MONMOUTH UNIVERSITY

SCHOOL OF SCIENCE

8th ANNUAL SUMMER RESEARCH PROGRAM SYMPOSIUM

AUGUST 11, 2016
10:30 A.M. — 1:00 P.M.
ERLANGER GARDENS

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SCHOOL OF SCIENCE

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MONMOUTH UNIVERSITY
SCHOOL OF SCIENCE

8TH ANNUAL SUMMER RESEARCH PROGRAM SYMPOSIUM

Thursday, August 11, 2016

PRESENTATIONS BY DEPARTMENT

DEPARTMENT OF BIOLOGY

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Vincent Bauman, Courtney Dunphy, Charlotte Kelly and Corrin Trerotola

Faculty Mentor: Dr. Cathryn Kubera

A-2 Effectiveness of Certain Essential Oils and Methylglyoxal as Bactericides for Antibiotic Resistant *Acninetobacter baumannii*

Karla Clavelo

Faculty Mentor: Dr. James P. Mack

A-3 Use of Pomegranate Juice Extract and Apple Extract to Treat and to Inhibit Inflammation in Cancers of the Oral Cavity and Gliobastomas

Christina Culmone and Nikki Keefe

Faculty Mentor: Dr. Jeffrey H. Weisburg

A-4 Diet of Atlantic Sturgeon in a Coastal Marine Aggregation

Marissa C. DeTorre

Faculty Mentor: Dr. Keith J. Dunton

A-5 Monmouth University Beach Nesting Bird Monitoring and Stewardship Program

Taylor Donovan and Marc Molé

Faculty Mentor: Assistant Dean John Tiedemann
Additional Mentors: Lauren Cruz, New Jersey Division of Fish and Wildlife
Todd Pover, Conserve Wildlife Foundation of New Jersey

A-6 *Trans*-Splicing of Interleukin-13 Receptor Alpha Variant 2 into EGFR Transcript to Block Growth and Reactivate Immunogenic Potential of Human Gliobastoma Cells

Sarah Falotico, Nicole Sivetz and Peter Nekrasov

Faculty Mentor: Dr. Martin J. Hicks

A-7 Synthesis of Mini-Reporter Construct to Test Gene Transfer of RNA Therapeutics

Kerianne Fuoco and Hemangi Patel

Faculty Mentor: Dr. Martin J. Hicks

A-8 Impacts of Increased Salinity on Mangrove Carbon Cycling Processes

Kristina M. Guarino and Kristen E. Jezycki

Faculty Mentors: Dr. Pedram P. Daneshgar, Department of Biology
Assistant Dean John A. Tiedemann

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Faraz Jamal

Faculty Mentor: Dr. Cathryn Kubera

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Faculty Mentor: Dr. Pedram Daneshgar

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Faculty Mentor: Dr. Martin J. Hicks, Department of Biology

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Katlyn Nielsen

Faculty Mentor: Associate Dean, Dr. Catherine Duckett
Additional Mentors: Dr. John Henning, Dean, School of Education
Dr. Kerry Rizzuto, School of Education

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Faculty Mentor: Dr. Keith J. Dunton

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Faculty Mentor: Dr. Martin J. Hicks

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Nicole Sivetz, Sarah Falotico and Peter Nekrasov

Faculty Mentor: Dr. Martin J. Hicks

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Jeffrey Webb

Faculty Mentor: Dr. Keith J. Dunton

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Faculty Mentor: Dr. T. Tongesayi

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Momna Ayub, Emily Beyer, Chioma Gabriel, Hannah Hilbrandt and Andrea Mora

Faculty Mentor: Dr. T. Tongesayi

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Crystal Diaz, Rebecca Klee, Christina Guarino, Kristen Jezycki, Cayla Sullivan and Kylie Johnson

Faculty Mentor: Dr. Dmytro Kosenkov
Additional Mentor: Dr. Pedram Daneshgar, Department of Biology

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Brian E. Macalush

Faculty Mentor: Dr. Gregory A. Moehring

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Katlynn Muratore and Erin Hoag

Faculty Mentor: Dr. Dmytro Kosenkov

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Devyn J. Streisel and Andrew L. Petrou

Faculty Mentor: Dr. Gregory A. Moehring

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Daniel Collins, Jack Dates, Brian DeLeonardis, Kevin DeStefano, Anthony Fasano, Ryan Goldstein, Brandon Guglielmo, Anthony Hamill, Matthew Kumar, Kiho Kwon, Tina Lu and Chase Moran

Faculty Mentor: Professor Robert M. Kelly, Jr.

