*The Research Dragon*

![dragon[1]]()



**Commack High School’s**

**Research Yearbook**

**2012 - 2013**

**A Celebration of Research at Commack High School**

**Thursday May 23rd, 2013**

**7:00 pm**

**Evening Events**

Poster Presentation of student projects

Slide Show Presentation… Laura Jao

Introduction…………..….Kayla Neville

Opening Remarks….….…Ms. Alison Offerman-Celantano

 Director of Science, K-12

Student Reflections…..….Monica Cramer, Hassam Syed

Alumni Comments……….Rebecca Alford, Savina Kim

Guest Speaker………….. Brian Fried

 Expert Inventor, Author, Radio Host,

 President, Nassau and Suffolk Inventor and

 Entrepreneurs Clubs

 TV Spokesperson

Special Recognition……..Anthony Bisulco, William Furst, Trinity Russell

Honoring Our Seniors…...Sarah Lamorte, Joshua Zweig

Closing Remarks…..…….Kayla Neville

Welcome to our Celebration of Science Research. This evening, we pay tribute to the creativity, hard work, and success of our students over the past school year. Participating in the science research program requires a personal commitment, dedication to the completion of a project from start to finish, and the enthusiasm to overcome the obstacles and enjoy the success along the way.

 At each science fair that we have participated in, our students represented the Commack community in a respectful and professional manner. They were all well prepared and eager to share their efforts and results with science fair judges.

 This evening, we honor each one of our science research students for their involvement and participation in the Commack High School science research program.

Ms. Jeanette Collette……………Science Teacher

Mr. Richard Kurtz………………Science Teacher

Dr. Lorraine Solomon…………..Science Teacher

Ms. Andrea Beatty……………...Lab Assistant

Ms. Alison Offerman-Celantano………….. Director of Science, K-12

*With gratitude we would like to thank the following who have helped our staff and students in so many ways all year to make our research program work so well.*

Susan Abbot, Carolyn Campbell, Susan Fanwick, Carolyn Gallogly, Paul Giordano, Dolores Godzieba, Camille Horak, Elizabeth Koelzer, Dr. Susan Lee, Nancy Nunziata, Eileen Rogers, Genny Sebesta, Elizabeth Smith, Victoria Stack, Judy Titolo, Frann Weinstein, and Ed Storck and our fabulous custodians.

Ms. Nolan, Ms. Shapiro, and the administrative staff for their continued support.

Dr. James, Dr. Pecora, Ms. Newman and Ms. Ryan, and the members of our Board of Education, for their support and recognition of our program.

**Science Fair Participation**

**Intel International Science and Engineering Fair**

Anthony Bisulco

Trinity Russell

Joshua Zweig

*Awards to Be Announced*

**Siemens Competition in Math, Science, And Technology**

**Rajkumar Pammal, National Semifinalist**

***Journal of Experimental Secondary Science***

Trinity Russell, Featured Student Research paper published

***Biomaterials* Journal**

Kayla Neville, Featured Student Research paper published

**Breast Cancer and Environmental Research Program**

Greta Huang

Kayla Neville

*Students were selected to present their breast cancer related research at the conference in San Francisco*

**Toshiba/NSTA ExploraVision Program**

Emily Chen, Victoria Ferlauto

Jianna Cressy, Colleen Flynn, Ryan McCaffrey, Chantel Yang

 - Honorable Mention, top 10% of students nationwide

 - Invited to present at a special Earth Day NY celebration

**Junior Science and Humanities Symposium**

*Students must apply to the symposium and be selected to present their projects*.

Kayla Neville

Trinity Russell

Joshua Zweig

Raj Pammal

**Long Island Science and Engineering Fair, Round 1**

*(Round 1 finalists advance to LISEF 2 for awards)*

Anthony Bisulco

Christina Cabana

Justin Cheung

Binoy Daniel

Greta Huang

Laura Jao

Andrew Kim

Rajkumar Pammal

Trinity Russell

Rachel Yang

Joshua Zweig

**Long Island Science and Engineering Fair, Round 2**

Anthony Bisulco - 1st Place Grand Award - Electrical and Mechanical Engineering

Christina Cabana - 3rd Place Grand Award, Microbiology

Justin Cheung - 3rd Place Grand Award, Material and Bioengineering

Greta Huang - 3rd Place Grand Award, Material and Bioengineering

Laura Jao - 2nd Place Grand Award, Microbiology

Trinity Russell - 1st Place Grand Award, Animal Science

Rachel Yang - 3rd Place Grand Award, Material and Bioengineering

Joshua Zweig - 1st Place Grand Award, Computer Science

National Society for Professional Engineers Award - Anthony Bisulco

INTEL Award for Excellence in Computer Science – Joshua Zweig

Yale Science and Engineering Award – Joshua Zweig

*All First Place winners advance to International Competition in Phoenix, Arizona in May*

**Long Island Science and Engineering Fair, JV Division**

Ryan Chan - Honorable Mention, Biology

Joshua Drelich

Brian Huang

Angela Kubik

Briana Kubik

Scott Massa - 3rd place, Biology

Ryan McCaffrey - 3rd place, Biology

Chimdi Obinero - Honorable Mention, Biology

Jin Ho Park

Thomas Vetere

**New York State Science and Engineering Fair, INTEL Division**

Anthony Bisulco \*

Christina Cabana – 2nd Place, Microbiology

Justin Cheung – Honorable Mention, Materials and Bioengineering

Binoy Daniel – Honorable Mention, Physics and Astronomy

Greta Huang

Laura Jao

Rajkumar Pammal – 1st Place, Chemistry

Trinity Russell \*

Rachel Yang

Joshua Zweig \*

*\*Students previously accepting First Place Grand Awards at LISEF are not eligible for awards*

**WAC Lighting Foundation Invitational Science Fair**

Daniella Azoulay

Eric Bass - Honorable Mention, Prototype Engineering, Underclass Division

Anthony Bisulco – 2nd Place, Earth and Environmental Science, Underclass Division

Allyson Britt - 1st Place, Biology, Underclass Division

Christina Cabana – 3rd Place, Biochemistry, Underclass Division

Katie Carone

Ryan Chan - 2nd Place, Biology, Underclass Division

Justin Cheung – 2nd Place, Chemistry

Monica Cramer

Jianna Cressy - Honorable Mention, Biology, Underclass Division

Joshua Drelich – Honorable Mention, Biology, Underclass Division

Claire Drotman - Honorable Mention, Prototype Engineering, Underclass Division

Charles Eder

Harrison Ferlauto – 1st Place, Earth and Environmental Science, Senior Division

Jake Finnell

Colleen Flynn - Honorable Mention, Biology, Underclass Division

**WAC Lighting Foundation Invitational Science Fair (Cont.)**

William Furst - Honorable Mention, Prototype Engineering, Underclass Division

Samantha Galina

Maya Glaser-Kshensky

Scott Gold

Gabe Green – Honorable Mention, Prototype Engineering, Underclass Division

Diana Hagedorn - Honorable Mention, Biology, Underclass Division

Hugh Han – 1st Place, Earth and Environmental Science, Underclass Division

Brian Hastings - 1st Place, Earth and Environmental Science, Senior Division

Greta Huang - 3rd Place, Biochemistry, Senior Division

Andrew Kim – 1st Place, Biology, Underclass Division

Angela Kubik - Honorable Mention, Biology, Underclass Division

Briana Kubik - Honorable Mention, Biology, Underclass Division

Sara Kurten - 1st Place, Biology, Underclass Division

Sarah Lamorte

David Li – 2nd Place, Prototype Engineering, Underclass Division

Scott Massa - 1st Place, Biology, Underclass Division

Marissa Mathew – Merit Award, Behavioral and Social Science, Underclass Division

Ryan McCaffrey - 1st Place, Biology, Underclass Division

Kayla Neville – 3rd Place, Biochemistry, Senior Division

Kerri Neville

Chimdi Obinero – 2nd Place, Biology, Underclass Division

Andrea O’Brisky – Merit Award, Biology, Underclass Division

Jin Ho Park - Honorable Mention, Biology, Underclass Division

Caitlin Passaro - 1st Place, Biology, Underclass Division

TJ Passaro – 2nd Place, Behavioral and Social Science, Underclass Division

Mehtaab Sawhney - 2nd Place, Prototype Engineering, Underclass Division

Zach Silber

Hassam Syed - Honorable Mention, Biology, Underclass Division

Rakia Syed - Merit Award, Behavioral and Social Science, Underclass Division

Daniel Tamer

Noah Tollin – 3rd Place, Biology, Underclass Division

Jake Vallen – 3rd Place, Biology, Underclass Division

Chantal Yang - Honorable Mention, Biology, Underclass Division

Rachel Yang - 3rd Place, Biochemistry, Senior Division

Joshua Zweig – 1st Place, Computer Science and Modeling

**iSWEEEP**

Andrew Kim

**Arts and Science Fair at Nassau Community College**

Daniella Azoulay

Stephanie Badir

Joseph Biondo

Emily Chen

Anthony Ciccarelli

Victoria Ferlauto

Alexander Ferreira

Hugh Han

Aryana Javaheri

Ibrahim Khan – 2nd Place

Gloria Kim – 2nd Place

Noah Marinaro

Lucas Marmorale – 2nd Place

Andrea O’Brisky – 3rd Place

Laxshika Raveendran – 2nd Place

Nakul Thampy

James Whittaker

**Noyce Symposium**

*Students must apply to the symposium and be selected to present their projects.*

Joseph Biondo

Daniel Choi

Charles Chun

Anthony Ciccarelli

Robert Delgado – 1st Place, Mathematics, $100 Award

Marcelo Eisenberg

Vignesh Gunasekaran

Gloria Kim

Angela Kubik – Honorable Mention, $50 Award

Brianna Kubik – Honorable Mention, $50 Award

Ryan Lee

Noah Marinaro

Maeve McLoughlin

Kayla Neville – 2nd Place, Overall in Fair, $200 Award

Chase Oliver

Alinor Rahim

Laxshika Raveendran

Eric Rizzo

John Voiklis

James Whittaker

**Long Island Science Congress**

*Awards announced on June 6, 2013*

Rachel Aitchison – Achievement Award

Jae Yoon Bae - Achievement Award

Katie Carone - Achievement Award

Monica Cramer – To Be Announced

Jake Finnell - To Be Announced

Maya Glaser-Kshensky - Achievement Award

Jonah Haber – Meritorious Award

Brian Huang – To Be Announced

Anthony Izzo - Meritorious Award

Anthony Jao - Meritorious Award

David Li - Achievement Award

Kerri Neville - To Be Announced

Adam Portnoy - Meritorious Award

Mehtaab Sawhney - Achievement Award

Nakul Thampy - Achievement Award

Erick Vaysman - Meritorious Award

Thomas Vetere – To Be Announced

**New York State Science & Engineering Fair, Andromeda Division**

*Awards announced on May 22, 2013*

Emily Alford

Zan Asif – To Be Announced

Stephanie Badir

Jason Bak - To Be Announced

Allyson Britt - To Be Announced

George Burke - To Be Announced

Emily Chen

Jianna Cressy - To Be Announced

Arya Doshi - To Be Announced

Claire Drotman

Victoria Ferlauto

Colleen Flynn - To Be Announced

Daniel Hosseinian - To Be Announced

John Ioannou - To Be Announced

Anthony Izzo - To Be Announced

Aryana Javaheri

Daniel Jung - To Be Announced

Ibrahim Khan - To Be Announced

Sara Kurten - To Be Announced

Lucas Marmorale - To Be Announced

Caitlin Passaro - To Be Announced

Adam Portnoy - To Be Announced

Claire Regan - To Be Announced

Tracey Rosenlicht - To Be Announced

Zach Shushan - To Be Announced

Erick Vaysman - To Be Announced

Chantal Yang - To Be Announced

**ABSTRACTS**

**Seniors**

***George Burke***

**The Design and Construction of a Novel Rotating Rain Gutter System**

The purpose of this project was to design and construct a universally designed rotating gutter system to allow a physically challenged individual or any person the opportunity to complete a household chore more easily without assistance. The main purposes of rain gutters are to allow rainwater and debris hitting a rooftop a path to the ground to avoid or minimize erosion to the foundation of a building and to minimize the inconvenience of getting drenched with water while passing under an overhang. In a standard gutter system debris is collected at the base of the gutter over time and needs to be removed. The current way of cleaning rain gutters is for a person to get onto the roof and manually scrape out the debris from the gutter. A physically challenged individual would need to acquire assistance for this task when using standard rain gutters. I propose a rotating gutter that can be attached to a roof and can be rotated outward will make it accessible to clean from the ground. The original design functioned by having a person use a long rod that would will be able to rotate a half round gutter, between two nearly full circular ends, in which the gutter can rotate freely and be tilted for cleaning from the ground. The additions from that point include an electric motor, which allows for quick and easy turning of the rotating gutter, and a switch, that regulates the direction that the gutter moves.

***Arya Doshi***

**A Comparison of Learning Between Wild Type and Neurologically Impaired Fruit Flies**

Fruit flies (Drosophila melanogaster) are model organisms that are used in various experiments in research to help us understand human biology. The purpose of this study was to determine how a normal fruit fly reacts in a Counter Current Apparatus compared to an Alzheimer’s model fly. Evidence indicates that the β-amyloid (Aβ) component of senile plaques may be the key molecule in the pathology of Alzheimer's disease (AD). The flies were applied this gene and they were tested in the maze. To conduct this study a Counter Current Apparatus was created using plastic and test tubes. To successfully perform this experiment, it required training fruit flies in memorizing scents of different fruits it might be attracted to, and also to see if it prefers light over complete darkness. The fly moved through the tube and into the moving chamber where it was dropped down to the decision area where it was presented with a choice of moving to the light arm or the dark arm. I then moved on to adding a banana to test the dark arm and test these flies again. Reaction time, whether it goes to light or dark and each specific fly was recorded and taken into consideration while drawing a conclusion to this experiment. Factors such as sight, movement, and smell were tested using this assay to differentiate between the two flies.

