SOUTH CAROLINA JUNIOR ACADEMY OF SCIENCE
SCHEDULE OF EVENTS

7:30 AM - 11:00 AM  SCJAS Registration  Trone Student Center
7:30 AM – 9:30 AM  Continental Breakfast

8:30 AM – 12:00 PM  SCJAS Oral Sessions  Furman Hall
See SCJAS oral session listing for details & room numbers

10:15 AM – 10:30 PM  Break

10:30 AM – 12:30 PM  Poster Session  Townes Science Center
(with SCBASM)
You can put your poster up anytime between 8 a.m. and 10 a.m.
(All posters must be on display by 10:00 a.m.)

12:00 PM – 1:15 PM  Lunch  Daniel Dining Hall
Ticket is in your badge holder

1:30 PM – 2:15 PM  Plenary Session  Burgiss Theatre; Trone Student Center

2:15 – 3:00  Governor’s Awards /
Undergraduate Awards  Burgiss Theatre; Trone Student Center

1:30 PM – 4:00 PM  SCJAS Oral Sessions  Furman Hall
See SCJAS oral session listing for details & room numbers

2:30 PM – 4:00 PM  Afternoon SCJAS Activities
Journey to the Center of the Atom  Meet at Trone Student Center
Tour of Campus/Science Departments  Meet at Trone Student Center
Planetarium Show  Meet at Trone Student Center
Shi Center for Sustainability  Meet at Trone Student Center

4:00 PM  SCJAS Pizza and drinks  Trone Student Center
Watkins Room

4:00 PM - ???  SCJAS Awards Ceremony  Trone Student Center
Watkins Room
SCJAS 2015 ANNUAL MEETING ORAL PRESENTATIONS
FURMAN UNIVERSITY, APRIL 11, 2015

**Biochemistry / Non-Mentored**
Furman Hall 106

8:30 a.m. Jane Lindberg and Vaibhav Bafna, Southside High School
COMPARISON OF THE DIFFUSION OF ACETAMINOPHEN BY ITS FORMS

8:45 a.m. Farris Sabir, Southside High School
EXAMINATION OF THE FLOW OF ACETAMINOPHEN

9:00 a.m. Dillon Harper, The Center for Advanced Technical Studies
DEVELOPING AN OPTIMAL BIO-PETROL DIESEL BLEND TO MAXIMIZE ENGINE PERFORMANCE

**Biochemistry / Mentored**
Furman Hall 106

9:15 a.m. Sean Conway, South Carolina Governor's School for Science and Mathematics
THE EFFECT OF HEPATOCYTE-SPECIFIC GLUCOCORTICOID RECEPTOR LOSS-OF-FUNCTION ON ARGINASE I EXPRESSION IN THE MOUSE LIVER UREA CYCLE

9:30 a.m. Elizabeth Grant, South Carolina Governor's School for Science and Mathematics
INCREASING THE EFFICACY OF ANTITUMOR THERAPY: A LYSINE SPECIFIC DEMETHYLASE 1 INHIBITOR IN COMBINATION WITH 5-DEOXYAZACYTIDINE

9:45 a.m. Mitchell Mills, South Carolina Governor's School for Science and Mathematics
GLYCOL CHITOSAN BASED NANOPARTICLES DELIVERING CISPLATIN FOR THE TREATMENT OF CANCER

10:00 a.m. Mayank Patel, South Carolina Governor's School for Science and Mathematics
EFFECT OF INTERLEUKIN-6 ON TRANSLATIONAL CAPACITY IN C57BL/6 AND APCMIN/+ MICE

**BREAK**

10:30 a.m. Jamison Hite, South Carolina Governor's School for Science and Mathematics
DETERMINING TBPEX13.2'S POTENTIAL FOR GLUCOSE-DEPENDENT LOCALIZATION IN TRYPANOSOMA BRUCEI

10:45 a.m. Ronit Kulkarni, Spring Valley High School
DETERMINING EXPRESSION OF WILD-TYPE PLK1 AND DRUG-RESISTANT MUTANT C67V PLK1 IN CERVICAL CANCER CELLS

11:00 a.m. Thomas Stanton, South Carolina Governor's School for Science and Mathematics
DYNAMIC REGULATION OF BIODIESEL PRODUCING ESCRECHIA COLI BIOSYNTHETIC PATHWAYS
11:15 a.m. Joshua Pope, South Carolina Governor's School for Science and Mathematics
ARTICULAR CARTILAGE AND ITS POTENTIAL FOR REGENERATION WHEN GROWN USING A NOVEL TECHNIQUE FOR CULTURING

11:30 a.m. Brooks Digh, South Carolina Governor's School for Science and Mathematics
DETERMINATION OF THE PHOSPHORYLATION SITE OF THE REGULATOR OF IRON TRANSPORT IN STREPTOCOCCUS PNEUMONIA BY MASS SPECTROMETRY / LIQUID CHROMATOGRAPHY

11:45 a.m. Carlan May, South Carolina Governor's School for Science and Mathematics
IMPACT OF TERT-BUTYL HYDROPEROXIDE CONCENTRATIONS IN RETINAL PIGMENT EPITHELIAL CELL MODELS IN VITRO

Botany / Mentored
Furman Hall 107

8:30 a.m. David Strickland, South Carolina Governor's School for Science and Mathematics
BUDGETING THE DEFENSE EFFICIENTLY: EFFECT OF NUTRIENT DEFICIENCY AND INSECT HERBIVORY ON TANNIN CONCENTRATIONS IN JAPANESE KNOTWEED

8:45 a.m. Trina Dinh, South Carolina Governor's School for Science and Mathematics
GENETIC MAPPING OF ADVENTITIOUS ROOTING IN PEACH: CORRELATION OF GENETIC MARKERS AND ROOT SYSTEMS

9:00 a.m. Olivia Smithson, South Carolina Governor's School for Science and Mathematics
LONG-TERM MONITORING OF HURRICANE HUGO'S EFFECTS ON SANTEE EXPERIMENTAL FOREST, NEAR CHARLESTON, SC

9:15 a.m. Angel Lopez-Akiyama, South Carolina Governor's School for Science and Mathematics
MOLECULAR CHARACTERIZATION OF A BASAL ANGIOSPERM CINNAMYL ALCOHOL DEHYDROGENASE (CAD) HOMOLOG

9:30 a.m. TK Cornish, South Carolina Governor's School for Science and Mathematics
UTILIZING ADVENTITIOUS ROOT VARIATION TO IDENTIFY THE CORRELATION BETWEEN ROOT FORMATION AND LEAVES IN PEACHES

9:45 a.m. Kendall Koon, South Carolina Governor's School for Science and Mathematics
WARMING AND ELEVATED CARBON DIOXIDE INCREASES SUBERIN CONTENT IN THE ROOTS OF A C4 GRASS SPECIES

10:00 a.m. Rose Dellinger, South Carolina Governor's School for Science and Mathematics
THE EFFECTS OF WARMING AND ELEVATED CARBON DIOXIDE ON THE SUBERIN COMPOSITION OF ROOTS: A CASE STUDY WITH A C3 PLANT SPECIES

BREAK

10:30 a.m. Charles Ison, South Carolina Governor's School for Science and Mathematics
LONG-TERM MONITORING OF THE DECREASING UNDERSTORY AT HOBCAW BARONY'S CYPRUS FORESTS POST-HURRICANE HUGO
10:45 a.m. Kayla Owens, South Carolina Governor's School for Science and Mathematics
LIRIODENDRON TULIPIFERA L. EST-SSR MARKER DEVELOPMENT FOR GENETIC LINKAGE MAP CONSTRUCTION

11:00 a.m. Adam Herbert, South Carolina Governor's School for Science and Mathematics
FUNCTIONAL CHARACTERIZATION OF A NEWLY IDENTIFIED NICOTIANA TABACUM SULFATE TRANSPORTER GENE NTASULTR2 INVOLVED IN SULFATE TRANSPORT AND DISTRIBUTION

Botany / Non-Mentored
Furman Hall 107

11:15 a.m. Rohan Brebion, Southside High School
IRON UPTAKE IN DUCKWEED

11:30 a.m. Ruth Dibble and Kate Nassab, Heathwood Hall Episcopal School
THE EFFECT OF HYDROPONIC GROWING TECHNIQUES ON THE AMOUNT OF VITAMIN C PRODUCED ON BRASSICA RAPA NIPPOSICIA

11:45 a.m. Jacob Brock, Spring Valley High School
THE EFFECT OF PUERARIA MONTANA ON THE GERMINATION OF CHAMAECRISTA FASCICULATA

LUNCH

1:30 p.m. Khanh Fleshman, Spring Valley High School
ALLELOPATHIC EFFECT OF ACER PALMATUM, PINUS TAEDA, AND LONICERA JAPONICA ON ZEA MAYS AND GLYCINE MAX

1:45 p.m. Isabelle Robinson and Carter Smith, Heathwood Hall Episcopal School
THE EFFECT OF DIFFERENT NUTRIENTS LEVELS IN SOIL ON THE OXYGEN PRODUCTION RATE OF WISCONSIN FAST PLANTS (BRASSICA RAPA)

2:00 p.m. Annie Heath, Heathwood Hall Episcopal School
THE EFFECT OF ORGANIC AND INORGANIC FERTILIZERS ON THE AMOUNT OF CHLOROPHYLL IN A BRASSICA RAPA PLANT.

2:15 p.m. Paris Tomlin and Lydia Comer, Heathwood Hall Episcopal School
THE EFFECT OF RUNOFF ON PLANT GROWTH

2:30 p.m. Aidan Powers, Heathwood Hall Episcopal School
THE EFFECT OF PLANT SPECIES ON ZINC ABSORPTION

3:00 p.m. Matt Watford, Heathwood Hall Episcopal School
THE EFFECT OF THREE DIFFERENT COMMERCIAL FERTILIZERS ON THREE VARIOUS GRASS TYPES

3:15 p.m. Sirila Padi, Spring Valley High School
THE EFFECT OF TARAXACUM OFFICINALE AND MYCORRHIZAL FUNGI IN CLAY, SILT, AND SANDY ON THE GROWTH AND DRYMASS OF GLYCINE MAX
3:30 p.m. Seungmee Kim, Spring Valley High School
THE EFFECT OF TWO ALOE VERA EXTRACTS AGAINST CHENOPODIUM ALBUM WITH TRITICUM AESTIVUM AS A CONTROL PLANT

Cell & Molecular Biology/ Mentored
Furman Hall 108

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

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

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

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

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

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

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

BREAK

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

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

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

8
11:15 a.m. Faith Mitchell, South Carolina Governor's School for Science and Mathematics
OPTICAL PROBES FOR NONINVASIVE MOLECULAR IMAGING OF CANCER
BIOMARKERS IN GLIOBLASTOMA CELL LINES

11:30 a.m. Madeline Grant, South Carolina Governor's School for Science and Mathematics
OPTIMIZING T CELL ACTIVATION CONDITIONS FOR ADOPTIVE CELL THERAPY
OF CANCER

11:45 a.m. Sean Cosh, South Carolina Governor's School for Science and Mathematics
SEMAPHORIN 3F RESPONSES TO NEUROPILIN 2 ISOFORM KNOCKDOWNS IN
H157 LUNG CANCER CELLS

LUNCH

1:30 p.m. Zachary Walsh, South Carolina Governor's School for Science and Mathematics
SITE-SPECIFIC MUTAGENESIS OF RAD51 IN ESCHERICHIA COLI

1:45 p.m. Phuong Huynh, The Center for Advanced Technical Studies
THE EFFECT OF MULTIPLE FLAVONOIDS ON AMYLOID-BETA AND
NEUROFIBRILLARY TANGLES IN ALZHEIMER’S DISEASE

2:00 p.m. Nathan Pignone, South Carolina Governor's School for Science and Mathematics
THE EFFECTS OF HIGH FAT DIET INDUCED OBESITY ON THE TRANSLATIONAL
CAPACITY AND EFFICIENCY IN THE SKELETAL MUSCLE OF MICE

2:15 p.m. Olivia Reszczynski, Dutch Fork High School
THE GENDER GAP: THE EFFECT OF OVARIAN FUNCTION IN THE CACHECETIC
RESPONSE AND IL-6 DURING CACHEXIA PROGRESSION

2:30 p.m. Aon Ali, South Carolina Governor's School for Science and Mathematics
TREATMENT OF PATIENTS WITH A NONSENSE MUTATION IN THE X-LINKED
INTELLECTUAL DISABILITY CUL4B GENE WITH G418

Cell & Molecular Biology / Non-Mentored
Furman Hall 118

10:30 a.m. Roann Abdeladl, Greenville Technical Charter High School
DIFFERENTIATING BETWEEN THE ABILITIES OF SYNTHETIC VERSUS
PHARMACEUTICAL ANTIBIOTICS TO PREVENT ANTIBIOTIC RESISTANCE

10:45 a.m. Emily Morton, The Center for Advanced Technical Studies
T CELL VACCINES AS AN IMMUNOTHERAPY FOR TYPE 1 DIABETES

Chemistry / Mentored
Furman Hall 109

8:30 a.m. Kelby Beam, South Carolina Governor's School for Science and Mathematics
BLOCK COPOLYMER SYNTHESIS THROUGH ATOM TRANSFER RADICAL
POLYMERIZATION AND RING OPENING POLYMERIZATION
8:45 a.m. Albert Wang, Dutch Fork High School
POLYMERS CONTAINING HIGHLY POLARIZABLE CONJUGATED SIDE CHAINS AS HIGH-PERFORMANCE ALL-ORGANIC NANODIELECTRIC CAPACITORS

9:00 a.m. Brooke Christensen, South Carolina Governor's School for Science and Mathematics
THE STUDY OF HUMAN SPHINGOSINE KINASE AND ITS POTENTIAL INHIBITORS

9:15 a.m. William Rivers, South Carolina Governor's School for Science and Mathematics
OXIDATIONS FACILITATED BY BIS-UREA BENZOPHENONE MACROCYCLES

9:30 a.m. Hansen Mou, South Carolina Governor's School for Science and Mathematics
OPTIMIZING NOBLE METALS ADSORPTION FOR CATALYST SYNTHESIS USING STRONG ELECTROSTATIC ADSORPTION (SEA)

9:45 a.m. Mattie Piness, South Carolina Governor's School for Science and Mathematics
IDENTIFICATION OF POST-TRANSLATIONALLY MODIFIED (O-GLCNAC) HEPATIC PROTEINS IN FASTED AND RE-FED MICE

10:00 a.m. Jack Runge, South Carolina Governor's School for Science and Mathematics
HETEROAGGREGATION OF CITRATE-COATED SILVER NANOPARTICLES WITH POLYSTYRENE AND SILICA PARTICLES

BREAK

10:30 a.m. Zachary Scott, South Carolina Governor's School for Science and Mathematics
FACET ENGINEERING ON THE TIP OF GOLD NANORODS

10:45 a.m. Will Carpenter, South Carolina Governor's School for Science and Mathematics
CONTROLLING THE DISSOLUTION OF AG IN AG-AU CORE SHELL NANOPARTICLES OF VARYING SHELL THICKNESS

11:00 a.m. Anya Bali, South Carolina Governor's School for Science and Mathematics
CONTROLLING ENERGY TRANSFER IN METAL-ORGANIC FRAMEWORKS BY COORDINATIVE IMMOBILIZATION OF PHOTOCHROMIC LIGANDS

Chemistry / Non-Mentored
Furman Hall 109

11:15 a.m. Samira Nematollahi, Shonte Clement, and Nathaniel Boen, Southside High School
TEST FOR CORROSION OF IRON IN YEAST AND YOGURT

11:30 a.m. Hannah Wilder and Rebecca Wu, Southside High School
ANALYSIS OF ELECTRONIC CIGARETTE VAPORS FOR CARBONYLS

11:45 a.m. Isabelle Doan, Southside High School
AN ANALYSIS OF ELECTRICAL CONDUCTIVITY AND PH IN ACETOUS FERMENTATION

LUNCH
1:30 p.m.  Caroline Bunch and Emmye Mullins, Heathwood Hall Episcopal School  
THE EFFECT OF THE CONCENTRATION OF STRONTIUM NITRATE IN A BLACK POWDER BASE ON THE INTENSITY OF THE 600 NANOMETER WAVELENGTH OF THE EMISSION SPECTRUM

1:45 p.m.  Anthony Frederick, Spring Valley High School  
THE EFFECT OF MULTIPLE PUNCTURE SITES ON THE HEALING RATE OF HINDERED UREA BOND SELF-HEALING POLYMER

2:00 p.m.  Jacob Cooney, Spring Valley High School  
THE EFFECT OF FIRE RETARDANT SPRAY, CPVC CEMENT AND STARCH AND AMORPHOUS SODIUM POLYBORATE ON INCREASING THE FIREPROOF ABILITY OF CLOTHING IN SEARCHING FOR A CHEAPER SUBSTITUTE FOR NOMEX/KEVLAR

2:15 p.m.  Patrick Van Hook, Greenville Technical Charter High School  

2:30 p.m.  Revanth Kanumuri, Spring Valley High School  
THE EFFECT OF L-HISTIDINE AND PLANT EXTRACTS ON THE CORROSION OF STEEL

3:00 p.m.  Pranathi Meda, Spring Valley High School  
THE EFFECT OF ADDING NAHCO3, NH4H2PO4, AND KHCO3 AND DNA FROM FRAGARIA ANANASSA IN WATER TO EVALUATE ITS FIRE-EXTINGUISHING CHARACTERISTICS ON COTTON FIBERS BY TESTING ITS FLAMMABILITY RATE

3:15 p.m.  Nigam Sheth, Spring Valley High School  
THE EFFECT OF SACRIFICIAL ANODE CATHODIC PROTECTION ON INHIBITING GALVANIC, CREVICE, AND FLAT CORROSION IN AL-MG-SI ALLOYS

3:30 p.m.  Paige Mewborn, Dutch Fork High School  
THE EFFECT OF THE FERMENTATION OF POTATOES ON THE PRODUCTION OF ETHANOL

Consumer Affairs / Mentored  
Furman Hall 110

8:30 a.m.  Chanon Amphan, South Carolina Governor's School for Science and Mathematics  
AN ANALYSIS OF SBIR FUNDING ACROSS THE NATION

8:45 a.m.  Tommy Berrigan, South Carolina Governor's School for Science and Mathematics  
COMPARATIVE ANALYSIS OF RECYCLING PROGRAMS IN THE SOUTHEASTERN UNITED STATES

9:00 a.m.  Logan Robinson, South Carolina Governor's School for Science and Mathematics  
ECONOMICS OF THE EYE: DEVELOPING AN ALTERNATIVE TO TRADITIONAL PACKAGING EYE TRACKING STUDIES

9:15 a.m.  Daniel Beasley, South Carolina Governor's School for Science and Mathematics  
REBRANDING THE PEE DEE: A CASE STUDY
9:30 a.m.  Jay Gohil, South Carolina Governor's School for Science and Mathematics
THE BENEFITS OF ECONOMIC DEVELOPMENT STRATEGIES FOCUSED ON HIGH TECH, EARLY-STAGE BUSINESSES VERSUS THOSE FOCUSED ON TRADITIONAL, LATER-STAGE BUSINESSES

9:45 a.m.  Jeff Rubillo, South Carolina Governor's School for Science and Mathematics
USING A DATA WAREHOUSE TO ANALYZE INFORMATION ABOUT INSURANCE CLAIMS AND POLICIES

10:00 a.m.  Shuler Black, South Carolina Governor's School for Science and Mathematics
THE BID: AN EXPLORATION OF THE BUSINESS IMPROVEMENT DISTRICT AND HOW IT RELATES TO THE CITY OF BEAUFORT

   BREAK

10:30 a.m.  Joel Fonseca, South Carolina Governor's School for Science and Mathematics
SUCCEEDING IN THE HIGH-GROWTH TECHNOLOGY INDUSTRY

10:45 a.m.  Joshua Bingham, South Carolina Governor's School for Science and Mathematics
EFFECT OF CULTURE ON A COMPANY'S SUCCESS

11:00 a.m.  Gavin Roser, South Carolina Governor's School for Science and Mathematics
COMPARING STATE TAX INCENTIVES FOR AEROSPACE MANUFACTURING CLUSTER GROWTH

11:15 a.m.  Sydney White, South Carolina Governor's School for Science and Mathematics
ANALYSIS AND RECOMMENDATIONS OF ONLINE LEARNING RESOURCES FOR TEACHERS WHO LEAD ECONOMICS AND FINANCIAL LITERACY COURSES IN K-12 SCHOOLS

   Consumer Affairs / Non-Mentored
   Furman Hall 110

11:30 a.m.  Brandon Hill, Heathwood Hall Episcopal School
THE EFFECTS OF ANTIOXIDANT VITAMINS A, C, & E ON THE PREVENTION OF BACTERIAL GROWTH IN GRANNY SMITH APPLES

11:45 a.m.  Matthew Breivik, Spring Valley High School
THE EFFECT OF CORPORATE FINANCIAL DATA ON STOCK VALUE FLUCTUATION

