-9:30 am IDENTIFICATION AND CHARACTERIZATION OF OLFACTORY RECEPTOR GENES IN FOUR SPECIES OF SC SNAKES
Author: Amanda Robinson

9:30-9:45am THE EFFECTS OF ZINC ACCUMULATION ON DIABETES IN THE AFRICAN AMERICAN COMMUNITY VS. THE CAUCASIAN AM
Author: Bianca Thomas

Chemistry/Biochemistry
Presiding: Justin Wyatt
Congaree A

8:30-8:45am SPIRO(BID-PYRAZOLES) FROM 1,4-DIANIONS OF SELECT HYDRAZONES AND AN ESTER-SULFONAMIDE
Author: Amanda Acevedo —Jake

8:45-9:00am HUMAN GLUTAREDOXIN 1 REDUCES DISULFIDE BOND OF HUMAN SUPEROXIDE DISMUTASE 1 BY MONOTHIOL MECHANISM
Author: Samantha Bouldin

9:00-9:15am MAGNETIC CIRCULAR DICHROISM AND UV-VISIBLE SPECTRAL STUDY OF P. AERUGINOSA PHUT HEME TRANSPORTER
Author: D.M. Indika Bandara

9:15-9:30am NEW DERIVATIVES OF THE ANTIBIOTIC CYTOSPORONE E, FOCUSING ON SIDE CHAIN SUBSTITUTIONS FOR SAR STUDY
Author: Erin Cartwright

9:30-9:45am NOVEL HETEROGENEOUS METAL CATALYSTS SUPPORTED ON POLYMERS FOR THE WATER GAS SHIFT REACTION
Author: Kevin Djordjevic

9:45-10:00am SPECTROSCOPIC STUDY OF CYP119 HAVING ITS CYSTEINE HEME AXIAL LIGAND REPLACED WITH SELENOCYSTEINE
Author: Jing Du

10:30-10:45am DIHYDROISOQUINOLINONES FROM POLYLITHIATED AROMATIC CARBOXYLIC ACID HYDRAZIDES AND ESTERS
Author: Sloan Hess

10:45-11:00am STUDYING MITOCHONDRIAL REDOX STATUS AND CONTROL MECHANISMS USING IN VIVO FLUORESCENT PROTEIN SENSORS
Author: Jingjing Hu

11:00-11:15am SAR STUDIES VIA DELETION CHEMISTRY AND NITROGEN INCORPORATION INTO THE ANTIBIOTIC CYTOSPORONE E
Author: Thomas Jenkins

11:15-11:45am FINDING HOMOLOGOUS MESOPHILIC THERMOPHILIC PAIRS IN ALPHA/BETA BARRELS USING COMPUTATIONAL ANALYSIS
Author: April Johnson

11:45am-12pm ESTIMATION OF BLOODSTAIN AGE ON POLYMER SUBSTRATES BY DIFFUSE REFLECTANCE INFRARED SPECTROSCOPY
Author: Jessica N. McCutcheon

1:30-1:45pm FABRICATION AND CHARACTERIZATION OF SEIRA SUBSTRATES UTILIZING ELECTROLESS DEPOSITION
Author: Brent Peters

1:45-2:00pm ALDOL/CLAISEN CONDENSATIONS OF BETA-DIKETONES WITH ALDEHYDES/ESTERS AND LHMDS
Author: Elizabeth Redpath

2:00-2:15pm PYRAZOLE-ACETIC AMIDES FROM POLYLITHIATED BETA-KETOAMIDES; ESTERS, AND HYDRAZINE
Author: Ellyn Smith

2:15-2:30pm DEVELOPMENT OF AN HPLC-F mETHOD FOR THE DETECTION OF MELATONIN IN STENOSTOMUN VIRGINIANUM
Author: Daniel Stanton

2:30-2:45pm ANALYSIS OF LEACHING BISPHENOL-A FROM POLYCARBONATE PLASTIC CONTAINERS
Author: Rhonda Winchester

2:45-3:00pm COORDINATED REGULATION OF YQJH BY IRON AND THE NICKEL METALLOREGULATORY PROTEIN YQJI
Author: Wei Wang

Environmental Sciences
Presiding : TBA
Carolina B

8:30-8:45am THIRTY YEARS OF CAREX PENSYLVANICA STABILITY AFTER GAMMA IRRADIATION, BROOKHAVEN NATIONAL LAB
Author: Richard Stalter

8:45-9:00am EQUATORIAL WIND VARIATIONS: THEIR DRIVERS AND THEIR CONNECTION TO WINTERTIME CLIMATE
Author: Eric DeMarco

9:00-9:15am FISH DIVERSITY STUDY IN FOUR HOLE SWAMP SOUTH CAROLINA
Author: Dr. Margarit Gray, Dr. Thomas Kozel, Dr. Diana Ivankovic

9:15-9:30am SUBCELLULAR LOCALIZATION OF MARINE BACTERIAL ALKALINE PHOSPHATASE
Author: Haiwei Luo

9:30-9:45am THE EFFECT OF CARBON LOADING AND FATTY ACID CONCENTRATION ON THE PRODUCTION OF BIOHYDROGEN
Author: Sharee Harris

9:45-10:00am THE EFFECTS OF FUEL REDUCTION TREATMENTS ON AVIFAUNA NEST SUCCESS IN THE PIEDMONT OF SOUTH CAROLINA
Author: Eran S. Kilpatrick

10:30-10:45am WETLAND CONTRIBUTIONS TO MERCURY TRANSPORT AND BIOACCUMULATION IN SOUTH CAROLINA COASTAL RIVERS
Author: Jane Guentzel

10:45-11:00am SEARCHING POTIENTAL PLANT SPECIES FOR BIODIESEL PRODUCTION
Author: Ajoy G. Chakrabarti

11:00-11:15am USING LIPID BIOMARKERS TO CHARACTERIZE BACTERIAL COMMUNITIES IN A CONSTRUCTED WETLAND
Author: Annie R. Whitley

11:15-11:30am THE ROLE OF PRETREATMENT IN BIOHYDROGEN PRODUCTION
Author: Sam Williams

11:30-11:45am THE EFFECTS OF THE SUMTER WASTEWATER TREATMENT PLANT ON THE SURVIVAL AND REPRODUCTION OF C. DUBIA
Author: Erin Worely

Experimental Therapeutics
Presiding: David Magnin
Carolina A

8:30-8:45am PROTECTIVE EFFECT OF RESVERATROL IN TOXIN-INDUCED ACUTE LUNG INJURY AND ACUTE RESPIRATORY DISTRESS
Author: Sadiye Amcaoglu Rieder

8:45-9:00am TARGETING CANNABINOID RECEPTORS AS A NOVEL APPROACH TO PREVENT DONOR T CELL-MEDIATED INFLAMMATION DURING ACUTE GRAFT-VERSUS-HOST DISEASE
Author: Rupal Pandey

9:00-9:15 CLONING AND INITIAL TESTING OF A RETROVIRAL VECTOR EXPRESSING AND ANTI-HIV-1 TAT HAMMERHEAD RIBOZYME
Author: Lindsey Padgett

9:15-9:30 ANTI-HIV-1 VIF ACTIVITY BY A HAMMERHEAD RIBOZYME EXPRESSED FROM A RETROVIRAL VECTOR
Author: Audrey Hendley

9:30-9:45 SYNTHESIS OF AZOLE INHIBITORS OF AP2: A NEW APPROACH FOR THE TREATMENT OF DIABETES
Author: Mr. Davis, Jr. and Ms. Baccus

9:45-10:15 DISCOVERY OF HIGHLY POTENT LONG ACTING DPP-IV INHIBITORS
Author: David Magnin

HPV Symposium
Presiding: Kim Creek, Gloria Frelix
Richland A

8:45-9:00am DIFFERENTIAL CONTROL OF GENE EXPRESSION BY TGF-beta DURING PROGRESSION OF HPV16-TRANSFORMED CELLS
Author: Sangeeta Kowli

9:00-9:15am TRISTETRAPROLIN-MEDIATED INDUCTION OF CELLULAR SENESCENCE IN HPV-TRANSFORMED CERVICAL CANCER CELLS
Author: Sandhya Sanduja

9:15-9:30am ANALYSIS OF HPV IN HEAD AND NECK CANCER PATIENTS WITH RESPECT TO RACE
Author: Geoffrey Pitzer

9:30-9:45am IMPACT OF CERVICAL CHLAMYDIA TRACHOMATIS INFECTION ON HPV PERSISTENCE
Author: Jeffrey Korte

9:45-10:00am HUMAN PAPILLOMAVIRUS PREVALENCE AND TYPE DISTRIBUTION AT ENROLLMENT AMONG FEMALES ATTENDING THE UNIVERSITY OF SOUTH CAROLINA
Author: Kim Creek

10:30-10:45am PATIENT CHARACTERISTICS AND OUTCOMES FOR LOCALLY ADVANCED CERVICAL CANCER IN MINORITY AND UNDERSERVED POPULATIONS IN EASTERN NORTH CAROLINA
Author: Gloria Frelix

10:45-11:00am CHANGING THE PICTURE OF CERVICAL CANCER IN SOUTH CAROLINA THROUGH CLINIC- AND COMMUNITY-BASED RESEARCH, PRACTICE, AND ACTION
Author: Heather Brandt

11:00-11:45am KEYNOTE LECTURE
Author: Anna Giuliano

Molecular Biology
Presiding: Heather Evans
Congaree B

10:30-10:45am PCR AMPLIFICATION OF TTH-LIGASE GENE
Author: Jessica Abercrombie

10:45-11:00am OVEREXPRESSION OF THE UBIQUITIN LIGASE WWP1 LEADS TO LEFT VENTRICULAR HYPERTROPHY AND SUDDEN DEATH
Author: Wassim Basheer

11:00-11:15am CONSTRUCTION OF A PLASMID CONTAINING THE P1 PROMOTER OF BURKHOLDERIA XENOVORANS AND GFP
Author: Matt Bowser

11:15-11:30am ANALYSIS OF FOXG1 SEQUENCE VARIATION IN RETT SYNDROME
Author: Amy Bradley

11:30-11:45am STRUCTURAL AND FUNCTIONAL ANALYSIS OF THE P1 PROMOTER OF THE LB400 BPH CLUSTER
Author: Ryan Buffett

11:45am-12pm CLONING OF A 159 BP FRAGMENT BEARING THE P1 PROMOTER REGION OF THE LB400 BPH CLUSTER USING PCR
Author: Sean Grubb

12:00-12:15pm LOSS OF FOXO1 IN ENDOTHELIAL CELLS CAUSES DECREASED CARDIAC MYOCYTE PROLIFERATION
Author: Katie Wessinger

Nanoscience/Physics
Presiding: TBA
Carolina A

10:30-10:45am FOURIER TRANSFORM INFRARED SPECTROSCOPY OF HYDROXYAPATITE-DOPED POC/PEG
Author: Damien Howard

10:45-11:00am ADSORPTION OF LYSOSTAPHIN TO PLA NANOPARTICLES RESULTS IN ITS ENHANCED ACTIVITY AGAINST S. AUREUS
Author: ROHAN SATISHKUMAR

11:00-11:15am VISIBLE AND FT-IR PHOTOACOUSTIC SPECTROSCOPIC CHARACTERIZATION OF BISMUTH NANORODS
Author: Erica Sheftic

11:30-11:45am WHAT'S GEOMETRY GOT TO DO WITH IT? INVESTIGATING EFFECTS OF MULTIPLE CAPACITORS IN A SINGLE CASING
Author: Shawn Ballenger

11:45am-12pm QUANTUM-WALK SIMULATION IN JAVA / NOT YOUR AVERAGE WALK IN THE PARK
Author: Jeremy Capps

12:00-12:15pm PHASE SEPARATION AND WETTING LAYER EFFECTS IN NEAR CRITICAL SULFUR HEXAFLUORIDE
Author: Gregory Smith

THE EFFECT OF FOUR CONCENTRATIONS OF A BORAX BASED FIRE RETARDANT ON THE IGNITION RATE AND COMBUSTION RATE OF COTTON FABRIC

Stephanie Ackerson
Spring Valley High School

There has been an increased concern about the health effects of flame retardants, such as Polybrominated diphenyl ethers: without flame retardants the number of people each year are injured and killed in house fires would increase. The purpose of this experiment was to make a natural flame retardant that would lower the ignition rate and combustion rate of cotton fabric. It was hypothesized that if different concentrations of borax and boiled water were used as a flame retardant, then the 0.18 g/ml concentration of borax in water will lower the ignition rate and combustion rate more than the other concentrations. Different amounts of borax, 42.5 g, 56.7 g, 70.9 g, and 85 g were mixed with 473 ml of boiling water. After the borax was dissolved then the solution was sprayed onto the squares of cotton, left to dry, then the fabric was set on fire. Stopwatches were used to measure the amount of time it took to catch on fire as well as the time it took to burn completely. The control was cotton squares without the borax-water solution. After all the data were collected a one-way ANOVA test was conducted on the ignition rate and combustion rate. For both the ignition rate and combustion rate the P-value was 0.001< alpha at 0.05. Using a Tukey Test, it was found that a 0.09g/ml concentration and 0.15g/ml or above had a positive, significant effect on the ignition rate of the cotton fabric, compared to the control, and that a 0.12g/ml concentration and higher concentration had a positive, significant effect on the combustion rate of the cotton fabric, compared to the control. Therefore, the study indicates that a natural, borax based flame retardant has a positive effect on the ignition rate and combustion rate of cotton fabric at the 0.12g/ml concentration and above. Meaning that the combustion rate was lowered considerably and the ignition rate was raised considerably. I would first like to thank my teachers at Spring Valley High School, Mrs. Spigner and Mr. Soblo, for providing me with the materials and time needed to conduct my research, and for helping me chose my project and for teaching me how to analyze the data. I would also like to thank my parents for helping me get my materials and for supporting me through the project. Finally, I would like to thank my friends, Margaret Carter, Michael Hobensack, and Bethan Fanning for helping me set up my experiment and for helping me watch the clock.

CHARACTERIZATION OF GREASE IN THE AH-64 APACHE TAIL ROTOR TRANSMISSION GEARBOXES

Divyanshu Agarwal
South Carolina Governor's School for Science and Mathematics

The University of South Carolina is working with the South Carolina Army National Guard to develop Condition Based Maintenance (CBM) systems for the AH-64 Apache helicopter. In CBM, an onboard system collects data to notify the operators when a part needs maintenance. This system saves the Army time and money by helping them avoid regular and unnecessary part replacements. The data is collected by measuring the amount of vibrations and the temperatures in the drivetrain components. These measurements are made on the state-of-the-art test stands at USC which are built to test the bearings, gearboxes, swashplates, oil coolers, and shafts of the AH-64 Apache.

During some of the test runs, the test stand had to be shut down because temperatures exceeded the safe operating range of 295^0F in the intermediate gearbox. This led to an investigation on the synthetic grease to find out its chemical properties and help identify the cause of this incident. The evaporation rate, the dropping point, and the flash point of the grease were found by carrying out separate experiments.

EFFECT OF SAND CHARACTERISTICS ON LOGGERHEAD SEA TURTLE NESTS ON CAPE ISLAND

Leigh Allison
Academic Magnet High School

The purpose of this study was to analyze the sand characteristics of loggerhead sea turtle nests on Cape Island in the Cape Romain National Wildlife Refuge and determine their effect on the nests. Samples were collected in July and August of 2008 and were analyzed for moisture content, organic matter, calcium carbonate, and grain size. The results showed no relationship between the sand characteristics and nest success (indicators of which were hatch success, emergence success, and incubation duration). There was also no a relationship between relocated and in-situ nests with their respective sand characteristics. Therefore, on Cape Island, it can be assumed that there is no negative effect of the sand characteristics on the nest success, and thus nests can be relocated to the safest area of the beach without intense consideration for the sand characteristics. I would like to sincerely thank my mentor, Melissa Bimbi and my advisor, Murray Eicher for their advice and support as well as the U.S. Fish and Wildlife Service and SCDNR for their cooperation in allowing me to use their facilities and equipment.

LOCALIZATION OF MALE MITOCHONDRIA IN M. GALLOPROVINCIALIS WITH FLUORESCENT IN SITU HYBRIDIZATION

Johnathon Anderson
South Carolina Governor's School for Science and Mathematics

The Mytilus Galloprovincialis, otherwise known as the Blue Mussel, is a bivalve mollusk originating in the Mediterranean region that thrives around the world. Unlike most organisms that inherit all of their mitochondria maternally, the Mytilus Galloprovincialis inherits mitochondria by doubly uniparental inheritance. When the egg is fertilized, the sperm head separates from the tail, bringing five male mitochondria into the fertilized egg. Depending on the sex of the zygote, the male mitochondria will either be destroyed over the course of a few days (females) or the mitochondria will replicate at a fast pace to match the quantity of female mitochondria (males). As the embryo grows and divides, the male mitochondria will distribute to different tissues in the cell. Somatic tissues tend to retain male mitochondria whereas gonad and adductor muscle tissue do not. This research specifically labeled male mtDNA via FISH. A mtDNA specific probe made with fluorescent nucleotides is allowed to bind to the mtDNA in tissues, which helps in localizing mtDNA under UV microscopy. This research will elucidate answers not only to localization of mtDNA in various tissues, but also the quantity of mtDNA in these tissues. The results from these experiments will determine how 5 mtDNA multiply exponentially to equalize the male to female ratio in male mussels. The FISH method was successful in localizing the male mitochondria in sperm tissue, but was inconclusive with the gonad tissue. I would like to thank the University of South Carolina for providing the facilities for my research, the South Carolina Governor's School for Science and Mathematics for the opportunity,my research mentor, Dr. Richard Showman, and Dr. Bhuvana Parameswaran, my advisor.

AN ANALYSIS OF THE EFFECT OF URBAN SPRAWL ON VOLTAGE GENERATION IN MICROBIAL FUEL CELLS DERIVED FRO

Soorya Avali
Spring Valley High School

As the world runs out of fossil fuels, more and more money is being invested in developing potential alternatives. One option that was uncovered a few years ago is the idea of using Microbial Fuel Cells (MFCs). Bacteria can oxidize organic matter, and then externally transfer the ensuing electrons via nanowires or mediators. In an MFC, the electrons are transferred to the electrode. From the electrode, the electrons can flow through an electrical circuit, creating electricity. As these fuel cells can run on virtually any organic matter, these can be powered by anything from sediment to wastewater. The purpose of this experiment was to determine if more voltage is produced from an MFC made with sediment from upstream of a city than from an MFC downstream of a city. The rationale was that because fuel cells produce more electricity in the presence of more organic matter, it could be established if more organic matter exists downstream. It was hypothesized that the fuel cell made from downstream sediment would produce more voltage overall. To test this, fuel was collected from Riverfront Park (upstream of Columbia) and Barney Jordan landing (downstream of Columbia) and a fuel cell was constructed using each. Voltage was measured twice a day over a 21-day period. A dependent-samples T-Test was conducted with alpha at .05 to determine statistical significance. The p-value for the test was <.001, so the null hypothesis was rejected. The hypothesis that the MFC made from downstream sediment would produce more voltage was supported.

THE EFFECT OF FERROUS AMMONIUM SULFATE CONCENTRATION ON MARINE SYNECHOCOCCUS SPECIES CO2 ABSORPTION

Emily Bakaj
Spring Valley High School

Iron-limited waters account for a significant part of the earth's oceans, and iron limitation in marine Synechococcus could lead to a shift to O2 as the electron acceptor in photosynthesis, leading higher levels of atmospheric CO2. The purpose of this study was to determine the effects of iron concentration on marine Synechococcus sp.'s CO2 absorption and O2 production as a result of photosynthesis. It was hypothesized that the lower the concentration of ferrous ammonium sulfate (a form of Fe2+,) the less CO2 absorbed by Synechococcus sp., and thus, less O2 produced (and that the opposite wouldn't apply for higher than normal concentrations.) Synechococcus sp. was cultured in varying concentrations of iron for 0.75 of an hour, as O2 and CO2 concentrations were recorded. The hypothesis was partially supported because the lower the concentration of iron, the less CO2 absorbed by Synechococcus sp., while O2 production was unaffected. The second part of the hypothesis was partially supported because a concentration of iron was reached where CO2 absorption and O2 production reached the maximum percent change of gas concentration. Statistical correlations between the concentrations of iron and the percent change values were performed to analyze the data. There was a weak negative correlation between concentration and percent change for oxygen gas, $r(3)= -0.35$, $p > 0.10$. There was a strong positive correlation between concentration and percent change for carbon dioxide gas, $r(3)= 0.85$, $p < 0.10$. This shows that Synechococcus sp. does use O2 as an electron acceptor in iron-limited conditions.

First of all, I would like to thank my parents for proving me with emotional and monetary support throughout the duration of this research. Also, I cannot thank my Research 1 Honors teacher, as well as research advisor, Dr. Robin Henderson enough for her extensive and much appreciated help and advisement. I would also like to thank Mr. Dale Soblo and the Discovery Magnet Program for providing me with the proper materials and setting to perform my research. Last, but certainly not least, I must thank Dr. Richard Castenholz of the University of Oregon, as well as the kind people at the UTEX Culture Collection for providing me with some algae when there was a slight emergency. Their generosity is appreciated immensely!

A STUDY OF THE WAYS TO GENERATE ELECTRICITY WITH A MODIFIED SHOCK ABSORBER

Jacob Baker
Spring Valley High School

The purpose of this project was to find out if a shock absorber could be modified to generate useable amounts of electricity for a car. The null hypothesis was that a shock absorber can not be modified to generate electricity and be used as an alternator, and the alternative hypothesis was that a shock absorber can be modified to generate electricity and be used as an alternator. A shock absorber was modified in two different ways. The first was by attaching a piezoelectric material to the piston. The second was by pushing a magnet through a tube with wire wrapped around it. If a diode were attached to the wire, the electricity would only be allowed to flow in one direction, so the electricity resulting from the electromagnet would not move as the magnet is pushed through one side of the tube. If the electricity can not move through the wire, it will resist the magnet's movement and act like the piston in an oil shock absorber. The electromagnetic shock absorber was set up with 50 wraps of wire and 700 wraps of wire to find if the difference in wraps of wire made the electricity produced by each shock absorber significantly different. When the methods were tested, the piezoelectric shock absorber would not work well enough to get any data, and the electromagnet would not produce enough electricity to resist the magnet's movement. When an LED light was attached to the electromagnet no light was produced, so the null hypothesis could not be rejected. SCJAS for funding my project. Thanks to Mr. Soblo for adjusting my paper and pointing my project in the right direction, my Uncle Henry for providing me a workspace and lending his time to help my project and my family for their support and assistance when an extra set of hands were needed

LOCALIZTION OF THE THROMBIN RECEPTOR IN THE AVIAN SPINAL CORD DURING THE PERIOD OF P.C.D

Meghan Barnes
South Carolina Governor's School for Science and Mathematics

During the development of the spinal cord, alpha-motor neuron numbers decrease by nearly 50 percent from embryonic (E) day 5-E10 through a process of naturally occurring programmed cell death (PCD). Previous research has shown that adding thrombin receptor (PAR-1) agonists decreases the survival of motor neurons both in vivo and in vitro. Previous evidence suggests the presence of PAR-1 in both the gray and white matter of the lumbar spinal cord during PCD. Due to the lack of appropriate antibodies for the chick PAR-1, studies have only been able to implicate the presence of PAR-1 based on the use of PAR-1 agonists previously shown to activate PAR-1 in other animal models. An antibody developed recently has shown to identify avian PAR-1 in

cardiovascular tissue; our goal was to determine the temporal and spatial localization of PAR-1 during PCD in the avian lumbar spinal cord. Using immunohistochemistry, we found that PAR-1 is expressed in both the gray and white matter beginning on E6 and the percentage of positive cells in the gray and white matters was not significantly different on E8 or E10. This study does confirm the presence of PAR-1 during PCD even though there were no significant differences. Therefore, activation of this receptor by naturally occurring PAR-1 agonists may help explain the process through which specific cells are eliminated. Continued PAR-1 expression may be one of the mechanisms through which cells are eliminated following injuries or diseases that may increase the concentration of PAR-1 agonists in the adult spinal cord.

BIOREMEDIATION OF LEAD USING SULFUR REDUCING BACTERIA

Austin Beachler
Dutch Fork High School

The purpose of this experiment is lead poisoning is a real threat in many places around the world and there is no good way right now that is known to clean the water, cheap and effectively. The procedure will be to grow a culture of sulfur reducing bacteria (Desulfovibrio desulfuricans) and add them to test tubes containing small amounts of lead sulfate. The test tubes would also contain different amounts of Na-Lactate. What I will find is that the more Na-Lactate put into the test tubes the faster the rate of lead is reduced. This concludes my project and verifies my hypothesis by proving that the amount of lead was reduced faster with more amounts Na-Lactate. Now with this data one could most likely more easily clean up lead contaminated groundwater areas through wells and hopefully cost effectively.

OPTIMIZING THE INSTALLATION OF FIBER OPTIC CABLE

Marc-Olivier Blais
Dutch Fork High School

This study is designed to determine the most favorable installation configuration for tight-buffer, single-mode optical cable so as to attain a minimal degree of attenuation which is desired in a fiber-to-the-home network. This method must not use any protective duct or conduit. In addition, the fiber being used must be bend-sensitive. This will be conducted by manipulating several variables in regards to the mechanical stress of the cable and measuring the resulting attenuation of the optical cable. Thus, an arrangement of said variables can be construed that provides minimal attenuation. In general, increasing the number of bends, and decreasing the diameter of said bends will increase attenuation. This project will focus mainly on the parameters of the installation configuration of said cable. Thus the foundations of a favorable method can be laid. The results of this research can be used in a subsequent study on the cost effectiveness of said method.

THE EFFECT OF VARYING AMOUNTS OF ATRAZINE4L ON HYPSIBUIS SEPTULATUS' RESISTANCE TO TEMP. DECREASE

Mason Branham
Spring Valley High School

In order to sustain life, each organism's respective system must maintain homeostasis. The phylum Tardigrada, though often classified as one of the ôlesser-knownö categories, has been found to posses extraordinary adaptations that allow them to survive under

extreme conditions. These small, translucent organisms, usually less than 1 mm in body length, can undergo a process known as ækryptobiosisÆ in which they do not show any metabolic reactions or life functions. Atrazine 4L is a widely used herbicide that usually runs off into streams and ponds. The experiment investigated if this certain herbicide in various amounts affected the Hypsibius septulatusÆ ability to enter its cryptobiotic state. Nine Petri dishes were assembled with each containing respective numbers of the organisms. One group was subjected to 15 micro liters of Atrazine, one was given 30 micro liters and one was used as the control. After being exposed to the herbicide, the organisms were placed in an environment with a temperature of about 4 degrees Celsius. After being removed from the cold temperature, survival rates were calculated. An ANOVA test was conducted yielding a p value of 0.001 thus statically supporting the data's significance. Compared to other findings, the tardigrades were indeed able to resist the below average temperatures but were unable to resist the toxicity of the Atrazine 4L. I would first like to thank Mr. T. Swindler for the supply of Atrazine-4L. The research would not have been possible without his contribution. Secondly, I would like Nathan Branham for ordering and purchasing the colonies of Hypsibius septulatus that were also essential to this study. Lastly, I would like to thank Mrs. M. Spigner, Katelyn Noel, and Kendall Hauck for their continuous help whenever I may have needed it.

THE EFFECT OF THE ADDITION OF SURROUNDING MIRRORS ON THE PRODUCTION RATE OF A NEWLY DESIGNED SOLAR STILL

Taylor Brazell
Spring Valley High School

The objective of this study was to determine if the addition of mirrors to a hexagonal solar-still would increase the rate of production of distilled water when compared to a hexagonal solar-still without surrounding mirrors. A solar still of original design was built with a hexagonal base, and a roof of 7/12 pitch (slope). Around the top of the basin, bisected cpvc tubing was placed to drain out the distilled water, which was collected in a container outside of the still. Surrounding the still, a mirror was placed at each side. The mirrors could be adjusted according to the direction of sun rays or laid down and covered when not needed. To test the hypothesis, the still was placed out under the sun for eight hours a day, alternating the days with mirrors or without mirrors. At the end of the eight hours, the amount of water collected was recorded. The production rate was calculated using milliliters/hour. A dependent sample t-test was conducted to determine if the production rates between the mirrored and non-mirrored stills were statistically different (α=0.05). I would like to thank my father, Don Brazell, for acting as my mentor during this process, and for purchasing the supplies. Also I would like to thank Dr. Henderson for her help in my decisions, her guidance during my research. Thank you also to my classmates of Dr. Hernderson's Research I class for all of their suggestions when I designed the solar still.

VISUAL REPRESENTATION OF STATISTICAL SHAPES IN THREE DIMENSIONS

Ryan Britt
SC Governor's School for Science and Mathematics

Medical imaging is one of the most viable ways of diagnosing patients with illnesses. Because medical imaging is so viable, many statistics have been accumulated relating to the images, including statistical data about organs in the human body. There are programs available that change the two dimensional pictures that medical imaging machines create into deformable three dimensional images. A tool to deform these 3D

images gives a medical technician the ability to see the differences between a mean shape (the average shape of an organ in a statistical set of data) and one particular shape of an organ. In this research project, software was created with the goal of viewing this deformable 3D object and displaying a deformation of it using multiple pre-deformed images.

THE EFFECT OF COLOR VERSUS NON-COLOR ON MEMORY

Megan Brovan
Spring Valley High School

The purpose of this experiment was to determine the relationship between the presence of color and a person's ability to remember pictures. Other studies have shown that color aids memory in text. This experiment was designed to see if this holds true for images. This information could be used to assist teaching methods in the future, as teachers could potentially use more colored images to aid studentsÆ memories of the material. The hypothesis was that when students were shown two posters, one in color, and one in black-and-white, the recall of items in the color poster would be significantly improved over black-and-white poster recall. In order to test this hypothesis, students were shown posters in both black and white and in color. The æpostersÆ were pages of clipart pictures along with colorful backgrounds. Participants were instructed to view the posters for sixty seconds. Following the poster viewing, participants were asked to write down as many objects from the poster as they could remember. Participants were then asked questions about the poster they had seen, to test their recall when prompted, compared to unprompted recall. The participants were then exposed to a second poster (non-colored if they first viewed a colored poster, and colored if they first viewed a non-colored poster). The number of recalled items in each test was analyzed using a dependent samples t-test to see if recall for the items in the æcoloredÆ posters was enhanced when compared to the recall of items in the ænon-coloredÆ posters. I would like to thank all of my classroom teachers for allowing me to use their class time for my research, along with other teachers that graciously let me use their students as my 'subjectsÆ: Mrs. Kim Bouchey, Mrs. Pam Gill, Dr. Robin Henderson, Mr. Andrew Corley, and Mrs. Michelle Spigner. I would also like to thank my parents, Melissa Mathia and Brad Brovan, for being supportive of all the time that was used for my academic work. I would also like to thank Kirstin McCutchan, Kellie Shell, Taylor Brazell, Heather Brovan, and Samuel Goodman for helping to analyze the raw data.

THE EFFECTS OF LOW TEMPERATURE AND PRESSURE ON BACILLUS THURINGIENSIS ENDOSPORE GERMINATION

Ian Buckley and Patrick Reeves
Heathwood Hall Episcopal School

The purpose of this experiment was to examine the effects of extreme temperature and vacuum conditions on the germination and growth of Bacillus thuringiensis endospores, and to lend further evidence to previous studies on the resistant qualities of endospores. It was hypothesized that endospores exposed to low temperature and low pressure would germinate differently than the endospores that were exposed only to a standard room temperature and pressure. Four sets of three test tubes were set up with 0.01 grams of Bacillus thuringiensis endospores and were exposed to unique conditions for one week, each receiving no light. Of the four groups, one was exposed to a temperature of -23 degrees Celsius, one was exposed to a vacuum of 400-500mmHg, one was exposed to both a temperature of -23 degrees Celsius and a vacuum of 400-500mmHg, and one

remained at standard room temperature and pressure. The samples were washed and stained with crystal violet at different time-points and were placed in cuvettes where transmittance was measured using a colorimeter; a higher transmittance meant less germination and growth of the endospores. The mean data were calculated and the results were analyzed using the one-way ANOVA statistical analysis test (alpha=0.05). The general trends seen were that the endospores exposed to the low temperature, low temperature and low pressure, and room temperature and pressure all experienced exponential growth past the first six hours, and the transmittance decreased, but later on, the bacteria began to die, and the transmittance increased. The low pressure group did not experience the exponential growth in the first six hours, but it did experience growth later on. At twenty-nine hours, all groups showed similar transmittance, and the final analysis showed that there was no statistically significant difference in the transmittance, and thus the germination and growth between the control group and the other groups, suggesting that previous studies were indeed correct in stating that endospores are incredibly resistant to a variety of single and combined extreme conditions. The null hypothesis was therefore accepted. Further research could be conducted, and that research could consist of exposing the endospores to extreme environments within household and business kitchens. First and foremost, we would like to thank our Biology teacher, Mrs. Lisa Norman for all of the support, insight, and motivation that she gave us, from the conceptual phases of the experiment all the way through the documentation of the experiment; her aid was invaluable. In addition, we would like to thank the rest of the Heathwood Hall science department: Mr. Jim Morris, for the use of his lab and supplies and for his support, Mr. Tim McKnight, for his extremely helpful knowledge of vacuum chambers, and Ms. Sondra Weiland, for the use of her lab and supplies and for unlocking the door when we showed up to school on a Saturday morning in desperate need of Tryptic Soy Broth. We would also like to thank Dr. Wayne Nicholson for the expert advice he gave us early in the conceptualization of our experiment.

MONITORING THE PERFORMANCE OF AN IEEE 802.11A LONG-RANGE WIRELESS LINK

Shari Carter
South Carolina Governor's School for Science and Mathematics

A sensor network was set up in the Clemson Forest by the Issaqueena Lake to monitor the volume of water flowing into the river. A system which allows the sensors to transmit data wirelessly to a centralized database where they can be archived and displayed in real time will allow remote site monitoring from any Internet access point. In this project, a long-range wireless link was established between the forest and the Clemson campus, and the performance of the link was measured and optimized. To optimize the link performance, different parameters including transmit power and antenna alignment were altered, and the effects of these parameters on signal strength and throughput were studied. For a line-of-sight wireless link, increasing the transmit power can potentially enhance the received signal strength and throughput. Signal strength and throughput are also expected to be greatest when the directional antennas are perfectly aligned to point at one another. Using a program called Iperf to measure throughput and a voltmeter to measure signal strength, the effects of these parameters were studied over the established wireless link. It was found that the received signal strength was dependent on both the antenna direction and the transmit power. On the other hand, while throughput had a clear dependency on antenna direction, it showed no noticeable dependency on transmit power in the full range of transmit power supported by the device.

THE EFFECT OF AMMONIA ON THE GROWTH OF *ARABIDOPSIS THALIANA* PLANTS

Margaret Carter

There has been a steady rise in the nitrogen pollution in the past few years. This rise is having an effect on plant development. The purpose of this experiment was to identify the effect of ammonia treatments on the growth of Arabidopsis plants in order to better predict the negative or positive potential environmental effects of the rising N pollution. It was hypothesized that the increase in ammonia would increase the growth of the *Arabidopsis* plants. Two apparatuses were created using PVC pipes. Each cube was covered in a plastic sheet and the plants for the control were grown in one cube and the experimental in the other in order to have a contained ôatmosphere.ö There were thirty A. thaliana seeds in each tray, each seed having a separate plot. Both the control and the experimental were watered once a day, and the second tray, the experimental, was sprayed with the ammonia concentration every seven days. Three applications of ammonia were administered. The spray treatment of ammonia represented the atmospheric pollution and the cube covered in the plastic sheet contained the atmosphere. Three weeks after planting the seeds, the mass of the control and experimental plants were taken. This was done by taking the plants out of the soil and then pressing them in order to dry them. After the plants were dried the mass of each was taken and recorded as a representation of the growth. After the data were collected a two-sample t-test = 2.40, $p<0.05$ was conducted. The hypothesis that the experimental masses would be greater then the control masses was rejected, showing that the ammonia treatments were detrimental to the plant's development. I would like the thank Mr. Soblo, my research teacher, for guiding me through the research process and my classmates for helping me narrow down a research choice and Benjy for helping with the collection of data.

SYSTEMIC AND DERMATOME SPECIFIC NOCICEPTIVE SENSITIZATION FOLLOWING EXPOSURE TO ENDOTHELIN-1 EARLY

Marla Caskey
South Carolina Governor's School for Science and Mathematics

Previous research has found that early pain experiences can increase pain experienced later in life. Whether this enhancement of pain is local to the site of early pain or throughout the body is not currently known. Our laboratory has previously characterized a rodent model of local nociceptive sensitization following exposure to endothelin-1 (ET-1) early in development. The hypothesis was that an early nociceptive experience will increase nociception throughout the body. To test this hypothesis, on postnatal day seven, either saline or endothelin-1 was administered in the left hindpaw. On postnatal day 11, endothelin-1 was administered in either the forepaw or the contralateral hindpaw. The rats were then videotaped for behavioral scoring. In comparison to a single exposure to ET-1 on postnatal day 11, male and female rats exposed to ET-1 on postnatal day 7 showed increased paw flinching in the contralateral hindpaw on postnatal day 11. Male rats exposed to ET-1 on postnatal day 7 and 11 showed increased paw flinching in the forepaw on postnatal day 11 in comparison to a single exposure to ET-1 in the forepaw on postnatal day 11. The female rats exposed to ET-1 on postnatal day 7 and showed no change in paw flinching in the forepaw in comparison to a single exposure to ET-1 in the forepaw on postnatal day 11. For the male rats, the findings support my hypothesis of a systemic nociceptive sensitization. For the female rats, sensitization was found to be dermatome specific but not systemic. These findings show nociceptive sensitization shows a sex-dependent profile with a greater spread in males versus females.

PROTEIN-NANOPARTICLE CONJUGATES AS POTENTIAL THERAPEUTIC AGENTS FOR TREATMENT OF HYPERLIPIDEMIA

Catherine Cochrane
South Carolina Governor's Schhol for Science and Mathematics

In past decades atherosclerosis became the primary cause of heart disease and stroke and the major underlying cardiovascular pathology for nearly half of all adult deaths in Western societies. Excessive Low Density Lipoproteins (LDLs) can lead to lack of LDL-receptors in hepatocytes, which consequently cannot recognize low-density lipoproteins and make it impossible for further metabolism of ôbadö cholesterol located in LDLs. In this investigation, we show that nanoparticles can be used to enhance delivery of low-density lipoprotein to liver via alternative route of uptake by liver macrophage (Kupffer) cells, which eventually results in their digestion by lysosomes and, thus provides the pathway similar to that for normal LDL uptake by hepatocytes. In this study nanoparticle-antibody conjugates were made with monoclonal antibody to human apolipoprotein-B (Apo-B100, Meridian Life Science Inc., ME) and 150 nm poly-(D,L)-lactide (PLA) nanoparticles. A solution of low density lipoproteins in PBS buffer was used as a model for high cholesterol human plasma. This solution was treated with nanoparticle-antibody conjugates and the concentration of LDLs in samples was measured. We have obtained approximately 20% decreasing of LDL level after incubation of LDL solution with PLA-apoB conjugates. Imaging of uptake of fluorescently labeled LDL-nanoparticle consumed by macrophages (RAW 264.7 Mouse leukaemic monocyte macrophage cell line) was studied using a fluorescent microscope. Macrophages were treated with fluorescently-labeled LDL-nanoparticle complexes and cells were investigated with the microscope to determine whether or not binding to the macrophages had occurred. The viability of the treated cells was checked using Live/Dead assay. Mentor: Dr. Alexey Vertegel, Clemson University

SEARCH FOR A NEW TYPE OF NEUTRINO INTERACTION: CHECKING FOR THE MINIBOONE ANOMALY

Csilla Czako
South Carolina Governor's School for Science and Math

In the MiniBooNE experiment, neutrinos produced from pion-decay were sent into a detector. An excess of events at low energy was measured. Harvey, Hill, and Hill postulated that this excess of events meant that there was a new type of neutrino interaction that they called anomaly mediated in addition to the three known neutrino interactions. To check their hypothesis, the data from the NOMAD experiment were analyzed after being filtered through a code written to eliminate events that do not fit the criteria. The data collected suggests that there is no anomaly-mediated photon. This result may be due to the three times better angular resolution and the ten times better directional resolution of the NOMAD apparatus. At this time, I would like to acknowledge the South Carolina Governor's School for Science and Mathematics and the University of South Carolina for giving me this opportunity. I would also like to thank Dr.Sanjib Mishra, Matt Seaton, and Andrew Scott for their mentorship.

THE EFFECT OF GRAPHENE OXIDE NANOFILLERS ON POLYVINYL ACETATE TEAR STRENGTH

Kekeli Dawes
Spring Valley High

The purpose of this experiment is to recognize greater tensile strength in polyvinyl acetate-graphene oxide (GO) nanocomposites containing concentrations of suspended graphene used as a nanofiller. Graphene is an atom-thick sheet of graphite that has high electrical capabilities that can be easily exfoliated by suspending oxidized graphite in polar substances like water. However, present exfoliation methods result in small, nanometer-wide flakes. There are transparent films and papers of layered GO flakes that exhibit exceptional electrical capabilities that can be used as transparent electrodes and paper-thin wires. It has not been shown that GO's nanoscale strength capabilities can translate to thin films or as a nanofiller in low concentrations. In this study, nylon-graphene nanocomposites usually used for electrical purposes were tested for tensile strength. It was hypothesized that nylon strands with the GO nanofiller present would display an acute increase in tensile strength. The GO was exfoliated using a modified Hummers method. Polyvinyl acetate was dissolved in acetone with different amounts of GO present. The GO was suspended in water. There were two nanocomposites made; one with 30ml of GO suspension, and one with 15mL of suspension. The control consisted of 30mL of distilled water. The polyvinyl composites were then cut into uniform stubs and were fastened to a table to be tested for tensile strength using a spring scale. The readings for 30 trials for each composite were analyzed using an ANOVA test. Preliminary analysis indicates that there is no significant difference in the composite tear strength. I would like to thank Bay Carbon for porviding the SP-1 graphite and the Spring Valley Education Foundation for financial support. I would also like to thank my research teacher Dr. Henderson and my family for guidence and endless support.

THE SUB-LETHAL EFFECT OF AN HERBICIDE ON EVAPORTRANSPIRATION

Aubree Decoteau
Dutch Fork High School

This project is measuring the change in the amount of evapotranspiration of plants that have been exposed to different amounts of an herbicide compared to plants that have not been exposed. There is a decrease of evapotranspiration by 57% with every increase of .1M of an herbicide. The treated and non-treated plants will be kept in separate and controlled environments with a light source while the temperature will be monitored. Transpiration will be measured by a potometer. The amount of transpiration of the treated plant should decrease. The soil evaporation is being measured separately by adding water to it and measuring the mass difference after a length of time. The soil evaporation should stay constant because it is going to be kept in a controlled climate for both the treated and non-treated plants. Studies have shown that the amount of evapotranspiration of the plants exposed to the herbicide should be lower compared to the amount of evapotranspiration of the plants that are not exposed to the herbicide. The student would like to thank Dr. Larry Williams and Dr. Langdon Warner for their assistance and ideas for this project.

INHIBITION OF BCL-2 POTENTIATED APIGENIN FOR INDUCTION OF APOPTOSIS IN SK-N-DZ NEUROBLASTOMA CELLS

Anurag Deeconda
Spring Valley High School

This research aims to show the ability of a dietary flavonoid called apigenin to inhibit tumor growth and induce apoptosis in SK-N-DZ neuroblastoma cells, and whether its efficacy is modified by a Bcl-2 inhibitor molecule HA14-1. Tumor cells were cultured and treated with 2.5, 5, 10, and 20 a%mol/L of HA14-1 monotherapy, 50, 100, 200, and 400 a%mol/L of apigenin monotherapy, and all possible combination therapies. An MTT assay was done on all treatments, and 6 ANOVAs were run to compare all treatment types to the control cells. All six p-values were less than .001, showing that HA14-1 and apigenin significantly reduced tumor cell viability. The 2.5 a%mol HA14-1/100 a%mol apigenin treatment was found to be the most effective combination therapy for SK-N-DZ cells. Wright Staining was done on this combination treatment, and compared to the control and monotherapy treatments, it showed the greatest morphological signs of apoptosis. FACS flow cytometric analysis was done for the treatment cells, and it was found that the apigenin/HA14-1 treatment arrests the neuroblastoma cell cycle in the sub-G1 phase, preventing cells from mitotically dividing and thereby initiating the apoptotic cascade. An Annexin V/PI-binding assay also showed significant apigenin/ HA14-1 induced apoptosis. Western Blotting was done on samples from combination therapy cells, and it was found that the apigenin/HA14-1 treatment causes activation of a Caspase-8-mediated extrinsic pathway of apoptosis. Upregulation of Bcl-2 associated X-protein (Bax), downregulation of Bcl-2, and activation of proteases Calpain and executionary Caspase-3 also occurred in the combination therapy cells. This all supports the hypothesis that apigenin is an effective apoptotic agent and, when modified by HA14-1, induces substantial apoptosis in a ligand-based Caspase-8 extrinsic mechanism in SK-N-DZ neuroblastoma. I would like to extend my first and foremost thanks to Dr. Swapan K. Ray, Professor of Pathology, Microbiology and Immunology at USC School of Medicine, for replying back to my emails and allowing me to work in the lab. Also, I would like to thank Dr. Surajit Karmakar and Subshree Chowdhary for helping me work the machines and giving me advice on the experiments and analysis. I would also like to acknowledge Mrs. Spigner for helping me tirelessly with my research ideas and with keeping me organized. Finally, I would like to thanks my parents for tirelessly providing me with transportation frequently to and from the laboratory.

SYNTHESIS AND CHARACTERIZATION OF 1D ZINC OXIDE, NICKEL, AND BISMUTH SULFIDE NANOSTRUCTURES

Joshua Duncan
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Clemson University, Physics Department
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Clemson University, Material Sciences Department

One-dimensional nanostructures are of great interest due to their wide range of applications in nanoscale electronics and optoelectronic devices. Zinc Oxide (ZnO) is a wide band gap (3.37 eV) semiconductor material and in the nanostructure form are effective in the use of solar cells due to their high surface area and specific crystalline orientation. Its piezoelectric property was exploited in making ônanogenerators.ö Alcoholic solution of ZnCl2 was used as the Zn source in a modified chemical vapor deposition (CVD) method for the synthesis of ZnO nanowires. The nanostructures were

grown on commercial glass and silicon substrates at 550%C. Apart from semiconducting nanostructures, metallic nanowires are of great potential due to their high conductivity and large aspect ratios. NiCl2 in conjunction with Si powder is being used in the CVD growth of Ni nanowires. The future goal is to synthesize NiS and Bi2S3 nanostructures. A field emission scanning electron microscope (FESEM) is currently being used for the characterization of all of the structures.

CONSTRUCTION OF A LUCIFERASE REPORTER VECTOR FOR THE E-CADHERIN PROMOTOR UNDER THE CONTROL OF ZEB1

Tony Dyer
Governors School for Science and Mathematics

Colon Cancer is the third most common form of cancer as well as the second leading cause of cancer related deaths in the Western World. The main reason for the deaths caused by colon cancer is a process known as Epithelial to Mesenchymal Transition. EMT is characterized by epithelial differentiation, loss of intercellular adhesion, and enhanced migratory potential. One of the causes leading to EMT is the repression of E-cadherin, a cancer suppressor gene, by Zeb1 transcription factors. Zeb1 binds to the promoter region of E-cadherin which inhibits E-cadherin's ability to act as a cancer repressor gene. The aim of this experiment is to produce a reporter vector with a PGL3 E-cadherin promoter so it can be tested to see if Zeb1 represses the E-cadherin. The effect will be determined by measuring the light emitted from luciferase when Zeb1 is introduced. However, the transformation to produce the reporter was not successful. This result might be caused by high levels of phenol contamination.

THE AFFECTS OF THE PERMIABILITY OF THE CORE OF A SOLENOID ELECTROMAGNET

Douglas Edmonson
Dutch Fork High School

This project deals with the strength of a magnetic field in a small area produced by a solenoid electromagnet. A solenoid electromagnet consists of a metal core surrounded by a wrapping of wire. The strength is directly related to the number of turns of wire per centimeter and directly related to the current in the wire. Also the permeability of the core has an affect on the strength of the magnetic field produced.The equation for the magnetic field strength of a solenoid is, B = a%0*(N/L)*I, and the calculated results will be used as a control for my experiment. Also to reduce the amount of error in gathering data, the core will have flat faces that will be relatively close to the measuring sensor. Also to keep the magnet producing a constant field it will be connected to the power supply along with a resistor to control the current. Also the solenoid magnet will have about a high turn per cm ratio 500 turns per cm. Dr. Purohit at USC Physics Dept.

