All abstracts are arranged alphabetically by the first author’s last name.

Faculty authors/advisors are indicated by *.

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- We thank all of the students and their faculty mentors for participating in this event showcasing the on-going research in the School of Natural Sciences & Mathematics.

- We also thank David Dimmerman for his help and patience printing the posters for this event.
Author Index

A
Anderson, 28
Ayub
   Momina, 5
   Zahara, 5

B
Bader, 6
Baker, 20
Barbato, 16, 26
Barnes, 6
Barsoum, 17
Bayewu, 6
Benjamin
   Earl, 8, 9, 11, 12, 17, 18, 20, 22, 27
   Ellis, 8, 9, 11, 12, 17, 18, 20, 22, 27
Biernat, 5
Binetti, 7
Bland, 7
Bonnan, 6, 9
Boyd, 17
Brown-Korsah, 8
Burleigh, 8

C
Chaudhry, 8
Chirenje, 25
Cohn, 15
Coke, 20
Cromartie, 30
Crowley, 9

D
DeCarlo, 16
Distefano, 9
DiVentura, 25
Donaldson, 21
Donley, 25
Drake, 9

F
Fan, 27
Farrell, 26

G
Gallo, 10
Gamble, 6, 11
Gazzara, 22
Ghorashi, 23
Golato, 10
Grabias, 15
Grugaric, 29

H
Haggerty, 11
Hallock-Waters, 18
Hamer Luke, 5, 13, 14, 18
Hartman, 16
Hernandez, 10
Herrera, 19
Honick, 12
Hossay, 14
Hutchison, 10, 22

I
Isak, 12

K
Kang, 13
Keenan, 23
King, 14
Kiska, 14
Koester, 10
Kotwicki, 15, 21
L
Lacey, 24, 28
Lague, 23
Lam, 15
Landau, 24
Le, 9
Lee, 16
Lewis, 11, 23
Licknack, 16
Lippman, 7, 17
Livia, 22
Lutes, 17

M
Malatino, 17, 30
Manson, 14, 30
Maturana, 18
McVeigh, 16
Meagher, 18
Michels, 19
Mitchell, 18
Monaghan, 19

N
Newnom, 20
Nguyen, 18

O
O'Brien, 20
O'Hara, 20
Olsen, 13

P
Pacana, 11
Palmer, 21
Patel
   Chintan, 10
   Keval, 12
   Rishi, 16
   Pinkney, 8, 9
Pollock, 9, 18, 19, 21, 22
Prajapati, 29
Puzzio, 28

R
Rabinovich, 19
Revay, 22
Richard, 5, 12, 28
Rodrigues, 6
Rogerson, 20
Rokita, 16
Rosche, 15, 21, 26
Ruiz, 22

S
Sachanandani, 23
Savard, 21
Semler, 20
Servis, 23
Shulman, 6, 9, 17, 30
Simon, 24
Siner, 24
Springer, 25
Stinson, 25
Sullivan, 26, 27

T
Tarby, 27
Taylor, 27, 28
Theisen, 13
Tolosa, 7
Toth, 19
Townshend, 25
Trainor, 21
Tran, 28
Tripepi, 7
Trout, 17, 29

V
Valenti, 29
Varadharajan, 9
Vera, 29
W

Walton, 26
Wang, 9, 20
Widjaja, 17, 30

Y

Yeager, 30

York, 5, 25, 28

Z

Zwick, 25
1. DNA Sequencing and Analysis of New Jersey Coastal Corals

Zahara Ayub, Maryse Biernat, and Tara L. Harmer Luke*
Biology

Many organisms depend on corals for survival. Progressively, coral reefs have become severely damaged and have subsequently threatened the surrounding marine life they typically benefit. In order to maintain coral reefs by prevention or control of damaging agents, a broader understanding of coral populations must be obtained. This research aims to expand the understanding of corals by sequencing DNA and studying the phylogenetic relationships of coral samples derived from a shipwreck off the New Jersey coast. A region of the 18s rRNA of *Astrangia pociulata*, the Northern Star Coral was cloned and sequenced. Data analysis was performed through the use of MEGA 5.2 and sequence alignments were constructed and used for phylogenetic analysis. Neighbor joining with bootstrap analysis revealed that our coral sample is most closely related to *Oculina diffusa*. The data allows us to compare the evolutionary development of coral species, and observe the molecular and genetic effects that result from coral being damaged over time. By taking these changes into consideration, a comprehensive understanding of this issue can be used to implement preservation and conservation actions to maintain the integrity of coral reefs.

2. The Molecular Identification and Characterization of Aquifer Microbes

Momina Ayub and Karen York*
Biology

The Richard Stockton College of New Jersey houses one of the largest thermal energy storage, heat pump (geothermal) systems in the world to heat and cool its academic buildings. Use of the geothermal system increased the surrounding underground temperature from 14°C (in 1997) to 24°C (in 2005) due to an imbalance in thermal energy storage. Water samples from the aquifer were taken in 1997 and 2005 to determine the effects of the temperature increase on bacteria. Forty bacteria were isolated and identified from the samples by 16S ribosomal RNA gene sequence. This study focuses on three of the bacteria initially identified as related to the genus *Microbacterium*. The phylogenetic relationship between isolates Cu 56, Cu 59, and Cu 65 were further studied using the single copy protein encoding genes *lepA* and *rplB*. These genes were cloned and sequenced for each of the isolates. DNA sequence analysis included sequences generated from previous and current studies. The aquifer bacteria were also compared to closely-related known bacteria in the NCBI database. Analysis of the *lepA* and *rplB* genes and phylogenetic analysis show that there is not a 100% match in DNA sequence between Cu 56, Cu 59, and Cu 65 or between known bacteria in the database. Additional research on the nutrient requirements of aquifer isolates Cu 56 and Cu 65 using BiOLOG plates showed that while the bacteria have some common nutrient preferences, they are not identical to each other. Thus
the phylogenetic and nutrient requirements of the isolates indicate that the bacteria are unrelated to known species and are distinct from each other.

3. **Forelimb Posture During Walking of Leopard Geckos (Eublepharis macularius) using 3-D Optical Tracking: A Pilot Study on a Basal Terrestrial Lizard**

Cailin Bader, Corey Barnes, Celia Rodrigues, Jason Shulman*, and Matthew F. Bonnan*
Biology and Physics

Lizard locomotion is well studied, though few studies focus on lizard forelimbs. Our study examines the 3-dimensional forelimb movements in a basal lizard clade, of which we chose leopard geckos (*Eublepharis macularius*) as a representative species. Unlike most species of geckos, members of the genus *Eublepharis* lack setae, which are specialized scales on the bottom of their toes that allow surface adherence. Our hypothesis states that during forelimb locomotion, the elbow of theses geckos will remain significantly abducted. To quantify this, we assume that abduction angles of >45° are significant. To test our hypothesis, we observed three male leopard geckos during walking. We used the OptiTrack V120 Trio system to record each gecko’s movements and quantify the X, Y, and Z coordinates of reflective beads placed on each test subject. These coordinates were then exported to a Microsoft Excel spread sheet and analyzed by Matlab. Mokka software was used to make 3-D animations of the geckos during walking. Upon analyzing our results, we found that the elbow was less abducted than hypothesized for roughly 75% of the step cycle. Although we had to reject our initial hypothesis, our work does support previous trends of forelimb locomotion (e.g. Jenkins and Goslow 1983). Further data from *Eublepharis macularius* and other more derived terrestrial lizard species (*Varanus exanthematicus*) will be collected to infer if this trend will continue across lizard phylogeny.

4. **How upright is upright? Investigating forelimb posture during walking in Rattus norvegicus using 3-D optical tracking: A Pilot Study**

Caleb Bayewu, Kelsey Gamble, Jason Shulman*, and Matthew F. Bonnan
Biology and Physics

Currently, controversy surrounds the reconstruction of early mammalian locomotion because the best-preserved specimens are often flattened. Inferences about early eutherian mammals, based on forelimb bone morphology, suggest they had a parasagittal posture. Using *Rattus norvegicus* as an extant model for early mammals we examined the animal’s range of forelimb motion. Given the crouching appearance of rats, we hypothesized that *R. norvegicus* does not maintain a parasagittal forelimb posture during locomotion. The forelimb movements of two adult male rats bearing tracking markers were captured as they traversed a 1.5 meter trackway toward a darkened hide box. After the collected data were analyzed, it was found that *R. norvegicus* does not exhibit a sprawling posture; instead, it has a crouched but parasagittal posture throughout locomotion. Therefore, we reject our initial hypothesis that rats do not
maintain a parasagittal forelimb posture during locomotion. Given the morphological similarities between rat forelimbs and those of Mesozoic eutherian mammals, we suggest that they were not sprawling and exhibited similar forelimb locomotor patterns to *Rattus norvegicus*.