   LUNCH

1:30 p.m.  Jason Lee, The Center for Advanced Technical Studies
GENETIC ANALYSIS OF CAFETERIA FOOD FOR THE ROUND-UP READY GENE

1:45 p.m.  Sonali Patel and Emma Shealy, Heathwood Hall Episcopal School
THE EFFECT OF VARIOUS TYPES OF PACKAGING ON THE CARBONATION IN COCA-COLA
8:30 a.m. Cameron Maes, South Carolina Governor's School for Science and Mathematics
A 3D MICROSCOPE FOR VISUALIZATION OF THICK SAMPLES

8:45 a.m. Mike Bhoi, South Carolina Governor's School for Science and Mathematics
AN ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY STUDY OF EPITAXIAL
GRAPHENE FOR USE IN A BREATH ALCOHOL ANALYZER

9:00 a.m. Jones Jenkins, South Carolina Governor's School for Science and Mathematics
AN EXPERIMENTAL STUDY OF THE ELECTROOSMOTIC BEHAVIOR OF VARIOUS
GLYCEROL SOLUTIONS, UNDER VARYING POTENTIAL DIFFERENCE IN A T-
SHAPE MICROCHANNEL ENVIRONMENT

9:15 a.m. Alex Mau, South Carolina Governor's School for Science and Mathematics
AN EXPLORATION OF THE USE OF ELECTROCHEMICAL IMPEDANCE
SPECTROSCOPY OF EPITAXIAL

9:30 a.m. Gordon Zhang, South Carolina Governor's School for Science and Mathematics
BIO-COMPATIBLE HYDROGELS FOR CONTINUOUS GLUCOSE MONITORS

9:45 a.m. Mehrzad Namiranian, South Carolina Governor's School for Science and Mathematics
CONSTRUCTION OF A WHITE LIGHT SOURCED COMPUTED TOMOGRAPHY
SCANNER PROTOTYPE

10:00 a.m. Madison Maddox, South Carolina Governor's School for Science and Mathematics
DESIGN OF A VACUUM THERMOFORMING DEVICE AND EXPERIMENTS ON PIN-
TOOLS TYPE RECONFIGURABLE SURFACES

BREAK

10:30 a.m. Zach Bills, South Carolina Governor's School for Science and Mathematics
EFFECTS OF AL2O3 AND LI2O MODIFIERS ON MOCC MEMBRANE
PERFORMANCE

10:45 a.m. Julia Daniels, South Carolina Governor's School for Science and Mathematics
DEVELOPING A TEST METHOD TO PRECISELY INDUCE AND MAINTAIN
DIFFERENT CRACK WIDTHS IN REINFORCED CONCRETE

11:00 a.m. Aspen Golden, South Carolina Governor's School for Science and Mathematics
ESTIMATION OF GREENSHIELDS MODEL PARAMETERS USING PYTHON

11:15 a.m. John Mathai, South Carolina Governor's School for Science and Mathematics
ELECTROSPINNING PVDF NANOPOROUS MEMBRANES FOR USE IN AIR GAP
MEMBRANE DISTILLATION TO DESALINATE DIRTY WATER

11:30 a.m. Deidra Ward, Academic Magnet High School
DEVELOPING A COMPUTER MODEL THAT PREDICTS THE OUTCOME OF
CORNEAL COLLAGEN CROSSLINKING
11:45 a.m. Andrew Re, South Carolina Governor's School for Science and Mathematics
EVALUATION OF CARBON BASED CATALYSTS FOR WATER ELECTROLYSIS AND CO2 ELECTRO-REDUCTION

LUNCH

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

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

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

2:15 p.m. BREAK

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

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

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

Engineering / Non-Mentored
Furman Hall 204

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

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

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

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

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

9:45 a.m. William Sullivan, Spring Valley High School
BUILDING A NOVEL PHOTOVOLTAIC THERMOELECTRIC DEVICE
10:00 a.m. Jenning Chen, Spring Valley High School
DEVELOPMENT AND PERFORMANCE EVALUATION OF A PHOTOVOLTAIC TREKKING POLE

BREAK

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

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

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

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

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

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

LUNCH

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

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

2:00 p.m. John Weiss, Heathwood Hall Episcopal School
THE EFFECT OF PLATINUM CATALYST (MEA) LOADING (.4/.4 G/CM2) (.4/.1 G/CM2) (.1/.4 G/CM2) AT TEMPERATURES OF (70OC, 80OC, 90OC), AND RELATIVE HUMIDITIES OF (50%, 75%, 100%), ON THE POWER OF A POLYMER ELECTROLYTE MEMBRANE FUEL CELL

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

2:30 p.m. Landon Louthian, Heathwood Hall Episcopal School
THE EFFECT OF UV RADIATION ON DIFFERENT TYPES OF SAIL CLOTH
3:00 p.m. Breanna Murrin, Spring Valley High School
THE EFFECT OF VARIOUS HEATING AND COOLING METHODS ON THE OUTPUT VOLTAGE OF A PELTIER TILE

3:15 p.m. Cam Ashcraft and Lamar Dawkins, Heathwood Hall Episcopal School
THE EFFECT THAT "CORKING" A WOODEN BASEBALL BAT HAS ON THE DISTANCE TRAVELED IN THE AIR BY A STRUCK BASEBALL

3:30 p.m. Albert Huang, Spring Valley High School
THE EFFECT OF INCREASED HYDROPHOBICITY ON WATER FLUX AND SALT REJECTION IN A SOLAR MEMBRANE DISTILLATION MODULE

Environmental Science / Mentored
Furman Hall 126

8:30 a.m. Patrick McKenzie, South Carolina Governor's School for Science and Mathematics
EFFECTS OF LIGHT COLOR ON POPULATION GROWTH IN RHODOMONAS SALINA

8:45 a.m. Lindsey Richardson, South Carolina Governor's School for Science and Mathematics
LAND USE AND SURROUNDING STREAMS: COMPARING FORESTED, PASTORAL, AND AGRICULTURAL LAND COVERS TO DETERMINE POSSIBLE HUMAN IMPACT IN THE SAVANNAH, SALUDE, AND ENOREE RIVER BASINS

9:00 a.m. Katelyn Kraichely, South Carolina Governor's School for Science and Mathematics
POPULATION ESTIMATE OF DIAMONDBACK TERRAPINS (MALACLEMYS TERRAPIN) IN GRICE COVE, SC

9:15 a.m. Brandi Windham, South Carolina Governor's School for Science and Mathematics
THE EFFECT OF RAINFALL VARIATIONS ON WATER CHEMISTRY, FISH ABUNDANCE AND DIVERSITY, AND CHANNEL GEOMORPHOLOGY IN AGRICULTURAL STREAMS WITHIN THE SALUDA AND UPPER SAVANNAH RIVER BASINS

9:30 a.m. Jo Jahn, South Carolina Governor's School for Science and Mathematics
THE EFFECTS OF A ONE METER SEA LEVEL RISE AND INCREASE IN STORMINESS ON THE PEOPLE AND PROPERTY IN THE GWENT LEVELS ON THE SEVERN ESTUARY

9:45 a.m. Olivia O'Connor, South Carolina Governor's School for Science and Mathematics
THE POTENTIAL IMPACTS OF A 1 METER SEA LEVEL RISE AND INCREASED STORMINESS ON THE LANDSCAPE AND WILDLIFE OF THE SOMERSET LEVELS IN THE SEVERN ESTUARY

10:00 a.m. Emily Navin, South Carolina Governor's School for Science and Mathematics
THE RELATIONSHIPS BETWEEN RURAL LAND COVERS AND WATER CHEMISTRY UNDER BASE FLOW CONDITIONS IN THE SOUTH CAROLINA PIEDMONT

BREAK
10:30 a.m.  Rhea Mathew, South Carolina Governor's School for Science and Mathematics
USING DIAGNOSTIC PCR TO ANALYZE TROPHIC RELATIONSHIPS BETWEEN MACROFAUNA AND MEIOFAUNA

10:45 a.m.  Jessica Collins, South Carolina Governor's School for Science and Mathematics
USING HYDROTHERMAL CARBONIZATION REACTORS TO REMOVE E. COLI FROM LIVESTOCK PRODUCTS

11:00 a.m.  Kristy Waterlander, South Carolina Governor's School for Science and Mathematics
VARIOUS FISH SPECIES ABUNDANCES AND DIVERSITY IN RELATION TO PERCENT COVERAGE OF MACROALGAL GROWTH

Environmental Science / Non-Mentored
Furman Hall 127

8:30 a.m.  Sahil Garg and Elise Volden, Southside High School
THE EFFECTS OF NITRATE LEVELS ON ALGAL GROWTH

8:45 a.m.  Lillian Meng, Southside High School
THE EFFECTS OF VARYING LIGHT WAVES ON ALGAL GROWTH

9:00 a.m.  Jarett Cantey, The Center for Advanced Technical Studies
TARGETED WASTE SEPARATION TO IMPROVE THE ECONOMIC VIABILITY OF METHANE HARVESTING

9:15 a.m.  Gage Burkhalter, The Center for Advanced Technical Studies
COULD SCALING FRESNEL LENS TECHNOLOGY RESULT IN A GREATER CAPACITY FOR SOLAR HEATING AND COOKING APPLICATIONS?

9:30 a.m.  Rakib Siddique, Spring Valley High School
DEVELOPMENT OF NOVEL AND COST-EFFECTIVE ADSORBENTS FOR WASTEWATER TREATMENT USING THE COMMON DANDELION

9:45 a.m.  Casey Brayton, Dutch Fork High School
DISRUPTIONS IN PHOTORESPiration OF GENUS MILLEPORA CORAL SYMBIODINIUM IN RESPONSE TO OCEAN ACIDIFICATION

10:00 a.m.  Yufei Wang, Heathwood Hall Episcopal School
THE EFFECT OF ALKALINE BATTERIES ON BRASSICA RAPA PLANTS GROWING HEIGHT

BREAK

10:30 a.m.  Anvith Deconnda, Spring Valley High School
THE EFFECT OF DIFFERENT PHOTOCATALYTIC SEMICONDUCTORS ON THE EFFECT OF PET SOLAR DISINFECTION OF E.COLI-CONTAMINATED WATER SOURCES

10:45 a.m.  Jordan Withycombe, Heathwood Hall Episcopal School
THE EFFECT OF GENETICALLY MODIFIED AND ORGANIC CORN ON THE AMOUNT OF CORN CONSUMED BY WILDLIFE
11:00 a.m. Azalfa Lateef, Spring Valley High School
THE EFFECT OF GYMNOSPERM, PINUS TAEDA, AND ANGIOSPERM, LAGERSTROEMIA, ON RED FOOD COLORING PARTICLES.

11:15 a.m. Almeera Lateef, Spring Valley High School
THE EFFECT OF DIFFERENT CONCENTRATIONS OF CITRUS SINENSIS ON THE PRODUCTION OF BIO-PLASTICS

11:30 a.m. Micah Nerielle Legaspi, Spring Valley High School
THE EFFECT OF ACESULFAME POTASSIUM ON THE PHOTOSYNTHESIS OF SPIROGYRA GREVILLEANA WHEN PRESENT AT THE CONCENTRATIONS OF 5, 10, 20, AND 30 MICROGRAMS PER LITER

11:45 a.m. Tylar Watson, Spring Valley High School
THE EFFECT OF A QUERCUS LAURIFOLIA FILTER ON THE BACTERIAL COLONY COUNT IN LAKE WATER

LUNCH

1:30 p.m. Shashwat Ravi, Spring Valley High School
THE CORRELATION BETWEEN REPORTED NUTRIENT LEVELS AND QUANTIFICATIONS OF MICROCYSTINS IN LAKE MURRAY, LAKE WATERRER, LAKE KEOWEE, AND SALUDA LAKE

1:45 p.m. Mohammad Arammash, Spring Valley High School
DESIGNING A COST-EFFECTIVE, ENVIRONMENTALLY-FRIENDLY, AND SUSTAINABLE WATER TREATMENT SYSTEM

2:00 p.m. Sarah Buchanan, Heathwood Hall Episcopal School
THE EFFECT OF MICROBEADS ON THE MORTALITY PERCENTAGE OF DAPHNIA MAGNA

2:15 p.m. Arya Soman, Spring Valley High School
THE EFFECT OF NITRATE ENRICHMENT ON LEMNA MINOR ON THE PHYTOREMEDIATION OF COPPER

2:30 p.m. Christopher Juhn, Spring Valley High School
THE EFFECT OF PERFLUOROOCTANOIC ACID ON THE GROWTH AND DEVELOPMENT OF DROSOPHILA MELANOGASTER

3:00 p.m. Alekhya Mitta, Spring Valley High School
THE EFFECT OF THE MICROALGAE, CHLORELLA VULGARIS VS. THE COCCOLITHOPHORID ALGAE, EMILIANIA HUXLEYI FERTILIZED WITH DIFFERENT CONCENTRATIONS OF AN IRON NITRATE SOLUTION ON THE BIO SEQUESTRAITION OF CARBON DIOXIDE

3:15 p.m. Jenna Seubarran, Greenville Technical Charter High School
THE EFFECT OF XYLEM FILTERS ON REDUCING WATER CONTAMINATION

3:30 p.m. Muhammad Fayyaz, Spring Valley High School
COMPARING THE EFFICIENCY OF CARBON CLOTH, GRAPHITE FELT, AND STAINLESS STEEL MESH AS ANODES FOR LOW-COST, SINGLE-CHAMBERED MICROBIAL FUEL CELLS
3:45 p.m.  Paige Mewborn, Dutch Fork High School
THE EFFECT OF THE FERMENTATION OF POTATOES ON THE PRODUCTION OF ETHANOL

Math & Computer Science / Mentored
Furman Hall 128

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

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

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

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

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

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

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

BREAK

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

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

11:00 a.m.  Bertrand Zhang, Academic Magnet High School
OBJECTIVE ASSESSMENT CRITERIA FOR MEDIAN BASED FILTERING OF IMPULSE NOISE CORRUPTED IMAGES
Math & Computer Science / Non-Mentored
Furman Hall 128

1:30 p.m. Rishi Suresh, Spring Valley High School
A COMPARISON OF THE PERFORMANCE OF PELTIER HYBRID COOLERS TO
STANDARD AIR AND WATER COOLERS AT COOLING AN OVERCLOCKED
COMPUTER PROCESSOR.

1:45 p.m. Luke Marazzo, Spring Valley High School
THE EFFECT OF AUTHENTICITY OF RESEARCH DATA ON COMPLIANCE WITH
BENFORD’S LAW

2:00 p.m. Lisa Qu, Spring Valley High School
THE EFFECT OF USING FFT AND BANDSTOP FILTER ON VOICE RECORDINGS
WITH DIFFERENT AMOUNTS OF BACKGROUND NOISE ON THE ACCURACY OF
A SPEAKER VERIFICATION SYSTEM

2:15 p.m. Eli Horner, Chapin High School
CAN BUS ROUTING BE IMPROVED THROUGH TRAFFIC STUDY

2:30 p.m. Emily Beach, Chapin High School
DO MATH- AND SCIENCE-ORIENTED STUDENTS PERFORM BEST ON THE ACT
OR SAT?

Microbiology / Mentored
Furman Hall 118

8:45 a.m. Nathan Leaphart, South Carolina Governor's School for Science and Mathematics
APOPTOTIC AND AUTOPHAGIC CELL DEATH IN GANODERIC ACID DM
TREATED PROSTATE CANCER CELLS

9:00 a.m. Annah Nieman, South Carolina Governor's School for Science and Mathematics
DETERMINING THE EXTENT OF TRYPANSOMA BRUCEI PEROXIN 13.2
(TBPX13.2)'S GLUCOSE-DEPENDENT LOCALIZATION OF THE GLYCOSONES IN
THIS ORGANISM

9:15 a.m. Sara Watson, South Carolina Governor's School for Science and Mathematics
EUKARYOTIC MICROBIAL DIVERSITY OF THE ICEMOLE; A REVOLUTIONARY
EXPLORATORY ICE PROBE COMBINING MELTING AND DRILLING

9:30 a.m. Victoria McCarthy, South Carolina Governor's School for Science and Mathematics
INDUCTION OF APOPTOSIS IN ESCHERICHIA COLI CELLS

9:45 a.m. Taylor DeHart, South Carolina Governor's School for Science and Mathematics
MAGNETIC HYPERThERMIA INACTiVATION OF ENTEROTOXIGENIC
ESCHERICHIA COLI USING BIO-FUNCTIONALIZED IRON-OXIDE
NANOPARTICLES

10:00 a.m. Noa Camp, South Carolina Governor's School for Science and Mathematics
THE EFFECTS OF PROTEASE ACTIVATED RECEPTOR-1 (PAR-1) ACTIVATION ON
MOTOR NEURON AXON EXTENSION IN A 3-D COLLAGEN MATRIX MODEL
Microbiology / Non-Mentored
Furman Hall 209

8:30 a.m. Katie Krouglicof and Emily Chen, Southside High School
INVESTIGATING THE EFFICIENCY OF DIFFERENT PRESERVATION METHODS ON BACTERIAL GROWTH

8:45 a.m. Vaibhav Bafna and Jane Lindberg, Southside High School
INVESTIGATION OF E. COLI AND ACETOMINOPHEN

9:00 a.m. Mary-Frances Behnke, Greenville Technical Charter High School
THE EFFECT OF UV-C IRRADIATION ON RAW FRUIT JUICE

9:15 a.m. Karen Ni, The Center for Advanced Technical Studies
THE EFFECTS OF SUGAR ALCOHOLS ON STREPTOCOCCUS MUTANS IN THE PRESENCE OF SUCROSE

9:30 a.m. Flinn Christian and Kristin Clemmons, Heathwood Hall Episcopal School
BACTERIAL GROWTH ON PROCESSED EGGSHELLS(US) VS UNPROCESSED EGGSHELLS(UK)

9:45 a.m. Lauren Groseclose, Spring Valley High School
THE EFFECT OF CERAMICS INFUSED WITH SILVER NANOPARTICLES ON ESCHERICHIA COLI FOR SMALL SCALE DRINKING WATER SYSTEMS

10:00 a.m. Noah Fechter, Spring Valley High School
THE EFFECT OF FEED COMPOSITION ON BIOLOGICAL HYDROGEN PRODUCTION IN SACCHAROMYCES CEREVISIAE

BREAK

10:30 a.m. Veronica McLean, Spring Valley High School
THE EFFECT OF LATHERIN ON THE GROWTH AND DEVELOPMENT OF CANDIDA ALBICANS FUNGUS

10:45 a.m. Brenna Connor, Heathwood Hall Episcopal School
THE EFFECT OF SALINITY ON THE FUNCTIONS OF A MICROBIAL MAT.