THE EFFECT OF CHANGING THE ORIENTATION OF A SOLAR PANEL ON THE PANEL'S PERFORMANCE

Bethan Fanning

The appeal of alternative energy sources has risen dramatically in the past few decades, due to the fear of climate change and oil shortages. As solar panels are increasingly used as potential energy production units, it is important to understand optimal orientation of panels. This experiment was performed to determine whether the orientation (direction and angle) of a solar panel significantly affects the output (in watts) of the panel. It was

hypothesized that there would be no significant difference between nine orientations. The panel was set up at each of 9 angles, a multimeter was turned to direct current (DC) voltage, then DC amperes (amps), and data were recorded. After experimentation, voltage values were multiplied by current values to determine overall wattage values. An initial two-way ANOVA suggested a significant difference between the orientations, and that the effects of the angle are independent of the direction. Therefore, a one way ANOVA was conducted and found $F(8, 171) = 290.42$, $p < .001$, rejecting the null hypothesis. The data were then run through a Tukey test, which supported the one way ANOVA results. The Tukey test suggested that there was a significant difference in all but one set of orientations. This study indicates that a change in orientation has a significant impact on the wattage output of the solar panel. I would like to thank my research teacher, Mr. Soblo, for helping me choose a research idea, as well as helping me along the way and my father for helping me narrow down ideas, find a solar panel and multimeter, and providing encouragement throughout the research process. I would also like to thank the Spring Valley Education Foundation for funding my project.

THE EFFECT OF SEED SOURCE ON THE RANDOMNESS OF THE OUTPUT OF A PSEUDORANDOM NUMBER GENERATOR

Will Fishburne

Most people use random number generators daily without noticing them or even caring about them. Pseudorandom number generators are generally well suited to their purpose and generate adequate numbers. The purpose of this experiment was to determine if changing the source of the generator's seed would affect the randomness of the resulting numbers. It is known that the choice of seed is crucial to the period length of the sequence, and therefore the usefulness of the generator. The generator used was Java's Random Class, and it was tested using seeds from Random.org, Fourmilab's HotBits generator, and Java's default seed generator. Ten trials of ten thousand numbers were generated using each seed source. Then each trial had the frequencies of its numbers counted. It was hypothesized that Random.org would produce more successful frequency tests than HotBits or Java. All the seed sources passed overall, but only Random.org had no failures. The two failing tests were HotBits 4 with $x2(99) = 131.92$, $p<.05$ and Java 5 with $x2(99) = 133.14$, $p<.05$. After these tests for local nonrandomness, a chi-square test for homogeneity was performed to attempt to locate any global nonrandomness, which was not found. Random.org resulted in $x2(891) = 904.322$, $p> .05$, HotBits had $x2(891) = 898.005$, $p> .05$, and Java had $x2(891) = 902.398$, $p> .05$. Therefore, Random.org seeds generated better numbers. I would like to thank Mr. Sawson Taheri for his assistance in forming this project, Mr. Dale Soblo for guiding me to complete this project, Dr. Jason OKane for helping with the programming, the Spring Valley Education Foundation for funding my research, and my family for all their support and love during this project.

THE INLUENCE OF FREE DRUG SAMPLES ON A PATIENT'S TREATMENT PLAN

Jennifer Flanigan
Spring Valley High School

It is unknown why some doctors tend to prescribe certain drugs than others. In previous research, it has been shown that free drug samples may influence doctorsÆ decisions. Other research shows that advertising has an influence on what doctors prescribe. The purpose of this study was to determine how doctors were influenced by the availability free drug samples when deciding their patientsÆ treatment plans. It was hypothesized

that doctors who receive free drug samples, are more likely to give the free drug samples to patients with no insurance. The relationship between free drug sample availability and patient treatment was analyzed by surveying doctors about their treatment plans. The results indicate that 64% of doctors would be more likely to give patients free drug samples if they could not pay for medications. Thirty-six percent of physicians indicated no strong preference for providing free drug samples to patients unable to afford medication. Also, 45.8% said they hand out free drug samples to the same patients numerous times, while 54.2% said they did not. The results indicate that doctors, who receive free drug samples, are not likely to give the samples to patients with no insurance. I would like to thank Dr. Robin Henderson for her help and assistance to my project, all of the doctors who compeleted my survey, and my parents for the money and help for my project.

THE VIDEOGRAPHIC AND MORPHOLOGICAL EVIDENCE OF WING COUPLING IN CADDISFLIES

Wickham Flannagan
South Carolina Governor's School for Science and Mathematics

Forewings and hind wings of insects may be joined in flight. This is because the wings are coupled at the edges in flight to provide a single airfoil. This phenomenon occurs in several insect orders and is especially well-known in Hymenoptera and Lepidoptera. However, it has been studied very little in Trichoptera. Several different structures suggesting that wing coupling occurs in Trichoptera have been documented (including multiple different hairs near the posterior edge of the forewing and anterior edge of the hind wing that potentially engage each other in flight), but caddisfly wing coupling has never been observed in flying specimens. It was hypothesized that selected caddisfly species with purported coupling structures do in fact join their wings in flight and those without evident structures do not. This hypothesis was tested with videography and morphological study. The wings of species with purported coupling structures appeared to be joined in flight, forming a single airfoil. The wings of some species lacking evident coupling structures were coordinated in flight, with wings forming a single airfoil in the lower part of the vertical power stroke and separating in the upper part of the stroke. This sequence may be the result of overlapped edges of forewings on hind wings. Also, it was observed that caddisflies jump to propel themselves into the air for flight and that Micrasema sp. (Brachycentridae) coupled its wings, leading to discovery of the morphological basis of its coupling mechanisms. This investigation was an initial attempt to use high-speed cameras to study wing function in Trichoptera.

THE EFFECTS OF SEPARATION ON ATYPICAL DEPRESSION

Ryan Flowers
Dutch Fork High School

Divorce is a growing problem in the US today. The current divorce rate shows that one in every two marriages will end in divorce. In addition atypical depression, a common form of depression is rising as well. Because of this it is necessary to check for a relationship between separation (because, divorce doesn't take into account life-partners and unmarried couples) and atypical depression and to see if there is a strong correlation. My hypothesis was that atypical depression is at least ten percent more likely to develop in teenagers who come from separated households. The experiment was conducted using a comprehensive questionnaire with each question loaded to test for a certain symptom. These questions, if answered in a specific manner, should be able to grant a good

understanding of whether or not that symptom is present. If more than three symptoms were present then it was assumed that the person had Atypical Depression. By comparing the percentage of people in Group A who had three or more symptoms with the percentage of people in Group B who had three or more symptoms I found in my preliminary results that there was a 32.5% difference between both groups which was a significant increase. My results indicate that there may be a correlation between separation and Atypical Depression however more research is needed before this statement can be validated. The sample size must be increased and the experiment must be repeated multiple times.

THE EXAMINATION Of THE EFFECT OF VARIOUS FERTILIZERS ON THE INITAL GROWTH RATE OF SPINACH PLANTS

Shaquille Fontenot
Spring Valley High School

The purpose of this experiment was to examine the effectiveness of organic plant fertilizers as opposed to traditional chemical methods of fertilization on initial spinach plant growth and health. Although research is continuously being executed in efforts to find new ingredients that could be used as alternatives to harmful chemicals, a serious product has yet to be introduced to the market that is either environmentally beneficial or non toxic (English, 2005).It was hypothesized that the spinach seeds planted with the organic fertilizer application would more effectively germinate than those that were planted with the chemical fertilizer application. 185 spinach seeds were separated and planted in different containers. 60 were fertilized with organic fertilizer, which was created by the experimenter and 60 were fertilized with chemical fertilizer (Miracle-Gro) and 65 were left unfertilized and acted as the control in this experiment. Each container of spinach seeds was given the same amount of water, growth formula, and sunlight. After a period of two weeks of data collection of number of spinach sprouts from each container and the average heights of those sprouts, the data was recorded and analyzed. The spinach seeds fertilized with the organic fertilizer did not seem to grow any more than those untreated and those treated with chemical fertilizer. There was no significant statistical evidence to suggest that there were any major differences between containers A, B, and C which were organic fertilizer, chemical fertilizer, and organic, respectively. This data could be applied to aid in the better understanding of the germination of edible plant seeds and be edited to aid in future research. I would first like to thank all who supported me throughout my research project, including helping with experimentation, setup, and the thought process that led to this project.

ANNOTATION AND PHYLOGENETICS OF THE DAPHNIA PULEX NUCLEAR RECEPTORS

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William Baldwin
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Nuclear receptors serve as important sensors of homeostasis and triggers in development. Recently, the genome of the first crustacean, Daphnia pulex, was sequenced. We annotated the nuclear receptors found in the Daphnia Pulex genome in part to find new families of xenosensing nuclear receptors. , These receptors used in the cells typically for detoxification, may be similar to CAR and PXR found in mammals. Automatically generated annotations were tested with Basic Local Alignment Search Tests (BLAST) and Clustal alignments against homologous receptors from multiple species including

fruit fly, human, and C. elegans. Changes were made to the annotations based on acquired knowledge of intron-exon boundaries and the results of BLAST and Clustal tests. A group of receptors named DpHR97 was found that is hypothesized to represent a nuclear receptor family unique to Daphnia species or crustaceans. To test whether DpHR97 (DpHR97a,b,g) is a unique family of receptors, the ClustalX and MrBayes computer programs were used to construct a phylogenetic tree comparing Daphnia pulex to Drosophila melanogaster, Homo sapiens (humans), and C. elegans. Last, the annotated sequence was used to prepare PCR primers for amplification of cDNA to determine if the receptors are expressed. Expressed receptors were cloned with the PCR primers and sequenced to confirm their identity. In conclusion, Daphnia pulex has a wide variety of nuclear receptors also found in human and fruitfly in addition to having a unique set of detoxification nuclear receptors that we call the DpHR97 group.

VECTOR CONSTRUCTION FOR THE OVEREXPRESSION OF PEACH DORMANCY-ASSOCIATED MADS-BOX GENE 6 (PpDAM6)

Sara Gramling
Governor's School for Science and Mathematics

There are six MADS-box genes missing in the peach evergrowing (evg) mutant. The evg mutant does not set terminal buds in winter. These genes, called Dormancy-associated MADS-box (DAM) genes, are candidates for the genetic control of dormancy in peach trees. One way to study the effects of a gene is to overexpress that particular gene and observe the phenotype. The goal of this experiment is to construct a vector that will cause peach trees to overexpress PpDAM6. First, enzyme cut sites were added to either end of the single-stranded cDNA using primers to allow for the ligation of the gene to the destination vector. The template cDNA was amplified using PCR technique and then ligated into the pGEM-T Easy plasmid. E. coli were transformed with the plasmid, grown, and several candidate colonies were chosen and verified using PCR and gel electrophoresis. Colonies containing correctly sized inserts were selected and grown. Plasmid DNA was then extracted from these colonies and digested to release the PpDAM6 sequence. Gel electrophoresis was used to separate the inserted gene from the plasmid, and the insert was extracted from the gel. The pBSKS plasmid was digested, and the insert was directionally ligated into it. The E. coli were then transformed with the pBSKS plasmid now containing the construct. The pBSKS plasmid will act as a holding place for the construct until the specific Agrobacterium plasmid to be used for delivery into the peach genome is chosen.

SIMPLE GAMES USING DECISION THEORY AND OTHER STRATEGIC

Robert Grant
Dutch Fork High School

The purpose of this experiment is to find out the correlations between strategies in board games and the people with the different strategies. First I will create a tiered system of computer players for Connect Four. These will range from extremely simple (random, or predefined moves) to medium (offensive or defensive moves only) to hard (combination of offensive and defensive) and if possible, unbeatable. Then, the program will be tested with real people, and create a ôpersonality profileö of each tier through use of what levels people achieve, and how they go about playing the computer. These will be then retested for the validity for the personality profiles for each of the tiers, to determine how different strategies apply to different people, and how they react to people who play like they do. Thanks to Dr. Warner and Mr. Lindler.

THE EFFECT OF SUNLIGHT DEPRIVATION ON THE GROWTH OF PANSIES

Andrew Grice and Fripp Prioleau
Heathwood Hall Episcopal School

Pansies are small flowers that grow well in cold temperatures. We put pansies out in the sun and covered them with boxes. Our purpose was to determine the effect depriving pansy flowers of sunlight would have on their growth. We ran 3 trials, over a period of 10 days, using 3 pansies in each trial. ÃÇ£Pansy 1ÃÇ¥ was exposed to sunlight 3 hours a day, and the rest of the day it was covered by a box. ÃÇ£Pansy 2ÃÇ¥ was in the sun for 6 hours a day, and was also covered then rest. ÃÇ£Pansy 3ÃÇ¥, our control group, was never covered a box, and was exposed to the sun naturally. The independent variable was how long the plants were covered, while the dependent variable was how quickly the pansies grew. We found that our control group, the pansies that were never covered, grew the most quickly (and looked to be the healthiest) after 10 days of experimentation. However, pansy groups 2 looked almost as colorful as the control group (3), and were almost as tall. Pansy groups 1 looked very unhealthy, and did not grow as much as the other groups of pansies. We discovered that pansies that are in the sun all day grow better than pansies that are not. However, we were able to conclude that pansies do not need sunlight all day to grow and look good.

THE EFFECT OF RADIO FREQUENCIES ON DENDROCTONUS FRONTALIS

Jonathan Grimes
Spring Valley High School

Southern Pine Beetles (SPB), Dendroctonus frontalis, are a major threat to the world's lumber industry. From the 1960s to the 1990s, bark beetles have caused over $900 million in damage. Much effort has gone into finding a cost-effective method of control southern pine beetles. If there was a radio frequency that attracted SPB, it could be used as a cost effective method for controlling SPB. The purpose of this experiment was to determine if radio frequencies had an effect on Dendroctonus frontalis. It was hypothesized that if southern pine beetles were exposed to radio frequencies, then the activity of SPB around the transmitter would increase and the beetles would be attracted to the transmitter. 46 southern pine beetles were placed in a plastic cylinder. The plastic cylinder was exposed to a radio frequency. After 5 minutes, the distance the pine beetles moved toward the transmitter from the starting point was measured. This procedure was repeated with various frequencies from 89.1 MHz to 107.1 MHz in increments of 1.0 MHz. A one-way ANOVA test showed that $F(20,924)=0.068$, $p>0.05$, meaning the distances the beetles moved at each radio frequency were not significantly different. Based on this experiment, there is not enough evidence to support the claim that radio frequencies have an effect on Dendroctonus frontalis. First off, I would like to thank Dr. Henderson for providing me with ideas about how I was going to carry out this experiment and for helping me write the research paper. She guided me throughout the process and offered encouragement. Secondly I would like to thank my parents for helping me pillage the SPB infested tree and sort out the SPB from the other insects. It was a very time consuming process and they helped me from the start to the finish.

THE EFFECT OF VARYING TYPES OF WEATHERING ON WOOD STRENGTH OF UNTREATED, TREATED AND SYNTHETIC WOOD

Sarah Guess

Weathering is a problem facing homeowners with wooden decks, especially in areas such as Texas. This area is subject to desert-like climates and rain, and most recently, flooding, as a result of the hurricanes. The purpose of experimentation was to determine the wood that best combats weathering over time, by comparing the strength of the wood after exposure and changes in dimensions. Untreated and treated southern yellow pine (Pinus taeda) was compared to synthetic wood composed of polyethylene, polypropylene, and fillers. During experimentation each type of treatment of wood used was cut into equal pieces. Three pieces of each type of wood was tested using a compression machine. Unweathered wood was used as a control. Each type of weathering was performed on each type of wood for four weeks and three pieces from each type of wood, undergoing each type of weathering were tested each week. The results were analyzed through two-way and one-way Analysis of Variance tests (ANOVAs) and Tukey tests using Minitab software and tests were performed at α=0.05. Time was found to have a significant affect on wood strength, the longer the exposure, the less resistant to pressure the wood becomes. Synthetic wood was found to have the weakest compression values, while treated and untreated wood had similar values.

DETERMINATION OF THE DISTRIBUTION OF PATERNALLY INHERITED MITOCHONDRIA IN MYTILUS GALLOPROVINCIALIS

Sharon Guffy
SC Governor's School for Science and Mathematics

Mitochondria in most organisms are strictly maternally inherited. However, marine mussels inherit mitochondria from both parents (Breton et al, 2007, 1). When fertilization occurs, five male mitochondria enter the egg along with the sperm head and join the 500,000 female mitochondria in the zygote. Male-line mitochondria disperse and are degraded within a few days in female mussel embryos. However, as a male mussel embryo matures, its male mitochondria remain clustered together through several divisions and are selectively distributed into certain tissues so that the relative numbers of male and female mitochondria are different in each tissue. These mitochondria then proliferate until they are as numerous as the mussel's female mitochondria. The two mitochondrial lines remain separate over time because only male-line mitochondria are ultimately attached to male germ cells. The goal of this experiment is to use in situ PCR to label male-line mitochondrial DNA with fluorescent nucleotides, making the mitochondria visible under a UV microscope and determining how these mitochondria are distributed among different tissues in male Mediterranean mussels. Male sperm, gonad, gill, and adductor tissues were tested. The results for the gill and gonad were inconclusive, but sperm contained 100% male mitochondria and adductor tissue contained approximately 96% male mitochondria. Since the rapid proliferation of male mitochondria mimics that of diseased mitochondria in humans, this research may also give us new insights into these debilitating diseases.

SITE FIDELITY OF DIAMONDBACK TERRAPINS (MALACLEMYS TERRAPIN) IN NORTH INLET, WINYAH BAY, SC

Christopher Hall
SC Governor's School for Science and Mathematics

Diamondback terrapins (Malaclemys terrapin) are found in river mouths and estuaries along the east coast of the United States from Maine to Florida and extend around the Gulf of Mexico along the coast to Texas. The subspecies M. t. centrata is found from Northern Florida to Cape Hatteras in North Carolina. In the late 1800s and early 1900s the diamondback terrapin was extensively harvested because it was considered a delicacy in the northern part of the United States. This caused a sharp decline in the wild population, leading to a collapse of the commercial industry. The current status of diamondback terrapins in South Carolina is unknown due to insufficient population surveys and there is also a lack of data on populations in North Carolina and Georgia. The one long-term study of terrapins in South Carolina around Kiawah Island indicated the population was declining in the local area. A significant factor from the previous study was a high site fidelity to a particular creek in the salt marsh. To capture Diamondback terrapins in the North Inlet Winyah Bay Estuarine Research Reserve, creeks were seined by hand at low tides during the months of May, June and July since 2006. Data on weight, size, and location were recorded and each turtle was given an individual mark. Data from the study indicated that these terrapins shared a similar behavior toward site fidelity as the terrapins around Kiawah Island. The results from this study could be used in preservation of the species.

THE EFFECT OF SEPARATION FROM A GROUP ON INDIVIDUAL PRODUCTIVITY

Jamora Hamilton
Spring Valley High School

Almost every human at one point in their life must work. Recently, there has been an increase of job loss in the U.S. The purpose of this study was to determine whether group presence affects the productivity of an individual (time to complete a task). It was hypothesized that the more individuals in a group would decrease the subject's productivity and increase the time it takes the subject to complete the task. The subjects completed a series of 25 piece puzzles. The times were recorded when the subject was alone and when the subject was in the presence of a group. The individuals were allowed to communicate with each other, but not with the subject although they were in the same room. A one way ANOVA test was used to compare the trial times of the subjects. The test showed that there was no significant difference between the subject times. It is possible that productivity is dependent on the individual, making it difficult to accurately analyze the data. I would like to thank Dr. Robin Henderson for all of her advice and assistance during my project, Dale Soblo for helping me with my research, and Andrea Clutts for allowing me to test her class. I would also like to thank my family and friends for all of their support during my experiment.

REVERSIBLE ENERGY TRANSFER BETWEEN KINETIC ENERGY OF A FLYWHEEL AND POTENTIAL ENERGY IN CAPACITORS

Jacob Hammers
South Carolina Governor's School for Science and Mathematics

A circuit was developed to optimize the percentage of energy extracted from an electric motor that could be stored in an electric double layer capacitor. Using an electric motor, the kinetic energy stored in the load of that motor was to be transferred into electrical energy and then stored in capacitors. A bidirectional motor control circuit was produced and tested for efficiency in energy transfer through the use of a photodetector to determine the maximum speed and energy storage of the flywheel. Flywheel design was optimized for specific energy storage to match the capacitance of the supercapacitors, with predicted angular velocity a function of the air resistance, mass, and radius of the flywheel as well as the motor's free speed. The relative effectiveness of an ABS plastic and brass flywheel were then analyzed and compared.

THE EFFECT OF BAROMETRIC PRESSURE ON THE FREQUENCY OF BEHAVIORAL INFRACTIONS IN HIGH SCHOOL STUDENT

Paul Han
Spring Valley High School

Weather impacts every organism in many complex ways. Biometeorology is the study of how different weather conditions affect the behavior of living organisms on Earth. For example, people claim that rainy weather causes them to feel gloomy or unhappy. The purpose of this study was to determine if the amount of barometric pressure affects the frequency of behavioral infractions by high school students. It was hypothesized that as air pressure decreases, the frequency of student infractions would increase. A list containing all of the discipline notices written for the 2006-2007 and 2007-2008 school years were obtained from a public high school. The number of behavioral infractions for each day of the month was tallied and correlated with the barometric pressure on the particular day. Preliminary analysis indicates that there was no correlation between the barometric pressure and frequency of behavioral infractions. I would like to thank Dr. Henderson for her guidance and support. I would also like to thank Mr. Wilson at Spring Valley High School for supplying me with the information I needed in order to conduct my experiment. Lastly, I would like to thank my family and friends for their support.

THE EFFECTS OF PROSTATE DERIVED ETS FACTOR (PDEF) IN MAMMARY GLAND DEVELOPMENT

Christine Hang
South Carolina Governor's School for Science and Mathematics

The prostate derived-ETS factor (PDEF) is part of the E twenty-six specific (ETS) family of transcription factors, which regulates cell proliferation, apoptosis, differentiation, and invasion. The PDEF protein was first identified in prostate tissue and is known to be expressed in other epithelial tissues such as breast, colon, and bladder. The loss of the expression of the protein is found to correlate with the defined tissue's invasive characteristics. Currently, the role of PDEF in normal developmental processes is not well understood. Understanding the normal developmental processes can help to determine the relationship between PDEF and cancer. The aim of this study was (1) to identify the role of PDEF in mammary gland morphology and (2) to determine the role of PDEF in mammary gland cell proliferation. This was determined using both PDEF

knockout mice and wild type Black Strain 6 mice. The role of PDEF was tested using immunohistochemistry, which involved a specific antibody (monoclonal antibody Ki67) binding to a specific antigen (Ki67 protein). Ki67 was a marker that showed proliferating cells. Morphology and proliferation patterns were observed in the wildtype and knockout genotypes in several stages (8 week, lactation day 7, and involution day 7) of the mammary gland cycle. Research indicated dramatic morphological changes in the 8 week and lactation day 7 stages. The wildtype's fat cells were smaller and more abundant than the knockout type in the 8 week stage, and the wildtype's lobular alveoli were larger in the lactation day 7 stage. The involution stage had a similar morphology differences between the two genotypes. Similar proliferation patterns were seen for all three stages of mammary development: the wildtype had more proliferating cells than the knockout genotype, meaning that PDEF might have an important role to play in cancer cell proliferation.

INFLUENCE OF CHLORINE DIOXIDE ON THE GERMINATION OF LETTUCE/ SPINACH PLANTS ON THE GROWTH OF E.COLI

Kendall Hauck

Escherichia coli (E.coli) 0157:H7 are harmful bacteria that are normally found in the intestinal tract of humans and in mammals (Hoyle, 2007).The E.coli 0157:H7 bacteria can cause serious if not deadly harm if ingested by humans. However, the serious effects from E.coli 0157:H7 infection can be prevented in plants which would reduce the number of E.coli outbreaks. One method that has been that had been found to inhibit the growth of the E. coli 0157:H7 is chlorine dioxide (Lenntech, 2008). The purpose of this investigation is to hinder the growth of E. coli 0157:H7 colonies in plant food sources and therefore reduce the number of outbreaks in the United States. It was hypothesized the lettuce and spinach plants that were affected by chlorine dioxide would decrease the growth of E. coli. Six lettuce and spinach seeds were infected with chlorine solution. The control was six lettuce and spinach seeds without chlorine dioxide. Each group was infected with E. coli water and the roots were tested in Eosin methylene blue agar for the presence of E.coli colonies. The bacteria colonies were counted and the data was analyzed with an ANOVA test. The probability was less than the confidence interval, so there was not a significant difference.

THE EFFECT OF A SOLAR DISTILLATION APPARATUS ON CONCENTRATIONS OF PHOSPHATE AND NITRATE

Amanda Herring
Spring Valley High School

Water is a valuable resource used by all life. It occupies 75% of Earth's surface; however, most of the water available to Earth's inhabitants is salt water. Most of the fresh water is frozen in glaciers and ice caps in the arctic regions. In fact only 1% of Earth's fresh water supply is available to people and other forms of life. The purpose of this study was to cleanse contaminated water via distillation. The water was contaminated with solutions of phosphate and nitrate. Phosphate and Nitrate were used because of the fact that it easily contaminates water in nature through the use of fertilizer and its simple detection methods. The solar still itself was constructed of an inner pan, an outer pan and a roof. The inner pan sat inside of the outer pan and was filled with insulation making a 22 gauge metal bi-layer. The roof was constructed with a piece of plexi-glass set at ~30 degree angle. The water was collected in a piece of pvc piping cut in half to make a trough, this was kept in the still along the low end of the roof. A sample of the water was

collected before and after the water was processed in the still. Two separate dependant t-tests were then conducted to determine whether or not the before and after samples showed any statistical difference. (α=0.05). I would like to thank Dr. Robin Henderson for the guidance she provided. I would also like to thank my grandfather and Aunt, Jeff Burke and Lesa Burke, for their assistance in helping me construct the still, my mom,Tracy Harling, for her finacial support, and ,last but not least, my friends, family, and teachers for their support.

THE EFFECT OF CARBON DIOXIDE ON THE GROWTH RATE OF EMILIANIA HUXLEYI

Michael Hobensack
Spring Valley High School

Due to the increase of carbon dioxide in the atmosphere, scientists are looking for a way to dispose of the excess carbon dioxide. One of the most promising methods for doing this is carbon dioxide sequestration. However, this may have affects on the marine environment. This experiment was designed to determine if carbon dioxide will have an affect on marine organisms and therefore if carbon dioxide sequestration is a viable method for carbon dioxide disposal. It was hypothesized that if more carbon dioxide is added to the water, then the growth rate of the Emiliania huxleyi will change. E. huxleyi were grown in bottles filled with either filtered ocean water or simulated salt water (depending on the experiment) and air with different concentrations of carbon dioxide was bubbled into the bottles. Samples were taken from the bottles periodically and the concentration was measured using a spectrophotometer. A one-way ANOVA $F(3,28) = 3.02$, $p < 0.05$ conducted on the data from the first experiment yielded a p-value of 0.046 which was less than the alpha value of 0.05, indicating a significant difference in the growth. However, a post-hoc Tukey test was unable to find the location of the difference. A two-sample t-test $t(27) = -0.07$, $p > 0.05$ was conducted on the data from the second experiment. The p-value of 0.945 was greater than the alpha value of 0.05, indicating that there was not a difference in the growth. Therefore, in the first experiment, the null hypothesis was rejected and it was concluded that there was a change in the growth rate if the E. huxleyi and in the second experiment the null hypothesis failed to be rejected and it was concluded that there was not a change in the growth rate of the E. huxleyi. From these results, it cannot be concluded whether or not carbon dioxide has an affect on marine organisms. I would first like to thank Dr. Chris Hintz for all of his help in designing the experimental setup and for providing me with the Emiliania huxleyi and the carbon dioxide gas. I would also like to thank my family and friends for all of their help and support throughout my project. Finally, I would like to thank Mr. Soblo for providing me with materials and helping with the statistical analysis of my data.

QUANTIFICATION OF GLYCOSAMINOGLYCANS TO BE USED AS TISSUE ENGINEERED NUCLEUS PULPOSUS REPLACEMENTS

Alley Hood
South Carolina Governor's School for Science and Mathematics

Lower back pain is a growing universal healthcare concern. Frequently, the pain is attributed to intervertebral disc (IVD) degeneration. The degeneration starts with the dehydration of the center region of the disc called the Nucleus Pulposus (NP) via a loss in water-biding Glycosaminoglycans (GAG). In degenerated IVDs, GAGs are degraded by an increased expression of GAG-targeting enzymes. In order to combat this process, an attempt is being made to develop an injectable hydrogel implantation that has a

greater resistance to enzyme degradation, with the long term goal of tissue engineering a NP replacement that will stop IVD degeneration. A series of pilot studies were completed in order to evaluate enzyme activity and certain fixated hydrogelsÆ resistance to this type of digestion. In the first study, two colormetric assays, dimethyl methylene blue (DMMB) and Hexosamine, were analyzed for their ability to quantify the GAG content of tissue cusps after an enzymatic digest. GAG and collagen were then stabilized in hydrogels through incubation in four different chemical study groups. The Hexosamine assay measured the GAG content of the samples after they were digested with enzymes to test for resistance to degradation. The PGG and EDC/ NHS crosslinkers proved to be promising candidates for future work.

VISUALIZING LARGE-SCALE COMPLEX MOLECULES IN THE THREE-DIMENSIONAL VIRTUAL ENVIRONMENT SECOND LIFE

Sophia Houtzer
South Carolina Governor's School for Science and Mathematics

Virtual environments have been used for many things, such as gaming. But more recently, people have begun implementing these computer-based worlds for more practical uses such as platforms for education, job training, therapy, research, architecture and molecular modeling. It has been predicted that, in the future, the internet will rely heavily on these virtual environments for social interaction, whether for professional collaboration or entertainment. Virtual environments already play a significant role in many people's lives and are only continuing to grow; games like World of Warcraft™ and EverQuest™ have become immensely popular in the past few years. As teachers are trying to reach out towards their students, they are often finding themselves in these new virtual worlds. The goal of this project is to show that it is possible to bring virtual environments to the classroom or vise versa by creating objects that can be used for learning. The focus is on the visualization of molecules for application in chemistry courses. We present an object that is designed in Second Life™ and an associated script written in LSL which parses PDB files of proteins such as DNA and constructs three-dimensional structures of them in the virtual environment. South Carolina Governor's School of Science and Mathematics

ENVIRONMENTAL EFFECTS ON GETTING ALLERGIES

Calvin Hu
Dutch Fork High School

This project intends to study the impact of pets and environment on the chances of getting allergies by extending the data collection to different environmental and geological areas like China. About 1120 survey forms are filled out and collected during the summer in 2008. Eight study cases have been conducted with 6 manipulated and 2 controlled variables. The 95% confidence interval formula is used to do the p-value evaluation, and the method of 2 by 2 Contingency table is for the odds ratio calculation. The study concludes that even under very different environmental conditions, there is still an association between the pets and the immune system. All three findings from my previous project are confirmed again. The association between the heretical effects and having allergies is strong. The pets would help if you do not have a family history of allergies. Also, the longer you keep the pets, the less chance you will get allergies. In addition to the impact of pets, the project has conducted data analyses against some environmental effects. It has found that overall the odds of getting allergies for those who live in China is only about 70% of those who live in US. The odds of getting allergies for those who

live in 5 people household is only 59% of those who live in 3 people household, and the odds of getting allergies for those who drink tap, well water are 34% to those who drink bottle water, and 26% of those who drink boiled water . I would like to thank Dr. Xie and Mr. Wang Yang for helping me in my project and for their time and also my mentor Dr. Warner.

WIRELESS NETWORK PERFORMANCE USING PHASED ARRAY SMART ANTENNAS

Jason Isenhower
South Carolina Governor's School for Science and Mathematics

In wireless networks, the most common type of antenna used is omni-directional. Omni-directional antennas radiate and receive power equally in all directions. Directional antennas, on the other hand, focus their power in one or more directions. Extensive research is being performed to make use of directional antennas to improve the performance and capacity of wireless networks, especially ad hoc and sensor networks. This project studied the effects different beam orientations and transmit powers had on the performance of a wireless network link between two electronically steerable directional antenna systems called Phocus Arrays. These antennas are capable of operating with an omni-directional radiation pattern or a number of different directional radiation patterns. A point to point wireless link was created between two phased array antennas, and the performance of the link was measured by calculating the throughput using a program called Iperf. More measurements were made at different transmit powers, and the main beam was rotated incrementally. The throughput of the link stayed fairly constant until a certain critical amount of rotation, after which the throughput of the link sharply dropped. The amount of rotation needed to reach the critical point was found to decrease rapidly as the transmit power was decreased.

HOW "ACTIVE OXYGEN" CLEANERS AFFECT THE DETECTION OF BLOOD WITH BLOOD IDENTIFICATION TESTS

William Ivey

Companies are producing more sensitive blood tests to detect and expose latent bloodstains because criminals are finding more ways to try to mask blood from detection. Many forensic blood tests rely on the oxidation of iron in the heme portion of blood. The purpose of this experiment was to determine if oxidative cleaners oxidized the heme moiety thoroughly enough so that when oxidative blood tests are performed, the already oxidized blood molecules are unable to respond. The hypothesis was that if oxi clean was applied to blood stains on household surfaces (tile, cloth, and carpet), then typical forensic blood identification tests would not detect the blood. 90 household surface samples were smeared with blood, let sit for 48 hours, then cleaned with cold water. 45 of the samples were then cleaned with an oxidative cleaner (Oxi-Clean), while the other 45 samples were used as controls. Three oxidative tests were used for the detection of the blood: phenolphthalein, luminol, and Blue Star 61651; Forensics Magnum solution. The results of this experiment showed that luminol and phenolphthalein were not able to detect blood on the oxi-cleaned carpet samples, but both chemicals detected blood on all of the cloth samples. Neither luminol nor phenolphthalein detected any blood on the tile samples. The BlueStar solution detected all blood on the samples. I would like to thank Dr. Henderson for overseeing the project, editing this saga of a paper, and for

being a great teacher in the whole process of the project. I would also like to thank all my friends and classmates, especially Kirstin for using her camera, and to my family for buying me the Blue Star# and helping me by giving me advice.

THE EFFECTS OF PHOSPHORUS ON THE BIOLUMINESCENCE OF PYROCYSTIS FUSIFORMIS DINOFLAGELLATES

Kristina Izett
Dutch Fork High school

The purpose of this experiment is to determine the effects of phosphorus on the bioluminescence of a population of Pyrocystis Fusiformis dinoflagellates. This is important because the bioluminescence reflects how healthy the dinoflagellate is. Therefore, the bioluminescence can reflect the quality of the water. The dinoflagellates will be cultured in five flasks with f/2 media, and set with a light cycle of twelve hours of light and twelve hours of dark. After the dinoflagellates have adjusted to the light cycle, various amounts of phosphorus will be added to four of the tanks, leaving the remaining tank as the control (with no additional phosphorus). The bioluminescence of the Pyrocystis Fusiformis population will be tested in each of the flasks before and after the addition of phosphorus. Data will include the bioluminescence of the dinoflagellates in each flask over time. The anticipated results are that the flasks with higher amounts of phosphorus added will also have a stronger increase in the bioluminescence of the dinoflagellates.

SYNTHESIS OF PYRIDINE CONTAINING MACROCYCLES FOR USE AS A BASE CATALYST

Mark Kalata
GSSM

Self-assembling macrocycles are synthesized in order to create nano-reactors. The structure of the marcocycle consists of two rigid C-shaped spacers and two urea groups. Changing the compounds used to make the spacer can lead to the marcocycle having different properties. To act as base catalysts, the spacers contain pyridine rings; the pyridine has a nitrogen atom with a lone pair of electrons, which allows it to act as a Lewis base. Thin-layer chromatography was used to monitor the reactions and the desired product was purified by column chromatography. 1H NMR was then used to characterize the structures of the macrocyclic building block and the host crystal. These macrocycles will catalyze reactions allowing chemists to design an environment that will give high yields.

THE EFFECT OF GUITAR HERO III SONG DIFFICULTY ON HEART RATE AND PERCENT OF NOTES HIT IN GENDER

Sanchit Kapur and Derek Kaczmarski
Heathwood Hall Episcopal School

In this experiment, the effect of Guitar Hero III: Legends of Rock song difficulty and song completion on heart rate and percent of notes hit was examined, with respect to gender. It was hypothesized that males and femalesÆ heart rate will increase and their percent of notes hit will decrease with increase in difficulty in song and/or difficulty level of the game. It was also hypothesized that there will be a difference between males and females in heart rate and percent of notes hit. 4 male and 4 female high school students, were asked to wear heart monitors and play Guitar Hero III: Legends of Rock

songs, Slow Ride, the game's easiest song and Through the Fire and Flames, the hardest song, on the easy and expert levels for each. Heart rate measurements were obtained and recorded at the beginning of the song, at 30 second intervals, and at the end of the song. The percentage of notes hit was also recorded. Between songs, the participants heart rates were allowed to return to resting. The results were analyzed using a one-way ANOVA test (alpha=0.05). The data did not fully support the hypothesis that a person's heart rate will increase with increase in difficulty in song and/or difficulty level of the game. In general, male average heart rate did increase with difficulty of song; however, female's average heart rate did not follow this trend. The data supported the hypothesis that there will be a difference between males and females in heart rate and percent of notes hit. The comparison of max heart rate for males versus females on ôThrough the Fire and Flamesö easy and the comparison of males versus female percent of notes hit on ôThrough the Fire and Flamesö expert showed a statistically significant difference ($p < 0.05$) with males having a 2.5 bpm higher max heart rate than females and hitting 23% more notes. The comparisons of resting heart rate versus average heart rate over time and the comparison of male Through the Fire and Flames expert resting heart rate versus average heart rate over time was also statistically significant ($p < 0.05$). This experiment that if ôThrough the Fire and Flamesö on expert level is played at the intensity level performed by the males in this experiment, cardiovascular fitness target heart rate is reached. Possible future studies include expanding the study to include different active video games. We would like to thank Mrs. Lisa Norman for her help throughout our research project, including helping with experimentation, setup, guidance, and the use of her classroom during experimentation. We would like to thank the participants of this study for donating valuable time after school to play Guitar Hero III. We would like to thank our families for letting us stay after school every day to complete testing and analysis.

A COMPARISON OF OIL EXTRACTION METHODS ON THE OIL YEILD OF ALGAE CULTURES

Curtis Keisler
Spring Valley High School

The world's supply of oil comes closer to depletion everyday. It is important to consider alternated methods of producing fuel. Algae have been considered as one of the top candidates for renewable bio-fuel because of its high lipid content. Lipids can be converted to fuel through transesterification. There are other ways to make fuel from bio-products that have been effective, like fermentation for instance. The fermentation of corn has been used to create ethanol, but this method of creating fuel has not widely been tested for algae. The purpose of this research was to determine if fermenting algae will yield more fuel than traditional oil extraction methods. It was hypothesized that fermenting the algae will produce the most fuel. The expeller/press and hexane solvent methods are commonly used in extracting oil from algae, but do not convert as much of the algae into fuel as fermenting would. To asses this hypothesis the following methods were used. Each algae strain, S. dimorphus, D. tertiolecta, and Diatoms, was cultured, and then distributed into other containers for individual trials. Each alga was tested against each method, Expeller/ Press, pressing out the oils, the Hexane solvent method, applying chemicals to remove oil, a combination of the Expeller/Press and Hexane solvent methods, and a Fermentation method. The mass of algae before extraction was compared to the mass of oil, and the percentage of oil yield was calculated.

MODELING THE THERMOPHYSICAL EFFECTS OF DRILLING ON HUMAN TEETH

Cuchulain Kelly
South Carolina Governor's School for Science and Mathematics

Many necessary dental operations require the use of a dental drill. Unfortunately, the friction caused by the drill bur rotating at high speed against the tooth generates high levels of heat that may denature dental proteins and harm the inner dental pulp cells. This study aims to model the thermal properties of teeth to better assess the possible damage done to dental cells by drill bur-generated heat. The propagation of heat through a tooth was modeled in 3D using the thermal conduction module of the COMSOL finite element model (FEM) solver. The parameters for the COMSOL model were obtained either from literature or through direct experimental measure. Thermal conductivity was set to 0.5800 W/(m-K) for the dentin and 0.9000 W/(m-K) for the enamel; density was measured to be 2000 kg/m3 for the dentin and 2700 kg/m3 for the enamel; and the specific heat was set to 1066 J/(kg-K) for the dentin and 700.0 J/(kg-K) for the enamel. Intact and sectioned teeth at room temperature were exposed to a 50.00-70.00 %C constant heat source. The tooth sections were found to heat up more slowly than predicted by the FEM model. However, both the analytical approximation and 3D FEM models of the full tooth closely matched the measured heating curve of the intact teeth. I would like to thank Dr. Delphine Dean of Clemson University for her willingness to take me into her lab. Also thanks to Dr. Kennedy of Clemson University and Dr. Alapati of the Medical University of South Carolina. Thanks to everyone in Dr. Dean's lab, including Will McAllister, Laura Datko, Celeste Peay, Sandy Deitch, Scott Wood, and Matt Cupelli. In addition, thank you to Linda Jenkins for help with histology and Michael Lemas for help with the micro-CT. This project was funded by the Howard Hughes Institute through the SPRI program associated with GSSM and SCLIFE.

EFFECTS OF SPHINGOSINE KINASE 1 DEFICIENCY ON GROWTH RATE AND SENESCENCE

Greyson Kerley
SC Governor's School for Science and Mathematics

Prior observations have led to the assumption that Sphingosine Kinase 1 deficient cells have a lowered proliferation rate. In this study, Mouse Embryonic Fibroblasts were used as a vehicle to examine the reasoning behind this slowed proliferation rate. The final number of cells after 96 hours of incubation starting with 100,000 cells was 476,000 cells for SK1 -/- MEFs and 1,347,333 in WT MEFs. Deficiency of the SK1 enzyme leads to this slowed proliferation rate through inducing premature senescence. The results of β-Galactosidase staining in 6-well plates shows for SK1 -/- an average of 10 senescent cells per field whereas WT MEFs average approximately one senescent cell per field. These studies showed that SK1 has a regulatory function in the prevention of senescence in MEFs, however it was not conclusive as to the mechanisms through which this occurs. I would like to thank Dr. Lina Obeid, my mentor, Chris Gault and Linda Heffernan for their help in the lab, my advisor Dr. Mark Godwin, Medical University of South Carolina and South Carolina Governor's School for Science and Mathematics for providing me this opportunity, and Mr. Randy LaCross for organizing the SPRI summer research program.

EXPRESSION ANALYSIS OF THE SD1 GENE INVOLVED IN THE HEIGHT MECHANISMS OF ORYZA SATIVA JAPONICA

Olivia Keyes
Governor's School for Science and Mathematics

Dwarf mutants in plants are crucial for elucidating regulatory mechanisms for plant growth and development. We have identified a rice dwarf mutant, SUPER DWARF derived from T-DNA insertional mutagenesis. Using inverse PCR, we have identified a potential genetic locus SUPER DWARF 1 (SD1), which encodes a novel protein containing tetratricopeptide repeat (TPR) motifs with unknown functions. The objective of this project is to analyze the expression of SD1 gene using reporter gene approach. The cloned SD1 5Æ regulatory region was fused with a reporter gene gusA encoding for Escherichia coli β-glucuronidase, resulting in a chimeric binary vector. The chimeric gene construct will then be introduced into Agrobacterium tumefaciens strain, LBA4404 for plant infection using embryogeneic callus prepared from mature seeds of japonica rice cultivar, TP309. GUS assay will be performed on the transgenic plants produced to reveal SD1 gene expression pattern. The fundamental knowledge gained in this project will provide significant insight into the regulatory mechanisms of rice dwarfism and related traits. This knowledge can be used to devise ways to improve rice yield through genetic modification of plant architecture. The author wishes to thanks the Governor's School for Science and Mathematics for providing the opportunity to complete this research. A thanks is also extended Clemson University for providing the project and facilities used, and Dr. Hong Luo of the Department of Genetics and Biochemistry for all of his guidance and mentorship. Dr. Jones-Cooper and Dr. Bhuvana also advised me on the construction of this paper, and Mrs. Ingram and Mr. Coleman proofread.

THE EFFECT OF TEMPERATURE ON THE STRESS RELAXATION OF ETHYLENE-PROPYLENE DIENE COPOLYMERS

Ji-hoon Kim
Spring Valley High School

This research project studied the effects of temperature on the stress relaxation of ethylene-propylene diene copolymers (EPDM), which is the type of rubber used in hydrogen fuel cells. The experiment's results were used to find the EPDM rubber's material constant value, which is different for different types of rubber. The importance of the material constant is that it can be used for the creation of prediction curves on the stress relaxation of EPDM given any temperature, and the specific length of time until gasket failure could then be mathematically discovered. The data curves were expected to be logarithmic expressions that could fit on to a master curve. A Rheometrics System Analyzer was used for experimentation. Four cylindrical samples of EPDM rubber were each put into the analyzer and put under an initial 2500 grams-force of pressure. The samples were subjected to 40, 80, 100, and 140 degrees Celsius, and the pressure of the rubber samples was measured in grams-force every five minutes for 120 minutes per sample. Once the data was collected, Arrhenius methodology was used to create a master curve of the data and to calculate the material constant of EPDM rubber. The master curve and the normalized data matched well with the data at 140 degrees Celsius, which was used as the reference curve. The material constant for the EPDM rubber in this experiment was found to be 3943.56. The results of this research could aid in the measurement of an accurate prediction equation for the durability of EPDM rubber gaskets in fuel cells over long periods of time, allowing hydrogen fuel cells to be safer and better maintained. Extended research could include the testing of other types of rubber gaskets or testing done over a much longer period of time than 120 minutes.

THE EFFECT OF TEMPERATURE AND SHAKING ON THE STRAIN OF ALUMINUM CANS

Young-hoon Kim
Spring Valley High School

Some materials have cracked, split, or even shattered completely under strain. The purpose of this experiment was to see if there was a relationship between temperature and shaking on the strain of aluminum cans. It was hypothesized that the relationship and correlation between temperature and shaking on the strain of aluminum cans would be strong enough to make it a plausible model for any data point. Fifteen cans were randomly chosen and put into 3 treatment groups; oven, fridge, and shaking and the averages were calculated. The relationship for the oven and shaking tests were best shown in a quadratic regression and the fridge test was best shown in a linear regression. A linear regression t-test indicated that the correlation for the fridge test was very strong. The linear regression t-test also failed to reject the null hypothesis and showed that there was a relationship between temperature and shaking on the strain of aluminum cans. This would make the linear equation a plausible model for future reference in the engineering field. I would first of all like to thank Dr. Yil Kim from the University of South Carolina for providing me with the equipment needed for this project. I would also like to thank him for allowing me to use his laboratories to conduct my experiments. I would also like to thank my teachers at Spring Valley High School for helping me narrow down my project ideas and for aiding me in statistically analyzing my data. I would like to thank my family for their support and encouragement they gave throughout my research. Lastly, I would like to thank SCJAS for funding for my project.

THE EFFECTS OF TESTOSTERONE ON SKELETAL MUSCLE MITOCHONDRIAL BIOGENESIS

Sarah Lancaster
South Carolina Governor's School for Science and Mathematics

Wasting diseases induce the loss of skeletal muscle mass and are associated with a loss of circulating testosterone. Mitochondria are cellular organelles that allow oxidative formation of ATP. Mitochondrial biogenesis and function contribute to muscle mass maintenance. The purpose of the current study was to examine if testosterone can regulate mitochondrial biogenesis or mitochondrial-dervied apoptosis, which accompanies skeletal muscle loss. Pro-apoptotic proteins, such as Bax, lyse the mitochondria and induce apoptosis. A key regulatory factor for mitochondrial biogenesis is PPAR-gamma coactivator-1 (PGC-1), a transcriptional coactivator for many oxidative metabolism genes. Effects of testosterone on Bax and PGC-1 protein expression have not been previously reported.

Fourteen male C57BL/6 mice were placed in one of three groups: 1) a control group, 2) a castration group, and 3) a castration group receiving injections of Nandrolone Decanoate (ND), a pharmacological testosterone derivative (n=6). Western blot analysis was done after sacrifice. Data were analyzed using a one-way ANOVA test with an alpha set at $P > 0.05$. Student-Newman-Keuls post hoc analysis was used to determine individual differences between groups. Weights were significantly decreased in the castration group. The expression of PGC-1 was decreased significantly ($P=0.001$) in the castration group in comparison to both other groups. Bax expression was significantly increased ($P=0.010$) in the castration group and expression returned to control levels in the castration + ND group. Anabolic steroids such as Nandrolone Decanoate could possibly be used to alleviate muscle atrophy in patients suffering from wasting diseases.