***Charles Eder***

**Searching for a Correlation Between Cosmic Ray Flux and Cloud Formation**

Cosmic rays are high energy particles, made mostly of protons, which originate in supernovae. They are accelerated by supernovae to energies of up to 〖10〗^20eV. Cosmic rays constantly bombard Earth from all directions. Some are deflected by the magnetic fields of the sun’s solar wind. Some reach Earth and collide with atmospheric nuclei. These interactions originate at 100 km above sea level, producing cosmic ray showers of mesons. Many of the particles do not reach Earth’s surface due to energy loss. Those that do reach the surface are detected by Cherenkov radiation detectors. The average number of cosmic rays detected /m^2 s^(-1) is the cosmic ray flux. Cosmic ray flux has been shown to vary with solar activity and lower atmospheric variations in barometric pressure (kPa) and temperature (K). The interactions between cosmic rays and the atmosphere may aid the process of nucleation by which clouds accumulate between altitudes of 1 and 11 km. Data of cosmic ray flux was collected over a period of about two years between 2007 and 2009. Data of barometric pressure and temperature were collected over a corresponding time period. The variation in flux over time was corrected to remove the dependence of flux on pressure and temperature in order to observe primary cosmic ray flux. These variations were compared to variations in cloud cover measured in percent over the same time period. A statistical analysis determined whether there was a correlation between cloud formation and cosmic ray flux. The trend lines for the graphs of cloud fraction as a function of cosmic ray flux showed an indirect relationship between the factors at Sites 1 and 3, and a direct relationship at Site 2. The R^2 values for the graphs of cloud fraction versus cosmic ray flux for the three sites were 0.023, 0.010, and 0.005 respectively and the correlation coefficients calculated for the three graphs were -0.152 for Site 1, 0.102 for Site 2, and -0.071 for Site 3 indicating a poor correlation between cosmic ray flux and cloud formation.

***Harrison Ferlauto, Brian Hastings***

**The Effect of Bisphenol A (BPA) on the Fecundity of Fruit Flies (Drosophila melanogaster)**

Bisphenol A (BPA) is used in the manufacture of polycarbonate plastics and epoxy resins that are found in a wide variety of common products such as reusable food and drink containers, baby bottles, protective liners in metal canned foods and beverages, dental composites and sealants, and many other products. Studies have shown that low doses of Bisphenol A, even doses below the US-EPA’s current reference dose of 50 µg/kg per day, can have negative effects on organisms of all sorts. The purpose of this investigation was to determine if Bisphenol A has an intergenerational effect on the fecundity of fruit flies. For a control, five virgin WT males were mated with five virgin WT females. The same experiment was also performed with both the males and females exposed to BPA. Once one generation of flies hatched, they were counted and then left to create a second generation which was also counted and compared to the first. Twenty trials were performed. Results show that there is no intergenerational difference between WT flies. It was found that BPA does decrease fly fecundity. Lastly, the second generation of BPA flies were less fecund than the first suggesting that BPA’s adverse effects increase with each generation exposed.

***Alexander Ferriera***

**An Exploration of the Validity and Use of Historical**

**Temperature Data from the H.M.S. Plover (1851-1852)**

The Arctic climate is changing rapidly. To understand why, scientists rely on historical weather data from many sources. To study these past weather conditions, it is imperative that past weather data be utilized to develop models for the investigation of climate-related trends. The quality of past data, however, needs to be evaluated as thoroughly as possible before it can be compared to modern data. During the stay of the H.M.S. Plover, a British survey ship stationed at Point Barrow, Alaska from 1851 until 1854, a thermometer was kept within a thermometer shelter to provide protection from environmental conditions whilst permit the surrounding air to enter. Did this thermometer shelter skew the actual temperature readings from Point Barrow, Alaska (screen-bias)? To determine the screen-bias of the shelter, a replica was constructed. This shelter, equipped with a modern platinum resistance thermometer, was installed at the National Oceanic and Atmospheric Administration (N.O.A.A.) Barrow Observatory at Point Barrow, Alaska alongside the facility’s standard instrument. The data collected from the two thermometers were compared to each other to determine the screen-bias of the thermometer shelter used on the H.M.S. Plover. Finally, temperature data were digitized from the records of the H.M.S. Plover and were then compared to the modern data from the N.O.A.A. Barrow Observatory to assess the extent of climate change in the Arctic. Thus far, the results of this study have shown that this past year’s temperature data is significantly lesser than that of the mid-nineteenth century temperature data. This conclusion, however, can only be confirmed by further data collection during the next few years.

***Greta Huang, Rachel Yang***

**Breast Cancer Detection and Treatment: Membrane Mechanics and**

**Receptor Mediated Endocytosis of Platinum Folate Nanoparticles**

Breast cancer accounts for nearly one in three cancers among women in the United States. Conventional therapies used to treat breast cancer do not effectively differentiate between cancerous and non-cancerous cells, leading to the destruction of healthy cells as well as tumor cells during treatment. The purpose of this investigation was to detect and target breast cancer cells based on differences in the membranes of cancerous and non-cancerous cells, especially differences in folate receptor expression and membrane mechanics. Certain overexpressed receptors in tumors are potential targets for nanoparticle treatments; for example, cancer cells have over five hundred times more folate receptors than healthy cells. There are also fundamental differences in terms of phospholipid bilayer membrane rigidity; the tumor cell membrane is less rigid than that of the healthy cell. This justified an investigation to determine whether coating platinum nanoparticles with folate would lead to selective increased nanoparticle uptake in MCF-7, a cancerous breast cell line, compared to MCF-10A, a non-cancerous breast cell line. After exposure to nanoparticles for 48 hours, the cells were analyzed using transmission electron microscopy to observe membrane structure, and for differences in membrane rigidity using atomic force microscopy. It was found that the cytotoxic effects of platinum folate nanoparticles in MCF-7 include nanoparticle localization in vacuoles and the disintegration of the membrane, while these effects are less prominent in MCF-10A. These findings are key in the development of folate-targeted cancer treatment, improving tumor-targeting specificity.

***Rachel Gross, Megan Kurten***

**The Effect of Salinity and pH on the Hatching Patters in Artemia Salina**

With changing environments, the bottom of the food chain is extremely affected. Brine shrimp are a main food sources for different creatures. Decrease in their numbers leads a decrease in predators. The domino effect: 1,000 less Brine Shrimp 🡪 10 less small fish 🡪1 large predator that can’t feed and die. By determining the combination of salinity and pH that Brine Shrimp eggs hatch leads to understanding of how pollution affects wild life. Brine Shrimp can live at salinity levels of 25 g/L to about 250 g/L, although when the eggs are laid, with levels around 150 g/L the eggs form a brown coating to preserve the egg until the levels are better for hatching. There is not much information on how pH levels affect how the eggs hatch. Determining if there is an effect of pH on these eggs, to determine if eggs laid in a prime salinity can be able to hatch in higher or lower pH is one of the objectives of the experiment. To do this, eggs were counted and hatched in small Petri dishes that have different levels of salinity, then a combination of different salinities and pH levels. The initial number of eggs was compared to the number hatched, a percentage was determined that provided insight into how these eggs are affected. Based on research, the increase in salinity had an effect on the amount of time it took the eggs to hatch. At salinity levels of 0 and 150 there was no hatching and the best salinities were 100-125. pH had an effect where the eggs were unable to hatch ay 5 or 9 but were able to at any other level, other than 7 had a negative effect.

***Laura Jao***

**Monitoring the Expression and Virulence Roles of**

**Chaperone/Usher Pathways in *Yersinia pestis***

*Yersinia pestis* is the causative agent of the plague that decimated Europe’s population during the 14th Century. *Y. pestis* continues to affect 3,000 people annually and is classified as a Category A agent of potential bioterrorism. To cause infection, *Y. pestis* must express pili- organelles assembled using its 11 chaperone/usher pathways that allow bacteria to bind to host cells. This study describes two experiments designed to increase our understanding of the novel chaperone/usher pathways, crucial to the infection cycle. First, the promoter regions of gene clusters that encode for chaperone/usher pathways were sub-cloned into a GFP vector and exposed to varying temperatures to determine optimal induction conditions. Results confirmed these conditions for the *caf* pathway, the focus of experimentation. Secondly, a four chaperone/usher pathway deletion strain of *Y. pestis* was used in adhesion assays to assess effects on host cell binding. Results indicate this four pathway knock-out strain decreases adhesion as compared to single pathway deletion strains previously studied. By elucidating these disease-causing mechanisms, preventive vaccinations can be synthesized to halt the reemergence of plague. More importantly, methods used in this study can be applied to other common species of pathogenic bacteria that infect using pili, such as *Escherichia coli*.

***Megan Kurten – See Rachel Gross***

***Kayla Neville***

**Synthesis and Testing of a Targeted Drug-Delivery System:**

**The Effects of Surface Coatings on the Drug Delivery Capacity Of Oxidized Graphene Nanoribbons**

Oxidized graphene nanoribbons (O-GNR) hold promise as a drug delivery agent. For this potential to be realized, O-GNRs must be functionalized with a surface coating to be stable in blood, and their drug loading and delivery capacities must be assessed. O-GNR was synthesized and solubilized with three different surface coatings, and then loaded with an anticancer drug, doxorubicin, to test the drug loading capacities. The lactate dehydrogenase viability assay was used on two cell lines, MCF-7 and SiHa, to determine the effectiveness of the different coatings in drug delivery. The coating that provided the most effective drug delivery in MCF-7 cells was dextran with a molecular mass of ten thousand kilodaltons (dextran 10K); in SiHa cells, 1,2-distearoylsn-glycero-3-phosphoethanolamine-N-amino(polyethylene glycol)-2000] (PEG-DSPE) was the most effective. It was determined that in both cell lines, the O-GNR delivered three times more doxorubicin than the cells would take up without the nanoparticles. This effect may have a large impact on the efficacy of drug therapy and reduce the side effects of treatments. In addition, the data suggests that cells may have a unique preference for a particular surface coating, which would be beneficial in applications such as targeted drug delivery

***Rajkumar S. Pammal***

**Combating Cancer: Synthesis of a Novel Tumor-Targeting Drug Conjugate based on**

**Tri-Branched Dendrimers**

Cancer, the second leading cause of death in the United States, remains a serious health issue and requires more effective treatment options. Current cancer chemotherapy causes many severe side effects due to its limited selectivity towards cancer cells. Therefore, the purpose of this investigation was to synthesize a drug conjugate that overcomes many of the problems associated with conventional chemotherapy via a novel tri-branched dendrimer-based drug delivery system. Synthesis began with the construction of HO-PEG3-NH2 and H2N-PEG3-NH-Boc for the branches of the dendritic connector. The tri-branched structure was synthesized using a Mitsunobu reaction to create a thiol-maleimide coupling ready construct. Reactions were monitored by thin layer chromatography, and the molecular structure was confirmed by NMR spectroscopy and mass spectrometry analyses. This novel structure possesses the ability to be coupled with one half-dendrimer functionalized by a tumor-targeting molecule (TTM) and another half-dendrimer functionalized by a potent cytotoxic drug (SB-T-1214), to create the final drug conjugate. The nanoparticle dendrimer base allows for both active targeting of cancer cells through conjugation with TTMs such as biotin, and passive targeting due to a macromolecular size that facilitates the Enhanced Permeability and Retention effect. Additionally, the tri-branched structure enabled the attachment of an imaging arm, for biological imaging and improved diagnosis. In combining targeted therapy with diagnosis, this novel drug conjugate may further the goal of more effective and comprehensive personalized cancer medicine.

***Trinity Russell***

**A Study of Transposition Events of the Gypsy Retrotransposon in the Neural Cells of**

***Drosophila melanogaster* and Its Relation to Neuronal Decline**

Transposable elements (TEs) are abundant mobile genetic elements that constitute a large fraction of most eukaryotic genomes. Retrotransposons, which replicate through an RNA intermediate, represent approximately 40% of the human genome and 30% of the *Drosophilia* genome. The expression levels of gypsy, a transposable element of *Drosophilia melanogaster*, have been correlated with the aging process and neuronal decline. However, the source of the increase in transposable element toxicity associated with aging is currently unknown. TO determine the source of the age dependent expression of gypsy, a trapping system was creates to detect de novo gypsy integration events. Results indicated that the gypsy retrotransposon actively mobilizes and proliferates throughout the genome of *Drosophilia melanogaster*, This suggests the novel hypotheses that the age-dependent activation of transposable elements disrupts functional genes causing neuronal decline and disease, Since transposable elements are suspected of causing over fifty reported types if human disease, it is crucial to increase our understanding of the behavior of transposable elements with respect to mutagenesis.

***Jared Wilson***

**Biomimicry**

Biomimicry is a form of engineering in which strategies and patterns found in nature are emulated to solve structural and mechanical issues in the world. The idea under which innovation involving biomimicry is based upon is that nature has adapted and evolved to solve its own structural problems, which are similar to the structural problems we face today. As a form of engineering, biomimicry can be approached in the several manners. Nature can be used as a model, emulating its sustainability and structure. Nature can be used as a mentor, teaching us how we can improve on modern structures and how we can adapt to various situations. Nature can also be used as a measure, in which we can evaluate the sustainability of nature as it has evolved over billions of years. Biomimicry can be broken down into the following modes and methods: Break down, Get, store, or distribute resources, Maintain community,Maintain physical integrity, Make, Modify, Move or stay put, Process information.Chemically break down Catalyze chemical reactions (17)[Enzyme quickly metabolizes alcohol: European starling](http://www.asknature.org/strategy/0abdd32261b5789248eef12e695e4ac0)[Enzyme catalyzes many reactions: plants](http://www.asknature.org/strategy/02ac87eb3abb2d5fe41d20da1fbd04af)

[Producing energy from sugars: cells](http://www.asknature.org/strategy/c0463bce6cf1bf94c6eed9cbd85aecdf)

[Creating energy from sunlight: plants](http://www.asknature.org/strategy/4a77b8541f02437695521f1c4185c93a)

[Larvae protect from cyanide: Sara longwing butterfly](http://www.asknature.org/strategy/6ca7e0c70f6f44d7234298c647cd32ef)

[Gut:enhancing anaerobic digestion:earthworm](http://www.asknature.org/strategy/30741eddc617dc0de4c6d4342b557a56)

[Tyrisonase enzymes aid crosslinking: organisms](http://www.asknature.org/strategy/2d642efe5cfdc7ac8d87e528c99c42d6)

[Plants starve caterpillars: tomato](http://www.asknature.org/strategy/793e0e6ac04457e165912895b8372619)

[Micro-compartment converts carbon dioxide: cyanobacteria](http://www.asknature.org/strategy/20f5f1b47b62124f70396e1c73c87032)

[Carbonic anhydrases catalyze conversion of carbon dioxide: mammals](http://www.asknature.org/strategy/6d0d0774969524de105f8ea214654aaf)

[Enyzme complexes "burn" hydrocarbons for energy: Pseudomonas putida bacteria](http://www.asknature.org/strategy/c0f64d60a847b207f3bcd9f2406afbbf)

[Bacteria cooperate to survive: Pelotomaculum thermopropionicum](http://www.asknature.org/strategy/249f7428ba4a80aca7545f8475f92dbd)