5. **An Extremophile at Stockton.**

Gianna Binetti, Andrew Lippman, and Manuela Tripepi*
Biology

*Halofexx volcanii* is a halophilic archaea that was isolated from the Dead Sea. This organism is able to live in areas of high salt concentration, ranging from 1.5 M to 3.5 M of NaCl. This is about nine times the salinity of seawater. The conditions in which *Halofexx volcanii* is able to grow are characterized by high salinity, high radiation and high heat, which resemble conditions found on planets such as Mars and Jupiter’s moon Europa. For this reason this organism has been used as a model for the possible existence of microbial life in extraterrestrial environments. As a model organism *Halofexx volcanii* has been extensively used for the understanding of Archaeal process. A motility mutant of *Halofexx volcanii* was previously created, using the genetic tools available for this archaea, and is available for our use. The flagella mutant is lacking two genes, *flgA1* and *flgA2* involved in the formation of the flagella structure, rendering the cell non-motile. A motility assay, using modified agar plates, is available used to check the phenotypic results of the flagella mutant. The purpose of this research is to test and develop an undergraduate level laboratory exercise for an introductory biology class involving an archaeal extremophile. Students will understand the correlation between gene and protein function. By using PCR analysis, targeting the flagellin gene *flgA1*, students will investigate first the genotype of an unknown strain of *Halofexx volcanii*. Subsequently using the motility assay they will test and correlate the presence or lack of the gene with the presence of motility.

6. **Using Variational Principles to Bridge Geodesics and Classical Mechanics**

Jared Bland and Juan Tolosa*
Mathematics & Applied Physics

The pendulum system may be described in terms of the Lagrangian related to the system. This Lagrangian is defined on a manifold (higher-dimensional surface) in the configuration space, which is determined from the constraints of the system. We have chosen two simple one-dimensional pendulums, connected them with an ideal spring, and are currently examining the motion of the system through time. The system is well-studied for small oscillations; however, with modern computational techniques, we may extend the solutions for any intial conditions. Additionally, we aim to show the equivalence of the Lagrangian representation with the representation of the system using geodesics (shortest paths) on tori. Currently, our work is
solving the Lagrangian systems computationally and finding appropriate manifolds and distance metrics to provide physical solutions.

7. Looking for the Needle in the Haystack

Jessica Brown-Korsah and David W. Burleigh*
Biology

Growth differentiation factor-15 (GDF-15) is a member of the transforming growth factor beta (TGF-β) superfamily. Depending on which tissue GDF-15 was “discovered” in by independent researchers, it was assigned alternative names. As such, GDF-15 is simultaneously known as macrophage inhibitory cytokine-1 (MIC-1), NSAID activated gene-1 (NAG-1), prostate derived factor (PDF), and placental transforming growth factor-β (PTGF-β). GDF-15 is highly expressed in organs such as the placenta, prostate, liver, and kidney. Expression of GDF-15 by diverse tissues suggests a possible basic physiological function. Although GDF-15 is highly expressed by many tissues, the receptor for this protein is currently unknown. The objective of this project is to produce the molecular tools needed to identify a potential receptor for the protein using a polyhistidine pull-down protein-protein interaction assay. DNA sequence data indicate that our bacteria cells transformed with rat GDF-15 may contain the gene product necessary for expressing the mature protein. The next part of this project will be to mix the poly-His GDF-15 protein (bait) with rat proteins (target) and pull-down the resulting protein-receptor complex with an anti-His antibody.

8. Computational Drug Design of Dopaminergic Receptors Inhibitors

Sadaf Chaudhry, Kadeisha Pinkney, Earl Benjamin*, and Ellis Benjamin*
Biochemistry and Molecular Biology

Neurological disorders like Parkinson’s disease (1 million), Huntington’s disease (30,000), schizophrenia (2.4 million), mood disorders (20.9 million), attention deficit hyperactivity disorder (ADHD) (4.1 percent of adults), and Tourette’s syndrome (48,000 children), affect millions of Americans every year. Dopamine (3,4-dihydroxyphenethylamine) is a hormone and neurotransmitter that is found in the brain, it is involved in several pathways, including that those that help regulate emotional responses, reward-motivated behavior, and movement. Molecules that modulate dopamine receptor activity are thus crucial to study the nervous system in general and neurological diseases, including the aforementioned disorders. In mammalian models, five subtypes of dopaminergic receptors have been discovered, which are labelled D1 through D5 and function as G protein-coupled receptors (GPCRs) via a second messenger system. Recently, computational methods have been developed to study binding interactions of preselected proteins and drugs. Using the program iGEMDOCKv2.1, which uses post-screening analysis to understand ligand mechanisms of a target protein, the drugs with the lowest binding energies were chosen as potential drugs for dopamine receptor-involved
disorders. This research sought to identify novel dopamine derivatives and structural motifs from a series selected FDA and novel compounds for improved binding efficacy.

9. **Computational Investigation of Antibacterial Agents on Bacterial Protein Targets**

Marley Crowley, Phuong Le, Jinchang Wang, Ellis Benjamin*, and Earl Benjamin*. Chemistry

Studies have long established that antibiotic agents have diverse effects on various strains of bacteria. Antibiotic agents that show high activity against one strain of bacteria may not be effective for others. To classify these agents scientist loosely base activity on the gram staining classifications. Antibiotic agents are classified into gram negative, gram positive or broad spectrum agents. The focus of this study is to examine the mechanism of action for various antibiotic agents. This goal was accomplished by binding various antibiotic agents to known antibiotic protein targets using I-GEM dock program. These results will allow for the development of models for these antibiotic agents mechanism of action.

10. **Kinetic Analysis of Mushroom Tyrosinase**

Chris Distefano and Elizabeth Pollock*
Biochemistry and Molecular Biology

Tyrosinase is the rate-limiting enzyme in the formation of the pigment melanin. This enzyme is present in the tissues of many plants, animals, and fungi. The enzyme has two distinct activities, the reduction of monophenols (cresolase activity) and the oxidation of diphenols (catecholase activity). Mushrooms contain many isoforms of tyrosinase that differ in enzymatic activity and tissue specificity. In this experiment, Portobello mushrooms (*Agaricus bisporus*) were divided into four regions and then partially purified using ammonium sulfate. The enzymatic activity of tyrosinase from each region was monitored by the conversion of 3,4-dihydroxyphenylalanine to dopachrome and the conversion of 1,2-dihydroxybenzene to 1,4-benzoquinone. The effectiveness of the purification process was determined by comparing proteins levels, observing the kinetic parameters before and after purification, and separation of macromolecules using electrophoresis. Finally, the impact of different inhibitors was observed.

11. **Using XROMM to test the mobility of the radius and ulna during locomotion in *Rattus norvegicus*: implications for fossil eutherians**

Evan Drake, Kadeisha Pinkney, Radha Varadharajan, Jason Shulman*, and Matthew F. Bonnan*
Biology and Physics

Due to ambiguity on the forelimb posture of early therian mammals, *Rattus norvegicus* acts as a model organism for the reconstruction of locomotor patterns. The scapula, humerus, and in particular, the antebrachium, of the rat was analyzed during the reconstruction because *R.*
norvegicus retains numerous primitive features within the forelimb. With studies conducted by Farish Jenkins (1971, 1974) and laboratory dissections, initial observations predicted the pronation of the hand to occur through the movement of the scapula, humerus and the antebrachium which moves as a single unit. With prior work by Jenkins, modern technology like X-ROMM (X-ray Reconstruction of Moving Morphology) and CT scans were utilized to further understand the relationship between the radius and ulna, and their contributions to the pronation and supination of the forelimb of the rat. XROMM consists of two C-arm fluoroscope cameras that emit X-rays in two lateral planes allowing for the capture of motion. These films were matched to 3-dimensional CT bone scans to create animated skeletal models. Upon reviewing reconstructed data, initial predictions were refuted for the radius and ulna moved independently in the recreated animations. Although the majority of pronation is predicted to occur from the origin of the scapula and humerus, the radius slightly crosses and pivots about the ulna; an observation that was unexpected during preliminary research.