THE EFFECT OF CHEMICALS LEACHED FROM DISPOSABLE CHOPSTICKS ON DAPHNIA MORTALITY OVER TIME

Ji-Hyun (Jack) Lim and Sam Feldman
Heathwood Hall Episcopal School

The purpose of this experiment was to determine the chemicals that can be leached from disposable chopsticks and to examine the effects of the chemicals leached from disposable chopsticks on the survivability of the aquatic indicator organism, Daphnia. Varying numbers of chopsticks (0, 5, 10, 20) were soaked in 500 ml of distilled water for twenty-four hours to allow any chemicals to leach into the water. Three trials were performed for each condition. Water samples from each container were analyzed for Sulfide, pH, and Hydrogen Peroxide. The pH of the control (no chopsticks) was 7.5, while water samples exposed to the chopsticks had a pH of 4.5. Hydrogen Peroxide levels were found to increase with increasing number of chopsticks. 0.2mg of hydrogen peroxide was found in the water treated with 5 pairs of chopsticks, 0.4mg in the water treated with 10 pairs, and 0.8mg in the water treated with 20 pairs of chopsticks. 27ml of sample water from each container was then transported to Petri dishes. Five Daphnia were then placed into each of the Petri dishes and observed over-hours. All 5 Daphnia survived in the water containers the chemicals from the 0 chopsticks. All of Daphnia exposed to the water treated with 20 chopsticks died within the first hour, Daphnia in the water containing 10 chopsticks died within the third hour, and Daphnia in the water containing 5 chopsticks died in the 30th hour of observation. This supported the initial hypothesis that disposable chopsticks release toxins into the water that reduce the survivability of Daphnia. The improper disposal of chopsticks could lead to the death of many other aquatic organisms, and could have a massive effect on fragile ecosystems. We would like to thank our Honor's Biology teacher, Mrs. Norman for ordering the materials and allowing us to use the lab for the experiment, and graciously spending extra time editing our paper. We would also like to thank Dr. Bill Brewer, a analytical chemist, for answering our questions regarding how to leach the chemicals from the chopsticks and Mr. Morris, a Honor's Physics teacher, for answering our questions about our experiment, and allowing us to use the science lab in the weekends.

FINDING CONSISTENT SOLVES FOR A 2X2X2 AND 3X3X3 RUBIK'S CUBES USING VISUAL BASIC.NET PROGRAMMING

Justin Lozano
Spring Valley High School

Rubik's Cubes are very popular puzzles invented by Erno Rubik in 1974. It was the icon of the 80s and millions were sold. . There are 43 quintillion different positions but only 1 solved state. There are two common methods into solving the Rubik's Cube. There is the Jessica Fridrich method which is the most common and there is the Lars Petrus Method. The method that will be incorporate into the program is the Jessica Fridrich Method. Following the popularity of Rubik's Cube, other Rubik's products came out including the 2x2x2, 4x4x4 and 5x5x5 Rubik's cubes. The 2x2x2 Rubik's cube may seem easier to solve, however it is necessary to solve it using the same strategy as if it was 3x3x3 Rubik's cube. Both the 2x2x2 and the 3x3x3 are going to be used for the program to solve.

A graphical program is going to be designed. Where the user will input the colors of a scrambled cube and once he click solve, the program will figure out how to solve it efficiently. This will apply both to a 2x2x2 Rubik's cube and 3x3x3 Rubik's cube. The purpose of the experiment is to become more knowledgeable with programming and helping people who put in countless hours to solve the Rubik's cube but can not. To

complete the program, the locations of where the color could exist had to be numbered. Using this locations and numbers rules were written to match a condition. When a condition matched the would do a series of moves called an algorithm and cube would be solved. The program solves the cube about 90% of the time and the other 10% is considered ôstuckö cases. Those cases are getting worked on. Future improvements would be to make the program more organized. Finding stuck cases can be a challenged by the way the program is organized. Future experiments could be to try more complicated sizes of Rubik's cube such as 4x4x4 or create a 3D cube and animate the moves.

FABRICATION AND CHARACTERIZATION OF NANOWIRE-BASED TRANSISTORS

Clarence Mabry
South Carolina Governor's School for Science and Mathematics

InN NWs are promising candidates for transistor fabrication due to their predictable material properties, high carrier density and mobility. In this work, InN NWs grown by chemical vapor deposition on SiO2 covered Si substrates were used, observed under a scanning electron microscope, and electron-beam lithography was performed to make nanoscale transistors. For fabrication, the sample was coated with four layers of Polymethyl methacrylate (PMMA), a photoresist, and e-beam lithography was used to selectively remove portions near the selected NWs for applying the metallic contact. The electrical conductivity, mobility, and carrier densities in these devices were tested in a Field Effect Transistor (FET) with a back gate of doped Si. These transistors were used for sensing NO2; sensing below 1 part per million (ppm) was possible. The mobility and carrier concentration of these transistors were measured to be 250 cm2/Vs and 5 x 1018 cm-3, respectively.

THE EFFECT OF ACUTE BOUT STRETCHING ON ATHLETIC PERFORMANCE

Nimrat Malhi

The benefits of stretching are widely known and accepted, including increased flexibility and a greater range of motion. As of late, researchers have stated that there may be negative effects of stretching also. Recent studies have shown that extensive stretching may decrease athletic performance. Because the elastic properties in the muscles are not as tight once stretched, the coil and spring with the collagen does not provide the runner with as much energy through contraction (Sharp, 2006). The purpose of this study was to test to see the effects of acute bout stretching on athletic performance. There have been many contradictory results in the past and this study could help in determining the true impact. Healthy participants with informed consent were asked to complete a 20 m sprint and a 40 m sprint for 2 days. On the first day, the participants were asked to stretch and complete a run in the following two manners: no stretching (NS) and stretching of the front leg in the starting position (RS) before the run. The times were taken by automatic timers and recorded. The next day, the procedure was repeated for the following two stretches: the stretching on the rear leg in the starting position (RS) and the stretching of both legs (BS). Again the times were collected and recorded. The results for the exercises on each day were recorded and analyzed. After testing, results were analyzed with an Analysis of Variance test (ANOVA) at α=0.05 which showed that there was no significant difference in the data. Therefore, the hypothesis was not supported.

BIOACTIVITIES ASSESSMENT OF MUSCADINE GRAPE, *GARCINIA MANGOSTANA*, *MOMORDICA CHARANTIA*, AND *RHODIOLA*

Shannon McCartha
South Carolina Governor's School for Science and Mathematics

Plants and fruits are natural reactors which produce a variety of phytochemicals, many having antioxidative properties. In this study, the antioxidative properties of extracts of muscadine grape (seed and skin), Garcinia mangostana, Momordica charantia, and Rhodiola were evaluated. The grape powder was extracted by sonication while the others were extracted using a combination of sonication and centrifugation. The extract was collected and tested using three assays: DPPH free radical scavenging activity, reducing power, and metal chelating. The muscadine , *Momordica charantia*, and *Rhodiola* extracts provided similar DPPH free radical scavenging activity as 100 ppm of BHT, a commercial antioxidant. The muscadine extracts and the 1:100 dilution of Rhodiola P.Z. showed at least three times the ability to reduce ferric into ferrous. The 1:1 dilution of the 30 minute sonication of muscadine extract contained reducing power similar to 10ppm EDTA. The other extracts, Garcinia mangostana, Momordica charantia, Rhodiola, and larger dilutions of muscadine, yielded no comparable results, leading to the conclusion that no significant metal chelating activity occurs in these extracts. The synergistic effect of muscadine extract and curcumin was investigated using the DPPH and reducing power assays. In both, there was more of an additive than synergistic effect. The total phenolic and flavonoid content for each extract was also quantified. Out of all of the extracts, Rhodiola P.Z. contained the most phenolics and flavonoids. Out of two muscadine extracts (100% and 80% MeOH), the 100% extract had the highest phenolic and flavonoid content.
I would like to thank Clemson University for providing the facilities, the South Carolina Governor's School for Science and Mathematics for the opportunity, my research mentors, Dr. Xi Wang and Dr. Feng Chen, and Dr. Jones-Cooper, my advisor.

CONDUCTION CHARACTERISTICS OF IAME-CO-IME 2-1 GOLD BIOCHIPS, COMPARED WITH SCHOTTKY DIODES

John McCrary
South Carolina Governor's School for Science and Mathematics

Electrical measurements were performed on Cu/4H-SiC n-type Schottky diodes, on a set of previously-tested histone- or lysosome-coated carbon nanotube (CNT) biochips, and on a newly-fabricated 11-AUT biochip. These measurements were performed to determine the conduction characteristics of the organic biochips, through comparing the diodes results with the biochips results. On the diodes, it was found that all contacts performed similarly, and each contact was consistent with an ideal diode. For the copper contacts, barrier heights varied from 1.05 eV to 1.35 eV, and ideality factors ranged from 1.12 to 1.41. These results exhibit homogeneity of the diodes and consistency with the Schottky-Mott limit of 1.1 eV.

On the original biochips, it was found that contacts coated with CNTs and histone or lysosome had conductivities six orders of magnitude larger than contacts with just CNTs. However, it was also found that the majority of the contacts were non-ohmic; of the ohmic resistances, they varied from 130 to 2178. Unfortunately, the chips may have been damaged in earlier measurements, so the current results are open to interpretation, and therefore conclusions are speculative. On the new 11-AUT biochip, it was found that all but one of the contacts were non-ohmic; for the ohmic contact, the resistance was 520 & 937;. The non-ohmic contacts imply that several unknown transport mechanisms are present in the biochip. Overall, the results show that the current understanding of conduction mechanisms is incomplete. However, starting with more-complete models

for solid state materials should allow continued progress in bioelectronics. I would like to recognize and thank Dr. Harrell, my research mentor, for his guidance throughout my research project. He helped formulate this research project, explained to me the physics behind the research, and allowed me to use his lab and equipment.

DOES GENDER AFFECT YOUTUBE VIDEO GENRE PREFERENCE?

Kirstin McCutchan
Spring Valley High School

Males and females are very different, physically and emotionally. They usually have different hobbies and like different things. The purpose of this experiment was to determine if gender plays a role in YouTube video preferences among male and female adolescents. It was hypothesized that males really do like sports videos the best, and that females really prefer music videos the most. For this study, a survey was handed out to 30 13-18 year olds. The survey consisted of ten multiple choice questions asking which video the participant enjoyed the most. Descriptively, the data showed a trend of females preferring comedy instead of music videos, while males preferred sports videos, as hypothesized. I'd like to thank Dr. Robin Henderson for help and support and Andrew Corley and Michelle Spigner for letting me use their class time to conduct the experiments. I'd also like to thank all the teachers that let me use their classes for my experiment. Thank you also to my parents and family for supporting me. Last of all, I'd like to thank Megan Brovan, Kellie Shell, and Bethan Fanning for helping out with my project.

THE NEMATOCIDAL EFFECT OF MARIGOLDS AMONG BUTTERBANS

William McGee
South Carolina Governor's School for Science and Mathematics

Meloidogyne, commonly called the root knot nematode, is a parasitic nematode that exists globally in soils of moderate temperatures. Meloidogyne attaches to plant roots, forming a gall, which feeds off the plant. Approximately 2000 species of plants are prone to infection by Meloidogyne, which causes between 5 and 7% of global crop loss. Phaseolus Lunatus, commonly called the butter, or lima bean, is cultivated across the world as a primary crop. The presence of Glebionis Segetum is known to have a negative effect upon the nematode count levels in the soil. The purpose of this project is to determine the effect of Glebionis Segetum (the corn marigold) upon the concentration of Meloidogyne in the soil when planted as a secondary crop in conjunction with butterbeans. Soil and root samples were taken to determine the level of nematode concentration and infestation. This information was compared with yield results to determine the effects of marigolds to the primary crop of butterbeans, and also to the soil environment. When the results were analyzed, it was found that the presence marigolds decreased the number of nematodes in the soil, as well as increased the total yield of beans. Dr. Goeff Zehnder—Clemson University, Department of Soils, Entomology and Plant Sciences

THE COMPARATIVE MORPHOLOGY OF FLATTENED AND LOGGERHEAD MUSK TURTLES

Raques McGill
South Carolina Governor's School for Science and Mathematics

Sternotherus depressus and Sternotherus minor, the flattened musk turtle and the loggerhead musk turtle, differ slightly in shell morphology although they are very closely related species. The shapes of their shells are influenced mostly by their habitats and their behaviors in relation to those surroundings. Scientists such as Seidel and Lucchino

(1981) and Ernst et al. (1988) conducted discriminant analyses to determine morphological distinction of Sternotherus depressus and Sternotherus minor. However, those morphological distinctions have never been shown by using three-dimensional models of turtles. To compare the shell shapes of these turtles, techniques of three-dimensional morphometric geometrics were used. The first step was to digitize, or create a 3-dimensional image of each shell by tracing their landmarks, which are essentially intersections of scutes, or plates, on the carapace, or the top of the shell. By using a MicroScribe digitizing arm, those specific points of the shell were marked to create 3-D images. Procrustes Analysis then superimposed the models onto one another and eliminated variables that did not account for shape (such as size, position, and orientation). Afterwards, the Morphologika program grouped similar shells onto a grid. Principles Component Analysis then revealed the morphological differences among all of the models in order of greatest to least significance. Ultimately, those morphological differences were then used to display morphological changes as size increased. The results of this project showed that the outermost (marginal) plates of all shells wear away with increasing age. Results also displayed that although Sternotherus depressus has a flatter carapace, the shell of Sternotherus minor male flattens over time to become morphologically similar to Sternotherus depressus.

BIOINFORMATICS AND FOUR GENES RELATING TO A PREDISPOSITION FOR TYPE 2 DIABETES

Kristen McLaurin

Albeit new diets and raised health concerns about diabetes mellitus, the risks of Americans and others around the world continue to increase. As the studies of Type 2 diabetes have increased, the focus on the genetics of the disease has increased as well. Recent research has begun to suggest four specific genes, GCGR, GCK, SUMO4, and WFS1 have a relation to Type 2 diabetes. The purpose of this study was to use bioinformatics technologies to study the four genes in their relation to the increase in predisposition to Type 2 diabetes. It was hypothesized that GCK gene will pose the greatest risk for causing Type 2 diabetes. It was further hypothesized that GCGR may have some role in causing Type 2 diabetes. It was also hypothesized that SUMO4 and WFS1 will have a slight effect, but not a major effect on increasing a person's risk for Type 2 diabetes. A list of criteria, which were based on a points system, were first developed for each of the online databases that was to be used throughout the research. Tests such as BLAST, Multiple Sequence Alignment and Gene Expression Omnibus (GEO) were conducted in the study of the genes in their relation to Type 2 diabetes. A paired t-test was run to study the differences in means in the GEO data and a Kruskal-Wallis test was performed to determine whether the difference in the points gained by each of the genes was significantly different. Based on the criteria, GCGR is most likely to increase a person's risk for Type 2 diabetes.

THE EFFECT OF SUGAR AND CAFFEINE COMBINATIONS IN COKE ON TEENAGE ATTENTION SPAN AND CONCENTRATION

Margaret Mercer and Taylor Stewart
Heathwood Hall Episcopal School

In this experiment, teenage attention span and concentration power were tested with respect to certain sugar and caffeine combinations in Coke products. The information gathered from this study would benefit the general population by determining if daily

supplements of caffeine and sugar show a significant impact on a teenager's ability to focus and concentrate. It was hypothesized that teenage attention span and concentration would be at its minimum when Coke, which contains both caffeine and sugar, was consumed, and concentration power and attention span would be at their maximum when Diet Coke, which consumes no sugar, was consumed. This was accomplished by testing 10 fifteen-year-old students (5 males and 5 females) using the Attention Span Test and Concentration Power Test found on www.superfocus.com after they each consumed 355 mL of the specified Coke product (Regular Coke, Diet Coke, Caffeine Free Coke, or Caffeine Free Coke) or water. The two controls were water and Caffeine Free Diet Coke, which each have neither caffeine nor sugar. Results from each test were averaged and standard deviation was calculated. The analyzed results revealed that the average attention span in teenagers was highest when neither caffeine nor sugar was consumed. We would like to thank our Honors Biology teacher, Mrs. Lisa Norman, for guiding us through every step of this difficult project and giving us constant feedback and support. Also, we would like to thank our ten Heathwood Hall sophomore and junior students who gave up their time to participate in our study. Finally, we would like to thank our parents for supplying the Coke products and helping us whenever possible.

GENE EXPRESSION IN RELATION TO THE ENDOCHONDRAL OSSIFICATION OF THE MIDDLE EAR COLUMELLA

Kathryn Mercer
South Carolina Governor's School for Science and Mathematics

Deafness is one of the leading congenital birth defects in newborns. It ranges from mild to severe, so it is a common but often overlooked problem that affects one out of every three hundred newborns. Domestic chickens, Gallus gallus, have one middle ear bone, known as the columella. Chick embryos are an accessible, cost effective model organism in which to investigate normal and abnormal development of the middle ear. In the chick, the columella is the equivalent of all three of the human middle ear bones. Endochondral ossification converts the cartilaginous columella condensation into bone on the medial side; this portion of the columella inserts into the oval window of the inner ear. The lateral portion of the columella, which inserts into the ear drum, the extracolumella, remains cartilaginous throughout life. In order to understand the timing and genetic signaling required for cartilage to bone transference, we have used markers for chondrocytes (Sox9 and Col2), prehypertrophic chondrocytes (Ihh and Col10), hypertrophic chondrocytes (VEGF), and osteoblasts (Col1). These markers will enable us to analyze when in embryonic development the cartilage to bone changes occur. I investigated the timing of gene expression of ossification in the columella by means of in situ hybridization using RNA probes and immunohistochemistry using antibodies. The results suggest that Ihh is a positive marker of prehypertrophic chondrocytes. The other markers were not found to be specific enough to mark one phase of development in chondrocytes or osteoblasts.

PRESENTATION OF SELF-ANTIGENS BY HUMAN FIBROBLASTS AND GLIOBLASTOMAS VIA THE HLA CLASS II PATHWAY

Anna Merryman
South Carolina Governor's School for Science and Mathematics

Human Leukocyte Antigen (HLA) class II molecules play a vital role in autoimmune responses as well as anti-tumor immune responses in the body. Specific components of the HLA class II pathway, such as the chaperone protein, Invariant chain (Ii), HLA-DR,

and the nonclassical class II molecule HLA-DM can significantly modulate antigen (Ag) presentation and immune responses. Research has recently shown that nonprofessional antigen presenting cells (APC) such as epithelial cells and tumors can also be induced to express HLA class II molecules and the components of the class II pathway. HLA class II molecules are also implicated in autoimmune disorders such as Rheumatoid Arthritis. In RA, the autoantigen Collagen type II peptide (hC II pep) or the genetically related bovine Collagen type II (bC II pep) and are presented on professional APCs. The aims of this research is 1) to show that Ii and HLA-DR4 transfected human fibroblast cell line M1 upregulated bC II pep presentation by cytokine IL-2 in the context of HLA-DR4 molecules and 2) to show that treatment of glioblastoma cells with all-trans retinoic acid (ATRA) coupled with IFN-γ, reduced Matrix Metallopeptidase 9 (MMP-9) protein expression, an indicator of virulence, while upregulating HLA class II molecule expression. Results indicated that Ii expression in M1.DR4 upregulated self-Ag presentation and that glioblastomas treated with ATRA and IFN-γ treatments downregulated MMP-9 expression and upregulated HLA class II molecules expression. In conclusion, the data from this research suggest that the Ag presentation via the HLA class II pathway may play an important role in both autoimmunity and cancer.

THE EFFECT OF ASPERGILLUS NIDULANS, ASPERGILLUS NIGER, STREPTOMYCES GRISEUS, AND CELLULOMONAS ON THE MASS OF BIODEGRADABLE AND PETROLEUM BASED PLASTICS

Anna Mesa
Spring Valley High School

The continuous mass production of non-biodegradable plastics has resulted in a seemingly uncontrollable accumulation of waste. The fabrication of biodegradable plastics was a hopeful solution but some manufacturers that claim to produce said plastics only create those that break into smaller and smaller pieces which remain toxic to the environment. Six-hundred microorganisms have been identified as capable of degrading plastic. This experiment was conducted to isolate microorganisms that could possibly biodegrade plastics. Four different microorganisms were chosen, Aspergillus niger, Aspergillus nidulans, Streptomyces griseus, and Cellulomonas. The two types of plastic included in the study were biodegradable starch based plastic and common petroleum based plastic. The experiment was conducted by aseptically culturing 10 petri dishes for each microorganism and five petri dishes with no organisms for the control. One hundred and twenty biodegradable pieces of plastic were randomly selected for placement in a blocked experimental design. Three pieces, each individually, were and placed in each petri dish and then placed in an incubator for 21 days. After being incubated the pieces were removed from the dishes and rinsed with tap water and placed out to dry. Each piece was then massed individually and the difference between the original mass and the final mass was calculated. The data were analyzed using a one-way ANOVA, $p > .05$ indicated that there was no significant difference in mass loss between each treatment. I would like to thank my family for their support. Mr. Soblo for all his guidance and allowing me to use his classroom for my research. SCJAS for donating money to purchase the necessary materials, and all of my classmates for their help.

MICRO-SYSTEM ANALYSIS AS IT RELATES TO SMART FABRICS AND NANOCANTILEVER-BASED BIOSENSORS

Rebecca Miles
South Carolina Governor's School for Science and Mathematics

This research combines two projects. The first is designing smart fabricùalso called e-textiles. Polyvinylidenefluoride (PVdF) and carbon-nanotubes (CNTs) are combined in a nanocomposite and converted into an unwoven fabric through the process of electrospinning. A piece of the fabric is cut and attached to a thin sheet of metal, which has adhesive on the underside. Electrodes are attached to the fabric and the Micro System Analyzer 400 (MSA-400) tests the piezoelectricity of the fabric. The laser on the MSA-400 records the micro motions on a three-dimensional plane. The second project uses nanocantilevers as biosensors. A nanocantilever is prepared, which is attached to a movable stage, and the tip is attached. The nanocantilever moves across the surface of an unknown specimen so the tip is bent at a certain angle. The stage moves up and down, allowing the tip to maintain the original distance from the specimen as the experiment continues. The movement of the stage charts the topography of the specimen. This is done using the MSA-400. A modified cardboard box is placed over the experiment in place of a vacuum, reducing the environmental factors which would affect the experiment. The MSA-400 automatically creates a graph of the resistance of the specimen to the bent tip of the nanocantilever. With the modified cardboard box in place, the graph remains nearly constant and the topography of the specimen can be measured more accurately. The factor which binds these projects together is the MSA-400 because it reads and measures three-dimensional micro-motions.

THE INTRODUCTION OF NATURAL DEFENSES INTO THE WOODY PLANT, POPULUS TRICHOCARPA

Marshall Mills
South Carolina Governor's School for Science and Mathematics
Haiying Liang
Clemson University
Chris Frost
University of Pennsylvania

The purpose of this project is to test the structure and function of anti-predation genes in Poplar trees. Poplars grow quickly and produce large amounts of biomass and for this reason they are harvested for paper and biofuels. However, poplars are susceptible to bacterial infection and predation by herbivorous insects. Many woody plants release natural chemicals into the air as a deterrent to such invertebrates or even as a defense. In this project we are trying to study the proteins and enzymes that produce these effects in the poplar tree. Dr. Liang and I worked with an over expression vector to create the target proteins. The method involves transforming plants with different vectors conveying disease resistance and to test their response when under stress. The experimental plant used is the OGY hybrid of the species Populus trichcarpa, and Agrobacterium tumefaciens is used for gene transfer in the process. For my part in the project, I transformed several of the plants with the anti vector and a control PRRR 2222 vector. The anti vector is involved in herbivory resistance and the over production of jasmonic acid. Jasmonic acid is one of the primary chemicals involved in response to predation by herbivorous insects. None of the transgenic plants survived the transformation process. Thanks to Clemson University and the SPRI program, Dr. Haiying Liang and her lab staff, The SC Governor's School for Science and Math. And Dr. Kurt Wagner.

DETERMING A STARS RELATIVE MAGNETIC FIELD USING A RADIO TELESCOPE

Joshua Moore
Dutch Fork High School

To determine a star's magnetic field, it usually is required to have an optical telescope. It should be possible to determine the same data from a radio telescope. However, an optical telescope is expensive and can cost from five hundred dollars to over 5000 dollars. It should be possible to use a radio telescope to determine a star's magnetic field and other information. To conduct the experiment, the telescope will be left out to examine a star, with an auto-rotational device to keep the telescope focused on the star so data is not skewed. After eight hours of following the star, it should have the recorded data saved on the computer. This data can be used to determine the start's magnetic field.

THE EFFECTS OF GROWING METHOD AND THE FOOD PROCESSING SYSTEM ON BACTERIAL CONCENTRATION IN SPINACH

Thad Moore
Heathwood Hall Episcopal School

The purpose of this study was to examine the bacterial effects of the industrial food processing system on bacterial contamination and the differences between conventionally and organically grown produce therein. This is significant because every day millions of people consume these products. The hypothesis was that organically grown and locally grown spinach will have the lowest levels of bacterial concentration, respectively, when compared to conventional and bagged spinach. Three samples each of local organic, loose, domestic organic, bagged organic and bagged conventional spinach were taken by rinsing a portion of each leaf in water. 500 m;L of this rinse was spread on nutrient agar plate and was incubated for 24 hours at 36C. Bacterial colonies in 10 randomly selected 1 cm2 areas were counted, and the colonies' morphologies were noted, as was any fungal growth. The data were averaged and analyzed using a one-way ANOVA test (α=0.05). There was no statistically significant difference between the bagged organic and conventional test groups. Local organic spinach had the least number of bacterial colonies with a total of 247 colonies, and bagged conventional had the most with 1813. These results support the hypothesis. Future research could test other types of produce as well. Other possibilities include focusing exclusively on testing organic produce against conventionally grown produce.

THE EFFECTS OF ESTROGEN ON CARDIAC FIBROBLAST RESPONSE TO STIMULATION BY PRO-FIBROTIC FACTORS

Brian Mugo
South Carolina Governor's School for Science and Mathematics

Previous studies have indicated that estrogen prevents the harmful effects of the renin-angiotensin system on the cardiovascular system particularly angiotensin II-induced fibrosis. It is unclear whether estrogen's effects are specific to angiotensin II or whether the anti-fibrotic effect is more general. This study investigated the effects of estrogen treatment on the response of adult female rat cardiac fibroblasts to diverse pro-fibrotic factors including angiotensin II (Ang II), insulin-like growth factor (IGF-I) and transforming growth factor; (TGF-β). The ability of varying physiological doses (10-8M to 10-10M) of estrogen to regulate the response to these agents was tested through collagen gel contractions and cellular proliferation. In contrast to previous studies with neonatal heart fibroblasts, estrogen treatment did not seem to significantly reduce

collagen gel contraction triggered by addition of Ang II, IGF-I, or TGF-β. Estrogen did significantly alter cellular proliferation ratios in some of the samples in Ang II and TGF-β. The findings of the study suggest that estrogen may have specific effects depending on particular cell types treated. I would like to thank the South Carolina Governor's School for Science and Mathematics and University of South Carolina School of Medicine for this research opportunity. I would also like to thank Dr. Wayne Carver, my mentor, for his help and supervision with this project as well as Erin Massey and Charity Dunn for their help in fibroblast culture.

REGULATION OF NFAT TRANSCRIPTION FACTOR GENE EXPRESSION BY MUTANT P62 IN PAGET'S DISEASE

Danielle Mumford
South Carolina Governor's School for Science and Mathematics

Paget's disease is a chronic focal skeletal disorder characterized by abnormal osteoclast activity. It was hypothesized that p62 gene mutations contributed to abnormal osteoclast development and high bone resorption activity in Paget's disease through upregulation of transcription factor(s) expression. The effects of P392L mutation in p62 gene on the NFAT transcription factor expression essential for osteoclast differentiation were examined. Site-directed mutagenesis was used to create a P392L mutation in the p62 wild-type or full length gene. Western blot analysis indicated that the p62 mutant protein induced NFAT expression 5-fold compared to wild-type p62 gene transfected into osteoclast precursor cells. RT-PCR analysis further indicated no significant change in the levels of NIP45, a negative regulator of NFAT expression in both the p62 wild-type and p62 mutant transfected cells stimulated with or without IL-1 stimulation. Thus, the results indicated that the P392L mutation in p62 gene affects bone modeling in Paget's disease through enhanced levels NFAT expression critical for osteoclast differentiation.

RESONANT AND HARMONIC FREQUENCY IDENTIFICATION OF THE AH-64 APACHE TAIL ROTOR DRIVE TRAIN

Steven Musselwhite
South Carolina Governor's School for Science and Mathematics

Condition Based Maintenance (CBM) is an ongoing shift into more advanced and efficient management of mechanical systems. Instead of relying on inaccurate and expensive methods such as replacing parts based on usage hours, CBM is able to utilize sensors that monitor the vibrations of a component and compare it to baseline data in order to determine the condition of the part. The South Carolina Army National Guard collects this data for CBM of the Tail Rotor Drive Train (TRDT) of the AH-64 Apache helicopter on a test stand constructed at the University of South Carolina. In order to correctly identify rotating component frequencies, system resonant frequencies must be determined. This data is also used to identify avoidance frequencies, or the speed at which the TRDT could become unstable should a rotating component match a resonant frequency. This is done with a rap test, where a percussion hammer strikes specific parts of the TRDT and accelerometers record the vibrations. The data is then analyzed with a Fast Fourier Transform to determine the natural frequencies. All naturally occurring frequencies of the TRDT test stand were isolated.

THE EFFECT OF VARIOUS FREQUENCY ELECTROMAGNETIC FIELDS ON THE GROWTH OF ECHERICHIA COLI

Susan Noh
Spring Valley High School

Radiation from electromagnetic fields is found everywhere on earth. Though the intensity of the field varies from product to product, the threat from electromagnetic radiation is still present. There have been previous studies which have shown that exposure to certain frequencies of electromagnetic radiation has been linked to being a cause of cancer. The purpose of this research is to test whether or not various frequency levels of electromagnetic fields will cause an abnormal change in the growth of E. coli. From the data, it could be then suggested whether or not exposure to certain frequency levels of electromagnetic fields could lead to cancer development. It was hypothesized that if the frequency of the electromagnetic field were lower, then the growth of E. coli would increase. When testing, a sterile inoculation loop was used to extract E. coli and place it in sterile nutrient broth to culture. A dropper was then used to measure 0.5ml of the E. coli within the broth and place it onto 8 agar plates. The plates were then subjected to an electromagnetic field frequency of either, 50Hz, 100Hz, 300Hz, or none as the control, created by a copper wire, attached to a battery and frequency converter, coiled around an iron nail. Colonies were then counted and compared to one other. A linear regression t-test was conducted on all four groups with a=0.05. Preliminary analysis indicated that there was some correlation between lower frequency electromagnetic field radiation and the abnormal growth of E. coli.

THE EFFECTS OF EXERCISE ON EQUINE OVARIAN FOLLICULAR DEVELOPMENT

Christine Noonan
SC Governor's School for Science and Mathematics

This research concentrated on the effects of exercise on the reproductive physiology and hormone levels of horses. There were six horses involved in the study, and of these, half were randomly assigned into a control, or non-exercising, group, and the other half were randomly assigned into an experimental group. The horses in the experimental group were exercised six times a week, in the early morning of each day. Blood was drawn from the jugular vein and rectal temperatures taken before and after each workout. Blood was taken from horses in estrus every day and horses in diestrus every other day. In the afternoon, all six horses were ultrasonically examined and their follicles were measured to track the development of the ovaries. The horses were monitored for two ovulatory cycles. The results of the follicular diameter data show that there was no significant relationship between exercise and follicular diameter. Future research will include radioimmunoassays on the frozen serum of the collected blood to determine the effects of exercise on gonadotropin-releasing hormone, luteinizing hormone, follicle stimulating hormone, estrogen and progesterone: hormones that control follicular development.

TRANSCRIPTIONAL REGULATION OF THE p53 PROMOTER REPORTER CONSTRUCT BY CCAAT ENHANCER BINDING PROTEIN

Megan O'Kelly
South Carolina Governor's School for Science and Mathematics

p53 is a suppressor gene that aids in proofreading the genome during the G1/S regulation point of the cell cycle. When p53 is mutated, it is unable to conduct its normal tasks, and mistakes can pass through the regulation point unnoticed. If the number of mutations incurred is great enough, cancer can develop as a result. C/EBPβ-2 is an enhancer binding protein that has been found to bind to the p53 promoter, thus activating the gene and its suppressor properties. Four plasmids were tested to determine the regulation of the p53 promoter by C/EBPβ: 1.7 PGL3, PGL3, C/EBPβ-2, and C/EBPβ-3. The 1.7 PGL3 contains the luciferase gene, under the control of the p53 promoter. PGL3 contains the luciferase gene, but lacks the p53 promoter. C/EBPβ-2 can bind to the p53 promoter, activating it. C/EBPβ-3 cannot bind to the p53 promoter, leaving it inactivated. Transfections were performed in Swiss 3T3 cells, and the expression of luciferase was determined. However, the results from the assay were not conclusive. This could be due to non-optimized numbers of Swiss 3T3 cells in the transfection protocol.

THE ROLE OF SPARC AND THE N-PROPEPTIDE OF PROCOLLAGEN I

Rishi Pandya
South Carolina's Governor School for Science and Mathematics

The main objective of this research is to examine how factors, specifically a protein SPARC and a mutant procollagen, affect collagen content levels. There were three distinct factors tested: no SPARC, a mutant procollagen, and the combination of no SPARC and a mutant procollagen. The main findings were that no SPARC led to a decrease in collagen levels; and no SPARC or mutant procollagen led to fatal decreases in collagen. The end result wanted is a way to manipulate collagen levels with these factors. Thus there would be fewer blockages and less cardiovascular disease.

AN EPIDEMIOLOGICAL STUDY ON THE RELATIONSHIP BETWEEN SERUM VITAMIN C AND CANCER PREVALENCE

Rachel Parker

Vitamin C is one of the most important substances that can be used in the body. Among other things, vitamin C is very important for the production of collagen and noepinephrine. Because it is such an essential molecule to the human body, its ability to be a predictor of diseases has been an ongoing topic of interest for many scientists. One of the most important studies that is still ongoing is the study of vitamin C and its relationship with cancer. The purpose of this epidemiological study was to measure the pure association between vitamin C and cancer. For this study, one hypothesis was posed: individuals that have non-deficient serum levels of vitamin C will experience protective effects, selecting against cancer. The statistical software packages, SAS« and Minitab, were used to perform the descriptive frequencies and statistical tests in this study. Specifically, the measures of association used for this project included the calculation of the odds ratio and model building using multiple logistic regression to determine the pure association between vitamin C and cancer. The first odds ratio calculated for vitamin C and cancer came out to be .607, which indicated a protective effect. Then a logistic regression was performed on the data to determine the odds ratio for the categorical study, excluding outliers. This was .44 with a 95% confidence interval (.23, .84). For this model, it is shown that the relationship between vitamin C and cancer is strongly

protective. This supported the hypothesis that vitamin C levels that are not deficient would have a protective effect on individuals, selecting against cancer. I would like to thank all of the following people for helping my project be as best as it can be: my mother, Brenda Parker, and my teacher, Mrs. Spigner.

The Effects of Thermal Pollution on Respiration and Metabolism

Sallie Pensa
Dutch Fork High School

This experiment will test the effects of increased temperature on the respiration and metabolism of goldfish. The purpose of this is to see what kind of effects thermal pollution has, and how severe the effects are. This will be done by having four tanks. One tank will be at the lowest temperature goldfish are recommended to be in, 19 degrees Celsius, and it will be empty. The next will be at the highest temperature goldfish can be in, 22 degrees Celsius. These two tanks will control dissolved oxygen levels. The next two tanks will be the same, but will have goldfish in them. A GLX will be used to measure the amounts of dissolved oxygen and the fish will be weighed. The fish in warmer water should have less of a difference of dissolved oxygen, and have a higher mass than the cooler tank.

TESTING BOND STRENGTH BETWEEN KRAZY GLUE, GORILLA GLUE, 1 MINUTE APOXY, AND LOCTITE 4013 WITH REFERENCE TO CREATING A NEW GLUE.

Jaron Pettis
Spring Valley High School

Glues are used in modern day society in surgery for closing deep cuts. Stitches take too long to close wounds and not everyone has had the training to apply stitches. Glues can be bought anywhere and can be used by anyone. New stronger glues are needed. The loctite 4013 shows the most promise of being the best glue. To determine glue strength loctite 4013, Krazy glue, 1 minute apoxy, and Gorilla were glued to two pieces of pig hides then given a time of two minutes to set. The pig hides were then attached to a spring scale and pulled apart. The force required to cause failure was recorded. The results were statistically analyzed with an ANOVA [$F (3, 56) = 2.77$, $p<0.05$]. Gorilla glue and Loctite 4013 required the greatest force to require failure. Crazy Glue required the third highest amount of force to cause failure. Different combinations of thrombin, chitin, agar, HCl, and blood by products were combined in an attempt to create a novel glue. None of the new combinations had the adhesion strength that commercial grade glues had. I would like to thank Mr. Soblo for all his guidance, Dr. Hartvigsen and his staff for allowing me to work at his office and to help me draw blood and separate the by-products from the blood for use also for his suggestion to try adding factor XII to see if it would make the chemicals stick to skin, Dr. Breci for giving me some thrombin and also for extracting my blood using blue test tubes that I could use in my experiment. Thanks to my parents for helping obtain the supplies I needed and for supporting me in the completion of this project and my friends for helping me find information and giving me suggestions.

THE EFFECT OF CONDENSED WATER VAPOR ON UVB IRRADIANCE

Tyler Pixley
Spring Valley High School

Harmful UVB radiation has increased since the 1970s, and has led to more cases of skin cancer and other mutations. Clouds have been a variable second line of defense. This experiment was to determine whether people could go out in sun-blocking light or medium cloud cover. Condensed water vapor (CWV) with smoke nuclei were used to simulate cloud cover. It was hypothesized that the presence of the CWV would decrease UVB irradiance. The CWV was created inside a modified 2 liter soda bottle and placed in between the sun and the UVB meter to determine the effectiveness of CWV in blocking UVB rays. A two sample t-test was conducted on the CWV and control groups. It showed that t0.05 (2), 10=1.96 with the t-value = -1.37 and p-value= 0.201, indicates that there was not enough difference between the two groupsÆ means. However, the high variance of the experimental group, as evidenced by an F-test result of F (9,8)=58.94, indicates that perhaps the CWV does affect UVB irradiance, but inconsistently. I would like to thank my parents for encouraging me to strive towards academic accomplishment. I would also like to thank Mr. Soblo and Mrs. Spigner for providing me with both the materials and science knowledge needed for the project to be a success. I also would like to thank SCJAS for donating to my research. I would finally like to thank Brady Russo and Will Fishburne for donating many 2 liter bottles to my experiment, even when they too had experiments to complete.

PROGRAMATICALLY DESIGNING ELECTRIC SHIPS FROM SPECIFICATIONS

Nicholas Pomata
South Carolina Governor's School for Science and Mathematics

One of the key aspects of the Virtual Test Bed (VTB) engineering simuation project at the University of South Carolina is the development of electric ships, especially their power systems. Such designs become important as ships with fuel propulsion are switched to ships with electric propulsion, given that technological advances since the advent of the fully electric ship about a century ago have allowed electric ships to consume fuel more efficiently and steer more precisely than fuel-propelled ships. In this project, a simple basis for these designs was developed, as an ideal model for a power system and no other systems besides. The application, designed using the C# programming language of Microsoft Visual Studio 2008, accomplishes two principle tasks. Firstly, it creates from user input a main ring bus for the power system, connecting two or more main generators and any number of auxiliary generators with two propulsion motors and one to four load centers (connected both by starboard and port) using ideal connectors and circuit breakers. In addition to the numbers of components, the generator voltage and frequency may also vary based on specifications. Secondly, the program builds the load centers using a variable number of loads with variable resistances, inductances, and capacitances from user input either in the alternating-current zone, connected to the ring bus by starboard or port, or in the direct-current zone, connected to the ring bus through the AC zone using rectifiers, all depending on specifications.

THE EFFECT OF SLEEP DEPRIVATION ON A HUMAN'S REACTION TIME AND MENTAL PERFORMANCE

Freddie Powers and Michael Mireb
Heathwood Hall Episcopal School

The purpose of this experiment was to determine the effects of sleep deprivation on the reaction time and mental performance of high school students. Our hypothesis was that is if a subject is deprived of a full night of sleep, then he/she will have a slower reaction time on the Biobytes reaction time software as well as a higher error rate than if he or she wasnÆt sleep deprived, and he or she will also do less math problems on the math test as well as getting fewer correct compared to if he or she had not been sleep deprived. Twelve students were split into groups of four, and each group was assigned an amount of sleep (no sleep, 4-6 hours of sleep, or 9-10 hours of sleep). They each took a reaction time test using the Biobytes reaction time program as well as an addition test, and their reaction time and percent error from the reaction time test and the number of math problems and the number of problems answered correctly from addition test were recorded. The same tests were taken the next day and the results were recorded again. The results show that on day 2, the 0 hours of sleep group had the slowest reaction time and the second highest error rate on the Biobytes program and the second highest number of attempted math problems and the highest percentage of correct problems on the math test. On day 2, the 4-6 hours of sleep group had the second fastest reaction time and the lowest error rate on the Biobytes program and the highest number of attempted math problems and the second highest percentage of correct problems on the math test. The 9-10 hours of sleep group had the fastest reaction time and highest error rate on the Biobytes program and the lowest number of problems attempted and the lowest percentage of problems correct on the math test. The data were then averaged; percent changes were determined, and the results were analyzed by a one-way ANOVA test (alpha=0.05). The results showed no significant differences between each group or when comparing groups to their own performance between the two days. Therefore, the null hypothesis that there was no difference in reaction time and mental performance in sleep deprived students versus non-sleep deprived students was accepted. Further research with more subjects is needed to determine if a relationship does exist.

THE EFFECT OF PREDNISONE ON THE LIFESPAN OF DAPHNIA MAGNA

Matthew Pritchett
Spring Valley High School

There are many diseases that often require the aid of an anti-inflammatory, and often, prednisone is used. The purposes of anti-inflammatory are to relax the muscles, which reduce the pressure caused by inflammation. Inflammation is the process by which the body's white blood cells and chemicals protect the body from infections and harmful substances. Apoptosis, also known as programmed cell death, is when a cell intakes negative signals, and commits suicide for proper development for mitosis or if it poses a threat. Inflammation and apoptosis are linked together by a cell losing positive signals, inflaming, thus destroying itself. The purpose of this experiment was to determine if an anti-inflammatory would have an effect on an organism's lifespan and if it had any effect on its heartbeat. Ninety Daphnia magna were randomly assigned and equally distributed into three treatments. The three groups contained a control group that contained 28mL of distilled water, a group with 0.01g prednisone/28mL distilled water, and the third group with 0.02g prednisone/28mL of distilled water. The numbers of Daphnia were recorded daily, and three Daphnia from each treatment were taken and heartbeat was measure for fifteen seconds. An ANOVA test, $F(2, 84) = 0.81$, $p>0.05$,

statistically analyzed the heart rate of the Daphnia. A chi-square analysis test on the longevity of the Daphnia showed with a p-value of 0.002 and with alpha at 0.05, the null hypothesis was rejected. It was found that the treatment, 0.01g prednisone/28mL distilled water, increased longevity of Daphnia magna. I would like to thank my teachers at Spring Valley High School for providing me with materials needed to conduct my research, for helping me narrow down ideas for my research, and for aiding me in statistically analyzing the data. I would like to thank Mrs. Spigner with providing me with the necessary prednisone to complete my project. Finally, I would like to thank my family for the encouragement they gave me to finish my research.

PROLIFERATION OF NEURAL CREST DERIVED CELLS FOR COLUMELLA CONDENSATION

Karolina Puskarczyk
South Carolina Governor's School for Science and Mathematics

Affecting up to 1 in 300 newborns, deafness is a prevalent congenital birth defect, second only to heart malformations. Model experimental organisms offer a way to understand normal and abnormal development. Using chicken (Gallus gallus) embryos, which have a single middle ear bone, the mechanism of induction of the columella was investigated because columella formation is not yet well understood. Neural crest cells migrate from the dorsal neural tube to the proximal part of branchial arch 2 to form the columella condensation. Once the condensation forms, the chondrocytes (cartilage cells) differentiate. Only much later does bone formation occur in a process known as endochondral ossification. In order for formation of the cartilage condensation to occur a critical mass of cells is required. The objective of this study was to find out if cell proliferation was required before condensation occurs and the timing of proliferation. Proliferating cells were labeled with two Uridine analogues, BRDU and EDU, for comparison. A 4-h pulse was applied to Day 3-6 embryos, and section analysis was performed using confocal fluorescence microscopy. With a better understanding of the timing of differential proliferation in the ear-forming region, an important tool can be developed for investigating the effect of manipulation of local signals that may play a role in induction and patterning of the middle ear. The preliminary results suggest proliferation in the neural crest cells that will give rise to the columella condensation is not required to the same extent as other neural crest derived cells. I would like to thank Clemson University and the South Carolina Governor's School for Science and Mathematics for the research opportunity, Dr. Susan C. Chapman for permission to use her laboratory, Dr. William Alexander for helping me with my paper and presentation, and the National Institutes of Health and the Howard Hughes Medical Institute for funding my research.

INVESTIGATIVE STUDY OF THE RELATIONSHIP BETWEEN AGE AND SPERM MORPHOLOGY IN BARN SWALLOWS

Miroslava Radieva
South Carolina Governor's School for Science and Mathematics

Barn swallows, Hirundo rustica, are migratory passerines that spend their winters in Africa and South America. The barn swallow population in Spain is one of the healthiest populations because of the short migration and more temperate climate, as opposed to longer migrations and a shorter breeding season of the barn swallows in eastern Europe. In humans, age is known to affect sperm morphology. As the donor becomes older, sperm count decreases as does sperm motility. Likewise, it has been found that the birdsÆ age

affects the motility and navigation ability of sperm. The objective of this study is to determine if the age of male barn swallows affects the morphology of the spermsÆ head and tail. In this experiment, the sperm samples from twenty five barn swallows from Badajoz, Spain were analyzed. The age of the male was approximated based on the tag number. Untagged males were assumed to be only a year old. After all of the sperm samples were gathered, they were videotaped under a microscope. Screen shots were captured from the video footage. The head and tail of the sperm in the screen shots were measured so that statistical analysis can be performed. Analysis of variance showed that age affects only sperm head variance. The affect of increasing sperm head variance on the barn swallow population is unknown. The research does not make clear if males develop greater head variance as they age, or if the sperm head variance is a result of natural selection. I would like to thank Dr. Tim Mousseau and the Department of Biological Sciences at the University of South Carolina for this research opportunity.

THRUST PRODUCTION DURING SWIMMING IN THE GREEN SEA TURTLE (CHELONIA MYDAS): A COMPARISON OF UPSTROK

Kimberly Redmond
South Carolina Governor's School for Science and Mathematics

While freshwater turtles and sea turtles may appear similar, key differences exist between the two kinds of marine organisms. Some differences affect the ability of these groups to generate thrust, the force that propels them forward during swimming. A major visible difference is in forelimb morphology: the forelimbs of freshwater turtles are webbed, whereas the forelimbs of sea turtles are modified into long, flattened flippers. In order to swim, freshwater turtles use asynchronous anteroposterior (front-to-back) limb movements, thereby creating intermittent thrust. Sea turtles, however, stroke the forelimbs synchronously and dorsoventrally, producing continuous thrust. The thrust found in sea turtles is created by both up- and downstrokes, but it is unknown how much thrust each stroke contributes: it has already been noted that the upstroke produces a slight thrust, but there exists no previous study on whether or not the downstroke produces a more forceful thrust. The thrust production between up- and downstroke in sea turtles was determined through study of Chelonia mydas, the green sea turtle, by digitizing its swimming motions captured on film. The data showed that the upstroke took 55 percent of the total swimming time; the downstroke only lasted 45 percent, but exhibited much higher velocity and acceleration than the upstroke phase. Due to its accomplishment of the same forward rate in a lesser amount of time, the downstroke was determined to produce more thrust than the upstroke. The upstroke was figured solely to create enough thrust output to overcome drag so the turtle could maintain momentum.