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Matt Drew and Cassandra Sannino

Faculty Mentor: Professor Gil Eckert

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Veronica Granite

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Maeve McClatchey

Faculty Mentor: Dr. Raman Lakshmanan

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Srivikarani S. Chettupally Sheeba and Lei Wang

Faculty Mentor: Professor Edwin R. Torres

DEPARTMENT OF MATHEMATICS

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Austin Alcott and Samantha Giordano

Faculty Mentor: Dr. Richard Bastian

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Jason Boynton and Brielle Fosthoffer

Faculty Mentor: Dr. Richard Bastian
Additional Mentor: Dr. Martin Hicks, Department of Biology

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Hope Sonner, Lindsay Weber and Jen Minor

Faculty Mentor: Dr. Richard Bastian

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Jennifer Urmston and Vincent Mack

Faculty Mentor: Dr. Richard Bastian

DEPARTMENT OF BIOLOGY

ABSTRACTS

In Ovo Electroporation of Chicken Embryo Cerebellum

Vincent Bauman[1], Courtney Dunphy[2], Charlotte Kelly[1], and Corrin Trerotola[1]

[1]Monmouth University
[2]Colgate University

Faculty Mentor:
Dr. Cathryn Kubera, Department of Biology

Funding Sources:
Pfizer, Monmouth University School of Science

ABSTRACT

Genetic manipulation of chick embryos through the transfer of genetic material using *in ovo* electroporation allows for the extensive study of developmental biology. The cerebellum was the target of interest for this investigation because abnormalities in cerebellar development may lead to deficits, such as Ataxia. Understanding the neurobiology of cerebellar development can be a means for improving treatments of Ataxia and other neurological impairments. The goal of this study was to successfully deliver a $GABA_A$ α2-GFP reporter plasmid to developing cerebellum in 5-day-old *Gallus gallus* embryos.

To accomplish this goal, fertilized hatching eggs obtained from a local farm were then incubated and windowed using a sterile procedure to view the embryos and locate the cerebellum. A glass needle was used to inject either a control GFP plasmid or the $GABA_A$ α2-GFP plasmid. The embryos were electroporated and then the tissue was prepared for cryosectioning and staining.

During development, gene expression patterns are temporally sensitive, making the timing of delivery of the plasmid a crucial factor for developmental studies. The electroporation procedure was conducted at different periods during development including 67 h and 120 h. During electroporation, several complications were encountered including bacterial infection, unsuccessful delivery of DNA, and embryo death from electroporation. Careful steps were taken to avoid these problems, leading to an overall 53% survival rate of electroporated embryos. Successful electroporation was assessed through the fluorescence of GFP from the introduced plasmids. GFP was detected in the developing hindbrain of electroporated tissue using fluorescence or confocal microscopy, and positive signal from cells was correlated with DAPI nuclear stain to verify the authenticity of the signal.

Effectiveness of Certain Essential Oils and Methylglyoxal as Bactericides for Antibiotic Resistant *Acinetobacter baumannii*

Karla Clavelo
Monmouth University

Faculty Mentor:
Dr. James P. Mack, Department of Biology

Funding Sources:
Pfizer, Global Essence, Kevin W. Young '89, Monmouth University School of Science

ABSTRACT

The time has come when health care professionals are unable to treat all diseases with traditional medications. Antibiotics are losing their effectiveness on infections such as *Acinetobacter baumannii*. Because this infection is commonly found in hospital settings, both healthcare professionals and the public should be concerned about the misuse of antibiotics that has led to this worrisome and worsening situation. We should also be seeking new, effective methods of treating these infections.