[Enzymes cleave toxic quaternary ammonium compounds: Gliocladium roseum fungus](http://www.asknature.org/strategy/21d233bf0a72409d69d0c792c4a61ea2)

[Enzymes break down pesticides: honey bee](http://www.asknature.org/strategy/40a973b785059da06b307cf640f6e354)

Cleave halogens from organic compounds (1)

[Test strategy](http://www.asknature.org/strategy/fdd313ca7c9084cdc469974eae8de1b2)

Cleave heavy metals from organic compounds (2)

[Enzymes detoxify mercury compounds: bacteria](http://www.asknature.org/strategy/1ee340b8e77682d012ce1f61ab65df68)

[Mining metals: marine bacteria](http://www.asknature.org/strategy/689041e6723c0f357a96865959609338)

Other inorganic compounds (8)

[CO2 breakdown used in organic compound manufacturing: plants](http://www.asknature.org/strategy/503a9e56f1c95569fe4db89052c712b1)

[Enzyme degrades lignin: Trametes fungi](http://www.asknature.org/strategy/a48f7da36d4875dc34c80ca7a8379d72)

[Digesting various substances: fungi](http://www.asknature.org/strategy/30ce62615f02629c0031dfd70a6c898f)

[Bacteria reduce iron oxide: Shewanella oneidensis](http://www.asknature.org/strategy/b69bbb0712cb36b2bae46ed20a352d2a)

[Enyzme complexes "burn" hydrocarbons for energy: Pseudomonas putida bacteria](http://www.asknature.org/strategy/c0f64d60a847b207f3bcd9f2406afbbf)

[Nitric oxide synthesis protects against oxidative stress: Bacillus subtilis bacterium](http://www.asknature.org/strategy/2a2bf810dc95e1eebc2d1d1055fba0ec)

Other organic compounds (43)

[Multiple organisms interact: soil ecosystem](http://www.asknature.org/strategy/7cdfe189e1e5148fd8d0a2f0d3bfcb9e)

[Multiple organisms strip nutrients: forests](http://www.asknature.org/strategy/4a40878949b8781e9e71f4f278d95a93)

[Enzymes allow cellulose digestion: bacteria](http://www.asknature.org/strategy/b09419cefaead56be2d7a65e2837c021)

[Enzymatic liquid digests insects: green pitcher-plant](http://www.asknature.org/strategy/6fcf4812f36b96fee2c5421f54e8b165)

[Cellulose digested for fuel: protozoans](http://www.asknature.org/strategy/a2bdbe102f8b0b72a87bbbbf7e6dfdc7)

[Enzyme oxidizes fat-soluble organic chemicals: animals](http://www.asknature.org/strategy/92ea7bf17e0ceac951055aa6b22a087f)

[Organisms work together to decompose cellulose: earthworm](http://www.asknature.org/strategy/46b5e3194233575d403290e52065b95c)

[Toxin breaks down tissue: Mycobacterium ulcerans](http://www.asknature.org/strategy/96c6ffc69319b7d022accc6899a86887)

[VOCs used as carbon and energy source: fungus](http://www.asknature.org/strategy/9977c6187dbcb18c8474f5c317ec0682)

[Enzymes help break down plant cell walls: Bacillus bacteria](http://www.asknature.org/strategy/726ae28d1901ddf598637da1a00a07b1)

[Organism digests blood: hookworm](http://www.asknature.org/strategy/2e5f2723275d03cc0cf9199e4fdb2a17)

[Gut microbes digest cellulose: termites](http://www.asknature.org/strategy/4686fcf7b4f0583191e40f9518e496bf)

[Special liquid softens hard cocoon: puss moth](http://www.asknature.org/strategy/eabaf827d0644647a4e8fe172658fecc)

[Bacteria degrade petroleum hydrocarbons: Marinobacter](http://www.asknature.org/strategy/58aec09fea7b3aba5e4c9489823014c0)

[Enzyme breaks down hydrocarbons: bacteria](http://www.asknature.org/strategy/4167cd6828a6d8853562a84aa53ef1a3)

[Chemicals used in defense: termites](http://www.asknature.org/strategy/85e75c63cf83b268b50f79be2c0f3463)

[Microorganisms degrade crude oil: bacteria](http://www.asknature.org/strategy/9b790ca8fabf7da14ca0b0cddc2d4ca2)

[Enzyme degrades lignin: Trametes fungi](http://www.asknature.org/strategy/a48f7da36d4875dc34c80ca7a8379d72)

[Extremophile converts fatty-acids into energy: bacteria](http://www.asknature.org/strategy/9b8f5568cb4410f9924e3973bfa628b3)

[Enzyme breaks down hydrogen peroxide: thermal pool microbes](http://www.asknature.org/strategy/2323ca97a35cfa9d620695402e34c67c)

[Exoskeleton is dissolved: dragonfly](http://www.asknature.org/strategy/680e8fad25dd3f04e76923ee45f7c9d6)

[Diversity increases efficiency: soil ecosystem](http://www.asknature.org/strategy/c305dc914ad01b94e6687213461eebf0)

[Breaking down crude oil: Archaea bacteria](http://www.asknature.org/strategy/e4b48c9f3e79296415ed6d4e915f9004)

[Breaking down crude oil: aerobic bacteria](http://www.asknature.org/strategy/57c2cde2efd9c86413d78c2112f0f4f2)

[Breaking down crude oil: fungi](http://www.asknature.org/strategy/37b2cc82344f2f0dfa4157e5b4154017)

[Breaking down crude oil: yeast](http://www.asknature.org/strategy/e3deda5cec82693a86f8520a08e21c6a)

[Skin resists microorganisms: pilot whale](http://www.asknature.org/strategy/d1cb32be3c76489375e383e6ed53a736)

[Digestive solution removes excess algae: giant clam](http://www.asknature.org/strategy/89f6ad5e7d72f55e6883480a777fa483)

[Secretions break down algal walls: stony corals](http://www.asknature.org/strategy/ee04782ebf8c1fb28d5c19f59eb16016)

[Digesting various substances: fungi](http://www.asknature.org/strategy/30ce62615f02629c0031dfd70a6c898f)

[Food digested externally: houseflies](http://www.asknature.org/strategy/5771ca2cad3b74ddbc6ad96fc7fabfe2)

[Mixture waterproofs nests: paper wasps](http://www.asknature.org/strategy/ed085a912c8436b34346bd1b414a4a97)

[Head bores through wood: shipworm](http://www.asknature.org/strategy/470530d782c517cd4af74064c75d75c4)

[Bees collect DDT: orchid bees](http://www.asknature.org/strategy/988a8af0914e131fae63ee7071485b55)

[Symbiosis enhances pollutant breakdown: plants and microbes](http://www.asknature.org/strategy/8ea24c1f1872710dbac52e986c6d24f6)

[Enzymes degrade fluoranthene: Pleurotus ostreatus](http://www.asknature.org/strategy/bf4d6d41a49fada364172e4e43d128f7)

[Biochemical pathways enable the use of caffeine as a feedstock: Pseudomonas putida](http://www.asknature.org/strategy/ff5814c6f1647647fbc4df628367fb94)

[Saliva breaks down blood clots: vampire bats](http://www.asknature.org/strategy/1848d3d4fdbdf17b001a72b2e7825c61)

[Enyzme complexes "burn" hydrocarbons for energy: Pseudomonas putida bacteria](http://www.asknature.org/strategy/c0f64d60a847b207f3bcd9f2406afbbf)

[Bacteria cooperate to survive: Pelotomaculum thermopropionicum](http://www.asknature.org/strategy/249f7428ba4a80aca7545f8475f92dbd)

[Enzymes sulfoxidize toxic organosulfur: Agrocybe aegerita fungus](http://www.asknature.org/strategy/6736ee1e73ef1c0eb7bd78b057b233b2)

[Enzymes break down pesticides: honey bee](http://www.asknature.org/strategy/40a973b785059da06b307cf640f6e354)

Polymers (12)

[Bacteria produce acetate, not methane: kangaroo](http://www.asknature.org/strategy/0c7d5df04243fc4054817990d4b3d0b4)

[Enzymes break down cellulose, toxins: multicolor gill polypore](http://www.asknature.org/strategy/87435d38f6922c3d55f5c0bb9448d435)

[Exoskeleton is dissolved: dragonfly](http://www.asknature.org/strategy/680e8fad25dd3f04e76923ee45f7c9d6)

[Digesting various substances: fungi](http://www.asknature.org/strategy/30ce62615f02629c0031dfd70a6c898f)

[Microbes make natural polyester: bacteria](http://www.asknature.org/strategy/aafff01c6748d9169047522c11c0280a)

[Lysosomes recycle protein building blocks: human cells](http://www.asknature.org/strategy/6eb3fb3131f864f614cd88cf46e02f56)

[Photosynthetic systems rapidly disassembles and reforms: Rhodobacter sphaeroides](http://www.asknature.org/strategy/9c9505a4bf262d2d2ef94bf039628f50)

[Enzymes catalyze cellulose breakdown at high temperatures: hyperthermophillic archaeabacteria](http://www.asknature.org/strategy/0e5f9b9bd788381381f760a4ab43fcdb)

[Enzymes bleach wood lignin: marine-fungus designate NIOCC #3](http://www.asknature.org/strategy/57b6ca8a30a293d3348d5ccdf02bd4db)

Physically break down

Abiotic materials (4)

[Teeth scrape and grind to break down coral: parrotfish](http://www.asknature.org/strategy/3c977cb0475ce2dee097ea3b9a075979)

[Mineral crystals enhance rasping power: chitons](http://www.asknature.org/strategy/b91cc7c16934434bb7c01ecbd8ad286c)

[Crystals of metal salts improve cutting ability: herbivorous insects](http://www.asknature.org/strategy/9aee02b13e1fd7758c745e2e6ad3fb06)

[Mineral crystals enhance cutting ability: limpet](http://www.asknature.org/strategy/ed0abd59a02c29fb4b8240d67b7fbadd)

Biotic materials (19)

[Multiple organisms interact: soil ecosystem](http://www.asknature.org/strategy/7cdfe189e1e5148fd8d0a2f0d3bfcb9e)

[Teeth scrape and grind to break down coral: parrotfish](http://www.asknature.org/strategy/3c977cb0475ce2dee097ea3b9a075979)

[Chewing through wood: harlequin beetle](http://www.asknature.org/strategy/fd30fc76645ecc51a8bb662737984ab7)

[Teeth crush shells: walrus](http://www.asknature.org/strategy/a4b6e837e8c8592abc5b09832aeba9ad)

[Jaws shear flesh: alligator snapping turtle](http://www.asknature.org/strategy/7e111eca904af261bdbb51452c82abf5)

[Tongue cuts through fish scales: lamprey](http://www.asknature.org/strategy/a5bffb898aa49131e6819d42c536f1a0)

[Mouth cuts through chitin: velvet mite](http://www.asknature.org/strategy/85c09483fdb4d8d2e81dbdf8a6a1f736)

[Jaws cut leaves precisely: leaf cutting ants](http://www.asknature.org/strategy/4e98d4f6841972626d0026c6cb00aaee)

[Teeth specialized to diet: macropods](http://www.asknature.org/strategy/9cd86674a4cde4788b1c044e6471d096)

[Mouth sorts and grinds food: platypus](http://www.asknature.org/strategy/e5c18862e8dcb9a64a2b3fc672e43b1b)

[Crystals of metal salts improve cutting ability: herbivorous insects](http://www.asknature.org/strategy/9aee02b13e1fd7758c745e2e6ad3fb06)

[Mineral crystals enhance cutting ability: limpet](http://www.asknature.org/strategy/ed0abd59a02c29fb4b8240d67b7fbadd)

[Mineral crystals enhance rasping power: chitons](http://www.asknature.org/strategy/b91cc7c16934434bb7c01ecbd8ad286c)

[Specialized teeth wear down but remain effective: grazing animals](http://www.asknature.org/strategy/0e68299d49a3956f3bbaaa5377739bd9)

[Snout works as drill: acorn weevil](http://www.asknature.org/strategy/7b63b18d64f8d7201921f240fff94cab)

[Ovipositor drills through wood: parasitic wasps](http://www.asknature.org/strategy/efd9f97ba5240b796b855c9bd5ee8397)

[Beak cuts up food: trogons](http://www.asknature.org/strategy/cdc34df9df3366e045fbc1a6204c3600)

[Head bores through wood: shipworm](http://www.asknature.org/strategy/470530d782c517cd4af74064c75d75c4)

[Teeth adapted to changing environments: great apes](http://www.asknature.org/strategy/66e5421b4c755cd14ef471d3bc84e820)

[Breaking down wood: galatheid crab](http://www.asknature.org/strategy/1c1486bc71c67fc832594c323e14205e)

[Secretion kills bacteria: burying beetle](http://www.asknature.org/strategy/a1cf3bcf7ce31b74c534c3b42f0ea350)

***Rachel Yang – See Greta Huang***

***Michelle Zhou***

**The Effect of Salt and Light on the Movement of Magnetotactic Bacteria**

Being a relatively new and unique discovered species, Magnetotactic bacteria (or MTB), many investigations have been launched for potential applications of the bacteria. However, though commonly found, it is difficult to mass culture. The purpose of this experiment is to compare the effects of salinity in the water and the presence of light will affect the Magnetotactic Bacteria’s speed by testing it on the 3 samples gathered from New York (Brooklyn, Northport Village, and Long Island Sound). The collected samples were left undisturbed for up to a month in order for the sediment to stratify. Each sample is tested for presence of magnetotactic bacteria by creating a hanging drop under the microscope. An apparatus was then set up in order to culture the bacteria more effectively. Behavior and activity will be determined by measuring the time it takes for the bacteria to congregate to one side in each of the 3 samples from different locations. The salinity concentrations used are at 0.00%, 0.07%, 0.14%, 0.21%, 0.28%.

**Underclassmen**

***Rachel Aitchison, Jae Yoon Bae***

**The Use of the Water Hyacinth (*Eichornia crassipes*) in the Construction of a Water Management Device**

This study was designed to determine the filtering capabilities of the water hyacinth with different chemicals such as phosphates, nitrates, and motor oil to aid in the process of constructing a water management device. The water hyacinth is an extremely invasive aquatic weed able to reproduce quickly using “runners” or stolons. These are small horizontal connection stems that create daughter plants to grow. One tank was filled with approximately 40 gallons of fresh water. The tank was filled with about 15 hyacinths and about 5 water lettuce plants. The lid was sealed and 2 lights were placed on top of the lid to provide more sunlight for the plants. Each cluster was then hand removed and each bulb/length was measured. The diameter of the bulb was measured and the plant tip of leaf to base was measured with a string. The string was tied around the plant when finished so that we would know which plants have already been previously measured. A small dash was then written on the string with the number of dashes coordinate with the letter given to the plant. (1 dash= A, 2 dashes= B, etc.) It was observed that the thinner the bulb is, the longer the plant is. In the next following weeks, each cluster of plants will be put into their own separate tanks to observe the pH levels/ nitrate/ phosphate levels that remain in the water after these solutions have been added.