THE EFFECT OF FLAME STOP II ON THE IGNITION TIME AND COMBUSTION TIME OF PRE-TREATED CEDAR WOOD SHINGLES

Rebecca Rhym
Spring Valley High School

Cedar wood shingles have always been favored because of their aesthetic appeal and durability if properly maintained. However, they also pose the threat of catching on fire because of their low ignition temperatures. The shingles used in this experiment were pressure impregnated at the treatment plant in British Columbia. The purpose of this experiment was to determine whether the use of the flame retardant Flame Stop II has a significant effect on the ignition time and combustion time of pre-treated cedar wood

shingles. It was hypothesized that adding Flame Stop II would increase the ignition time and decrease the combustion time of the shingles. Thirty shingles were randomly chosen, soaked in flame retardant, and left to cure for twenty-four hours. The hypotheses were then tested by burning the shingles in a ventilation hood and using one stopwatch to measure the ignition time and another to measure the combustion time. The ignition time was measured as the time it took for the shingle to initially catch on fire. The combustion time was measured as the time it took for the fire to burn out after its initial ignition. Once the data were collected, two-sample t-tests were conducted at α=.05; one for the ignition time, $t(30) = -3.85$, $p < 0.05$, and another for the combustion time, $t(32) = 2.79$, $p < 0.05$. The results of this test showed that the null hypotheses were rejected, and the alternate hypotheses were tentatively accepted. I would first of all like to thank Mr. Lloyd Clefstad for providing me with the wooden shingles and for giving me the technical advice I needed, and Ms. Amy Marie for providing me with information on Flame Stop II. I would also like to thank my teachers at Spring Valley High School for providing me with the materials needed to conduct my research, for helping me to narrow down the ideas for my research project, and for helping me in statistically analyzing the data. Finally, I would like to thank my family for the support they have given me in finishing my research project. Lastly, I would like to thank SCJAS funding my research project.

A DETERMINATION OF THE CALORIFIC VALUE OF CHICKEN FEATHERS IN COMPARISON TO WOODCHIPS

Jae Ro
Spring Valley High School

There has been an increase in gas prices throughout the past few years due to the world's overreliance on fossil fuels, which creates a need for new biomass fuels. The purpose of this experiment was to calculate what the calorific heat value of chicken feathers and compare its value to that of woodchips. The hypothesis was that if the chicken feathers are burned for energy content, then they will have a higher calorific heat value than woodchips. To do this, a shopping bag full of chicken feathers was gathered and later burned in a homemade burner, consisting of a pot of water over some cans. While the feather burned, the temperature was recorded using a lab temperature probe. The data were then analyzed and compared to the calorific value of woodchips. There was no significant difference between the calorific value of chicken feathers and woodchips, shown in the two sample t- test (Table 2). The two- sample t-test showed that $T(2) = 0.12$, $p>0.05$, meaning that there was no significant difference between the calorific value of the two biomasses. Compared to the literature value of woodchips, 19MJ/Kg, chicken feathers, including the factor (27.40 MJ/ Kg), had 8.4 more MJ/Kg in the experimental value, but when statistically analyzed, there was no difference (Channiwala & Parikh, 2001). I would like to thank Mr. Soblo for helping and guiding me during this research. I would also like to thank the USDA of Florence, SC and the McKinley farm for providing me with chicken feathers for my experiment. Finally, I would like to thank Mrs. Spigner for letting me use her ventilation hood and my family for supporting me all the way. I would also like to thank SCJAS for providing me with a fifty dollar grant for this research.

COMPARING THE MYOSIN LIGHT CHAIN PROTEIN PROFILE OF ATLANTIC SALMON TO STANDARD PROTEIN PROFILES

Ali Robertson

Consumers today assume that they receive what they pay for; however, tests have shown that sometimes, when limits are placed on the amount of species of fish that can be caught, prices rise, and retailers look elsewhere for cheap fish. A Western Blot provides a way to identify specific proteins from a tissue sample, commonly using the muscle proteins myosin and actin. Because of its necessity in life, myosin has only slight variations, and the molecular weight of the protein can be used to show the species of a tissue sample. This project studied and compared the myosin light chain protein profile of Chilean farm raised Atlantic salmon, Salmo salar, purchased from a food supplier to a protein standard. The hypothesis of this project was that due to the amount of mislabeling documented in the past, there will be a difference in the molecular weights of myosin in Salmo salar samples from the retailer. Tissue samples were prepared, and were loaded into a vertical polyacrylamide gel electrophoresis system that was run for 30 minutes at 200 V. The unstained gels were blotted overnight at 20 V. After immunodetection, molecular weight was calculated, and it was determined that every Salmo salar sample was consistent and had the same molecular weight, disproving the hypothesis.

THE EFFECT OF AEQUORIN ON THE BIOLUMINESCENCE OF PYROCYSTIS FUSIFORMIS

Jasmine Ruiz-Yi
Spring Valley High School

Bioluminescence is a chemical reaction within an organism where light is produced. For this chemical reaction two chemicals are required, luciferin and luciferase. Luciferin produces light while luciferase fuels the reaction. In order to test this chemical reaction, the bioluminescent organisms used in this experiment, dinoflagellates called Pyrocystis fusiformis, were given a concentration of 0.01 grams of protein called Prevagen aequorin in three 50ml bags, leaving three bags without the protein as the control, and observed to see how their bioluminescence was affected. For the chemical reaction that results in bioluminescence, aequorin is one of the proteins needed other than luciferin. Extracted from jellyfish, aequorin is used in calcium ion concentration measurement. Prevagen is the only supplement from jellyfish, and was thus chosen to be tested. The purpose of this study is to see if bioluminescence within the dinoflagellates is affected in a positive way, such as glowing brighter than it normally would otherwise. By conducting this research it is hoped that it may help in biomedicine by enabling a more efficient use of bioluminescence on the human body for surgery as well as advancing scientific research on the subject. It is hypothesized that adding aequorin to the dinoflagellate Pyrocystis fusiformis will result in increasing the intensity of its bioluminescence. Preliminary analysis indicates that the protein was both effective and limited given that when the days passed it seemed its efficiency decreased as well. I would like to thank Mr. Dale Soblo for helping me find a research topic and aiding me with my project. I would also like to thank my family for providing support on my experimentation. I would like to thank South Carolina Academy of Science as well for funding my research. Finally, I would like to thank my friends and classmates for their encouragement and support.

THE EFFECT OF BEHR WEATHERPROOFING WOOD FINISH AND LINSEED OIL ON THE FLAMMABILITY OF PRESSURE TREATED WOOD

Brady Russo
Spring Valley High School

Decks are popular attachments to houses and are usually made of wood planking that is treated to protect it from the sun, weather, and the other elements. However, decks can prove dangerous, as the wood they are made from and the coating used to protect them are flammable. The purpose of this experiment was to determine if decks were more at risk from fire with or without these special coatings. It was hypothesized that BEHR weatherproofing wood finish would make the wood more flammable than linseed oil treated wood and untreated wood. The three treatments were tested over a flame from a Bunsen burner and measured for ignition temperature and time to ignition. The mean ignition temperatures were all very close to each other, but the untreated wood had the lowest mean time to ignition. For the ignition temperature, $F(2,27) = 1.95$, $p > 0.05$ with a critical value of 3.35, and for the time to ignition, $F(2,27) = 0.620$, $p > 0.05$ with a critical value of 3.35, so the null hypothesis was not rejected. I would like to thank Mr. Soblo for helping me turn my idea into an experiment and helping me get it done, Mrs. Spigner for allowing me to use her ventilated hood in her classroom, my parents for getting me my materials and for giving me support, my friends for their support, and SCJAS for funding my project.

THE EFFECTS OF PRENATAL ALCOHOL EXPOSURE ON MALE SEXUAL BEHAVIOR AND NEURONAL ACTIVITY

Carolyn Ryan
South Carolina Governor's School for Science and Mathematics

Perinatal alcohol exposure leads to adverse physical and mental defects, known in humans as Fetal Alcohol Spectrum Disorders (FASD). People with FASD exhibit social problems that fail to be explained by IQ or other cognitive problems. These social problems often express as crimes against others, sexually inappropriate acts, and difficulty determining the consequences of actions. Male rat sexual behavior accurately simplifies of social behavior. Previous studies have shown that perinatal alcohol exposure in male rats may result in altered sexually dimorphic behaviors, reduced sexual differentiation, and failure to show partner preference. This study assessed neuronal activity following the expression of sexual behavior in rats with perinatal alcohol exposure, utilizing a three trimester model of FASD. The three trimester model exposes rats to ethanol during the equivalent of all three trimesters in the human. Previously, it was shown that the ability to acquire competent sexual behavior and respond to odors from a female in estrus were impaired using this model of FASD. It was hypothesized that this ethanol-induced impairment was due to altered sensory processing during exposure to a female. Na)"ve adult rats (postnatal day 90 through 120) of the three trimester model and a hormonally primed female were given one hour to mate. The testing was recorded for later scoring. Immediately after testing, their brains were analyzed by immunoreactivity for c-Fos, a marker of neuronal activity. A significant difference between the ethanol and control groups was evident in the arcuate nucleus.

THE EFFECT OF PERSONAL CARE PRODUCTS ON TOTAL CHLORINE AND THE PRODUCTION OF DISINFECTION BY-PRODUCTS

Hitomi Saito
Spring Valley High School

Chlorine is widely used as a disinfectant because of its effectiveness and cost. Chlorine prevents many waterborne diseases, but research shows that there is a possible link between chlorine disinfection, disinfection by-products and health risks, especially in swimmers. The purpose of this project was to determine whether personal care products have an effect on total chlorine and the production of disinfection by-products. In this experiment, different personal care products were being tested to find products that might increase or decrease the amount of chlorine, a precursor of disinfection by-products. By finding products that could increase the production of harmful by-products from chlorination, procedures can be carried out to prevent the product from coming in contact with chlorinated water. It was hypothesized that the personal care products with the most organic substances would have the greatest decrease in chlorine content. To test this hypothesis, different brands of shampoo were mixed with chlorinated water. The mixture was allowed to sit for approximately six hours before the chlorine level was compared to the chlorine level before the shampoo and conditioner were added. The amount of total chlorine after the experiment for each treatment was statistically analyzed at an alpha equal to .05 with a one-way ANOVA. The ANOVA indicated that there was a significant difference, $F(3, 76) = 529.15$, $p < 0.05$, between the treatments. The Tukey test showed that there was a significant difference between each of the treatments except between the first two treatments, Tri-Swim and Jason. I acknowledge my teachers, family, and friends for helping me to complete this project. I would like to thank Mr. Dale Soblo for guiding me through the research period and allowing me to use the lab equipment and his room to conduct my experiment. I want thank Mrs. Michelle Spigner for letting me take class time to finish collecting data and Dr. Robin Henderson for helping me find a method for my project. Lastly, I want thank my family for funding my research and my friends for keeping my spirits up.

DETERMINATION OF OVULATORY FOLLICULAR DIAMETER IN LACTATING DAIRY COWS FOLLOWING THE FIRST ADMINIST

Mary Saleeby
South Carolina Governor's School for Science and Mathematics

Ovulation synchronization in dairy cattle may be justified to reduce or concentrate the need for labor during times of artificial insemination or calving. By determining what diameter follicle is most likely to ovulate in response to exogenous GnRH, a reference profile may be established, which will show how effective synchronization may be relative to follicle diameter. It was predicted that follicles of 12-15 mm would be the most likely to ovulate following an injection of GnRH. The project was carried out by first choosing twenty open cows to be tested: 11 jerseys and 9 holsteins. As designated by the Ovsynch protocol, on Day 1, each cow was injected with 200 mg of GnRH. On Day 7, these cows received 25 mg of PGF2;. Forty-eight h following the PGF2; administration, the cows were injected with another 200 mg of GnRH, and approximately 16 h later, were artificial inseminated. On Day 35, the cows were evaluated for pregnancy. On Days 1-9, blood was drawn from each cow in the project in order to determine progesterone levels via a RIA. Trans-rectal ultrasounds were administered Days 1-4 in order to monitor follicle and CL diameter and to determine if ovulation had occurred after the first GnRH injection. Follicles ranging from 11-15 mm were most likely to ovulate, with the average diameter of ovulated follicles being 13.56 mm, and the average diameter of non-ovulated follicles

being <9.43 mm or >17.17 mm. The RIA levels indicated that cows with a CL had substantially higher levels of progesterone than those lacking the structure. Future research will answer the questions of, whether follicle/CL profiles influence the response of the largest follicle to GnRH, and whether there is a relationship between ovarian structures and progesterone proof and pregnancy rates following OvSynch.

ABSORPTION KINETICS OF A 1:1 MIXTURE OF LiNH2 AND MgH2 FOR HYDROGEN STORAGE

Timothy Salizzoni
South Carolina Governor's School for Science and Mathematics
Donald Anton and Joshua Gray
Savannah River National Laboratory

In the search for a suitable hydrogen storage material for vehicular applications, researchers have turned to powdered materials that bind to and store hydrogen. Of particular interest in these materials is a system consisting of Lithium, Nitrogen, and Hydrogen due to its high storage capacity. However, due to the high temperatures needed to remove the bound hydrogen (500°C) , Magnesium has been added to destabilize the system. The potential of the Li-Mg-N-H system for hydrogen storage currently shows promise for use as a viable storage material. These materials are attractive due to their high storage capacities and lowered discharge temperatures. This research examines the product of a desorption of 1:1 mixture of LiNH2:MgH2 with a 4 wt % TiCl3 catalyst as a candidate for hydrogen storage in the current system. This mixture is interesting because the reported product, LiMgN, has a theoretical 8.2 wt% hydrogen storage capacity and discharge has been observed at 160°C . In this research, the mixture produced Mg3N2 or a solid solution of the same chemical involving lithium which displayed a maximum discharge of 6.0 wt%.

SOFTWARE DEVELOPMENT FOR THE COMPARISON OF MEDICAL IMAGES

Maggie Savidakis-Dunn
SC Governor's School for Science and Mathematics

Although most humans have the same basic shape for organ structure, there are some common deformities and mutations that exist. Surgeons use various procedures to correct the malformed organs. Medical professionals use various imaging systems, such as MRIs, to the look of the malformed organ. By reviewing these images before operating, surgeons can plan corrective surgery with more accuracy. Computers can aid in the pre-surgery planning process by allowing doctors to analyze images in new ways and make comparisons between different organ structures. Software was developed to aid in these comparisons. By allowing medical professionals to select two images, one of the malformed organ, and the other of a normal organ, it is hoped that they will be able to get a better idea of what changes need to be made to the organ. The software highlights the corresponding points between the images, which allow the medical workers to see the organ deformity, and will give them a new edge when treating patients. By allowing the surgeons to select the viewing angle of the organ, the software displays views that an MRI cannot project. The goal of this project is to provide improved care for patients by providing medical professionals with the software to allow new views of the medical images used in surgery.

A COMPARATIVE STUDY OF THE MUTATION RATES OF DROSOPHILA MELANOGASTER EXPOSED TO ORGANIC MILK AND NON-ORGANIC MILK

Hope Sendler
Spring Valley High

The purpose of this project was to determine whether the hormones in milk have an effect on the mutation rates in flies. Extensive background research has been done on the effects of hormones on animals like cows and sheep, but little information is known about the long-term effects on humans and other animals. Certified organic milk contains no antibiotics, hormones, herbicides, or pesticides, unlike non-organic milk. Based on this knowledge, it was hypothesized that the non-organic milk would cause the most mutations in the flies. To test this hypothesis, three treatments of flies were established. Each treatment consisted of three jars of ten flies- five male and five female. The three treatments, organic milk, non-organic milk, and water were randomly assigned to the nine culture bottles. After the flies laid eggs, the parents were anesthetized and disposed of. After the eggs hatched, the flies were examined under a dissecting scope to check for mutations and disposed of. The number of wild type and mutant flies were counted in each group and the numbers were statistically analyzed with a Chi-square test with alpha equal to .05. The results indicated a significant difference in the numbers. The hypothesis that non-organic milk causes the most mutations was supported. First off, I would like to thank my research teacher Mr. Soblo for providing me with all the materials to complete my project. All the materials were available at school, so the project cost little money out of pocket. I would also like to thank him for his time and effort in helping me along the way. He guided me through the experimentation and statistical analysis and answered all of my questions. His assistance was truly invaluable throughout this whole experience. I would also like to thank my parents for supporting me and helping me along the way. Finally, I would like to thank my classmates Benjy Strauss, Anna Mesa, and Harmony White for helping me conduct the research on days when I had a lot to do. Thank you to everyone who gave their time and effort to help me complete my research project.

FORM ALTERNATION IN MALE PROCAMBARUS VERSUTUS: MORPHOMETRICS AND A STATIC VIEW OF A DYNAMIC LIFE HI

Lauren Sharpe
South Carolina Governor's School for Science and Mathematics

The life cycle of male Cambarid crayfish (Astacidea: Cambaridae) includes alternate reproductive and non-reproductive forms. Reproductively capable males (i.e., form I) are aggressive and have high dominance status within social hierarchies. High social status is achieved and maintained by dominating conspecifics during aggressive interactions. Non-reproductive males (i.e., form II) are less aggressive and thus have lower dominance status. Although it has not been documented for all species, alternation between form I and form II is presumed to occur throughout a reproductively mature male's life. The current model for the male Cambarid life cycle assumes that the form II state enables individuals to allocate a greater portion of energy to growth rather than aggressive interactions. In many Cambarid species, form I males have secondary sexual characteristics such as enlarged chelae that distinguish them from form II males. Enlarged chelae serve as weapons and act as signals for intra-specific contests. We used morphometric data to examine two hypotheses about male sly crayfish (Procambarus versutus,). First, we used individual crayfish weight by length ratios as a measure of condition and compared average condition values of form I to form II males. Because the current model of the male Cambarid life cycle assumes that form II males are able to

allocate more energy to growth, we hypothesized that form II males would have higher condition values than form I males. Secondly, we tested for allometry in chelae size between the two male forms and hypothesized that form I males would have proportionally larger chelae than form II.

THE EFFECT OF FLUORIDE ON THE DYE PENETRATION OF AMALGAM TOOTH FILLINGS

Kellie Shell
Spring Valley High School

More than 50 percent of U.S. children, 96 percent of employed U.S. adults, and 99.5 percent of Americans 65 years and older have experienced dental caries, also called cavities. Studies have shown that fluoride can be used to prevent dental caries. However, there is no significant decrease in the amount of dental caries present from fluoridation than non-fluoridation. A more reasonable method for the treatment of dental caries is to fill them with either amalgam or composite tooth fillings. The purpose of this study was to see how higher concentrations of fluoride effect how far dye will penetrate under amalgam fillings. It was hypothesized that as the concentration of sodium fluoride increases, the amount of visible dye penetration under the amalgam filling would increase as well. This research consisted of 4 amalgam teeth. The types of teeth extracted were both frontal and cusped teeth. Under a microscope at x2 magnification a cusped amalgam filling immersed in 200 ppm of fluoride had dye leakage deep under the filling. The dye penetrated .65 cm under the filling. When immersed in 150 ppm of fluoride, an amalgam cusped measured slightly less penetration at .2 cm under the filling. In 100 ppm of fluoride, a frontal tooth showed less visible penetration under the filling at .1cm. At 50 ppm of fluoride, a cusped also measured .1 cm under the filling. A descriptive analysis was then used to determine if there was a significant difference of dye penetration in teeth exposed to higher concentrations of fluorides as opposed to the teeth exposed to lower concentrations of fluorides. I would like to thank my teachers and family for all of their support, encouragement, and contributions. I would also like to thank Dr. Henry T. Marshall for contributing the teeth needed to conduct my experiment.

THE EFFECT LEADING AND TRAILING EDGE DEFLECTION ON THE PERFORMANCE OF A NACA 23013 AIRFOIL

Eric Shine
Spring Valley High School

The four forces that affect all aircraft are: lift, weight, thrust and drag. Thus, modern-day aircraft designers are constantly in search of means to improve performance by way of: increased power from the engines (more thrust), more streamlined designs (less drag), lighter materials (less weight), and more efficient wing or airfoil designs (greater lift). The purpose of this study was to ascertain if modification of the leading edge and trailing edge camber of a popular wing design can improve performance under certain flight conditions. A variety of software packages were used to design and test various airfoil configurations. These software packages were Solidworks, DesignFoil, AeroFoil, and Profili2. Profili 2 was ultimately chosen as the main testing program because it allowed for different types of airfoils to be defined. Also, it allowed for leading edge and trailing edge deflection to be done on the airfoil. In addition the airfoil could be tested at different flight conditions and multiple AOAs simultaneously. Profili 2 was used to generate and test the airfoils in this study. In the initial climb stage the best configuration was with 4% leading camber and 20% flaps. In the cruise climb stage the best configuration was

with 5% leading camber and 0% flaps. In the cruise stage the best configuration was the standard airfoil. The best configuration in the descent cruise phase was the standard airfoil. The best configuration in the approach stage was with 1.5% leading camber and with 10% or 20% of flaps. In summary it was observed that throughout all of the flight regimes, flap deflection of the airfoil with 1.5% leading camber was overall the most effective. This is consistent with what is experienced in the real world in the RV aircraft. It was determined that leading edge camber helped in certain flight conditions but not enough to offset the expected complexity and weight penalty of these devices over the flight conditions observed. Thank you to everyone who provided me any assistance with my project. This includes James Clark for providing his insight for my project, Mrs. Spigner for her guidance and support, and my Mom for her financial assistance and her support throughout the project. In addition, I would particularly like to thank the software providers of AeroFoil, DesignFoil, and Profili 2 and Solidworks.

ALBIZIA JULIBISSIN SEED PREDATION: THE EFFECTS OF BRUCHIDIUS TERRENUS ABUNDANCE AND SPATIAL AUTOCO

Carly Slack
South Carolina Governor's School for Science and Mathematics

The beetle Bruchidius terrenus was unintentionally introduced to the United States from China, most likely in conjunction with the mimosa tree (Albizia julibrissin). Although the mimosa tree is known to have been introduced to the United States in 1745, the year in which this Bruchidae beetle was introduced in the U.S. is currently unknown. The beetle's long-term effects on mimosa populations, and on the populations of other closely related native plant species are also unclear at this time. B. terrenus larvae feed on the inner portions of mimosa seeds, and the adult beetles feed on the pollen of mimosa blossoms. Here, I discuss the relationship between the number of predated seeds of eight mimosa trees on the banks of South Carolina's Lake Richard B. Russell, and the size of the B. terrenus population samples collected on inflorescences of the same mimosa trees. I also discuss the relationship between seed predation and geographic location of the mimosa trees in respect to one another. A direct relationship was seen between the numbers of predated seeds and the quantities of bruchids found in population samples. Also, the quantities of predated seeds were found to be most similar in trees growing nearest together.

THE EFFECT OF AMERICAN GINSENG AND GINGER ON THE BLOOD GLUCOSE LEVELS OF TYPE 2 DIABETICS

Ellis Sojourner

In this experiment, the different effects of American Ginseng and Ginger on the blood glucose levels of type 2 diabetics and non-diabetics when compared to fasting blood glucose levels were investigated. This information yielded by this research could benefit type 2 diabetics by informing them of a convenient, safe, and practical means of maintaining a normal blood glucose level because of the simple preparation and oral intake of these all-natural dietary supplements. It was hypothesized that blood glucose levels of type 2 diabetics will decrease when Ginger or Ginseng are taken as supplements when compared to fasting blood glucose levels, Ginger having a greater effect. Two type 2 diabetics and three non-diabetics were divided into three groups: no herb added to tea, 6mL of American Ginseng added to tea, 6mL of Ginger added to tea, with one diabetic and one non-diabetic in each experimental group. For four mornings, before eating anything that day, participants tested their blood sugar levels, drank 250 mL of tea, and

then tested their blood sugar 45 and 90 minutes after consumption and recorded their results, the following four mornings, participants followed the same procedure except the American Ginseng group had 6 mL of American Ginseng added to their tea, the Ginger group had 6 mL of Ginger added to their tea, and the no herb group did not have any additives combined with their tea. Data was analyzed by averaging each participant's blood glucose level at each time interval and by finding the percent change between two time intervals. It was revealed that a majority of the participantsÆ blood glucose levels were increased after the consumption of plain tea. Although the number of participants was too small to draw any significant conclusions, the data suggests that non-diabetics were more susceptible to the effects of herb root extracts then diabetics, and that Ginseng was more effective at lowering non-diabetic blood glucose levels (-19.83%) and Ginger was more effective at lowering the blood glucose levels of diabetics (-12.84%).

REGULATION OF CYCLOOXYGENASE-2 GENE EXPRESSION IN MCF-7 CELLS

Abby Spangler, Chin Fu Chen, and Chun-Huai Cheng

Cyclooxygenase-2 (COX-2) is a pro-inflammatory gene that converts arachidonic acid to prostaglandin PGE2. PGE2 has been found to contribute to breast cancer by stimulating proliferation, promoting angiogenesis, inhibiting apoptosis, and by suppressing antitumor immune cells. The use of non-steroidal anti-inflammatory drugs and selective COX-2 inhibitors has been shown to reduce the risk of developing colorectal cancer and therefore, may help prevent breast cancer. The purpose of this research was to determine the effects of chemicals parthenolide and 5-azacytidine (non-steroidal reagents) on the expression of COX-2 in U-937 human lymphoma cells and MCF-7 human breast cancer cells. U-937 and MCF-7 cells were treated with 2 M of the reagent at a density of 2 x 105cells/mL and incubated at 37%C. U-937 cells were incubated for 24 hours, while MCF-7 cells were incubated for 48 hours due to their longer doubling time. Real-Time PCR was used to determine the change in gene expression of COX-2. β-Actin was used as a reference gene to normalize the data for COX-2. In U-937 cells, 5-azacytidine caused an average increase of 600 % in COX-2 expression, while parthenolide did not cause a distinguishable change in COX-2 expression. In MCF-7 cells, parthenolide caused an insignificant increase in COX-2 expression while, 5-azacytidine caused a small but significant increase in COX-2 expression. The results were surprising since parthenolide was considered as a potential anti-cancer drug and was expected to have anti-inflammatory effects. These results indicate that a more complex mechanism may account for the drug's anti-cancer nature. Therefore, more research is required to determine the effects of parthenolide and 5-azacytidine on MCF-7 and U-937 cancer cell lines. I would like to thank the Howard Hughes Medical Institute and the SC LIFE program through SPRI and GSSM for funding my research and giving me this opportunity. Also, Dr. Chin Fu Chen for giving me this project and allowing me to work in his lab, Chun-Huai Chen for his patience in teaching me all the techniques and procedures I used for this research, Madison Stevens helping me with lab procedures. Finally, I would like to thank Dr. Bhuvana Parameswaran for her guidance at GSSM.

THE EFFECTS OF VARIOUS CHARACTERISTICS ON THE EX-VITRO SURVIVAL OF SOMATIC EMBRYOS OF LOBLOLLY PINE

Mary-Kate Spillane
South Carolina Governor's School for Science and Mathematics

Pinus taeda is a commercially important species mainly found in the southeast United States. In somatic embryogenesis, the identical trees are produced via asexual reproduction of a callus tissue taken from an immature loblolly pine seed. Mass production of these somatic embryos can have huge benefits to varietal forestry. An experiment was conducted to observe the effects of three different characteristics of embryo quality on the ex-vitro survival of somatic embryos of loblolly pine: 1) number of cotyledons, 2) stem length, and 3) root length. The germinating embryos were sorted in each of these and planted. The trees were then stored in a greenhouse for 6 weeks. It was observed that out of those 3 categories, root length has the best survival percentages. Surprisingly, the factors that had the biggest impact were the date planted and the speed of planting.

THE EFFECT OF ELEVATED AMOUNTS OF CARBON DIOXIDE ON THE GROWTH OF *ARABIDOPSIS THALIANA*

Benjy Strauss
Spring Valley High School

The purpose of this project was to understand how plants grow when exposed to higher carbon dioxide levels. It was hypothesized that the effect of elevated carbon dioxide would increase the growth of *Arabidopsis* thaliana by at least two times more than a normally grown *Arabidopsis thaliana.* The Arabidopsis seeds were planted into inserts in trays and put in to custom growth chambers. A light source was put over the chambers. The plants were watered five times a week and were administered carbon dioxide via carbon dioxide regulator two times a week. There was a control group, 500 ppm CO2 treatment, and a 1000 ppm CO2 treatment. The Results indicated a significant effect of carbon dioxide on the *Arabidopsis* mass. An ANOVA was conducted $F(2, 90) = 5.28$, $p < .05$ to see if there was a significant difference. A postûhoc Tukey test was performed and it indicated a significant difference between the 500 ppm treatment and the 1000 ppm treatment. The null hypothesis was rejected. The Carbon dioxide had an effect on the plants mass. The 1000 parts per million treatment's average mass was significantly smaller than the 500 ppm treatment's mass. I would like to thank my parents for helping my buy the materials I need. I would like to thank Mr. Soblo for for all his guidance and lending space in his classroom for my project. I would like to thank my friends for there help and support. I would like to thank SCJAS for funding the project

THE EFFECT OF ELECTRICAL FREQUENCIES ON BACTERIAL GROWTH RATES

Rohan Sunthankar
Spring Valley High School

Bacteria have been linked to numerous diseases, many of which are very deadly. Electrical frequencies could be a possible solution to try and limit this harmful bacterial growth. The focus of this project was to study, in more detail, the effect of external electric frequencies on bacterial growth rates. The hypothesis of the study was that electrical frequencies would inhibit bacterial growth in relation to normally grown bacteria. A transmitter was used to generate the electrical frequencies. Bacillus megaterium, Micrococcus luteus, and Spirillum volutans were the three different bacteria used in the experiment. The bacteria were split up into two groups. One group was put into the

incubator with a transmitter and the other was not. Both were incubated at 32%C. Results were obtained after a week of growth. The bacteria's cell density was measured using a spectrophotometer. It was determined that growth was hindered in two of the three bacterial samples compared to the normal growth samples. The electrically transmitted bacteria, in samples of Micrococcus luteus and Spirillum volutans, exhibited statistically (independent samples t-test, ά = 0.05) lower cell densities than the normal bacteria. Bacillus megaterium, on the other hand, was not statistically lower than the normal cell densities at the 95% confidence level. In conclusion, it was determined that bacterial growth is potentially hindered by exposure to electrical frequencies. Many people helped me during my experimentation. First, I would like to thank Dr. Robin Henderson for all of her guidance and help throughout this process. I would also like to thank Spring Valley High School for supplying me with the various materials I used for this project. In addition, I would like to thank the SVHS education foundation for funding parts of my project. Lastly, I would like to thank my parents for also helping fund parts of my project and for all of their support during the entire duration of my research project.

THE EFFECT OF PHOSPHORIC ACID IN SODA ON TEETH

Nazia Tabassum
Dutch Fork High School

As the concentration of phosphoric acid is increased by .01M, the mass of each tooth will decrease by 1.6 percent. The experiment will be done on ten cow teeth and ten pig teeth from a local meat market. These twenty teeth will be assigned to four different experimental groups with varying concentrations of the acid, starting from .0002M and one control group, where the teeth will soak in distilled water. The teeth will be massed before soaking, will be soaked for one month's time, and will be massed again at the end. Each group will be placed in the same area and will have the same amount of liquid and be at the same temperature. The percent change in mass will then be calculated and matched to the hypothesis and the control group's change in mass. Studies have shown that teeth soaked in phosphoric acid should have a lower mass than those soaked in deionized water. The student would like to thank Mrs. Julie Krusen, Mr. Patrick Smallwood, Dr. Langdon Warner, and Dr. A. Patel, USC biologist for their ideas, support, and assistance for this project.

THE EFFECT OF VARYING DISTANCES BETWEEN THE CAMERA LENS AND THE EYE ON THE APPEARANCE OF RED-EYE

Alyssa Trenery

Almost everyone with a digital camera has experienced some form of red-eye in photographs. Red-eye occurs when the flash goes off and the light enters the inner eye and eventually hits the retina, which is filled with blood vessels. This experiment can help determine whether varying distances have an affect on the amount of red-eye in a picture. It was thought that as the distance increases, the amount of red-eye would decrease. Since red-eye is most common in light colored eyes, all of the participants chosen for experimentation had blue, green, or hazel eyes. They were taken to a dark room and from there, subjects were asked to keep their head still exactly a meter off the ground and look directly into the digital camera, which was also a meter high on a tripod. Three pictures were taken for each distance 1 meter, 2 meters, and 3 meters for each subject using a Casio Exilim EX-Z80 8.1 mega pixel digital camera. The pictures were then uploaded and the red eye was measured and compared using an ANOVA test.

Since the p value of 0.719 was greater than the alpha value of 0.05, the data supported that distance does not affect the amount of red-eye in pictures. Therefore, it can be concluded that distance does not affect the amount of red-eye present in pictures.

THERAPEUTIC EFFICACY OF T CELLS SPECIFIC FOR HUMAN TYROSINASE IN THE TREATMENT OF MELANOMA

Whitney Tucker
South Carolina Governor's School for Science and Mathematics

The newly developed Human Tyrosinase Tumor Infiltrating Lymphocyte-derived T Cell Receptor (H3T) murine strain is transgenic for T cell populations with T cell receptors specific for the human tyrosinase enzyme found to be up-regulated in melanoma and presented on the human HLA-2 MHC Class I molecule. Utilizing this strain, the immunogenicity of a self-antigen in the context of human Class I presentation was studied. This project was specifically aimed at analyzing the ability of H3T mice to reject melanoma cells and evaluating the therapeutic efficacy of T cells from H3T cells after Adoptive T Cell Transfer (ACT). Magnetic labeling and enrichment analysis, flow cytometry analysis, ACT, and tumor measurement all showed that H3T mice have the ability to reject B16 tumors that present tyrosinase epitopes in the context of human HLA-A2 molecules. It was also found that the adoptive transfer of ex vivo activated H3T cells increases the survival of mice bearing B16-A2 melanoma tumors.

THE EFFECTS OF VEGETATION ON WIRELESS NETWORK PERFORMANCE

James Vaughn
South Carolina Governor's School for Science and Mathematics

The use of wireless networks to garner data in wilderness settings is becoming increasingly popular because of their ease of deployment and maintenance in rough terrains. However, obstructions like vegetation and rough terrains greatly affect wireless network performance due to the complex multipath effects caused by the reflection of wireless signals trees and other surrounding objects. The project aims to study the effects of vegetation on wireless network performance. The experiment tested how transmit power affects the network performance for a point to point network in a densely vegetated forest. The antennas used in this experiment were omni-directional Linksys antennas. The results of the research will help to quantify the effects of vegetation on wireless network performance.

THE SPIRITUALITY-HEALTH CONNECTION

Evan Wechsler
Dutch Fork High School

This project seeks to analyze the relationship between spirituality and health in human beings. This study's objective is to determine whether there is a significant difference in health of people who are spiritual and people who are not spiritual. The hypothesis for this experiment was that higher levels of religious belief are correlated with higher levels of health in humans. To do this, a survey inquiring into level of spiritual belief, physical and mental health, and other possible confounding variables, was developed and administered to 100 people from various areas, 17 of which were in the control group. This study found evidence of a positive correlation between spirituality and health in the upper levels of spirituality. The study is continuing to collect samples in order to validate the previous results, increasing the control group to 50 samples and

increasing the amount of surveys gathered from people with lower levels of spirituality, to a total number of surveys gathered of 200. First off, I would like to thank my Research teacher, Dr. Langdon Warner, for his help in making this project a reality. I would also like to thank Mrs. Greta Shealy for her help as a mentor in this area, guiding me in the fundamental principles of the subject. I would also like to thank my other peers in my Research class for giving me their valuable advice in constructing the survey.

MODAL IDENTIFICATION OF A UNIFORM SIMPLY SUPPORTED STEEL BEAM

Andrew Wentzel
South Carolina Governor's School for Science and Mathematics

Modal identification techniques can be used to determine the dynamic properties of a structure, such as the mode shapes, natural frequencies, and modal damping ratios, by measuring the response of the structure to stimuli. An understanding of the mode shape and how the structure responds when excited helps engineers to build and design better and safer structures and products. This research studies the best sensor location for modal identification on a simply supported steel beam. Three accelerometers, each recording at a sampling frequency of 400 hertz, are used to measure the beam's response. One sensor remains at a reference location throughout each round of testing, while the other two are moved throughout the beam in two inch intervals until every position has been tested. At each testing location, data is gathered for one minute while an impact hammer or sinusoidal exciter is used to excite the beam. The data collection process is repeated five times at each of the eleven testing locations. Using MATLAB« the mode shapes and natural frequencies of the steel beam are found, along with their mean and standard deviation. Results show that the best location for the identification of the first mode shape is close to the center of the beam. The second mode is better identified when the reference sensor is located around 2/3rd the length of the beam. The location of the reference sensor does not affect the identification of the natural frequencies.

THE EFFECT OF PREDATORY (FLATFISH) AND NON-PREDATORY (SALMON) FISH SKIN EXTRACT ON THE MORPHOLOGY OF LYTECHINUS VARIEGATUS LARVAE

Harmony White
Spring Valley High School

The purpose of this study was to observe how sea urchin larvae react when exposed to a predator threat. Lytechinus variegatus larvae were exposed to skin extract from either flatfish (predatory) or salmon (non-predatory). It was hypothesized that flatfish extract would cause the L. variegatus larvae to exhibit cloning indicated by reduced size. Twenty-four hours after exposure, the numbers of small and normal larvae in each treatment were counted and recorded. These numbers were analyzed using a chi-squared test at alpha = 0.05 and resulted in a p-value of 0.008. Since the p-value was less than the alpha value, the null hypothesis was rejected and the proposed hypothesis was supported, indicating that L. variegatus larvae do change when exposed to predatory skin extract. This project could not have been done without the many people who were standing behind me the whole way. I would like to thank my research teacher Mr. Soblo for supporting me and convincing me that I was smart enough to create and carry out a good research project, and for allowing me use of his room and materials. Special thanks goes to my mom for her financial and emotional support and for letting me bounce ideas off of her even when she didnÆt have a clue what I was saying. I would also like to thank my friend Hitomi Saito for staying after school twice to help me culture the urchins, Jasmine

Ruiz-Yi for helping me care for the urchins, and both of them for making me laugh and keeping my spirits up through the many mistakes and urchin deaths I had to go through before getting this to work. I would also like to thank SCJAS for granting me money to help cover the cost of the project.

THE EFFECT OF POINT SOURCE POLLUTION FROM FERTILIZER AND CATTLE ON LONG BRANCH CREEK

Corey Wood
Heathwood Hall Episcopal School

The purpose of this research project was to determine if the application of fertilizer and the presence of cattle affected the water quality present at five locations along Long Branch Creek on Wood Charolais Ranch in Dandridge, Tennessee. Water samples from a well upstream of the farm served as a control group and were a sixth observation. Three water samples were collected at all sites. The following water quality tests were performed: coliform bacterial tests, nitrate, phosphate, pH, and dissolved oxygen. The results were averaged and analyzed. The major findings from the testing for this research project suggest that the application of fertilizer and presence of cattle in the selected area of Long Branch Creek contributed to contamination and a decrease of water quality. The tests confirmed that coliform was present at all six sites including the control site. The positive coliform test results from the control samples might have been caused from contamination from the spigot, the crack in the well pipe, or pollution from heavy rain the day before the samples were taken. In addition to the presence of coliform, the nitrate levels were above normal at sites four, five, and six at 20 parts per million. At sites five and six, the levels of phosphates were above normal at two parts per million. The pH dropped by one level for each site at sites two through six, which means that the water at these sites had become more acidic as it moved down stream. Dissolved oxygen levels dropped at sites five and six, which indicated that the nitrites had taken oxygen and made more nitrates. Test results from samples taken farther downstream also confirmed the hypothesis that the application of fertilizer and presence of cattle negatively impacted the water quality as one moved downstream. For the most part, the results from sites four and five (farther downstream on the creek) showed a greater contamination level and served to support the hypothesis. The results of these tests indicate that the aquatic environment along Long Branch Creek had been compromised and this pollution may affect life forms living in the stream. Corey Wood would like to thank the following individuals for their involvement in this project: Mrs. Anne Bivens, Mrs. Lisa Norman, and Mr. Mark Petit.

THE EFFECT OF MUSIC TEMPO ON RUNNING PERFORMANCE

Leigh Yarborough
Heathwood Hall Episcopal School

In this experiment, the effect of music tempo on running performance was examined. This information would be beneficial because it would heighten the awareness of the impact of music on exercise and insure that the benefit of using music while exercising is maximized. It was hypothesized that if one runs with music and thus different tempos of music, then their performance will be affected and furthermore that increasing music tempo would also increase running performance. This was accomplished by having 10 volunteers each perform a total of 4 trials, one for each music condition. Music was set into playlists of slow beats per minute (bpm) with music from 60-80 bpm, medium bpm, with music from 100-130 bpm, and fast bpm with music from 160-180 bpm. Resting

heart rate and breathing rate were obtained. Participants then ran one-half of a mile with a heart rate monitor and an mp3 player with music playlists loaded and volume controlled. On day 1 they ran with no music, day 2 with medium tempo music, day 3 with fast tempo music, and day 4 with slow tempo music. At the conclusion of each run, participantsÆ running time was recorded, their heart rate immediately after and maximum heart rate were recorded from the heart rate monitor, their breathing rate was counted for 15 seconds and recorded, and they rated their perceived effort. The data was averaged and percent changes in parameters were identified. Overall findings suggested that running performance was greatest without music, showing faster running times and a lower heart rate. Other trends included that slow tempo music lengthened running time and lowered perceived effort while fast tempo music lowered breathing rate immediately following exercise. The results were analyzed using a one-way ANOVA statistical analysis test (alpha=0.05). The analyzed results revealed that there was no statistically significant relationship between various tempos of music and running performance.

MECHANICS OF BUTTERFLY FEEDING: A DETAILED STUDY OF THE MONARCH BUTTERFLY PROBOSCIS

Campbell Yore
South Carolina Governor's School for Science and Math

The purpose of this research project is to discern to mechanics of nectar intake (feeding) in Monarch Butterflies. Previous feeding studies performed using Hawkmoths and Orchid Bees as well as the accepted mathematical model for determining the pressure drop generated by nectar dependent insects during feeding will be used in this experiment. These two tools provide a strong foundation for designing and organizing experiments to yield the logical and accurate data necessary for further investigating how butterflies are able to take up very viscous liquid when producing minimal pressure of their own. Several different experiments will be conducted to learn exactly how butterflies are able to feed. First, experiments observing butterfly feeding from vessels and drops will be performed using sucrose solutions of varying concentration and viscosity. These first set of experiments will be used to discern the upper limit of pressure difference butterflies can generate while feeding. A second set of experiments will then be conducted to measure the jurin length of a capillary tube with the same radius as a butterfly proboscis for liquids with different viscosities. These experiments will be conducted to explore the possibility of creating an alternative feeding theory to replace the accepted pump feeding mechanism. This new theory will highlight capillary forces instead of butterfly muscular structure as butterfly's means for in-taking nectar during their feeding process. I'd like to thank Dr.Konstantin Kornev my research mentor, Dr. Jones Cooper my research adviser,Clemson University, and the South Carolina Governor's School for Science and Math.

THE EFFECT OFOMEGA-3 FATTY ACID CONCENTRATIONS ON THE SUSTAINABILITY OF ASTROCYTOMA CELLS WHEN EXPO

Nancy Zhong
Spring Valley High School

Astrocytes are type of glial cell located in the brain apart of the nervous system. Their major goal is functioning with neurons(Svendsen, 2002).Astrocytes modulate the environment around neurons, release a range of neuronal growth factors, and help maintain the cellular barrier between blood and brain. When a neuron is damaged by a

toxin such as in Parkinson's disease, the astrocyte population grows rapidly around the other neurons in order to protect them. They take up the toxin and transform it into a byproduct (MPTP to MPP+). However, the new byproduct produced is shown to play a role in the sequence of events leading to a dopamine neuronal cell and astrocyte death (Wong et al., 1999). Champeil-Potokar et al. did a study on the effect of astrocyte cultures in DHA, an n-3 polyunsaturated fatty acid t showed that astrocytes cultured in medium plus DHA had a more physiological n-3 status, grew better, and retained their astrocyte phenotype, with changes to the phospholipids membrane. Therefore astrocytes are physiologically relevant provided with adequate DHA. In this experiment, omega-3 fatty acid were tested to see its effects on the astrocytoma, cancer form of astrocytes, from the toxin, MTPT, through possible manipulation in the plasma membrane. It was hypothesized that as more omega-3 fatty acid is added to the cells there will be stronger resistance to the toxin. A one-way ANOVA was used to test the significance. It was found that the p-value was less than 0.000 and then the Tukey's test proved that there was a significance between all of the tested variables.

END

SCJAS 2009 ABSTRACTS

PCR AMPLIFICATION OF TTH-LIGASE GENE

Jessica Abercrombie, Shravan Komaragiri, and Jianguo Chen
Claflin University

The purpose of this experiment is to clone a ligase gene from Thermus Thermophilus (Tth), an Archaea organism. The ligase is thermo-stable and will be used in SNP (single nucleotide polymorphism) detection applications. The ligase gene is amplified by polymerase chain reaction (PCR) and will be cloned into an expression vector (pET - 15b). The primer pairs used in PCR contain two parts: 3' ûend's ligas gene specific sequence and 5'-end restriction enzyme specific sequence. Ligase gene specific part is about 20 base pair (bp) long. At 3' end of the primers, one primer contains the ligase sequence of the beginning of the gene and the other the sequence of the end of the gene. The restriction û enzyme-site other contains NdeI site. The PCR was successfully performed and amplified the ligase gene at the size about 2 kb.

SPIRO(BID-PYRAZOLES) FROM 1,4-DIANIONS OF SELECT HYDRAZONES AND AN ESTER-SULFONAMIDE

Amanda Acevedo-Jake, Zacchary Kenneday, Ellyn Smith, and Andrew Puciaty
College of Charleston

A variety of substituted spiro(BID-pyrazoles) [2H-spiro[Benzo[d]isothiazole-3,3'-pyrazole]-1,1-dioxide-2'(4'H)-carboxylates] have been prepared by the overall condensation-cyclization-acetylation of dilithiated hydrazones N-carboalkoxy-hydrazones] with lithiated ester-amide [methyl 2-(aminosulfonyl)benzoate]. The initial condensation could involve N-lithiated ester-sulfonamide with the dilithiated hydrazone to afford a C-acylated intermediates that underwent an initial cyclization to BID intermediates that were isolated and not characterized, but cyclized directly with acetic anhydride/pyridine. Although the transformation of lithiated ester-sulfonamide to lithium saccharin followed by condensation with dilithiated hydrazone is possible, efforts to isolate even trace amounts of saccharin under the reaction conditions were not successful. The powerful cyclodehydration mixture of acetic anhydride in pyridine not only resulted in a second cyclization but an unexpected N-acetylation. This N-acetylation did not occur when carbo-tert-butoxyhydrazones were used under identical reaction conditions, and spiro NH products resulted instead. Since the products are a part of a new spiro mixed heterocyclic system, their characterization included several X-ray single crystal analyses.
Acknowlegements: College of Charleston, Summer Undergraduate Research Forum {SURF), Research Corporation; recently, NSF-RUI and USDA

MIM: A Species Independent Approach for Distinguishing Coding and Non-Coding DNA Sequences in BacteRIA

Achraf EL Allali and John Rose
USC Columbia

A number of competing methodologies have been developed to identify genes and classify DNA sequences into coding and non-coding sequences. This classification process is fundamental in gene finding and gene annotation tools and is one of the most challenging tasks in bioinformatics and computational biology. An information theory measure based

on mutual information has shown a high accuracy in classifying DNA sequences into coding and non-coding. In this poster we describe a species independent iterative approach that distinguishes coding from non-coding using the mutual information measure (MIM). A set of sixty representative bacterial genomes is used to extract universal coding and non-coding training data. The experimental results demonstrate the accuracy of iterative MIM algorithm in distinguishing coding from non-coding sequences while remaining species independent.

POLYMERIZATION OF EPOXY TELESCOPE MIRRORS ON AN IONIC LIQUID SUBSTRATE

Ankoma D. Anderson and K. Lisa Brodhacker
Lander University

Polymerization on an ionic liquid substrate is used to reduce the surface defects of a parabolic mirror. Various ionic liquids were made and tested for the possible allowance of epoxy polymerization to occur atop. Ionic liquids were chosen due to their known margin of safety and other chemical properties. Furthermore each type of ionic liquid was temperature tested to determine further progression, using the resulting liquid to support epoxy polymerization. This work was funded by a grant from the South Carolina Space Grant Consortium. We thank the SCSGC for their support.