11:00 a.m. Zahida Ashroff, Spring Valley High School
THE EFFECT OF SHRIMP SHELL AND FISH SCALE EXTRACTS ON THE PATHOGENIC BACTERIAL STRAINS OF KLEBSIELLA

11:15 a.m. Marie Demetriedes, Heathwood Hall Episcopal School
THE EFFECT OF TEMPERATURE ON BACTERIA GROWTH

11:30 a.m. Grayson Byrd, Heathwood Hall Episcopal School
THE EFFECT OF TEMPERATURE ON THE GROWTH OF PSEUDOMONAS SP. AND PENICILLIUM SP. WHEN GROWN USING MOTOR OIL AS A SOURCE OF NUTRIENTS
11:45 a.m. Priyanka Rao, Spring Valley High School
THE EFFECT OF VARIOUS KINDS OF SWEETENERS ON THE CALCIUM DEGRADATION OF THE TOOTH ENAMEL CAUSED BY STREPTOCOCCUS MUTANS IN DENTAL CARIES

LUNCH

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

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

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

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

Physics / Mentored
Furman Hall 111

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

Physics / Non-Mentored
Furman Hall 111

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

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

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

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

9:30 a.m. Austin Wiesehahn, Spring Valley High School
COMPARING THE SPLATTER RATES OF LOW GRADE, MID GRADE, AND HIGH GRADE PAINTBALLS WHILE BEING SHOT FROM A PAINTBALL MARKER
9:45 a.m.  Krishna Gorrepati, Spring Valley High School  
THE EFFECT OF A P-N TiO2/Cu2O/ITO COMPOSITE JUNCTION USING E-BEAM EVAPORATION ON A SHEWANELLA ONIEDENSIS MR-1 MICROBIAL COUPLED PHOTOELECTROCHEMICAL CELL

BREAK

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

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

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

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

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

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

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

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

8:45 a.m.  Troy Hodge, South Carolina Governor's School for Science and Mathematics  
BODY COMPOSITION IN RELATION TO VO2MAX AND RUNNING PERFORMANCE

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

9:15 a.m.  Allie Young, South Carolina Governor's School for Science and Mathematics  
LACTATE THRESHOLD AND VO2MAX AS PREDICTORS OF RUNNING PERFORMANCE

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

9:45 a.m.  Elizabeth Mugo, South Carolina Governor's School for Science and Mathematics  
PROGRESSION TOWARDS A 3-DIMENSIONAL INNERVATION MODEL OF THE HUMAN BLADDER
10:00 a.m. Sayaka Reed, South Carolina Governor's School for Science and Mathematics
THE EFFECT OF MEDIA SUPPLEMENTS ON DIFFERENTIATION OF HUMAN ADIPOSE DERIVED STEM CELLS INTO UROEPITHELIAL CELLS

BREAK

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

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

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

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

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

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

LUNCH

Physiology & Health / Non-Mentored
Furman Hall 208

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

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

9:00 a.m. Natalie Reszczynski, Dutch Fork High School
JUST KEEP SWIMMING: AN APPROACH TO ALZHEIMER'S VIA COMMON-SUBSTANCE INGESTION
9:15 a.m. Cherilyn Heintz, Chapin High School  
EFFECTS OF YOGA ASANAS ON STUDENT STRESS

9:30 a.m. Alyssia Mitchell, Spring Valley High School  
THE EFFECT OF CHITOSAN SOLUTIONS ON THE REPRODUCTION OF EVOLVING PATHOGEN AND NOSOCOMIAL INFECTION STAPHYLOCOCCUS EPIDERMIDIS

9:45 a.m. Amelia Robinson-Brown and Alyce Petit, Heathwood Hall Episcopal School  
THE EFFECT OF DIFFERING CONTACT METHODS ON THE SPREAD OF GERMS IN CLASSROOM ENVIRONMENTS

10:00 a.m. Tanvi Mehta, Spring Valley High School  
THE EFFECT OF EXOGENOUS MELATONIN ON MATRICIDAL HATCHING IN CAENORHABDITIS ELEGANS

BREAK

10:30 a.m. Matthew Reupke, Spring Valley High School  
THE EFFECT OF INAUDIBLE HIGH FREQUENCY SOUNDS RANGING FROM 20-22 KILOHERTZ ON THE VISUAL ACCURACY OF HOMO SAPIENS

10:45 a.m. Savannah Hillmeyer, Heathwood Hall Episcopal School  
THE EFFECT OF DIFFERENT STYLES OF UNDERWATER KICKING ON VELOCITY IN SWIMMING

11:00 a.m. Jackson Hall, Spring Valley High School  
THE EFFECT OF THE AMOUNT OF CELECOXIB ADMINISTERED ON THE NUMBER OF CASES OF ATRIAL FIBRILLATION IN FOUR POPULATIONS OF DAPHNIA MAGNA

11:15 a.m. Jordan Lester, Chapin High School  
DIFFERENCES IN FLUID INTAKE POST-WORKOUT BETWEEN GATORADE AND WATER

11:30 a.m. Carl Lobitz, Spring Valley High School  
THE EFFECT OF CINNAMOMUM CASSIA ON THE HEART RATE OF DAPHNIA MAGNA

Psychology / Mentored  
Furman Hall 227

8:30 a.m. Daniel Newsome, South Carolina Governor's School for Science and Mathematics  
AFFECTIVE CIRCUMPLEX IN MUSIC

8:45 a.m. Alexia Junker, South Carolina Governor's School for Science and Mathematics  
CREATING DYNAMIC VISUAL STIMULI FOR USE IN FMRI AND EEG STUDIES ON THE INTERNAL REPRESENTATION OF AFFECTIVE STATES

9:00 a.m. Austin Gibbs, South Carolina Governor's School for Science and Mathematics  
EXAMINING DIFFERENCES IN FACE SPECIALIZATION IN SUBJECTS WITH ALZHEIMER'S DISEASE USING FUNCTIONAL MAGNETIC RESONANCE IMAGING
Psychology / Non-Mentored
Furman Hall 227

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

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

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

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

BREAK

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

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

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

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

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

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

LUNCH

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

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

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

2:15 p.m. Amy Loy, Chapin High School
THE CORRELATION BETWEEN VISUAL ARTS AND MATH AND SCIENCE
2:30 p.m.  Rachel Shroyer, Spring Valley High School
THE EFFECT OF BRAIN HEMISPHERE DOMINANCE ON 15-WORD
MEMORIZA
TION USING THE METHOD OF LOCI

Psychology / Non-Mentored
Furman Hall 228

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

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

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

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

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

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

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

BREAK

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

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

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

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

27
11:30 a.m. Jamie Milliff, Chapin High School
THE EVOLUTION OF VILLAINS

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

LUNCH

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

Zoology / Non-Mentored
Furman Hall 230

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

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

BREAK

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

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

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

Zoology / Mentored
Furman Hall 230

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

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

EXAMINING THE EFFECTS OF DIFFERENT KNEE FLEXION ANGLES AND DIFFERENT QUADRICEPS MUSCLE STRENGTHS ON THE PATELLAR TENDON
Omar Abdeladl
Greenville Tech Charter High School

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

DIFFERENTIATING BETWEEN THE ABILITIES OF SYNTHETIC VERSUS PHARMACEUTICAL ANTIBIOTICS TO PREVENT ANTIBIOTIC RESISTANCE
Roann A. Abdeladl
Greenville Technical Charter High School

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

AN INCONSPICUOUS BRACE THAT WILL CORRECT POSTURE TO RELIEVE SCIATICA
Chandler Abrams
The Center For Advanced Technical Studies

Sciatica is a set of symptoms that arise when the sciatic nerve is compressed or inflamed which causes pain, numbness or tingling and muscle soreness and stiffness in the affected leg of the compressed sciatic nerve. It usually occurs in older adults between 25 and 50. Sciatica is mainly caused by a herniated lumbar disc, which can often be traced back to incorrect posture. People don’t always take note of the way they sit, and posture is commonly overlooked. And while braces and other interventions created to correct posture exist, they are extremely bulky and far too visible for comfort. Creating an inconspicuous product that will correct ones posture without the user having to make a conscious effort to do so will greatly help to relieve sciatica and help to solve the problem at the source as well as make their problem less obvious to others. An unobtrusive innovation would be the creation of a Tank-Brace, a slim, but firm back brace that is embedded into a tank top. The initial designs feature a back brace component lined with slim nylon webbing for support, spacer mesh for padding, and spandex for comfort and elasticity. The brace will be secured by conjoining elastic straps with thin velcro attachments on each end for adjustability. The user will be able to adjust and fasten the velcro straps under the tank top by way of slits on either side of the front of the tank top, similar to a front pocket on a hoodie. After designs are sketched and appropriate materials are gathered, the adjustable prototype will be created and tested on 6 different people of varying body types who have, or have experienced, sciatica. They will rank the Tank-Brace on a scale of 1-10, on the effectiveness of the brace. It is expected that comfort level and particularly efficacy level will reach a level of 9 or above, and that the brace will not be extremely obvious on the user.
TREATMENT OF PATIENTS WITH A NONSENSE MUTATION IN THE X-LINKED INTELLECTUAL DISABILITY CUL4B GENE WITH G418
Aon Ali
Governor’s School for Science and Mathematics

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

THE EFFECT OF MASS ON THE VIBRATION OF A HELICOPTER DRIVESHAFT
Dimitri Amiridis
Heathwood Hall Episcopal School

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

AN ANALYSIS OF SBIR FUNDING ACROSS THE NATION
Chanon Amphan
Governor’s School for Science and Mathematics

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

DETERMINING THE RELATIONSHIP BETWEEN SPORTS AND ATHLETES PERSONALITY TYPES BASED ON THE BIG FIVE PERSONALITY TEST
Isabella Antonetti and Leila Barwick
Heathwood Hall Episcopal School

This experiment was based off of multiple prior studies done to determine a relationship between personality type and the sport each athlete plays. This study focussed on teenagers who played football, volleyball, or soccer. This study differentiates from the prior studies because it was specific sports rather than sport type, previous studies observed the relationship between extreme and traditional sports, and the athletes’ personality types. After reviewing these studies and their data, the hypothesis for this experiment was formed: If athletes are tested using the Big Five Personality Test, then the results will suggest a defined relationship between the athletes’ personality type and the sport they play. The null hypothesis formed is as follows: If athletes are tested using the Big Five Personality Test, then the results will suggest there will be no clear relationship between the athletes’ personality type and the sport they play. The independent variable is the sport each athlete plays. The gender, sport, day, and school are the constants/ controlled factors in the experiment. Each test was taken on practice days rather than game days to insure they were taken in the most relaxed manner possible. After completing the test and analyzing the results, the hypothesis was accepted.
THE EFFECT THAT “CORKING” A WOODEN BASEBALL BAT HAS ON THE DISTANCE TRAVELED IN THE AIR BY A STRUCK BASEBALL
Cam Ashcraft and Lamar Dawkins III
Heathwood Hall Episcopal School

A corked bat is believed by many to give a batter an advantage over the pitcher while at bat. This theory was tested by measuring the distance that two identical bats hit the balls before and after being drilled and corked. A skeet shooter was modified to fit this need. Two identical baseball bats of same length that were made by the same company took twenty-five swings on a modified skeet shooter. Each distance the ball traveled away from the tee was recorded and rounded to the nearest inch. A hole three-fourths of an inch in diameter and five inches deep was drilled through the center of the bats. Three wine corks were then pressed down into the hole. Each bat then took twenty-five swings with the distances having been recorded and rounded to the nearest tenth of an inch. The data then showed that the cork did affect the ball by hitting it 7.3% farther than the uncorked bats.

INVESTIGATION OF E. COLI AND ACETAMINOPHEN
Vaibhav Bafna and Jane Lindberg
Southside High School

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

CONTROLLING ENERGY TRANSFER IN METAL-ORGANIC FRAMEWORKS BY COORDINATIVE IMMOBILIZATION OF PHOTOCHROMIC LIGANDS
Any Bali
Governor’s School for Science and Mathematics

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

DO MATH- AND SCIENCE-ORIENTED STUDENTS PERFORM BEST ON THE ACT OR SAT?
Emily Bench
Chapin High School

While many studies use high school students’ standardized testing scores to predict areas of success after graduation and performance on exams administered in college, and some studies detail personality traits that could predict students’ level of performance on standardized tests, there are no studies that use high school students’ areas of academic success to predict performance on the ACT vs. SAT. This study attempts to illustrate a relationship between Chapin High School seniors’ scholastic success in sciences and mathematics and performance on the ACT and SAT tests. Its results will assist parents and guidance counselors in recommending which standardized test a student should take.

It is hypothesized that math- and science-oriented students will perform best on the ACT, as the ACT requires planning skills most seen in math- and science-oriented students. The following data about 139 Chapin High School seniors have been collected from the District 5 Testing Database: SAT score, ACT score, weighted math GPA, weighted science GPA, and weighted Humanities GPA. Researcher executes a multiple regression test designed to provide levels of influence of math GPA, science GPA, and humanities GPA on the difference between ACT score and SAT score on the data. The multiple regression test provides a function with coefficients whose values
predict the influences of math GPA, science GPA, and humanities GPA upon the difference between ACT and SAT scores. A T-test is performed upon the influence levels yielded by the multiple regression to determine respective levels of statistical significance. Researcher analyzes the results of the T-test to conclude how scholastic success in sciences and mathematics can predict success on the ACT.

BLOCK COPOLYMER SYNTHESIS THROUGH ATOM TRANSFER RADICAL POLYMERIZATION AND RING OPENING POLYMERIZATION
Kelby Beam
Governor's School for Science and Mathematics

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

REBRANDING THE PEE DEE: A CASE STUDY
Daniel Beasley
Governor's School for Science and Mathematics

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

ANALYSIS OF CHEMOTAXIS AND PHOTOTAXIS IN PLANARIA
Katie Beaudoin, Vineeth Sama, and Anna Hardison
Southside High School

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

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

THE CORRELATION BETWEEN AGE AND FRUSTRATION
Donzelle Benton
Westwood High School

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

THE CORRELATION BETWEEN AGE AND FRUSTRATION
Donzelle Benton
Westwood High School

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

COMPARATIVE ANALYSIS OF RECYCLING PROGRAMS IN THE SOUTHEASTERN UNITED STATES
Tommy Berrigan
Governor's School for Science and Mathematics

In South Carolina there is an established recycling cluster, and research has shown that an increase in the recycling rate in South Carolina will lead to a direct boost in the overall economy of South Carolina. In order to increase the amount of recycling in the state, more information on tactics for accomplishing such a task were needed. EngenuitySC, an economic development firm which works on boosting the economy in South Carolina, currently has a focus on the South Carolina recycling industry. This research of recycling economies in other southeastern states was conducted and the information was gathered to benchmark recycling. Then the steps that would be most economically advantageous if implemented were selected to be advised. While South Carolina has better recycling statistics than many other southeastern states, with a current rate of 31.8%, a much better percentage is desired. The research conducted was for the purpose of looking outside of South Carolina to see what other states have done in the area of both laws and regulations in attempts to increase their own recycling. Then all the data on other states' recycling were taken and the different strategies that showed the most success once employed were pulled out. In conclusion it was found that South Carolina can improve its recycling the most through a few different tactics: a pay-as-you-throw program, bans on certain materials from landfills, and expansions of current incentive programs for individuals and companies.
EFFECT OF TATA-BOX-BINDING-PROTEIN ASSOCIATED FACTOR 1 (TAF1) AND P0071 (AN ADHERENS JUNCTION PROTEIN) ON CELL POLARITY OF CACO-2, A HUMAN COLON CARCINOMA CELL LINE
Zachary Berry
Governor’s School for Science and Mathematics

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

AN ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY STUDY OF EPITAXIAL GRAPHENE FOR USE IN A BREATH ALCOHOL ANALYZER
Mike Bhoi
Governor’s School for Science and Mathematics

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

THE EFFECT OF PACLITAXEL AND CISPLATIN ON A VARIETY OF METASTATIC MAMMARY HETEROGENEOUS NUCLEAR RIBONUCLEOPROTEIN – E1 (HNRNP-E1) KNOCK DOWN CELL LINES
Dae Bigach
Governor’s School for Science and Mathematics

Breast cancer is the most commonly diagnosed cancer in women (9). One protein Heterogeneous nuclear ribonucleoprotein E1 (hnRNP E1) when absent allows epithelial mesenchymal transition to occur in primary tumors. This protein was knocked down in a variety of Normal Murine Mammary Gland (NMuMG) cells so they would metastasize. The cells then underwent in vivo passage in mice to mimic a metastatic tumor returning in a patient. The resulting cell lines were named NMuMG, hnRNP E1 Knock Down (E1KD), mammary 1 passage (M1P), lung 1 passage (L1P), and lung 2 passage (L2P). The aim of this research was to test the drug resistance of these five cell lines. These cells lines were treated for four hours with two chemotherapeutic drugs at concentration gradients of 0uM to 1uM for Paclitaxel and 0uM to 20uM for Cisplatin. An MTT assay was performed to determine the viability of the cells. The results showed that the L2P cells had the highest rate of survival followed by the L1P, the E1KD, the M1P, and lastly the NMuMGs, showing that the more metastatic cell lines were better able to overcome the drugs. To further characterize the cell lines, the five lines were then subjected to growth curves, RT-PCRs to look at mesenchymal markers, immunofluorescence microscopy to look at spindle growth, and flow cytometry to look at cell cycle patterns. Results indicate that the L2P’s lost contact inhibition and were able to overcome the G2/M checkpoint better than others in the cell line.
Currently anthropogenic climate change is a major threat to our society. A primary cause of this change is CO2 emitted from coal burning power plants. The first step to mitigate CO2 emissions is a cost-effective method to capture them at point sources. A proposed system for cleaner power generation from coal necessitates a semi-permeable membrane which allows for the transport of CO2 while restricting the flow of other gases. This new class of membranes are called mixed oxide-ion and carbonate-ion conducting (MOCC) membranes. These membranes currently are not stable at high temperatures due to loss of molten carbonate, a liquid trapped within that generates the necessary semi-permeability. This research focuses on improving the stability of the MOCC membranes via the utilization of Al2O3 and Li2O as additives. The addition of these additives to the base ceramic which comprises the main structure of the membrane is intended to reduce the size of the pores in which the molten carbonate is trapped as well as making the ceramic itself stronger. Gas permeation analysis of the membranes which simulates operational conditions indicates that membranes composed of a base ceramic incorporating the Al2O3 additive demonstrated substantially higher performance increases. Structural analysis of the membranes using scanning electron microscopy indicate that both additives significantly reduced pore size of the ceramic.

**EFFECT OF CULTURE ON A COMPANY'S SUCCESS**

Joshua Bingham

Governor's School for Science and Mathematics

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

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

Katherine Bishara

Governor’s School for Science and Mathematics

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

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

Shuler Black

Governor’s School for Science and Mathematics

The formation of Business, Community, and Municipal Improvement Districts has become a common practice in the modern United States. What is the difference between the BID, CID, and MID and which, if any, could be beneficial to Beaufort, SC? After researching the three, it became evident that these terms are synonymous. A business improvement district, commonly referred to as a BID, is a region with specific geographic boundaries, including residential and commercial property. This specified district taxes itself an ad valorem millage rate, which is a tax based on the assessed value of the property, in order to accrue money. With this money, various improvements are made in the sectors of marketing, maintenance, security, and housing, exclusively for the businesses paying the tax. These changes provide the groundwork for economic progress and stimulate local business by promoting a business-friendly environment, and are governed by a board of business owners. In this research, tax information was collected on a set of parcels covering a large portion of the Beaufort municipality. After gathering the market values for over 500 parcels, the information was transferred to an Excel spreadsheet. Then, through sensitivity analyses, various millage rates were studied in order to analyze revenue. Finally, the increase in revenue
generated by the various millage rates was examined to propose an appropriate rate of 3-5 additional mills for the Beaufort area. If the proposed BID is put in place, this research suggests it could generate significant economic growth, as it has in many other cities across the US.

CREATING AN ADAPTING SMART VIRTUAL CAMERA HEIGHT CONSTRAINT ALGORITHM
William Blanchett
Governor's School for Science and Mathematics

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

THE PROPAGATION OF LAMB WAVES IN HONEYCOMB STRUCTURES
Adam Blocker
Governor's School for Science and Mathematics

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

DISRUPTIONS IN PHOTORESPiration OF GENus MILLEPORA CORAL SYMBiODiNiUM IN RESPONSE TO oCEAN ACiDiFiCATiON
Casey Brayton
Dutch Fork High School

Coral bleaching poses an imminent threat to the health and longevity of the world’s coral reef systems. The recent increase of ambient CO2 in sea water endangers the photoprotective process of photorespiration, which may overwhelmingly contribute to these bleaching events. While it has been established in numerous studies that ocean acidification negatively impacts calcification rates in corals, ocean acidification’s potential effect on other physiological processes has been largely overlooked, and the link between photoprotection disruption and bleaching events has been highly suggested, but has yet to be definitively established within a controlled environment. This study will investigate the effect of increasing CO2 levels on photorespiratory processes and their effect on coral bleaching patterns. When thirty specimen of genus Millepora are placed in ocean water with lower-than-average pH (“business-as-usual” projections ranging from normal levels to 1000 ppm), it is hypothesized that there will be a marked increase in surface area of bleached coral, measured in mm2. The surface area of bleached coral will be measured by a laser grid in mm2, while oxygen levels will also be monitored to observe the adjustment in photosynthesis after photorespiration declines. It will be analyzed whether the area of surface bleached in the high acidity group deviates from the control specimen where all conditions are at an optimal level.