This research explores how essential oils and methylglyoxal compare in effectiveness with currently used antibiotics to address the dangers of antibiotic resistant bacteria. The research was conducted using the biology facilities at Monmouth University in West Long Branch, NJ and the microbiology lab at Jersey Shore University Medical Center (JSUMC) in Neptune City, NJ. Emollients of the essential oils (Cassia, Cinnamon Bark, Thyme White, and Oregano) and methylglyoxal (the key component in Manuka Honey) were made in conjunction with common carrier oils (Jojoba, Coconut, Olive, and Aloe Vera) to determine their efficacy in inhibiting *Acinetobacter baumannii*. These essential oils were chosen because of their proven effectiveness against other bacteria in previous research at Monmouth University.

Since there is a potential for skin irritation from the concentrated essential oils if applied directly, they were diluted using carrier oils. The Minimum Inhibitory Concentration (MIC) for the emollients was determined for each of the four essential oils and methylglyoxal. It was determined that a concentration of 10% was the MIC for each essential oil and methylglyoxal. At the 10% concentration, the tested emollients worked better than Colistin, an antibiotic commonly used in treating *Acinetobacter baumannii* infections. The results indicate that the emollients made with the essential oils and with methylglyoxal at the MIC using the tested carrier oils could potentially be used as an alternative treatment for the infections from multidrug resistant *A. baumannii*.

Use of Pomegranate Juice Extract and Apple Extract to Treat and to Inhibit Inflammation in Cancers of the Oral Cavity and Glioblastomas

Christina Culmone and Nikki Keefe
Monmouth University

Faculty Mentor:
Dr. Jeffrey H. Weisburg, Department of Biology

Funding Sources:
Bristol-Myers Squibb, Monmouth University School of Science

ABSTRACT

Nutraceuticals are defined as any products derived from food sources with extra health benefits in addition to the basic nutritional value found in foods. One of the most powerful nutraceuticals is pomegranate juice extract (PJE). PJE has been shown to have antiproliferative and proapoptotic properties in breast cancer and prostate cancer. Another strong nutraceutical is apple extract (AE), which has also been shown to induce apoptosis in prostate cancer and colorectal cancer. In these experiments, we want to see if PJE and AE could selectively target and kill cancers of the oral cavity, using the human squamous carcinoma HSC-2 cells as compared to human normal gingival fibroblast cell HF-1, and glioblastomas, using the human glioma cell lines A172 and U118.

The association between inflammation and cancer has been studied widely so we want to determine if PJE and AE can inhibit vital proteins in the inflammatory process. The transcription factor NF-kB has been a key element in inflammation, and its activation have been shown to upregulate gene expression of other pro-inflammatory cytokines. Although NF-kB was first characterized in cells of the hematopoietic system, research has shown that NF-kB activation can occur in most cell types. Using PJE and AE on all of the cell lines, we want to observe if these nutraceuticals could inhibit or slow down the activation of NF-kB and prevent the inflammatory process. One of the major signaling molecules in activating inflammation is IL-1β. IL-1 is an important mediator of inflammation in the CNS by its release from microglial cells, which have also been suggested as targets for its action. It has also been reported that oral cancers secrete interleukin-1 beta (IL-1β), which promotes the proliferation. We want to examine if treating the cells with the individual nutraceutical can also inhibit the secretion of IL-1β.

Diet of Atlantic Sturgeon in a Coastal Marine Aggregation

Marissa C. DeTorre
Monmouth University

Faculty Mentor:
Dr. Keith J. Dunton, Department of Biology

Funding Sources:
Monmouth University Urban Coast Institute Marine Science and Policy Initiative, Santander,
Urban Coast Institute Heidi Lynn Sculthorpe Research Grant,
Monmouth University School of Science

ABSTRACT

Atlantic Sturgeon, *Acipenser oxyrinchus oxyrinchus*, is a federally protected species that undergoes large coastal migrations. Aggregations of Atlantic Sturgeon are known to occur in several coastal locations, including large seasonal aggregations in the spring and fall off the coast of New York. This New York aggregation is known to consist of sub-adults largely from the Hudson River.