***Emily Alford, Claire Drotman***

**Investigating Intergenerational Relationships between Senior Citizens and Teenagers**

**Through Social Networking**

As technology plays an ever-increasing role in our changing lives, the senior members of our society have been left behind. The growth of social networking has changed the lives of millions of people and senior citizens have found themselves outdated with new advances, which have impacted their ability to feel connected to our world today. Facebook, a popular social networking site used to connect and reconnect with friends was launched in 2004, and has over five-hundred million users. It is evident that the way people interact and establish relationships has rapidly changed. The purpose of this investigation is to study intergenerational relationships between senior citizens and teenagers established exclusively through social networking and how it affects their sense of well-being as well as comfort with unfamiliar technology. Each senior citizen was paired with a teenager and communicated strictly through Facebook. The teenagers gave a Facebook and Internet safety workshop prior to the start of the experiment. During this time, the teenagers helped set up participant’s Facebook accounts and answer any questions. After the workshop, the participants were no longer given assistance with the Internet and Facebook. In order to measure the senior citizen’s sense of well-being and comfort with unfamiliar technology, two surveys were filled out by each senior citizen at the beginning, middle and end of the investigation, which were kept constant throughout the entire experiment. Results reflected each individual’s progression and comfort with the unfamiliar technology as well as positive or negative changes in well-being. Results were difficult to obtain due to the circumstances of the participants. Challenges such as the environment of the participants, trouble using the mouse, and frustration were only some of the difficulties which seniors encountered. Future research will develop ways to help seniors overcome these challenges.

***Zan Asif***

**Investigating the Existence and Degree of Cold Tolerant Arthropods**

The purpose of this study is to explore the cold tolerance in 2 types of insects, the hymenopteran WOW bug (*Melittobia digitata*) and the 2 isopods (*Armadillidium vulgare* and *Porcellio laevis*). Cold tolerance is the ability for an organism to withstand freezing temperatures. *Melittobia digitata* or WOW Bugs are a species of parasitic wasp in the family Eulophidae, order Hymenoptera. The female WOW Bug's stinger is small and weak that it cannot penetrate human flesh. It is used to insert eggs into used on immature insects that are in the pupa stage. WOW Bugs are tiny, easily maintained, harmless insects. The WOW bugs were given blow fly pupae to lay the eggs in them and then the emerging larvae will eat the pupae from the inside out (Dahms, 1983). Pill bugs and Sow bugs on the other hand are very different. They are in the Order Isopoda, Family Armadillidae and species *Armadillididae vulgare*. The best known species in the family is [*Armadillidium vulgare*](http://en.wikipedia.org/wiki/Armadillidium_vulgare), the common pill bug. Woodlice in the family, Armadillidae, are able to form their bodies into a ball shape, in a process known as conglobation. Sow bugs are similar in all aspects, except they grow to a larger size and their behavior is more aggressive. The objective is to compare their cold tolerance. To test for cold tolerance each organism will have individual members of the group go into the freezer for 30, 40, and 50 seconds for 25 trials. I hypothesize that Sow bugs will have a greater degree of cold tolerance because of their conglobation, agility and aggressive behavior.

***Daniella Azoulay***

**An Investigation of the Testis- Specific Protein in *Cercopithecus lomamiensis***

**By determining the structure of a protein, information about the protein’s function may be determined, as well as any genetic mutations. The purpose of this study was to investigate the structure of the Testis- Specific Protein (TSPY) in the recently discovered Lesula monkey (*Cercopithecus lomamiensis*). The Lesula was first publicly identified in September of 2012. It is native to the Democratic Republic of the Congo and it is an endangered species. The Testis-Specific Protein is a highly conserved protein that is involved in the process of spermatogonial proliferation and the development of testicular tumor cells. The knowledge gained from this research is especially important in the field of molecular biology, as it also lends itself to draw conclusions about functional partners of the protein and variations of the protein in other species that have strong evolutionary relationships with the Lesula, such as *C. hamlyni* and *Homo sapiens*. This research also allows us to highlight the specific structures in TSPY that causes tumorigenesis, and mutate the protein to stop the process. The structure and functions of the Testis- Specific Protein in *Cercopithecus lomamiensis* and their analyses have not been publicly identified. By identifying the structure of the protein, the active amino acids and their secondary structures may be studied. Thus, conclusions may be drawn about the relationship between structure and function. Aspects of structure such as beta- sheets, alpha helices, phosphate binding sites, loops, etc. will be used to help draw conclusions. Finally, the newly identified TSPY protein and its mutated form have been modeled. Computational tools such as the National Center for Biotechnology Information (NCBI), Basic Local Alignment Search Tool (BLAST), PyMol, PhosFinder, and QUARK Ab Initio were used to identify characteristics of TSPY.**

***Stephanie Badir***

**A Survey Study of School Nurses’ Knowledge on the Primary Care of Students with Diabetes**

Diabetes Mellitus is an autoimmune disease that affects 1 in every 400 to 500 children in the United States. Thus a school nurse would be expected to encounter diabetic students during the course of the day. A major part of controlling diabetes in children and adolescents is managing it in the school setting- therefore school nurses are a key part of a team of caregivers that include parents and physicians in the management of diabetes in children. School nurses’ familiarity with how to handle students with diabetes is an important concern. The methods to monitor and treat diabetes have and are advancing quickly with the frequent introduction of new medications and delivery technologies. With quickly improving diabetes technology, the question arises, do nurses, given their busy and unpredictable schedules, have the experience and exposure to the new approaches for treating diabetes? If not, what are the best ways to convey new information about new modes of diabetes treatment to nurses? To investigate these issues I will administer an online survey through the New York State Association of School Nurses website to nurses all over New York State. This survey will be used to determine the types of control and treatment that nurses give to their diabetic students, as well as find out how nurses typically find out about new technology that should be used for their students.

***Jae Yoon Bae – See Rachel Aitchison***

***Jason Bak, Daniel Hosseinian, Daniel Jung***

**The Correlations Between Systemic Problems, Age, and Gender to the Severity of Periodontal Disease**

Periodontal disease is a serious inflammation of the gums that can cause pockets of infection around the roots and crowns of teeth, loss of bone, damage to gum tissue which will lead to teeth loss, if not treated. It has been previously shown that there are correlations between certain attributes, such as age and gender, to the presence of periodontal disease (Greene, 1963). But more importantly, there have been a growing number of recent studies associating rising numbers of people who suffer from periodontal disease to prevalent systemic problems such as cancer, cardiovascular disease, and preterm birth (Meyer et al., 2008). In addition, there is research made on correlations between systemic problems, such as type 2 diabetes, and periodontal disease, but such studies focus only on the prevalence of periodontal disease (Sandberg et al., 2000). This study attempted to come upon correlations between the severity of periodontal disease to age, gender, and systemic problems by comparing the probing pocket depths and bleeding on probing between patients. Due to the many variables affected by periodontal disease, a patient scoring system was developed in order to be able to compare patients with a single variable. Then, the scores were analyzed to find significant data by means of ANOVA and t-tests. Thus far, the research has shown minimal significant data. It is assumed that this is due to a small sample size. If correlations are found, doctors and dentists will be able to have a more probable cause for one’s periodontal disease or systemic problems. This would provide information to be used for prophylactic purposes and will either support or oppose the movement to turn dental practices into a place to screen for diseases.

***Joe Biondo, Anthony Ciccarelli, Noah Marinaro***

**An Analysis of Modern and Historical Weather Data from Mohonk Preserve, New York**

Climate change has been an important and controversial issue in science and politics where data has often been misused or misinterpreted. It is imperative that historical weather data be used to help get a clearer picture of global climate change. The goal of this investigation was to analyze historical and modern weather data from Mohonk Preserve in the New Paltz area of New York to determine if there was a warming, cooling or neutral trend in the local climate over the past 120 years. Data from log books that were collected by workers at the Mohonk Preserve from 1890 to the present day were obtained. From 1890 to 1895 the temperatures were recorded three times per day. From 1896 to 2005 the temperatures that were taken were the maximum and minimum temperature for the day. Data was transferred from logbooks into Excel spreadsheets and organized by year and month. It was hypothesized that a warming trend would be observed at Mohonk Preserve that is similar to global trends in temperature. The data supported the hypothesis that temperature has increased in the area of Mohonk Preserve, New York over the past 110 years. The minimum temperature of colder months has risen 4.7°F in 110 years and the maximum temperature of the warmer months has risen 2.7 °F in 110 years. The number of days above 90 °F for the warmer months in 1896-1905 was 4 and in 1996-2005 was 81 days (95.1% difference). The temperature increase was about the same with respect to the global trends in the summer, but a higher extreme in the winter.

***Anthony Bisulco***

**A Practical Notification System to Identify Incoming Sudden Ionospheric Disturbances**

Solar flares, which are the sudden release of high energy particles from the sun, are a threat to our vital communication and power networks. This investigation devises and evaluates a method to minimize this threat by creating a solar flare early detection system based upon identifying characteristics of the solar flare. When a Very Low Frequency wave reflects off the ionosphere with ionization due to a solar flare it bounce back with a larger amplitude than if it were to bounce off with no ionization. Therefore, a high amplitude VLF signal could indicate a solar flare. The detection and warning system consists of a loop antenna which detects the VLF waves, a preamplifier and sound card, and MATLAB software which processes the signal and identifies the potential solar flare. A smart phone application has been written and implemented to deliver the information about a potentially disruptive solar flare to various communication devices.

***Allyson Britt, Sara Kurten, Caitlin Passaro***

**The Effect of an Antidepressant on Brine Shrimp Hatching and Behavior**

The objective of this study was to see how the hatching percentage and adult brine shrimp phototaxic and geotaxic behavior was affected by a chemical that is found in marine environments. As more people are taking drugs such as antidepressants, the total quantity of drugs excreted by humans is increasing therefore excreted drugs not broken down in the body are also increasing. These excreted drugs, through the sewer system, are ending up in aquatic ecosystems. This can negatively affect living aquatic communities by altering their behavior and reproductive success. Past research has shown that the antidepressant fluoxetine (Prozac) causes developmental delays in amphibian larvae as well as the marine amphipod, Echinogammarus marinus. First we compared the behavior of adult brine shrimp exposed to the antidepressant, St. John’s Wort, to our control group, adult brine shrimp without an antidepressant. Then we exposed brine shrimp cysts to an antidepressant, St. John’s Wort, and observed how the hatching percentage was affected. Hatching percentages were evaluated against a control group of brine shrimp cysts that had not been exposed to an antidepressant. We hypothesized that the effect of an antidepressant on brine shrimp, cysts and adults will cause them to have different geotaxic and phototaxic behavior as well as lower hatching percentage as compared to the control. The geotaxic and phototaxic tests on the adult brine shrimp supported our hypothesis. The adult brine shrimps’ vertical upward movement against gravity and movement towards light increased compared to the control group in both tests. This showed that the St. John’s Wort had a negative effect on the natural behavior of Artemia. The test of the percentage of hatching in brine shrimp cysts also supported our hypothesis. After being exposed to St. John’s Wort the percentage of hatching dramatically decreased.

***Christina Cabana***

**The Effects of Sub-therapeutic Antibiotic Treatment (STAT) on Temporal Variation of the Mouse Gut Microbiome As Determined Through Fecal Samples**

Ten percent of the cells within the human body are human, the other ninety percent belonging to a range of symbiotic microbes. This overwhelming microbial population partakes in various interactions with the host organism to regulate host homeostasis. Moreover, the microbiota, particularly which inhabits the gut, has been linked to obesity, immune response, and disease pathogenesis. Characterization of perturbation of the microbiome is imperative in order to understand the relationship of the microbiome and disease, and to manipulate this relationship in the future. This study sought to determine the effects of sub-therapeutic antibiotic treatment on temporal variation of the mouse gut microbiome. It was expected that STAT would not only alter temporal variation, but that the effects would be reproducible and overcome expected inter-mouse variation. Abundance of total bacteria and Firmicute bacteria from control and treated mice was analyzed through qPCR. A significant trend between experimental groups was observed, with higher dispersion between mice of different experimental groups at all timepoints. Using landscape ecology, it was theorized that after the initial decrease in total bacteria in STAT mice, positive fluctuation of gut flora occurred due to blooming of once hindered “species”. If the experiment was continued it was expected the treated microbial populations would continue to grow in size until they reached some new equilibrium. The implications of this on-going study could help combat the obesity epidemic and the rise of other diseases, as well as pave the way for more personalized medicine and narrow spectrum antibiotics.

***Katelyn Carone, Maya Glaser-Kshensky***

**Happy Trails: The Study of Snail Aggregation**

The purpose of this investigation was to understand the aggregation patterns of the mud snail Littorina littorea. We tested to see if the removal of mucus trails affected the aggregation patterns of the snail. This mud is snail found along the eastern and western coasts of the United States, Northern Europe, and Russia. They are found in clusters because they aggregate towards each other’s mucus trails and follow them. They are found in escargotieres (clusters). These snails have been known to negatively affect coastal ecosystems because of their invasive nature. We are studying whether or not we can control the aggregation of the mud snails by removing the mucus trail from the environment. To do this, a snail was placed by itself in a small fish tank (one gallon) to explore the tank for 10 minutes. Next, a new snail was placed in to see if it would follow the path made by the first snail. This was the control experiment. In the experimental trials, we placed one snail in the corner of the tank, with twelve secluded in the opposite corner (escargotiere). There were no mucus trails to guide the snail to the opposite corner. This experiment was designed to test if the mucus trails were necessary for a snail to find its way to the escargotiere. It was hypothesized that the experimental trial snails would be unable to make it to the escargotiere without a mucus trail. The hypothesis was supported by the data. Seventy-six percent of the experimental snails did not make it to the escargotiere and only twenty-four percent did make it to the escargotiere. Many of the snails that did not reach the escargotiere did not come close to the netted corner. Eighty percent of the control snails followed the path accurately. The outcome thus far of this experiment showed snails need a mucus trail to successfully aggregate. More trials are needed to verify the results.