IRON UPTAKE IN DUCKWEED
Rohan Brebion
Southside High School

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

Tyler Brown
Governor’s School for Science and Mathematics

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

THE EFFECT OF MICROBEADS ON THE MORTALITY PERCENTAGE OF DAPHNIA MAGNA

Sarah Buchanan
Heathwood Hall Episcopal School

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

INTRACELLULAR LOCALIZATION OF HGF RECEPTOR FRAGMENTS IN LUNG FIBROBLASTS

Taylor Buckner
Governor’s School for Science and Mathematics

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

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

Caroline Bunch and Emmye Mullins
Heathwood Hall Episcopal School

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

Gage Burkhalter
Center for Advanced Technical Studies

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

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

Grayson Byrd
Heathwood Hall Episcopal School

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

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

Noa Camp
Governor’s School for Science and Mathematics

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

TARGETED WASTE SEPARATION TO IMPROVE THE ECONOMIC VIABILITY OF METHANE HARVESTING

Jarrett Cantey
Center for Advanced Technical Studies

Landfill methane harvesting is the process through which methane released through anaerobic digestion is collected and put to use in energy production. The viability of this method is historically unpopular due to the low energy output. In order to improve the economic viability of methane harvesting, this study seeks to improve the energy output of landfill gas harvesting through separation of waste components into common groups. The waste group which is found experimentally to have the greatest potential for methane production which then be further sub-divided to determine which components specifically lead to increased efficiency.
CONTROLLING THE DISSOLUTION OF AG IN AG-AU CORE SHELL NANO PARTICLES OF VARYING SHELL THICKNESS
Will Carpenter
Governor's School for Science and Mathematics

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

THE STUDY OF HUMAN SPHINGOSINE KINASE AND ITS POTENTIAL INHIBITORS
Brooke Christensen
Governor's School for Science and Mathematics

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

BACTERIAL GROWTH ON PROCESSED EGG SHELLS(UK) VS UNPROCESSED EGG SHELLS(UK)
Flinn Christian and Kristin Clemmons
Heathwood Hall Episcopal School

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

AUDITORY NERVE INJURY INDUCES MACROPHAGE ACTIVATION
Anne-Marie Coble
Governor’s School for Science and Mathematics

Macrophages are a special type of immune cell that engulfs dead or damaged cells. They are found everywhere in the body and become more active after damage to cells. Their role in healing acute injury in the mature mouse cochlea has not been fully determined. We used Ouabain surgery, a chemical that kills neurons, to investigate the behavior of macrophages after injury. We hypothesized that macrophages would become more active after direct injury to the cochlea. Using immunofluorescence, we were able to observe the behavior of macrophages stained with anti ionized calcium binding adapter molecule 1 antibody (IBA1), which is found on the surface of macrophages. We found that after the model of acute injury, the number of macrophages in the cochlea increased and appeared more active based on their morphology. This information can lead to future studies about the types of macrophages and the specific healing role in acute injury.
Scientists have been researching new methods that are eco-friendly and least costly when debating the topic of eliminating the spread of pathogen and antibiotic resistance in the environment. Prior research of this field has been rarely studied until the introduction of Hydrothermal Carbonization (HTC) Reactions which emit carbon-rich hydrochar. These reactors were used to test the elimination of the E. coli O157:H7 from infected cow bone and muscle tissue at different temperatures and time. Kanamycin, an antibiotic resistance drug containing the E. coli plasmid, has been known to have an increased resistance with bacteria used agriculturally. Because of this, Kanamycin was used in the agar plates in order to track the growth or lack of growth with the experimental E. coli. The leftover liquid from the reactor was serial diluted to test for growth in bacterial colonies. DNA extractions were taken on the different samples and ran on electrophoresis gels after undergoing PCR reactions. Detection of the E. coli plasmid was negative for 200° bone and muscle tissue samples and 150° meat samples but was positive in the first well of the 150° meat sample. Essentially, the HTC Reactors were essential in eliminating the bacteria which now lead into investigating which HTC reactor would be ideal for farmers to use in the future for livestock disposal.

THE EFFECT OF SALINITY ON THE FUNCTIONS OF A MICROBIAL MAT.
Brenna Connor
Heathwood Hall Episcopal School

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

THE EFFECT OF HEPATOCYTE-SPECIFIC GLUCOCORTICOID RECEPTOR LOSS-OF-FUNCTION ON ARGINASE I EXPRESSION IN THE MOUSE LIVER UREA CYCLE
Sean Conway
Governor’s School for Science and Mathematics

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

UTILIZING ADVENTITIOUS ROOT VARIATION TO IDENTIFY THE CORRELATION BETWEEN ROOT FORMATION AND LEAVES IN PEACHES
TKaylia Cornish
Governor’s School for Science and Mathematics

Adventitious rooting of plants is beneficial to the cloning of desired plants; no matter the use. However, many desired species of plants do not produce adventitious roots, so the characteristics of adventitious roots are studied to see if these desired species of plant can get the genome needed to do so. In this research, the ultimate goal is to identify the different that leaves make when growing adventitious roots. Two populations, A and C, are phenotyped for their production of adventitious roots. Approximately ten, twenty-centimeter cuttings of current year wood were taken from 378 trees in the A population and 57 trees in the C population. The leaves were stripped and the stems were dipped in IBA, indole-3-butyric acid, and placed in a soilless media, which consisted of vermiculite and perlite. They were then put in the greenhouse and kept misted for four weeks. The cuttings were scored for various properties such as: number dead, callus, rooting, and budding. DNA from the dried leaf tissues of the same populations were extracted quantified and quality checked in order to produce a more detailed genetic map. A second experiment was done after this with the same populations leaving the leaves on the cuttings to see if they make a difference. The success of the growing stems, with or without leaves, will tell us whether the rooting of the plants can be controlled so that maybe in the future the genome of adventitious rooting can be modified and placed in other plants.
SEMAPHORIN 3F RESPONSES TO NEUROPILIN 2 ISOFORM KNOCKDOWNS IN H157 LUNG CANCER CELLS
Sean Cosh
Governor’s School for Science and Mathematics

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

THE EFFECT OF ARROW MASS ON BOTH THE ARROW VELOCITY AND THE EFFICIENCY OF THE BOW
Coleman Couick and Spencer Hann
Heathwood Hall Episcopal School

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

EFFECT OF BOLUS VISCOSITY ON EPIGLOTTIC INVERSION DURING SWALLOWING
Ramsey Coyle
Governor’s School for Science and Mathematics

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

INSULATIVE PROPERTIES AND HEAT TRANSFER
Tryston Crawford
Greenville Technical Charter High School

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

COMMUNITY SERVICE AWARENESS THROUGH THE USE OF MEDIA
Reid Creswell
Chapin High School

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

DEVELOPING A TEST METHOD TO PRECISELY INDUCE AND MAINTAIN DIFFERENT CRACK WIDTHS IN REINFORCED CONCRETE
Julia Daniels
Governor's School for Science and Mathematics

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

EFFECTS OF DIFFERENT TYPES OF MUSIC ON VARIOUS LEARNERS AND THE AFOREMENTIONED'S COGNITIVE ABILITIES
Gracie Daughtry
Greenville Technical Charter High School

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

HAS THE ADDITION OF WIRELESS HOUSEHOLD ELECTRONICS EFFECTED THE LEVELS OF EMF IN HOUSEHOLDS?
John Davis
Heathwood Hall Episcopal

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

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

MAGNETIC HYPERTHERMIA INACTIVATION OF ENTEROTOXIGENIC ESCHERICHIA COLI USING BIO-FUNCTIONALIZED IRON-OXIDE NANOPARTICLES
Taylor DeHart
Governor’s School for Science and Mathematics

Rapid emergence of new multi-drug resistant bacterial strains warrants new therapy options for treating bacterial infections caused by these strains. The purpose of this project was to use magnetic hyperthermia, in the presence of bio-functionalized iron-oxide nanoparticles (IONPs), as a non-antibiotic technique that effectively kills bacterial infections caused by enterotoxigenic Escherichia coli (ETEC), specifically E. coli ATCC 13762 (EC K99). EC K99 is known to cause bloody diarrhea in newborn pigs and calves and foodborne illnesses. The IONPs were coated with polyethylene oxide (PEO-IONPs) and bio-functionalized with specific sialic-acid glycoconjugate Neu5ac(α2-3)-Gal-(β1-4)Glcβ-sp (GM3-IONPs) that mimic the receptors of EC K99 adhesins. Magnetic hyperthermia treatment of a mixture of EC K99 and GM3-IONPs resulted in a 2-log reduction of colony-forming units (CFUs) of EC K99 after 60 minutes. There also was a significant decrease in the ATP activity of EC K99 seen from luminescence assays after the hyperthermia treatment. These results suggest that magnetic hyperthermia can potentially be used as a novel non-antibiotic therapy option for treating bacterial infections.

THE EFFECTS OF WARMING AND ELEVATED CARBON DIOXIDE ON THE SUBERIN COMPOSITION OF ROOTS: A CASE STUDY WITH A C3 PLANT SPECIES
Rose Dellinger
Governor’s School for Science and Mathematics

Warming temperature and increasing CO2 have a positive feedback loop known as the greenhouse effect. To estimate the changes that will present themselves in future years, the Prairie Heating and CO2 Enrichment (PHACE) experiment in Wyoming set up twenty plots to see how the greenhouse effect will affect mixed-grass prairie. The amount of suberin, a compound found in the radial and transverse cell walls of the endodermal plant roots cells can help determine the rate of decomposition which affects the amount of carbon in the soil. The storage of carbon in soil is particularly important because soil is the largest reservoir of organic carbon in the terrestrial ecosystems (Rasse, Rumpel, & Dignac, 2005). We took C3 roots from the PHACE experiment, ground them in a mill until powdered, completed a solvent extraction, conducted base hydrolysis with and without heat, and a phase separation to try to determine the amount of suberin in the plant roots from each plot. The solvent extract and the methyl chloride from the phase separation were analyzed using gas chromatography mass spectrometry. Using the area of the peaks as references, it was determined that warming and CO2 had a p = .07 effect on the C3 species suberin production.

THE EFFECT OF TEMPERATURE ON BACTERIA GROWTH
Marie Charlotte Demetriades
Heathwood Hall Episcopal School

Bacteria is grown under many different conditions. The bacteria E. coli and Streptococci were used to determine the effect that temperature has on the growth of bacteria. Previous work has failed to address if the temperature affects all bacteria in the same way. The research was conducted by germinating the bacteria in a lab in different temperatures. The experiment is relevant to the conditions of bacteria growth. The hypothesis is that if bacteria are cultured in a warm environment, then the bacteria will grow at a more rapid pace. The Streptococci bacteria supported the hypothesis, while the E. coli supported the null hypothesis.
Hydroponics is a relatively new technology, evolving rapidly since its inception 70 years ago. Hydroponics is the process of growing plants without soil but with added nutrients. The purpose of this experiment was to investigate the effect of growing techniques on the amount of vitamin C produced by Brassica rapa nipponosica, also known as mizuna lettuce. This study was conducted by assembling an NFT hydroponic system and growing twenty-eight mizuna plants using each technique: hydroponics and soil grown. Once the system was built, sixty mizuna plants were grown and tested for vitamin C levels. The hydroponic mizuna received nutrients in two parts, A and B, while the soil grown mizuna received only water and the bagged soil. The mean for the amount of vitamin C produced in the hydroponically grown plants was 0.0321 mg. The mean for the amount of vitamin C produced in the conventionally (soil) grown plants is 0.0082. The null hypothesis is able to be rejected because the t stat, 4.9478, is bigger than the t-critical one tail 1.6736 and the t-critical two tail 2.0049. The results were obtained by using a T-test (two-sample assuming equal variances) and indicate that the hydroponic growing technique helped to increase the amount of vitamin C found in the mizuna lettuce. Aside from nutrient levels, the hydroponically grown mizuna had a much greater mean height; 8.6 cm. as compared to the soil grown mizuna having a 5.8 cm. average height.

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

Brooks Digh
Governor's School for Science and Mathematics

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

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

Trina Dinh
Governor's School for Science and Mathematics

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

AN ANALYSIS OF ELECTRICAL CONDUCTIVITY AND PH IN ACETOUS FERMENTATION

Isabelle Doan
Southside High School

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

THE EFFECT OF SALINE IRRIGATION ON TEMPERATURE PROFILE DURING RADIOFREQUENCY (RF) ABLATION
Katherine Duchinski
Governor's School for Science and Mathematics

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

SUCCEEDING IN THE HIGH-GROWTH TECHNOLOGY INDUSTRY
Joel Fonseca
Governor's School for Science and Mathematics

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

DNA METHYLATION CHANGES RESULTING IN ENHANCER AND NON-ENHANCER REGIONS OF THE SIX3B GENE
Mackenzie Foster
Governor's School for Science and Mathematics

Several regions upstream of genes affect whether transcription and translation occur. Two of these regions are the enhancer and the promoter, previously it was thought that promoters are the driving force for transcription, but now we are looking into the effects of enhancers. We isolated possible enhancer sequences, which we identified from where transcription factors bound, upstream of the six3b gene. These regions were cloned into entry and destination vectors for microinjection into zebrafish embryos. These regions where cloned so that expression of the GFP gene, which was located downstream of our possible enhancer regions, had the possibility to be expressed. If there was expression the region could be determined as an enhancer and if no expression was seen then the region could be looked at as a non-enhancer. After microinjection, we looked for patterned expression in the head and eyes of developing zebrafish, because the six3b gene has previously been shown to be expressed in the head and eyes region of the body. We identified the six3b-e1 region as a possible enhancer and the six3b-ne1 region as a possible non-enhancer, both by the fact that they were bound by transcription factors. The results provided evidence to support that these assumptions were correct because the six3b-e1 plasmid drove patterned expression in the head and eyes and the six3b-ne1 drove no patterned expression. We conclude that regions that experience DNA methylation, the
addition of methyl groups to a cytosine, throughout development can be considered enhancer regions. Six3b-e1 experienced DNA methylation, but six3b-ne1 did not.

HUMAN FALL DETECTION: VIBRATION FREQUENCY DIFFERENTIATION
Mimi Foster
Governor’s School for Science and Mathematics

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

POLLUTION-SENSITIVE LARVAE OF WORMALDIA SPP. (TRICHOPTERA: PHILOPTAMIDAE) AND NEURECLIPSIS MELCO ROSS, 1947 (TRICHOPTERA: POLYCENTROPODIDAE)
Leslie Galvez
Governor’s School for Science and Mathematics

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

FLAT VS. VERTICAL
Elyse Hope Gandy
Greenville Technical Charter High School

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

THE EFFECTS OF NITRATE LEVELS ON ALGAL GROWTH
Sahil Garg and Elise Volden
Southside High School

Run-off continues to pollute water systems with nitrates, yielding large amounts of algal growth. This growth can be harmful to the remaining aquatic ecosystem, since the algae decreases the amount of oxygen present in the environment for other organisms. With these consequences of unregulated algae growth, it is evident that in some situations, it would be beneficial to have the ability to better control the growth and spread of algae. Information about the optimum nitrate levels for algal growth may be used to harness the growth of algae and better prevent against unwanted algal growth that may cause harm to other organisms in aquatic environments. This experiment demonstrates the relationship between nitrate levels in algal-
Alzheimer’s disease (AD), a devastating neurodegenerative disease, profoundly affects an individual’s ability to socialize, stay motivated, and recognize faces. Grasping an understanding of the neural basis of this disease may lead to future behavioral or pharmacological interventions. The overall goal of the study was to identify group differences in neural activation of AD subjects and healthy controls (HC) while viewing face and non-face stimuli. The main hypothesis of this study is that AD subjects would show decreased activation in the fusiform face area (FFA) and increased primary visual cortex activation. To test this hypothesis, 5 AD and 55 HC subjects underwent a functional magnetic resonance imaging (fMRI) session, in which they viewed blocks of faces, objects, and textures. The fMRI images were preprocessed to correct for any head motion or geometric distortions using FSL (the interface for looking at brain images), FEAT (for skull-stripping and creating a model), and FEATQUERY (to extract the signals) software programs. Once the signals were extracted, ANOVAs were conducted for each region of interest. The results did not reveal significant group differences in face specialization in the FFA and the primary visual areas, but additional exploratory analyses revealed group differences in the face specialization of the amygdala, an area linked to emotional processing and detecting salience. Unlike the healthy control group, the amygdala activation in AD subjects was not face specific. This activation pattern may reflect diminishing salience of faces vs. objects in Alzheimer’s disease.

THE BENEFITS OF ECONOMIC DEVELOPMENT STRATEGIES FOCUSED ON HIGH TECH, EARLY-STAGE BUSINESSES VERSUS THOSE FOCUSED ON TRADITIONAL, LATER-STAGE BUSINESSES
Jay Gohil
Governor’s School for Science and Mathematics

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

ESTIMATION OF GREENSHIELDS MODEL PARAMETERS USING PYTHON
Aspen Golden
Governor’s School for Science and Mathematics

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

INCREASING THE EFFICACY OF ANTITUMOR THERAPY: A LYSINE SPECIFIC DEMETHYLASE 1 INHIBITOR IN COMBINATION WITH 5-DEOXYAZACYCITIDINE
Elizabeth Grant
Governor’s School for Science and Mathematics

Lysine-specific demethylase 1 (LSD1) is a chromatin remodeling oxidase enzyme that is over expressed in a number of human cancers. It has been targeted for the development of specific inhibitors with therapeutic potential. LSD1 has been shown that the interactions between histones and chromatin remodeling are very important for selective control of gene expression. Because of this, chromatin remodeling enzymes are very quickly becoming attractive therapeutic targets for multiple diseases with an epigenetic basis. Through histone and DNA marker changes such as: acetylation, methylation, and sumoylation, certain genes can be turned “on” or “off.” LSD1 acts as a demethylase enzyme and removes methyl groups from the mono- and dimethylated forms of histone 3 lysine 4 (H3K4). Demethylation of mono- and dimethylated H3K4 results in gene silencing. Because H3K4 is over expressed in cancer, important tumor suppressor proteins are not formed. The drug 5-
deoxyazacytidine is a standard therapy for lung cancer, but has serious side effects that limit its use. We hypothesized that combining a specific LSD1 inhibitor with 5-deoxyazacytidine would allow the use of a lower dose, reducing side effects. To test this hypothesis, we treated CALU-6 human lung adenocarcinoma cells with novel LSD1 inhibitors combined with various concentrations of 5-deoxyazacytidine. We concluded that there was no significant difference between the CALU 6 cells that were only dosed with 5-deoxyazacytidine and the ones that were dosed with both a novel LSD1 inhibitor and 5-deoxyazacytidine.

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

Madeline Grant  
Governor's School for Science and Mathematics

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

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

Meredith Hammer  
Governor’s School for Science and Mathematics

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

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

Dillon Harper  
Center for Advanced Technical Studies

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

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

Sydney Hart  
Governor’s School for Science and Mathematics

Parkinson’s disease (PD) is a disorder where the brain’s motor neurons are affected, resulting in tremors, impaired balance, and muscle spasms. Aggregates and oligomers of the α-synuclein protein were discovered in the dopaminergic neurons of post-mortem PD patients. It is unknown as to why these aggregates and oligomers form or how they cause the symptoms of PD. This study used the budding yeast, Saccharomyces cerevisiae, as a model for the examination of these α-synuclein proteins by overexpressing the protein, leading to its aggregation. The results of this study showed that the human α-synuclein gene,
tagged with His6 and GFP, can be successfully integrated into the yeast genome. These α-synuclein-containing aggregates and oligomers were purified using affinity chromatography and detergents. The next step will be analysis using mass spectrometry to identify any other proteins or particles aggregated along with α-synuclein. Once the components of these aggregates and oligomers are identified, greater insight will be gained on their formation in the neurons, thus leading to pharmaceuticals that could inhibit the formation of these multi-protein complexes.

SEVERITY OF ASD SYMPTOMS IN RELATION TO CHILDREN’S GENDER
Lorraine Haselden
Chapin High School

The purpose of this project was to determine whether or not the symptoms of Autism spectrum disorder (ASD) are more severe based on gender. If the severity of symptoms of both male and females with ASD are studied using the Childhood Autism Rating Scale (CARS), then males will be found to demonstrate the most severe symptoms. The data was collected through video analysis of children with ASD and then rated on the childhood autism rating scale (CARS). The data was analyzed using a 2 t-test to compare the mean scores of males and females. Through the analysis it was determined that males have significantly higher ratings on the CAR scale than females. These findings were statistically significant because the p value was 0.00000000000172 meaning that my hypothesis was supported by the data. In conclusion, the hypothesis that males will present more severe symptoms of ASD was proven correct by the analysis of the data. This project could be expanded to include publishing these findings in order to share the information and provide more specialized programs for males with ASD. These programs could be used to help elevate some symptoms to help make them higher functioning members of society.

THE EFFECT OF ORGANIC AND INORGANIC FERTILIZERS ON THE AMOUNT OF CHLOROPHYLL IN A BRASSICA RAPA PLANT.
Annie Heath
Heathwood Hall Episcopal School

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

EFFECTS OF YOGA ASANAS ON STUDENT STRESS
Cherilyn Heintz
Chapin High School

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

THE EFFECT OF GASOLINE ADDITIVES ON ENGINE PERFORMANCE/RUN TIME
Parker S. Henderson
Greenville Technical Charter High School

Gasoline additives have often made headlines in the last ten years. As scientists search for reliable sources of alternative fuel, additives have taken the role of temporary measures or as performance boosters. Some like ethanol did not live up to expectations as they reduced performance as well as emissions, which “balanced out” each other. Some like lead were banned in the US because of their devastating environmental impact. Still others like octane boosters can be bought at a nearby auto parts store. In this experiment an old lawnmower engine was fixed and was used it to measure several different effects of gasoline additives. The additives involved lead, ethanol, and two store bought additives, all in various amounts. Pure gasoline was ran first as a control, then each additive was ran in constant amounts. Performance of the engine was measured
in RPM (measured every 30 seconds) and total run time was recorded. In the end, it was determined that the control of pure gasoline ran the best, with lead and ethanol tied for second. It is believe the generally poor performance of the additives had to do with the fact that our engine was a two stroke, not a four-stroke engine like the additives were designed for.