To understand potential reasons why sturgeon aggregate, temporal changes in diet were examined from sub-adult fish within these coastal aggregations. The prey of the Atlantic Sturgeon was determined through stomach contents, collected through non-lethal gastric lavage in both the spring (n=28) and fall (n=39) of 2013. Thirteen unique prey taxa were identified with Atlantic Sturgeon ingesting large numbers of Gammarid amphipod spp. in both seasons. In addition to gammarids, the sturgeon diet included considerable numbers of *Glycera dibranchiata*, *Leitoscoloplos fragilis*, *Squilla empusa* and other various polychaete, oligochate and crustacean species. Concurrent studies indicate that this area is important for migrating Atlantic Sturgeon, and the high abundance of prey resources indicates an important feeding habitat. This might explain temporal aggregations in this region.

Monmouth University Beach Nesting Bird Monitoring and Stewardship Program

Taylor Donovan and Marc Molé
Monmouth University

Faculty Mentor:
Assistant Dean John Tiedemann

Additional Mentors:
Lauren Cruz, New Jersey Division of Fish and Wildlife
Todd Pover, Conserve Wildlife Foundation of New Jersey

Funding Sources:
New Jersey Division of Fish and Wildlife Endangered and Nongame Species Program,
Conserve Wildlife Foundation of New Jersey

ABSTRACT

The Piping Plover (*Charadrius melodus*) was at one point common along the Atlantic coast. However, their populations were driven close to extinction in the early 20th century. In 1918, the Migratory Bird Treaty Act stopped the reaping of these birds and allowed the population to rebound slightly. Toward the end of the 20th century the populations had once again been threatened, this time by the over development of coastal communities driving them from their preferred habitats. Least terns *(Sternula antillarum),* American oystercatchers *(Haemtopus palliates),* and black skimmers *(Rynchops niger)* also reside in the same areas as plovers, subjecting them to the same fate of population declination. Many of these species exhibit high site fidelity, so the loss of breeding site habitat could be mean never ending devastation to their populations.

In New Jersey piping plovers, least terns, and black skimmers are all considered endangered species and American oystercatchers are listed as a species of concern. In an effort to help preserve and maintain these populations, the New Jersey Division of Fish and Wildlife, Endangered and Nongame Species Program is tasked with surveying Monmouth County beaches for birds actively nesting and utilizing these habitats. Through this program, beaches known to be nesting sites for these species undergo daily monitoring, as well as various protective measures. These measures include beach closures for areas being utilized by all species of concern as well as predator exclosures for plover nests that have reached a full clutch and have yet to hatch. NJDFW is also tasked with determining the nesting success of mating pairs of each species and when necessary, determining if and why a nest failed. As of now, 2016 is considered a bumper year for the plover population due to the fact that there have been more fledges this year than in the past several years combined, with 10 nests already fledged.

Trans-Splicing of Interleukin-13 Receptor Alpha Variant 2 into EGFR Transcript to Block Growth and Reactivate Immunogenic Potential of Human Glioblastoma Cells

Sarah Falotico[1] , Nicole Sivetz[1] and Peter Nekrasov[2]
[1]Monmouth University and [2]Biotechnology High School

Faculty Mentor:
Dr. Martin J. Hicks, Department of Biology

Funding Sources:
Bristol-Myers Squibb, Independent College Fund of New Jersey, Johnson & Johnson and Monmouth University School of Science

ABSTRACT

Overexpression and activation of tyrosine kinase receptors, such as epidermal growth factor receptor (EGFR), has been detected in as much as 60% of glioblastoma multiforme (GBM) tumors, a lethal, but common malignancy of the central nervous system (CNS). Current therapies for GBM are limited due to the blood brain barrier and the relatively immunologically privileged status of the CNS. Activation of alternative polyadenylation within transcripts has the potential to generate shortened EGFR transcripts. Translation of these shortened isoforms leads to soluble decoy EGFR isoforms that sequester the epidermal growth factor. Pre-mRNA *trans* splicing of an alternative polyadenylation signal into EGFR has the potential to generate an extracellular decoy rather than membrane-bound receptors. Here, we describe a pre-*trans* splicing molecule (PTM) against EGFR that contains interleukin-13 receptor alpha chain variant 2 (IL13Rα2), a decoy receptor for IL-13. This highly immunogenic isoform is selectively expressed in GBM. Additionally, IL13Rα2 has become an effective target for immunotherapy due to the strong immune response of cytotoxic T lymphocytes it elicits. Cloning a portion of IL13Rα2 into the multiple cloning site of the PTM after exon definition, but before the polyadenylation signal, would lead to greater IL13Rα2 expression and, therefore, greater immunogenic potential of the tumor microenvironment. Delivery of hybrid PTM and immunogen in an adeno-associated virus plasmid vector would lead to synergistically inhibiting EGFR expression with the potential to reactivate CD8 T-cells. Levels of EGFR expression will be evaluated via Western Blot and ELISA in several GBM cell lines. Preliminary cloning of IL13Rα2 into the PTM and testing of the PTM *in vitro* has also begun.