12. The Identification and Genome Sequence of A Novel Betaproteobacteria Associated With Pathogenicity in Limulus Eggs

Carla Gallo, Tyler Golato, Mark Koester, Chintan Patel, Ron Hutchison*, and Daniel Hernandez*
Biology and Biochemistry and Molecular Biology

Limulus polyphemus, the Atlantic horseshoe crab, is a marine chelicerate arthropod that spawns in Delaware Bay each Spring. Members of the genus Limulus appear in the fossil record during the late Ordovician period, approximately 450 mya. The blood of horseshoe crabs is a vital and commonplace tool for medical research. Limulus Amebocyte Lysate (LAL) is an extract from horseshoe crab blood that reacts with bacterial endotoxins and is used for the quantification and detection of endotoxins, serving as an important assay in pharmaceutical quality control. Additionally, horseshoe crab eggs serve as a key dietary resource for shorebirds during the final leg of their North-bound migration. The threatened red knot, Calidris canutus, is particularly dependent on horseshoe crab eggs to reach critical departure weight. In the span of a few weeks knots must consume enough eggs to nearly double their mass before departing. Recently, a phenomenon has been observed in which horseshoe crab eggs turn red, coinciding with arrested development of embryos. In order to identify the pathogen responsible for this phenomenon, conventional DNA sequencing and Next-Generation Sequencing (NextGen) technology was utilized to analyze microbial diversity in both healthy and afflicted horseshoe crab eggs. Ribosomal RNA sequences are used to identify organisms. Both 16S/18S universal primers that amplify ribosomal RNA allowed for the identification of prokaryotic and eukaryotic microbial communities within the egg. The sequences obtained from healthy and afflicted eggs were compared using QIIME (Quantitative Insights Into Microbial Ecology). The microbial community within afflicted eggs was found to consist of about 25% betaproteobacteria. Healthy eggs did not contain these bacteria in significant numbers. A novel betaproteobacteria was isolated from afflicted eggs and a complete genome sequence of this organism is being determined and will be discussed further.
13. “Who are you?” Forensic Individualization of Unknown Human Skulls

Kelsey Gamble and Margaret Lewis*
Biology

Through a process known as individualization, metric and non-metric traits of the human skull can be used to determine the age, sex, and ancestry of an unknown individual. This study assessed osteological material recently donated to Stockton by Dr. Michael Hennessy with respect to these categories. Preliminary hypotheses in this study were formed from observations of the non-metric features of three skulls in this collection (MS001, MS002, and MS003). Age was estimated through non-metric observations of patterns of cranial suture closure. Specific craniometric points were used to take linear measurements of the skulls. Discriminant function analyses were then run on these measurements to determine sex and ancestry. MS002 was most likely a juvenile male between the ages of 12 and 15. Both the nonmetric characteristics and metric analyses indicate a European ancestry. MS001 belonged to an adult male approximately 20 to 34 years of age. Non-metric features of MS001 indicate European ancestry. Discriminant function analyses indicate African ancestry, however, interorbital indexes again indicate European ancestry. Specimen MS003 is made up of three disarticulated skull bones; the frontal, sphenoid, and left temporal. From the size and morphology of these bones, this was probably a very young child. Future analysis is needed to determine how young. Race is a social construct. There is no true biological basis for the separation of Homo sapiens into racial, ethnic, or ancestral groups. Uncertainty in resolving the ancestry of MS001 is a direct result of this lack of concordance. While it is possible that this individual is multiracial, it is more likely that the morphology of MS001 reflects the fact that variation within human groups is greater than variation between groups. This study is just the first step in a larger study of the donated skeletal material.


Amanda Haggerty, Joshua Pacana, Earl Benjamin*, and Ellis Benjamin*
Chemistry

The ability to sense decaying bodies is often left to the heightened sense of a cadaver dog’s nose. In times of emergencies and or dangerous situations the use of dog may not be a viable option for the identification of corpse. Our research used a series of gas sensors to identify the breakdown gases of pigsfeet in air (control), soil, and sand for use in these emergency situations. Three gas sensors (methane, propane, and ethanol) were placed in 5 large glass jar. These jars were labeled as the following [1] overall control (pigsfoot only), [2] sand control (no pigsfoot), [3] sand experimental (pigsfoot added), [4] soil control (no pigsfoot), and [5] soil experimental (pigsfoot added). Data was collected using a Propeller Activity Board over 1 hour interval for 400 hours. Results found that propane and ethanol were the leading identification component of the three gasses with a sigmoidal buildup in the experimental groups when
compared to control groups. These results indicated that gas sensors can be used as an alternative to a cadaver dog’s nose.

15. Electrochemical Deposition of Copper-Nickel Films on Indium Tin Oxide (ITO) Substrates

Brian Honick and Marc Richard*
Chemistry

Diamond impregnated tools are used in a variety of industrial cutting and machining applications. In order to understand the wear of diamond cutting tools, a theoretical model is being developed by Dr. Edward Paul, Emeritus Professor of Chemistry at Stockton. Along with Dr. Paul, Professor Chris Evans of University of North Carolina, Charlotte is developing methods to test the model. The goal of this project is to synthesize films of copper-nickel alloys to test the proposed model at UNC-Charlotte. Copper-nickel films of the desired compositions are not available commercially. Indium tin oxide (ITO) is a coating valued for its electrical conductivity and transparency and is used in a variety of applications ranging from aircraft windshields to LCD displays. ITO coated surfaces can also be used as electrodes for electrodeposition of metals. In this study, a zinc electrode (anode) and an ITO coated surface (cathode) were connected to a power supply and immersed in a solution of copper and nickel salts. The voltage, time of deposition, and resistivity of ITO substrate was varied to determine the optimal deposition parameters. Preliminary results indicate that the resistivity of the ITO substrate significantly impacts the quality of the deposited metal film. Future work will attempt to further assess the quality of the films through electron microscopy and composition analysis.

16. Computational Understanding of GluR2 Antagonist Inhibition for Improved Anticonvulsant Efficacy

Abraham Isak, Keval Patel, Earl Benjamin*, and Ellis Benjamin*
Biochemistry and Molecular Biology

Recent understanding of the detrimental effects of traumatic brain injury has been linked to a dramatic increase in glutamate receptor (GluR2) production and a decrease in the inhibitory GABAergic proteins of excitatory interneurons. The overproduction of GluR2 increases the likelihood of uncontrolled interneuronal excitation resulting in a seizure. Using computational docking methods, this research sought to elucidate structural motifs necessary for novel anticonvulsants production. Several computational programs including IGemDock, Pyrx, Autodock Vina, and Dragon, were used to determine the most effective structural motifs for anticonvulsants by docking energy and molecular descriptors.
17. Comparison of 18s rRNA sequences from two populations of the Northern Star Coral

Sara I Joyal¹, Sarah-Anne Rohlfing², and Tara L Harmer Luke*¹
Biology¹ and Environmental Science²

The purpose of this research was to characterize genetic variability in Astrangia poculata, the Northern Star coral. Genetic variability is important in the ability of organisms to adapt and evolve with environmental changes. This coral is different from tropical corals in that it is found in waters that are cooler than 20°C and also often deeper. The coral also do not always rely on zooxanthellae to gain nutrients, but use their tentacles to sweep surrounding waters to gather detritus and nutrients. The Northern Star coral forms on hard surfaces such as ship wrecks and other artificial reef structures. In this study, we are comparing coral colonies collected in 2011 from the Great Bay, NJ to those collected in 2013 at the site of the wreck of the John Marvin at 21 m depth off the coast of NJ. 10 to 30mg of tissue from multiple polyps of each colony was extracted. DNA was amplified by the polymerase chain reaction (PCR), cloned into a vector, and then sequenced. By observing the amount of genetic variation between locations, we can better understand the range of distribution and exchange of genetic information between populations of the Northern Star coral.