***Ryan Chan, Chimdi Obinero***

**A Study of the Effect of Curcumin on the Neurophysiological Capabilities**

**Of *Drosophila melanogaster* models of Alzheimer’s disease**

Alzheimer’s disease (AD) is a disease that affects one in eight seniors in America. Current research suggests that AD is caused by an abnormal accumulation of amyloid beta (Aβ) and tau proteins in the brain. A mutation in the amyloid beta precursor protein (APP) can trigger this abnormal buildup of proteins in the brain. For this experiment, a *Drosophila melanogaster* stock with a mutated APP gene expressed was obtained by using the GAL4/UAS system, where the GAL4 protein binds to the Upstream Activation Sequence (an enhancer), which then activates gene transcription of the APP gene. The flies then began to express Alzheimer’s-like behavior. This project was designed to test the effects of the chemical curcumin (present in the turmeric spice) on the AD fly models. First, the wild-type and AD flies’ locomotion, coordination, speed, and responses to stimuli were tested using two assays: upward flight assay with a light source and a light/dark T-maze assay (tests reasoning and response to light stimuli). Following the initial tests, the turmeric spice was mixed into the wild-type flies’ food and the flies went through the same assays again. Finally, the flies’ performances on the assays before and after ingesting curcumin were analyzed. The results indicate that 1) wild type flies respond differently in the assays that AD flies, and 2) curcumin has a positive effect on AD flies. On the upward flight assay, when Alzheimer’s flies were fed curcumin, they spent an average of 47 seconds less to complete assay than their Alzheimer’s counterparts with no curcumin. On the T-maze assay, 37.5% of the AD flies did not finish the maze, and only 32.5% went to the light, as opposed to 92.5% of AD flies with curcumin that went to the light. Although there is insufficient evidence to assess the effect of curcumin, the results demonstrate the effectiveness of the GAL4/UAS system to replicate human disease in *Drosophila melanogaster*, and imply a positive correlation between curcumin and improved neurophysiological capabilities in AD flies as determined by locomotion/light stimuli response assays.

***Xiaoxuan Chen, Victoria Ferlauto, Aryana Javaheri***

**The Effect of Different Types of Light on the Regeneration of**

 **California Blackworms (*Lumbriculus variegatus*)**

The purpose of this investigation was to determine the effects of exposure of different types of light sources on the regeneration of California Blackworms (CBW). Incandescent bulbs light up due to heat energy being transmitted through a filament wire inside the bulb. Fluorescent bulbs have electrodes at the end of a fluorescent tube containing mercury vapor. Electrons move from one electrode to the other while reflecting off the mercury atoms and exciting them. As the mercury atoms move from excited behavior to unexcited behavior, they emit ultraviolet photons (UVC and UVA). Fluorescent bulbs have cracks in their make-up that can cause ultraviolet photons to leak out from the bulb. Ultraviolet light is known to cause mutations in the cell that cause the cell to divide at a rapid, uncontrolled rate in the human body. Based on this, UV radiation may cause DNA mutations to worm cells, which would have an effect on *Lumbriculus variegates* regeneration by speeding it up. CBWs are aquatic worms that exchange gases through their skin and usually regenerate quickly. The shallow water they live in can absorb ultraviolet energy, which in turn can reach the surface of their skin. To carry out this study, CBWs were cut in half, and then exposed to incandescent, fluorescent or no light (control). They were then monitored for regeneration. We hypothesized that the CBW’s segment regeneration will not be affected by the incandescent bulb but increase under the fluorescent bulb. Our hypothesis was not supported. Results indicated the incandescent lighting sped up the regeneration of the CBWs. The worms under fluorescent lighting grew the least and died the quickest. The incandescent light and fluorescent light had effects on the regeneration of the California compared to the control worms.

***Justin Cheung***

**Scanning Tunneling Microscopy Imaging of Concentration Induced Polymorphism for the**

**Tailoring of Self-Assembled Nanostructures**

Molecular self-assembly is the spontaneous formation of molecular patterns (polymorphs) through the adsorption of molecules in solution onto a surface. Previous studies have established that both solute concentration and solvent identity influence self-assembly. However, the determination of the threshold concentration for trimesic acid (TMA) self-assembly on graphite, and the exact concentration parameters for the observed polymorphs (chicken wire, filled-chicken wire, flower, filled-flower, and dodeca-rim) have not yet been investigated. Eight TMA dissolved in pentanoic acid solutions were studied (concentrations from 0.1666 mM-3.5290 mM). Scanning tunneling microscopy was used to image each solution on the graphite surface to determine the extent and type of polymorphism. Analysis of images using Nanoscope software showed that the minimum concentration for TMA self-assembly was 0.3331 mM. Additionally, the polymorph packing density decreased with solution concentration. As the threshold concentration for self-assembly was approached, voids were observed between adjacent self-assembly domains. The ability to choose a polymorph through control of solute concentration will enable the design of tailored nanostructures in medical and electronic applications.

***Daniel Choi, Charles Chun, Vignesh Gunsekaran***

**The Effect of Sleep Deprivation on the Behavioral Development of Fruit Fly Larvae**

The effect of sleep deprivation on humans is a very well-researched topic. Many studies have shown that sleep deprivation has a negative effect on a person’s cognitive performance and behavior. There have also been many studies done on fruit flies, or *Drosophila melanogaster*, with similar results. However, none of these studies have tested the effects of subjecting an organism to sleep deprivation at the larval stages of its life. For our trials, we took 6 sets of fruit fly larvae, let 3 grow normally (this was our control group) and subjected the other 3 to sleep deprivation by putting them in to a fly deprivation chamber which spun them for 10 seconds every 15 minutes. Once the larvae in both sets became adults, behavioral assays were performed. These included the Line Activity Assay (which measures how active a fly is), and the Upward Movement Assay (which measures how fast a fly can walk upwards). This study could potentially be applied to humans, so we can see what kind of effect sleep deprivation has on human babies. Thus far, the results have shown the flies that have been subjected to sleep deprivation were more active than the flies that were not. However, adults from fly larvae that had been subjected to sleep deprivation did not respond as rapidly to light as the flies that were not sleep deprived.

***Charles Chun – See Daniel Choi***

***Anthony Ciccarelli – See Joseph Biondo***

***Monica Cramer, Kerri Neville, Jake Finell***

**Associative Learning Capabilities Of the Marine Hermit Crab *Parugus longicarpus***

The purpose of this experiment was to find out if hermit crabs (Parugus longicarpus) exhibit associative learning. Marine hermit crabs are known as the long-armed hermit crab; Marine hermit crabs are small western Atlantic hermit crabs that belong to the genus parugus. They have right chelipeds (claws) and protects its soft, asymmetrical abdomen by keeping it coiled in its shell. An adult marine hermit crab has a length of approximately 2.5 centimeters or less. In this experiment, marine hermit crabs in tanks were first exposed to individual empty plastic canisters with four varying possible colors, black, red, blue, and purple, with holes in the bottom. Next, these four canisters were each filled with clam meat. We recorded the number of crabs that came within a five centimeter radius in a ten minute time span for each of the four canisters. The canisters were then individually placed into the tank, this time without food, to test if the crabs learned to associate the color of the canister with food. We hypothesized that the hermit crabs will respond to the blue container more often, with or without food, less often than they would respond to the blue, black, and purple containers, with or without food. After we conducted our research we found that the hermit crabs do not exhibit associative learning between food and the color of the container the food is offered in, however they seem to be most attracted to the color blue.

***Jianna Cressy, Colleen Flynn, Chantel Yang***

**The Effect of the Anti-Diabetic Drug, Metformin, on the Gene Expression**

**Of LKB1 in *Drosophila melanogaster***

The purpose of the investigation was to study the effect of the anti-diabetic drug, metformin, on the expression of the gene LKB1 (Liver Kinase-B1), found in fruit flies, or *Drosophila melanogaster*.  LKB1 is a gene found in both humans and fruit flies and is responsible for regulating apoptosis and activating the AMPK (AMP-activated kinase.), a component of the mTOR pathway.  Activation of the AMPK is correlated with the suppression of the mTOR tumor signaling pathway.  Wild type fruit flies were obtained and consumed varying dosages of metformin orally.  RNA was extracted from the fruit flies to compare their gene expression levels.  Then RT-PCR and reverse transcriptase enzymes were used to convert the mRNA into ­­­­­­cDNA.  Additionally, qPCR was used to determine what quantity of LKB1 was expressed by flies of the various experimental groups.  It was hypothesized that a high dosage of metformin would have a greater gene expression of LKB1 because past research supports that higher amounts of LKB1 is associated with the inhibition of the mTOR tumor signaling pathway. Thus far, we have not obtained any viable data; however, our projections analyze the possible outcomes that are based on past studies which support the notion that metformin may be used as a tumor suppressant. In the future, improvements include conducting more trials and collecting accurate and applicable data. Moreover, different organisms could be utilized to observe the effect of metformin on oncogenes in different biological systems.

***Binoy Daniel***

**A Novel Approach to Automated Spectral Characterization of**

**Photonic Structures for Quantum Information Application**

Photonic crystals are finding applications in the fields of quantum information due to their ability to manipulate light. Critical for these applications is to not only quantify whether the photonic crystal couples to the correct wavelength within its cavity but to determine if a high quality factor is present in its spectrum. Conventional methods include the alignment of a laser to the cavity for spectral measurements; however this proves inefficient when multiple photonic crystals on a chip are characterized. Conversely, if a scan is completed across these structures, then a map of the spectrum’s properties in the region can be eluded for an automated spectral characterization. Measurements of the GaP photonic crystal consists of a fluorescence measurement which introduces white light to the structure and outputs the resonance of the cavity. A confocal setup then scans the structure by outputting the cavity’s spectrum at each focal point. A high intensity value was found near the center of the cavity with this scan, however a constant quality factor of the resonant peak was found throughout the structure. The characterization of the diamond nano-cavity array consisted of a cross-polarization measurement that scans across each cavity. Resonance was found at the center of the cavities that were not faulty.

***Robert Delgado***

**Comparing Different Methods for Solving Different Types of Improper Integrals**

Integrating improper integrals, integrals with no absolute domain of integration, is both a necessary and complex task done by computers because they allow for approximations of many natural phenomenon (Cordeiro, 2008). As of now computers rapidly execute these operations, which would normally take an average person minutes to do, in seconds (Muldowney, 2005). However, with most algorithms requiring many calculations in the span of only a few microseconds (Shabani, 2011), an even faster method for solving improper integrals is necessary (Spiring, 2011). In this study, multiple methods for computing several kinds of improper integrals were evaluated. This was done by comparing the run times for several mathematical orientated programming languages such as mathematica and Java. The types of integrals that were computed were ones that have no discontinuities, at least one zero with imaginary part greater than zero, and zeros only with imaginary parts less thanzero (Traub, 1968). Comparing the run times for each method showed that numerical approximations, the method already used by most programs, is overall the fastest out of all methods. However, for some specific types of integrands, such as the one where we evaluate it as a limit, the numerical approximations method is actually found to be slower. The data acquired supports the argument that the method for solving several kinds of improper integrals is best accomplished by the numerical approximations. This is a method where the program sums up many infinitely small rectangles under the integrand.

***Joshua Drelich, Jin Ho Park, Hassam Syed***

**The Effect of Wind on the Growth of Wisconsin Fast Plants (*Brassica rapa)***

The purpose of this experiment was to test the effect of wind on different growth factors of Wisconsin Fast Plants (*Brassica rapa*). Jaffe (1973) first introduced the idea of thigmomorphogenesis as the physiological, biochemical, and morphological responses of plants to wind and other mechanical perturbations. The artificially generated wind in a laboratory setting can be used to reveal the effects of wind on plant growth and physiology. This investigation focused on three different growth factors of the plants under different intensities of wind: 1) the height of the plant; 2) rate of growth and the 3) ratio between the dry mass of roots to the shoots. Sixteen Wisconsin Fast Plants were observed per trial. Every two days, the height of the stems were measured and recorded. At the end of the life cycle of the plants, the dry mass of the roots and shoots were measured. It was hypothesized that the plants affected by wind perturbation will have, compared to the control (no wind), a decreased stem height, a lower growth rate and a higher ratio of dry biomass of the roots compared to the dry mass of the shoots. Thus far, results show that the wind is not having a significant effect on the different growth factors of Wisconsin Fast Plants. This may have been caused by the fragile nature of the plant more than the wind effect. However, photographs of the plants showed a substantial difference in the bending of the stems. Those affected by higher intensities of wind had a much steeper slope or bend of the stem, but those not affected by wind had almost no slope of the stem. However, a trial conducted using sunflowers (*Helianthus annuus*) showed substantial difference among the different test groups. The results supported the original hypothesis in every aspect.

***Claire Drotman – See Emily Alford, William Furst***

***Marcelo Eisenberg, Ryan Lee, Chase Oliver***

**A Study of the Drop Shapes of Liquids**

Liquid droplets can be found everywhere around us. They are seemingly simple but there is still much to discover about them. The study of water droplets is part of the field of fluidics. Understanding the behavior of fluids is important because many industries such as printing, food processing, and microbiology depend on the understanding of how fluids act under certain environmental conditions for honey, water, and oil. There are many factors that affect drop formation. These factors include surface tension, viscosity of the liquid, and other external variables. Such external variables include things such as temperature and humidity of the surrounding area. These variables changed certain characteristics of the drop formation such as length, horizontal diameter, and the “neck’s” vertical measure. The “neck” is the point at which the water droplet breaks when accumulates too much mass and falls from the dropper. It was hypothesized that the external variables will affect the physical characteristics only slightly compared to the viscosity of each liquid which will have the greatest impact on the formation of the drops. The results showed that changing temperature of liquids has a profound effect on the physical characteristics of the drops such as number of subdrops and neck characteristics. Each of type of fluid had a unique signature drop characteristics.

***Victoria Ferlauto – See Xiaoxuan Chen***

***Jake Finnell – See Monica Cramer***

***Colleen Flynn – See Jianna Cressy***

***William Furst, Gabriel Green, Jonah Haber, Claire Drotman***

**The Design and Construction of Assistive Technology Devices for the Greenhouse**

The purpose of this project was to construct assistive technology devices for disabled greenhouse workers to effectively carry out their daily work. Assistive technologies are meant to ease the boundaries presented by a disability. The workers in the greenhouse have physical and neurological disabilities, which affect their ability to work due to stiffness and inability to stand for long periods of time. To create these devices, we had to first brainstorm and determine what our participants needs were, and what would increase their efficiency in the work place. Several devices where designed, including a pot holder, soil distributer, plugger, and watering device. The pot holder and soil distributer where developed and built. The pot holder makes pot organization easier, and is universally accessible. The soil distributer is meant to eliminate soil overflow and increase consistency by exacting the amount of soil that can be distributed per pot. This also eliminates the issue of indoor air-pollution by not spilling any soil. These two prototypes are ready to be implemented and evaluated, and the other devices are ready to be built.