BIOINFORMATICS OF INSECT MUSCLE PROTEOMES: EVOLUTION AND FUNCTIONAL ANALYSIS

Agnes Ayme-Southgate and Richard Southgate
College of Charleston

Insect flight uses either asynchronous flight muscles that are characterized by multiple contractions per nerve impulse or synchronous muscles, which display a 1:1 ratio between contractions and nerve impulse. These two basic physiological types of flight muscles can be distinguished by many criteria, the two most striking being a difference in calcium cycling and muscle resting stiffness. Previous research has suggested that the density of the Sarcoplasmic Reticulum (SR) and its location within the cell are good indicators of muscle type. In asynchronous muscle tissue, there is low calcium cycling and a sparse dispersal of SR, as opposed to synchronous muscle tissue, which has a much higher volume of SR and relies on active, high frequency calcium cycling. In derived insects, high resting stiffness has been associated with the presence of connecting C-filaments and the muscle asynchronous behavior. We will present a summary of our current bioinformatic analysis of several muscle proteins known to be involved in calcium cycling (SR-calcium ATPase Pump, SERCA and Sarcoplasmic Calcium Binding Protein, SCBP), as well as projectin, one of two components of the C-filament system. Evolution of the proteins and their distribution will be discussed in the context of the different physiological modalities. We wish to acknowledge the support of SC-INBRE

SYNTHESIS OF AZOLE INHIBITORS OF AP2: A NEW APPROACH FOR THE TREATMENT OF DIABETES

Shekelia Baccus, M. Perry Davis, Jr., and David Magnin
Morris College

Adipocyte fatty acid binding protein (aFABP, aP2) is a 14.6 kDa cytosolic protein located in adipocytes and macrophages and assists in the intracellular transport of fatty acids.1a,b,c,d It is one of a class of fatty acid binding proteins (FABPs) that are found

predominately in the liver, heart, intestine and connective tissues. Hotamisligal et al. have reported that aFABP deficient mice, when placed on a high fat diet (40% of caloric intake as fat), were significantly protected from hyperinsulinemia and insulin resistance compared to the wild type. Additional genetic experiments have been reported in which aFABP null mice have been crossed with ob/ob and in another instance apoE-/- mice. The aFABP deficient ob/ob mice were more insulin sensitive when compared to ob/ob controls as demonstrated measuring by circulating glucose and insulin levels. Based on these genetic knock-out models, we pursued the development of inhibitors of aFABP for their therapeutic potential in the treatment of diabetes. Herein we disclose the synthesis of an imidazole and an oxazole inhibitor of aP2.

WHAT'S GEOMETRY GOT TO DO WITH IT? INVESTIGATING EFFECTS OF MULTIPLE CAPACITORS IN A SINGLE CASING

Shawn Ballenger and Larry Engelhardt
Francis Marion University

A capacitor is a device that stores an electric charge on a set of conducting plates when the plates are subjected to a difference in electrical potential. Capacitors are found in a myriad of electrical and electronic equipment ranging from power supplies to televisions to computer microprocessors. For this project capacitors with various geometries are simulated on a two-dimensional surface using a java program. This program is used to calculate the overall capacitance for a user defined plate geometry. This is accomplished using the following method: The plates of the capacitors are first placed by the user in specific regions of a grid, and then they are assigned a known potential. The potential of the entire grid is then determined using a relaxation method. Using the known grid potentials, the charge density is then determined for each plate and is used to determine the overall capacitance of the specific geometry. The electric field within the grid is also determined using the grid potential, and this electric field is displayed visually during the simulation. Using this simulation, an arrangement of multiple capacitors located inside a single casing, such as an integrated circuit, can be investigated to determine how the geometry affects the overall capacitance and if a more favorable geometry exists.

Magnetic Circular Dichroism and UV-Visible Spectral Study of P. aeruginosa PhuT Heme Transporter

D.M. Indika Bandara[1], Yong Tong[2], Masanori Sono[2], and Maolin Guo[2]
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Iron is an essential element for the almost all organisms. In particular, pathogenic bacteria must acquire iron from the host in order to be infectious. An essential component of the heme transport (uptake) system in Gram-negative pathogenic bacteria is the periplasmic protein that shuttles heme between the outer and inner membranes. In this study, we have characterized a periplasmic heme transport protein (PhuT) from Pseudomonas aeruginosa, a tyrosinate-ligated heme protein, and its non-heme axial ligand mutants Y285F and Y146F PhuT using magnetic circular dichroism (MCD) and UV-visible (UV-vis) absorption spectroscopic techniques. The crystal structure of holo (heme-bound) wild type PhuT has recently been reported. The MCD spectrum of native (Y71) ferric PhuT (as isolated, partially heme-bound) shows spectral patterns that are very similar to those of another periplasmic heme binding protein, ShuT from Shigella dysenteriae but can be distinguished from those of other well characterized tyrosinate-ligated heme proteins such as allene oxide synthase (AOS) and bovine liver catalase

(BLC). Addition of imidazole (Im) to ferric PhuT yielded a mono imidazole bound protein, presumably an Im-Fe(III)-Tyr complex, at relatively low Im concentration (Kd = ~10 mM) and an apparently bis-imidazole complex at higher Im concentration (Kd = ~250 mM). This indicates that the Im replaces the proximal Tyr ligand. Judging from the detectable CD signals of the complexes, the heme was not released from the protein during the Im binding processes until even higher concentrations of Im were added. When cyanide was added to ferric PhuT, the starting high spin-type spectrum of the protein (UV-vis Soret peak 401 nm) changed to that of another high spin complex (Soret ~403 nm, Kd = ~20 mM) that can be assigned as a mono-cyanide-bound 5-coordinate heme complex. The result suggests that the Tyr-Fe(III) bond is cleaved upon cyanide binding while the heme is still bound to the protein. Further addition of higher concentrations (> 0.5 M) of cyanide resulted in formation of a low spin bis-cyanide heme complex and heme release from the protein. The results in this study indicate that, as expected for the nature of a heme transporter protein, the Tyr-Fe(III) bond in PhuT is considerably weaker than that in non-heme transfer Tyr-ligated heme proteins like AOS and BLC. National Institute of Health

OVEREXPRESSION OF THE UBIQUITIN LIGASE WWP1 LEADS TO LEFT VENTRICULAR HYPERTROPHY AND SUDDEN DEATH

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Hypertrophic cardiomyopathy (HCM) is the most common genetic myocardial disease and is the leading cause of sudden cardiac death in athletes and young people. HCM is characterized by left ventricular hypertrophy (LVH) predominantly involving the interventricular septum in the absence of identifiable clinical causes. In HCM, the cardiomyocytes typically appear disarrayed with an accompanying disorganization of intercalated discs and gap junction proteins. Most known HCM-causing mutations map to genes that encode sarcomeric proteins. However, recapitulation of these mutations in rodents rarely leads to a sudden death phenotype. Recent findings indicate that the molecular mechanism underlying some of the more common mutations may be an impairment of the ubiquitin proteasome system. We have recently created an inducible transgenic mouse model, which develops a HCM-like phenotype when the ubiquitin ligase Wwp1 is globally overexpressed. Interestingly, we found that WWP1 was normally expressed in vesicular structures in the cytoplasm of cardiomyocytes and was overexpressed in the myocardium of HCM patients. Mice overexpressing Wwp1 died very suddenly at 7- to 12-weeks of age, and this phenotype displayed 100% penetrance in two independent founder lines. Transgenic mice that overexpress Wwp1 exhibited significantly increased heart weight-to-body weight ratios at 6- and 8-weeks of age compared to their wild type littermates. Examination of Wwp1 overexpressers by echocardiography revealed LVH. This was supported by morphometric analysis of cardiomyocyte diameter which was increased in Wwp1 overexpressers, particularly in the interventricular septum. Quantitative PCR demonstrated a significant upregulation of fetal genes known to be highly transcribed in cardiac hypertrophy (including *Anf*, *Bnp* and *beta-MHC*) in these animals. Evaluation of cardiac tissue derived from Wwp1 overexpressers by confocal microscopy showed myocyte disarray, a disruption of intercalated discs as well as internalization and possible degradation of the cardiac gap junction protein, connexin 43. Alterations in the expression of WWP1 in HCM have not

been previously described; therefore, this novel mouse model will provide new mechanistic insight into a deadly cardiac pathology which could lead to innovative therapeutic interventions. This research was supported in part by the Intramural Research Program of the NIH, National Cancer Institute, Center for Cancer Research and by the NIH COBRE grant awarded to USC Center for Colon Cancer Research (P20RR17698-01).

WAVED-ALIGNED NANOFIBER COMPOSITES WITH BIOMIMETIC MICROSTRUCTURE THAT MATCH VESSEL WALL COMPLIANCE

Vince Beachley and Xuejun Wen
Clemson University - MUSC Bioengineering Program

Current vascular grafts do not achieve consistent long term patency. One possible failure mechanism is mechanical property mismatch. Blood vessels adopt a ôJ-shapedö stress strain profile to address biological requirements, and this shape is not easily mimicked by synthetic materials. It is hypothesized that a synthetic composite fibrous material that mimics the fibrous components of natural blood vessels would also match the compliance of the bulk vessel wall. This compliant material could be used to fabricate vascular grafts with increased patency. To this end, we developed several fabrication technologies to construct synthetic fibrous materials by orienting electrospun nanofibers in a composite with interlacing wavy and aligned configurations similar to the arrangement of collagen and elastin fibers in natural blood vessels. Elastic polyurethane was used to mimic the mechanical properties of elastin and polycaprolactone was used to mimic the mechanical properties of collagen.

Fiber mats were fabricated with alternating PU and PCL layers. PU layers were collected and stretched. PCL fibers were then collected on top of the stretched PU layer. Upon relaxation of the mat, the PU fibers pulled the PCL fibers into a wavy configuration. SEM confirmed that some of the fibers were straight and aligned, while others were in a wavy orientation. Fluorescent pictures further confirmed that PU fibers are straight and PCL fibers are waved. Nanofiber mats were mechanically tested for tensile strength and stress strain curves were obtained. A composite containing wavy PCL fibers and straight PU fibers closely mimicked the mechanical behavior of natural tissue while a control composite containing straight PCL fibers and straight PU fibers did not. It was concluded that the structural and mechanical properties of the fabricated composite fibers mats were similar to that of native tissue in microstructure and compliance. This novel method of fabrication may be used to fabricate vascular grafts with the appropriate properties to improve the patency of vascular grafts.

QUANTUM CHEMICAL CALCULATIONS TO DIRECT ORGANIC CHEMISTRY RESEARCH

Prashant Bhenswala, Gordon Brown, and Pramod Chopade
Coker College

We have used quantum chemical calculations to both direct the synthesis and interpret the results of our research in organic chemistry. Since Gordon Moore, Intel co founder, first observed that the transistor count in inexpensive computers doubled every two years, “Moore’s Law” has held true. Due to this exponential growth in computing power, as well as highly sophisticated computational software, it is now possible to perform extremely advanced quantum chemistry calculations even at small, liberal-arts institutions. Furthermore, the emergence of readily-available graphics-based interfaces between the user and the calculations has made these calculations accessible to undergraduate chemistry students.

The chemicals of interest for this study are aziridine compounds, compounds which contain a three-membered, carbon-carbon-nitrogen ring. Aziridine compounds are very useful in pharmaceutical applications, both directly and indirectly. Numerous pharmaceutical agents used today have ringed structures that contain nitrogen which allows for stability and polar interactions inside the body. Many of these agents can be synthesized using aziridine compounds as a starting material. The ability to produce aziridine compounds in few steps would allow for quick, efficient, and cost-effective research. Further manipulation of aziridine compounds can be easily done by having various functional groups connected to the ring.

After synthesizing various aziridine compounds, further reactions were performed with alkynes in the presence of samarium iodide. In one example, methyl acrylate cyclohexyl aziridine is reduced by samarium iodide, which is expected to produce one or more open-ringed structures. These intermediate species will likely react with the alkyne to form a product containing a 5- or 6 membered, nitrogen-containing ring. As spectroscopic evidence was unclear as to which product this reaction formed, calculations were performed to predict which intermediate species would be energetically favorable. Geometry optimizations and vibrational frequency calculations were performed on four candidate structures at the 3-21+G[*] level of theory, and subsequent energy calculations were performed at the 6-311+G[2d,p] level of theory. From these calculations, precise zero-point-energy corrected relative energies were calculated and will be presented. This work was supported by the South Carolina Independent Colleges and Universities (SCICU) Student/Faculty Research Program.

CHAOS GAME REPRESENTATION OF SEQUENCES AND ANALYZING PHYLOGENY BY CALCULATING EVOLUTIONARY DISTANCE

Priyasma Bhoumik
USC Columbia

The Flaviviridae family of viruses is an interesting group for studying phylogeny. Flaviviridae family consists of the following genera- Flavivirus, Hepacivirus and Pestivirus. However there are some viruses which are still not classified under a particular genus. The Flavivirus genus consists of more than 70 viruses, many of which are the agents of human diseases.

Chaos Game Representation or CGR is an iterative mapping technique, which shows patterns in sequences of units such as amino acids in a protein or nucleotide bases in a DNA sequence in order to find out coordinates for their positions in a continuous space. The CGR plots produce both a local and global pattern from the sequences.

The genome sequences that were considered for this study was from Flaviviridae family including HCV (6 genotypes), Westnile1 & 2, Yellow fever, Encephalitis (Japanese, St. Louis, Murray valley), Dengue (types 1-4). Chaos game plots of these genome sequences were made and the results were plotted as scatterplots. A distance matrix was created for each genome and these distances were used to make a phylogenetic tree in order to study about evolutionary groups. The results showed an interesting pattern of evolution from the phylogenetic tree. Hence it would be a novel idea to study this group of viruses utilizing chaos game representation as a tool, and hence analyze their phylogeny. I would like to acknowledge Sriharsha Hammika and Stephanie Irausquin for their suggestions in this study.

HUMAN GLUTAREDOXIN 1 REDUCES DISULFIDE BOND OF HUMAN SUPEROXIDE DISMUTASE 1 BY MONOTHIOL MECHANISM

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Human superoxide dismutase 1 (hSOD1) is normally a protective enzyme that detoxifies superoxide (O2ò) by catalyzing its dismutation to H2O2 and O2. However, mutations in hSOD1 can cause amyotrophic lateral sclerosis (ALS or Lou Gehrig's disease), a common neurodegenerative disease. In the wild type form of hSOD1, an intramolecular disulfide bond aids in the stability and function of the protein. In ALS mutant forms of SOD1, reduction of this bond has been linked to destabilization, misfolding and finally aggregation of hSOD1. We are investigating the role that an oxidoreductase in human cells, namely glutaredoxin 1 (hGrx1), plays in reduction of this critical disulfide bond in hSOD1. We have overexpressed and purified hGrx1 in order to examine its effects on the disulfide in hSOD1. Our in vitro results indicate that hGrx1 preferentially reduces the intramolecular disulfide bond in ALS mutant forms of SOD1, but not wild type SOD1. Expression of WT and ALS mutants of hSOD1 along with hGrx1 in vivo in a yeast cell model support this observation. Active site mutants of hGrx1 indicate that only one cysteine is required to reduce this bond in ALS mutant hSOD1, indicating that hGrx1 uses a monothiol mechanism. When measuring the reduction potential of the disulfide bond of hSOD1 in the presence of hGrx1, preliminary results find that hGrx1 not only reduces but also reoxidizes the disulfide bond of WT-hSOD1. Overall this research will provide a better understanding of the biochemical mechanisms underlying ALS development and progression.

CONSTRUCTION OF A PLASMID CONTAINING THE P1 PROMOTER OF BURKHOLDERIA XENOVORANS AND GFP

Matt Bowser and James Yates
USC Aiken

Polychlorinated biphenyls (PCBs) are toxic environmental pollutants that do not degrade readily. However, a soil bacterium, Burkholderia xenovorans, can use biphenyl as a sole carbon and energy source and can convert PCBs into a more degradable form. The genes coding for the catabolic enzymes are grouped together in the bph cluster on one of the chromosomes. One of the promoters of the bph cluster is thought to lie between the first two genes of the cluster. In order to verify the location of this promoter we attempted to create a recombinant plasmid containing the region of interest and a reporter gene. The promoter region is contained in a 522 bp fragment that was previously subcloned into a plasmid called pGEM4A2a.1. To determine if this fragment contains a functional promoter, a reporter gene encoding Green Fluorescent Protein (GFP) was inserted downstream. This was accomplished by digesting the plasmid pGreen TIR, and pGEM4A2a.1 with two restriction enzymes. The resulting fragments were ligated using T4 DNA ligase. The recombinant plasmids thus generated were transformed into E. coli. A rapid plasmid extraction procedure was performed on several of the transformants. Restriction enzyme digestion and gel electrophoresis was used to identify clones containing the GFP gene in pGEM4A2a.1. The orientation of the pGREEN insert in our clones was determined using restriction enzymes. Recombinant plasmids with a functional p1 and the correctly oriented pGREEN cassette should express GFP, and can be detected by using blue light (490nm).

TRANSPORT OF FERROCENE MONOCARBOXYLIC ACID THROUGH P(HEMA)-PEG HYDROGELS

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Hydrogels are usually formed by the covalent cross-linking of hydrophilic polymers to form a network that has the ability to swell in the presence of water. Poly(hydroxyethyl methacrylate) {P(HEMA)}-based hydrogels exhibit highly biocompatible properties and high hydrolytic stability and are similar to body tissue with respect to their high water content [1]. As a result, they have become one of the most widely utilized commercially available biomedical hydrogels. A small molecule mediator within the hydrogel to address low oxygen tension within the tissue bed is necessary in developing oxidoreductase enzyme biosensors for lactate and glucose monitoring in hypoxic tissue. The diffusion of glucose and lactate through the hydrogel, catalysis of the analytes by glucose oxidase (GOx) and lactate oxidase (LOx) and finally molecular redox mediated electron transfer between the enzymes and the electrode are all important to the functioning of the enzyme-based biosensors [2]. The release of ferrocene monocarboxylic acid (FcCO2H), a well known electron mediator used in amperometric and voltammetric enzyme biosensors, from P(HEMA)-based hydrogels of varying crosslink densities (1, 3, 5, 7, 9 and 12 mol% tetraethyleneglycol diacrylate (TEGDA) crosslinker) has been investigated. The release profiles from FcCO2H-loaded hydrogel membranes were determined in 0.1M HEPES/ 0.1M KCl solution by monitoring the magnitude of the oxidation peak current obtained from cyclic voltammograms of the released FcCO2H. The temperature dependent (at 10, 15, 20, 25 30, 35, 40 and 45 oC) release profiles of FcCO2H from 3, 7 and 12 mol% TEGDA crosslinked hydrogels were obtained and diffusion coefficients for FcCO2H found within the range of 2x10-9 cm2/s and 4.75x10-8 cm2/s. Consistent with established theories, it was shown that 1) the degree of hydration is directly dependent on the degree of crosslinking, i.e. increasing crosslink density is associated with decreasing hydration; 2) the release profile and diffusion coefficient of the hydrogel increases with decreasing crosslink density and increasing temperature. Activation energies for thermally activated transport of FcCO2H within the hydrogel films (3 %, 7 % and 12 mol % TEGDA crosslink densities) were found to be 30, 45 and 57 kJ/mol respectively.

ANALYSIS OF FOXG1 SEQUENCE VARIATION IN RETT SYNDROME

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Rett syndrome is a genetic neurodevelopmental disorder that affects mostly females and is caused by mutations in the MeCP2 gene located at chromosome position Xq28. Individuals with Rett syndrome show early signs of normal developmental growth but after 6-18 months show a decrease in motor function and signs of mental abnormalities. Recent research has indicated that mutations in two other genes result in Rett-like symptoms: CDKL5 gene located at chromosome position Xp22 and FOXG1 gene located at chromosome position 14q12. Of these Rett-spectrum genes, FOXG1 is the least characterized, with only a few described mutations. 87 individuals were selected on the basis of a clinical presentation of a Rett-like phenotype in conjunction with negative results for other known Rett causing mutations. To date, 42 individuals from the Rett cohort have been tested for mutations in FOXG1 and all have failed to reveal any known pathogenic mutations. However, three previously unreported sequence variations have been identified; based on the nature and location of these changes within the gene these variations are not predicted to be pathogenic.

Structural and Functional Analysis Of The p1 Promoter Of The LB400 bph Cluster

Ryan Buffett and James Yates
USC Aiken

LB400 is a strain of bacteria that is able to degrade polychlorinated biphenyls (PCBs). It is able to do so through the activity of Biphenyl dioxygenase. The genes for this enzyme, bphA, E, F, and G, are contained in the bph cluster. The promoter for these genes is thought to be between an open reading frame (orf0) and bphA and is called p1. A plasmid created in our lab (pGEM4A2a) contains the promoter region as well as orf0 and bphA. This plasmid was digested with the restriction enzyme Pst I and the resulting fragments were ligated into the pUC18. Using blue/white screening and restriction enzyme digestion, plasmids were found that contain correct fragment of pGEM4A2a. This new plasmid was named pGEM4A2a.1. By utilizing PCR, the orientation of the insert was determined. Digestion of this plasmid with Pst I followed by ligation and transformation into E. coli creates clones with the insert in the opposite orientation. Recombinant plasmids with the insert in both orientations can be used to express a reporter gene such as pGreen TIR. The expression of Green Fluorescent Protein is a strong indicator that p1 is functional in E. coli.

PROGRESS ON DESIGN AND DEVELOPMENT OF A BI-LEAFLET MITRAL BIOPROSTHETIC VALVE

Jason Burnside and Arash Kheradvar
USC Columbia

Purpose of Study: This study aims to develop a bi-leaflet bioprosthetic heart valve for mitral position whose annulus' saddle shape curvature changes dynamically according to the shape of the cardiac base, imitating the characteristics of a natural mitral valve. Unlike the current bioprosthetic valves, this valve represents a flow field similar to natural transmitral flow while does not restrict the motion of the base in a cardiac cycle.

Methods Used: The annulus is made of super-elastic Nitinol wire-frame due to its nonlinear recoverable behavior. Accordingly, the chordae tendineae were replaced by Nitinol prongs that hold the leaflets from being prolapsed. The cusps are substituted with pericardial tissue with nearly identical mechanical properties to natural leaflets. The saddle-shape annulus is shaped by constraining the wire-frame while they were exposed to high temperature during forming/heat-treatment process.

Summary of Results: We developed the mitral prosthesis that consisted of a saddle-shape annulus that deflects due to the pressure change facilitating the unidirectional flow. This deflection results in a geometrical transformation allowing the valve to open and close effectively. The curvature of the annulus base and the angle of the supporting prongs are currently being adjusted to attain desired hydrodynamics. Jason Burnside was selected for the Magellan Scholar during the Spring 2009 semester for this project. The Magellan Scholarship has allocated additional fundig for this project.

QUANTUM-WALK SIMULATION IN JAVA / NOT YOUR AVERAGE WALK IN THE PARK

Jeremy Capps and Larry Engelhardt
Francis Marion University

In quantum mechanics, wave functions contain all the measurable properties of a particular particle. Wave functions are solutions to the Schrodinger equation, which is a second order differential equation. Some wave functions can be found analytically. However, the majority of wave functions cannot be found analytically. These wave functions need to be approximated numerically. The ground state wave function for an electron in the presence of an arbitrary potential can be calculated by using random numbers to go on a quantum-walk in the region of the potential of choice. The particular scenario chosen for this project is an electron present between two protons in three dimensions (H2+). The wave function and the energy are calculated as functions of the proton-proton separation. The results of the investigation as well as the computational methods used will both be discussed.

A BIOINFORMATIC APPROACH TO THE IDENTIFICATION OF OLFACTORY RECEPTOR GENES IN TAENIOPYGIA GUTTATA

Jennifer Carrick and Michelle Vieyra
USC Aiken

Olfactory Receptors (ORs) are transmembrane proteins within the epithelium of the nasal cavity and are found in all vertebrates. Odor molecules bind to ORs allowing odors to be sensed. Olfactory receptor genes code for these proteins. ORs not needed by an animal have respective OR genes that accumulate mutations and become pseudogenes with internal stop codons. More pseudogenes correlate with a lesser need for olfaction. 1,300 OR genes have been identified in the species Mus musculus (mouse) by doing molecular analysis and mining the mouse genome. 20% are pseudogenes. These genes are known as MORs and have been characterized into 286 OR gene families based on sequence similarity. In comparison, around 60% of the OR genes in humans, a species not known to rely heavily on olfaction, are pseudogenes. The traditional argument is that most avian species have either weak or no odor sensing abilities. Species now known to have well developed odor sensing abilities include chickens and some species of sea birds and vultures. The objective of our experiment is to find and characterize the OR genes and the OR pseudogenes of the Zebra Finch (Taeniopygia guttata) using the Zebra Finch genome, located on the National Center for Biotechnology Information (NCBI) database. The Zebra Finch is from a genus of small songbirds from the South Pacific islands and Australia and is believed to rely on auditory and visual senses rather than olfactory. We expect it to have more pseudogenes as compared to mouse since it has not been shown to readily use olfaction. The Bioinformatic software tools used for this project were as follows: BLAST, ClustalX, and MEGA4. BLAST was used to compare known sequences of MORs against the Zebra Finch genome to identify ZFOR genes. Conserved regions of OR genes were used to determine the proper reading frame and pseudogenes were characterized. ClustalX was used to align multiple OR sequences based on similarities between sequences. MEGA4 was used to construct phylogenetic trees between MORs and ZFORs. In our preliminary data, 220 ZFOR gene sequences were identified. Out of these, 92 were characterized as pseudogenes, which is a percentage of 41.82. Based on this it can be concluded that Zebra Finches do have some reliance on olfaction, more so than humans but less than mouse.

New Derivatives of the Antibiotic Cytosporone E, Focusing on Side Chain Substitutions for SAR Study

Erin Cartwright and Justin Wyatt
College of Charleston

The novel antibiotic cytosporone E, a metabolite of the endophytic fungus Cytospora sp., shows weak antibacterial activity towards Gram-positive bacteria and is inactive against Gram-negative bacteria. Thus, to find a more potent antibiotic, we synthesized multiple derivatives of cytosporone E with changes in the side chain of the lactone. These derivatives were synthesized from N,N-diethyl-3,4,5-trimethoxybenzamide via ortho-alkylation of the aromatic ring with the appropriate aldehydes, followed by hydrolysis to afford the lactones. Finally, the methoxy groups were removed giving the corresponding cytosporone E derivatives. These synthetic derivatives will be assayed for a structure activity relationship (SAR) study. Future derivatives will be synthesized using the findings of the SAR study to increase potency.

The Effect of Obesity on the Incidence of Breast Cancer

Allison Catoe and Diana Ivankovic
Anderson University

The purpose of this study is to explore the level of correlation between obesity and breast cancer. According to the National Cancer Institute, a study in 2001 showed that obesity increases a person's chance of developing breast cancer among other cancers. This study was done to compare rate of breast cancer incidence in obese women to that of normal women. Also, in the study, pre-menopausal and post-menopausal women were considered separately to determine whether estrogen production was a factor in development of cancer in obese women. Estrogen is well known as a powerful mitogen that plays an important physiological role in the function and growth of human breast. Data was obtained by using the height and weight to calculate the body mass indices of cancer patients and the body mass indices of healthy women. These two groups were then compared to determine the level of correlation between breast cancer incidence and obesity in women. All the data was collected from patients at AnMed, in Anderson, SC. Our deepest gratitude goes to AnMed employees who allowed us to use their data to complete our research.

PROPOSED SYNTHETIC ROUTE FOR (-)-beta-KAINIC ACID

Nandeo Choony, Lisa James, and Courtney Rabun

Causing neuronal death, (-)-α-Kainic Acid along with its derivatives are toxic to several known animal species, including rats. These gaba-mimetics have been shown to cause neuroexcitatory activity observed in several neurological disorders. In this research project, a synthetic route which involves control of the stereochemistry in order to synthesize a pure stereoisomer of kainic acid is proposed. The pure stereoisomer possesses certain medical properties of interest to pharmacological companies. The laboratory synthesis is gaining popularity and increasing importance by chemists all over the world in that extraction from seaweeds, where kainic acid is found, does not produce reasonable yield. This laboratory procedure will attempt to synthesize kainic acid using an ENE reaction in the final step of the ten steps as shown in the overall scheme. We thank the USC (USC) for offering us partial funding for this project through the Magellan Scholar program.

IMINES MADE EASY: A NEW EXPERIMENT FOR AN ORGANIC CHEMISTRY LABORATORY

Justin Collier, Pramod Chopade, and Gordon Brown
Coker College

Generally the first semester of an organic chemistry lab focus on techniques such as chromatography, distillation, recrystallization, and extraction while the second semester is devoted to fundamental and widely known organic reactions. These include C-C bond formation (aldol, Diels-Alder), C=C bond formation (Wittig), C-O bond formation (esterification, ether synthesis), C=O bond formation (oxidation of alcohols), and C-N bond formation reactions (synthesis of Nylon, nitration of benzene). Students also learn different mechanism associated with these reactions such as nucleophilic addition, aromatic electrophilic substitution, nucleophilic addition-elimination, oxidation, reduction, and concerted reactions. Three important omissions from most organic labs are (a) synthesis of C=N bonds (imines), (b) the experimental study of conjugation, and (c) the use of microwaves in organic synthesis. It may be difficult to introduce a separate laboratory for each of these concepts. Therefore, we have developed a simple and straightforward experiment for the sophomore organic chemistry laboratory that introduces all three concepts. This experiment (a) involves the synthesis of diimines (containing C=N bond formation), (b) demonstrates the effect of conjugation on the ultra-violet (UV)-visible absorption spectra of unsaturated molecules, and (c) effect of microwaves on rates of reactions.

This experiment is extremely useful in a sophomore laboratory because (a) it is easily completed in less than three hours, which is the normal time allotted to a lab period, (b) it utilizes readily available and inexpensive chemicals, (c) students learn to work individually, but also as a part of a group towards a common goal, (d) it creates a pseudo-research environment where students do not know the final answer but have to come up with their own hypothesis and prove it by experimentation. The authors thank the South Carolina Independent Colleges and Universities and Coker College (SCICU) for funding this project.

CLONING OF ANTI-HIV-1 VIF HAMMERHEAD RIBOZYMES INTO A RETROVIRAL VECTOR

Megan Cooper and William Jackson
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In 2006, the CDC estimated that there were approximately 56,300 new HIV infections in the United States. Like all retroviruses, HIV-1 expresses the structural genes and enzymes gag, pol, and env. However HIV-1 is a member of the lentivirus family of retroviruses and expresses additional genes important for viral replication. These include the accessory genes, known as tat, rev, vif, vpu, vpr, and nef. The Virion infectivity factor (Vif) is necessary for viral replication in nonpermissive cells, such as primary T Helper lymphocytes, macrophages, and some restrictive T-cell lines. Vif increases infectivity during assembly of viral particles by preventing packaging of the host anti-retroviral factor, APOBEC3G. Vif does this by targeting APOBEC3G for degradation through the ubiquitination-proteasome pathway. If packaged, APOBEC3G induces hypermutations of the HIV-1 genome during reverse transcription by deamination of cytidine to uracil on the minus-sense DNA strand. This affects nucleocapsid morphology and weakens the reverse transcription complex, which results in nonintegration of the provirus. Therefore Vif is a prime target for inhibition. In this study hammerhead ribozymes were designed to target the Vif mRNA of the HIV-1 genomic clone NL43

(Accession # M19921). The model for hammerhead ribozyme design, described by Haseloff and Gerlach, includes two complementary flanking sequences and a catalytic core derived from the satellite RNA of Tobacco Ringspot Virus. A catalytic ribozyme targeted to nucleotide 5154 of the HIV NL43 sequence was designed based on this model. A non-catalytic control ribozyme was generated by incorporating a G to A substitution in the catalytic core. Each of these ribozymes was cloned into the retroviral vector, pSuper.retro.puromycin (pSRP), which was designed to express siRNAs under control of the RNA Polymerase III H1 promoter. We hypothesize that this vector will efficiently express hammerhead ribozymes. These new retroviral vectors are currently being analyzed for their ability to produce recombinant retroviral particles, as well as their anti-vif activity.

EFFECT OF MATRIX ON CARDIOMYOCYTE VISCOELASTIC PROPERTIES IN 2D CULTURE

Sandra Deitch, Bruce Z. Gao, and Delphine Dean
Clemson University

Cardiomyocyte phenotype changes significantly in 2D culture systems depending on the substrate composition and organization. Given the variety of substrates that are used both for basic cardiac cell culture studies and for regenerative medicine applications, there is a critical need to understand how the different matrices influence cardiac cell mechanics. Clean glass slides were coated with thin layers of fibronectin and collagen (1 mg/ml solutions), in aligned and unaligned orientations. A modified inkjet printer was utilized to align the substrate fibers within thin printed lines. Cardiomyocytes were obtained from day 3 neonatal rat hearts and seeded at 50,000 cells/cm2. At various time points between 1 and 15 days in culture, mechanical properties were measured using AFM. On each sample, 15-20 cells were each indented 5 times to approximately 1 micron depth at 1 micron/sec using a borosilicate spherical probe (radius ~2.5 microns). The elastic modulus was estimated by fitting the Hertz model to the first 500 nm of indentation. Cells were also subjected to 1 micron step indentation and 60 sec hold (stress-relaxation) experiments to characterize their viscoelastic behavior. The resulting curves were fit to the Quasilinear Viscoelastic (QLV) and Standard Linear Solid (SLS) models. It was observed that the cells stiffened over the first 5 days in culture before reaching a plateau. After 5 days, the cells on fibronectin were stiffest, followed by those on aligned collagen and finally unaligned collagen ($p<0.1$, t-test). These results correlate with the observed changes in cytoskeletal architecture associated with culture on the different substrates. The QLV model fit the stress-relaxation data very well. On collagen, the cells cultured for 3 days had significantly slower stress relaxation than cells at earlier times in culture. In addition, cell viscosity decreased from seeding to day 3 in culture. No significant changes in relaxation were observed for cells on different matrices. This research illustrates the dependence of cellular mechanics on matrix composition and organization. These results should be taken into consideration when choosing a specific matrix for a given experiment. Acknowledgements: Cassie Gregory and Drew McRae for rat dissection and cardiomyocyte isolation, Dr. Thomas Boland for use of modified printer, Jason Hemmer for help with data analysis

HABITAT SELECTION IN THREE SPECIES OF CO-OCCURRING DESMOGNATHINE SALAMANDERS IN GREENVILLE COUNTY

Ben DeLancey and Wade Worthen
Furman University

Several different species of desmognathine salamanders coexist in the mountains and foothills of the Southern Appalachians. We characterized rock refugia used by 'adult' (gill-less) Desmognathus fuscus, D. quadromaculatus, and D. ochorophaeus in several drainages at The Furman Forestùa 1500 acre tract northwest of Landrum, South Carolina. Salamanders found beneath rocks were identified to species and snout-vent length was measured. We also measured the following characteristics of the refuge: distance from open water, distance to emergent sediment, the depth of the refuge from the sediment surface (depression depth), and the depth of the refuge from the surface of the water (water depth). These characteristics were compared across species with Students t-tests. D. ochrophaeus were found in refuges with significantly deeper depressions than D. fuscus. The depression depth of D. quadramaculatus refuges was intermediate and not significantly different from the other species. D. ochrophaeus refuges were significantly farther from water than those of D. fuscus and D. quadramaculatus, which did not differ from one another. The water depth of refuges used by D. quadromaculatus was significantly greater than the water depth in refuges used by the other two species. There were no significant differences in the distance from refugia to emergent sediment among the species. Previous studies with horizontal transects have also found that D. ochrophaeus uses refuges farther from water than the other two species.
We thank The Nature Conservancy, the Spartanburg Water System, and the Tryon Water District for providing access to the property.

Equatorial Wind Variations: their Drivers and their Connection to Wintertime Climate

Eric DeMarco and Varavut Limpasuvan
Coastal Carolina University

The Quasi-Biennial Oscillation (QBO) is a stratospheric equatorial wind fluctuation that changes phase every 27-30 months. In one phase, the equatorial winds would be predominantly eastward; the winds would then shift westward as a new phase begins. Overall, the QBO phase can influence the winter-time climate by altering the propagation of mid-latitude atmospheric waves which transfer momentum and heat toward the winter pole. In this talk, using a 50-year global data set from the National Center for the Environmental Prediction, we reconstruct the QBO using daily wind and temperature data. Examination of the wintertime stratospheric vortex composites (with respect to the QBO phase) reveals that the vortex tends to be weaker when the equatorial winds are predominately westward. The derived QBO pattern exhibits a slower descent rate of the equatorial wind shear zone during the 1970's leading to the lengthening of the QBO period. A mathematical model (based linear wave theory of wave-mean flow interaction) is then adopted to examine the relative importance of viscosity effects and equatorial wave forcing on the QBO period. Our results illustrate that forcing due to equatorial waves is more effective at altering the QBO phase.

NOVEL HETEROGENEOUS METAL CATALYSTS SUPPORTED ON POLYMERS FOR THE WATER GAS SHIFT REACTION

Kevin Djordjevic, Allen Larion, and Neal Tonks
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The primary focus of our research group is to develop new catalyst systems for the production of hydrogen fuel from a mixture of carbon monoxide and water vapor via a reaction called the water gas shift. The basic premise of the research is to create heterogeneous catalyst systems by synthesizing polydimethylsiloxane (PDMS) membranes and physically occluding relevant transition metal catalysts into the polymeric membrane. By occluding the metal centers into a porous membrane, the hope is to be able to conserve the metal in the polymer and utilize the catalyst system for further reactions. The three metal centers utilized in the project thus far are Fe(CO)5, Mo(CO)6, W(CO)6 and we have evaluated the catalysts in both homogeneous and heterogeneous reaction systems. Experimentation was also performed on PDMS structure via different cross-linking ratios and solvent systems to determine the optimum catalyst support for these reactions. Preliminary results indicate that both metal centers function as active catalysts in the water gas shift reaction, and Fe(CO)5 appears to also have catalytic activity in hydroformylation reactions. Validation studies on two homogeneous catalysts were done that closely matched the literature results. Polymer supported catalysts that were developed for this project were synthesized and tested, and were successful in producing hydrogen in our reactor. Further work will be performed on covalently binding the metal centers to the PDMS membrane, and we also intend to investigate the potential of using these catalysts in organic synthesis reactions such as hydroformylations and nitro group reductions. We want to thank the following financial sponsors of our work: College of Charleston SURF program, Department of Chemistry and Biochemistry at the College of Charleston, and we thank the following for helpful contributions: Dr. Wendy Cory, Dr. Richard Lavrich, Dr. Rick Heldrich, Dr. Justin K. Wyatt

SYNTHESIS OF A NOVEL CHIRAL OXAZOLINE TO CONTROL THE DIASTEREOSELECTIVTY OF THE MEYERS ORTHO-ALKYLA

Courtney Drew and Justin Wyatt
College of Charleston

The Meyers ortho-alkylation of achiral aromatic oxazolines has been well studied and utilized. However, the use of chiral aromatic oxazolines to induce chirality in the alkyated product has not been well explored. The development of a new chiral aromatic oxazoline has been developed with the potential to control the diastereoselectivity of alkylating prochiral electrophiles (i.e. aldehydes). Control is envisioned to arise from a steric effect of an alkyl group and chelation effect of a pendant ôdangling-donorö of the chiral oxazoline. The oxazoline is derived from an unnatural chiral α,α-disubstituted amino acid, which is synthesized from the naturally occurring amino acid L-phenylalanine. The synthesis and the attributes of the new chiral oxazoline will be discussed.

SPECTROSCOPIC STUDY OF CYP119 HAVING ITS CYSTEINE HEME AXIAL LIGAND REPLACED WITH SELENOCYSTEINE

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The native proximal cysteine thiolate heme axial ligand (Cys317) of the thermophilic cytochrome P450 from Sulfolobus solfataricus, CYP119, has been replaced by an alternative amino acid, selenocysteine (SeCys). The relatively low pKa value (~5.2) of the R-SeH group of SeCys makes its selenolate (R-Se») anionic form as a dominant ligand to the heme iron at physiological pH. In the present study, we have examined this novel Cys317SeCys CYP119 mutant, especially focusing on the effects of SeCys proximal ligand on the electronic properties of heme iron center as revealed by UV-visible (UV-vis) absorption and magnetic circular dichroism (MCD) spectroscopy. We report the first UV-vis and MCD spectra of Cys317SeCys CYP119 in its ferric, ferrous, ferrous-CO and ferric-NO forms. In addition, we have successfully generated, stabilized and investigated the oxyferrous form, a very unstable intermediate (at ambient temperatures) of the catalytic cycle of the wild-type enzyme, of the mutant as well as wild-type enzymes at -50 centi-degree using 60-65% (v/v) glycerol as a cryo-solvent. All of these complexes consistently display MCD spectra that are similar to those of the corresponding derivatives of wild-type CYP119. This can be explained by similarities in valence electron configuration and available oxidation states for sulfur (S) and selenium (Se) atoms even though Se has a considerably larger (by ~2.5 times) atomic weight and electronegativity than S. Ferrous-CO Cys317SeCys CYP119 mutant has an absorption maximum near 450 nm, consistent with selenolate coordination to the heme iron center. The data in this study represent a thorough investigation of the spectral properties of the Cys317SeCys CYP119 mutant, the first SeCys ligated P450 heme system. National Institutes of Health (NIH) Grant

INTEGRATING RESEARCH PROJECTS INTO UNDERGRADUATE LABORATORY COURSES

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North Greenville University

Engaging undergraduate students in research projects is an important goal that can be difficult to accomplish with limited time and resources, especially at smaller institutions where teaching loads may be high. One way to approach the problem is to incorporate student directed research projects into traditional laboratory courses. The challenge is to cover content and teach skills that are traditionally found in laboratory courses, while including time for independent or team research projects.

A microbiology laboratory course has been developed that allows students to learn all the skills deemed essential by the American Society for Microbiology and requires them to participate in group research projects. This course begins with students determining the number of culturable bacteria in a gram of soil, then isolating one that appears to be producing an antimicrobial substance. Students learn pure culture techniques and staining procedures while describing this unknown bacterium. After learning basic microbiological techniques in the first half the semester, teams of 2-4 students identify a research topic, develop methods, perform experiments, interpret data and present the information in a poster session. Research initiated in the microbiology laboratory has led to independent student projects, development of a laboratory for a Cell and Molecular

Biology class and presentations at regional and national scientific meetings. The outline of the course, examples of projects and methods of evaluating student learning will be presented.

DEVELOPMENT OF A FLUORESCENT MARKER SYSTEM FOR DETECTION OF HYPOXIA IN ENCAPSULATED CELLS

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The transplantation of Islets of Langerhans is a promising treatment option for patients with Type 1 Diabetes Mellitus. However, the procedure requires lifelong immunosuppressants and the insufficient supply of human donor tissue prevents its clinical use. The encapsulation of isolated islets prior to transplantation provides a layer of immunoprotection that would facilitate allogenic transplantation and possibly allow xenotransplantation, addressing the tissue shortage issue via the use of animal tissue.

One challenge to sustaining functional encapsulated islets is insufficient oxygen, termed hypoxia. The capsule surrounding the islets prevents revascularization of the islets after transplantation, creating a longer diffusion distance for oxygen to reach the islets. Due to the importance of oxygen supply, we are developing a hypoxia marker system to identify islets without sufficient oxygen in ôreal timeö. Our marker uses a recombinant adenovirus to express a red fluorescent protein (rfp) only when hypoxic conditions exist. Throughout our experimentation we use two viruses, a positive control virus utilizing a cytomegalovirus (CMV) promoter causing infected cells to continuously produce rfp and our marker virus which contains a destabilized rfp sequence under the influence of hypoxia response elements.

Our research has focused on the optimization of the marker virus in cell lines. First we wanted to observe what effects the viral infection had on cell viability and proliferation. We infected ovarian cancer cells (OVCAR3) with our control and marker viruses and correlated cell viability and proliferation with signal strength. The optimal concentration was deemed to be that which yielded the strongest signal without affecting cell growth. Next we wished to determine whether the virus could infect previously encapsulated cells; we encapsulated OVCAR3 cells and MIN6 cells (murine insulinoma cell line) in a poly (ethylene glycol) (PEG) gel and added our control virus at varying concentrations. We observed that the virus produced a significantly weaker signal at a given concentration compared to the unencapsulated cells in the study described earlier. Thirdly we tested the marker system under hypoxic conditions (1% oxygen) with aggregated MIN6 cells. We infected cells with our marker virus, aggregated, encapsulated them in PEG gels and incubated them in hypoxic conditions for 48 hours. The infected cells displayed a strong signal under hypoxic conditions. When the MIN6 cells were returned to normal oxygen conditions (20% oxygen) and incubated for 48 hours our signal intensity decreased demonstrating the ôreal timeö properties of the marker system.

PHYLOGENETIC ANALYSIS OF OLFACTORY RECEPTOR GENES IN FOUR SPECIES OF SOUTH CAROLINA SNAKE

Catherine Freiler, Amanda Robinson, and Michelle Vieyra
USC Aiken

Olfactory receptor (OR) genes were identified and characterized in four species of snake; Heterodon simus (Hog Nosed Snake), Nerodia fasciata (Water Snake), Agkistrodon contortrix (Copperhead) and Lampropeltis getula (King Snake). These genes code for

olfactory receptor proteins in the nasal epithelium. Olfactory receptors are seven û transmembrane proteins which bind to odor molecules as the first step of odor detection. Binding is specific but an individual odor molecule is complex and may bind to more than one receptor. OR genes are small, have no introns and have domains that are highly conserved across vertebrate lineages. These genes also evolve quickly and the OR gene family is the largest gene family in vertebrates. In some species many of the functional OR genes were lost in the expansion of this family by acquiring stop codons which produce psuedogenes. Because of the direct relationship between an OR gene sequence and its subsequent functional protein, similarities between the nucleic acid sequences of OR genes across species reflect functional similarities as well as evolutionary history. It can be expected that two OR genes on the same branch of a phylogenetic tree would code for proteins that bind to very similar if not the same odor. Olfactory receptor genes have been well characterized in mice and an effort is being made to identify the particular odors that bind to the proteins encoded by specific genes. By comparing these fully characterized OR genes in mice to those found in snakes it might be possible to predict what odors snakes can or can not sense based on sequence similarity. DNA was extracted from blood collected at the Savannah River Site. Olfactory receptor genes were isolated using PCR, cloned and sequenced. The sequences were checked against known OR genes in Genbank using NCBI Blast and sequences with stop codons were characterized as pseudogenes. OR genes from snake, mouse and several other reptiles and mammals were aligned using Clustal X and phylogenetic trees were generated using Mega 4. Several snake specific OR gene families were identified as well as some possible orthologs to OR genes in mouse and other species.

IMPACT OF ELASTIN MATRIX DISRUPTION ON ITS INDUCED REGENERATIVE REPAIR BY VASCULAR SMOOTH MUSCLE CELLS

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Though regenerating elastic matrices lost to disease or trauma (e.g. in aneurysms) is vital to deter adverse impact on vascular homeostasis, poorly elastogenic post-neonatal cells challenge this. We showed exogenous hyaluronan (HA) oligomers and TGF-β to synergistically enhance elastin precursor and matrix deposition by healthy adult rat aortic SMCs (RASMCs). Since aortic aneurysms exhibit site-specific heterogeneity in matrix content and structure and contain proteolytically-injured SMCs, we investigated the impact of pre-existing ECM quality on elastogenic responses of injured/activated RASMCs. RASMCs were cultured for 21 days to deposit a robust matrix. Select wells (n=3/case) were then treated with 0.15 U/ml (PPE15) and 0.75 U/ml (PPE75) of porcine pancreatic elastase to variably degrade elastin matrix. Control cultures were not injured. One culture set each was harvested at 21d, before and after injury to quantify viable cell count and matrix elastin loss. Other injured cell layers (n=3/case) were cultured to 42d with or without factors (0.2 μg/ml HA, 1 ng/ml TGF-β). The spent medium was assayed for tropoelastin, LOX and MMPs. Cell layers were assayed for cell viability, DNA content, and matrix elastin and elastin matrix distribution/structure assessed using IF,SEM,TEM. After moderate elastin breakdown (PPE15, 15%), provided factors stimulated RASMCs to regenerate mature elastin matrix to levels measured in healthy cell cultures; after more severe injury (PPE75,50%), the factors stimulate matrix elastin synthesis and crosslinking, though not to healthy levels. Our results demonstrate that the elastogenic factors can induce elastin matrix synthesis by injured adult RASMCs

(p=0.04 factor vs. no-factor), and though the induction is influenced by the extent of prior matrix injury. Our results will help customize elastin repair for aneurysms based on their cause, extent, and location.