FUNCTIONAL CHARACTERIZATION OF A NEWLY IDENTIFIED NICOTIANA TABACUM SULFATE TRANSPORTER GENE NTASULTR2 INVOLVED IN SULFATE TRANSPORT AND DISTRIBUTION
Adam Herbert
Governor's School for Science and Mathematics

Sulfur, one of six macronutrients required by plants, is the rudimental component of cysteine, methionine and sulfolipid. It also serves as the active center of many enzymes. In soil, inorganic sulfate (SO4\(^{2-}\)) is the most common sulfur source for plants. Over the past twenty years, sulfate transporters involved in sulfate uptake and distribution have been well studied in plants. Fourteen sulfate transporter genes, classified into five groups, were identified in Arabidopsis thaliana. To date, twelve sulfate transporter genes have been identified in rice, Oryza sativa. However, only one sulfate transporter gene, NtaSULTR2 has been identified and cloned in tobacco, Nicotiana tabacum. NtaSULTR2 is regulated by a sulfate responding micro-RNA, with repression of NtaSULTR2 expression in transgenic tobacco leading to impaired sulfate homeostasis. The purpose of this study is to functionally characterize the gene NtaSULTR2. A micro-RNA resistant NtaSULTR2 cDNA, rNtaSULTR2 was created using a site-directed mutagenesis method. rNtaSULTR2 was ligated into the plasmid pH721 in order to overexpress the cDNA. rNtaSULTR2 was also ligated into the plasmid pH722 for RNA-interference, repressing NtaSULTR2. These two vectors were then transformed into Agrobacterium tumefaciens LBA4404 by electroporation. They will be transformed into tobacco using the leaf disc transformation method. This experiment could help solve issues with soil having decreasing sulfur levels by allowing the tobacco to have a higher uptake of sulfur.

THE EFFECTS OF ANTIOXIDANT VITAMINS A, C, & E ON THE PREVENTION OF BACTERIAL GROWTH IN GRANNY SMITH APPLES
Brandon Hill
Heathwood Hall Episcopal School

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

THE EFFECT OF DIFFERENT STYLES OF UNDERWATER KICKING ON VELOCITY IN SWIMMING
Savannah Hillmeyer
Heathwood Hall Episcopal School

The purpose of this experiment was to compare different styles of underwater kicking with respect to velocity of a swimmer. Four underwater kicking styles were compared; underwater dolphins, underwater freestyle, on the surface dolphins, and on the surface freestyle. One of the largest uncertainties in the competitive swimming world is which type of kick is fastest, therefore the results of this study could help clear the air of some of this controversy, by showing which type of kick is fastest for competitive swimming. The subjects used in this were asked to swim at least fifteen meters using their designated kick, and they were timed using stopwatches to measure how long it took them to kick fifteen meters of their designated kick. The hypothesis was that if the swimmer uses underwater dolphin kicking or underwater freestyle kicking, then the swimmer will have a greater velocity than if they use on the surface dolphin kicking or on the surface freestyle kicking. The results of this experiment supported the null hypothesis. In conclusion, this experiment will benefit the swimming community by displaying which type of underwater kick has the greatest velocity.

DETERMINING TBPEX13.2’S POTENTIAL FOR GLUCOSE-DEPENDENT LOCALIZATION IN TRYpanosoma brucei
Jamison Hite
Governor’s School for Science and Mathematics

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

**BODY COMPOSITION IN RELATION TO VO2MAX AND RUNNING PERFORMANCE**

Troy Hodge
Governor’s School for Science and Mathematics

Previous research on body composition and aerobic fitness has indicated that a lower percentage of body fat results in better endurance performance. Previous studies have also shown a high correlation between maximal oxygen uptake (VO2Max) and running performance. This study examines the correlation between body composition and aerobic performance. Body composition was measured using a Bodpod air plethysmography system. VO2Max was measured using a progressive treadmill test and Cosmed CPET breath analyzer. A significant correlation was found between body composition and absolute VO2Max, relative VO2Max, VO2Max relative to fat free mass, 1609-meter race time and 5000-meter race time. It was concluded that a lower body composition results in more efficient oxygen consumption and better running performance. This data can be used to determine one’s own physiological data with the goal of improved training and performance.

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

Stone Holt
Governor’s School for Science and Mathematics

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

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

Patrick Van Hook
Greenville Technical Charter High School

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

**THE EVALUATION OF THE K-MEANS CLUSTERING ALGORITHM USING DIFFERENT DISTANCING METHODS**

Alex Hoover
Governor’s School for Science and Mathematics

This research primarily focused on finding differences in various distancing methods used in the k-means clustering algorithm. The distancing methods used throughout the experiment are the Euclidean, Manhattan, and Earth Movers Distance. To accomplish this task, code in Python, wrapped around some C and Fortran code, was used to process images and determine the quality of the clusters made in the algorithm. The tests executed were performed on a ground truth to determine the quality of the measurements. For this experiment, Kylberg’s Texture Set was used as that primary ground truth. After initial results were determined, with an assumed cluster count of 28 (1 cluster per texture), further testing was required to search for significant differences in the data. So, the cluster count was optimized using a Q-test and the Anderson-Darling Statistic. All the optimization data was used to find more accurate results of the primary experiment, and the cluster count, for Kylberg’s Texture set, was actually optimized around 400 or 500. Results for the k-means clustering run on Kylberg’s Texture set clusters, using the optimized cluster count, are not included in this paper.
This project examined how traffic study can be used to reduce the amount of time that school buses must spend on the road. The purpose of the project is to reduce the amount of time that students at Chapin High School spend riding the bus. This could also reduce the cost of transportation for the school district. Major intersections near Chapin High School were examined in order to determine the number of vehicles passing through them and the times at which the amount of vehicles was the highest. The hypothesis was that there would be significant variations in the traffic density over the time period studied. The data was analyzed and compared with current routes. New routes will be drawn from the results that will adjust the timing of the buses so that they arrive at the high traffic locations at ideal times. Data collection from the intersection of Amick’s Ferry Road and Chapin Road, shows that the amount of vehicles traveling through the intersection peaks twice, around 7:30am and 8:00am. In between those peaks, there is a pronounced decrease in the amount of traffic. From this data, preliminary conclusions can be made that show that there are variations in the volume of vehicles in the intersections within the two hours preceding the start time of the school, therefore supporting the hypothesis. These results can be used to help to improve the efficiency of the Chapin bus system, by allowing the buses to be routed through these intersections at lower traffic times.

THE EFFECT OF MULTIPLE FLAVONOIDS ON AMYLOID-BETA AND NEUROFIBRILLARY TANGLES IN ALZHEIMER’S DISEASE
Phuong Huynh
The Center for Advanced Technical Studies

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

LONG-TERM MONITORING OF THE DECREASING UNDERSTORY AT HOBCAW BARONY’S CYPRESS FORESTS POST-HURRICANE HUGO
Charles Isom
Governor’s School for Science and Mathematics

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

THE EFFECTS OF A ONE METER SEA LEVEL RISE AND INCREASE IN STORMINESS ON THE PEOPLE AND PROPERTY IN THE GWENT LEVELS ON THE SEVERN ESTUARY
Jo Jahn
Governor’s School for Science and Mathematics

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

New restrictions by the Environmental Protection Agency (EPA) are limiting the amount of certain gases released into the atmosphere by industries. These restrictions will have the greatest effect on the automobile and power industry, especially in fossil fuel burning power plants. These industries rely on powerful gas sensors to monitor and control emissions. But in order to meet the demand set by the new standards a new sensor is needed. This new sensor must be capable of withstanding harsh temperatures (In excess of 60°C) and providing a quick response to change in gas environment. We have developed a high throughput cell capable of exposing multiple new sensors to the same gas environment simultaneously. By using a physical deposition chamber we were able to quickly manufacture new sensors to be tested in the cell. Currently we are in the process of validating this high throughput system by testing it using previously studied sensors.

AN EXPERIMENTAL STUDY OF THE ELECTROOSMOTIC BEHAVIOR OF VARIOUS GLYCEROL SOLUTIONS, UNDER VARYING POTENTIAL DIFFERENCE IN A T-SHAPED MICROCHANNEL ENVIRONMENT
Jones Jenkins
Governor's School for Science and Mathematics

Microfluidics data for various fluid solutions (such as different concentrations of glycerol, Ferro fluid, Pb buffers, and MnBr2) is important that the microfluidic and manufacture mechanical microfluidic devices created for a variety of applications (mostly “lab on a chip” applications, the goal of which is the miniaturization of biological and chemical tests to the size of microscope slides). The goal of these experiments is to determine the electroosmotic behavior of different concentrations of glycerol solution (0%, 5%, 10%, 20%, and 30% by mass) under various electric field strengths (Between 500 - 1300 Volts dc), in a T-shaped microchannel. The behavior of the solutions is observed under a microscope, with a selective frequency light source, and a fluorescent Rhodamine B dye as the secondary solution. Recordings are taken of the solution’s behavior for later analysis. Criteria of this behavioral analysis include the threshold voltage range at which instability at the barrier between the glycerol and dye solutions became apparent, the correlations between voltage, instability wave frequency and amplitude, and the different instability behaviors as you look further away from the beginning of the barrier between the glycerol and dye solutions. It was determined that as the strength of the electric field increases, the frequency of the instability increases until a certain point, where the wave form becomes more jagged and the frequency drops, then increases gradually with the electric field strength. It was also determined that the relationship between glycerol concentration and threshold voltage at which instability first occurs is linear.

WILL SLIME MOLDS BE ABLE TO PREFERENTIALLY MAINTAIN THE SHORTEST ROUTE OF A MAZE?
Catherine Johnson and Lawson Leidinger
Heathwood Hall Episcopal School

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

CREATING DYNAMIC VISUAL STIMULI FOR USE IN FMRI AND EEG STUDIES OF THE INTERNAL REPRESENTATION OF AFFECTIVE STATES
Alexia Junker
Governor’s School for Science and Mathematics

Affective states are central to how the world is experienced. An affective reaction to presented stimuli is included in the perception of the stimuli, becoming a property of it. According to the circumplex model of affect, affective states are represented along the dimensions of valence and arousal. These results have been shown for word, picture, and face stimuli. The use of dynamic visual stimuli is important because they are naturalistic. This study focused on the examination of the internal representation of dynamic visual stimuli. First, visual stimuli were created to vary on valence (positive, neutral, negative) while balancing across semantic features (human, animals, inanimate) and arousal across valence categories. The stimuli were found online and edited into five second clips. Second, in a behavioural experiment, 9 participants rated the video clips on six rating scales (e.g., how sad, how calm, how anxious, etc.). The similarity on video ratings was analyzed with multidimensional scaling. The results showed that most of the variability in the ratings was accounted for by dimensions of valence and arousal, consistent with the circumplex model of affect. This study was instrumental in the dynamic visual stimuli creation for fMRI and EEG studies of the internal representation of affective states.
WARMING AND ELEVATED CARBON DIOXIDE INCREASES SUBERIN CONTENT IN THE ROOTS OF A C4 GRASS SPECIES
Kendall Koon
Governor’s School for Science and Mathematics

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

MOTORS AND MATLAB: PROGRAMMING WHITE LIGHT COMPUTERIZED TOMOGRAPHY RESEARCH SCANNERS USING ARDUINOS, MOTOR DRIVERS IN CONJUNCTION WITH MATLAB TOOLBOXES
Aida El Kouri
Governor’s School for Science and Mathematics

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

SAFER SEATBELTS
Akim Koutsioukis
Greenville Technical Charter High School

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

POPULATION ESTIMATE OF DIAMONDBACK TERRAPINS (MALACLEMYS TERRAPIN) IN GRICE COVE, SC
Katelyn Kraichely
Governor’s School for Science and Mathematics

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

Katie Krouglicof and Emily Chen
Southside High School

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

ABSTRACT #: 370
A WINDY DAY: THE EFFECT OF WIND PATH AND DIRECTION ON ITS FORCE ON OBJECTS
Caitlin Kunchur
Dutch Fork Middle School

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

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

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

APOPTOTIC AND AUTOPHAGIC CELL DEATH IN GANODERIC ACID DM TREATED PROSTATE CANCER CELLS
Nathan Leaphart
Governor’s School for Science and Mathematics

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

GENETIC ANALYSIS OF CAFETERIA FOOD FOR THE ROUND-UP READY GENE
Jason Lee
Center for Advanced Technical Studies

This study’s objective is to analyze school foods for the Round-Up Ready gene. The study is conducted to prove that Round-Up Ready is in school foods and how reliant society is on Genetically Modified Organisms. The use of Gel Electrophoresis is used to find if the school foods have the Round-Up Ready gene. Results indicate that on the stained gel the Round-Up ready gene will be expressed. The Round-Up Ready Gene being expressed will indicate how society leans towards the use of Genetically Modified Organisms and how far this field has advanced.
DIFFERENCES IN FLUID INTAKE POST-WORKOUT BETWEEN GATORADE AND WATER
Jordan Lester
Chapin High School

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

COMPARISON OF THE DIFFUSION OF ACETAMINOPHEN BY ITS FORMS
Jane Lindberg and Vaibhav Bafna
Southside High School

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

ARE ANTI-ANXIETY MEDICATIONS WORTH THEIR BENEFITS?
Julia Long
Center for Advanced Technical Studies

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

ULTRAVIOLET RADIATION
Alexis N. Lopez
Greenville Technical Charter High School

Excessive exposure to ultraviolet radiation remains the leading cause of skin cancer and premature aging. There are a number of skin care experts who firmly believe that clothing color and material play a huge role in determining its ability to block the transmission of ultraviolet radiation. Throughout the duration of this project, a series of two experiments were conducted in order to test both variables by changing the material color and fabric type of cloth. During the experimentation process, the fabric was exposed to the sun for a select period of time. Then, a UV Meter obtained an accurate reading of the amount of ultraviolet radiation that was able to be transmitted through the cloth. Upon the completion of this experiment, the results were analyzed and compared to a UV Index Scale, which categorizes ultraviolet radiation readings based upon the potential risks it can cause to one’s health. After reviewing the results, the fabric type and color that best prevents the transmission of ultraviolet radiation was determined. Due to the fact that darker colors tend to absorb the most amount of ultraviolet radiation, the color black was initially hypothesized to yield the best results.
Liriodendron tulipifera L., commonly known as yellow-poplar, is a member of the Magnoliaceae family. It is a fast-growing hardwood tree species with great ecological and economic value. Liriodendron also occupies an important phylogenetic position as a basal angiosperm and has been used in studies of the evolution of flowering plants. Genomic resources, such as EST databases and BAC libraries, have been developed for this species. In this project, we mined available EST databases for CAD markers with the goal of developing informative EST CAD markers that would help us discover a link between lignin biosynthesis and CAD genes. These markers will be used to construct the first framework genetic linkage map of L. tulipifera with 380 full-sib seedlings. Such a linkage map is essential for future molecular breeding and quantitative trait locus (QTL) mapping, and as a framework for sequencing the Liriodendron genome in the future. When analyzed with polymerase chain reaction (PCR), informative markers were obtained from screening of EST-CAD markers. These markers are being utilized to tell us where certain CAD genes are located that will allow us to increase the biomass in the yellow poplar, leading to greater profit from each tree.

THE EFFECT OF UV RADIATION ON DIFFERENT TYPES OF SAIL CLOTH
Landon Louthian
Heathwood Hall

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

THE CORRELATION BETWEEN VISUAL ARTS AND MATH AND SCIENCE
Amy Loy
Chapin High School

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

DESIGN OF A VACUUM THERMOFORMING DEVICE AND EXPERIMENTS ON PIN-TOOL TYPE RECONFIGURABLE SURFACES
Madison Maddox
Governor's School for Science and Mathematics

Thermoforming is a manufacturing process in which a thermoplastic material is heated and pulled over a mold to form a product. Examples of thermoformed articles include clamshells, refrigerator door panels, and automobile components. While thermoforming is a versatile and useful procedure itself, the tooling is not easily adaptable. The creation of molds is expensive and time consuming, and each one can only generate a specific shape. A reconfigurable mold would reduce expenses while increasing functionality (and leveraging the advantages of vacuum thermoforming). Specifically, in this research project, a self-inclusive thermoforming device was designed and constructed with a pin-type tool reconfigurable mold fitted in. The pin-tooling consists of a ten by ten matrix of height-adjustable pins with hemispherical tips. Though pin-tooling is less costly and more variable, there are other challenges, found in attaining a high quality surface finish and accurately producing a desired surface shape. To explore and address these challenges, experiments were devised with various configurations of the pin-tooling, including variable sheet materials and material thicknesses, different surface shapes, changes in plastic temperature, heating time of plastic, orientation of the pin-tool, and variation of interpolators. Initial results indicate the importance of the distance from the heating element to the plastic, that the materials' stretch limits act as a minor interpolator, that the taller drops the plastic has to mold over require higher heated and/or more flexible material, and the orientation of the pins relative to the vacuum mouth is significant.
Three dimensional images of cells can be produced by multiphoton excitation and confocal laser scanning microscopy, in which a laser scans the cell point-by-point and layer-by-layer. Though the lateral scan is executed rapidly (several kHz), scanning through the entire depth of thick samples hinders the speed of real-time visualization of the volume. Here we use a different type of laser known as a Bessel beam, which does not diffract based on its unique properties. The beam’s extended focus eliminates the need to scan the depth, allowing the entire volume of the cell to be recorded by a lateral scan of the sample. Recording the volume from two different angles, known as a parallax view, provides the sample's depth information. This pair of images can be combined using computer code to create a red-cyan stereoscopic image of the volume. These stereo images can be viewed in as a real-time three dimensional scan of a sample.

**FISH GROWTH VS. TANK SIZE**

Melina Manos and Olivia Moran
Heathwood Hall Episcopal School

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

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

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

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

John Mathai
Governor’s School for Science and Mathematics

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

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

Rhea Mathew
Governor’s School for Science and Mathematics

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

Alex Mau
Governor’s School for Science and Mathematics

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

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

Carlan May
Governor’s School for Science and Mathematics

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

COOKING CLASS FOR CHILDREN WITH AUTISM TO IMPROVE FRACTION RELATED PERFORMANCE

Samantha McCall and Abigail Tempel
Chapin High School

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

The purpose of this project was to determine if children with Autism would learn fraction skills better with hands on learning rather than in a regular classroom environment. A group of three students (grades 3rd and 4th) were taught fraction skills through cooking, measuring and reading fractions. They attended five, one hour, cooking classes, with all classes including use of fractions in following recipes and measuring ingredients. To document changes in their abilities to use fractions appropriately, students were given multiple pre-tests and a post-test. Throughout the classes, multiple fraction evaluations were completed by the students. There was an increase in scores for Students A and B, while Student C stayed the same. A matched pairs t-test was completed for both a pre/post-test and an advanced pre/post-test. P-values were 0.33 and 0.50 respectively indicating that this study was not statistically significant.

INDUCTION OF APOPTOSIS IN ESCHERICHIA COLI CELLS

Victoria McCarthy
Governor’s School for Science and Mathematics

Bacterial cells have been proven to go through programed cell death similar to the apoptosis of mammalian cells. MazF is a bacterial toxin that plays an important role in bacterial apoptosis by cleaving mRNA when it is activated. MazE is the antitoxin that prevents MazF from being activated in the lag and log phases of bacterial cell growth. MazF is capable of cleaving mRNA at the ACA sequence, but the toxin is only active in the stationary phase when there are not enough nutrients to sustain the population. mazF is able to cleave itself due to the ACA sequence on its mRNA, which reduces apoptosis of the bacterial cells. The aim of this research is to study the effect of altering the ACA to another sequence encoding the same amino acid and study its role in bacterial apoptosis. To achieve this goal, mazF was amplified using PCR and digested with XhoI and HindIII. The digested product was cloned into the pBAD vector under the control of an arabinose-inducible promoter E. coliDH10B and transformed with pBAD carrying the modified mazF. The transformed E. coli were grown on M9 minimum medium supplemented with 0.2% arabinose, and 100 µl of bacteria were plated onto M9 plates every two hours for 24 hours. The plates were incubated at 37°C and the number of colonies counted after 24 hours of incubation. A 3-log reductions in population in cells expressing the altered mazF mRNA 8 hours post arabinose-induction was observed.
THE RELATIONSHIP BETWEEN LIPOPROTEINS AND CORONARY HEART DISEASE IN AFRICAN AMERICANS: THE SEA ISLANDS GENETIC AFRICAN AMERICAN REGISTRY

Dixie McCollum
Governor's School for Science and Mathematics

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

DEVELOPMENT OF A SOCIAL MEDIA APPLICATION FOR GOOGLE GLASS

John McElvenny
Governor's School for Science and Mathematics

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

EFFECTS OF LIGHT COLOR ON POPULATION GROWTH IN RHODOMONAS SALINA

Patrick McKenzie
Governor's School for Science and Mathematics

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

THE EFFECTS OF VARYING LIGHT WAVES ON ALGAL GROWTH

Lillian Meng
Southside High School

Unwanted algal growth remains an issue in many aquatic systems. The presence of algae may present a wide array of problems ranging from rendering water impotable to having detrimental effects on aquatic ecosystems. These negative aspects of algal growth demonstrate why it is often beneficial to have the ability to control the growth and spread of algae. Information regarding the effects of various light waves on algal growth may be used not only to better control the growth of algae, but also to prevent future unwanted algal growth that may have harmful effects. This experiment demonstrates the relationship between the length of light waves absorbed by algae samples and the resulting amount of algal growth. Light wavelengths associated with red, blue, and violet of the visible light spectrum have been obtained through applying colored filters to white light. Different samples of algae have been exposed to one of these types of light waves. The effects on algal growth have then been observed through spectrophotometry, revealing a relationship in which certain lengths of the light waves absorbed by algae result in greater amounts of algal growth.
Mice with Toll-like receptor 4 (TLR4) induces the presence of UCP2 (uncoupling protein 2). UCP2 is found in great quantities in the hepatocytes of the Steatotic liver. UCP2 uncouples proteins in the mitochondria causing a decreased production of ATP. Steatotic mice lacking TLR4 have an increased survival rate because they do not produce as much, if any, UCP2 and therefore produce enough ATP. It was confirmed that TLR4 follow the JNK pathway to stimulate UCP2 growth in earlier experiments. During my six weeks, we genotyped the mouse colonies to confirm the presence or absence of TLR4 and UCP2 based on which gene was knocked out. We used Real-time PCR to find the presence of TNF-alpha, TNF-beta and CCL2, which are inflammatory cytokines. We also isolated hepatocytes by the perfusion and removal of the liver to be treated with LPS. The cells were cultured over a 24 hour time period and then treated with LPS, a bacteria commonly found in the gut. The RNA of the hepatocytes was then isolated and quantified using a nanodrop technique. The series of experiments showed an increase of NDUFβ8 and Drp1, both of which show mitochondrial dysfunction in the lard-fat diet fed mice. The mice lacking TLR4 did not show any change, because the LPS was not accepted.