***Samantha Galina***

**Stresses Involved in the Activation of an Inducible Promoter in *Arabidopsis thaliana* Plants**

The purpose of this study was to determine the stresses that activate an inducible promoter. The inducible promoter is known to be activated in pathogen attacks and stress stimulations. The promoter is followed by various genes, which encode for proteins that each have a specific function. The proteins were replaced by the reporter gene GUS, to test the activity of the promoter, through a change in coloration to blue. The experiment used the small flowering plant, *Arabidopsis thaliana*. It is commonly used in biology because of its small size, rapid life cycle, simple genetic sequence, prolific seed production, and many types of possible mutations. *Agrobacterium*, was used as a medium to transfer the DNA, it is the only bacteria able to transfer DNA trans-kingdom. This bacterium causes the plant disease crown-gall, that result in the formation of “tumors” (uncontrolled cell division) or galls on the plant. *A. thaliana* plants were grown, and then the plants were dipped into specific protein *Agrobacterium* solutions. The fruits were cut from the plants, and the seeds extracted and placed on Petri dishes to grow in a B5/Kanamycin agar solution. The B5 contained nutrients necessary for plant growth and the Kanamycin was used to determine which plants were transgenic. Transgenic plants were used in experimentation. Various tests were used to test the activity of the promoter. In this experiment stresses included a heat shock, growth in darkness, infection with VIP1, transferred through the vector A99, salicylic acid and callus inducing medium (CIM). Localized tests in the plant’s roots proved to be more consistent, with a 7%-10% increase in promoter activation in transgenic plants.

***Maya Glaser-Kshensky – See Katelyn Carone***

***Scott Gold***

**Study of Locomotion in Grasshoppers and Humans using Tracker Video Analysis**

In nature, jumping is used by small animals to maneuver through complex environments where many obstacles exist. Jumping gives animals the ability to overcome large obstacles despite their small size. This same challenge exists for humans. This investigation will analyze the locomotive features that allow insects to jump and apply them to human locomotion. Grasshoppers are best known for their ability to jump close to twenty seven times their length. To achieve these feats the jumper must build thrust by storing potential energy much like a grasshopper’s extensor muscle, then quickly release this energy to jump. Developing ways to increase the efficiency of a jump can be very valuable to athletes who play sports such as track and field. When researched using video analysis tools, grasshoppers serve as models of desirable jumping performance.

***Gabriel Green – See William Furst***

***Vignesh Gunasekaran – See Daniel Choi***

***Jonah Haber, Anthony Jao***

**Using Food Scraps as an Energy Source in the Process of Yeast Fermentation**

The purpose of this experiment was to create an alternate biofuel source using kitchen food scraps. Biofuels are an alternate source of fuel for vehicles that can either replace or augment gasoline. It is considered “clean energy” since it does not emit as harmful emissions into the atmosphere as compared to fossil fuels. Both gasoline and ethanol produce carbon dioxide and water vapor when they are burned, but ethanol does not produce as much of it. The energy found in the food scraps will be used in the process of fermentation. A combination of yeast and a mixture of various scraps of food such as potato skins and apple cores will be used as a source of energy for the yeast to produce ethanol through the process of fermentation. The concentration of CO2 produced by the food mixture will be measured to see which food mixture is the best at producing ethanol. The more CO2 produced by the yeast will be directly proportional to the amount of ethanol produced. A combination of foods with the most amount of sugar will most likely produce the most the most CO2 since there is more energy in the mixture for the yeast to use during fermentation. To carry out this study the food scraps were first liquefied using a food processor. Yeast will then be added to the liquid and the amount of CO2 produced will be measured as an indication of fermentation, the yeast will use the food scraps and create byproducts of ethanol and CO2.It is hypothesized that through the process of fermentation the yeast will use the glucose in the food scraps and create a byproduct of carbon dioxide and ethanol. After doing two trials of each combination of food scraps a conclusion can be made that the apple cores produced the most ethanol since it had the overall highest rate of ethanol production.

***Diana Hagedorn***

**Comparing Behavior between Wildtype and Parkinson’s Disease Model Fruit Flies**

**With Respect to Sleep Deprivation**

Over one hundred years of innovative experimentation with the “common fruit fly” or Drosophila melanogaster, has earned this organism a place at the forefront of our modern day scientific research. Drosophila has emerged as a valuable model organism in the study of genetically linked Parkinson’s disease. Apparent to even the most novice of observers, is the fact that Parkinson’s patients exhibit symptoms that are related to locomotion, and motor control. Parkinson disease is the most common movement disorder and the second most common neurodegenerative disorder, affecting an estimated seven to ten million people worldwide. Although phenotypically, fruit flies seem to be completely unrelated to humans, certain cellular processes, genes, and signaling pathways, are actually similar between the two organisms. In addition, these flies are capable of performing advanced motor behaviors such as walking, climbing, and flying. Their brain and body movement is complex enough to make these behaviors applicable to humans. The purpose of this experiment is to observe differences in behavior among regular, healthy, wild type fruit flies, and fruit flies carrying Parkinson’s Disease when exposed to environmental stressors such as sleep deprivation. I will utilize a series of three different assays to carry out my experiments. If healthy wild type Drosophila, and Drosophila carrying Parkinson’s Disease are both exposed to a common stressor such as sleep deprivation, I hypothesize that the Parkinson’s carriers will display differing reactions, and form different behaviors compared to normal wild type flies. The implications of such results extend into the belief that genetic mutations in Drosophila will prove responsible for the varying behavior in these flies.

***Hugh Han***

**An Investigative Analysis of Climate Change Using Historical and Modern Weather Data**

The purpose of this study was to compare meteorological differences between the 1800s and 2000s using recorded historical and modern weather data from four different time periods, each approximately 60 years after the previous period. The average air temperature has been increasing at a significant rate in recent years due to global warming, caused by increasing atmospheric greenhouse gases. Historical data may be used to observe the significance of climate change in not only recent years, but years dating back to the early 1800s as well, to note if there is has been an acceleration of the rate of temperature change in recent years. Factors observed and compared between time periods included air temperatures and various aspects of precipitation. Historical weather data from 1826-1836 was obtained from a journal recorded at Erasmus Hall High School, in Brooklyn, NY, digitized, and compared to data recorded during 1894-1898, 1940-1948, and 2003-2012 from various weather stations in proximity of Erasmus Hall High School. Results showed that annual mean temperatures increased at a higher rate in later years and that the number of extreme days each year (defined as the days with temperatures ≥ 90ºF or temperatures ≤ 10ºF) increased over time. The number of days with precipitation each year has also increased; however, the amount of annual precipitation has remained constant.

***Daniel Hosseinian – See Jason Bak***

***Brian Huang, Thomas Vetere***

**The Effects of Coprophagic Microbiome Transfer in Isopods**

The purpose of this study is to observe the effects of microbiome transfer and alteration through coprophagia in isopod behavior, mass change, and response to antibiotics. A microbiome is the collection and collaborative living of all microbes existing in or on the surface of an organism. Coprophagia is the consumption of feces and is known to influence the internal microbiomes of organisms. Microbiomes have been shown to have considerable influence on animal behavior, weight, metabolism, and disease. In this study, isopod behavior was be analyzed before experimental testing was performed to establish a baseline of behavior. Experimental testing included the recording of the behavior of three different species of isopods after they had consumed the feces of another isopod species. In another experiment paper disks soaked with the antibiotic kanamycin were given to each isopod species to see if the antibiotic would affect isopod behavior. Data was recorded and analyzed using an ethogram assay and Chi-square Goodness of Fit Test. In addition, a Chi-square test of independence was used to determine if the coprophagic transplant and antibiotics had an effect on the isopods’ behavior. In general, the results showed that antibiotics have a significant influence on behavior due to the isopods’ lack of movement and lethargy after consuming antibiotics. Antibiotic did not affect the direction in which the isopods moved around the testing bowl. In addition, the results show the consumption of another species feces did not affect behavior of the isopod with respect to direction of movement and location.

***John Ioannou***

**Effect of Pickup position on the Frequency of an Electric Guitar**

Electric guitars use magnetic pickups that convert disturbances in the magnetic field caused by metal strings into a signal. This process is a phenomenon in electromagnetic science called induction. Faradays law states that when a magnet is wrapped in a coil wire and magnetic material is moved close to the coil, thus disturbing the magnetic field, a voltage or electromotive force (EMF) is produced. Guitar pickups are a direct application of Faraday’s law. If the pickup is moved from one point on a guitar to another the sound changes noticeably to the human ear. This is due to a change in the point at which the pickup is recording the magnetic disturbances of the strings. In the bridge position, the section of string above the pickup has a higher tension then the rest of the guitar. This results in smaller oscillations of the strings and a high-end tone when amplified. In the neck position, oscillations of the strings are much larger, causing a lower-end amplified tone. The focus of this research is to find to correlation between the oscillations of the strings and the voltage of the signal that is produced. Testing will be conducted using a Lab Pro system with voltage probes wired directly to the guitar. Analysis over a 20 second timeframe will be conducted for each pickup position. Statistical analysis of each pickup position using the Lab Pro program showed a direct correlation between the position and output of a pickup.

***Anthony Izzo, Adam Portnoy, Erick Vaysman***

**The Biomechanics of the Bess Bug *Odontotaenius disjunctus***

The purpose of this investigation was to observe how increasing mass pulled by the Bess Bug (*Odontotaenius disjunctus*) affects the biomechanics of their movement. Bess bugs are large (up to 3 cm) Coleopteran insects that live in logs and damp wooded areas in North America; they are fairly common and are used in many insect related studies. Bess bugs are an excellent organism in which to study biomechanics because they are large, slow moving and possess the ability to move a large mass in proportion to their body size. Research conducted with Bess bugs include observing the crawl patterns of the bug at various temperatures, and the observation of this insects exoskeleton and what makes it able to pull so much (Gunderson 1989). There have been many studies in the field of insect biomechanics but most of the work done has involved insect flight, not many studies have focused on insect walking. The objective of this study was to observe the insect’s movement while pulling various masses, and to apply what we learned to help engineering and robotics. We did this by having the Bess bug pull weights while it walks on a treadmill. The insects were video recorded while walking on the treadmill. We then recorded the angle of the back and front legs and the height of the head. It was hypothesized that if the Bess Bug carries greater mass then the way the insect uses its body to pull the mass will change compared to the control group of the insect not pulling extra mass. The data supports our hypothesis; the Bess bugs did have to adjust the angle of its front and back legs and the height of their head. The angle of the front legs increased as the more weight was added and the angle of the back legs decreased as more weight was added. The height of the bug’s head was higher off the ground when mass was added. This project relates to biomechanics because our entire study dealt with the motion of the appendages of Bess bug. In the future we hope to be able to us our analyzed data and apply it to the real world, creating an iron-man like exoskeleton.

***Anthony Jao – See Jonah Haber***

***Aryana Javaheri – See Emily Chen***

***Daniel Jung – See Jason Bak***

***Andrew Kim, Scott Massa, Ryan McCaffrey***

**Touch Screen Constituents and Folic Acid:**

**Their Effects on Autism Using *Caenorhabditis elegans* as a Model Organism**

Autism is a neurological disorder which impairs one’s communication and socialization skills. During the past decade, autism has increased dramatically and now affects one in eighty-eight children. Touch screen technology has also become widespread over the past decade. Current technology utilizes indium tin oxide (ITO) in the transparent conductive layer of touch screens. Studies show the body can absorb touch screen ITO and ingest it if hands are not washed prior to eating, and this can lead to health problems. Graphene, copper, and silver may replace ITO since they are cheaper and more abundant; though, they also pose health risks. The relationship between these four materials and autism development has not been tested. Studies also show that folic acid may be used as a preventive measure against autism. This study incorporated the materials and the model organism *Caenorhabditis elegans* to determine whether the materials may lead to autism and if folic acid may counteract the materials’ effects on autism. Since the *C. elegans* gene *NLG-1* is similar to an autism related gene in humans, the *NLG-1* expression was compared among samples, and lower expression indicated autism in *C. elegans*. It was hypothesized that for *C. elegans*, graphene and copper would be the safest materials, and the addition of folic acid would decrease autism rates as indicated by *NLG-1* expression. Results thus far are not conclusive but suggest that in *C. elegans*, indium tin oxide and graphene lead to autism while folic acid does not counteract autism.

***Ibrahim Khan, Lucas Marmorale***

**Reanimating Bdelloid Rotifers**

The purpose of this experiment was to test what conditions can make a bdelloid rotifer successfully go into and out of the tun state the fastest, and how various temperatures (-20°C, 25°C, 150°C,) and exposure to microwave radiation affect the rotifers while they are in the tun state. A bdelloid rotifer is a microscopic organism that is able to withstand desiccation by entering a state of suspended animation called the tun state. Unlike other anhydrobiotic organisms, rotifers go into the tun state without using trehalose, a disaccharide that is normally used to replace water during anhydrobiosis. It was hypothesized that they would survive in the 25°C and the -20°C conditions, and the rotifers would reanimate the fastest after exposure to the 25°C conditions. The rotifers were obtained by soaking lichens that were collected from oak trees, in water, then looking for them under a microscope. Then, the experiment was conducted by collecting rotifers, waiting for approximately two days while the 210µm of the water containing rotifers evaporated. Then they were exposed to different conditions for different amounts of time, and after they were exposed to these conditions, 210µm of water was placed where the desiccate rotifer was and the time it took for it to reanimate was recorded. The rotifers that went into and out of the tun state most successfully were the rotifers that were reanimated after being in the tun state for two days at room temperature (25° C). Also, the length of time under specific temperature and microwaves had an impact on the times that rotifers to reanimate. For example, the longer the rotifers were in the freezer, the longer it took to reanimate. Also, all the rotifers that were put in a microwave and the oven (150°C) did not reanimate within ten minutes. Since the rotifers were able to survive sub-zero temperatures and room temperature conditions, further investigation into their biochemical mechanism of their anhydrobiotic tun state would be a fruitful avenue of research.