INDUCED ELASTIC MATRIX REGENERATION AND REPAIR BY ANEURYSMAL HUMAN SMOOTH MUSCLE CELLS (SMCS)

Carmen Gacchina and Anand Ramamurthi
Clemson-MUSC Bioengineering

Due to the poor elastin regenerative capacity of adult cells, elastic matrix regeneration within tissue engineered constructs and in situ within diseased tissues (e.g., aortic aneurysms or AA) remains a challenge. We previously showed that hyaluronan oligomers (HA) and transforming growth factor-b (TGF-b) synergistically enhance tropoelastin and elastic matrix synthesis, crosslinking, and elastic fiber deposition by healthy rat vascular SMCs, promising their utility to tissue engineering elastic constructs. Here, we investigate if these factors can likewise stimulate human aneurysmal SMCs, a requirement for elastic matrix repair in vivo. Primary SMCs were isolated from a 4 x 1cm human AA tissue explant obtained during open AA repair. The initially emergent spindle-like cells appeared smaller and less spread than healthy cells, developed cytoplasmic extensions and finally assumed a more spread morphology and attained confluence at 28 days (20 days for healthy cells). Passage 1 AA SMCs were cultured for 3 weeks in the absence (controls) of TGF-β and HA 4mers, or with various dose combinations thereof (1ng/ml & 0.2mg/ml, 1ng/ml & 2mg/ml, and 10ng/ml & 2mg/ml; n = 3/group). Cell proliferation and tropoelastin synthesis were unaffected by presence or dose of HA and TGF-b. Synthesis of alkali-soluble matrix elastin was increased 1.6-fold for dose combinations containing 2 mg/ml HA, while insoluble matrix elastin was enhanced >2 fold at the highest dose combination. Preliminary analysis has also shown more organized elastic ultrastucture and higher crosslinking density and stability in the AA SMC cultures treated with the highest dose combination. The results confirm that HA oligomers and TGF-β are useful, though at much higher doses than applicable to healthy SMCs, to elastogenically stimulate human aneurysmal SMCs, and enhance elastic matrix crosslinking, fiber formation, and stability and may thus be therapeutically useful to regress elastic matrix damage in AAs.

ACTIVATION OF ENDOTHELIUM IN AD BRAIN INVOLVES SOLUBLE AGGREGATES OF THE AMYLOID-BETA PROTEIN

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Alzheimer's disease (AD) is characterized by the presence of amyloid plaques in the brain parenchyma and cerebrovasculature which are comprised primarily of fibrils formed via self-association of the amyloid-beta protein. Vascular accumulation of fibrillar amyloid-beta is associated with increased homing and extravasation of circulating immune cells, which may contribute to elevated immune response observed in AD brain. We have employed human brain microvasculature endothelial cell monolayers to assess the effect of various amyloid-beta preparations on endothelial adhesion and related responses. Amyloid-beta(1-40) monomer, fibril, and soluble aggregates were prepared and isolated using a combination of size exclusion chromatography (SEC) and centrifugation, and aggregate size was characterized using dynamic light scattering (DLS). Experimental data demonstrates that isolated soluble amyloid-beta(1-40) aggregation intermediates selectively activate endothothelial monolayers for both

adhesion and subsequent transmigration of monocyte cells, as well as increased permeability, in the absence of endothelial cell death. In contrast, unaggregated amyloid-beta(1-40) monomer and mature amyloid-beta(1-40) fibril fail to induce any change in endothelial adhesion, transmigration, or permeability. Correlations between average amyloid-beta aggregate size and observed increases in both endothelial adhesion and monolayer permeability illustrate that smaller soluble aggregates are more potent activators of endothelium. Immunocytochemistry and antibody blocking studies further reveal that NF-kappaB signaling cascades are involved in amyloid-beta stimulation of endothelial adhesion. These results support previous studies demonstrating heightened neuronal activity of soluble amyloid-beta aggregates, and further show that soluble aggregates also selectively exhibit activity in a vascular cell adhesion model.

FISH DIVERSITY STUDY IN FOUR HOLE SWAMP SOUTH CAROLINA

Margarit Gray, Thomas Kozel, and David Higgins
Anderson University

The Four Hole Swamp watershed occupies approximately 72,553 acres and is located in the Francil Beidler Forest, which is managed by the National Audubon Society. This swamp contains 1700 acres of virgin, old growth tupelo/cypress trees, some of which are in excess of 1000 years. This makes it the largest tupelo/swamp in the world. The Four Hole Swamp watershed flows into the Edisto River, the longest black water river in the United Stated (400 km). A fish survey was completed for parts of the Edisto River Basin in 1995, but a survey to determine species diversity has never been conducted for the actual Four Hole Swamp watershed.

With Help from the South Carolina Department of Natural Resources (DNR), 41 fish species were positively identified in a Four Hole Swamp fish survey completed in the summer of 2006. Electrofishing equipment and manpower were furnished by the DNR. Two lakes or "holes" in the swamp were sampled with an electrofishing capable boat and smaller streams were sampled using backpack electrofishing equipment.

Of the 1331 fish samples, the dominant family represented was Centrarchidae and the most common fish species were Lepomis auritus (redbreast sunfish), Lepomis punctatas (spotted sunfish), Aphredoderus sayanus (pirate perch) and Lepomis macrochirus (bluegill). The Shannon Diversity Index was 2.7 and the eveness of the sampled population according to Shannon's equitability was 0.373 I wish to thank the South Carolina Department of Natural Resources for the electrofishing equipment and manpower necessary to complete this survey

ANTHROPOGENIC IMPACT ON CORAL REEFS IN BOCA DEL TORO, PANAMA

Margarit Gray, Thomas Kozel, and Diana Ivankovic
Anderson University

Anthropogenic influences, such as over-fishing, pollution, wastewater runoff, sedimentation from deforestation and coastal development are causing the decline of coral reefs. By 1998 human activities had destroyed approximately 11% of the world's coral reefs, as compared to 16% attributed to global warming. Human influences have been especially harmful in the Caribbean, due to the increased tourism and development in this area. The Boca del Toro Archipelago in Panama has been isolated for years and most reefs in this region are still pristine. Tourism and coastal development are starting to increase on these islands in Panama. The Nature Conservancy has already taken steps to protect large plots of land. The Amistad/Boca del Toro region has a Biosphere

Reserve and a World Heritage Site. The healthy reefs in this area need to be protected, since a wide variety of plant and animal species depend upon coral reefs for food and shelter. Reef biodiversity is an indicator of reef health. A higher biodiversity increases the reef resilience after catastrophic events. To determine if a reef is healthy, the species richness and species diversity of the reef need to be determined. The best way to determine the level of human impact on a reef is to compare the perceived damaged reef to reefs located in areas that have little or no human interaction. Species richness and species diversity can then be compared. The impacted reef will not have as many overall organisms living in and around the reef. Species diversity studies can also be used as baselines for future surveys.

CLONING OF A 159 BP FRAGMENT BEARING THE P1 PROMOTER REGION OF THE LB400 BPH CLUSTER USING PCR

Sean Grubb and James Yates
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Burkholderia xenovorans, more commonly known as LB400, is a gram-negative bacterium that metabolizes biphenyl and PCBs. The bph cluster is a group of genes that encodes enzymes for PCB and biphenyl metabolism. The p1 promoter is located directly upstream of a gene called bphA. This promoter initiates transcription for at least four of the genes on the bph cluster (bphA, bphE, orf1, bphF). The goal of this project was to isolate a small fragment of DNA containing the p1 promoter and clone it into the plasmid pUC18. We used PCR to amplify a region containing the p1 promoter. The template for the reaction was a recombinant plasmid (pGEM4A1) that was created in our lab. The oligonucleotides we used corresponded to the 3' end of orf0 and the 5' end of bphA. Agarose gel analysis revealed that a fragment of the correct size had been amplified. This 159bp DNA fragment was cloned into pUC18. Recombinant plasmids were isolated from the resulting clones and analyzed. Several clones with an insert of the correct size were obtained. The orientation of the insert of selected clones was determined by PCR. Oligonucleotides corresponding to regions where the promoter is thought to be located were designed. These oligonucleotides can be used in PCR reactions to generate deletions in the selected region. Deletions of small regions of the insert will be useful for determining the precise location of p1.

REDUCTION OF BACTERIA ON SPINACH, LETTUCE, AND SURFACES IN FOOD SERVICE AREAS USING EO WATER

Jane Guentzel
Coastal Carolina University
Stuart Emmons, Kang L. Lam, and Michael Callan
Integrated Environmental Technologies, Ltd.

Problems related to food safety are an important public health issue. Increases in food borne illnesses have promulgated the development of new sanitation methods to eliminate pathogenic organisms on foods and surfaces in food service areas. Electrolyzed oxidizing water (EO water) shows promise as an environmentally friendly broad spectrum microbial decontamination agent. EO water is generated by the passage of a dilute salt solution (~1%NaCl) through an electrochemical cell. This electrolytic process converts chloride ions and water molecules into chlorine oxidants (Cl2, HOCl/ClO-). At a near-neutral pH (pH=6.3-6.5), the predominant chemical species is the highly biocidal hypochlorous acid species (HOCl) with the oxidation reduction potential (ORP) of the solution ranging from 800-900 mV. The high ORP of the solution disrupts the outer membrane, thus

facilitating the transfer of HOCl across the cell membrane, resulting in further oxidation of intracellular reactions and respiratory pathways such as the glutathione disulfide-glutathione (GSSG/2GSH) cellular redox couple. The application of EO water at a near neutral pH minimizes human health and safety issues from Cl2 off-gassing, reduces corrosion of surfaces, and limits phytotoxic side effects while maximizing the application of the hypochlorous acid species. The objectives of this study were to evaluate the effectiveness of using near neutral electrolyzed oxidizing water for inactivation of bacteria in pure culture, its potential for use in reducing bacterial counts during post-harvest rinsing of spinach and lettuce, and as a microbial decontaminant of surfaces in food service areas.

WETLAND CONTRIBUTIONS TO MERCURY TRANSPORT AND BIOACCUMULATION IN SOUTH CAROLINA COASTAL RIVERS

Jane Guentzel
Coastal Carolina University

There are three distinct geological provinces in South Carolina (SC), with the blue ridge/ piedmont regions in the west/central portion of the state and the coastal plain region in the central/eastern regions of the state. Concentrations of total Hg and total organic carbon (TOC) in water were determined from sites along this gradient. Overall, there is a spatial west to east gradient in the state, with water column concentrations of total Hg (10-55 pM) and total organic carbon (10-2500 uM) increasing as one moves from the western upstate piedmont region to the eastern coastal floodplain region The coastal plain sites are located in watersheds that contain a significantly ($P<0.001$) higher percentage of wetlands (16.3+/-5%) than the blue ridge/piedmont region (1.14 +/-1.6%), suggesting that drainage through wetlands contributes to the increased concentrations of total Hg and TOC found in SC coastal plain Rivers. Correspondingly, approximately 86% of the SC fish consumption advisories are located within these coastal flood plain regions. There is a significant correlation between increasing fish Hg concentrations and increasing percent wetland area across the state ($r2 = 0.66$; $p=0.003$). This correlation explains 66% of the variance in the data and suggests that increasing percentages of wetland area contribute to fish Hg concentrations in SC coastal plain rivers.

PHYLOGENETIC ANALYSIS OF THE INSECT CALCIUM ATPASE PUMP

Katherine Gumps and Agnes Ayme-Southgate
College of Charleston

Changes in calcium concentration within muscle cells are critical for the regulation of muscle contraction. Muscle cells contain the sarcoplasmic reticulum (SR) which serves as a calcium ôreservoir.ö Calcium passively cycles out of the SR through calcium channels and is actively cycled back into the SR through the Calcium ATPase pump (SERCA). There are two basic types of insect muscle (synchronous and asynchronous) based on the extent of calcium cycling and previous research has suggested that the density of the SR and its location dispersal within the cell are good indicators of muscle type. In asynchronous muscle tissue, there is low calcium cycling and a sparse dispersal of SR, as opposed to synchronous muscle tissue, which has a much higher volume of SR and relies on active, high frequency calcium cycling. Our hypothesis states that the amount of the SERCA protein can be used in predicting muscle type for different insects. Sequence alignment of the SERCA gene for eight insects where the genome is available in online databases was performed to obtain non-species specific primers (or markers) so that the SERCA gene sequence could be determined in other insect species where the genome is

not available. Gene expression will be quantified using quantitative PCR analysis with species specific primers from RNA representing different muscle types in several insects. Immunofluorescence would be used to visually represent the density and location of SERCA within the muscle cells of each of the insects. We wishto acknowledge support from the SC-INBRE and the College of Charleston

THE EFFECT OF CARBON LOADING AND FATTY ACID CONCENTRATION ON THE PRODUCTION OF BIOHYDROGEN

Sharee Harris, Joe Emily, and Nazimuddin Mohammed
South Carolina State University

Biological hydrogen production through biomass conversion has been the subject of basic and applied research for many years. The development of technology where hydrogen is produced from agricultural biomass through microbial bioprocesses, can help overcome current biohydrogen production limitations and provide a means of reducing agricultural waste. The key problems, substrate inhibition of hydrogen producing reactions and hydrogen consumption by methanogenic microorganisms can be overcome by substrate pretreatment, improved bioreactor design and culture selection. This research addresses the effect of fatty acids and carbon loading on biohydrogen production. The design of a successful bioreactor depends on the ability to optimize the conversion of biomass and to maximize the efficiency of biohydrogen production by direct anaerobic fermentation. In this experiment we look at the effect of two known limiting factors; carbon loading and volatile fatty acid concentration, on biohydrogen production.

ANTI-HIV-1 VIF ACTIVITY BY A HAMMERHEAD RIBOZYME EXPRESSED FROM A RETROVIRAL VECTOR

Audrey Hendley, Christine Gross, and William Jackson
USC Aiken

HIV-1 is a retrovirus that primarily infects CD4+ T helper lymphocytes (TH), resulting in a gradual deterioration of immune function and leading to the onset of Acquired Immune Deficiency Syndrome (AIDS). Recent research suggests that HIV replication can be combated with ribozyme therapy. Hammerhead ribozymes are small, catalytic RNAs that can be designed to cleave substrate RNAs at specific sequences defined as XUX', where X = any nucleotide and X' = A, C, or U. Hammerhead ribozymes targeted to HIV-1 mRNAs have been shown to reduce or inhibit viral replication. The HIV-1 virion infectivity factor (vif) gene encodes a protein that counteracts an innate, antiretroviral defense mechanism of non-permissive cells, such as CD4+ T helper lymphocytes. This mechanism is mediated by apolipoprotein B mRNA-editing enzyme-catalytic polypeptide-like 3G (APOBEC3G), a cellular cytidine deaminase that is encapsulated into assembling virions in the absence of vif and is inhibitory during the next round of viral replication. Vif neutralizes APOBEC3G by reducing its translation and by rapid degradation of the native protein. Vif, therefore, may be a good target for ribozyme-mediated inhibition of HIV-1 replication. To test this hypothesis, three catalytic and non-catalytic hammerhead ribozymes targeted to nucleotides 5113, 5127, and 5154 of the HIV-1 genomic clone NL43 (Accession # M19221) were designed and cloned. Non-catalytic ribozymes were inactivated by a G to A substitution within the catalytic core and given a "Delta" designation. Each of these ribozymes was cloned into the retroviral vector, pSuper.retro.puro (pSRP) for tissue culture studies. pSRP was designed to express siRNAs and we hypothesized would also efficiently express hammerhead ribozymes. The retroviral vector pSRPVif5113 or pSRPVif5113Delta was transiently transfected into 293T cells, along with pCMV-

VifFLAG, which expresses the HIV-1 vif gene fused to the FLAG epitope. A Vif-targeted siRNA cloned into a similar retroviral vector, (pSuper.retro.GFP+neo) was analyzed in parallel. Total protein was isolated and ribozyme-mediated reduction of vif expression was analyzed by Western blot. The initial analysis of these ribozymes suggested reduction of vif expression in ribozyme positive cells as compared to non-catalytic (Delta) transfected cells. Interestingly, cells transfected with anti-Vif siRNA appeared to have an even greater reduction in vif expression. Current studies are underway to verify these results.

A STEP FORWARD : PHER2 BIOMARKER DISCOVERED FOR THE PROLACTIN RECEPTOR ANTAGONIST G129R

Victoria Herold and Diana Ivankovic
Anderson University

According to the American Cancer Society, breast cancer is the second most common cause of cancer death in American women. This year alone, about 40,480 women will die from breast cancer in the United States (American Cancer Society, 2008). Dr. Wen Chen has discovered a new treatment for breast cancer patients. G129R is a prolactin receptor antagonist designed by Dr. Chen. He changed the guanine to an arginine at the 129TH position in the prolactin gene. His main focus for G129R was to block the signaling pathway of prolactin in human epidermal growth factor 2 (HER2)-overexpressing breast cancers. Prolonged exposure to prolactin increases breast cancer cell proliferation and metastasis. Thus, G129R is an effective protein therapy giving a brighter outlook to women with HER2 type breast cancer: making up approximately 30 percent of women with breast cancer. G129R has been through numerous tests since its creation in 1998. However, before becoming marketable this drug must have a viable biomarker. Biomarkers provide information on exposure to xenobiotics (chemicals found in organisms but not expected to be produced or present in them, i.e. antibiotics) and chemopreventive compounds (use of chemical agents to prevent disease) and on the effects of that exposure in an individual or group (Schwab, 2001). The biomarker is needed for doctors to analyze the efficacy and pertinence of the treatment for each of their specific patients. The levels of the biomarker would tell the physicians whether to proceed or alter their patients' treatments. G129R will be in clinical trials in about two years; thus, a biomarker is needed soon. The following biomarkers were worked with: pAKT, (anti-apoptotic) cytochrome-c (pro-apoptotic), cleaved caspase-3 (pro-apoptotic), pERK (also known as pMAPK which is involved in proliferation), and pHER2 (involved in proliferation) (Genentech, 2008).

Among the tissues analyzed, the tumor showed the greatest percent of reduction when compared with the proteins from the spleen and mammary tissues. Even though the liver showed the greatest reduction overall, the tumor was the only tissue analyzed further because a biopsy of the tumor would be less invasive than a biopsy of the liver.

This research proved that G129R treatments can be effectively monitored in mice according to the levels of pHER2 in the mice mammary tumor cells: according to the data thus far. Hence, pHER2 appears to be a dependable biomarker for G129R , leading the path to find the cure for this dread disease. Sincere thanks goes to Anderson University, Dr. Diana Ivankovic (for teaching and preparing all spring semester on the latest lab techniques and breast cancer research), Dr. Wen Chen, and Dr. Alison Springs for allowing so much knowledge and incite into breast cancer research to be gained. This experience will forever be motivation and inspiration. Their faith, kindness, and patience will never be forgotten.

PARAMETRIC STUDY OF ACOUSTIC EXCITATION-BASED GLYCEROL-WATER MICROSPHERE FABRICATION IN JETTING

Leigh Herran, Wei Wang, Yafu Lin, and Yong Huang
Clemson University

Microspheres or droplets are increasingly finding their biomedical applications as drug microcapsules and multicellular spheroids. Precise control of microsphere size distribution is still of great manufacturing interest. The objective of this study is to numerically model a glycerol-water microsphere fabrication process using acoustic excitation-based single nozzle jetting. The study has been performed based on glycerol water microsphere fabrication, and it has studied the effects of material properties and fabrication conditions such as the acoustic excitation frequency and amplitude and the carrier stream velocity on the microsphere size. It is found that 1) the microsphere diameter decreased as the glycerol volume percentage increased; 2) the excitation frequency and pressure had a pronounced effect on the microsphere size. The microsphere diameter decreased as the excitation frequency increased and the microsphere diameter increased with the excitation pressure amplitude; and 3) the microsphere size decreased as the carrier stream velocity increased. The authors would like to thank Dr. Scott Little of the South Carolina EPSCoR/ IDeA office (CCD grant), Dr. Joann Sullivan of the Medical University of South Carolina, and Drs. Nicole Coutris and Richard Swaja of Clemson for their support and discussion.

DIHYDROISOQUINOLINONES FROM POLYLITHIATED AROMATIC CARBOXYLIC ACID HYDRAZIDES AND ESTERS

Sloan Hess, Krista Koch, Sarah Williams, and Allison Horger
College of Charleston

The phenylhydrazides of benzoic or ortho-toluic acids were polylithiated with lithium bases such n-butyllithium or lithium diisopropylamide (LDA) that were condensed with a variety of aromatic esters or carbonyl compounds to form intermediate compounds that could be isolated and characterized, or the intermediates could be acid cyclized to heterocyclic compounds. Trilithiated ortho-toluic acid phenylhydrazide underwent C-acylation with methyl benzoate or other substituted benzoate esters. These intermediates were easily acid cyclized with dilute hydrochloric acid to afford a group of substituted dihydroisoquinolinones, all of which were new compounds. Polylithiated 3,4,5-trimethoxybenzoic acid hydrazide underwent ortho-acylation to with select benzoate esters to afford an intermediate hydrazide which was isolated and characterized. This intermediate has the potential to undergo cyclodehydration to give a variety of phthalazinones.

Other electrophilic reagents, such as aldehydes, ketones and isocyanates, are also being investigated regarding their respective condensations with each of the two types of polylithiated hydrazides. Acknowledgements: College of Charleston, Summer Undergraduate Research Forum (SURF), Research Corporation; recently, NSF-RUI and USDA

EFFECT OF FRUIT EXTRACT ON BACTERIA GROWTH IN UTI

Vanessa Hilliard, Casey O'Dell, Natalie Mattson, and Daniela Arias
Erskine College

One out of every five women will suffer from at least one UTI in her lifetime. A survey of 60 female Erskine College students was conducted in which occurrence of UTI was compared to several correlating factors. Cranberries and their juice are a common

household remedy for UTIs. The antibacterial properties of cranberries has been studied repeatedly and their effectiveness has been supported by the results. Many other berries and their juices carry claims of antioxidant powers, so, their juices were tested, along with cranberry juice, both using the Kirbey-Bauer method and a rat model system. In the Kirbey-Bauer Assay enterobacteria were cultured and then exposed to various fruit juices. Effectiveness was rated by the ability to suppress bacterial growth and extent of suppression. In the model system, rat subjects with UTIs were fed berries, and severity of UTI was monitored for regression. Results will be presented at the upcoming meeting.

EFFECT OF FRUIT EXTRACT ON BACTERIA GROWTH IN UTI

Vanessa Hilliard, Casey O'Dell, Natalie Mattson, and Naoma Nelsen
Erskine College

Millions of people are treated for urinary tract infections(UTI) each year, and one out of every five women will suffer from at least one UTI in her lifetime. A survey of 60 female Erskine College students was conducted in which occurrence of UTI was compared to several correlating factors. Cranberries and their juice are a common household remedy for UTIs. The antibacterial properties of cranberries have been studied repeatedly and their effectiveness has been supported by the results. Many other berries and their juices carry claims of antioxidant powers, so, their juices were tested, along with cranberry juice, both using the Kirbey-Bauer method and a rat model system. In the Kirbey-Bauer Assay enterobacteria were cultured and then exposed to various fruit juices. Effectiveness was rated by the ability to suppress bacterial growth and extent of suppression. In the model system, rat subjects with UTIs were fed berries, and severity of UTI was monitored for regression. Results will be presented at the upcoming meeting.

FOURIER TRANSFORM INFRARED SPECTROSCOPY OF HYDROXYAPATITE-DOPED POC/PEG

Damien Howard and Narayanan Kuthirummal
Department of Physics and Astronomy, College of Charleston

Hydroxyapatite (HA) is a calcium apetite used in the medical field as filler in damaged bone to help encourage bone growth. Though hydroxyapatite is a well known substance, hydroxyapatite nanomaterial is a more exotic material. Using FTIR, HA doped with POC/PEG polymer material was investigated to understand the nature of interaction between the POC/PEG matrix and HA. This was done by keeping the size of the HA nanoparticles constant while varying the concentration percentage of the HA in the doped mix, and by keeping the concentration percentage of the doped mix constant while varying the nanoparticle size. When keeping the size of the HA nanoparticles to a constant 200 nm diameter, four concentrations of 3%, 10%, and 20% hydroxyapatite doped with POC/PEG had their infrared absorption spectrum collected. When keeping the concentration of HA in the sample constant 200 nm in diameter HA, nanoneedle HA, 75 nm in diameter HA, and a POC/PEG control had their absorption spectrum collected. Among the major absorption peaks obtained, we are specifically interested in the frequencies close to the 1053cm-1 region corresponding to the hydroxyapetite P-O stretching vibrations. The 1053 cm-1 peak revealed a significant increase in intensity upon reducing the concentration to 3% for 200nm diameter HA nanoparticles. Our preliminary results reveal that the interaction of HA nanoparticle with the POC/PEG matrix is highly size and concentration dependent. A detailed analysis of the result is currently underway. This work was supported by the Nanotechnogy Undergraduate Education (NUE) program of the National Science Foundation (Award No.EEC-0634142).

ENHANCING IDENTIFICATION OF DIFFERENTIALLY EXPRESSED GENES USING GENE PRUNING

Jianjun Hu, Jia Xu, and Xu Sun
USC Columbia

Motivation: Identification of differentially expressed genes from microarray datasets is one of the most important analyses for microarray data mining. Popular algorithms such as statistical t-test rank genes based on a single statistics with or without a significance score. These methods can be improved by considering other features of differentially expressed genes.

Results: We proposed a pattern recognition based strategy for identifying differentially expressed genes. Genes are mapped to a two dimension feature space composed of average difference of gene expression and average expression levels. A density based pruning algorithm (DB Pruning) is developed to screen out potential differentially expressed genes usually located in the sparse boundary region. Biases of popular algorithms for identifying differentially expressed genes are visually characterized. Experiments on 17 datasets from Gene Omnibus Database (GEO) with experimentally verified differentially expressed genes showed that DB pruning can significantly improve popular statistics-based identification methods such as t-test, rank product, and fold change in terms of prediction accuracy.

Conclusions: Density based pruning of non-differentially expressed genes is an effective method for enhancing statistical testing based algorithms for identifying differentially expressed genes. It improves t-test, rank product, and fold change by 11% to 50% in the numbers of identified true differentially expressed genes. The source code of DB pruning is freely available on our website http://mleg.cse.sc.edu/degprune

STUDYING MITOCHONDRIAL REDOX STATUS AND CONTROL MECHANISMS USING IN VIVO FLUORESCENT PROTEIN SENSORS

Jingjing Hu, Lixue Dong, and Caryn Outten
USC Columbia

The mitochondrion is an essential cellular organelle that houses critical metabolic pathways such as respiration, Fe-S cluster and heme biosynthesis, and biosynthesis of lipids, amino acids and nucleotides. These pathways are all dependent on cysteine-containing proteins, thus maintaining thiol-disulfide balance in this organelle is critical for cellular function. Thiol-disulfide equilibrium is primarily controlled by the reduced and oxidized forms of the abundant tripeptide glutathione (GSH and GSSG), which serve as an intracellular redox buffer. In order to better understand the factors that influence mitochondrial GSH:GSSG balance, we used genetic engineering methods to target fluorescent protein-based redox sensors to the mitochondrial matrix and intermembrane space (IMS) of yeast mitochondria. This approach allows us to separately monitor the in vivo redox state of the matrix and the IMS, providing a more detailed picture of redox processes in these two compartments. The two sensors employed (rxYFP, or redox-sensitive yellow fluorescent protein1 and roGFP, or redox-sensitive green fluorescent protein2) specifically equilibrate with the local GSH:GSSG pool and register redox changes via disulfide bond formation. Redox western and fluorimeter measurements were used to demonstrate that the GSH:GSSG redox status of the mitochondrial IMS is maintained separately from the cytosol and matrix. Furthermore, our lab was the first to demonstrate that this subcellular compartment is more oxidizing than the cytosol and mitochondrial matrix3. Using the rxYFP in vivo sensors, we have also found that the mutations in an

IMS-localized sulfhydryl oxidase leads to reduced levels of GSH in the cytosol and matrix, demonstrating that IMS protein function can have direct consequences on the overall cellular redox state. The sensors were also used to monitor temporal and spatial changes in GSH:GSSG equilibrium upon GSH or GSSG overaccumulation. Overall, these tools allow for non-destructive, real-time redox potential measurements in subcellular compartments and may help to elucidate the mechanisms for maintaining mitochondrial redox balance.

IMPEDIMETRIC CHARACTERIZATION OF TEMPERATURE RESPONSIVE P(HEMA)-PEG-HMMA HYDROGELS

Lorcan Ingham[1], Lauren Koch[1], Stephen Finley[1] and Gary Wnek[2]
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Temperature responsive poly(hydroxymethacrylate) [p(HEMA)]-polyethylene glycol (PEG) hydrogel networks were prepared with the inclusion of N-[tris(hydroxymethyl)methyl] acrylamide (HMMA) to confer temperature responsive characteristics. Hydrogels were cross-linked with tetraethylene glycol diacrylate (TEGDA) and synthesized by UV initiation (2 M% DMPA photoinitiator). The p(HEMA)-PEG-HMMA based hydrogels were fabricated as discrete gel pads (D = 2.5 mm, H = 2 mm and V = 9.82 μL) on top of 250 micron diameter cysteamine modified and acryloyl (polyethylene glycol)110 N-hydroxy succinamide ester (Acryloyl-PEG-NHS) derivatized gold electrodes. Gel pads were fabricated with cross-link densities corresponding to 1, 3, 5, 7, 9 and 12 M% TEGDA and were studied by frequency dependent electrochemical impedance spectroscopy (1 mHz û 100 kHz; 50 mV p-t-p) and by temporal impedimetry (4,000 Hz; 50 mV p-t-p) over the temperature range 30 û 45 %C at 90% RH or in aqueous 0.1M Tris/KCL at pH 7.2 buffer. The p(HEMA)-PEG-HMMA hydrogels showed an increase in the real component of impedance with increasing cross-link density and demonstrated activation energies for transport that ranged from 15kJ/mol (3M%) to 20kJ/mol (12M%) confirming the dominance of proton migration in the impedance of the hydrogels. Ali Boztas for gel hydration work.

SALARIES OF REPRODUCTIVE BIOLOGISTS IN 2008

Jobby Jacob1, H. Lee Higdon III[2], and Herman Senter[2]
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The Reproductive Biologists Professional Group (RBPG) and the Reproductive Laboratory Technologists Professional Group (RLTPG) are professional groups affiliated with the American Society of Reproductive Medicine (ASRM). The 2008 salary survey for the members of RBPG and RLTPG was conducted online and ended in November 2008. Such a survey was carried out threes times prior to 2008: in 2000, 2004 and 2006. The previous survey analyses are available at the official websites of RBPG and RLTPG. For the 2008 survey, invitations were sent to the active members of these groups, and out of 1468 invitees 287 completed the survey. This leads to a response rate of 19.6%; however this rate is higher than a typical online response rate for these professional groups, which is 12% according to ASRM. We analyze and summarize the results of this survey by characterizing the members of these professional groups based on the nature of their jobs, education and experience. For each group considered, the average annual salary for 2008 is calculated along with the standard error of the mean (SEM). For directors

and lab supervisors, we found that there are discrepancies in average 2008 salaries for males and females. Also, comparison of the average salaries of directors and non-directors in the private sector versus the non-private sector showed interesting results.

HOW DO INSECTS FLY: BIOINFORMATICS ANALYSIS OF THE MUSCLE PROTEIN PROJECTIN

Jeff Jankowski and Agnes Ayme-Southgate
College of Charleston

Insect flight uses either asynchronous flight muscles that are characterized by multiple contractions per nerve impulse or synchronous muscles with a 1:1 ratio between contractions and nerve impulse. Using data mining tools and molecular biology techniques we isolated and characterized parts of the gene for projectin in several insects belonging to different orders. We will focus our discussion on the on-going analysis of the gene in the cricket and the cicada as both use synchronous muscles. More derived insects (beetles, bees and flies) use asynchronous-type muscle. We want to investigate how the projectin protein structure relates to the anatomy and physiology of flight muscles. Data will be presented describing the gene isolation and sequencing, the analysis of the gene structure, and its evolution from basal to derived insects. We want to acknowledge support from SC-INBRE grant

SAR STUDIES VIA DELETION CHEMISTRY AND NITROGEN INCORPORATION INTO THE ANTIBIOTIC CYTOSPORONE E

Thomas Jenkins and Justin Wyatt
College of Charleston

Cytosporone E is a biologically active, but weak, antibiotic consisting of a fused trihydroxybenzene ring and a five-membered lactone ring (i.e. a phthalide backbone) with a seven-carbon side chain off the lactone. We are using this compound as a template from which we hope to synthesize more potent derivatives by changing features of its structure. Specifically, we have focused on two alterations: the first is utilizing deletion chemistry to determine which of the oxygen atoms are needed for activity; the second is the incorporation of nitrogen into different sites on the parent antibiotic. Nitrogen will allow us to add new substituent groups, change the overall shape, and alter the functionally of the molecule. These derivatives of the parent antibiotic will be tested on both gram-positive and gram-negative bacteria in order to discern the relationship between cytosporone E's structure and its biological activity. This structure activity relationship study will provide information for developing more effective analogues of the parent antibiotic, which is needed with the ever-increasing number of antibiotic-resistant bacteria.

FLOW CONTROL BASED ON RECEPTIVITY TO ENHANCE MASS TRANSFER FOR BIOREACTOR

Hong Jiang and Guiren Wang1
GraceFLow Technology
1USC Columbia

Bioreactor plays a key role in tissue engineering and regenerative medicine, where transport of oxygen and nutrition to cell and tissue is required. In tissue engineering and regenerative medicine, the Reynolds number is relatively low and the flow is laminar, in which, the transport of oxygen and nutrient from culture medium to the cells on the

matrix becomes very slow. Under such condition the supply of oxygen and soluble nutrients becomes critically limited for the in-vitro culture of 3-D tissues and the tissue growth will be negatively influenced. The external mass-transfer limitations can conventionally be reduced by culturing constructs in a stirred flask that induces mixing of oxygen and nutrients throughout the medium and reduces the concentration boundary layer at the construct surface. However, in many cases we cannot place the glass slide based culture system into a stirred flask, since in that way we will lose the potential control of the later mechanical test capability on-line and the inline microscopic monitoring of the tissue growth. One way to increase the Reynolds number is to increase flow velocity. However, increasing flow velocity will result in the increasing in shear stress, which will, in turn, could cause increased release of the deposit necessary for tissue growth from a scaffold into the culture medium. The high shear force can also damage cells. Low Reynolds number flow with high mixing efficiency is therefore highly desirable.

We have recently discovered a new receptivity phenomenon, where extraordinarily fast mixing can be realized in a pipe at low Reynolds number flow, which is originally laminar. Such a flow could be used in the future for bioreactor to enhance the mass transfer. In this presentation, we will introduce the design of the flow and its corresponding control system, the experimental results of the mixing based on qualitative visualization and quantitative measurement using laser induced fluorescence in both meso- and microscale flow channel. Forcing influence on mixing, such as forcing amplitude and frequency, will also be introduced. For mesoscale, we use acoustic wave to force the flow. In microchannel, AC electrokinetics is applied to force the flow to enhance mixing.

FINDING HOMOLOGOUS MESOPHILIC THERMOPHILIC PAIRS IN ALPHA/ BETA BARRELS USING COMPUTATIONAL ANALYSIS

April Johnson and Nicholas Panasik
Claflin University

On Earth, most living things survive under temperatures of approximately 20˚C to 50˚C. This is similarly to mesophiles, which can neither withstand temperatures that are too hot nor cold. In contrast, thermophiles such as Bacteria can thrive under very high temperatures. Overall, in order for organisms to live their proteins must be functional and folded. In proteins, thermostability is the ability to resist irreversible physical and chemical changes and maintain its three dimensional conformation. What determines thermostability of a protein is not yet fully defined. Things that are thought to determine thermostability are ion pairing, hydrogen bonding, hydrophobic surface area, and flexibility. From the Bioinformatics approach, NCBI searches and blasts are conducted in order to analyze all extant thermostable Alpha/Beta Barrel protein structures and identify their most closely related homologue in the mesophilic temperature range. The temperature ranges of the mesophillic enzyme were gathered based on published species growth rate data. From this research, we will extend our capacity to perform computational analysis to in-house database. Specifically, it will allow for pair wise comparisons of 72 thermophilic enzymes with their most closely related mesophilic homologues in areas such as the lnature and type of solvent accessible surface area, ion pair interactions, and distribution of hydrogen bonds.

IS OUR ENVIRONMENT FIGHTING VIRUSES?

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Coastal Carolina University
[1]Scholars Academy

Coliphage are specific viruses that control the population of E. coli in the environment. Our lab has been collecting and isolating coliphage throughout Horry County. Unlike samples from the county, samples from campus have not shown the presence of coliphage. This posed an interesting question as to what on campus is causing the absence of coliphage. Our lab is currently testing environmental extracts (including plants, soil, and water) for the inhibition of coliphage replication. Current results indicate that plant extracts have no effect on the growth of coliphage and that the soil and water samples contain bacteria that might outcompete E. coli on campus.

THE EFFECTS OF FUEL REDUCTION TREATMENTS ON AVIFAUNA NEST SUCCESS IN THE PIEDMONT OF SOUTH CAROLINA

Eran Kilpatrick[1], J. Drew Lanham[2], and Thomas Waldrop[3]
[1]USC Salkehatchie
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The National Fire and Fire Surrogate Study (FFS) is a national study installed at 13 sites across the United States. The goal of the FFS is to assess the effects of fuel reduction treatments on seven categories of physical and biological response variables. One installation of the FFS represents the southeastern Piedmont ecoregion and is located on the Clemson Experimental Forest. There, the impacts of fuel reduction treatments such as prescribed burning and thinning have been studied on a multitude of factors, including avifauna nest success. Nest searching and monitoring took place within twelve 10-hectare study plots during the breeding seasons of 2003 and 2004. A total of 82 nests representing 23 species were discovered and monitored. Out of those nests, 72% were successful in fledging young and 28% failed. Treatment responses were detected for total nest density and four of seven ecological functional groups. Total nest density was higher in Thin/Burn and Burn plots than in Thin and Control plots. Early successional bird and high PIF scoring bird nests were denser in Thin/Burn plots than in Burn, Thin and Control plots. The number of migrant nests was higher in Burn and Thin/Burn plots than in Thin and Control plots. High PIF scoring bird nest densities were higher in Burn and Thin/Burn plots than in Thin and Control plots. Positive avian nest responses to Burn and Thin/Burn treatments were positively correlated and best predicted by increases in understory herbaceous vegetation diversity and cover. Higher quantities of herbaceous material, shrubs, and small diameter trees provided more nesting substrate in Thin/Burn and Burn plots. This study has shown that prescribed burning and a combination of prescribed burning and thinning was beneficial for Southern Piedmont bird communities. It is clear that pine plantations in the Southern Piedmont with high basal area and closed canopy conditions will not provide maximum benefit to the avian community unless they are thinned and burned. Increasing the area of upland Piedmont forest receiving prescribed burning and thinning treatments would benefit early successional species that are presently experiencing population declines across the United States. The National Fire and Fire Surrogate Study was supported by funding from the U.S. Department of Interior and USDA Forest Service Joint Fire Science Program. Partial funding was provided by USDA Forest Service Research Work Unit SRS-4104, Disturbance and Management of Southern Forest Ecosystems.

QUARTZ CRYSTAL MICROBALANCE ANALYSIS OF AMYLOID-B PROTEIN ASSEMBLY AT A BIOLOGICAL INTERFACE

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Alzheimer's disease (AD) is a neurodegenerative disorder that effects approximately 4.5 million Americans over the age of 65- statistic that is set to triple by 2050. The widely accepted amyloid hypothesis proposes that the disease is caused by the accumulation of aggregated forms of the amyloid-beta protein within the brain. In early-onset forms of the disease, which account for 3-5% of AD, amyloid-beta aggregation is initiated by genetic mutations that promote amyloid-beta production and assembly. However, for late-onset forms of disease, which account for the majority of AD cases and are not genetically linked, the trigger for amyloid-beta aggregation is unknown.

Phospholipid bilayers that comprise cellular membranes are capable of supporting the accumulation of aggregated forms of amyloid-beta, and the extent of this accumulation appears to be dependent upon bilayer composition. Still, the influence of phospholipid bilayer content upon the transformation of benign monomeric amyloid-beta into toxic aggregates is not completely understood. Predominant hurdles include both the isolation of surface-specific aggregate growth and the accurate quantification of aggregation in real time. The quartz crystal microbalance (QCM) is well suited as a biosensor to study amyloid-beta aggregation at this biological interface, as it provides a heterogeneous system that can measure mass changes in the nanogram range. QCM utilizes the piezoelectric effect in quartz crystals to detect changes in bound elastic mass as a variation in the frequency of oscillation.

Initially, amyloid-beta(1-40) aggregates were coupled directly to the crystal surface using traditional avidin-biotin chemistry to examine the capabilities of QCM for quantifying aggregate binding and studying isolated aggregate growth in real time. We show that this biosensor can detect binding of amyloid-beta(1-40) with sensitivity approaching the nanomolar range. Furthermore, real time measurements of aggregate growth via monomer addition facilitated the collection of kinetic data and the application of a first-order, reversible kinetic model. The resulting kinetic parameters are in good agreement with physiological parameters. In particular, the calculated dissociation constant reflects the levels of amyloid-beta observed at the transition between normal and AD brain.

Subsequently, supported phospholipid bilayers were constructed upon the crystal surface to study aggregate interactions with these surfaces as well as subsequent aggregate growth at the bilayer surface. We show that zwitterionic, but not anionic, phospholipid bilayers are capable of binding amyloid-beta(1-40) aggregates in a saturable fashion, and these bound aggregates can undergo growth via monomer addition in a dose dependent manner

DIFFERENTIAL CONTROL OF GENE EXPRESSION BY TGF-β DURING PROGRESSION OF HPV16-TRANSFORMED CELLS

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Transforming growth factor-beta (TGF-β)is a potent inhibitor of epithelial cell proliferation. An important step in the development of malignant disease, including cervical cancer, involves a loss of sensitivity to the growth inhibitory effects of TGF-β .

Furthermore, TGF-β can switch from being growth inhibitory to growth stimulatory and can induce epithelial to mesenchymal transition (EMT) which involves modulation of expression of focal adhesion pathway genes and genes whose products mediate cell-matrix interactions. EMT is often associated with enhanced invasiveness of tumor cells. Human papillomavirus type 16 (HPV16) is the most common cause of cervical cancer. We have developed an in vitro model system for HPV16-mediated multi-step carcinogenesis, in which normal human keratinocytes (HKc), transformed by HPV16 DNA (HKc/HPV16) progressively acquire differentiation resistance (HKc/DR) coupled with complete resistance to the antiproliferative effects of TGF-β, despite the fact that some smad signaling remains intact in HKc/DR. In this study we describe the effects of TGF-β treatment on gene expression profiles of HKc/HPV16 and HKc/DR, using Agilent 44k human microarrays. As expected, we found that TGF-β treatment altered the expression of genes belonging to the cell cycle and MAP kinase pathways in HKc/HPV16, but not in HKc/DR. However, TGF-β-mediated modulation of the expression of genes involved in focal adhesion was comparable between HKc/HPV16 and HKc/DR in both extent of change and specific gene targets. These findings indicate that the signaling pathways through which TGF-β elicits growth inhibitory responses are separate and independent from those involved in the modulation of focal adhesion and possibly EMT, and support the concept of a dual role of TGF-β as an inhibitor of carcinogenesis at early stages, and as a promoter at late stages of transformation and progression.

A MOLECULAR DYNAMIC STUDY OF THE INTERACTIONS BETWEEN LEA PROTEIN AND TREHALOSE

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Both Late embryogenesis abundant (LEA) proteins and trehalose have been found in a number of anhydrobiotic (i.e., a state of anhydrobiosis or life without water) organisms that are adapted to severe water deficit as a result of extreme drought and/or cold in nature. A research has been reported indicate LEA proteins protect organisms in response to water depletion usually together with trehalose. However, the precise mechanism by which LEA proteins interact with trehalose remains to be undefined. In this study, molecular dynamics simulations were performed to understand the structure and the stability of a group 3 LEA protein from an anhydrobiotic nematode by means of the intermolecular interaction between the LEA protein and trehalose. The structural analysis shows that the LEA protein yields a slightly distorted structure at the carbon teminal similar to that in vacuum when the trehalose content is too low to completely cover the LEA protein. After the molecular shield formed by trehalose molecules, the hairpin-like, double-bundled, α-helical 3D conformation of LEA protein is stabilized according to the RMSD results. This is because the H-bonding interaction (H-bonding interaction dominate in all interactions) between the LEA protein and trehalose molecules are favorable to the LEA protein structural stability. In addition, the molecular shield formed by trehalose also improves the structural stability of LEA protein because the molecular shield can prohibit the thermal vibration from unfolding the LEA protein. This work was supported by National Science Foundation (NSF/SC EPSCoR grant # EPS-0447660). Acknowledgment is due to the USC's High Performance Computing Group for the computing time used in this research. The authors wish to express their gratitude to Dr. Alan Tunnacliffe and Dr. Guy Grant at the University of Cambridge, Cambridge, UK for their critical review of the manuscript.

DESICCATION INDUCED STRUCTURAL ALTERATIONS IN AN ANHYDROBIOTIC NEMATODE LEA PROTEIN

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Late embryogenesis abundant (LEA) proteins have been found in a number of anhydrobiotic (i.e., a state of anhydrobiosis or life without water) organisms that are adapted to severe water deficit as a result of extreme drought and/or cold in nature. However, the precise mechanism by which LEA proteins protect the organisms in response to water depletion remains to be defined. Since protein functions are generally determined by its structure, molecular dynamics simulations were performed in this study to understand the structure and its stability of a group 3 LEA protein with a 66-amino-acid fragment from an anhydrobiotic nematode during desiccation. It was found that unlike the vast majority of proteins, the fully hydrated LEA protein in an aqueous solution is by and large unstructured (mainly in the form of random coils and turns). The protein gradually becomes folded into a hairpin-like, double-bundled, α-helical 3D conformation in response to the loss of water. Major structural formation was observed to occur only when the water content is less than ca. 20 wt%. Moreover, the folded LEA protein structure in the extremely dry state (< ca. 5 wt% water) is much more stable than that of the fully hydrated, unfolded protein. It was further found the protein structure and its stability during desiccation are determined primarily by hydrogen bonding interactions followed by electrostatic interactions, both of which are a result of the extremely hydrophilic nature of the LEA protein. The Lennard-Jones interactions (mainly van der Waals interactions) are the least important in determining the protein structure and its stability during water deficit. This work was supported by National Science Foundation (NSF/SC EPSCoR grant # EPS-0447660). Acknowledgment is due to the USC's High Performance Computing Group for the computing time used in this research. The authors wish to express their gratitude to Dr. Alan Tunnacliffe and Dr. Guy Grant at the University of Cambridge, Cambridge, UK for their critical review of the manuscript.

SUBCELLULAR LOCALIZATION OF MARINE BACTERIAL ALKALINE PHOSPHATASE

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Microbial alkaline phosphatases are important enzymes in microbe-mediated phosphorus cycling in the ocean. Quantification of alkaline phosphatases based upon their subcellular locations has significant ecological implications but not yet studied. We design and apply an ensemble classifier algorithm to predict the subcellular locations of marine microbial alkaline phosphatases, which are recovered from Global Ocean Survey metagenomic databases by a bioinformatics pipeline. We find that 64% of alkaline phosphatases may locate in the cytoplasm. This finding challenges the common wisdom that marine microbial alkaline phosphatases are exclusively secreted proteins. We also identify approximately 28% of alkaline phosphatases as truly extracellular (cell free) proteins, while the remaining 8% is dominated by periplasmic alkaline phosphatases, which again revolutionizes the traditional perspective that periplasmic and cell surface bound alkaline phosphatases predominates over those secreted to extracellular space. The significant amount of potentially cytoplasmic and extracellular alkaline phosphatases has important implications in marine phosphorus cycling.

DISCOVERY OF HIGHLY POTENT LONG ACTING DPP-IV INHIBITORS

David Magnin
Morris College

A series of methanoprolinenitrile-containing dipeptide mimetics were synthesized and assayed as inhibitors of the N-terminal sequence-specific serine protease dipeptidyl peptidase IV (DPP-IV). The catalytic action of DPP-IV is the principle means of degradation of glucagon-like peptide-1, a key mediator of glucose-stimulated insulin secretion, and DPP-IV inhibition shows clinical benefit as a novel mechanism for treatment of type 2 diabetes. However, many of the reversible inhibitors to date suffer from chemical instability stemming from an amine to nitrile intramolecular cyclization. Installation of a cyclopropyl moiety at either the 3,4- or 4,5-position of traditional 2-cyanopyrrolidide proline mimetics led to compounds with potent inhibitory activity against the enzyme. Additionally, cis-4,5-methanoprolinenitriles with beta-branching in the N-terminal amino acid provided enhanced chemical stability and good inhibitory potency. Extension of this approach to adamantylglycine-derived inhibitors led to the discovery of highly potent inhibitors with excellent activity in vivo. 1) Discovery and preclinical profile of Saxaglipton (BMS-477118): a highly potent, long acting, orally active dipeptidyl peptidase IV inhibitor for the treatment of type 2 diabetes.

DIET ANALYSIS OF DIAMONDBACK TERRAPINS, MALACLEMYS TERRAPIN, FROM NORTH INLET, WINYAH BAY, SC.

Abby Marlow and Peter King
Francis Marion University

The diet of diamondback terrapin turtles, Malaclemys terrapin, from North Inlet Winyah Bay, Georgetown, SC. was studied. Feces from 5 terrapins in 2007 and 19 terrapins in 2008 were collected and examined for evidence of prey or food items. Food items included two species of snails, at least three species of crabs, fish, mussels and barnacles. The diet of terrapins was found to consist primarily of periwinkle snails (Littorina irrorata). Different species of crab represented the second most common food item. Male terrapins seem limited to smaller periwinkles, reducing competition for the larger periwinkles by female terrapins.