18. An Investigation into the Mechanical Properties of Microtubules

Elizabeth W. Kang, Kelly E. Theisen¹², Ruxandra I. Dima¹, and Robert Olsen*
Computational Science
¹ Department of Chemistry, University at Cincinnati
² Department of Cell Biology, Duke University School of Medicine

Microtubules (MTs) are cytoskeletal filaments that are essential to several important functions in eukaryotic cells - such as intracellular transport, mitosis, and structural support. Many of the proteins that work with microtubules, such as kinesins and katanins, bind to the C-terminal domain of an MT. Experimental removal of the C-terminal domain by enzymes such as subtilisin shows that without the C-terminal domain, proteins such as kinesins and katanins can still bind to an MT but cannot perform their intended functions. Because the binding of proteins to an MT exerts forces on the latter, it is crucial to understand how forces affect the mechanical properties of MTs. Previous computational simulations on bending intact MT protofilaments (PFs) by Theisen et al. were able to replicate experimental results though the use of coarse-graining. This project builds on prior research by analyzing how the removal of the C-terminal domain affects the PFs mechanical properties. Simulations show that the removal of a single C-terminal domain from a four-dimer PF affects the mechanical behavior and tension propagation within the PF. Most importantly, while previous work on intact PFs shows that they are able to contain a large amount of tension in the interdimer interface closest to the fixed end [3], simulations on PFs lacking the C-terminal domain suggest that the corresponding interdimer interfaces loses its ability to absorb much tension. Therefore, the tension travels to the
intradimer interface closest to the fixed point and breaks the dimer - a pathway not seen in experimental research.

19. *Streptobacillus moniliformis* Genome Annotation Project

R. Kimia Kheirkhah\textsuperscript{1,2} and Tara L. Harmer Luke*\textsuperscript{1}

Biochemistry and Molecular Biology\textsuperscript{1} and Computational Science\textsuperscript{2}

*Streptobacillus moniliformis* DSM12112 is a gram negative pathogenic bacteria that causes rat-bite fever, but the mechanism by which these bacteria cause this disease is currently unknown. In order to better understand the pathogenicity of this organism, the complete genome was sequenced and is currently being annotated by several undergraduate research groups across the United States, and each group is responsible for annotating a different region of the genome. Annotation of all of the transcriptional regulators in the *S. moniliformis* genome is the focus of our research group. Of the 26 transcriptional regulators in the genome, we have analyzed and partially annotated 21 of them. Using the Geni-Act platform, we have localized potential genes in the genome, related these genes to cellular functions and proteins that already exist by using different tools used for sequence analysis and the wide variety of databases available. So far this semester, we’ve cataloged basic information, performed sequence-based similarity analysis, and determined cellular localization using available computational tools.

20. CFD Analysis of Wake Vortex Evolution at Atlantic City International Airport

David Eric King, Jr., and Russell Manson*

MSCP (Computational Science Graduate Program)

Wake vortices are a major hazard concern that are generated by all aircraft during flight. In our simulation model, we will be using the Lamb-Oseen vortex model to generate the twin vortices which will then be placed inside our generated geometry of Atlantic City International Airport. We will utilize average expected weather conditions over Atlantic City International Airport, gathered from a computational weather model, as boundary conditions for our simulation and simulate the expected time evolution of wake vortices behind landing aircraft.

21. The Next Step for Wastewater Treatment: The feasibility of Advanced Treatment in Atlantic County

Ryan Kiska and Patrick Hossay*

Sustainability

The current trend and technology supports smaller, localized wastewater treatment plants with slower, more comprehensive treatment. The current regional wastewater infrastructure in Atlantic County is outdated and infrastructural changes are necessary to update it to advanced
treatment. An update from secondary treatment to advanced treatment would increase the removal from 85-90% to above 99% making the water reusable. Through an analysis using Geographic Information Systems, ideal locations for advanced treatment facilities were determined for Atlantic County based on population, elevation, and the proximity to industries that could reuse the effluent. The analysis indicated three ideal locations located among different centers of population. However, confounding factors such as economic constraints and social concerns will be major challenges to this infrastructural change. Ultimately, the implementation of advanced treatment would help address the increasingly imminent problem of water security in the future by using wastewater as a future water resource and is thus a rational next step.

22. Determination of the Minimum Inhibitor Concentration of Clove Oil in Gram-negative bacteria

Christopher A. Kotwicki and William A. Rosche*
Biology

Essential oils are used by holistic healers to treat bacterial infections, often only using sent to dose or blend oils. The minimum inhibitory concentration (MIC) was determined for several Gram-negative bacteria. While several different species were used, the MIC was 0.125% clove oil. Using this concentration, clove oil was found to be bacteriostatic. This assay was done in liquid media, and it will be interesting to see if the MIC remains constant in solid media.

23. Anion-Responsive Liquid Crystals

Liane Lam, Klaudia Grabias, and Pamela G. Cohn*
Chemistry

Previous efforts in the field of sensing have focused on developing materials that can respond to a stimulus (e.g. light or chemical) with a measurable output signal in the solid phase. One limitation of many of these materials is their limited solubility in water, which is the medium for the majority of anion-sensing applications. One strategy to address this issue is to incorporate the small molecules into a larger responsive assembly, which can respond to stimuli at the interface between water and a solid film. In order to employ this strategy, the present research focuses on studying the assembly of anion-responsive azo-benzenes in liquid crystalline phases. As a proof of concept, an azo-benzene with a long alkyl chain urea was synthesized and it was characterized thermally and spectroscopically, and it was shown to have liquid crystalline phases in DSC analysis. The molecules also change colors in response to different tetrabutylammonium halide salts in organic solutions. Future efforts will focus on characterizing the color changes of the azo-benzene materials in films in response to water-soluble anions.
24. The microRNA miR-100 Reduces mTOR-Dependent Protein Translation

Elisa Lee and Nathaniel Hartman*
Biology

Tuberous Sclerosis Complex (TSC) is a rare genetic disorder that affects 1 in 6000 live births. TSC is caused by hyperactivity of the mammalian target of rapamycin (mTOR) pathway, which is a convergence point for many cellular signals, including growth factors and metabolism. The mTOR pathway is a master regulator of protein translation in the cell. Recently, a few microRNAs (miRNAs), such as miR-100, have been found to target mTOR-related proteins, and alter the activity of the pathway. To investigate the possibility that miR-100 may reduce mTOR pathway activity and slow or reverse the progression of TSC, we overexpressed miR-100 in the Neuro-2A neuroblastoma cell line along with dual luciferase plasmids containing the 3’ UTR of the mTOR mRNA. We found that miR-100 directly binds to the 3’ UTR of the mTOR mRNA in order to suppress gene expression. In addition, using dual luciferase readout of mTOR-dependent protein translation, we found that miR-100 can modulate the activity of the mTOR pathway in Neuro-2A cells. These results suggest that miR-100 may be able to reduce mTOR hyperactivity in vivo and reduce phenotypes observed in TSC.

25. Comparative Embryonic Development in High or Low Stress Lines of Coturnix japonica

Tim Licknack, Ryan McVeigh, Andrea DeCarlo, Rishi Patel, Guy Barbato*, and John Rokita*
Biology

Last year, we discovered significant differences in hatch times of birds from two lines of Japanese quail selected for either high or low plasma corticosterone (in response to restraint stress) – where the high line hatched approximately 12 hours earlier than the low line. Three hundred and fifty eggs of each line were incubated at 99F and developing embryos removed from the incubator at 10, 12, 14, 16 and 18 days of incubation during their 18-day development period. Embryo weights and length of the femur and humerus were determined at each age. The High stress strain was found to have a faster growth rate than the Low strain, having an exponential rate of $y=0.10e^{0.23x}$. Low strain had an exponential rate of $y=0.07e^{0.24x}$. The femur of the Low strain developed at a higher exponential rate, $y=1.82e^{0.11x}$, than the High strain, which developed more slowly, $y=2.39e^{0.09x}$. However, the humerus of the High strains developed at a higher exponential rate, $y=3.81e^{0.04x}$, than the Low strains, where $y=2.38e^{0.07x}$. These data suggest an inverse relationship between hatch time and embryonic developmental rate. The model created from these data can be used in future experiments to determine both genetic and environmental effects on embryonic development.
26. In-Silico Analysis of Terpenoids found in the Atlantic White Cedar Tree

Andrew Lippman, Rae Jean Boyd, Marina Barsoum, Ellis Benjamin*, and Earl Benjamin*. Chemistry

Botanical antibiotic agents are playing an increasing role in our society. Terpenoids are a large and diverse class of naturally occurring organic chemicals similar to terpenes, derived from five-carbon isoprene units. These compounds have shown antibiotic activity versus certain bacterial species. The goal of this study is to use computational methods to examine the binding efficiencies of Terpenoids with essential bacterial proteins. Compounds such as Pinene, Terepinene, Limonene, Eucalyptol were computationally bound to various bacterial proteins including the 50 s and 30 s subunits of the ribosome to identify which terpionid shows the best binding efficiency.