THE EFFECT OF THE FERMENTATION OF POTATOES ON THE PRODUCTION OF ETHANOL
Paige Mewborn
Dutch Fork

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

THE EVOLUTION OF VILLAINS
Jamie Milliff
Chapin High School

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

GLYCOL CHITOSAN BASED NANOPARTICLES DELIVERING CISPLATIN FOR THE TREATMENT OF CANCER
Mitchell Mills
Governor’s School for Science and Mathematics

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

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

Faith Mitchell
Governor's School for Science and Mathematics

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

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

Mary Lyn Mitchell
Governor's School for Science and Mathematics

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

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

Vaibhav Mohanty
Academic Magnet High School

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

T CELL VACCINES AS AN IMMUNOTHERAPY FOR TYPE 1 DIABETES

Emily Morton
Center for Advanced Technical Studies

The goal of this project is to create a T cell vaccine which will reduce or eliminate circulating autoreactive CD4+ T cells in Type 1 Diabetes (T1D) patients. This vaccine will preserve the Honeymoon Phase, as well as lead to a cure for T1D when administered in conjunction with pancreatic islet transplantation. When T cell vaccines were studied in Multiple Sclerosis, all patients experienced a significant reduction in circulating autoreactive T cells, and all except one patient experienced no relapses.
The T1D vaccine will be created by isolating CD4+ T cells from diabetic peripheral mononuclear blood cells, then attenuating proliferation and antigen expression in vitro with T Cell Protein Tyrosine Phosphatase. Patients who receive the vaccine are expected to experience a reduction in circulating autoreactive CD4+ T cells, while patients who receive the placebo are expected to experience no change in circulating autoreactive CD4+ T cells.

OPTIMIZING NOBLE METALS ADSORPTION FOR CATALYST SYNTHESIS USING STRONG ELECTROSTATIC ADSORPTION (SEA)
Hansen Mou
Governor’s School for Science and Mathematics

This research examines the strong electrostatic adsorption (SEA) method of catalyst formation using carbon black, alumina, and silica supports at various pH. At a certain pH, the functional groups on the support's surface reach a maximum level of ionization, causing the support to adsorb the maximum amount of precursor. This point of maximum ionization differs for each support, and it needs to be known in order to make the best catalysts possible with this method. This research examined carbon black (Darco G-60, Oxidized VXC 72), alumina (SBA 200), and silica (Aerosil 380) supports for their maximum uptake of PTA, PdTA, PTC, PdCl42-, and CoHA precursors via uptake surveys extending from pH 1 to 14. The results showed that SBA 200 adsorbed the most PTC at about pH 4.5, Darco G-60 had a maximum adsorption of PdCl42- at about pH 2, Oxidized VXC 72 had maximum adsorptions of PTA and PdTA at about pH 12, and Aerosil 380 had a maximum adsorption of CoHA at about pH 12. From this and previous knowledge of the materials and this concept, it is possible to accurately document the optimal uptake pH for other support/precursor combinations by narrowing the pH range for testing. If the point of zero charge (PZC) of the support and the ionic charge of the dissolved precursor are known, a range of possible optimal pH can be determined, allowing future experiments to focus on those points exclusively to save time and resources.

PROGRESSION TOWARDS A 3-DIMENSIONAL INNERVATION MODEL OF THE HUMAN BLADDER
Elizabeth Mugo
Governor’s School for Science and Mathematics

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

THE EFFECT OF BLADE PITCH ON THE ELECTRICAL OUTPUT OF A WIND GENERATOR
Athreyea Murali
Heathwood Hall Episcopal School

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

CONSTRUCTION OF A WHITE LIGHT SOURCED COMPUTED TOMOGRAPHY SCANNER PROTOTYPE
Mehrzad Namiranian
Governor’s School for Science and Mathematics

An X-Ray Computed Tomography (CT) scanner is an instrument of medical imaging used to study the human body from the 3D scans that it compiles. However, these machines are generally large, expensive and can emit harmful radiation. In order to study the basics of CT and medical imaging there is a need for more cost-effective, non-ionizing alternatives. To accomplish this, we constructed a scanner using white light and practical materials to create a three dimensional image of any suitably sized, transparent object. SolidWorks was used to create the designs of the various components of the scanner, while MATLAB was used to program an assortment of functions that the desk sized CT scanner needed to operate. The aim of this part of the project was to convert the designs into a finished prototype. Our design utilized a main galvanized vent pipe along with two
identical end pieces that were connected through metal tubing. With the help of a laser cutter, we were able to create camera and light mounts as well as end handles that stopped light seepage. Collimators for the camera and light source were designed and tested, as they were an important aspect in increasing image quality by directing the light rays. Our aim was to eliminate the harmful X-ray exposure normally present in CT scanners, while maintaining the capability of taking a snapshot every degree an object rotated, so that these pictures could be sliced and reconstructed together to create a 3D CT image.

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

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

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

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

TEST FOR CORROSION OF IRON IN YEAST AND YOGURT

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

AFFECTIVE CIRCUMPLEX IN MUSIC

Wilhelm Wundt’s theory of affective circumplex has been largely unexplored, despite the fact that it has been around over two hundred years. This theory suggests that affective stimuli will, when graphed on a two dimensional grid with valence and arousal as the axes, naturally fall into a circle formation. Recently, studies have been confirming this hypothesis on a number of stimuli, yet the theory has largely been unexplored. Unfortunately, no such study had been done on affective circumplex in
music. Based on the theory of affective circumplex, the intensity of a piece of music would interact limit the valence of affective reactions. Likewise, it suggests that truly neutral music is rare and that music will end up being categories affectively. This means that when one affective characteristic of music is normalized, listeners focus on the other, and that when both are normalized they will rate the stimuli with the same overall magnitude. This study seeks to answer this debate by showing participants affective music stimuli and asking them to rate them. The stimuli were rated by valence and arousal and mapped onto a two dimensional grid. The results verified the model of affective circumplex in music, as the data formed clear circle. Only three of the thirty stimuli deviated from this circle. When looking back at the data, it was clear that the magnitude of the participants’ ratings was consistent. This strange cross between music theory and psychology usually involves psychology proving musical theories, yet this study does the opposite.

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

Karen Ni
Center for Advanced Technical Studies

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

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

Annah Nieman
Governor's School for Science and Mathematics

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

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

Sloan Nietert
Academic Magnet High School

Lung cancer and its treatment often result in high symptom burden and reduced quality of life [QoL]. Recently, exercise has been recognized as an effective therapy for the disease, and fitness trackers offer a cheap, objective way of measuring this activity. However, feasibility of such data collection among lung cancer patients needs to be established. Forty-three patients with Stage III/IV lung cancer were approached at MUSC’s Combined Thoracic Oncology clinic. Participants were given surveys assessing dyspnea, QoL, and depression, and ten agreed to wear a Fitbit Zip® to collect their step counts for seven days. Associations between survey domains and average daily step counts were assessed using
Spearman rank correlations. Forty of 43 patients [93%] participated, and all approached participants agreed to wear Fitbit® pedometers and returned them with usable step counts. Positive correlations with step counts were noted for physical, social, role, and emotional functioning as well as QoL. Negative correlations were observed with pain, constipation, breathlessness, and insomnia. Despite high symptom burden, this cohort’s high participation rate, low survey completion time, and 100% activity data collection confirms study feasibility. Active patients with advanced lung cancer report greater overall QoL, suggesting exercise as a therapeutic target in advanced-stage lung cancer.

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

Olivia O'Connor
Governor's School for Science and Mathematics

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

BAND SIZE AND PERFORMANCE

Madison Owen
Chapin High School

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

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

Kayla Owens
Governor’s School for Science and Mathematics

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

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

Sonali Parmar
Heathwood Hall Episcopal School

Since 1972, there has been an ongoing trend in which males have outperformed females on the math section of the SAT, although females perform just as well, if not better than males in the classroom. Many attribute females’ lower performance on the SAT to a phenomenon known as the stereotype threat, which is defined as “being at risk of confirming, as self-characteristic, a negative stereotype about one’s group” (Steele and Aronson, 1995). Much research involving the stereotype threat has focused on male and female high school or college-aged students. Little research, however, has been conducted using younger students to determine whether younger males and females are also affected by societal stereotypes. The purpose of this research is to determine the effects of the stereotype threat on sixth grade males’ and females’ performance on a math test. Three groups of sixth-grade students, both male and female, were given two math tests. Group 1 was told that
the first test had previously not shown gender differences, and the second test had shown gender differences. Group 2 was told the opposite: the first test had shown gender differences and the second test had not. Lastly, Group 3, the control group, was not given any statements and was instructed to simply take the test. While there were many trends indicating lower test performance for both males and females due to the stereotype threat, these trends were not statistically significant.

EFFECT OF INTERLEUKIN-6 ON TRANSLATIONAL CAPACITY IN C57BL/6 AND APCMIN/+ MICE
Mayank Patel
Governor's School for Science and Mathematics

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

A GENETIC MAP INVESTIGATION OF ADVENTITIOUS ROOTING AND THE CORRELATION BETWEEN GENETIC MARKERS AND ROOTING TYPES OF PEACHES
Shawn Patel
Governor's School for Science and Mathematics

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

THE EFFECT OF VARIOUS TYPES OF PACKAGING ON THE CARBONATION IN COCA-COLA
Sonali Patel and Emma Shealy
Heathwood Hall

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

ANALYSIS OF SPACE-TIME RECEPTIVE FIELDS OF SILICON-BASED GANGLION AND CORTICAL CELLS IN THE PHYSIOLOGIST'S FRIEND CHIP USING MATLAB SOFTWARE
Carla Jane Pax
Governor's School for Science and Mathematics

It has been known for decades that individual neurons in the brain respond selectively to distinct types of sensory or motor information. For instance, in the visual processing areas, some brain cells respond only to stimuli presented at a specific orientation while other cells respond to stimuli moving in a particular direction. Such feature selectivity of a retinal neuron's receptive field is presumed to be static meaning that it does not change over time. However, our sensory perception is
dynamic, adapting within tens of milliseconds to the ever-changing environment. The hypothesis of this research is that the neural basis for the dynamics of sensory perception partially emerges from the dynamics of individual neural responses. With a natural eye, it is difficult to test this hypothesis, and even modern neuroscience textbooks describe receptive fields only by their spatial properties. This research will test the above hypothesis by using the Physiologist's Friend Chip to produce action potentials based on the stimuli it is presented. The stimuli will be computer controlled using the Bar and Wave V7.6.5 program. The three aims of this research include a) comparing the size of the center and antagonistic surround of retinal receptive fields; b) determining if the retinal receptive fields peak at the same time; and c) demonstrating whether the orientation selectivity of cortical neurons is sufficiently accounted for by an elongated receptive field. This research supported the hypotheses that the chip functions similarly to a natural eye.

THE EFFECT OF WATER COLOR ON THE THERMAL CAPACITY OF A SOLAR HEAT CAPTURING DEVICE
Payton Phillips
Heathwood Hall Episcopal School

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

THE EFFECTS OF HIGH FAT DIET INDUCED OBESITY ON THE TRANSLATIONAL CAPACITY AND EFFICIENCY IN THE SKELETAL MUSCLE OF MICE
Nathan Pignone
Governor's School for Science and Mathematics

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

IDENTIFICATION OF POST-TRANSLATIONALLY MODIFIED (O-GLCNAC) HEPATIC PROTEINS IN FASTED AND RE-FED MICE
Mattie Piness
Governor's School for Science and Mathematics

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

Joshua Pope
Governor's School for Science and Mathematics

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

The effect of plant species on zinc absorption

Aidan Powers
Heathwood Hall Episcopal School

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

The correlation between implicit and explicit racial attitudes

Olivia Price
Heathwood Hall

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

A sonar device to aid the visually impaired

Matthew Quan
Heathwood Hall

In this research project, tests were conducted to see whether a person could avoid a series of objects without vision, while using a custom made sonar device. This device would eventually be used to assist the blind. For the experimentation, an obstacle course was set up which consisted of objects which one might come across every day. There was a large toy jeep, two foldable chairs, a row of balls, two bicycles, a low lying ridable toy, two large lawn chairs, and a large gate. The test subjects were asked to navigate through the obstacle course while detecting, and avoiding, as many objects as possible. The results showed that the test subjects were able to complete the obstacle course while detecting and avoiding every single object 23 of the 40 trials. The most missed object was the low lying ridable toy which was about 8 inches of the ground. Overall, the device seemed to be capable of detecting a variety of different objects. It was also able to help the test subjects navigate throughout the obstacle course well. Even though there were only 23 perfect runs, out of the 280 combined opportunities there were for the test subjects to detect any of the 7 different objects, only 23 objects were missed.
With the decrease in supply of nonrenewable resources, water electrolysis and CO2 Electro-reduction have recently received attention as means of converting renewable energy into storable products. Platinum, the most commonly used catalyst for these reactions, has become too rare to use on a large scale. Previous studies have shown that carbon based materials may provide a viable alternative catalyst. This research focused on testing the activity of Ti2AlC, carbon black, and ketjen black towards both water electrolysis and CO2 reduction in hopes of discovering a potential alternative. Electrodes were constructed of each material and placed in a cell with an Ag/AgCl reference electrode. Using cyclic voltammetry, the current through the cell was measured against the potential. The current through the cell indicates the amount of reduction or oxidation taking place within the cell at a given potential. The CO2 reduction experiment was conducted similarly to water electrolysis except in the presence of CO2. The results of these experiments concluded that ketjen black is the best contender of the materials tested for water electrolysis. Ti2AlC was the only material to show any slight activity towards CO2 reduction. The products of CO2 reduction could be better described through further experimentation using gas chromatography. Future studies in water electrolysis should focus on testing more possible materials or combining ketjen black with nonprecious materials to improve catalytic activity. In CO2 reduction, more titanium carbide materials should be tested as well to find an even more active catalyst.

**NOTHING BUT NET: THE SCIENCE OF SHOOTING HOOPS**

Romello Reed
Greenville Technical Charter High School

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

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

Sayaka Reed
Governor’s School for Science and Mathematics

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

**JUST KEEP SWIMMING: AN APPROACH TO ALZHEIMER’S VIA COMMON-SUBSTANCE INGESTION**

Natalie Reszczynski
Dutch Fork High School

Approximately five million Americans are affected by Alzheimer’s every year. Alzheimer’s affects the brain, specifically by depleting the memory, and is caused when the neurons can no longer communicate with each other. Ginkgo biloba is given to improve patients’ memories, yet other substances have been suggested to be a memory enhancer greater than ginkgo biloba. This research will give Carassius auratus auratus, or comet goldfish, various natural medications and place them in an aquarium maze, followed by a measuring of the amount of time for them to complete the maze. It is predicted that the medicated fish’s swim time through the maze will decrease, showing a benefited memory of the maze. The substances chosen to test include ginkgo biloba, Asian Ginseng, Omega 3, and Vitamin B12 because each of these substances are suggested to improve memory. Each substance should improve the fish’s memory functioning; and ginkgo biloba is currently given to patients with Alzheimer’s. The purpose of using ginkgo biloba will be to assure that the test and maze theory of showing an increase in memory is valid as well as to provide a basis for comparison as to whether the substances tested are in fact better at improving memory than the ginkgo biloba that is currently being given. The plan is to build an aquarium maze containing plastic sheets with circular holes in them for the fish to swim through. The medicinal substances will be infused in the water, and absorbed through the fish’s scales. Using a control of fish without medication as a comparison, the time it takes the fish to complete the maze will be repeatedly tested. If the substances are improving the memory, then there should be a decrease in the time it takes the fish to swim the maze.
THE GENDER GAP: THE EFFECT OF OVARIAN FUNCTION IN THE CACHETIC RESPONSE AND IL-6 DURING CACHEXIA PROGRESSION

Olivia Resczynski
Dutch Fork High School

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

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

Lindsey Richardson
Governor’s School for Science and Mathematics

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

OXIDATIONS FACILITATED BY BIS-UREA BENZOPHENONE MACROCYCLES

William Rivers
Governor’s School for Science and Mathematics

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

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

Isabelle Robinson and Carter Smith
Heathwood Hall Episc. School

This study investigated the effect of nutrients levels in soils, and their effect on the oxygenation rate of the Wisconsin Fast Plants grown in the different soils. The independent variable in this experiment is the five different types of soil used, and the dependent variable is the oxygen level produced by the Wisconsin Fast Plants. This study is beneficial, because while growing plants one can use the soil that allows plants to produce the most oxygen to help the environment. The motivation for this
project came from hearing a USC Honor student talk about her work on a similar topic. The problem that was being studied was whether the nutrients levels in soil, in particular nitrogen, affect the oxygenation rate of the plants grown in them. In order to make progress in discovering the answer to our problem, seeds were planted in five different soils: Heathwood’s greenhouse soil, Black Kow soil, Miracle-Gro Garden soil, Miracle-Gro Potting Mix, and Scotts’ Topsoil. The oxygenation rate of the plants was measured every five days, for three trials. The hypothesis was, if plants are grown in soil with a higher nitrogen content, then they will produce more oxygen. The null hypothesis was that the oxygenation rate of the plants would not vary based on the soil they were grown in, and this was accepted. The results indicated that the soil with the highest nitrogen percentage did not produce the highest oxygenation rate.

ECONOMICS OF THE EYE: DEVELOPING AN ALTERNATIVE TO TRADITIONAL PACKAGING EYE TRACKING STUDIES
Logan Robinson
Governor’s School for Science and Mathematics

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

THE EFFECT OF DIFFERING CONTACT METHODS ON THE SPREAD OF GERMS IN CLASSROOM ENVIRONMENTS
Amelia Robinson-Brown and Alyce Petit
Heathwood Hall Episcopal School

This experiment tested to see if there is a difference between the spread of germs in human to human contact versus object to human contact. This experiment was done in two early childhood classrooms with a completely safe germ simulator. There have been no other studies testing this and very few that are similar. The few previous studies that were located have failed to address a difference in contact type. Conducted by directly applying the simulator to either a human or object, this study took one hour to perform. The main impact of this experiment is helping prevent the transmission of infectious, and deadly, diseases. It was hypothesized that if simulated germs are placed on a human subject, then the simulated germs would spread more than if placed on an inanimate object. The data collected in the experiment did support the hypothesis because the infection rate of the second trial was 2% higher than that of the first.

COMPARING STATE TAX INCENTIVES FOR AEROSPACE MANUFACTURING CLUSTER GROWTH
Gavin Roser
Governor’s School for Science and Mathematics

South Carolina has felt the ripple effects of The Boeing Company’s recently constructed Charleston plant in the form of new jobs, higher average income, and improved infrastructure. Boeing’s multi-million dollar investment in the state has increased the flow of suppliers into South Carolina, while also expanding the correlated support chain. This sequence of compounding growth is described in the University of South Carolina’s Economic Impact Study as the influx of aerospace-related companies attributed to Boeing. Building on the findings of the Economic Impact Study, legislative reform can maximize South Carolina’s cluster growth with readily available tax incentives and public financing. This study aims to evaluate the calculated quality of in-state tax incentives and perform a direct comparison of similar incentives existent in competitor aerospace industry states. In a joint effort of the South Carolina Aerospace Initiative and the South Carolina Department of Commerce, the comparison of competitor aerospace states revealed a deficiency of tax incentives in South Carolina and pinpointed the most common aerospace-specific tax incentives.