Synthesis of Mini-Reporter Construct to Test Gene Transfer of RNA Therapeutics

Kerianne Fuoco and Hemangi Patel
Monmouth University

Faculty Mentor:
Dr. Martin J. Hicks, Department of Biology

Funding Source:
Bristol-Myers Squibb

ABSTRACT

Glioblastoma multiform (GBM), a grade IV tumor of the central nervous system, is the most common malignant primary brain tumor in adults. Individuals diagnosed with GBM have a poor life expectancy of approximately 12 months. The poor survival rate is due to a lack of efficacy in current therapies, including chemotherapy and radiation, which are limited by the blood-brain barrier. We are creating novel strategies to bypass these barriers by developing gene transfer vectors to deliver the genetic sequences of RNA therapy molecules to alter the splicing pattern and expression of tyrosine kinase receptors (TKR), creating soluble TKR decoys. In this approach, we expect to modify GBM and CNS cells to deliver the therapeutic anti-cancer molecule into the local milieu. To test this approach, we are creating an *in vivo* tissue culture model. We have designed mini-reporter gene constructs that contain the targeted regulatory elements, including the 5' and 3' splices sites as well as the intrinsic region of interest of the TKR, vascular endothelial growth factor receptor 2, VEGFR2 (KDR). This mini-reporter construct will test the efficacy of RNA anti-sense therapeutics to block the pre-mRNA splicing event leading to intron retention and alternative polyadenylation signal recognition. Using fluorophores as visual markers, eukaryotic green fluorescent protein (eGFI) will be used to detect the natural exon splicing product, whereas the monomeric red fluorescent protein, cherry will detect RNA anti-sense mediated intron retention. In this manner, the mini-reporter construct provides a quick and visually measurable test to optimize RNA anti-sense therapies against VEGFR2. In addition to VEGFR2, we will use this mini-reporter design to test the efficacy of RNA therapies directed toward alternative TKRs known to be upregulated in cancer.

Impacts of Increased Salinity on Mangrove Carbon Cycling Processes

Kristina M. Guarino and Kristen E. Jezycki
Monmouth University

Faculty Mentors:
Dr. Pedram P. Daneshgar, Department of Biology
Assistant Dean John A. Tiedemann, Director of the Marine and Environmental Biology and Policy Program

Funding Sources:
Monmouth University Urban Coast Institute, Heidi Lynn Sculthorpe Summer Research Grant, Santander Bank, Monmouth University School of Science

ABSTRACT

Salinity is expected to rise in marine ecosystems of the tropics, particularly in the Caribbean, due to increased evaporative loss in surface waters related to warming. Changes in salinity are expected to have significant impacts on coastal ecosystems and the services they provide. Mangrove ecosystems, which have been demonstrated to have great value for carbon sequestration, are likely susceptible to these impacts, as their productivity is tightly related to salinity. This is clearly demonstrated by the dwarfed mangroves in regions like The Bahamas where there are no freshwater inputs to these systems. An understanding of how mangroves will respond to salinities rising above current ambient ocean levels is needed in order to assess the impacts of climate change on these valuable ecosystems.

We explored the impacts of elevated salinity on red mangrove (*Rhizophora mangle*) carbon cycling processes, primarily focusing on mangrove photosynthesis rates and mangrove sediment respiration rates. Sampling was done of mangrove tidal creeks in Eleuthera, The Bahamas where salinity ranges from ambient ocean levels to hypersaline along naturally occurring salinity gradients. Utilizing these gradients, predictions can be made on how red mangroves will respond to rising salinities both in the Caribbean and in estuaries that are experiencing changes in salinity due to sea level rise.