***Gloria Kim, Laxshika Raveendran***

**The Effects of Melatonin on the Locomotion-Light Behavior of Brine Shrimp (*Artemia salina)***

The purpose of this study was to test the effects of melatonin on the locomotion-light response behavior of Brine Shrimp. Brine shrimp are aquatic crustaceans found worldwide in saltwater lakes. Studies have confirmed that melatonin, a hormone, also found in vertebrates, has been found in the head, eyes and brain of different invertebrate organisms such as crabs and some shrimp. This hormone, whose production and effect is influenced by the light, dark cycle, is generally responsible circadian rhythms for example: the natural sleep and wake cycle and female reproductive hormone production in humans. It has also been shown that melatonin also affects the locomotive activity and circadian behavior of crabs and shrimp. No studies have been done to test the effect of melatonin on brine shrimp. Brine shrimp are particularly good organisms to work with as they are easy to maintain in the laboratory and both the adult and egg stage are commonly used in toxicity testing. To test the locomotive response of the brine shrimp to light, shrimp were placed in a water column with a light at the top of the column. The time it took for the shrimp to swim to the source of light, was recorded. The results showed that either the melatonin exposed shrimp did not swim towards the light at all or that they took a significantly longer time to reach the light compared to the controls (no melatonin exposure). The results indicate that melatonin does have an effect on brine shrimp behavior.

***Angela Kubik, Briana Kubik***

**A Comparison of Pitcher Plant Fluid in Unopened and Opened Pitchers**

Enzymes in pitcher plants play an important role in the digestive process of the plant. The pitcher plant is an insectivorous plant that gains most of its nitrogenous nutrients from the insects in the surrounding environment. Many pitcher plants live in acidic soils that do not have, due to low pH, the nitrifying bacteria that are needed to convert N2 into usable nitrogen in the soil. This lack of soil nitrogen is the reason why pitcher plants require the ability to utilize nitrogen from insects. In order for a pitcher plant to digest its nutrients from an insect it must release enzymes into the pitcher. Scientists suggest, although not proven, that there could be two mechanisms involved in insect digestion. One being proteases produced within the pitcher plant (endogenous) and the other being proteases produced from bacteria. It was hypothesized that if a pitcher of a pitcher plant is closed it would have fewer bacteria than an open pitcher. The purpose of this study was to determine whether bacteria aids in the production of enzymes in a pitcher plant or if the plant digests endogenously. To determine this, three variables were tested in open and closed pitchers. The variables tested were enzyme activity, the quantity of enzymes, and the size of the enzymes. Results show that proteins existing in the open pitchers are found in the greatest concentration and enzyme activity compared to the closed pitcher.

***Briana Kubik – See Angela Kubik***

***Sara Kurten – See Allyson Britt***

***Sarah Lamorte***

**A New Approach to the Lacquer of Musical Instruments**

As brass musical instruments are becoming more valuable, musicians are looking for new ways to preserve the condition of their instruments in order to prolong their years of use. There is more of an emphasis on keeping an instrument clean and protecting it from the degradation that occurs when an instrument is played. From years of use and contact with sweat, a metal instrument can succumb to red rot, worn patches of lacquer where metal is exposed leading worn patched of exposed metal allowing the instrument to be more susceptible to dents and holes. The purpose of this study was to create a lacquer for musical instruments that is impenetrable by sweat, therefore protecting the lacquer and instrument from degradation and corrosion. To create a novel lacquer, polypropylene was dissolved into a lacquer before it contained a polymer base. Zinc samples were coated with this polypropylene based lacquer and was compared to pieces of zinc lacquered in the widely used cellulose based lacquer. Two sweats with different pHs were used: ISO with a pH of 4.7 and EU with a pH of 6.6. Each trial was conducted over a cycle of three weeks: two weeks of sweat application and one week of data collection. 1 ml of each type of sweat was applied to all the metals every day. The effects of sweat were tested by measure the contact angle of 1ml of water on each metal as well as by documenting the visual changes. The contact angle was measure by using a microscope on its side and Motic Image. Over the course of nine weeks, it was observed that the polypropylene based lacquer had less of a percent change in contact angle as well as leaf of a discoloration on the surface f the zinc. The polypropylene was more effective because when it copolymerized with the ethylene in the lacquer, it became stronger.

***Ryan Lee – See Marcelo Eisenberg***

***David Li, Mehtaab Sawhney***

**Impact of the Location of a Solar Cell in Relationship to the Focal Length**

**Of a Fresnel lens on Power Production**

The purpose of this project was to optimize the energy output of solar cells using a Fresnel lens. Due to the high cost and low efficiency of solar cells that convert light energy into electrical energy, ways of improving solar cell energy output are continually being explored. In the experiment, small solar cells were placed at the focal point of Fresnel lenses where all rays that shone into the lens perpendicular to the lens converge into a single point, thus concentrating the light. In addition, the experiment explored the impact on solar cell output at 8 different distances between the lens and solar, each distance being a multiple of the focal length, which was .4 of focal, .6f, .8f … etc., 1.8f. The experiment was done outdoors using 9 solar panels that were connected to an Arduino-based data logging circuit to log output at 2 minute intervals for 12 hours each day. One solar panel was used as the control group (no Fresnel lens). Using Ohm’s law (Voltage=Current×Resistance) and Power=Current×Voltage, the power that a load consumed was calculated. When the power data *vs.* time graphs were plotted, the energy output over the 12 hour period was calculated by finding the area under the power *vs.* time graph. The results showed that the Fresnel lens at .8f was the most optimal, increasing the energy production of the solar cells by an average of 15%, compared to the control group. It was also observed that different focal lengths performed the best at different parts of the day. Therefore, power output could be further increased by building a device that optimizes the distance between the lens and the panel at different times of the day. The results of this study indicate that integrating Fresnel lenses with solar cell use by optimizing lens-solar cell distance could enhance efficiency and therefore the practicality of the use of solar energy.

***Sam Luber***

**A Comparison of Stock Sectors and Individual Stocks to the Dow Jones Industrial Average,**

 **the NASDAQ, and the S&P 500 During an Election Year**

The purpose of this study is to determine whether or not individual stocks and sectors outperformed the Dow Jones Industrial Average, the NASDAQ, and the S&P 500 during an election year. The stock market was instituted on March 8, 1817, and has continued to grow in equity value. The New York Stock Exchange was estimated to have a market capitalization of 14.242 trillion US dollars in December 2011. The market has not always excelled throughout the years, events such as the Great Depression, and economic recessions have caused the market to depreciate in value. During a majority of election years, there has also been a flux in prices when compared to non election years. When a Democratic presidential candidate was elected president, smaller capitalization stocks outperformed the market, however, during 1937-1993, large corporations have benefited more when a Republican president was elected. Data will be collected from various websites and journals, indicating individual stock returns for each company on the Dow Jones from the past 40 years. It was hypothesized that certain stock sectors outperformed the three major indexes over ten US election years, because depending on which president was elected, certain sectors benefit more. It was also hypothesized that certain individual stocks, such as the banking stocks, have performed better when a Republican president was elected, because Republican presidents tend to decrease government regulation. After the data was collected and the percentages were analyzed, it was determined whether or not individual stock return percentages outperformed the Dow Jones Industrial Average, the NASDAQ, and the S&P 500 during an election year.

***Noah Marinaro – See Joseph Biondo***

***Lucas Marmorale – See Ibrahim Kham***

***Scott Massa – See Andrew Kim***

***Marissa Mathew, Rakia Syed***

**The Effect Age has on Body Image Coping Mechanisms**

Body image is often defined as "the subjective concept of one's physical appearance based on self-observation and the reactions of others" (Dictionary.com, n.d.). Body image can be classified as either positive or negative, with positive being a good, optimistic body acceptance, while negative is body dissatisfaction. Over the years, people’s perception of the “ideal body” has changed significantly as society and media evolved, so have people’s coping mechanisms. Body image coping mechanisms refers to the ways in which a person deals with body image issues. The purpose of this investigation was to assess the effects of age on coping mechanisms in relation to body image. Female participants, various teachers and students, were recruited from a suburban high school, and given a packet containing a letter, consent form and the surveys, recording only their ages on the surveys. The three measures used were the MBSRQ, BICSI, and the BIDQ. The MBSRQ assesses an individual’s investment in appearance through grooming behaviors and satisfaction. The BIDQ assesses body concerns. The BICSI assesses the cognitive and behavioral coping mechanisms. Contingency tables were made of the frequencies of the scores, while the ages were divided into groups, then a chi-squared test was conducted on the data. Many scales came out significant, only the MBSRQ subscales of FO, HO, and OWP were insignificant, thus concluding that younger females have more negative body images, and use more negative coping mechanisms than older participants. This investigation was beneficial because it allows people to understand the complexity body image and the differentiation in coping methods amongst different ages.

***Ryan McCaffrey – See Andrew Kim***

***Maeve McLoughlin***

**How Does the Shoulder Angle of a Horse Affect its Stride Length?**

The purpose of this study was to determine the relationship between the shoulder angle of a horse and its stride length. This information would be useful in predicting if a horse could be successful in jumping. It is also known that horses with a shoulder angle that deviates from 90° by more than 25° will develop shoulder lymphangitis and laminitis. Lymphangitis is the inflammation of the lymph vessels and laminitis is when the shoulders dislocate and becomes inflamed. These conditions result in the horse not being able to jump or even be ridden. To carry out this study three horse breeds were used, Irish Sport, Belgian Warmblood and Thoroughbred. For each horse the shoulder length and the distance between the shoulder to the top of the left leg was measured. The horses, with a rider, were video recorded walking, trotting and cantering. Still frames from each video were captured using Pinnacle Video Analyzer. Using Image J, each frame of the walking, trotting and cantering was analyzed by measuring the horses’ shoulder angle. Data collected in this project depicted what horse has the closest shoulder angle to 90°. The horse that had the closest to 90° was the Belgian Warmblood. This data can be applied to future research because the results gathered could be used to show veterinarians if a horse has either laminitis or lymphangitis. The table and graphs depict what the measurement of each horses shoulder angle was without laminitis or lymphangitis affecting the measurement. These measurements can be used as comparisons to horses without lymphangitis or laminitis.

***Kerri Neville – See Monica Cramer***

***Chimdi Obinero – See Ryan Chan***

***Andrea O’Brisky***

**The Effect of Different Bacterial Strains and Electrodes Used**

**On the Energy Derived from Microbial Fuel Cells**

The purpose of this project is to maximize the amount of energy harvested by a microbial fuel cell (MFC). A MFC uses bacteria to derive electricity through oxidation using organic matter. MFCS consist of two chambers, electrodes and a salt bridge to create a circuit. MFCs commonly use waste water which contains different bacterial strains. For this study, individual strains of bacteria were initially tested to contrast the voltage produced from each strain. Bacterial strains used in this project include *Lactococcus lactis, Clostridium acetobutylicum,* and *Bacillus cereus*. The most successful strains were combined and further testing was conducted to test what affect successful combined strains will have on the voltage produced. Different electrodes were also tested to see the effect of changing the amount of surface area will change the voltage number. It was hypothesized that when multiple successful bacterial strains and electrodes with high surface area are used, there will be higher voltage numbers shown in the data. Voltage levels were taken once every minute using a data logger. When tested, individual strains were more successful than combined strains. *Clostridium acetobutylicum* provided the highest voltage number at 165 millivolts and *Lactococcus lactis* lasted the longest before voltage was depleted after 89 hours when a carbon brush electrode was used with a surface area of 96.52 cm2. When *Clostridium acetobutylicum* was tested with a graphite electrode with a surface area of 111.71 cm2 the highest voltage number produced was 1.002 volt or 1002 millivolts which contrasted greatly to the highest point of 165 millivolts produced using the carbon brush electrode. Results indicate that the strain that produces the most amount of voltage is *Clostridium acetobutylicum* and higher surface areas of different electrodes have major impacts on the amount of energy derived from a microbial fuel cell.

***Chase Oliver – See Marcelo Eisenberg***

***Jin Ho Park – See Joshua Drelich***

***Caitlin Passaro – See Allyson Britt***

***Thomas Passaro***

**Small Fish in Big Ponds, Big Fish in Small Ponds**

Proposed by Robert K. Merton in 1968, The Matthew Effect states that prominent scientists receive more credit than newer scientists for the same research. There has been much discussion about the validity of the Matthew Effect especially due to the lack of empirical evidence to support it. However, there have been multiple non-empirical examples of when the Matthew Effect has occurred. For example, students who go to top colleges will have the top mentors for their doctoral programs. These students will move on to become successful scientists who gain the most fame, and subsequently most citations for their papers. Contrary to the Matthew Effect, there are some professors from top colleges who are rarely cited, and some professors from less prestigious universities have gained relatively substantial citation counts. There has been little research conducted on the scientists who supposedly “defy” the Matthew Effect, even though it could be instrumental to determining exactly how a scientist becomes academically successful. The purpose of this investigation was to determine if these seemingly counter intuitive citation counts occur and why. A citation count is the number of times an article was cited and used in this study as a measure of academic success and prestige. Higher citation counts imply more influential and scholarly work. I compared data among professors from colleges that rank as having one of the top ten doctoral programs in the country against professors who work at colleges ranked as having between the top 30 and 40 doctoral programs in the country. Findings suggested that there is a significant difference between the mean number of citations between the different colleges

***Adam Portnoy – See Anthony Izzo***

***Alinur Rahim, Eric Rizzo, John Voiklis***

**An Analysis of the Movement Patterns of Brook Trout (*Salvelinus fontinalis)* in**

**Beaver Brook, Oyster Bay, Long Island, New York**

The purpose of this experiment was to analyze the movement patterns of brook trout (*Salvelinus fontinalis*) relative to astronomical noon, and to determine the characteristics of their preferred habitat. The data was obtained from the Adopt-a-Trout Program on Long Island (www.adoptatrout.com). Radio and PIT tags were inserted into the fish’s body cavity. The data recorded for each fish spanned approximately 40 days for the radio tags; PIT-Tagged data is still being recorded. The coordinate location, water temperature, bottom color, bottom type and canopy type were noted twice per week for the Radio-Tag trout. Several common behavioral patterns were observed. Many of the fish formed clusters in small areas where the fish stayed for several days; other trout moved between multiple clusters. Most fish remained in areas of the brook, where the bottom type was primarily sand and gravel. This implies that a light bottom color is preferred. In the PIT-tag data from the LIRR antenna, an indirect relationship between the stream’s water level and the distance traveled by each trout was noted. Fewer trout were detected during daylight, except for in the late morning. The data from the June release showed that the trout stayed in the same general area during daylight. Data is still being collected and the information from this study can be used to improve brook trout habitat for increased survival in other areas of the region.