USING A DATA WAREHOUSE TO ANALYZE INFORMATION ABOUT INSURANCE CLAIMS AND POLICIES
Jeff Rubillo
Governor’s School for Science and Mathematics

Big companies involving insurance, social media, and retail amass large amounts of data from day to day. Every time a user enters information about their profile on social media or about the order they would like to place, these data must go somewhere to be processed. These are stored in large databases, or data warehouses, that hold information about each person or entry. With these data, it is possible to generate significant reports which would benefit the company and assist in making informed business decisions. On the front end, most people are not aware of the potential these data possess. The back end
process of examining data can significantly impact profits and reduce financial risks. The goal of this experiment was to discover if management reports could be generated from Seibel’s insurance data warehouse, which was accomplished after an analysis of their warehouses.

HETEROAGGREGATION OF CITRATE-COATED SILVER NANOPARTICLES WITH POLYSTYRENE AND SILICA PARTICLES
Jack Runge
Governor’s School for Science and Mathematics

Silver nanoparticles (AgNPs) have many different useful properties and are incorporated into many industrial products. However, once these particles enter the environment after use, they pose a threat to the safety of many organisms. Overall though, not much is known about these particles and how they interact with their environment. There is especially a lack of research as to how these particles aggregate with different particles. Investigating the stability of AgNPs in the presence of other colloids will give a better understanding of the mobility and toxicity of the particles in the environment. The zeta potentials of isolated AgNPs, AgNPs in the presence of polystyrene, and AgNPs in the presence of silica were taken via electrophoretic light scattering and compared with both kinetics and spectra data from UV-Vis spectroscopy. Both the zeta potentials and the data taken from UV-Vis spectroscopy indicated that the AgNPs were the most stable in the presence of polystyrene particles, less stable isolated, and least stable in the presence of silica particles. The average critical coagulation concentration (CCC) of the AgNPs in the presence of the polystyrene particles, isolated AgNPs, and AgNPs in the presence of the silica particles were 170.9±4.7, 149.7±2.0, and 81.9±9.3 mM NaNO3, respectively. Further research using transmission electron microscopy will determine the exact interactions between these particles.

MEXICANIN I INHIBITS FIBROCYTE GENERATION FROM MOUSE SPLENOCYTES ACCOMPANIED BY DOWN REGULATION OF KLF4
Maya Rush
Governor’s School for Science and Mathematics

Tumor metastasis is a multiple step process which affects all cancer patients. Previous research in Dr. Walden Ai’s lab at the University of South Carolina’s School of Medicine showed that deficiency of kruppel-like factor 4 (KLF4), a transcription factor, reduced tumor lung metastasis and was associated with decreased fibrocyte generation from splenocytes. Given that there is a strong association between fibrocyte levels and tumor metastasis, it was hypothesized that the inhibition of KLF4 would reduce fibrocyte generation leading to decreased tumor metastasis. Mexicanin I and C188-9 were used to assess the inhibitory effect on KLF4 and fibrocyte generation from mouse splenocytes. The expression levels of KLF4 downstream targets were examined by real-time PCR and Western blotting. Both Mexicanin I and C188-9 inhibited KLF4 expression and fibrocyte generation, but Mexicanin I was more efficient. Microscopic examination revealed that the fibrocyte generation was far less expressed when treated with 0.1 μL of Mexicanin I, compared to 2 μL of C188-9. When the splenocytes were treated with 0.1 μM of Mexicanin I there was one fibrocyte cell. After being treated with 2 μM of the C188-9 there was only 1 spindle like cell left. Real time PCR revealed that the expression of fibroblast specific protein-1 (FSP-1) and CXCR4 was notably reduced with the treatment of Mexicanin I. The KLF4 inhibitor Mexicanin I inhibits fibrocyte generation from murine splenocytes.

EXAMINATION OF THE FLOW OF ACETAMINOPHEN
Farris Sabir
Southside High School

A substance’s flow is determined by the characteristics of the substance in motion and the material through which it travels. Overall, the conditions of certain parts of the human body create a diverse environment for the flow of pharmaceutical substances, from the distance at which the body part is located with respect to the ground and the pressure of the fluids through which the flow must occur through. In fact, according to Bernoulli’s equation, flow velocity shares a directly proportional relationship with pressure and height. This experiment, which utilizes acetaminophen in particular, simulates this environment by allowing velocity and height to be manipulated to measure the diffusion of acetaminophen. Although we are not measuring pressure exactly, this variable affects the change in the concentration of the substance as to most effectively simulate the dispersal of acetaminophen across a digestive tract. We theorize that velocity will be directly associated with the rate of diffusion of acetaminophen to a certain extent, as there is a distinct shift between laminar and turbulent flow with a certain change in velocity. By changing the orientation of height of flow, we may also create this turbulent flow and therefore, disrupt the diffusion of the substance.

THE EFFICACY OF HOME REMEDIES, CITRIC ACID AND TEA TREE OIL, ON THE INHIBITION OF STAPHYLOCOCCUS EPIDERMIDIS
McKenna Savoca
Heathwood Hall Episcopal School

Millions upon millions of people are infected with a skin disease called acne vulgaris, and one of the major bacterias stemming from this disease is called Staphylococcus epidermidis. In this experiment, the efficacy of two different home remedies, lemon
juice and tea tree oil, is tested on the bacteria Staphylococcus epidermidis. It is hypothesized that the growth of S. epidermidis will be inhibited by a small degree by the lemon juice and by a larger degree by the tea tree oil. The null hypothesis is that the citric acid and ten tree oil will have no affect on the inhibition of S. epidermidis. The inhibition of the bacteria is dependent variable, while the independent variables are 100% lemon juice, 50% lemon juice, 100% tea tree oil, and water. After letting the S. epidermidis grow for several days, the bacteria is transferred onto 9 plates. In order to measure inhibition, the agar disc diffusion method is used on all 9 plates, and each independent variable has 3 plates each. The zones of inhibition are measured to the nearest millimeter, and the data was then imported into an Excel spreadsheet where statistical analysis was conducted. Data suggests that tea tree oil is statistically significant as a solution that can effectively inhibit the growth of S. epidermidis because the p-value is significantly greater than 0.05 and the F is greater than the F critical. The null hypothesis, the growth of S. epidermidis will be inhibited by a small degree by the 50% lemon juice and by a larger degree by the tea tree oil, failed to be rejected.

**FACET ENGINEERING ON THE TIP OF GOLD NANORODS**
Zachary Scott
Governor’s School for Science and Mathematics

Research was conducted on the development of different shapes and sizes of gold nanorods, a developing research field with a wide range of applications. It is not understood how some shapes of gold nanorods form, so this research focused on determining more about the mechanism of formation. The seed mediated growth method was used to make various nanorods of different shapes. Adding different amounts of gold seed allowed for different aspect ratios to be found, proving that there can be control over sizes of gold nanorods. Factors such as Cu(NO3)2 concentration allowed the different shapes to form. The next step in this research is finding which nanorods are needed for different applications.

**THE EFFECT OF XYLEM FILTERS ON REDUCING WATER CONTAMINATION**
Jenna Seubarran
Greenville Technical Charter High School

Water pollution is a major issue in society today that can come from Point and Nonpoint Sources. This experiment contains tests to reduce pollution including coliform bacteria. To complete this experiment coliform, pH, phosphate and nitrates tests were taken from the middle, upstream, and upstream underneath the bridge at the Reedy River in Downtown Greenville. After these tests were taken a xylem filter was built to filter and clean the water. Once the tests with the filter were conducted the results for the coliform bacteria came back negative for the first test. When referring back to notes about the xylem filter, thoughts were constructed to why the results came back negative. The xylem tubing grew a fungus and that fungus was dropped into the clean water. In conclusion, the xylem filter has not fulfilled the original hypothesis that the xylem filter will cleanse dirty water.

**EDITING FOR A BRIGHTER FUTURE**
Sarah Sharpton
Chapin High School

This project is a study on the effects of a review of an essay by a higher-level English student in comparison to the traditional peer review used in classrooms. It measured the effects in terms of students' confidence in their essay. It was designed to determine which method is most effective in order to improve the writing skills and confidence of students. Two Honors English 3 classes at Chapin High School were partnered with to conduct the study. Each class wrote an essay as an assignment, and the entire class peer edited the essays except for five randomly selected students from each class. Those who were selected worked with an AP English student instead. The students who peer edited took a survey on how peer editing affected their confidence in their writing; and the ten experimental students took a pre- and post-survey on how the different style of editing affected their confidence. According to the post-survey, the experimental students experienced an average of a 23% increase in confidence level. It was also interesting to note that of students whose essays were peer edited, the largest group felt that peer editing mostly helped with spelling and mechanics, while the largest group of experimental students felt that editing with an AP student addressed their wording and phrasing issues.

**ALCOHOLISM SKIPPING GENERATIONS**
Cameron Shull
Chapin High School

The hypothesis is that people will be more likely to have an alcohol dependency if someone in their family does also and that it will skip generations more often than not. This research was conducted by creating a survey asking if the survey taker was an alcoholic and who in their family had/is an alcoholic, the survey was then put on social media. The data that was collected went against the hypothesis in that the results were that it tended to not skip generations when it did run in the family. Some results were not able to be used due to the person who took it being underage. Many results were unable to be used because the alcoholism didn’t run in the survey taker’s family. For the future of the project, more results are going to be obtained.
Statistics have been done that prove my hypothesis wrong. In the results where the results weren't included for where alcoholism didn't run in the family, it skipped generations 22.7% while it didn't skip 77.3%. For the survey results, 48.8% of the survey takers didn't have alcoholism running in their family at all.

DOES HIGH SCHOOL STRESS PROGRESS
Alexander Siegfried
Chapin High School

This project is about the differences in stress seen in the different grade levels and genders in the high school setting. My hypothesis is that the ability to handle stress will decline through the grade levels in high school. The initial idea was to compare the differences in handling stress between the two genders but data gathered through the survey, suggested that there is a more significant change when moving through the grade levels than the two genders. This project entered a second phase to further explore the acquired data.

Data was collected through a National Health Institution survey that finds a hardiness score based on the questions. The survey was given to multiple grade levels and genders to produce a mean hardiness score for each gender in each grade level. It was observed that the hardiness went down through the grade levels and that females generally had a higher hardiness score than males. The difference between males and females was different at a linear rate while it was exponential for grade level.

This data shows that the initial hypothesis was correct and females do have a better ability of handling stress. This also supports previous research that male brains are more hardwired for one task objectives like survival while female brains are more hardwired towards multitasking like caring for a child. As stated by Dr. Nussbaum in my 2014 interview.

LONG-TERM MONITORING OF HURRICANE HUGO'S EFFECTS ON SANTEE EXPERIMENTAL FOREST, NEAR CHARLESTON, SC
Olivia Smithenson
Governor's School for Science and Mathematics

In September of 1989, Hurricane Hugo struck the South Carolina coast, causing damage to cypress forests due to winds and tidal surges. In order to better prepare for future natural disasters, a study was created to observe the forests' compositions for 20 years after Hugo. Within the Hurricane Hugo study, four sites were monitored for their long-term change of regeneration after Hurricane Hugo. Of these four, three were studied for understory regeneration: Beidler forest, in Harleyville, SC; Hobcaw forest, in Georgetown, SC; and the Santee Experimental Forest in the Francis Marion National Forest, located in Huger, SC. The number of seedlings and saplings were recorded every three years in all sites. Santee was the closest site to the storm and had 47-70 percent of all hardwood trees damaged. In 1994, bald cypress and water tupelo were the dominant species in the swamp overstory. The invasive species, Chinese tallow, was present in the entire twenty years of the study. Bald cypress seedlings and saplings decreased by 2013. From 2000 to 2013, the green ash seedling count almost reached 0. Chinese tallow small saplings showed little variation over the years. Twenty five years after Hugo, results show that the Santee cypress swamp did not return to pre-hurricane composition. In order to know if the cypress swamp will ever return to its original composition, the forest must be studied further. This data will allow for better preparation before another storm and provide a possible description of the forests' compositions for the years after.

SAFE AND SIMPLE: DESIGNING MINIATURE COMPUTERIZED TOMOGRAPHY SCANNERS FOR MULTIPURPOSE SCIENTIFIC TESTING WITHIN RESEARCH LABORATORIES AND CLASSROOMS
Bethany Spencer
Governor's School for Science and Mathematics

Computerized Tomography (CT) scanners are medical imaging devices that utilize ionizing radiation to view inside the human body and generate 3D scans. These devices are large, expensive, and have a high risk of radiation exposure. As a result, using one of these for the purpose of teaching and understanding the operation of fundamental imaging is complicated, cost prohibitive, and dangerous. We were tasked to create a simple and a more viable option. Through an engineering project, our lab worked to create and implement a miniature, white light scanner. The purpose of the overall project was to use simple, everyday materials such as metal duct working, Matlab, and SolidWorks to design, build and test a miniature and safer, classroom version of the normal medical CT scanners. This new scanner could then be used in future projects such as designing multi-purpose scanners that could potentially do varying types of scans. The first major part of this multistep process was designing the scanner. In the large spectrum of this project, this particular project focused just on design. A computer aided design program, SolidWorks, was used to construct and render the individual parts of the scanner, from base to camera system. The program was then used to test the structures before the building process began. The main purpose of this portion of the endeavor minimized mistakes and maintained cost effectiveness and time efficiency. The result was a completed scanner design that was ready to be used in future projects.
DYNAMICS OF A SINGLE PARTICLE FALLING THROUGH A FUNNEL: AN ANALYSIS OF THE EFFECTS OF FRICTION ON AVERAGE TRAJECTORY DURATION

Jay Sridharan
Governor’s School for Science and Mathematics

The objective of this research was to investigate the phenomena simulated by Zhang et. al. concerning a single frictional, inelastic sphere falling through a funnel. Zhang asserts that for funnel walls angled greater than 45 degrees above the horizontal, certain phenomena – such as the trend of average duration increasing as the angle increases – become extremely evident. These trends are important considerations when one is using a funnel system in order to accomplish a task such as limiting exit velocity or minimizing duration of time spent within the funnel. After plotting the average duration of a single acrylic sphere falling at various locations along the length of the funnel wall, we concluded that Zhang’s assertions do not hold true for every case.

DYNAMIC REGULATION OF BIODIESEL PRODUCING ESCHERICHIA COLI BIOSYNTHETIC PATHWAYS

Thomas Stanton
Governor’s School for Science and Mathematics

FAEE (Fatty Acid Ethyl Ester) is a biodiesel valued as an alternative to the depleting fossil fuel supply. This is due to its high energy density, low water solubility, and low toxicity to production hosts like E. coli. The engineered W strain of E. coli has been developed to contain biosynthetic pathways that produce FAEE from fermentable sugars. The W strain contains a dynamically regulated FAEE pathway with three distinct modules. Accumulation of the key intermediate ethanol in E. coli inhibits cell growth, and thus, FAEE production. Since ethanol in module B is produced at a much faster rate than fatty acyl-CoA (in module A), FAEE yields (in module C) can be improved by controlling ethanol production to match fatty acyl-CoA production. Due to the dynamic pathways of the W strain, induction by L-arabinose, a 5-carbon sugar, increases FAEE production. To test the sensitivity of L-arabinose induction in increasing FAEE production, we added various concentrations of up to 0.2% L-arabinose to W cell cultures and then used gas chromatography to analyze the products. We discovered that, at the tested concentrations, L-arabinose induction is not effective in maximizing FAEE yield. Future projects include manipulation of specific genes in module B. Less efficient enzymes in that pathway would slow ethanol production and increase FAEE production.

BUDGETING THE DEFENSE EFFICIENTLY: EFFECT OF NUTRIENT DEFICIENCY AND INSECT HERBIVORY ON TANNIN CONCENTRATIONS IN JAPANESE KNOTWEED

David Strickland
Governor’s School for Science and Mathematics

Tannins are polymers of phenolic molecules produced by plants that can act as defense compounds by creating an unpalatable sensation and causing somatic damage to guts of insect herbivores. This study focused on delineating the ability of plants to produce tannins when faced with nutrient-sufficient vs nutrient-deficient environment; also we were interested in assessing the influence of herbivory on the tannin concentration within the above nutrient treatments. We analyzed the concentration of tannins in leaf tissues of Japanese knotweed (Fallopia japonica) that were grown under nitrogen deficient conditions (sugar added) and nitrogen sufficient condition (fertilizer added) from 2009 to 2013. Green leaves with (10-20% loss of leaf area) and without herbivore damage were collected during June 2014, from plants grown at Musser Fruit Research Farm, Seneca, SC, that were exposed to nutrient treatments. Total tannin concentration did not vary with either nutrient treatment or herbivory. Despite similar total tannin content, the plants grown under nitrogen deficiency had a higher concentration of extractable tannins. The leaves with herbivore-damage had marginally higher fiber-bound tannins. We conclude that under lower soil nutrient levels knotweed produces more extractable tannins to protect the already acquired biomass, and mobility of extractable tannins within plants could enhance the defense capability of knotweed.

CREATING A MOBILE APPLICATION FOR COLLEGE STUDENTS VIA GAMIFICATION

Crystel Sylvester
Governor’s School for Science and Mathematics

Colleges and universities are constantly creating new opportunities and expanding existing ones for students so that they may fully utilize their undergraduate education experience. However, these opportunities are often lost on college students because they are not communicated effectively. For example, most schools just list these opportunities at orientation sessions, soon to be forgotten in a wave of academic preparation, dorm decorating, and last-minute tasks. One promising approach consists of a mobile application (app) that reminds students to take advantage of opportunities, such as visiting the Career Center to find internships and exploring the breadth of online courses. Although this method has potential, such an app would need to be engaging to college students; otherwise, it would see little use. A recent trend in app development is gamification, which is defined as the concept of applying game mechanics and game design techniques to engage and motivate people to achieve their goals. The project utilized gamification to make the app as interesting as possible; it was based off of the popular board game Chutes and Ladders. Additionally, the app was coded using the Massachusetts Institute of Technology’s App Inventor 2. By the end of the six-week program, the app, called the Academic Pathway of the College of Charleston, was fully functioning on the Android platform.
Autism spectrum disorder refers to a group of complex disorders of brain development characterized by difficulties in social interaction and communication, with many individuals also displaying repetitive behaviors. Scientific studies have demonstrated that early intensive behavioral intervention improves learning, communication and social skills in young children with Autism.

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

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

### The Effect of Runoff on Plant Growth

Paris Tomlin and Lydia Comer
Heathwood Hall Episcopal School

This project researches a deeper look into how runoff affects plant growth. The researchers have tested how different types of runoff can hinder the height of a plant, while comparing it to the same type of plant that contains no runoff. The researchers knew that this topic has been studied before, but found it interesting and intriguing to do their own research, and find their own results. The researchers wanted to find ways to help the environment and plants around them. The project was tested by growing plants in a suitable environment and measuring each plant’s heights. The researchers were looking for a way to prove how much harm the world today has affected nature all around our community.

### The Amount of Energy Output from a Fungi-Based Microbial Fuel Cell (MFC) Utilizing Graphene Electrodes

Edoardo Tremolada
Spring Valley High School

Researchers today are trying to find more environmentally friendly solutions for the situation we are in today with the emission of greenhouse gases in our atmosphere. One of those is a microbial fuel cell (MFC), which creates energy from metabolic processes of usually a bacteria. However, most MFC’s are not as efficient or powerful to be implemented in everyday uses. The purpose of this experiment was to see if changing the microorganism used to yeast with graphene electrodes instead of a bacteria would provide a sufficient amount of voltage. Also to be certain the electrodes were not the ones only providing more power, a test was run with regular aluminium electrodes. A control group with E. coli as the microorganism was used for comparison. The MFC was recorded for every 30 minutes for 15 hours each. The control did not create sufficient voltage; r (31) = 0, p > 0.05, while the MFC with yeast with regular and graphene electrodes did provide significant voltage; r (31) = 0.4220, p < 0.05 and r (31) = 0.4600, p < 0.05, respectively. These tests were analyzed with a Sign test, at the alpha = 0.05 level.

### The Development of a Lid for a Nosey Cup to Improve Efficiency

Connor G. Walpole and Jason W. Shaffer
The Center for Advanced Technical Studies

The nosey cup is limited in its effectiveness to prevent aspiration and rehabilitate dysphagia due to spillage and loss of contents. By developing a lid it will minimize spillage, maintain functionality, improve efficiency, and optimize effectiveness. Due to the necessity of a lid for a nosey cup, several models will be constructed through engineering software and fabricated by means of a 3D printer. The designs will be tested and the most effective model will serve as the final product. After collecting the data and analyzing it, there will be modifications respectively. By developing a lid for a nosey cup, the quality of life for any individual that may benefit from the utilization of a nosey cup will be enhanced, dignity will be restored, and it will consequently aid in the rehabilitation process.