27. Numerical Model Simulation of the Atmosphere above the Atlantic City Airport

Tiffany Lutes and Joseph Trout*
Computational Science and Physics

In this research project, the Weather Research & Forecasting (WRF) model from the National Center for Atmospheric Research (NCAR) is used to investigate past and present weather conditions. The Atlantic City Airport area in southern New Jersey is the area of interest. Long-term hourly data is analyzed and model simulations are created. By inputting high-resolution surface data, a more accurate picture of the effects of different weather conditions will be portrayed. Currently, the impact of gridded model runs is being tested, and the impact of surface characteristics is being investigated.

28. Novel Approach to Circuit Equations

Frank Malatino, Matthew Widjaja, and Jason Shulman*
Physics

For complex circuits, implementation of Kirchoff’s Laws can become tedious and time consuming. Here, we present an alternative procedure, which is based on an methodology designed to control complex networks. It is an experimental, rather than analytical, approach to analyzing circuits. It generates equations that describe the behavior of a circuit. These are the same equations that would be obtained through more traditional means.
29. Metabolic Profiling: Radish Experiment

Joanne Maturana and Elizabeth Pollock*
Chemistry

The purpose of the experiment was to determine the impact of ionic liquids on seedling development. The radish plants were grown between 4-7 days in the presence or absence of 1-butyl-3-methylimidazolium bromide on agar. After 4 or 7 days the metabolites of the radishes were extracted using 2:1 ratios of methanol/water and NMR spectra was collected. The PCA analysis of the NMR data showed there was a significant difference between the 4 day and 7 day controls, as well as the radishes grown in ionic liquid. Based on the PCA analysis and previous experiments with similar chemical shifts, some of the compounds that appear to be most relevant in distinguishing these groups are threonine, alanine, glutamic acid, GABA, fumaric acid, beta glucose, malic acid, and choline.

30. Determination of Possible Antimicrobial Agents of the Atlantic White Cedar Tree

Melissa Meagher, Tram Nguyen, Kristen Hallock-Waters, Ellis Benjamin*, and Earl Benjamin*. Chemistry

Research has suggested that essential oils of various plant species possess molecular component that have antibacterial and antioxidant properties. Primary among these molecular components is terpenoids which are currently being used as medication for fevers and malaria. The goal of this investigation was to identify the components of and antibacterial properties for essential oils extracted from the Atlantic White Cedar Tree (Chamaecyparis thyoides). This research sought to determine if the Atlantic White Cedar Tree possessed antibiotic properties similar to other conifer plants. Analyses for the antibacterial activity were conducted using Escherichia coli and Bacillus subtilis via a disc diffusion method. Additional studies compared the effect of terpoinods found in the Atlantic White Cedar Tree versus established antibacterial agents. The results suggest that molecular components of the Atlantic White Cedar Tree did show some antibacterial activity.

31. Analysis of the Effects of External Electrochemical Charge on the Astrangia ploculata Transcriptome

Sage A. Mitchell and Tara L. Harmer Luke*
Marine Science and Biology

Coral reef health is a notable environmental indicator, as reefs are known to be vital elements in ecosystems around the globe. Despite this, global warming and climate change have destroyed or threatened a majority of reefs worldwide. Global ocean temperatures and acidity rise yearly, further threatening these ecosystems. Determining ideal conditions that would permit growth, or regrowth, of these corals would be extremely beneficial to many ecosystems,
and could lead to global initiatives to restore coastal and deep-water reefs. It has been predicted that the incorporation of electrical charge to a coral colony would boost metabolic processes and ultimately accelerate the rate at which coral exoskeletons form and reefs are built. The purpose of this research is to examine the impact of electrochemical charge on the growth and survival of *Astrangia pociulata*, the Northern Star Coral. We will introduce a mild electrical charge to a coral sample and measure coral gene expression patterns. Charge will be generated by creating an electrochemical cell made from small samples of zinc and copper. Gene expression patterns of the Northern Star coral will be measured using Next Generation Sequencing techniques to examine transcriptomes of both the untreated and treated samples. We expect to see a difference in gene expression between control groups and those experimental groups exposed to the charge, and we hypothesize that those polyps exposed to the influence of a small voltage created by the cell will be induced to grow more quickly, as manifested in an increase in expression of genes associated with growth. These data will provide insight into a possible method to enhance artificial reef restoration. This research serves as a follow-up to our study presented in April 2013. After constructing phylogentic trees using the gene products of Nad4L and MSH1, in a range of different cnidarian species, we extracted genomic DNA from *Astrangia pociulata*. These samples were PCR amplified to examine the quality of the DNA and kept for use in sequencing. In addition, preliminary culture conditions have been determined in the laboratory setting. These results have caused us to fine-tune our growth conditions in preparation for the main experimental phase of our study.

32. Synthesis and Reactivity of a New Pyridine/Thione Ligand

Ashley N. Michels, Logan P. Herrera, Daniel Rabinovich*, and Elizabeth Pollock*

Biochemistry

Pyridines and heterocyclic thiones are among the most common nitrogen- and sulfur-donor ligands but the coordination chemistry of simple bidentate ligands containing both functional groups remains largely unexplored. The synthesis and reactivity of a new pyridine/thione mixed-donor ligand is described in this report. More specifically, an n-butyl-substituted (mercaptomimidazolyl)picoline and its group 12 metal complexes (mpicnBu)MX2 (M = Zn, Cd, Hg; X = Cl, Br, I) have been prepared and fully characterized.

33. Sighting patterns of bottlenose dolphins (*Tursiops truncatus*) in Cape May, New Jersey

Danielle Monaghan, Jacalyn L. Toth*, and Jeffrey Stewart¹

Biology and ¹The Cape May Whale Watcher, Cape May, NJ

Large numbers of bottlenose dolphins (*Tursiops truncatus*) annually occur off of Cape May, NJ, during the months of May through September. Previous research in more northern areas of New Jersey suggests that these animals do show at least some seasonal site fidelity. We conducted 15 surveys aboard the Cape May Whale Watcher from May 2013 through August 2013 in order to determine dolphin sighting patterns in the undocumented Cape May area.
During 15 surveys, dolphin groups were sighted 41 times. A total of 1,997 photos were taken, and 235 individuals were individually identified. Of those identified, 31 were re-sighted a second time, and 204 were seen only once. This low re-sight level indicates a larger population than what was identified in this preliminary study. Several individuals were initially sighted traveling together in the same group, and subsequently re-sighted together at a later date. This provides preliminary insight into a social structure that may exist. Presence of the barnacle *Xenobalanus glaciensis* on dorsal fins and bottlenose dolphin group size remained consistent, while presence of neonates and young of the year varied considerably throughout the study. This study provides baseline information on a previously undocumented seasonal population of bottlenose dolphins.

34. Examination of Antibiotics on *B. subtilis* and *E. coli* Protein Targets

Michael J. Newnom, Lamarque Coke, Anna Baker, Jinchang Wang, Ellis Benjamin*, and Earl Benjamin*.

Chemistry

Antibiotic resistance is a problem that has far reaching implications. When antibiotic resistance is coupled to pathogenic conditions, patient out is severely diminished. Antibiotic resistance has been found in bacteria including but not limited to *E. coli, P. aeruginosa, S. aureus, V. cholera, K. oxytoca, C. koseri, P. stuartii, and M. morganii*. In order to better understand antibiotic resistance several established antibiotic agents (Chloromycetin, Erythromycin, Penicillin, Streptomycin, Tetracycline, Chloromycetin, Furadantin, Kanamycin, Nalidixic Acid, and Triple Sulfa) are being combined and tested to via the disc diffusion method using *E. coli* and *B. subtilis* to determine the combined effects of each antibiotic agent. The results showed varied disinfection responses for the antibiotic combinations. These results will allow for the development of models for these antibiotic agents mechanism of action.