***Laxshika Raveendran – See Gloria Kim***

***Claire Regan***

**Alzheimer’s disease in *Caenorhabditis elegans***

Alzheimer’s disease (AD) is a neurodegenerative disorder that has been linked with a mutation of the APP gene in humans, which produces the beta-amyloid peptide which can cause the symptoms of Alzheimer’s Disease. The APP gene in humans is homologous to the APL-1 gene in *C. elegans.* The purpose of this investigation is to study the effectiveness of the chemicals Huperzine A and Ginkgo Biloba, which are herbal supplements marketed toward patients of AD, using *C. elegans* with mutated APL-1 genes. The worms being tested will each receive either Huperzine A, Ginkgo Biloba, or no additive to act as the control, and each chemical will be put on a plate of wild type *C. elegans* and on a plate of VC1246 (APL-1 mutated) *C. elegans*. The worms on these plates will be observed using a camera on a microscope to record the *C. elegans* and filmed in 10 seconds clips. I hypothesized that the worms receiving the herbal supplements will show improvement in locomotive condition. This hypothesis was somewhat correct. The N2 worms did show significant differences in locomotive ability in comparison to the VC1246. The additives did not affect the N2 worms and it did improve the locomotive ability of the VC1246 worms. However, the locomotive condition of VC1246 worms exposed to the additives was not improved so much that they acted like N2 worms. The results of this experiment can be used by sufferers of Alzheimer’s disease in choosing an herbal alternative to drug treatments for the disease.

***Eric Rizzo – See Alinor Rahim***

***Tracey Rosenlicht***

**The Effect of Colored Overlays on Computer Vision Syndrome (CVS)**

The increasing use of computer monitors, smartphones, and electronic book readers have altered the traditional way people observe the printed word. Small screens and fonts require positions at a closer viewing distance than had previously been adopted for hard copy printed materials, such as books and newspapers. Up to 90% of computer users experience the effects of Computer Vision Syndrome (CVS), which are visual symptoms including eyestrain, headaches, and dry eye (Bali 2007). The purpose of this project was to examine the effect of Irlen Spectral Filters on CVS. Irlen Spectral filters have been developed to fit over a computer screen to reduce the symptoms of CVS. To carry out this study fifteen volunteers were tested to see if the filters reduced symptoms of CVS, by reading aloud jumbled words from a LCD lit desktop screen, sitting 50 cm, to induce CVS, for ten minutes continuously while their voices were recorded. After this the participants repeated the readings two more times, once with a placebo, and one with the actual Irlen filter (color of choice). Volunteers chose either a green, magenta, yellow, or orange overlay. A questionnaire was distributed to the volunteers preceding every trial, to determine on a scale from 0-10 the severity of their symptoms relating to CVS. Irlen Spectral filters reduced the symptoms of CVS (at an average of 19.00%). Volunteers who were prescribed by a doctor to wear corrective lenses benefited by 40.00% from using the filters, and volunteers who were not prescribed by a doctor to wear corrective lenses benefited by 5.00% from using the filters.

***Mehtaab Sawhney – See David Li***

***Zack Shushan***

**A Comparison of Body Size in the Parasitic Wasp *Melittobia digitata***

**Between Asexually and Sexually Produced Males**

The purpose of this investigation was to see if the head, thorax and/or abdomen lengths of male *Melittobia digitata* are affected by the way the wasp was produced; sexually compared to asexually. Also known as “Wow bugs”, *Melittobia digitata* are parasitic wasps mainly found in south-eastern U.S. One interesting attribute is they can reproduce asexually and sexually. The type of asexual reproduction they use is called parthenogenesis, in which embryos develop without fertilization occurring. Other attributes include vestigial wings and harmless stingers. To study male *Melittobia digitata*, which are less commonly found compared to females, two different types of cultures were made. One culture type sexually produced wow bugs in which only 3% develop into males while the other asexually produced only males (<10). When laying eggs they lay them on a blowfly pupae host. The wow bugs life cycle ranges from 14-21 days therefore efficient reproduction is vital in cultures. Determining the lengths of these *Melittobia digitata* will be done by taking photos using a microscope camera, and then using a computer program to measure them. The objective of this investigation is to test whether the body lengths of male wow bugs differ based upon how they were produced. It is hypothesized that there will be a difference between asexually produced and sexually produced male wow bug body lengths. Understanding the reproduction biology of *Melittobia digitata,* especially males due to them being so uncommon, is essential for a better understanding of the biology of this unique species, *Melittobia digitata.*

***Zachary Silber***

**A Comparison of 2D and 3D Biometric Identification Modalities**

Biometrics are the identification of people based on their traits. Facial recognition is a subset of biometrics where pictures are captured and automatically classified by a computer. Facial recognition systems are used in high risk security applications so every advancement can help improve world security. This study was a comparison of the accuracy of facial recognition based on standard color images compared to the accuracy using range images, which show the distance from the camera for each pixel; both types of images were captured via Microsoft Kinect. Two tests were used to measure accuracy, a facial detection test, where a computer was programmed to predict whether a section of either a color or depth image was a face or not, and a facial recognition test, where the section was already known to be a face and the computer had to identify who it belonged to. The effectiveness of using principal component analysis, a process which transforms the data of the picture to isolate the most important parts, was reviewed. Principal component analysis improved the results of depth images, but it did not have a statistically significant effect on the accuracy of the color images. Accuracy increased when using depth data to detect faces from a picture; however, when it came to identifying those faces, color images provided far superior results. The study was able to show that there are merits to both standard and depth image capturing modalities and that combining them could provide results that outperform each modality individually.

***Hassam Syed – See Joshua Drelich***

***Rakia Syed – See Marissa Mathew***

***Daniel Tamer***

**The Effects of Caffeine on the Locomotive Ability of Parkinson's Disease Model *C. elegans***

This project was designed to determine the effects of caffeine on Parkinson’s Disease (PD) model *C. elegans.* PD is the second most common neurodegenerative disease in the world. A neurodegenerative disease is one that denatures neurons in the nervous system, hence debilitating motor skills and general movements. Caffeine has the potential to provide protection from PD and prevent the deterioration of neurons. To carry out this study PD model worms were exposed caffeine and their movements were compared to those PD worms that were not exposed to caffeine as well as wild normal type N2 worms. They were then video recorded under a microscope to record the rate of head turns as a measure of movement. It was hypothesized that the PD worms would have a lower rate of head turns compared to normal worms but those PD worms exposed to caffeine will have a similar rate of head turns to that of wild-type N2 worms. This would be the result of the shielding ability of caffeine. Results show there was a significant effect of caffeine on the PD model worms. The caffeine improved the motor ability of PD worms, supporting the hypothesis.

***Nakul Thampy***

**A Comparison of Antibiotic Resistance Between Standard Antibiotics and Home-based Antimicrobials**

Selection mutation is the process by which an organism carries a gene mutation for resistance to a substance, which is passed on to their offspring. In bacteria, this mutation is passed on through plasmid DNA. Bacteria have been growing resistant to common antibiotics such as Kanamycin, which was used in this experiment. Home remedies, such as cranberry juice or spices, are sometimes used to treat bacterial infections. Recent studies have shown that turmeric is an effective antimicrobial. In this study, antibiotic resistance was tested for by culturing bacteria on a petri dish and exposing them to an antibacterial substance on a paper disc. When the bacteria grew, there was a zone of inhibition present around the disc. The size of this zone indicated how powerful the antibacterial substance was at killing the bacteria, as well as how resistant the bacteria were to the substance. The resistance of bacteria to one substance, in this case Kanamycin, in comparison to another, turmeric was tested for by comparing zone sizes. Also, exposure of bacteria that are resistant to Kanamycin were exposed to turmeric. The zones of inhibition for this trial were crucial, as they indicate how effective turmeric is at killing bacteria that are resistant to Kanamycin. My results show that turmeric is almost as effective as Kanamycin on killing *E. coli* K-12. This suggests that turmeric can be used as a substitute for Kanamycin, but only at a mild level.

***Noah Tollin***

**Dispersal of Resistant Bacteria (*Escherichia coli* K-12) Among German cockroaches (*Blattella germanica*)**

The purpose of this study was to examine the spread of *Escherichia coli* K-12 among German Cockroaches. Cockroaches are known vectors for disease. They can carry diseases such as salmonella, and bacteria such as *Staphylococcus*, and *Streptococcus*. They can also carry antibiotic resistant bacteria from one location to another. Antibiotic resistant bacteria are a major health concern because the antibiotic resistant pathogenic bacteria cannot be controlled with known antibiotics. My objective is to explore if cockroaches can spread resistant bacteria. In this study, cockroaches were exposed to genetically modified *E. coli* that is resistant to the antibiotic Kanamycin and have the ß-Galactosidase gene. This allowed for the bacteria among the cockroaches to be traced when the feces of the cockroach were present on the nutrient agar plate that contains X-gal and kanamycin. Any feces containing the genetically modified *E. coli* on the agar will grow and appear blue. I hypothesized that if a cockroach is exposed to bacteria, then the bacteria will be spread from one cockroach to another through their bodies or via feces that they eat. The results found supported the hypothesis. The bacteria, found in the feces, remained in the cockroaches for approximately 6 days, and were able to spread from one cockroach to another.

***Jake Vallen***

**A Comparative Analysis of the Over-Expression of Genes using Serial Analysis of Gene Expression (SAGE)**

The purpose of this investigation was to compare the gene expression levels of normal skin cells to that of cancerous melanoma cells. Melanoma is the most common human cancer that are malignant neoplasms of the skin. The fact that melanoma has been one of the fastest rising malignancies in the last four decades, makes it imperative to study genes that may be over-expressed in skin tissue. If the gene is over-expressed the disease will advance. In this study I used the bioinformatics tool, SAGE Genie to compare and identify molecular-level differences such as genes expressed at significant rates between cancer genes and normal genes in areas of the skin. This allowed me to measure the level of gene expression based on the frequency of occurrence of the 3´ SAGE Tags. Two databases within the SAGE Genie are the SAGE Gene Expression Displayer and the SAGE Anatomical Viewer. I compared SAGE data from the SAGE Gene Expression Displayer and SAGE Anatomical viewer with the Digital Northern in malignant melanoma tissue. In addition, SAGE tag locations and gene expression frequencies were analyzed. Results exhibit that the higher the tag frequency, the greater chance the gene is over-expressed. Lastly, three locations on the human genome were found to be prominent in the cause of melanoma: the third chromosome, the 17th chromosome, and the fifth chromosome.

***John Voiklis – See Alinor Rahim***

***James Whittaker***

**The Study of the Byssal Threads from the Ribbed Mussel**

Mussels reside in relatively shallow water along coasts, and secrete an adhesive, that hardens into strong, silk like hairs called byssus which are used to secure the mussel to a solid surface. The purpose of this study was to determine the effectiveness of marine mussel byssus as a thread or securing agent. These strands of hair like threads are utilized by mussels to secure themselves to a solid surface in or near an aquatic environment. These structures could have practical applications as a binding material. Ribbed Mussel byssus may especially be useful in marine environments, where other thread types may break down. In this study, Ribbed Mussels (*Geukensia demissa*) were placed in a filtered, salt water tank. The mussels were removed from the tank for experimentation and their shells were forced open and the byssal threads were removed from them. The byssus was tested for strength using an apparatus that recorded the force that the byssus exerted as it was stretched to the point of failure. The mussel's byssus strength was compared with common household threads and binding agents, including rubber bands of a similar gauge and cotton thread. The test was conducted on both wet and dry samples. It was hypothesized that mussel byssus was expected to hold more force compared to the other threads under wet conditions**.**  10 trials that have been conducted for each material reveal that mussel byssus to be capable of handling forces comparable to or exceeding that of the man made material. However, when the weight of the byssus is factored in, the rubber bands and especially cotton thread exceed, gram for gram, the holding ability than that of the byssus.

***Chantel Yang – See Jianna Cressy***

***Erick Vaysman – See Anthony Izzo***

***Thomas Vetere – See Brian Huang***

***Joshua Zweig***

**Wireless Coordination of a Multi-Robot System Via Fuzzy Logic Control**

As robots play an increasingly important role in society, many applications emerge that require robots working together as a team. Maintaining wireless communication among the robots is imperative. In this research robots were given the goal of effective area coverage of an unknown environment. This is important because as the robots move through the environment they can also perform a task such as environmental cleaning, sampling, or testing. This is challenging in a real world environment as the signal strength of the communication levels between robots vary due to factors such as physical obstacles or large distances between the robots. There are two general methods to control a team of robots: centralized control and decentralized control. Decentralized control, implemented in this investigation, consists of robots that only communicate with their neighbors. The decentralized controllers onboard each robot utilized Fuzzy Logic. Fuzzy Logic is an approximate reasoning system that groups values into fuzzy sets based on signal strengths, to determine how a robot should behave. Furthermore, to ensure the success of the system, obstacle avoidance capabilities were incorporated into the controllers on each robot. The controller was coded in C++ and trials were run in the simulator MobileSim and on Pioneer 3Dx robots. For all trials, signal strengths among robots ended in the desired range, verifying the success of the implemented controller. Additionally, obstacles were successfully avoided. The results of this study are applicable to other systems of robots assigned various tasks, such those used in the cleanup of oil spills.

**Alumni Updates**

***Rebecca Alford, Class of 2012***

Work at Bonneau Lab, NYU and Langmead Lab, Carnegie Mellon University

Summer work in Bioinformatics at Johns Hopkins University

Chosen to speak at TED conference held at Carnegie Mellon University

***Matthew Katz, Class of 2011***

Researching Chemical Engineering and Nanotechnology

***Matthew Kim, Class of 2011***

Summer Internship with Facebook

Majoring in Computer Science

***Savina Kim, Class of 2012***

Summer Internship at National Institute of Health

Summer research at Yale University

***Rachel Lordahl, Class of 2010***

Semester spent in Spain

Summer work as a Clinician at Animal Medical Center in Manhattan

***Shalini Pammal. Class of 2009***

Completed senior thesis in the History & Science department at Harvard, *Examining Ayurvedic Revitalization Efforts in India, 1993-2010*

Conducted field work over the past two summers in India as a History of Medicine student

Produced preliminary manuscript for publication titled*, The Role of Physical Activity in Ancient Indian Medical Texts*

***Patryk Piascek, Class of 2012***

Work on research paper, *Thirty-Day In-Parallel Artificial Lung Testing in*

*Sheep, University of Michigan*

***Erica Portnoy, Class of 2011***

Summer Internship at Facebook

***Savitha Racha, Class of 2011***

Volunteer work at Massachusetts General Hospital

Working on MCAT preparation

***Arpon Raksit, Class of 2011***

Mathemetical Biology and theoretical Computer Science work at Harvard University

Summer work at Google as a Software Engineering Intern

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