ROLE OF P-GLYCOPROTEIN IN THE TRANSPORT OF AMYLOID-β PROTEIN IN CEREBRAL AMYLOID ANGIOPATHY

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Cerebral amyloid angiopathy (CAA), a cerebrovascular deposition of the shorter 40-residue form of amyloid-β (Aβ-40) peptide, is a well-known cause of hemorrhagic stroke that can cause premature death in the elderly and Alzheimer's disease patients. Vascular accumulation of the fibrillar form of Aβ, that begins in larger, brain-supplying arteries and then progresses into smaller vessels, has also been implicated in producing vessel dysfunction reducing cerebral blood flow and inducing ischemia. Altered Aβ transport may be responsible for vascular Aβ accumulation. However, it remains unclear how the transport of Aβ from the brain parenchyma to the vasculature through the blood-brain barrier (BBB) is impeded to facilitate accumulation of Aβ. P-glycoprotein (Pgp), an ATPase transporter, interacts with amphipathic molecules and mediates their extrusion from the brain to the cerebrovasculature. Importantly, Pgp could be responsible for the efflux of Aβ from the brain since Aβ is a known in vitro substrate for this transporter. It is

hypothesized that Pgp is involved in the transport of Aβ from the brain through the BBB. This hypothesis will be tested by identifying the Aβ1-40 assembly state(s) transported from the basolateral to the apical side of model endothelial monolayers and confirming a role for Pgp in this transport. These findings could clarify how aggregation might sequester Aβ protein to modulate CAA progression. Aβ 1-40 assembly state(s) that are transported from the basolateral to the apical side of the endothelium will be identified by comparing endothelial permeability coefficients (Pe) for transport of different Aβ 1-40 assembly state(s) through confluent monolayers of human brain microvascular endothelial cells (HBMVEC). In addition, Aβ 1-40 assembly state(s) that interact with Pgp will be identified using an in vitro assay that measures ATPase activity of Pgp to quantify kinetic parameters (Km(ATP), Vmax(ATP)). Finally, a role for Pgp in the transport of Aβ 1-40 assembly state(s) will be confirmed via measurement of Pe through HBMVEC monolayers exhibiting up-regulation and inhibition of Pgp. Elucidation of the Aβ 1-40 assembly state(s) that are transported through the BBB as well as the role of Pgp in this process will provide insight into the elimination of Aβ from the brain. The understanding of this process has the potential to identify a new risk factor for the development of CAA and provide a novel diagnostic and therapeutic target.

DEVELOPING STRUCTURAL ARRAYS OF HYDROXYAPATITE TO MIMIC DENTIN AND ENAMEL

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Restorative dental materials are mechanically distinct from native dental tissue (dentin and enamel). This difference can lead to increased stresses along the junction, and eventual fracturing between the restorative fillings and the native tooth. By creating restorative materials from hydroxyapatite, the reliability of restorative fillings can be increased. This study aims to pattern hydroxyapatite films with varying micro-architecture to mimic dry enamel and dentin. During this study, HA was deposited using both passive and electrophoretic methods onto substrates of varying surface energies, including patterned gold and polymer films on silicon wafers. HA solutions were prepared by titrating 0.769M phosphoric acid in 0.0211M calcium hydroxide under nitrogen atmosphere to prevent reaction with CO2. Scanning electron microscopy showed that HA was deposited uniformly onto the 300nm Au films and formed sparse islands on polymer films and silicon substrates. When compared to dry enamel and dentin under backscatter SEM, the deposited HA on gold more closely resembled dentin structure than enamel. Mechanical testing was completed using nanoindentation and compared to native tissues. The Latour lab for use of the glove box; Dr. Satish Alapati for helpful discussions. Funding provided by NASA SC Consortium.

DISCOVERY INFORMATICS

Renee McCauley
College of Charleston

Discovery informatics is all about knowledge discovery / discovering new knowledge from existing knowledge. Computer technology gives us the ability to gather and store vast amounts of information in the form of data sets or data streams. By combining mathematics and computer science in innovative and practical ways, discovery informatics can be applied to any large body of information to reveal patterns and new meanings.

Since 2005, the College of Charleston has offered an undergraduate degree in Discovery Informatics, with concentrations in16 different areas including molecular biology and organismal biology. This session will discuss the degree program, and track its graduates.

ESTIMATION OF BLOODSTAIN AGE ON POLYMER SUBSTRATES BY DIFFUSE REFLECTANCE INFRARED SPECTROSCOPY

Jessica McCutcheon, Anthony Trimboli, Michael Myrick, and Stephen Morgan
USC Columbia

Evidence involving bloodstains is of great importance to the investigation of a crime scene. Methods for estimating the age of bloodstains have been widely proposed. The research described in this presentation was designed to validate the forensic applicability of a direct spectroscopic method for dating bloodstains discovered at crime scenes. The relative amounts of secondary protein structures change as blood oxidizes and degrades. For this reason, our focus is on the use of bands in the IR region around 1650 cm-1 to 1200 cm-1 that correlate to the secondary structure of blood proteins.

Attenuated total reflectance Fourier transform infrared (ATR/FT-IR) spectroscopy was previously used in estimating the age of bloodstains and provided promising results. Diffuse reflectance infrared spectroscopy was applied for the characterization of the age of dried bloodstains present on textile samples. It is a more precise and sensitive sampling method, and DRIFTS sampling requires little to no sample preparation. Samples were prepared by doping blood on textile substrates (acrylic, cotton, nylon, and polyester). They were subjected to three different environments: 1) controlled lighted laboratory conditions, 2) outdoor light, heat, and humidity, and 3) a dark room setting. Reflectance spectra were collected at regular time intervals for a period up to 270 days. Changes from the secondary protein structures in the spectra were modeled as a function of time using principal component regression (PCR). Interval PCR (iPCR) was employed to determine the optimal spectral regions most relevant to systematic changes due to the aging of bloodstains. Linear regression models were created using iPCR, and the coefficient of multiple determination (R2) along with the root mean square error of cross validation (RMSECV) were utilized in determining the adequacy of the calibration quality.

BIODEGRADABLE SCAR-INHIBITING IMPLANTS FOR GUIDED SPINAL CORD REGENERATION

Angel E. Mercado, Kevin A. Carnevale, and Esmaiel Jabbari
USC Columbia

Approximately 5,000 people are living with spinal cord injury in the state of South Carolina with a cost of greater than $350 million per year not including the loss of wages and productivity. Finding a ôcureö for spinal cord injury (SCI) is hampered by the lack of regenerative capacity within the spinal cord. The aim of this project was to design and develop a biodegradable graft for patients with spinal cord injury using a tissue engineering approach. We have developed a novel bioengineered scaffold to facilitate the re-establishment of neuronal circuits following spinal cord injury. Our graft is unique in that the elasticity and degradation of the multi-channel tubular scaffold can be controlled by changing the chemical composition of the graft, the anti-inhibitory factor chondroitinase ABC (C-ABC) can be released from the implant to reduce scar formation, and the channels can be seeded with bone marrow stromal (BMS) cells to provide a permissive environment for differentiation of spinal cord (SC) cells to multiple lineages. An injection molding/in-situ crosslinking technique was used to produce degradable multi-channel scaffolds, with consistent internal dimensions, based on (lactide-co-glycolide

ethylene oxide fumarate) (PLGEOF) macromer. The lactide-co-glycolide (LG) to ethylene glycol (EG) ratio in the macromer was varied to optimize scaffold elasticity. The lactide (L) to glycolide (G) ratio in the macromer was varied to optimize tube degradation time. For example, the tube degradation time could be varied from 4 to >40 weeks by varying the L:G ratio in PLGEOF. PLGEOF tubes supported adhesion and migration of Bone marrow stromal (BMS) cells, seeded on the tubes and cultured in primary media. Chondroitin sulfate proteoglycans have been identified as key inhibitory factors in this process of cord regeneration. It has been reported that the most effective time course and concentration for C-ABC is 7 days. We have further developed novel nanospheres that can slowly release C-ABC in the channels after embedding the nanospheres in the implant. Implants that mimic the structural features of the spinal cord, have a permissive environment for neural cells to grow, degrade concurrent with regeneration of axons, and locally release anti-inhibitory factors, have the potential to provide the basis for a cure. This work was supported by grant from the South Carolina Spinal Cord Injury Research Fund.

THE EFFECTS OF ZINC ACCUMULATION ON BREAST CANCER

Sharne' Morrow, Leslie Johnson, and Omar Bagasra
Claflin University

Breast cancer is an uncontrolled growth of breast cells. The term breast cancer refers to a malignant tumor that has developed from cells within the breast. According to the National Cancer Institute in 2008, there are currently 183,000 new cases of breast cancer. Astoundingly, there were around 41,000 individuals who have died from the condition. This research was performed to study the down regulation of zinc in breast cancer in an attempt to develop a newfound early detection system that could help evaluate the onset of the disease to help in the efforts of saving lives. It has been previously theorized that zinc, selenium, calcium and iron are factors in the development of breast cancer. Based upon previous studies reported, I hypothesize that an essential trace element such as zinc plays a vital role in the development of breast cancer. Zinc is needed for proper cell function and maintenance. It is required by certain cell types such as the breast epithelial cells in very high amounts. Without the use of zinc for key biological processes such as growth and development, malignancy and metastasis can be sought after. Through a series of experiments using fresh frozen cancerous breast tissue, histological, differential staining, and intercellular zinc determination using zinc indicator dyes (NPG and TSQ), zinc accumulation can be detected. It has been found that African Americans experience a lower capacity of zinc accumulation than European Americans as well as any other race due to their inherent down regulation of specialized zinc transporting proteins.

ANALYSIS OF BIOLOGICALLY REALISTIC PREFRONTAL CORTEX PYRAMIDAL CELL MODEL

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Current research on schizophrenia links the disorder to neuronal dysfunction in the prefrontal cortex. To facilitate further projects we explored the parameter space of a compartmental Hodgkin-Huxley style model of a prefrontal cortex pyramidal cell. The model was implemented in NEURON, a neuron simulation environment, and XPPAUT, a general differential equation software package capable of bifurcation diagrams. We varied the model channel conductances, passive membrane properties, and morphology, and examined their affect on the neuron firing behavior, particularly Rheobase, spike

amplitude, and spike frequency. Notably, model excitability was sensitive to changes in neurite size and other variables related to the structure of the cellular membrane. Since anatomical changes have been observed in neurons of the schizophrenic brain, our results may be of use to future models of schizophrenic neurons.

PROJECTIN AND MYOFIBRIL ASSEMBLY IN DROSOPHILA MUSCLES

Cynthia Oliva and Agnes Ayme-Southgate
College of Charleston

We are interested in understanding how the myofibrillar structure assembles during insect muscle development, and in particular the role of the projectin protein. This extremely large protein (~1 MgDa) has a modular repeated structure, and localizes over the I-Z-I region of the myofibril in insect flight muscles, but in the A band in all other muscles. Immunofluorescence data indicate that the early assembly of projectin in flight muscles is consistent with its proposed role as the protein component of the elastic C-filaments. In particular, projectin coassembles very early with other Z-band components such as alpha-actinin. We will present data from transgenic Drosophila studies that indicate how different regions of the projectin molecule interact with different parts of the myofibril apparatus. The effects of mutations on these interactions will also be presented. We wish to acknowledge support from the SC-INBRE grant

CLONING AND INITIAL TESTING OF A RETROVIRAL VECTOR EXPRESSING AND ANTI-HIV-1 TAT HAMMERHEAD RIBOZYM

Lindsey Padgett and William Jackson
USC Aiken

Human Immunodeficiency Virus (HIV-1) is a lentivirus of the genus Retroviridae that targets CD4+ T helper (TH) lymphocytes. HIV infection results in the gradual loss TH cells, which results in the loss of immune competence and a greater susceptibility to various opportunistic infections. The presence of a number of defined clinical conditions, in addition to a TH lymphocyte count below 200/mm3, define the Acquired Immune Deficiency Syndrome (AIDS).The HIV-1 genome encodes three replicative genes found in all retroviral genomes: gag, pol, and env. In addition, the HIV genome encodes the following accessory genes: nef, tat, rev, vpr, vpu and vif. Of particular interest is the regulatory protein Tat, which increases transcription from the HIV-1 LTR several hundred-fold by interacting with the cis-acting RNA enhancer TAR (Transactivating Response Region), present at the 5' end of all viral transcripts. Because of its importance to HIV-1 replication, Tat is absolutely necessary for viral replication and is an important target for antiviral reagents. One class of these reagents is the hammerhead ribozyme, which can cleave viral mRNA's and may prevent the virus's ability to replicate. These RNA enzymes target and cleave mRNA at any XUX', where X is any nucleotide, and X' is Adenine, Cytosine, or Uracil. A model for the design of hammerhead ribozymes was first proposed by Haselhoff and Gerlach in 1988. Previously, our lab cloned a library of three hammerhead ribozymes targeted to HIV-1 tat. These ribozymes were tested in an in vitro cleavage assay and one (Tat 5910) was shown to efficiently cleave tat RNA. A second, noncatalytic ribozyme (Tat 5910Delta) was shown to have no cleavage activity. To test ribozyme activity in tissue culture, Tat 5910 and Tat 5910Delta were cloned into the retroviral vector p.Super.Retro.Neo+GFP (pSRNG). Initial testing of these retroviral vectors indicated GFP (Green Fluorescent Protein) exoression in transiently transfected 293T cells. The ability of each plasmid to produce recombinant virus was next studied in a transient transfection model using NIH-3T3 cells as targets. The results of this

experiment revealed transduction of the target cells, as indicated by the presence of GFP-positive cells. Current studies are underway to optimize the conditions for generating retrovirus in this system.

FABRICATION AND CHARACTERIZATION OF SEIRA SUBSTRATES UTILIZING ELECTROLESS DEPOSITION

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Surface-enhanced infrared absorption (SEIRA) spectroscopy is an emerging sensor technology that dramatically improves infrared spectroscopy's low detection limits while also maintaining the molecular differentiation capabilities of the technique. SEIRA involves the enhancement of the infrared band intensities for molecules that are either adsorbed or in close proximity to metal surfaces composed of ideally shaped nanoparticles. In this study, in an effort to prepare these ideally shaped nanoparticles, electroless deposition has been utilized to form Ag and Cu nanoparticle films on the surface of oxidized, infrared-transparent Ge windows. Submonolayer coverage of cast films of probe molecules, such as para-nitrobenzoic acid (PNBA), placed onto these metal surfaces display SEIRA enhancement factors ~40 for the Ag nanoparticle substrate compared to the same organic films formed onto bare Ge windows. Due to the disruptive nature of this method towards the bare surface of the Ge window, a current limitation of this method is the reproducibility of the substrates prepared. Significant effort has been given towards improving the reproducibility of these substrates through the regeneration of the Ge surface through polishing. Careful monitoring of the transmission properties of the Ge window prior to electroless displacement is vital in determining that the surface is adequate for the fabrication process. A discussion about this procedure, as well as the impact of other experimental variables, such as deposition time, concentration of the plating solution, and temperature will be presented. A comparison of the quality and spectral response of the SEIRA substrates prepared with either Ag or Cu nanoparticles will be also be discussed including comments regarding the morphology of these different metallic substrates as observed by scanning electron microscopy. Acknowledgement is made to the donors of the The American Chemical Society Petroleum Research Fund for partial support of this research.

CYTOSOLIC PHOSPHOLIPASE A2 IS REQUIRED FOR HUMAN SMOOTH MUSCLE CELL PROLIFERATION BUT NOT MIGRATION

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Platelet derived growth factor BB (PDGF BB) has an important influence on smooth muscle cell proliferation in restenosis and atherosclerosis. Our understanding of different signal transduction pathways involved in the response of smooth muscle cells to PDGF BB is potentially significant for understanding and manipulating these processes. Prior studies have demonstrated a crucial activation of cytosolic phospholipase A2 (cPLA2) in smooth muscle cells to PDGF BB with the production of arachidonic acid and prostaglandin E2. In these studies we investigated the role for another PLA2, calcium-independent PLA2 (iPLA2) in comparison to cPLA2 on smooth muscle cell migration and proliferation. Pharmacological inhibitors of cPLA2 were found to substantially inhibit proliferation, but not migration. AACOCF3 (cPLA2 and iPLA2 inhibitor) and 1,2,4-trisubstituted pyrrolidine derivative (cPLA2 inhibitor) both inhibited smooth muscle proliferation where Bromoenol lactone (iPLA2 inhibitor) had no effect. None of these

inhibitors prevented smooth muscle chemotaxis to PDGF BB in a modified Boyden chamber. In reconstitution experiments, arachidonic acid fully restored smooth muscle cell proliferation after being treated with 1,2,4-trisubstituted pyrrolidine derivative. These data demonstrate the distinct role of cPLA2 on smooth muscle cell proliferation which is a critical step in the pathogenesis of restenosis and atherosclerosis.

VIRAL CANCER PATHOGENESIS: REGULATION OF THE MICROENVIRONMENT BY AN ONCOGENIC HERPESVIRUS

Zhiqiang Qin, Eduardo Freitas, Ben Kalivas, Roger Sullivan, Karlie Plaisance, and Chris Parsons
Medical University of South Carolina

Viruses are the etiologic agent of approximately 8% of all cancers and represent the most common cause of cancer in patients with immune deficiencies. The prevalence of HIV infection in South Carolina is increasing disproportionately, and cancers caused by viruses are emerging as a leading cause of morbidity and mortality in patients infected by HIV. The most common cancer associated with HIV infection, Kaposi's sarcoma (KS), is caused by the Kaposi's sarcoma-associated herpesvirus (KSHV). Like other oncogenic viruses, KSHV expresses unique viral oncogenes which orchestrate the transformation of target cells following infection. It follows that targeted approaches for reducing virus entry and viral oncogene expression may offer safe and effective therapeutic strategies for KS, and possibly other viral tumors. An amino acid membrane transport protein subunit, xCT, maintains intracellular glutathione stores to enhance the survival of cells producing reactive nitrogen species, and xCT was recently identified as a fusion-entry receptor for KSHV. A number of intracellular and extracellular triggers regulate xCT expression, including binding of the xCT promoter by transcription regulators and the activation of xCT transcription by reactive nitrogen species. We have determined that xCT is expressed by multiple cell types within KS lesions and by circulating mononuclear cells from HIV-infected patients at risk for KS. However, it remains unknown whether KSHV itself regulates xCT expression to promote KSHV infection and cell transformation in the local environment. Using novel cell culture systems, we have found that KSHV-encoded microRNA upregulate xCT expression in macrophages and facilitate KSHV entry and oncogene expression in these cells. We have identified two independent mechanisms for these observations: 1) KSHV microRNA suppression of BACH-1, a transcriptional repressor of xCT; and 2) induction of reactive nitrogen species secretion by KSHV microRNA. Based on these findings, we proceeded to validate two independent strategies for reducing viral oncogene expression during infection: targeted inhibition of a single viral microRNA which downregulates BACH-1, and inhibition of nitric oxide synthase activation (and, therefore, reactive nitrogen species secretion) by the virus. These data provide new insights for mechanisms of viral persistence and viral oncogene expression in the tumor microenvironment, and new directions for developing therapeutic or preventative strategies for virus-associated cancer.

EFFECTS OF 17β-ESTRADIOL AND TAMOXIFEN ON MCF-7 HUMAN BREAST CANCER CELLS

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The purpose of this research was to study the structure and function of MCF-7 human breast cancer cells following in vitro treatment with a natural estrogen, 17β-estradiol (E2), and anti-estrogen, tamoxifen (TAM). Tamoxifen has the structural conformation

such that it resembles steroidal molecules located within the nucleus of cells. This enables it to attach to the estrogen receptors, and thus antagonize against molecules as estrogens. In this study we tested the role of these compounds on MCF-7 breast cancer cells. MCF-7 human mammary adenocarcinoma cell lines were obtained from American Type Culture Collection and routinely maintained in Dulbecco's Modified Eagle's/F-12 media with 10% charcoal dextran-treated fetal bovine serum. Cells were cultured in a 5% CO2 incubator at 37 degrees C. The media was removed and replaced with 0.1% BSA containing media or media containing 0.01% DMSO (as vehicle) or in media with vehicle containing 10-6M E2, 10-8M E2, 10-6M TAM and 10-8M TAM. Cell viability was determined by MTT colorimetric assay. We employed an immunohistochemical assay for the detection of 5-bromo-2'-deoxy-uridine (BrdU) incorporated into cellular DNA. Morphological changes were observed under a phase-contrast microscope. MCF-7 cell counts were high with 10-6M and 10-8M E2. The number of BrdU labeled cells was determined and counted under a microscope. The10-6M and 10-8M E2 increased proliferation of MCF-7 cells significantly ($P<0.05$). Tamoxifen at 10-6M or 10-8M did not alter BrdU labeling but over 90% of these cells appeared ER-alpha immunoreactive when compared to the control groups. Using indirect immunofluorescence microscopy, we investigated cellular localization of a tight junction protein, ZO-1 in MCF-7 cells following treatment with 17beta-estradiol and tamoxifen. The 10-6M E2 increased ZO-1 staining at the position of tight junctions. With 10-6M TAM treatment ZO-1 staining was reduced. We also investigated cellular localization of galectin-3 in MCF-7 cells using indirect immunofluorescence microscopy and by western blot analysis to test if galectin-3 is involved in cell proliferation and differentiation following treatment with E2 and TAM. With 10-6M TAM galectin-3 localization was reduced. The down regulation of ZO-1 and galectin-3 protein expressions as observed with tamoxifen treatment, were associated with the morphological changes and growth suppression in MCF-7 cells. Supported by NIH Grants GM068627, HD38342 and MD00233

ALDOL/CLAISEN CONDENSATIONS OF BETA-DIKETONES WITH ALDEHYDES/ESTERS AND LHMDS

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Lithium hexamethyldisilazide [LiHMDS] has been used to prepare multiple anion type intermediates from beta-diketones, beta -ketoesters, and beta-ketoamides and related compounds having potential to form reactive and reaction selective dianion-type intermediates. These intermediates were condensed with carbonyl compounds and esters to afford a variety of known and new compounds. The products include alkenyl beta-diketones and beta-ketoesters; the beta -ketoamides gave a dianion and not trianion intermediate that resulted in a different alkenyl beta-ketoamide. As a follow up to our unexpected 2:1 condensation of benzoate esters with acetone in excess LiHMDS for the preparation of symmetrical 1,5-diaryl-1,3,5-pentanetriones, good-to-excellent yields of unsymmetrical 1,5-diaryl-1,3,5-pentanetriones resulted from the lithiation of 1-benzoylacetone with excess LiHMDS followed by condensation with a variety of aromatic esters. Several explanations of these unexpected latter results may include a regioselective condensation of a less likely dianion intermediate at the second ionization site (new bond with C4) with the ester carbonyl, or the condensation of one of the two possible monoanions, the more reactive one (C4 bond formation), in an equilibrium mixture of both of them, or the more stable anion (C2 carbanion-enolate delocalized over five atoms) in the presence of liberated hexamethyldisilazine, HMDS, to form a LiHMDS/HMDS complex involving the oxygen bonded to C3, and permitting easier deprotonation of a C4

hydrogen followed by condensation at C4 with the carbonyl ester carbon to give another complex or series of complexes involving and stabilized by LiHMDS and HMDS. Acknowledgements: College of Charleston, Summer Undergraduate Research Forum (SURF), Research Corporation; recently, NSF-RUI and USDA

A PRELIMINARY STUDY OF LANDFILL LEACHATE INTERACTION ON CELL MORPHOLOGY AND DNA

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An environmental study sponsored by the UN indicated that millions of people are exposed to metal containments via their food and water sources. The metal contaminates enter into the soil and ground water from landfills. The overall goal of this study is to determine how landfill leachate metals, cadmium, lead and zinc affect human epithelial cheek cells. The metals will be assessed for the induction of morphological changes, DNA damage and enhanced cell death. The results of cell morphology and DNA analysis will be documented and presented. This work is supported by NSF-HBCU-UP #0411383

PROTECTIVE EFFECT OF RESVERATROL IN TOXIN-INDUCED ACUTE LUNG INJURY AND ACUTE RESPIRATORY DISTRESS

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USC Columbia

Clinical disorders such as sepsis, trauma, pancreatitis and pneumonia can lead to acute lung injury (ALI) and respiratory failure. This is characterized by infiltration of inflammatory cells into the lungs and, in result, damage to pulmonary endothelial (EndoC) and epithelial (EpiC) cells. The mechanism of disease remains unclear to date, and treatment options are very limited. In some cases, ALI further develops into acute lung distress syndrome (ARDS), and because this leads to pulmonary edema and dysfunction, this syndrome is often lethal. In this study, a mouse model of Acute Respiratory Distress Syndrome induced by Staphylococcal enterotoxin B (SEB) is used in order to investigate the effectiveness of resveratrol (RES) as a treatment method. Resveratrol (trans 3,5,4'-trihydroxystilbene) (RES) is a natural plant product and its anti-inflammatory properties make RES a top candidate for complementary and alternative medicine. It is a nonflavonoid polyphenol found in many plants such as grapes and mulberries, and its beneficial effects have been shown in many disease models such as cardiovascular disease and cancer. Here, we demonstrate that treatment of mice with 100 mg/kg body weight RES significantly reduced vascular leak in our mouse model. In vivo, our histological studies showed decreased infiltration in the lungs upon resveratrol treatment compared to SEB-treated animals, and flow cytometry studies further confirmed less CD8+ T, NK and NKT cells in the lungs of RES-treated mice. Our in vitro studies showed that RES induced apoptosis only in activated T cells and not in na)"ve T cells; therefore decreasing TNF-alpha and IFN-gamma secretion by activated lymphocytes. Overall, RES is immunosuppressive in this model of ARDS because it induces selective apoptosis in SEB-activated lymphocytes, and inhibits the amplification of the immune response.

THE ROLE OF MULTIPOTENT EPICARDIAL CELLS IN THE FORMATION OF CARDIAC VALVES AND SEPTA

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USC School of Medicine

Epicardial cells have an emerging role as cardiac stem cells. These cells and their progenitors, proepicardial (PE) cells, have been demonstrated to give rise to all resident cell types in the heart. The contribution of PE-derived cells to the atrioventricular (AV) septum and valves is not well established. However, recently published reports and our own studies indicate that AV valve progenitor cells stimulate PE cells to migrate into this region of the developing heart. Once there, PE cells are reported to stimulate the deposition of fibrous extracellular matrix (ECM) molecules including periostin and collagen. The expression and localization of these ECM proteins is critical to the proper development and function of the heart. Using a unique 3-D culturing modeling, we have found that AV cushion tissues can induce PE cells to undergo an epithelial to mesenchymal transformation (EMT). These transformed cells were then observed to migrate into the developing valve tissues. Our early studies indicate that members of the TGFb family of proteins, specifically TGFb1 and 3, are critical regulators of this process. When PE cells were cultured on the tube scaffolds containing TGFb1, TGFb3, or both, PE cells underwent EMT. Using confocal analysis, we have also observed the expression and localization of ECM molecules in these transformed cells. These observations indicate that the AV cushions release TGFb molecules that attract PE cells, which then express fibrous ECM proteins. Since AV valve and sepal birth defects are amongst the most common of all birth defects, delineating molecular mechanisms of their formation is critical. We further suggest that understanding the mechanisms of valve formation, and specifically the role of these multipotent cells, will benefit the long term goal of developing new therapies for these birth defects and pave the way for the in vitro production of replacement valvular and septal tissues. USC School of Medicine IRF and NIH RO1 to RLG # HL 086856

IDENTIFICATION AND CHARACTERIZATION OF OLFACTORY RECEPTOR GENES IN FOUR SPECIES OF SC SNAKES

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USC Aiken

The Purpose of this study was to identify and characterize olfactory receptor (OR) genes from Lampropeltis getula (King Snake), Nerodia fasciata (Water Snake), Heterodon simus (Hog Nosed Snake), and Agkistrodon contortrix (Copperhead) to determine how reliant these snakes may be on olfaction as an odor detection system. There are two chemosensory systems for detecting odors; olfaction and the vomeronasal system. The vomeronasal system involves a structure on the roof of the mouth called the Jacobson's Organ and it is well characterized in snakes. Olfaction involves olfactory receptor proteins within the nasal cavity that bind to odors in the air. It has not been well studied in snakes although olfaction may play an important role in helping snakes forage for prey. Olfactory receptor proteins are coded for by olfactory receptor (OR) genes. If an animal's use for olfaction is limited mutations will accumulate in these genes making them nonfunctional (pseudogenes). Apes rely on vision more than olfaction and around 60% of their OR genes are psuedogenes. Mice rely on olfaction for many behaviors. Twenty percent of their OR genes are pseudogenes. If snakes rely more on the vomeronasal system, or another sensory modality such as heat sensing, for detecting prey then many of their OR genes will be pseudogenes. Reliance on the olfactory system may depend on foraging strategies and other sensory capabilities so four species of snake were compared. It is expected that snakes will have more pseudogenes then mice but perhaps not as

many as apes. Copperheads may have more pseudogenes than the other snakes studied because they use heat sensory pits to detect prey. DNA was extracted from blood samples collected at the Savannah River Site. Olfactory receptor genes were isolated using PCR, cloned and sequenced. The sequences were checked against known OR genes in Genbank using the NCBI Blast server and conserved regions of OR genes were used to select the appropriate reading frame to characterize sequences as pseudogenes. Preliminary data shows that Hog-nosed snakes have around 29% pseudogenes.

ANALYSIS OF HPV IN HEAD AND NECK CANCER PATIENTS WITH RESPECT TO RACE

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Introduction: South Carolina exceeds the U.S. incidence rate for head and neck squamous cell carcinoma (HNSCC), ranking 3rd in the nation in mortality. Black males in SC have a higher incidence of HNSCC than any other ethnic/gender group, and suffer a mortality rate that is twice that observed in white males and females. High-risk human papillomavirus (HPV) has recently been identified as an etiologic factor in ~25% of all HNSCC. Due to the observation of better survival in HPV related disease, differences in HPV infection need to be accounted for when significant differences in survival are noted between racial groups. We therefore investigated whether differences in HPV infection of HNSCC correlated with the observed racial disparities in disease.

Methods: 48 frozen HNSCC specimens were obtained from the MUSC-HCC Tissue Biorepository. Genomic DNA and total RNA were extracted and tested for HPV16 E6 and E7 sequences by real-time qPCR. GAPDH was also quantified as endogenous standard. Patient charts were examined for data on race, sex, age, and response to therapy. Results: 16/48 (33.3%) had on average >0.05 copies of HPV16 E6/E7 DNA per cell, which correlated with 104 - 106 E6 and/or E7 cDNA copies per reaction. 8/48 (16.7%) had lower levels of viral DNA (0.01-0.05 copies per cell), with correspondingly lower levels of E6 and/or E7 transcripts, <5,000 cDNA copies per reaction. HPV16 E6/E7 DNA and RNA were undetectable in 24/48 specimens (50.0%). Preliminary results indicated that a trend was seen for white race and male sex correlating with HPV16 status >0.05 copies per tumor cell. Conclusions: In this relatively small sample of HNSCC patients (n=48), we found preliminary evidence indicating that race might be a factor in HPV tumor status. Since HPV infection correlates with better survival, additional patient research is warranted.

INTERACTION OF EXOGENOUS AND ENDOGENOUS VIRUSES IN HEAD AND NECK CARCINOMA.

Semyon Rubinchik, Jacob Smith, Brian Hoel, and Lucinda Halstead
MUSC

Oncogenic viruses are etiologic agents in two forms of head and neck cancer. Epstein-Barr virus (EBV) is associated with virtually all undifferentiated nasopharyngeal carcinomas (NPC), and human papillomavirus (HPV) is associated with approximately half of oropharyngeal squamous cell carcinomas (OSCC). We previously discovered that EBV transactivates a human endogenous retrovirus, HERV-K18, that encodes a superantigen in its envelope gene. Superantigens cause strong T cell activation and cytokine production, resulting in inflammation. Recently, we found that HPV also induces this superantigen in epithelial cells, suggesting a possible etiological role for HERV-K18

related inflammation in virally associated head and neck cancers. In support of our findings, superantigen transcripts were detected in 20/20 EBV+ NPC specimens tested, and were significantly increased In HPV+ OSCC compared with HPV- tumors. HPV16 E6 and E7 oncoproteins were each sufficient to transactivate the HERV-K18 superantigen in primary tonsil (oropharyngeal) epithelial cells, while EBV LMP2 was sufficient to transactivate the superantigen in primary adenoid (nasopharyngeal) epithelial cells. We hypothesize that HERV-K18 superantigen activated T cells affect virally associated head and neck cancers by eliciting a localized inflammatory response that could either promote or inhibit carcinogenesis, depending upon the T cells present in the tumor microenvironment. Superantigen associated T cell proliferation might result in expansion of either effector or regulatory responses, while activation induced cell death might cause functional tolerance of either T cell subset, altering the balance between cytotoxicity and T cell suppression. This work is supported by the following: ACS-IRG-97-219-05, HCC Seed Grant Award, COBRE P20RR017696, COBRE 2P20RR017696-06

INVESTIGATING STRUCTURAL HETEROGENEITY IN SINGLE DIMERS OF AMYLOID-BETA PEPTIDE

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Amyloid-beta (Abeta) is a peptide of 39-43 amino acids that aggregates to form the senile plaques associated with Alzheimer's disease. Recent evidence suggests that soluble oligomers as small as dimers may be linked to disease progression. As such, understanding how these peptides first begin to associate is a vital step toward preventing and treating Alzheimer's. We are using single molecule spectroscopy (SMS) to investigate the structures of individual fluorescently labeled Abeta(1-40) dimers. Dimers are prepared by combining monomers singly labeled with the donor and acceptor dyes FAM and HilyteFluor TR (HFTR). Biotin moieties on the donor-labeled peptides permit tethering to functionalized cover slips. Laser excitation prepares excited donor (FAM) dyes; peptide association into dimers (and larger species, excluded during analysis) is evidenced by acceptor (HFTR) fluorescence, which can occur due to F÷rster Resonance Energy Transfer (FRET) between the dyes. Dimers are located by imaging 2020-micron regions of sample, separating dye fluorescence onto donor and acceptor channels: the appearance of a co-localized spot on both detectors is indicative of at least a dimer. By measuring donor and acceptor fluorescence as a function of time, we are able to determine time-dependent FRET efficiencies for individual dimers, gaining insight into inter-dye distance and dimer structure. To date, we have determined that dimers prepared in solution, prior to surface-tethering, exhibit a particular range of FRET efficiencies. Comparison to published simulations of planar Abeta(1-40) dimers suggests that we observe only a subset of the likely dimer structures, perhaps representing preferred structures in solution. We are currently studying dimers prepared on the glass surface, to determine whether a broader distribution of (preferred and transient/trapped) structures may be observed. Together, these results may lend important new insight into the structures of small Abeta oligomers to be targeted in the treatment of Alzheimer's disease. The work described was supported by NIH Grant Number P20 RR-16461 from the National Center for Research Resources, for support of the program entitled ôSouth Carolina IDeA Networks of Biomedical Research Excellenceö (SC-INBRE). Additional support was received from the Winthrop University Research Council (Grant Number 59228).

TRISTETRAPROLIN-MEDIATED INDUCTION OF CELLULAR SENESCENCE IN HPV-TRANSFORMED CERVICAL CANCER CELLS

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USC Columbia

Cervical cancer is the second most common cancer among women worldwide and about 1/3 of the infected women die of the malignant form of the disease. A necessary factor in the development of nearly all cases of cervical cancer is human papillomavirus (HPV) infection. HPV promotes cell transformation through expression of the early viral genes E6 and E7. The HPV E7 protein neutralizes the retinoblastoma (Rb) tumor suppressor pathway, while the E6 protein promotes degradation of the p53 tumor suppressor, through its interaction with the cellular ubiquitin ligase E6-associated protein (E6AP). E6 also activates transcription of the human telomerase reverse transcriptase gene (hTERT). In the present study, we found that expression of the mRNA decay factor TTP in HPV18-positive HeLa cells dramatically inhibited cell proliferation and tumorigenesis by inducing cellular senescence. Actively growing HeLa cells maintain a dormant p53 pathway and elevated telomerase activity. TTP expression by the means of an inducible expression system in HeLa cells increased expression of p53 protein and enhanced p53-dependent transcriptional activity. Upon investigating the p53 regulatory network, we found no change in mRNA levels of E6 and E7 oncoproteins in the presence of TTP, indicating that these viral factors are not direct targets of TTP. However, E6-AP was found to be down regulated both at mRNA and protein levels in the presence of TTP. Furthermore, the association of E6 and E6-AP promotes transcriptional activation of hTERT, and TTP-dependent down regulation of E6-AP resulted in inhibition of hTERT expression and cellular telomerase activity. Similar results were obtained with other high-risk HPV-positive cell lines that employ the E6-AP pathway to control p53 and hTERT levels. Sequence analysis of E6-AP mRNA indicated presence of putative AREs in its 3'UTR. RNA-binding studies demonstrated the interaction between TTP and E6-AP mRNA and the presence of TTP promoted rapid degradation of E6-AP mRNA. TTP-mediated rapid decay of E6-AP mRNA was seen to occur in an ARE-dependent manner since deletion of the 3'UTR completely abrogated this decay while presence of the 3'UTR down regulated the reporter expression. Finally we demonstrate that TTP expression is lost in cervical cancer. Based on these results we conclude that TTP promotes cellular senescence in HPV-transformed cervical cancer cells through rapid decay of E6-AP mRNA leading to p53 protein stabilization and inhibition of hTERT transcription. Moreover, absence of TTP expression in cervical cancer strongly suggests that loss of TTP expression is a critical step that occurs early in HPV-mediated carcinogenesis. Thanks to Dr. Lucia Pirisi-Creek and Dr. Kim Creek.

ADSORPTION OF LYSOSTAPHIN TO PLA NANOPARTICLES RESULTS IN ITS ENHANCED ACTIVITY AGAINST S. AUREUS

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Staphylococcus aureus is an opportunistic Gram-positive pathogen capable of causing a wide range of infections. Currently, there is a constant need for new antistaphylococcal drugs owing to the development of antibiotic-resistant strains. Use of proteins and peptides as antimicrobial agents is inspired by nature and has recently attracted much attention as an antibiotic-free approach to treat bacterial infections. Lysostaphin is an antibacterial enzyme which specifically cleaves cross-linked pentaglycine bridges in the peptidoglycan of S. aureus, thereby hydrolyzing the cell wall and lysing the bacteria. The use of such antibacterial enzymes attached to biodegradable and biocompatible

polymer nanoparticles is of special interest because of enhanced stability of enzyme-nanoparticle conjugates compared to that of free enzyme and the possibility of targeted delivery at the site of infection. The objective of this approach was to study and compare the antimicrobial activity of lysostaphin adsorbed on the surface of 200 nm PLA (poly(lactic acid)) nanoparticles and compare the activity of conjugated lysostaphin to that of the free enzyme. A Rabbit polyclonal S.aureus antibody was also coadsorbed along with lysostaphin to evaluate the effectiveness of delivery based on antibody-directed targeting. Monodisperse PLA nanoparticles were synthesized using an oil/water emulsion method using Pluronic F68 as a surfactant. Adsorption of of Alexa 594 labeled lysostaphin with or without Alexa 360 labeled S. aureus antibody to PLA nanoparticles was studied at several concentrations and enzyme: antibody ratios. The samples were incubated overnight at RT and centrifuged at 2000 g for 1 hr to separate unbound protein from the pellet. Binding yield for enzyme and antibody was calculated from fluorescence intensities of initial suspension, supernatant and redispersed pellet. At least a three fold increase in the rate of S. Aureus degradation was observed in the case of enzyme-nanoparticle conjugates as compared to that of free enzyme at the same concentration. We hypothesize that the greater activity of enzyme-nanoparticle conjugates is due to its binding to the bacteria through multiple ligands. Presence of the antibody did not significantly affect the rate of the S. Aureus degradation, suggesting that lysostaphin binding plays critical role in the process of bacterial lysis. Such enzyme-nanoparticle conjugates have a potential for becoming novel therapeutic agents for treatment of antibiotic-resistant S. Aureus infections.

EXTRACTION OF SEED OIL FOR BIODIESEL

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Some crop and weed seed species that are native of South Carolina have been attempted to explore as potential source for biodiesel production. The percent lipid per fresh weight of seeds was measured gravimetrically following petroleum ether extraction process. The highest percent lipid per fresh weight of crop seeds was exhibited in mustard, string bean and soybean species and they were 10.0, 12.05 and 14.2 percent respectively. The highest percent lipids per fresh weight of weed seeds were exhibited in crotalaria seed species and they were 8.01 and 10.2 percent respectively. Considering cost for raising plants and costs for chemicals used for processing it may not be economically feasible for biodiesel production. Mechanical extraction of seed oil produces more lipids as compared to ether extraction and it is probably more economical. Methyl ester of fatty acids (FEMA/biodiesel) was prepared from extracted seed lipids and was quantities. The extracted lipid volume and the added methanol volume determined the volume of prepared biodiesel. The research was guided by the second author Dr. Ajoy G. Chakrabarti and funded by NSF/UP/RISC program at South Carolina State University.

EXPRESSION AND ACTIVITY OF GAMMA-AMINOBUTYRIC ACID RECEPTOR (SUBTYPE A) IN HUMAN BREAST CANCER

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The neurotransmitter gamma aminobutyric acid (GABA), acting via the GABA subtype A receptor (GABAar), is the main inhibitory neurotransmitter in the mammalian brain. In addition to neuronal cells, functional GABAa receptors have been found in non-neuronal cells such as endocrine and smooth muscle cells. GABA can be synthesized from glutamate

by the enzyme glutamate decarboxylase (GAD). A significant increase compared to normal tissue in GABA and GAD levels has been reported in breast, gastric and colorectal cancer. GABA activity has also been associated with prostate cancer proliferation and metastasis. In this study we have examined the expression of GABAar in 45 human breast cancer specimens, by immunohistochemistry. A moderate level of GABAar was observed in a normal human breast specimen. GABAar expression in the 45 breast cancer specimens, was found to be very low in 2 (4%), low in 5 (11%), moderate in 20 (44%), high in 13 (29%) and very high in 5 (11%). The GABAa agonist isoguvacine stimulated the proliferation of two human breast cancer cell lines: MCF-7 (~ 35% maximal stimulation at 10 ug/mL) and MDA-MB-231 (~ 65% maximal stimulation at 5 ug/mL). Dihydroergotoxine, which can modulate GABAar chloride ion-channel activity, inhibited the proliferation of both the breast cancer cell lines, in a dose-dependent manner. Half-maximal concentration for growth-inhibition was ~18 ug/mL dihydroergotoxine. These data suggest that GABAar is frequently expressed in human breast cancer and is involved in cell proliferation.

AGING MEMBRANE RESPONSE OF ENZYME CONTAINING P(HEMA)-BASED HYDROGELS

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Physiological parameters such as cardiac output, oxygen tension (VO2) and renal output are altered with the body's hemostatic response to state of injury or 'shock'. It has been established that lactate concentration in blood is the best indicator for assessing the degree of shock subsequent to traumatic hemorrhaging. Blood lactate concentrations in excess of 4.5mmol/l is critical and requires the patient to be given immediate medical attention [1]. Ease of determination of such lactate concentrations at the site of an accident or in a battlefield setting helps commitment to consistent triage. Such an implantable biosensor is currently under development for rat hemorrhagic models [2]. These electrochemical sensors comprise lactate oxidase (LOx) and glucose oxidase (GOx) immobilized within a poly(hydroxethyl methacrylate) (p(HEMA)) based hydrogel matrix [3, 4] , which in turn is covalently attached to an electrode surface for transduction of the chemical signal to an electrical one (resulting in an amperometric or voltammetric response). Commercially available glucose and lactate sensing membranes have been studied for their time-dependant response in a YSI Glucose-Lactate Bioanalyser. While the glucose sensing membrane maintains its activity for as long as 50 days, the lactate sensing membrane does not survive more than 30 days. PEGylated glucose oxidase and lactate oxidase have been introduced into a p(HEMA)-based hydrogel for immobilization onto polycarbonate membranes. The membranes were inserted at the glucose and lactate probes of the bioanalyzer to evaluate the aging membrane response, which is a function of declining enzyme activity. It is hypothesized that immobilization of PEGylated enzymes within the hydrogel will improve enzyme stability and extend the lifetime (activity) for glucose or lactate sensing. Immobilization of the enzyme loaded hydrogel membranes onto polyethylene terepthalate membrane was done by glutaraldehyde induced crosslinking of bovine serum albumin protein.

VISIBLE AND FT-IR PHOTOACOUSTIC SPECTROSCOPIC CHARACTERIZATION OF BISMUTH NANORODS

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Bismuth, as encountered in nature, is a high molecular weight semimetal, and has electrical properties between metals and semiconductors. It is highly diamagnetic and has low thermal conductivity. However, when observed on the nanoscale, it has markedly different properties than it does in the bulk form. The most significant and useful of these properties is the semimetal-semiconductor transition. Bismuth nanorods are a promising material, but at this time not much is known about them. Elucidating their optical properties is the goal of this project. Visible and Fourier Transform Infrared (FTIR) Photoacoustic Spectroscopy (PAS) were used to measure the absorption characteristics of bulk and nanorods (10 nm diameter) of Bismuth in the visible and mid-IR regions. Bulk Bismuth did not provide any absorption features in the visible and IR regions. Bismuth Oxide, however, revealed a semiconducting transition with a band gap around 3.10 eV. The Bismuth nanorods revealed two broad absorption features. Preliminary analysis reveals that the absorption local maxima are most likely the result of transverse and longitudinal plasmon resonances due to the large aspect ratio of the nanorods. Another possibility is that the presence of impurity levels may also contribute to the absorption peak at the higher wavelength. Two major IR peaks for bulk Bismuth Oxide and 10 nm diameter Bi nanorods occur at exactly the same wavenumbers (1388 cm-1 and 1469 cm-1). However, two peaks at 543 cm-1 and 636 cm-1 have also been observed specifically for Bi nanorods. Our results reveal that the Bismuth Oxide cover present on the Bi nanorods is very active in the IR spectra and should be taken into serious consideration while analyzing the IR spectra of Bi nanorods. A detailed analysis of the observed data is currently underway. This work was supported by the Nanotechnology Undergraduate Education (NUE) program of the National Science Foundation (Award No.EEC-0634142). Thanks are also due to Professor Apparao Rao and Mr. Jason Reppert at Clemson University for providing the Bi nanorods.

CELL THERAPY AS A NOVEL TREATMENT FOR VASCULAR CALCIFICATION

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Vascular calcification occurs during physiological aging and is clinically recognized as a major risk factor for myocardial infarction, systolic hypertension, heart failure and coronary insufficiency caused by loss of aortic recoil. Medial arterial calcification is an active remodeling process that involves the deposition of bone-specific matrix in close association with elastic fibers. Elastin, a major structural protein in the extracellular matrix of arterial walls, provides elastic recoil to the arteries. Increasing evidence suggests that vascular calcification share features with skeletal bone formation such as bone matrix deposition and bone resorption. Bone morphogenic proteins and bone cells have been found in explanted atherosclerotic plaques. In bone a homeostasis is maintained by its two major cell types; osteoblasts and osteoclasts. Osteoblasts form new bone matrix and osteoclasts, multinucleated giant cells which are derived from bone marrow progenitor cells, are responsible for bone resorption.

Our objective is to evaluate the use of osteoclasts differentiated from bone marrow progenitor cells as a cell therapy treatment for vascular calcification. Previously we have shown that osteoclasts are effective in demineralizing calcified elastin both in vitro and in vivo using our subdermal calcification model (Simpson, 2007). We are proposing

a cell therapy treatment to use osteoclasts to resorb calcified elastin in an abdominal aortic injury model. The authors would like to acknowledge the department of Bioengineering at Clemson University, the Godley Snell Research Center and Hunter Endowment for funding.

PYRAZOLE-ACETIC AMIDES FROM POLYLITHIATED BETA-KETOAMIDES; ESTERS, AND HYDRAZINE

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College of Charleston

Several beta-ketoesters were dilithiated with excess lithium diisopropylamide (LDA) to form dianion type intermediates that were condensed with a variety of substituted aromatic esters that resulted in C-acylated products, 3,5-dioxopentanates, that were readily isolated and characterized. Their transformation to NH-pyrazoles, 5-aryl-1H-pyrazole-3-acetates, by a second condensation with hydrazine was straightforward.