35. Zebrafish (*Danio rerio*) as a model for studying adaptive immunity

John O’Hara, Ashley O’Brien, Keith Semler and Brian Rogerson*

Biochemistry and Molecular Biology

The B-cell immune response is characterized by the affinity maturation of antibody molecules, a redesign process which results in improved antibody binding to antigen. Studying how this process is affected by aging is of great interest because less robust and poorly protective responses to vaccines are observed in aged individuals. Activation-Induced Cytidine Deaminase (AICD) is the enzyme responsible for introducing mutations in the antigen binding sites of antibody genes. Since the immune systems of zebrafish and humans show remarkable similarities, AICD gene expression in zebrafish was analyzed and quantified. Total RNA was isolated from the ventral region (gut) tissue of adult zebrafish, where AICD and IgZ antibody expression are highest, using a Trizol extraction followed by isopropanol precipitation. Following DNase I treatment, the integrity of the purified RNA was evaluated by
Levels of zebrafish AICD mRNA were then quantified by RT-qPCR using specific primers and a fluorescent oligonucleotide probe. Between 5 and 13 months of age we observed no decline in AICD levels. What remains is the analysis of 22 month-old zebrafish. We will then clone and sequence antibody genes to characterize any changes in the frequency of somatic mutation as zebrafish age.

36. Use of biphasic cultures increases plasmid yield from *Escherichia coli*

Phillip R. Palmer, Christopher A. Kotwicki, Corey R. Savard, Brandon M. Trainor, and William A. Rosche*

Biology

Plasmids are extrachromosomal circles of DNA in prokaryotes. Plasmid DNA is commonly used in recombinant DNA experiments as cloning vectors. Isolating plasmid DNA is a common laboratory technique and several methods have been used to try to increase the yield of plasmid DNA per extraction. Most of these methods have used growth media that increases the number of cells per milliliter of culture. We have employed a biphasic media that uses readily available and cost effective materials to increase the yield of plasmid DNA. Our method not only increases the number of cells per milliliter of culture, but also amplifies the DNA inside the cells. This method is a cheaper and more efficient method for plasmid DNA isolation.

37. Analysis of the metabolic adaptation due to cold shock in the algae *Chlamydomonas reinhardtii* via Nuclear Magnetic Resonance

Elizabeth Pollock*, Ashleigh Donaldson

Biochemistry and Molecular Biology

This experiment provides insight into stress adaptation in the organism *Chlamydomonas reinhardtii* using NMR-based metabolic profiling. This organism is a single celled green alga that is adapted for growth in warm, fresh waters and soil. The experiment conducted studied changes in the metabolic profile of this alga when subjected to cold shock for various time intervals. This allowed for insight into whether or not the metabolic processes of this organism are affected by a colder growing environment, and if so, how these processes are affected. This research may have significance in developing crop resistance, as the organism is related to *Chlamydomonas altera* – an alga that is found in frozen lakes in upper North America and that has been studied for developing cold resistance crops. CC125 was grown at 20°C to early log phase. Cultures were moved to 10°C to monitor adaptation over the course of 24 hours. Polar metabolites were extracted and the resulting mixtures analyzed by NMR. Preliminary results suggest that there are real differences in the metabolic profiles of cold-stressed algae compared to cells experiencing no temperature changes during growth.
38. Non-polar extraction of E.coli through nuclear resonance spectroscopy

Elizabeth Pollock*, Frank Livia, and Robert Gazzara
Biology

In order to fully understand the effects of natural food substances as antimicrobial agents, both polar and non-polar metabolites must be understood. A previous study conducted by this group showed that the composition of polar metabolites changed when bacteria were grown in the presence of essential oils. However, it is likely that essential oils have their greatest impact on lipid-soluble compounds. The overall goal of this study was to develop an effective method to extract such non-polar compounds. E. coli was grown in LB in the presence and absence of triton-X, which will serve as an emulsifier when oils are used. NMR analysis of different extraction methods showed that a chloroform extraction was most effective and reproducible. Further research must be done to confirm these results and refine the method. Once confirmed, the impact of essential oils on growth and metabolic processes can be assessed.

39. Raccoon (*Procyon lotor*) Disease Control Through Vaccination Systems in Wildlife Rehabilitation Centers

Rebecca Revay and Ron Hutchison*
Biology

Controlling disease in a wildlife rehabilitation facility is difficult because of the close quarters all the wildlife is kept in. Most workers in these types of facilities are one term summer interns and once weekly volunteers so training must be quick in order to get anything done. An organized system for raccoon vaccination that is easy to follow could help a wildlife rehabilitation center in keeping disease among raccoons in check while allowing almost anyone being able to follow it in a short amount of time. Here I created a system of keeping track of all the raccoons in a wildlife center and their vaccinations. Then I compared the release rates of raccoons of the years the system was in place to the years previous that had to system in place. The results showed that there was a higher release rate of raccoons in the years with the vaccination system in place.

40. Using Computational Techniques to block TACE promoted inflammation for the limitation of Alzheimers Disease

Ryan Ruiz, Earl Benjamin*, and Ellis Benjamin*
Chemistry

Alzheimers disease, a leading cause of dementia and death is caused by plaque formation of abnormally folded beta amyloid and tau amyloid proteins in the brain that affects over 5.2 million Americans. Currently there are few treatments for the progression or blockade of Alzheimers disease. Systemic inflammation has been found to increase the progression of
Alzheimers disease. Tumor Necrosis Factor α Converting Enzyme (TACE or ADAM17) is an enzyme which converts membrane bound TNFα to a membrane free form allowing for wider inflammation interaction. Limitation of TACE by the blockade of it kinase can limit inhibition thereby limiting Alzheimers disease progression. Crystal structures of the kinase moiety of the TACE protein were docked using IGEMDock to FDA approved pharmaceupticals, Alkaloids, Lactams, Lactones, Flavinoids, Sulfanilamide, Cyclic Imides, and NSAIDs drugs to determine structural correlation for the most effective binders. Structural similarities were determined with IGEMDock and partition coefficient was determined using DRAGON program. This data found a cluster of drugs to preferentially bind to the TACE kinase for use as targeted anti-inflammatory treatments. This work will be used in the engineering of improved TACE kinase inhibitors.

41. The Comparative Analysis of BCAA Content in Whey, Protein Supplements and Fresh Milks

Kunal Sachanandani, Atossa Ghorashi, and Kelly Keenan*
Biochemistry and Molecular Biology

The purpose of the experiment was to measure the level of branched chain amino acids (BCAAs) in various types of supplements and milks that are made out of whey protein. The method involved the use of an enzyme assay using the enzyme leucine dehydrogenase, which functions to alter BCAAs and produces NADH. The level of BCAAs in the samples were much smaller than what was reported on the nutritional labels provided by the manufacturers. The samples were also tested for all protein using the Lowry assay and the values conformed with the nutritional labels. The samples were then hydrolyzed to augment the release of the BCAAs and both SDS-PAGE and protein analysis indicated that hydrolysis was complete. Even though the hydrolysis yielded an increase in the BCAA content in the samples, it was not nearly as high as what was being reported on the nutritional labels. Further studies will be done to confirm this conclusion.

42. Fossil Proximal Femora Evolution in Striding Bipedalism

Andrew Servis, Margaret Lewis*, and Michael Lague*
Biology

One of the most recognized and important advances in hominid evolution is the adaptation of striding bipedalism. This adaptation allowed for hominins to abandon their arboreal lifestyles and commence a broad dispersal throughout the biome. If early hominids were primarily bipedal as opposed to quadrupedal, their femoral morphology would have to differ from that of apes. Their femora would also differ from Homo sapiens because at this point they would not have evolved the efficient biomechanics that are seen today. Therefore, it was hypothesized that early hominin fossils would fall somewhere between these two clades. Since many fossils are damaged or fragmentary, only proximal femora were included. Data consisted of eight sets
of coordinates landmarks along the proximal femora. Many of these measurements were taken from the femoral head and neck; therefore any femora with damaged heads or necks were not used. Femoral scans from six different species of apes were used: G. g. gorilla, G. g. graueri, Pan paniscus, Pan troglodytes troglodytes, Hyllobates lar, and P. p. pygmaeus. Scans from Homo sapiens, and fossil scans of different hominin species from both eastern and southern Africa were also used. Measurements were divided by the geometric means to adjust for size. The resulting shape data were then compared using multivariate analyses. Structural similarities can be seen between many different early hominin femora. Though they share some similarities of both apes and humans they are clearly distinct. Though these early hominins have achieved bipedalism they are most likely not as efficient as Homo sapiens because they still retain some ape like features. Though this does not offer a complete look at the functionality of bipedalism, it is a good starting point. In order to gain a more in depth understanding, an examination of the hip joint and the lower leg would be essential.