### Site-Specific Mutagenesis of Rad51 in Escherichia Coli

Zachary Walsh
Governor’s School for Science and Mathematics

Rad51 is a gene whose protein is vital in homologous recombination, where it acts as a single-stranded “cage” for DNA to attach to and copy a template strand in order to repair double-stranded breaks due to harmful exposure to UV light. Rad51 is also a proto-oncogene which is over expressed in cancer cells. The absence of Rad51 leads immediately to cell death.
Investigating RAD51 would be extremely beneficial to both biochemical research and cancer research. In spite of its importance in cell repair systems, very little is known about the regulation of RAD51. This project aimed to elucidate the mechanisms which control RAD51 and to determine suitable vessel bacteria for the RAD51 expression by mutating the RAD51 gene in E. coli. Our research determined that the E. coli strain Db3.1 was ideal for the plasmid DNA. Mutating RAD51 in order to clarify its pathways is the next step in this investigation.

POLYMERS CONTAINING HIGHLY POLARIZABLE CONJUGATED SIDE CHAINS AS HIGH-PERFORMANCE ALL-ORGANIC NANODIELECTRIC CAPACITORS

Albert Wang
Dutch Fork High School

Organic Nanodielectric Polymer Capacitors tainted with gold plating were prepared in this experiment using the hot press method to determine the effectiveness of their applications in energy storage by analyzing their energy density and D-E Loop. The results procured from this study demonstrated the feasibility of the organic copolymer, PTTHEMA-co-PBA capacitor and its possible applications for energy storage in comparison to the homopolymer, PTTHEMA. The copolymer was capable of reaching a field of about 120 MV/m, whereas; the homopolymer was only capable of reaching about 30 MV/m. The significant difference in their field strengths demonstrates the success of the copolymer transfer agent PBA. Moreover, charged and discharged electric energy densities of both the homopolymer and copolymer were examined by electric displacement-electric field (D-E) hysteresis loop measurements on pressed films. Similar to commercialized inorganic ceramic polymers such as biaxial-oriented polypropylene (BOPP), both polymers displayed strong linear correlation while demonstrating narrow D-E loops suggesting low dielectric loss. Furthermore, the copolymer capacitor shows better mechanical properties than the homopolymer and produced a freestanding film. Specifically, the apparent success of the copolymer over the homopolymer will be concluded, with the aim of developing novel, successful organic polymer capacitors that display low dielectric loss with high breakdown strengths. In essence, the outcome of this project determined the effectiveness of the organic copolymer capacitor as seen by comparing to the homopolymer base—with the hopes of finding an alternative and innovative method of encapsulating and accumulating energy at an economic, environmental, and production decrement.

THE IMPACT OF TEMPERATURE ON THE EFFICIENCY OF A NEWTON’S CRADLE

Shuai Wang
Heathwood Hall School

The purpose of this experiment was to find out if there is a relationship between temperature(T for short) and kinetic energy transferring by observing and calculating the efficiency of a Newton’s Cradle in different T variables. The efficiency means the lost of kinetic energy divided by the initial kinetic energy, which can be calculated through the distance that the ball on the left side is lifted and the distance that the ball on the right side swings out. (Finnigan 1987) In three T settings, which are 0°C, room temperature, RT for short, which was 22.3°C, and 95°C, the ball on the left side of the Newton’s cradle was lifted 13cm (initial distance, Di for short) away from the next ball. After dropped the ball, measure the distance that the right side ball swings out (final distance, Df for short) with Logger Pro. The results indicated that there is only a slight difference between Di and Df, which could be concluded that changing of T did not give an effect on the difference between Df and Di, calculated as Df-Di(ΔD for short). From the data collected, T does not affect the efficiency of the Newton’s cradle. In conclusion, T does not affect kinetic energy.

THE EFFECT OF ALKALINE BATTERIES ON BRASSICA RAPA PLANTS GROWING HEIGHT

Yufei Wang
Heathwood Hall Episcopal School

This study is researching the impact of the heavy metal or chemicals in alkaline batteries on general Brassica Rapa plant height while the plants are growing. Letting people know why humans need to recover batteries instead of throwing them away into landfills and the ground is the focus of this research. The alkaline batteries have all been cut to let the chemicals seep into soil where the Brassica rapa plants are placed. The result shows a very strong and harmful effect from the batteries to the Brassica rapa plants when the plants are growing over a certain period. For conclusion, the pollutants in the batteries made impact on the height, leaves, flowers and even its health of Brassica Rapa plants. The more batteries it has in the pot where the Brassica Rapa plants grows, the more impact it makes on the plants. Into a bigger picture, as people trying to protecting the environment, the base of protecting can be human need to stop discard alkaline batteries everywhere.

DEVELOPING A COMPUTER MODEL THAT PREDICTS THE OUTCOME OF CORNEAL COLLAGEN CROSSLINKING

Deidra Ward
Academic Magnet High School

Keratoconus is a degenerative disorder of the cornea that affects 1 in 2000 people worldwide. Corneal collagen crosslinking (CXL) has been developed as a treatment option for this disorder. Many different CXL protocols exist, so the development of a model that can predict the effect a certain CXL protocol will have on the cornea is necessary. Current models of CXL do not account for oxygen, but it has been shown in various studies that oxygen is needed for CXL. To fill this gap, an oxygen-dependent model of CXL was developed. Corneas were crosslinked for 10, 20, and 30 minutes, and tensile tests were...
performed to determine the Young’s Modulus [YM]. The results of the tensile tests were compared to the model that was developed and used to validate it. Ultimately, it was concluded that the oxygen-dependent diffusion model that was developed was successful in modeling the CXL procedure and could be useful in determining the efficacy of different CXL protocols and optimizing the CXL procedure.

VARIOUS FISH SPECIES ABUNDANCES AND DIVERSITY IN RELATION TO PERCENT COVERAGE OF MACROALGAL GROWTH
Kristy Waterlander
Governor’s School for Science and Mathematics

The North Carolina coastal region represents only a small part of the South Atlantic Bight but it serves as an important independent microcosm. This region supports many different species of fish that scientists know very little about. One aim of the Marine Resources Monitoring, Assessment, and Prediction (MARMAP) program is to learn more about the fish populations and diversity in this region. The goal of this project was to study the relationship between fish populations and percent coverage of macroalgae growth. Macroalgae is the generalized term used in this project for the outcroppings of plant life on hard-bottom ocean floor. There is some evidence that areas with higher macroalgae have higher populations of fish associated with them. Using video cameras on the ocean floor, this study accurately measured and calculated the fish populations and percent coverage of algae growth. Results met expectations, in that fish populations generally increased with an increased percent coverage of algae growth. However, a surprising find was a slight decrease in overall diversity with increased percent macroalgae coverage. Further studies are necessary to better understand this surprising finding.

THE EFFECT OF THREE DIFFERENT COMMERCIAL FERTILIZERS ON THREE VARIOUS GRASS TYPES
Matt Watford
Heathwood Hall Episcopal School

The purpose of this experiment is to determine how various commercial fertilizers impact and affect the growth of different grass species. The types of Cynodon dactylon that were used are as follows: Bermuda Grass, Rye Grass, and Smart Blend. The types of fertilizers that were used are as follows: Sta-Green Lawn Food, Sta-Green Starter Fertilizer, and Shake ‘n’ Feed. The hypothesis for this project is that Sta-Green Starter fertilizer will cause Rye grass to grow better than all other mixtures or control groups. The null hypothesis is that no other tested fertilizer or seed combination will impact the growth of the grass. The growth was judged by how healthy the grass looked while growing and the height of the grass. Statistical analysis was conducted after the data was collected shows that there is a statistically significant difference in the mixture of grass seed and fertilizer. The analysis disproved the hypothesis and the Smart Blend grass seed by itself grew the tallest and thickest as evidenced by the difference in the groups by seeing how the F value in the ANOVA test was much greater than the F-crit value.

EUKARYOTIC MICROBIAL DIVERSITY OF THE ICEMOLE; A REVOLUTIONARY EXPLORATORY ICE PROBE COMBINING MELTING AND DRILLING
Sara Watson
Governor’s School for Science and Mathematics

The IceMole is an ice probe combining melting and drilling technologies for use in environments such as Antarctica and Enceladus, a moon of Saturn. The Minimally Invasive Direct Glacial Exploration (MIDGE) project focuses on keeping the IceMole sterile in these environments so as to avoid contaminating fragile ecosystems. Last field season (approximately November to February), the IceMole conducted field tests in Antarctica. Prior to complete sterilization, the IceMole was swabbed to test for DNA. The results showed DNA, as expected. During field tests, meltwater from drilling was collected. Tests again confirmed the presence of DNA, so a clone library was constructed using Polymerase Chain Reaction (PCR) transformation and Restriction Fragment Length Polymorphism (RFLP) techniques. Sequencing results showed no bacterial contamination in either the rinses or the swabs. The rinse water contained marine and ice-specific fungi. However, the swabs showed common skin and air fungi, likely from the environment where the IceMole was originally built. Although DNA testing results after sterilization yielded nothing, future researchers will now be aware of what organisms might contaminate results and the environment if sterilization fails.

THE EFFECT OF PLATINUM CATALYST (MEA) LOADING (4.4 g/cm²) (4.1 g/cm²) (1.4 g/cm²) AT TEMPERATURES OF (70°C, 80°C, 90°C), AND RELATIVE HUMIDITIES OF (50%, 75%, 100%), ON THE POWER OF A POLYMER ELECTROLYTE MEMBRANE FUEL CELL
John Weiss
Heathwood Hall Episcopal School

With resources and training done at the University of South Carolina, this research was completed with the intent to discover whether the power of a Polymer Electrolyte Membrane Fuel Cell (PEM) is affected by three different catalyst (MEA) loadings; each at three different temperatures, and three different relative humidity readings (RH). The procedure consisted of the assembly of the fuel cells and the running of the fuel cell testing system, which measures the current, voltage, and power. The
results were analyzed with power/current comparison graphs, as well as an Analysis of Variance (ANOVA) test for each of the nine variables. The results showed the highest amount of power in the .4/.4 (mg/cm²) loading at 80°C and 100% RH. The lowest power readings were in the .4/.1 loading. It is important to note the reaction on the hydrogen side of the MEA (anode) is significantly shorter than the reaction on the oxygen side of the MEA (cathode). This is because the kinetics of the reaction on the cathode catalyst takes twice as long as the anode side. To balance the rate of the reaction, there must be twice the loading on the cathode catalyst. Because of this, the loading of .1/.4 produced a lower power reading than the .4/.4 loading but a higher reading than the .4/.1 loading. Therefore, with a ratio of 1:2 (anode:cathode loading), the higher the MEA loading, the higher the power.

**ANALYSIS AND RECOMMENDATIONS OF ONLINE LEARNING RESOURCES FOR TEACHERS WHO LEAD ECONOMICS AND FINANCIAL LITERACY COURSES IN K-12 SCHOOLS**
Sydney White
Governor's School for Science and Mathematics

While the economic vitality of most of the world’s population depends on financial literacy and economic knowledge, these are scarce resources. Increasing financial and economic education may seem like an easy task, but a majority of teachers are uncomfortable teaching these subjects because of their lack of knowledge. This leads to a cycle of ignorance, with only a select few people exempt. Teachers are not the only pathway to financial and economic education; however, the Internet is full of useful resources. Unfortunately, suitable websites are often difficult and time consuming to locate. If teachers were given a list of useful online economic and financial literacy resources, they would be able to use them in their classroom and would be more comfortable teaching the subjects. Approximately 100 free online resources were compiled and analyzed. Then rubrics were created that evaluated resources based on their quality, content, reinforcement of concepts, aesthetics, along with other criteria. There was a rubric for each type of resource: website, YouTube channel or video website, game, or app. The resources were evaluated and average rubric scores were examined. The final resource list was created with the resources sorted into sections by type, then into subsections by grade level. The final list included a brief description of each resource along with a link and the source’s type (finance- or economics-based). These resources included useful links to organizations such as Gen I Revolution and Secret Millionaires Club.

**ANALYSIS OF ELECTRONIC CIGARETTE VAPORS FOR CARBONYLS**
Hannah Wilder and Rebecca Wu
Southside High School

With the rise in popularity of e-cigarettes or ‘vaping,’ especially among young people believing the practice to be harmless, more information is needed to better inform the public in their decision-making regarding the activity. In this work, we describe the analysis of electronically-produced vapors of commercially available nicotine-vaporization liquids and variable voltage vaporizers for carbonyl byproducts by liquid chromatography. Carbonyls have been collected by dinitrophenylhydrazine (DNPH) derivatization and desorption with acetonitrile. Analyses have been performed on a novel, inexpensive liquid chromatography system utilizing both UV and stop-flow Raman detection. Carbonyls have been effectively separated and detected using the novel method. The system has been chosen for its ease of use and appropriateness for an educational setting.

**THE EFFECT OF GENDER AND GENRE ON WORD USAGE AS MEASURED BY LINGUISTIC INQUIRY AND WORD COUNT**
Mary Royall Wilgis
Heathwood Hall Episcopal School

In this experiment, the effect of gender and genre on word usage, as measured by Linguistic Inquiry and Word Count (LIWC), was observed. This information would be beneficial to society because it helps understand the intersection between gender and communication as well as how the artistic minded versus the science minded convey meaning. It was hypothesized that will be a statistically difference in word usage in males and females, as well as in art and science categories, as measured by LIWC, in TED talks. The Null Hypothesis is that there will be no statistical difference in word usage in males and females, as well as in art and science categories, as measured by LIWC, in TED talks. This was accomplished by analyzing 100 randomly selected scripts from live TED talks. These scripts were then entered into the LIWC word analysis program where each word was compared to an online dictionary and put into one or more categories. This data was then imported into excel where statistical analysis was conducted. This statistical analysis revealed that there was no statistically significant difference between the word usage of males and females and the word usage of science and art, or any of these categories compared to the control group. This was determined because the P-Value was greater than .05 for all of the sets of data. Therefore, the null hypothesis failed to be rejected.
Stream water quality, biological communities, and habitat structure in agricultural areas may vary greatly depending on climatic conditions. This study addressed streams draining watersheds with active row crop land cover in the South Carolina Piedmont (Saluda and upper Savannah River basins) during two summers of varying rainfall. Specifically, this study addressed if the difference in rainfall would affect water chemistry, fish abundance and diversity, and channel geomorphology. It was expected that rainfall would affect the fish abundance and diversity along with the stream quality negatively. While most measured variables did not differ significantly between the two years with varying rainfall conditions, bankfull depth was marginally significantly greater in 2013 reflecting the higher rainfall that summer. The incision ratio was also significantly higher in 2014 compared to 2013. A significantly higher QHEI in 2014 may reflect the greater variety of runs, pools and riffles when the water levels were normal. The iron and sulfate concentrations were higher in 2013, while the chlorine and nitrate concentrations were higher in 2014. Despite greater habitat quality scores in 2014, our results suggest that total fish abundance and diversity are relatively insensitive to the variations in rainfall recorded during this period of study. Further research could address what amount of rainfall would affect the habitat quality and fish diversity significantly.

The purpose of this project was to investigate if there is a correlation between genetically modified and organic corn feed for wild animals and the amount of corn consumed when given the choice. Genetically modified corn is when scientist change proteins at the genetic level of the seed corn. Two types of Pioneer genetically modified corn were used, one being 3371 with Round-up Ready and LibertyLink genes and another type, 33G71, that contained both of these genes as well as the a third one called the Herculex (HXRW). The third type of corn was an organic shelled corn which had not been genetically modified. Thirty cups of each type of corn was added to labeled tubs and then placed on the ground in the woods about 5 feet apart for three weeks. Also, a trail camera was set up to capture any movement by the tubs. At the end of the three weeks the corn was measured in cups and the data was collected. After 21 days, the wildlife had eaten 6 cups of Pioneer 3371 and 4 cups of Pioneer 33G71. From the organic tub, 21 cups of corn was consumed. These findings concluded that when given a choice wildlife consumed organic corn over GM corn by percent, thus, supporting the hypothesis that there would be a difference in the amount of corn consumed.

The goal of this project is to design and fabricate a more efficient underwater turbine blade to optimize ocean energy generation. Since aquatic animals use specific distinct fin designs constantly and highly efficiently, it seems reasonable to mimic the design for turbine blades. The goal of this study is to mimic aquatic animal fins on existing turbine blades to improve efficiency by using an Ampair UW100. For this project an underwater flow meter from PASCO was used to measure water flow rates in the test tank and a high voltage sensor from Vernier with Logger pro software was used to analyze output from the generator. Results to date indicate that a trolling motor can be used to produce various flow rates from .412 m/s is achieved, trolling motor speed 6 a speed of .612 m/s, trolling motor speed 7 a speed of .710 m/s, trolling motor speed 8 a speed of .836 m/s is achieved. So far the maximum voltage reached was 15.208 V with a motor speed of 8. Current blade designs include a pectoral fin of a humpback whale, tuna fish and sail fish and the dorsal fin of a dolphin. The next phase of this project has involved 3D printing of turbine blades in various designs and the creation of a metal hub for quick blade changes between trials.

The purpose of this project was to augment an existing simulation environment with a visualization front end for smart farming scenarios. Using real world machinery as a testing environment for software that autonomously-controls equipment is neither cost effective nor safe. A simulation environment in which virtual prototypes of smart farming applications are graphically displayed would ensure safety, reliability and efficiency of the systems under development in a cost-efficient way.
in order for the smart farming controller to be able to be used on a commercial level. The farming Simulator 2014 game provided the basic visualization frontend for the simulation of smart farming systems. Using Lua scripts to modify the game, an external program was able to control the tractor inside the game. XML files were used as the communication medium between the simulation framework and the game. Both the tractor within the game as well as the simulator can read and write to the XML files, allowing for two way communication and interaction. The Farming Simulator was used as testing environment to control the automated tractor in certain scenarios. The final step will be to add XML support to the smart tractor program. Then the existing smart tractor controller may be tested and its functionality may be verified safely and reliably.

LACTATE THRESHOLD AND VO2MAX AS PREDICTORS OF RUNNING PERFORMANCE
Allie Young
Governor’s School for Science and Mathematics

Lactate threshold, maximal oxygen consumption VO2MAX, and running economy are considered the three best predictors of running performance. While in the past runners typically only have thought of VO2max when measuring their performances, recently, lactate threshold is becoming just as popular. This study sought to measure if lactate threshold data was a reliable predictor of running performance in the 1 mile and 3.1 mile (5K) times. Nineteen subjects performed a laboratory based progressive treadmill VO2max test, and a 1 and 3.1-mile race in random order over a period of three weeks. Field tests were used to gather maximal effort race performance times, which we compared with both lactate threshold data and VO2MAX data. The results show that lactate threshold correlates more closely with both the one-mile and 5K race performances that did VO2MAX data.

OBJECTIVE ASSESSMENT CRITERIA FOR MEDIAN BASED FILTERING OF IMPULSE NOISE CORRUPTED IMAGES
Bertrand Zhang
Academic Magnet High School

Impulse noises can seriously corrupt images. Median based filters are used to remove impulse noises. However, these filters introduce distortions while removing impulse noises. Traditionally, the capability of a median based filter in reducing impulse noises is simply measured by MSE (mean square error) or SNR (signal-to-noise ratio) based criteria. However, MSE or SNR based criteria is not very effective in filtering assessment for impulse noise corrupted images because it makes no difference between impulse and non-impulse noises, ignores spatial distributions and fails to take into account the sensitivity of human vision. Because of these shortcomings, subjective assessment has been used as supplement, which is not quantitative, inaccurate, uneconomic and inefficient. This paper proposes a set of objective criteria, named Target Criteria, as an alternative. The proposed criteria measures impulse noise reduction, image structure preservation and visual sensitivity by distinguish impulse and non-impulse noise and taking into consideration of spatial distribution and human visual sensitivity. A computer simulation study shows that the proposed criteria provide a number of advantages in objective assessment of median based filtering for impulse noise corrupted images and identifying filter’s strength and weakness, which are unavailable with traditional MSE or SNR based criteria and subjective evaluation.

BIO-COMPATIBLE HYDROGELS FOR CONTINUOUS GLUCOSE MONITORS
Gordon Zhang
Governor’s School for Science and Mathematics

The Wang Group Lab in the Chemical Engineering Department of the University of South Carolina has developed an effective continuous glucose monitoring (CGM) device utilizing a bio-compatible hydrogel to detect glucose concentration in diabetic patients. The purpose of this experiment was to synthesize a gel with high stability (that is, not prone to decomposition), high porosity (allows sugar to pass through quickly and not collect), and high selectivity (reacts only with glucose, not other sugars) for use in a commercially viable CGM. We created gels with discrete ratios of key components and tested their properties using a rheometer. Through these experiments, we found an optimized recipe that exhibits the properties of stability, porosity, and selectivity. This recipe, in combination with the Wang group’s CGM, may prove useful to diabetic patients seeking a faster, more accurate, and more convenient alternative to current blood-prick monitors.

SCJAS ABSTRACTS END