Acetoacetanilide was trilithiated with excess LDA to a reactive trianion-type intermediate, followed by the selective condensation of this intermediate with a variety of aromatic esters to 3,5-diketopentane-carboxanilides that were not isolated but immediately condensed-cyclized with hydrazine to afford the pyrazole-amides [5-aryl-1H-pyrazole-3-acetanilides], before these C-acylated intermediates had an opportunity to rearrange to 2-pyranones [4-anilino-6-aryl-2H-pyran-2-ones]. Acknowledgements: College of Charleston, Summer Undergraduate Researdh Forum (SURF), Research Corporation; recently, NSF-RUI and USDA

PHASE SEPARATION AND WETTING LAYER EFFECTS IN NEAR CRITICAL SULFUR HEXAFLUORIDE

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Near the liquid-gas critical point the compressibility of a fluid is very high, so a near critical fluid will collapse under its own weight in a gravitational field. Modern space exploration has enabled new experiments to be performed in microgravity and new phenomena to be observed. Image processing techniques were applied to study images of near critical sulfur hexafluoride recorded during an experiment performed in microgravity. Two image segmentation methods were tested to analyze the growth of liquid and gas clusters during early stage phase separation. The first method, called thresholding, segments the image based on a gray-level threshold. The second method, called k-means, separates the image into clusters based on the cluster centroids and the mean value of the clusters. Images of intermediate to late stage phase separation show the development of a wetting layer around the fluid. The growth of this wetting layer in time was investigated using segmentation and edge detection methods. Lastly, an image processing method called granulometry was applied to study the growth of spherical droplets during late stage phase separation.

INHIBITION OF ALZHEIMER'S DISEASE AMYLOID-β FIBRIL FORMATION

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Alzheimer's disease (AD) is a progressive neurodegenerative disorder and the leading cause of dementia in the elderly, accounting for 70% of all diagnosed dementia cases. Current therapies for the disease allow AD patients to delay or mitigate the symptoms in order for them to have a better quality of life. However, these therapies do not stop the progression of the disease. Leading theories suggest that accumulation of amyloid plaques is one of the first abnormalities in AD; thus, our study addresses inhibition of amyloid plaques formation.

The primary component of the amyloid plaques found in AD is the fibrillar form of the amyloid-β protein (Aβ). Aβ is a short peptide proteolytic product of the transmembrane amyloid precursor protein (APP). The 'amyloid cascade hypothesis' states that monomeric Aβ self-aggregation forms fibrils that are subsequently deposited in AD brain. Soluble intermediates have been identified along the fibril formation pathway and increasing evidence suggests that these soluble aggregates could be the primary cause of toxicity. Inhibition of Aβ self-assembly at different points of the process has emerged as a therapeutic strategy for AD.

A number of small molecules have been identified as inhibitors of Aβ self-assembly. However, no information about the relationship between the structures of potential inhibitors and their mechanism of inhibition has been reported. This study will focus upon the identification and characterization of small molecules that inhibit Aβ fibril formation *in vitro*. We will identify key structural components that will define effective inhibitors and may serve as active ingredients in future drug development. This study considers the hypothesis that small molecules containing aromatic structures will have different effects on specific mechanisms of Aβ fibril formation as a result of differences in their interaction with Aβ. A number of aromatic compounds will be evaluated on their ability to inhibit fibril formation from monomeric protein aggregation. The ability of these compounds to inhibit fibril formation from two distinct mechanisms of soluble aggregates growth will also be assessed. After identifying the compounds that exhibit effective inhibition in different mechanistic assays, an analysis of the relationship between structure and function will be performed. Also, we hypothesize that the conjugation of inhibitory molecules to a surfaceûmodified gold nanoparticle will enhance the inhibitory activity. Aromatic compounds identified as effective inhibitors of Aβ fibril formation will be conjugated to nanoparticles varying in size, shape and coating surface and will be tested in the same assembly mechanisms.

ATOMIC FORCE MICROSCOPY STUDIES OF POLYHYDROXYALKANOATE INCLUSION SURFACE STRUCTURE

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Polyhydroxyalkanotes (PHAs) are storage inclusions formed by some bacterial species when carbon levels are low and an essential nutrient, such as nitrogen, is limiting. PHAs are of considerable interest because they can be formed into a biodegradable plastic and, in fact, a production facility is currently being constructed in Iowa. Though much is known about PHA biosynthesis pathways, little is known about the structure of PHA inclusions that house the polyester in the cell. Employing atomic force microscopy (AFM), we have demonstrated that the inclusions contain three layers at their surface; an outer

membrane, a network underneath the membrane that is likely to be protein, and a crystalline lamellar shell composed of polymer. These data were gathered through AFM scans of thousands of micrographs, looking for infrequently found aberrant structures (such as torn outer membranes). In order for this technique to be facile enough to conduct further gene deletion/structure studies a technique must be developed that results in a higher frequency of abberant surface structures that still retain the basic structure of the inclusion. In preliminary experiments we have found that freeze-thaw cycles under varying conditions have shown promise. We are in the process of conducting controlled investigations into the efficacy of this procedure and will present the results and their interpretation.

DEVELOPMENT OF AN HPLC-F mETHOD FOR THE DETECTION OF MELATONIN IN STENOSTOMUN VIRGINIANUM

Daniel Stanton and Cliff Calloway
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Melatonin has been described as an almost ubiquitous hormone in living systems, including animals and plants. Small amounts of melatonin have been shown to be present in grape skins and wines. It has been associated with regulating circadian and diurnal rhythms and exhibits anti-oxidant properties, similar to vitamin C. Anti-oxidants like melatonin have been associated with such phenomena as the so-called ôFrench paradoxö. That is, high-fat cuisine, yet low incidence of cardiovascular disease. In triclad flatworms (Platyhelminthes, Rabditophora), melatonin suppresses asexual reproduction. It has been suggested that melatonin's most primitive function is to act as a scavenger of free-radicals. Melatonin exhibits fluorescence spectroscopic properties, which is often used as a detection method due to the selective nature of this property. In this study we develop and validate an analytical HPLC method using fluorescence detection for melatonin in Stenostomum virginianum (Platyhelminthes, Catenulida). We calculated the average amount of melatonin per worm and analyzed the worms for diurnal variance in levels present at the time of death. We then use this data to create a biological production clock indicative of S. virginianum that can be compared to other species production clocks.

HISTORY OF THE SOUTH CAROLINA ACADEMY OF SCIENCE

David Stroup
Francis Marion University

The South Carolina Academy of Science (SCAS) was organized in 1924 under the direction of Dr. G.C. Mance, Professor of Geology at Winthrop College. In 1927, the academy affiliated with the American Association for the Advancement of Science. Publication of the Bulletin of the Academy began, and in 1973 the SCAS Newsletter was established as a vehicle for communication among members. Beginning in the 1960s, 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. The South Carolina Junior Academy of Science was founded by Dr. John Michner in 1969 and the Middle School/Elementary School Academy was founded by Dr. Don Jordan in 1991. The first issue of the peer reviewed, electronic, Journal of the South Carolina Academy of Science was published in the Fall of 2003. The Academy is dedicated to raising the level of science education in South Carolina and to promoting research and the transmission of knowledge within the State. The Academy of Science is the only statewide interdisciplinary science organization whose membership includes high school students, teachers and 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. One reason for this broad spectrum of support for the Academy is that individually and collectively, members share a deep commitment to promote research and to stimulate the creative abilities of senior scientists and the youth of our State.

FLUID FLOW REGULATES ECM EXPRESSION AND DEPOSITION DURING CARDIAC VALVE DEVELOPMENT

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Cardiac valve formation can be divided into two phases: Epithelial to Mesenchymal Transformation (EMT) phase and post-EMT phase. Formtion of endocardial cushions, the primodia of cardiac valves, involves extracellular matrix (ECM) deposition and an EMT of endothelial cells. After endocardial cushion formation, the mound-like swellings attenuate, elongate and stiffen into fibrous valve tissues during the post-EMT phase. Intensive studies have been focusing on EMT phase and this process has been well described. However, little is known about the post-EMT phase. It has been postulated that the increasing fluid flow forces that occur during cardiovascular development play an active role in the morphogenesis of valve tissues. To investigate the effect of fluid flow mechanical force on valve maturation and the underlying molecular mechanisms, we have utilized a novel three-dimensional in vitro culture system. In our model, AV cushion explants from chicken embryos are cultured inside a tubular collagen scaffold, which is connected to a pulsatile pump that mimics the in vivo closed circulatory system. Our data from real-time PCR, immunohistochemistry and westernblot indicate that fluid flow can regulate the expression and localization of ECM proteins in developing AV cushions, including tenascin C, Type I collagen (col1) and an important regulator of col1, periostin. Our interest in determining the underlying mechanisms by which fluid flow regulates the fibrous development of valve tissues has led us to investigate the Rho signaling pathway. This pathway has long been implicated as an important mediator of mechanical signals in endothelial cells. Our current work supports the importance of the Rho pathway in fibrous valve development. The long-term goal of this research is to use the mechanisms that we delineate to become better valve tissue engineers, in the hope that this will lead to better therapies for the numerous cardiac valve disorders. This work is supported through the National Institute of Health: HL086856-01(RLG) and many thanks to instrumental resource facility of SOM.

PROCESSING ENDOTOXIN-CONTAMINATED METALLIC BIOMATERIALS WITH COMPRESSED CO2-BASED MIXTURES

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Universiy of South Carolina

The presence of bacterial endotoxins on reusable medical devices and biomaterials has been a major challenge for reprocessing centers and manufacturers in achieving depyrogenation. Conventional cleaning methods employing water and detergents are not sufficient to eradicate endotoxins. This study evaluated the removal of E. coli endotoxin from titanium (Ti) substrates and stainless steel lumens using compressed carbon dioxide (CO2) and compressed CO2-based mixtures as the cleaning fluids. The results demonstrated that, for a well mixed system, a water-in-CO2 microemulsion at room temperatures and moderate pressures (25C and 27.7 MPa) can remove 100% of the

endotoxin applied on Ti surfaces and stainless steel lumens. The successful removal of endotoxins from metallic biomaterials with compressed CO2 indicates a promising alternative technology for the final cleaning of biomaterials and reused medical devices. The authors acknowledge the National Institutes of Health (NIH) for partially supporting this work under a Bioengineering Research Partnership grant (R01EB55201). Financial assistance for Pedro J. Tarafa was provided by the Alfred P. Sloan Foundation and the South East Alliance for Graduate Education and the Professoriate (SEAGEP).

THE EFFECTS OF ZINC ACCUMULATION ON DIABETES IN THE AFRICAN AMERICAN COMMUNITY VS. THE CAUCASIAN AM

Bianca Thomas, Leslie Johnson, and Omar Bagasra
Claflin University

Diabetes is one of the number one killers of African Americans. According to the American Diabetes Association, there are currently 23.6 million people in the United States living with the disease. Approximately 3.7 million African Americans have been diagnosed with diabetes in the year 2006-2007. There is a 27% higher rate of diabetic cases in African Americans than whites just in America alone. African Americans are 1.6 times more likely develop diabetes when compared to Caucasian Americans. Why is this so? My research examines the effects of zinc accumulation in the pancreatic tissues of various racial groups to see if zinc receptors may hold an answer to this question. Through evolutionary time African Americans have genetically down regulated their zinc absorption capacity. The content of zinc in the pancreatic beta-cells is among the highest in the body, serving as an essential trace element responsible for key biological processes. Zinc acts as an important mediator in the storage and secretion of insulin. I hypothesize that the effects and degree of zinc accumulation plays a role in the onset of diabetes and the magnitude of susceptibility in African Americans. Through a series of experiments using zinc indicator dyes (NPG and TSQ), fresh frozen pancreatic tissue, and a technique of differential staining using specialized fluorescently labeled zinc indicator dyes zinc accumulation can and was detected. When examining the pancreatic tissues of a Caucasian and African American with same or similar sex and age, it is clear that Caucasian Americans have more zinc accumulation.

AN ANALYSIS OF INTRAUTERINE INSEMINATION PREGNANCY RATES

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Intrauterine Insemination (IUI) is an Assisted Reproductive Technology (ART) procedure that aids infertile couples in becoming pregnant when they are unable to conceive naturally. In most cases, a couple will have to attempt several IUIs, referred to as cycles, before achieving a successful pregnancy. As a result, analysis of IUI data is complicated by correlations that develop among these multiple cycle attempts within the same couple.

This study consists of 356 couples who attempted a total of 679 IUI cycles from September 2005 to January 2008 at Greenville Hospital System. The goal of this study was to discover what factors affect the pregnancy rate among women who are artificially inseminated. In order to account for the presented dependency, three statistical approaches were taken. First, the individual cycle attempts were analyzed since each patient only underwent each cycle once. Second, a Generalized Estimating Equations

(GEE) model that clusters the same patient observations was applied. Thirdly, one cycle per patient was randomly selected to create a new data set for analysis, in a process that was repeated 100 times.

In all three methods, SAS software was used to fit a logistic regression model in order to determine which variables, out of a possible fourteen, had a significant effect ($P < 0.05$) on pregnancy. The first approach indicated that a woman's age has a negative effect on pregnancy in the first two cycles and that a non-linear model for pregnancy when given the patient's age is actually a better fit. The second approach conveyed that a woman's age, stimulation group, diagnosis group, and sperm recovery percentage all had a significant effect on pregnancy. And the third approach additionally uncovered that gravida, the total number of motile sperm after semen gradient preparation, and days of abstinence had a significant positive effect on pregnancy.

However, by dividing the data set up by cycle, the first approach erroneously assumes that cycle has a significant effect on pregnancy. Additionally, by clustering the multiple cycles of each patient in the second approach, an inaccurate unstructured correlation matrix had to be employed and the pregnancy outcome became a non-random variable. In conclusion, the best approach to the analysis of the data was determined to be the third approach. This research opens many doors for future analysis that may consider more variables as well as non-linear models in conjunction with the third approach to determine significant factors that affect pregnancy.

CAUGHT ON CAMERA: CAMERA TRAP ASSESSMENT OF FAUNA AT WILDSUMACO WILDLIFE SANCTUARY, ECUADOR

E. Natasha Vanderhoff, Travis Knowles, Jeff Camper, and Monica Sokol
Francis Marion University

The Andes region of South America is particularly high in biodiversity, and biologists have sought to better understand and monitor the fauna to aid conservation efforts in this valuable region. Although tropical forests teem with wildlife, the majority of animals are elusive and difficult to monitor, and thus are often overlooked. As a result of these oversights, assessments of tropical diversity can be misleading and inaccurate. Camera traps, a recent and valuable technology, allow scientists to capture rare and elusive animals that are normally missed by normal detection methods. We conducted a preliminary camera trap investigation of the fauna at Wildsumaco Wildlife Sanctuary (WWS), Ecuador. We examined habitat preference and daily activity patterns of fauna captured, as well as created a species accumulation curve. We captured images of several taxa including birds, rodents, and cats. Our results suggest that WWS, although surrounded by human disturbance, still maintains high diversity. We are grateful to Jim and Bonnie Olson, and Jonas Nilsson, owners of Wildsumaco. Francis Marion University supported this project through QEP, IT, Professional Development, Women and Minorities in Science, and Biology Enhancement funds.

IDENTIFICATION OF GONADAL BIOMARKERS OF LOW DOSE POLYBROMINATED DIPHENYL ETHER (PBDE) EXPOSURE

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Polybrominated diphenyl ethers (PBDEs) are flame retardants that are widely used in textiles, plastics, and electronics. PBDE levels in human serum increased by 8000-9000% from 1973 to 2003. High doses of penta-BDEs in the mg/kg bw range negatively impact behavior, memory, thyroid hormone function, reproduction, and bone development. This study investigated the effects of ingestion of a relatively low dose of the penta-BDE mixture DE-71 by pregnant rats on reproductive and endocrine parameters of the F1 offspring. F0 dams received 60 mg/kg bw of DE-71 by gavage from day 1 of pregnancy through lactation. F1 animals were sacrificed at postnatal day 21, or after breeding, at 5 months of age. Some adult F1 females were sacrificed at day 14.5 of pregnancy. At sacrifice, tissues were dissected, weighed, and either frozen for RNA isolation or fixed for histology; serum was also collected. At day 14.5 of pregnancy, F1 females exposed to DE-71 perinatally had significantly higher total serum T3 and T4 levels than F1 females receiving vehicle perinatally ($P<0.01$). Thyroid weight/bw was higher in 5-month-old F1 females from dams treated with DE-71 compared to controls ($P=0.002$). No differences in gonadal weights or offspring numbers were observed. Microarray analyses of RNA from 5-month-old F1 ovaries and 21-day-old F1 testes demonstrated gene expression changes in response to perinatal DE-71 exposure. Real-time PCR confirmed expression of osteopontin mRNA was significantly elevated ($P<0.05$) in the same tissues. In summary, low dose PBDE exposure during development altered both the thyroid axis and gonadal gene expression.

COORDINATED REGULATION OF YQJH BY IRON AND THE NICKEL METALLOREGULATORY PROTEIN YQJI

Suning Wang and Wayne Outten
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Iron，the fourth most abundant element in the earth's crust, is essential for almost all living organisms and plays an important role in various biological processes. Also, iron is one of the vital nutrients that determines whether pathogens can survive in host cells. Therefore, the study of bacterial iron metabolism will provide new approaches for drug design and disease treatment. In our study, we found a new ferric reductase YqjH in E. coli, which is capable of reducing ferric-EDTA and ferric-citrate to ferrous forms. We also discovered that yqjI, divergently transcribed from yqjH, encodes a nickel metalloregulatory protein. YqjI activates its own transcription but inhibits the transcription of yqjH. When E. coli is grown in an anaerobic environment, nickel is an essential element. It is a cofactor for hydrogenases to maintain their proper function. We also found that yqjH is induced under nickel excess and iron limitation conditions, and a yqjH mutant is sensitive to high nickel conditions. All of these results indicate a correlation between iron metabolism and nickel metabolism and yqjH-yqjI acting to bridge the iron-nickel connection.

PROCESS MODELING AND CELL DAMAGE EVALUATION IN LASER-ASSISTED CELL DIRECT WRITING

Wei Wang, Yafu Lin, Leigh Herran, and Yong Huang
Clemson University

Maskless jet-based (including laser- and ink jetting-based) cell direct writing is a revolutionary advance to print arbitrary cell patterns as well as to create heterogeneous three-dimensional living scaffolds, resulting in what is known as organ printing. Unfortunately, cell direct-write process-induced thermomechanical damage to cells still poses a significant challenge to ensuring a satisfactory post-transfer cell viability.

Using a representative laser-assisted cell direct-write technology, we have been addressing the aforementioned direct writing-induced cell damage challenge by studying 1) the process-induced cell thermomechanical loading profiles during cell droplet formation and landing processes; and 2) the cell post-transfer viability through understanding the mechanistic correlation between the cell damage/viability and process-induced thermomechanical loading profiles. It is expected that a complete understanding on manufacturing process-induced cell damage will significantly promote safe implementation of biomaterial direct writing for biomedical research and manufacturing applications. This work was partially supported by the National Science Foundation and the National Textile Center. The help from Drs. Jeremy Tzeng and Xuejun Wen of Clemson and Dr. Douglas Chrisey of RPI is highly appreciated.

AGE EFFECTS ON ARTERIAL AXIAL STIFFNESS IN WILD TYPE AND DIABETIC MICE

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The risk of cardiovascular disease is high in both type 1 and type 2 diabetes mellitus, making it the main cause of death due to these diseases. A significant part of this increased risk is thought to be directly linked to pathological changes in mechanical response resulting in vascular dysfunction. Previous biomechanics studies have pointed to an increase in arterial circumferential stiffness in diabetes; however, less work has been done to evaluate the axial stiffness of the elastic vessels. We compared mechanical properties and histology of carotid arteries in spontaneously diabetic Ins2+/- mice and C57Bl/6 wild type (WT) controls as a function of age.

Methods: Carotid arteries were harvested from groups of 4-7 male mice at 4, 6, 8, and 12 months of age. The left carotid was cannulated and exposed to uniaxial tensile loading for 180 cycles at 1 Hz. The vessels were stretched sequentially to lengths 30-80% greater than the original physiological length. An exponential curve was fitted to the stress-strain data. The exponent varies directly with general stiffness of the material. Sections of the right carotid were stained with Picrosirius Red, and collagen content was quantified by image analysis.

Results: Statistical analysis demonstrated a significant effect of age on axial stiffness in diabetic mice at 30%, 50%, and 60% stretch, which was abolished at 80% stretch. There was no apparent effect of age on axial stiffness in WT mice at any stretch value. Post-hoc t-test analysis confirmed that the arterial stiffness parameter at 6 months was significantly reduced ($P<0.05$) vs. 4 months at stretch values between 30-60%. There was also a significant increase in longitudinal stiffness between 6 and 12 months at

50%-60% stretch, and a trend toward increased stiffness at 12 months vs. 6 months (0.05<P<0.10) at 30%-40% stretch. Histological study indicates a trend towards reduced collagen content in diabetic carotid arteries at 6 months vs. 4 months.

Conclusions: Our results suggest that changes in axial stiffness of large elastic arteries as a function of age and diabetes are distinct from previously reported trends in circumferential stiffness. At stretch values small enough to avoid inducing permanent damage to the vessel (<60%), we observed a pronounced, unexpected drop in stiffness at 6 months of age in diabetic mice, which was absent in WT controls. Our results to date do not demonstrate a strict correspondence between collagen content as measured by histology and the longitudinal stiffness parameter. This work was funded in part by CMS-0556362 from the National Science Foundation.

LOSS OF FOXO1 IN ENDOTHELIAL CELLS CAUSES DECREASED CARDIAC MYOCYTE PROLIFERATION

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During heart development, the proliferation of cardiac myocytes plays a critical role in both normal and aberrant heart development. Endothelial cells influence cardiac myocyte proliferation via cell signaling between the myocardium and the surrounding endocardium. Our aim was to investigate if the disruption in the function of endothelial cells negatively affects the proliferation of cardiac myoctyes.

In order to disrupt the function of endothelial cells, the Fox01 gene was targeted. Fox01 is a member of a subclass of the Forkhead genes, which encode for transcription factors involved in proliferation, apoptosis, and cell cycle regulation. In endothelial cells, Fox01 controls excessive endothelial cell growth by establishing a balance between proliferation and apoptosis. Our hypothesis is that Fox01 regulates the ability of endothelial cells to influence cardiac myocyte proliferation. Transgenic mice were generated using the Tie2Cre promoter to specifically delete Fox01 in endothelial cells.

The gross morphology of the transgenic (lacking Fox01 in endothelial cells) and non-transgenic mouse embryos was examined at embryonic day 10.5. The absence of Fox01 in endothelial cells resulted in embryonic lethality and the embryos demonstrated growth retardation, pericardial edema, and a poorly formed vasculature. In order to confirm that the absence of Fox01 was responsible for the difference in morphology, we employed immunohistochemistry (IHC) to show that Fox01 was being expressed in the endothelial cells of the non-transgenic mouse embryos, and not in the transgenic embryos. Genomic PCR was used to confirm the loss of Fox01. Proliferation of cardiac myocytes was assayed using the Phosphohistone H3 (PHH3) antibody. Decreased expression of PHH3 in cardiac myocytes indicates decreased proliferation in transgenic embryos.

Thus, the loss of Fox01 in endothelial cells results in decreased proliferation of cardiac myocytes, and causes embryonic lethality due to heart defects. Future studies include in vitro assays to further define the role of Fox01 in endothelial cells during heart development. The project described was supported by NIH Grant Number P20 RR-16461 from the National Center for Research Resources for support of the program entitled ôSouth Carolina IDeA Networks of Biomedical Research Excellenceö (SC-INBRE).

ELUCIDATING THE EFFECTS OF CHRONIC INFLAMMATION ON TUMORIGENESIS IN *MIN* MICE

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USC Columbia

Ulcerative colitis and Crohn's disease are two common autoimmune-mediated inflammatory bowel diseases (IBD). After 10 years of chronic inflammation, IBD patients display elevated rates of colorectal cancer. *Itchy* mice are homozygous for a loss of function allele of *Itch*, an E3 ubiquitin ligase. On a C57BL/6J background, these animals develop a systemic and progressive autoimmune disease that proves lethal at six to eight months of age. Notably, *itchy* mice display chronic inflammation in the lamina propria of the gastrointestinal tract beginning at 12 weeks of age. Therefore, we hypothesize that the *itchy* mutation could exacerbate the development of tumorigenesis in the intestinal and colonic epithelium. $Apc^{min/+}$ mice have a mutation in the *Apc* tumor suppressor gene that causes a predisposition for tumor growth in the intestines and colon. $Itch^{-/-}$ mice were crossed with $Apc^{min/+}$ mice, in order to create $Itch^{-/-}; Apc^{min/+}$ mice which are homozygous loss of function for *Itch* and carry the *min* mutation. The $Itch^{-/-}; Apc^{min/+}$ mice were compared to three different control groups to assess tumor number, size, and location. The control groups consisted of $Apc^{min/+}$ (single mutant *min* mutation), $Itch^{-/-}$ (single mutant loss of function *Itch*), and wild type. Mice were euthanized at 9 weeks of age, the intestines and colon were harvested, and the number of tumors was recorded. Statistical analysis of the data indicated no significant difference in tumor formation at the 9 week time point. Studies are in progress to asses the effects of chronic inflammation on tumor burden and/or latency at later time points (e.g., 15 and 20 weeks of age). These results will strengthen the connection between chronic inflammation and the development of colorectal cancer. This project was supported in part by the South Carolina Honors College and by the NIH COBRE grant awarded to the USC Center for Colon Cancer Research (P20RR17698-01)

CREATION OF A CUSTOM DESIGNED ELASTIC LAMELLAR SCAFFOLD FOR INTERVERTEBRAL DISC REGENERATION

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Low back pain has affected over 80% of the adult population. Low back pain costs society nearly $90 billion each year. One primary cause of low back pain results from a degenerative intervertebral disc (IVD). Spinal fusion does not restore the natural kinematics of the spine by restricting movement and possibly causing subsequent IVD degeneration. The use of an elastic polymeric artificial disc offers a solution to some of the problems encountered with current disc replacements. A lamellar disc scaffold formed from elastomers would offers better compliance and allows greater surface area for cell adhesion and growth. A lamellar structure mimics the natural histological structure found in the annulus fibrosus. We used a novel rapid prototyping technique that combines ultra-fine pipettes for liquid extruding and a freezing stage for the solidification of the scaffolds mimicking natural IVD structure. This technique permits the use of many different polymers and is suitable for fabricating scaffolds with different 3D configuration. A custom bioprinter with a computer controlled X-Y-Z freezing stage was used for this study. Microsoft excel was used to design the scaffold and to control the three stepping motors on the bioprinter. Polymer solution was pumped to the X-Y-Z stage with a syringe pump. Ultra-fine pipette tips were created to have an inner diameter varying from 5a%m

to 50a%m. Elastic degradable polyurethane and degradable chitosan-gelatin were used for this study. The bioprinter controls the extrusion of the polymer allowing the creation of specific designs. Solidified scaffolds were removed from the freezing stage and freeze dried in the lypholizer for to extract out the solvent. Human IVD cells were seeded on the scaffolds to examine the growth on printed scaffolds. Using our customized bioprinter, elastic polymers can be printed into lamellar structures mimicking the natural structure of IVD tissue. Fine pipettes allow fabrication of scaffolds with high resolution. Polymer stream can be controlled precisely up to a resolution of 10 a%m. Concentric layers were created with spacing ranging from 100a%m to 300a%m for the accommodation of cells. Freezing stage allows fast solidification of polymer solution. The scaffold was porous, aiding cell attachment and growth on the scaffolds. An AlamarBlue Assay verified the cytocompatibility of the materials. Human IVD cells attach and spread well inside the lamellar scaffolds and proliferate in three dimensions. The spacing between the subsequent layers of the printed scaffolds is optimal because it allows room for cell attachment while also providing space for ECM growth within the scaffold. National Science Foundation and AO research Fund

USING LIPID BIOMARKERS TO CHARACTERIZE BACTERIAL COMMUNITIES IN A CONSTRUCTED WETLAND

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The H-02 constructed wetland was established to treat the building process water and storm water runoff from the Tritium Facility on the Savannah River Site in Aiken, SC. Sediment cores were taken from H-02 after initial construction of the wetland as well as one year later in order to document the progress of the wetland towards becoming efficient at removing metals and other wastes from the treated water. All lipids were extracted from the sediments, then column chromatography was used to isolate the bacterial phospholipids which were then converted to their fatty acid methyl esters (FAME) and analyzed on a gas chromatograph-flame ionization detector(GC-FID). An analysis of the lipid biomarkers was then used to identify the bacterial communities as well as to establish a semi-quantitative measure of the total biomass within the wetland sediments. Sediment cores from A-01, a mature wetland system located on the Savannah River Site were also analyzed for comparison of the development status of H-02.

CARDIOVASCULAR CHANGES UNDER DIVING MAMMAL REFLEX AT DIFFERENT TEMPERATURES AND SWIM CONDITIONING

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The influence of antecedent athletic training on diving mammal reflex expression within human cardiovascular functions raises interesting questions. Does long-term training in swimmers enhance the expression of this reflex? Could this have implications for improved cardiovascular health and possibly new clinical diagnostic tests? Physiological effects of the diving mammal reflex are well documented among marine mammals, diving birds, other vertebrates, and humans. Changes in cardiovascular functions include blood pressure drops, bradycardia, and alterations in EKG parameters. Previous research on human diving mammal reflex actions included effects of water temperature, but more research is needed in relating subtle effects of past physical conditioning, especially

swimming, on altering this reflex. Additionally, expanded studies of diving mammal reflex effects on human EKG may have applications as clinical tests to compliment traditional stress testing. Currently, 25 athletic college-age subjects have been tested for EKG and blood pressure changes using three treatments to stimulate apnea with diving mammal reflex. Subjects submerged their faces into plastic basins while connected to EKG leads and sphygmomanometer transducers for up to 30 sec. Three basin treatments were used: 1) empty basin, 2) basin filled with 34 oC water, and 3) basin filled with 7.5 oC water. EKG and BP signal analyses were conducted using LabScribe Software for electrode and transducer input to IWorx 214 Recorder and laptop computer. Statistical analyses for patterns among different conditioned groups utilized SAS. Bradycardia and reduced R-wave amplitude were observed for all treatments, but were most pronounced in the 7.5 oC water. Mean pulse rate was significantly reduced with apnea in the empty tray (79.8 bpm down to 62.7 bpm), and in the 7.5 oC water (73 bpm down to 60.6 bpm), but was not significantly reduced in the 34 oC water. Persons classified as conditioned swimmers displayed significantly reduced R-wave amplitudes, while non-swimmers did not. Both swimmers and non-swimmers displayed significantly reduced pulse rates. However, swimmer reductions were more highly significant (78.2 bpm at start, declining to 61.9 bpm). This ongoing study is expanding sample sizes for comparisons between treatments and athletic conditioning.

THE ROLE OF PRETREATMENT IN BIOHYDROGEN PRODUCTION

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Direct fermentation of cellulosic feedstocks by microorganisms is one of a number of potential technologies for producing hydrogen for transportation and renewable energy. The long range goal of our research is to develop a reactor capable of fermenting agricultural feedstocks by mixed microflora obtained from livestock manure to optimize the production of H2. Hydrogen is a clean energy source and can be used in fuel cells with high efficiency, and combustion of hydrogen produces only water as a by-product, making it a nonpolluting, carbon-free energy alternative. Moreover, the U.S. economy currently depends on a transportation system which is heavily reliant upon the imported petroleum from other nations, and the cost of oil has reached unimaginable levels in the last few years. Due to global environment and national energy security considerations, a non-polluting and renewable energy source needs to be developed. Hydrogen can be produced from renewable raw materials including agricultural feedstocks such as switchgrass. There is also a considerable amount of undigested carbohydrates in the manure of farm animals. Before hydrogenase bacteria can gain access to the hydrogen found within cellulosic biomass sources such as switch grass, it must first be made available in the form of simple sugars by pretreatment. Pretreatment serves to breakdown the complex structures of cellulose, hemicellulose and lignin which protect plants from insects and other potential parasites. We investigated chemical means of substrate pretreatment such as dilute strong acids and bases. Optimization of substrate pretreatment is one of the keys to the design and development an improved bioreactor system, capable of efficient production of H2 from cellulosic biomass.

POLYELECTROLYTE-FUNCTIONALIZED NANORODS: EFFECTS ON EXTRACELLULAR MATRIX ASSEMBLY AND REMODELING

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Nanoparticles have demonstrated utility in imaging, targeting, and drug delivery, and novel surface chemistries have reduced the cytotoxic effects of these materials. At the same time, it has become clear that cells are sensitive to nanoscale variations in substrate topography and adhesion ligand clustering. In addition, several matrix proteins exhibit self-assembly under physiologic conditions to generate networks with characteristic dimensions on the nanoscale. However, the capacity for nanoparticles to elicit meaningful biophysical responses, such as modulation of matrix protein organization, has not been determined. The objective of this work was to investigate the effects of gold nanorods on type I collagen polymerization and mechanical properties. Gold nanorods (392nm long x 22nm wide) were prepared via seed-mediated, surfactant-directed synthesis. The nanorods were functionalized with various polyelectrolytes, including poly(styrene sulfonate) (PSS), poly(diallyldimethylammonium chloride) (PDADMAC), poly(acrylic acid) (PAA), and poly(allylamine hydrochloride) (PAH), via layer by layer assembly. Various concentrations of polyelectrolyte-coated nanorods were added to ice cold neutralized type I collagen, and polymerization at 37C was monitored by measuring the absorbance at 400nm. Subsets of gels were fixed and examined by darkfield, confocal, and electron microscopy. The mechanical properties of polymerizing gels were determined by oscillatory torsion tests, and remodeling of the collagen-nanorod composites was examined by in vitro contraction assays. Polyanion-coated nanorods nanorods attenuated the lag phase of collagen fibrillogenesis by 50%, whereas polycationic nanorods tended to prolong the lag phase. Darkfield and reflectance microscopy revealed that the morphology of the collagen networks was different between groups. Electron microscopy indicated that the morphology of collagen fibers was also similar between nanorod-doped and control gels, and particles were found on the surfaces of some fibers. The apparent stiffness of gels containing polyanionic nanorods was up to 95% higher than controls. All polyelectrolye-functionalized nanorods tested inhibited the cell-mediated contraction of the collagen gels with low or no cytotoxic effects. These results suggest that polyelectrolyte-coated nanomaterials can perturb collagen self-assembly and thereby influence cell behavior.
The authors would like to thank Cheryl Cook for assisting with the isolation and culture of the cardiac fibroblasts. CW was supported by a fellowship administered through NIH grant P20 RR-016461 from the National Center for Research Resources. This work was also supported by NIH HL73937.

ANALYSIS OF LEACHING BISPHENOL-A FROM POLYCARBONATE PLASTIC CONTAINERS

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Bisphenol-A (BPA) is a chemical of concern because it acts as an estrogen mimic, which can induce abnormal hormonal responses. The focus of this research was to find and use a sensitive method for measuring the leaching of BPA from polycarbonate containers. Various experimental methods were considered, including ultraviolet spectrometry, a Fe3+ spot test, and voltametry. The method chosen was voltametry. BPA was oxidized at about +0.5 volts vs. SCE on a carbon paste electrode with a detection limit of about 1e-7 molar. Supelco ENVI-18 cartridges were used to concentrate the samples and further

increase sensitivity. Various brands of polycarbonate bottles were subjected to conditions of high temperatures and basic environments, in which the BPA was found to leach at significant levels.

MODELING OF VASCULAR SMOOTH MUSCLE CELL MECHANICS

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Vascular smooth muscle cells (VSMCs) are constantly under dynamic load due to arterial pressure in normal healthy conditions. In response to injurious mechanical loading, VSMCs can undergo significant cytoskeletal remodeling, leading to changes in mechanical properties that may eventually contribute to restenosis. The ability to predict the behavior of cells from their nanoscale structures could elucidate the mechanisms behind many tissue mechanical properties. In this study, we used finite element analysis (FEA) to model the geometry AFM indentation of VSMCs with contractile and synthetic phenotypes. Cells were modeled as Hertzian, isotropic materials and our results were compared to Atomic Force Microscopy (AFM) stress relaxation tests performed on living VSMCs in media. Since the VSMCs were found to be viscoelastic, our model more accurately represented the mechanical response of VSMCs at infinitesimal deformations and it diverged at larger deformations. In future studies, we are incorporating viscoelastic behavior and cytoskeletal structures (e.g., actin stress fibers, microtubules, intermediate filaments) into our model. These types of cytoskeletal models would be a good starting point for multiscale models of tissue that include not only cells but their nanoscale structures as well.

EFFECTS OF THE SUMTER WASTEWATER TREATMENT PLANT ON THE SURVIVAL AND REPRODUCTION OF *CERIODAPHNIA DUBIA*

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The Pocotaligo River is a freshwater wetland that originates in Sumter, South Carolina, and joins the Black River at the Clarendon-Williamsburg County line. The Pocotaligo swamp which encompasses 272,000 acres with over 30,000 acres as wetlands has endured severe anthropogenic and natural alterations to its ecology over the last eight or nine decades. The Sumter Wastewater Treatment Plant discharges an average of 45 million liters/month of treated sewage into the swamp and is an important source of point pollution. The plant is also slated for expansion within the next year. Water quality can be assessed through physiochemical measurements and use of biological indicators. One of the commonly used biological indicator of water quality is C*eriodaphnia dubia* (*C. dubia*), a freshwater zooplankton. The objective of the present study was to determine the possible effects of the wastewater treatment plant on water quality by conducting acute and chronic toxicity tests using *C. dubia.* Surface water samples were collected every two months from 3 sites, an upstream (control) site, a point at which the effluent is released and a downstream site using as many habitats as possible within each site. Sampling occurred on four occasions. Physical parameters such as pH, temperature, conductivity, dissolved oxygen, and total dissolved solids were measured. In addition, chemical analysis of nitrites, nitrates, phosphates and ammonia was conducted. For the acute (48 hour) and chronic (7 day) toxicity tests, twenty replicates, each containing one *C. dubia* neonate was prepared for each type of water. Reconstituted hard water was used as a control. The acute toxicity test examined the mortality of *C. dubia* in a 24 hour

time period. The chronic toxicity tests examined the total numbers of live offspring produced per parent animal. Results indicated that there were significant differences among sites in the seasonally averaged water temperature, dissolved oxygen and conductivity ($p<0.05$). However, there was no significant difference in mortality or alterations in reproductive success among *C. dubia* between the three sites. Presently, the Sumter Wastewater Treatment Plant is adequately treating its sewage before discharge. However a long term study is needed before more definitive conclusions can be drawn. The project is funded by the USC Magellan Scholar Fellowship awarded to Erin Worley.

2-D PDPA: IDENTIFYING HOMOLOGOUS STRUCTURES FOR AN UNKONW PROTEIN USING UNSASSIGNED RDC DATA

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The use of Residual Dipolar Coupling (RDC) data for the determination of protein structure and dynamics has been increasing in recent years. While cheaper than the acquisition of NOE datasets, structure determination from residual dipolar couplings still depends on the costly step of resonance assignment. However, there is a tremendous amount of information contained within a set of unassigned residual dipolar couplings. Our group has previously introduced Probability Density Profile Analysis (PDPA) as a method to find similar structures for a protein of unknown structure using unassigned backbone N-H RDCs. While our method was limited to one dimensional data, recent developments in 2D order tensor estimation have made using 2D data in PDPA possible. We show that 2D-PDPA is capable of identifying the structure most homologous to an unknown protein by using backbone N-H RDC data acquired from two alignment media from a large (600-1000) database of candidates.

In abstract, 2D-PDPA proceeds very similarly to the previously presented 1D-PDPA. At first blush, an expansion to 2-D RDC data would seem to necessitate a computationally infeasible search over two sets of three Euler angles. The search over two independent sets of Euler angles that are needed to describe two order tensors would increase the computation time over that of 1D-PDPA by a factor of 373248. Our recent work], however, has succeeded at estimating both the principal order parameters and the relative orientation of the two order tensors yielding the seven required parameters to describe a set of relative order tensors. Next, 2-D RDC datasets are calculated for each structure in the database over all possible orientations of the molecular frame. We then calculate a probability density profile for each possible orientation using a 2D kernel density estimation. The best match between these simulated probability density distributions and the experimental distribution was then used to pick the best structural match.

We have tested this process on the three proteins 1SF0 (69 residues), 110M (153 residues), and 1A4Y (460 residues) with synthetic data (with %1Hz error) generated with typical order tensors. We also used empirical data provided for 1P7E from the BMRB database. The structural database consisted of ~600 FSSP protein fold family representatives supplemented by the structures of 1SF0, 1A4Y, 110M and 1P7E. The results for all four experiments identified the correct homologous structure.

MODELING THE CELL TYPE DEPENDENCE OF DIFFUSION-LIMITED INTRACELLULAR ICE NUCLEATION AND GROWTH

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In this study, a set of models for predicting the diffusion-limited ice nucleation and growth inside biological cells were established. Both the heterogeneous and homogeneous nucleation mechanisms were considered in the models. Molecular mobility including viscosity and mutual diffusion coefficient of aqueous cryoprotectant (i.e., glycerol here) solutions was estimated using models derived from the free volume theory for glass transition, which makes it possible to predict the two most important physical properties (i.e., viscosity and mutual diffusion coefficient) over wide ranges of temperature and concentration as encountered in cryopreservation. After being verified using experimental data, the models were used to predict the critical cooling rate (defined as the cooling rate required so that the crystallized volume is less than 0.1% of the cell volume) as a function of the initial glycerol concentration in a number of cell types with different sizes. For slowing freezing, it was found that the required critical cooling rate is cell type dependent with influences from cell size and the ice nucleation and water transport parameters. In general, the critical cooling rate does not change significantly with the initial glycerol concentration used and tends to be higher for smaller cells. For vitrification, the required critical cooling rate does change significantly with the initial glycerol concentration used and tends to decrease with the decrease of cell size. However, the required critical cooling rate can be similar for cells with very different sizes. It was further found that the thermodynamic and kinetic parameters for intracellular ice formation associated with different cells rather than the cell size per se significantly affect the critical cooling rates required for vitrification. For all cell types, it was found that homogeneous nucleation dominates at ultrafast cooling rates and/or high glycerol concentrations whereas heterogeneous nucleation becomes important only during slow freezing with a low initial glycerol concentration (< 1.5-2 M), particularly for large cells such as mouse oocytes. This work was partially supported by a startup fund from the USC Research Foundation through an NSF/SC EPSCoR grant (# EPS-0447660) and by the Chinese Ministry of Education for a joint doctoral training program.

BUCKLING MODELING OF INNER SURFACE GROOVE FORMATION IN FABRICATING HOLLOW FIBER MEMBRANE FOR NERVE

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Hollow fiber membrane (HFM) is one of the most popular membranes used for different industrial applications. Under some controlled fabrication conditions, axially aligned grooves can be formed on the HFM inner surface during typical immersion precipitation-based phase inversion fabrication processes. Such grooved HFMs are finding promising medical applications for nerve repair and regeneration. For better nerve regeneration performance, the HFM groove morphology should be carefully controlled. Towards this goal, this study has modeled the HFM groove number based on the inward pressure-induced buckling model in HFM fabrication. HFM has been modeled as a three-layer long fiber membrane, and the HFM inner layer has been treated as a thin-wall elastic cylindrical shell under the shrinkage-induced inward radial pressure. The groove number has been reasonably estimated based on the resulting buckling mode upon the inward

pressure as compared with the experimental measurements. This study has laid a mathematical foundation for HFM circumferential instability modeling, which is of recent interest in membrane fabrication. The support from the National Science Foundation (MPM-0600551) and the Clemson Center for Advanced Engineering Fibers and Films is highly appreciated. The authors also would like to thank Yu Long, Chun Cheong Yeung, and Yafu Lin for their assistance and Drs. Hai Yao and Philip Brown for their discussion and experiment help.

PROTEIN SUBCELLULAR LOCATION PREDICTION USING PHYSICOCHEMICAL ENCODED AMINO ACID GROUPS

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Computational prediction of protein localization is useful for characterizing the functions of newly sequenced proteins. Protein sequence features such as amino acid (AA) composition have been widely used for subcellular localization prediction due to their simplicity. However, these methods have issues of low coverage and low prediction accuracy. We present a physicochemical encoding method that maps protein sequences into feature vectors composed of the locations and lengths of amino acid groups (AAGs) with similar physicochemical properties. This high-level modular representation of protein sequences overcomes the shortcoming of losing order information in the commonly used AA composition and AA pair composition encoding. When applied with SVM classifiers, we showed that AAG based features are able to achieve higher prediction accuracy (up to 20% improvement) than the widely used AA composition and AA pair composition to differentiate proteins of different localizations. When AAGs and AA composition encoding combined, the prediction accuracy can be further improved thus achieving synergistic effect.

ENCAPSULATION OF LIVING CELLS IN SMALL (~100 μM) ALGINATE MICROCAPSULES BY ELECTROSTATIC SPRAYING

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A parametric study was performed to understand the effect of preparation parameters on size, morphology, and encapsulation efficiency (i.e., cells/microcapsule) of alginate microcapsules prepared using the electrostatic spray method. The preparation parameters studied include sodium alginate concentration, spray voltage, flow rate, and cell density. It was found that both the flow rate and spray voltage have a significant impact on microcapsule size while the microcapsule morphology is greatly influenced by both the sodium alginate concentration and spray voltage. To obtain small (~100 μm) cell-loaded microcapsules with good morphology (i.e., round in shape and uniform in size) and high encapsulation efficiency (>5 cells/microcapsule), the optimal ranges of spray voltage, flow rate, alginate concentration, and cell density are from 16 to 18 kV, 2 to 3 ml/h, 1.75 to 2.25 % (w/v), and 3 to 5k%106 cells/ml, respectively. Under optimal preparation conditions, cells encapsulated in the microcapsules were found to survive well in culture at least in the seven-day period studied. This work was supported by a startup fund from the USC through an NSF/SC EPSCoR grant (# EPS-0447660)

INTRACELLULAR DELIVERY AND CONTROLLED RELEASE OF TREHALOSE USING A THERMALLY RESPONSIVE NANOCAPSULE

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The thermal responsiveness of a Pluronic based nanocapsule in size, surface charge, and particularly wall permeability was successfully utilized for trehalose (an exceptional bioprotectant for long-term stabilization of biologicals) nanoencapsulation, intracellular delivery, and controlled release. Trehalose was loaded into the nanocapsule at 22 oC when its wall permeability is high. The nanocapsule was found to be capable of withholding trehalose for hours at 37 oC when its wall permeability is low. However, a quick release of trehalose was achieved by thermally cycling the nanocapsule between 22 and 37 oC. A significant amount of trehalose was delivered into NIH 3T3 fibroblasts by incubating the cells with trehalose-loaded nanocapsules at 37 oC for 40 min. Trehalose encapsulated in the nanocapsule could be released into the cytosol by cold shocking the cells at 22 oC since the swollen nanocapsule was observed to mechanically break the endosome/ lysosome. Moreover, cytotoxicity of the nanocapsules for the purpose of trehalose delivery was found to be negligible. Altogether, the thermally responsive nanocapsules are effective for intracellular delivery of trehalose, which is critical for long-term stabilization of mammalian cells at ambient temperatures and the eventual success of modern cell-based medicine. This research was supported by a research opportunity program (ROP) award from the USC Office of Research and Economic Development and a USC startup fund (provided through an NSF/SC EPSCoR Grant # EPS-0447660) to XH. QW is indebted to the financial support from US DoD BCRP Program, the Alfred P. Sloan Scholarship, the Camille Dreyfus Teacher Scholar Award, and the W. M. Keck Foundation. Acknowledgement is due to Dr. Catherine Murphy in the Department of Chemistry and Biochemistry, Drs. Melissa Moss and Harry Ploehn and Ms. Carol Stork in the Department of Chemical Engineering, and Dr. Bill Chao in the Department of Mechanical Engineering at USC for technical assistance from their labs.

CRYOPRESERVATION OF SMALL (<100 A%M) ALGINATE MICROCAPSULES: A CRYOMICROSCOPY AND DSC STUDY

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In the present study, small alginate microcapsules (<100 a%m) were prepared to investigate its potential usage for cryopreservation of microencapsulated cells. The microscopy and DSC study showed that 10 % (v/v) DMSO was enough to maintain the microcapsule morphology in normal saline (0.9 % (w/v) sodium chloride solution) during cryopreservation process. The presence of calcium ions could prevent the microcapsule from swelling. Moreover, 0.1 M calcium ions could help reduce the DMSO concentration to 7.5% to maintain the microcapsule morphology in normal saline. Wujie Zhang and Geer Yang contributed equally. This work was supported by a startup fund from the USC through an NSF/SC EPSCoR grant (# EPS-0447660).

South Carolina Academy of Science Annual Reports

Annual Reports are no longer included in the Bulletin to reduce the environmental impact and printing costs of the SCAS Bulletin. Information typically contained in the annual reports may be obtained through the SCAS office or the SCAS website.

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