43. Categorizing Florida Coral Reefs Using Fish Assemblages

Natalie Simon and Matthew Landau*
Marine Science

Reef fish assemblage is important in understanding fishery management. Fish survey data collected by the Reef Environmental Education Foundation was used with the following restrictions: (1) analysis limited to 26 reefs along the Florida Keys with a large number of “expert surveys”, and (2) only “moderately common” fish species considered. Using several cluster analysis techniques, dendrograms were constructed; Ward’s method, which is distinct from other methods because it uses an analysis of variance, gave the most distinct separation. Clusters were tested using discriminant analysis to “back-predict” a reef’s cluster, using latitude, distance of a reef to the nearest neighbor reef, and shortest distance of a reef to one of the island chain Keys (an approximate index of depth). One significant factor was found; using that factor, 73% of the reefs would have been correctly classified if unknown. Additional physical characteristics might be used in the future to get even clearer partitioning.

44. Echinoid population impact on benthic cover on a Caribbean coral reef in Bocas del Toro, Panama

Peter Siner and Elizabeth Lacey*
Marine Science

Herbivory on coral reefs by sea urchins is commonly the driver to change in benthic cover yet it is unknown if sea urchin populations today persist in high enough densities to reduce detrimental macroalgal cover. This research observed the relationship of sea urchins, Diadema antillarum, Echinometra virides, Echinometra lucunter, to benthic cover in Isla de Colon in the Boca del Toro district of Panama. Through our observations we expected to see low macroalgal cover and high coral and crustose coralline algae (CCA) cover as denser sea urchin populations
removed algae to provide space for coral and CCA recruitment. Densities of sea urchins and percent cover of all benthic substrates were recorded in 40-m² quadrats in two sites. Data showed that densities of *E. virides* were highest among sea urchins and there were relatively little to no *D. antillarum* and *E. lucunter* sea urchins present at the observed sites. Benthic cover was highly variable with the majority of the benthos covered by bare rock (47% ± 24%), followed by macroalgae (18% ± 12%) and coral (15% ± 12%). Overall densities of all observed sea urchins strongly correlated to algal (rₛ = 0.45, p < 0.01), CCA (rₛ = 0.32, p < 0.01) and coral cover (rₛ = 0.56, p < 0.01). These results suggest that while the presence of sea urchins may increase CCA and coral cover, the populations of larger grazing sea urchins may not have reached high enough densities to impact macroalgae growth. While abundant benthic substrate may be available for coral growth, overgrazing by sea urchins or the Allee effect may be preventing coral recruitment.

45. **Preparation for Research: Teaching Biology Majors to Read, Cite, and Paraphrase Scientific Literature**

Melanie Springer, Daniella DiVentura, Karen York*, and Melissa Zwick*

Biology

The ability to properly research and cite scientific papers is a vital and valuable skill all students need to master. Unintentional plagiarism often occurs due to lack of formal instruction on proper paraphrasing technique and citation style and rules. Students are often left to develop these skills on their own. Preparation for research (PFR) is a 1 credit course designed to teach biology majors and minors how to read, cite and paraphrase scientific literature. Students enrolled in PFR during the spring 2014 semester were administered surveys during the first week of classes. Survey questions measured student confidence levels toward their ability to paraphrase and cite source text correctly and interpret scientific literature (indirect assessment). Student ability to identify key components of scientific literature as well as determine whether or not paraphrased text was plagiarized was also measured (direct assessment). Pre-survey data will investigate relationships between student confidence and ability prior to taking the course. Insights gleaned from this study will aid instructors in future adjustments to the course.

46. **Distribution of arsenic and lead in surficial waters: a possible link to hydrocarbon exploration and extraction, Middle Susquehanna River Sub-basin, Pennsylvania**

Robert J. Stinson, Ian Townshend, Tara L. Donley, and Tait Chirenje*

Several environmental and human health concerns have emerged in the past few years due to the recent boom of hydrocarbon exploration and the new hydraulic fracturing methods involved. Though, many different concerns exist, groundwater contamination has continually been the focal point of water issues relating to hydraulic fracturing. Surficial water has a fast residence time in the hydrologic cycle and does not directly impact humans as much as
groundwater. Therefore, it tends to be overlooked. Effluence in surficial water can be acquired via direct runoff, which can originate from different phases of the hydraulic fracturing process; specifically, the handling and disposal of all fluids. This project is the beginning stage in helping to determine if hydraulic fracturing is influencing the local watershed due to an increase in dissolved element concentrations. For a chance to better understand the interaction between surface water and hydraulic fracturing, water and sediment samples were collected from waterways bounded by gas pads found in Bradford and Wyoming Counties, PA, to measure the concentrations of potential pollutants. Concentrations of lead and arsenic were measured by means of a graphite furnace atomic absorption spectrophotometer. Results of the water samples showed that concentrations were of undetectable amounts, < 2.00 ppb for lead and < 5.00 ppb for arsenic. Results of the sediment samples showed no abnormal concentrations for both elements, overall. However, sample locations C-4, C-19, SR-3 and SR-6 show spikes in the dataset when concentrations are graphed and compared to each other. Total average concentrations were, 168 ppb of lead and 117 ppb of arsenic. Further investigation and modeling will be attempted to develop a larger database of element concentrations to recognize the following: how pollutants are deposited and transported, watershed quality and impacts, if the pollutants found are at levels that can endanger human health, and, most importantly, whether hydraulic fracturing can be labeled as a point-source or not.

47. A Novel Purification Strategy to Identify Anti-Adhesion Molecules from Vaccinium macrocarpon

Alexis Sullivan, Douglas Farrell, Guy F. Barbato*, E. Walton*, and William A. Rosche*
Biology

Extracts of the American cranberry, Vaccinium macrocarpon, have been reported to possess antibacterial properties. Cranberry juice has been used to reduce health hazards and economic losses due to food borne microorganisms, and the bulk of the research concerning these antibacterial activities is focused on prevention of urinary tract infections. There is a dearth of research regarding its effectiveness as a topical treatment on epidermal infections. Prior studies in our laboratory have shown that cranberry extract inhibits E. coli adhesion to membrane proteins, potentially preventing epidermal infection via the primary step in the process – bacterial adhesion to the wound. In our previous research, the extraction methods for obtaining the inhibitory molecules from the cranberry juice were successful, but did not result in sufficient yield for large-scale testing. Over the past year, we tested a new protocol exploiting three-phase partitioning that should theoretically result in higher yields. The first trial consisted of dissolving 15.0g of lyophilized cranberry extract into 1.0L of 30% (NH₄)₂SO₄, followed by the addition of 400mL tert-butanol. The solution was mixed and allowed to divide into three phases, then the top two phases, the butanol and protein layers, were separated and removed. We then increased the concentration of the remaining aqueous layer to 70% (NH₄)₂SO₄ to isolate any remaining proteins. All non-organic phases were desalted, lyophilized, and weighed. The initial partitioning in 30% (NH₄)₂SO₄ resulted in yields of 12.000% in the butanol phase,
2.899% in the protein phase, and 1.598% in the aqueous phase. The second partitioning in 70% 
(NH₄)₂SO₄ yielded, 1.333%, 3.898% and 2.397%, respectively.

48. Computational Design of EGFR kinase inhibitors for the treatment of Non-Small Cell 
Lung Cancer

Shannon Tarby, Earl Benjamin*, and Ellis Benjamin*
Chemistry

With over 174,000 new cases of lung cancer being diagnosed in the United States each year 
novel chemotherapy treatments with efficacy towards both small-cell and non-small cell lung 
carcinoma is of interest to increase the survival rate of cancer patients. The Epithelial Growth 
Factor (EGF) and its Receptor (EGFR) EGFR is protein that initiates cellular growth and has been 
found to be overexpressed in lung cancer cells which makes it an effective targeted approach to 
cancer treatment. Specifically, this research determined structural blockade of the tyrosine 
kinase receptor of the EGFR as a way to inhibit cancer propagation with the use of FDA 
approved drugs. 22 crystal structures of the tyrosine kinase of the EGFR protein were docked 
using IGEMDock to 714 FDA drugs to determine structural correlation for the most effective 
binders. Structural similarities were determined with IGEMDock and vROCS and partition 
coefficient was determined using DRAGON program. This data found a cluster of 
approximately 25 drugs to preferentially bind to the EGFR tyrosine kinase for use as targeted 
cancer treatments. This work will be used in the engineering of improved EGFR tyrosine kinase 
inhibitors.

49. Spatial Analysis of Oyster Growth on Marine Debris in the Mullica River - Great Bay 
Estuary

Jamie Taylor, Weihong Fan*, and Mark Sullivan*
Marine Science

This Advanced Geographic Information Systems final project will examine oyster growth on 
recovered derelict fishing gear. Dr. Mark Sullivan and team has mapped derelict fishing gear 
(mostly crab traps) within the Mullica River - Great Bay Estuary and has recorded oyster growth 
upon the traps. This data will be used to analyze the successful spaces in which oysters are 
growing in this area. The data will be compared with specific environmental factors to establish 
potential areas of successful oyster growth. This information can then be used to distinguish 
areas of restoration for the oyster population.
50. Characterizing Pollution in Marine Ecosystems in Bocas del Drago, Panama

Jamie Taylor and Elizabeth Lacey*
Marine Science

As the world population increases, it is becoming more and more apparent that we need to manage our waste output. Pollution all around the world has the potential to permanently alter and harm Earth’s natural ecosystems. This study analyzed pollution, including metals, plastics, and glass, in Bocas del Drago, Panama, and characterized the amount and identity of marine organisms utilizing the debris as settlement space. Results from this project determined the abundance of pollution according to each ecosystem, where mangroves collected the most debris. The results also described the associations of organisms to marine debris categories, where harder items (glass bottles) in deeper water (depth 6-10 meters) were found to have the most growth, including epiphytic crustose coralline algae, sponges, and even successful corals.

51. Identification and Characterization of Aquifer Bacteria

Thai Tran, Cooper Anderson, Cara Puzzio, and Karen York*
Biology

In 1994, Richard Stockton College of New Jersey installed a geothermal system; a closed circuit of water pipes exchanging thermal energy with the underground environment to heat the buildings in the winter and cool them in the summer. During the first ten years of operation, the thermal energy exchange was not balanced, resulting in an increased temperature in the underground environment. Seven bacterial isolates (CU 2, 7, 8, 10, 18, 24) were collected from the Upper Cohansey aquifer in 1997 when the temperature of the aquifer was 14°C. Isolate 73 was collected in 2005 when the Upper Cohansey aquifer temperature was 24°C. All eight isolates of aquifer bacteria were previously identified as the genus "Acidovorax" by cloning and DNA sequencing of the 16S rRNA gene. The purpose of this project was to determine whether or not these isolates are the same as existing bacterial species or distinct species entirely. The approach has been to clone and compare DNA sequences for the single copy protein encoding gene lepA. This gene, also known as translation elongation factor Tu (EF-Tu), is highly conserved in all bacteria. Our results suggested that these isolates are all distinct from each other, and that they are not 100% identical to any other known bacteria with lepA sequences in the NCBI database. The bacteria were also analyzed for their nutritional requirements on BIOLOG Eco plates. There were similar nutritional requirements for these isolates, but each one also had some distinct nutritional phenotypes.
52. Determining what caused the error in the prediction of the December 1st, 2013 snow storm using the Weather Research and Forecasting Model

Joseph Trout* and Nikunjkumar Prajapati
Physics

The severity of snow events in the northeast United States depends on the position of the pressure systems and the fronts. Although numerical models have improved greatly as computer power has increased, occasionally the forecasts of the pressure systems and fronts can have large margins of error. For example, the snow storm which passed over the north east coast on the week of December 1, 2013, which proved to be much more severe than predicted. In this research, The Weather Research and Forecasting Model (WRF-Model) is used to model the December 1, 2013 storm. Multiple simulations using nested, high resolution grids are compared.

53. Lateral and Vertical Variations in Inorganic Parameters throughout the Mullica River-Great Bay Estuary

Rick Vera, Jessica Valenti, and Gordan Grguric*
Marine Science

Monitoring lateral and vertical inorganic parameters in an estuary is crucial in understanding its health. This is of particular importance in the Mullica River-Great Bay (MRGB) estuary since it is used as a model for other estuaries along the East coast. In this study, we monitored several inorganic parameters within the MRGB estuary with depth at one site (Bass River) and laterally throughout the estuary (8 sites). Some findings associated with depth at the Bass River site include an increase in silica ($r^2=0.9287$) and alkalinity ($r^2=0.9843$) and a large decrease in dissolved oxygen (D.O.). The observed increasing trend in silica with depth could be attributed to leaching from the bottom sediments, an abiotic process. However, the observed increase in alkalinity with depth may be the result of the decomposition of benthic organic matter, a biotic process. This process utilizes oxygen which could explain the decrease in dissolved oxygen with depth. Decomposition of large amounts of organic matter, whether anthropogenic or natural, can lead to hypoxia or even anoxia in marine environments. Consequently, this can result in stress on the marine ecosystem. The findings for the lateral transect across the bay include a strong correlation between surface alkalinity and salinity ($r^2=0.9082$) as well as an increase in salinity moving from Bass River towards the Atlantic Ocean. In addition, upon comparison of the surface and bottom salinity measurements of the 8 sites, an average difference of 1.1 ppt was present between surface and bottom salinities indicating the existence of a salt wedge.
54. Modeling Ecological Networks

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Computational Sciences (under a Biology Concentration)

For decades, many scientists have tried to study and control ecosystems in order to protect endangered species and/or to reduce the populations of invasive species. And while several computational models, such as Lotka-Volterra’s model, have been developed to study ecosystems, the adaptation of these models to solve practical problems is extremely challenging. Experimentally obtaining the required parameters is not practical and often unfeasible. To avoid these difficulties, my research group and I took an effective modeling approach which was developed for gene networks and adapted it for use with ecological networks. This approach is able to construct a model with a relatively small amount of data and does not suffer from the same complications as more conventional methods. To test these ideas, we generated a synthetic, computer-based, ecological system created using the classic Lotka-Volterra model, which acted as a proxy for an actual ecosystem. It provided synthetic data from which the effective model could be generated. We found that the effective model successfully predicted the behavior of the synthetic Lotka-Volterra system. Furthermore, we were able to use it to control the network, indicating that such an approach will prove useful with actual ecosystems. By creating a more simplified model of ecological networks, we will be better suited to challenge the boundaries and powers that invasive species hold in their new territories.

55. Emergence Patterns and Distribution of Overwintering Wood Frogs (Rana sylvatica)

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Environmental Science

The wood frog (Rana sylvatica) utilizes distinct habitats for different portions of its annual lifecycle to feed, breed, and overwinter. The loss of one habitat could cause serious consequences for the population. Our study sampled wood frogs moving towards a breeding pond on campus to investigate their winter distribution and determine whether a reduced 175 ft. or the standard 300 ft. buffer zone protects the majority of the wood frogs’ winter habitat. Three concentric rows of drift fence and pitfall traps were constructed on Feb 3, 2014. The first row was near the edge of the vernal pond, the second row was 175 ft. away, and the third row was 300 ft. away. Frog captures in the various zones gave insight into how far from the pond the frogs were overwintering. 180 frogs were captured between Feb 4 and Mar 13, and breeding occurred on Mar 11, 12, and 15. 44% of total captures and 41% of large female captures occurred at the outer two fences, showing that a significant portion of the population spends the winter farther than 175 ft. away from the breeding pond. Thus, current buffer regulations do not protect the entire wood frog winter habitat. Additionally, the majority of male frogs emerged before females. This phenological strategy may increase an individual male’s reproductive success by maximizing the number of potential female mates available.