Examining the Role of Fascin in Primary Brain Cancers

Faraz Jamal
Monmouth University

Faculty Mentor:
Dr. Cathryn Kubera, Department of Biology

Funding Sources:
Pfizer, Monmouth University School of Science

ABSTRACT

As one of the main actin bundling proteins found in the body, Fascin plays an important role in maintaining many regulatory behaviors. It is vital for proper cell-cell adhesion through cytoskeletal structures and has been shown to play a role in a cell's motile and invasive properties. In particular, Fascin is an important protein to study because its overexpression is seen in various cancers. Previous literature has shown that upregulation of Fascin increased the metastatic and invasive properties of colorectal cancer cell lines. Additionally, Fascin has been previously identified in a set of genes that mediated breast cancer metastasis to the lungs and has been implicated in gallbladder, pancreatic, and prostate cancer as well. Primary brain cancers, which can be very aggressive, also seem to have elevated Fascin levels that correlate with tumor grade. In this project we examine the role of Fascin in neural cancers like neuroblastoma and glioblastoma. We characterized Fascin gene expression in brain cancer cell lines using RT-qPCR to assess mRNA levels, and immunocytochemistry to determine relative protein abundance. Preliminary results show robust Fascin mRNA expression in Neuro2a neuroblastoma and A-172 glioblastoma cells. Furthermore, immunostaining of both total Fascin and phosphorylated Fascin was elevated in mouse Neuro2a neuroblastoma cells when compared to Human Embryonic Kidney cells (HEK-293), which have reportedly low Fascin expression levels.

Following analysis of Fascin expression in additional brain cancer cell lines, we will evaluate whether overexpression of Fascin increases motile properties of neuroblastoma and glioma cells in culture using a scratch invasion assay technique.

Community Succession After Cranberry Bog Abandonment Within the New Jersey Pinelands

Kylie Johnson and Rebecca Klee
Monmouth University

Faculty Mentor:
Dr. Pedram Daneshgar, Department of Biology

Funding Sources:
Monmouth University Urban Coast Institute, Heidi Lynn Sculthorpe Summer Research Grant, Monmouth University School of Science, Santander

ABSTRACT

Since the 1860s, the cultivation of the native American cranberry, *Vaccinium macrocarpon*, has been a major agricultural practice in the Pinelands of New Jersey. The Pinelands have been well suited for cranberry production due to the sandy, organically rich soil and the abundant sources of freshwater. Cranberry bog agriculture includes the clearing and leveling of land, usually wetlands, to create bogs. Water flow and drainage is controlled by diversion canals and channelized stream segments. These manipulations can cause significant changes in the structure and function of wetland communities. Although cranberry agriculture can represent over a third of wetlands in the pinelands, the industry has been on the decline as it has moved to other regions of the country. As a result, many bogs have been abandoned. The effects of abandonment have not been investigated thoroughly.

In this study, we explored the fate of bogs and examined bog succession after abandonment from time zero (an active cranberry bog) to 60 years after abandonment in both flooded and unflooded communities. We hypothesized that the fate of the community succession would be heavily influenced by the original agricultural practice and whether or not the bog was kept flooded or not. Therefore, cranberry bogs were expected to develop into two different ecosystems after abandonment. A full inventory of plant, vertebrate, and invertebrate species were collected from multiple cranberry bogs of different ages from three locations. Community diversity and structure were determined from the inventories and a chronosequence for bog succession was developed. With this information, recommendations can be made onto how the lands should be managed in the future in order to maintain healthy and native communities.

Essential Oils and Methylglyoxal: A Possible Treatment for Inhibiting the Growth of the Extended Spectrum Beta-Lactamase Producing *Escherichia coli (Esbl-Ec)*

Joseph Kellett
Monmouth University

Faculty Mentor:
Dr. James P. Mack, Department of Biology

Funding Sources:
Pfizer, Global Essence, Kevin W. Young '89, Monmouth University School of Science

ABSTRACT

The overuse and misuse of antibiotics have produced antibiotic resistant bacteria. Infections from these bacteria are, therefore, difficult to treat. Recent problems in healthcare settings include infections of patients with certain antibiotic resistant bacteria which do not respond to traditional antibiotic treatment. Natural products, including essential oils, derived from plants show promise as strong bactericides which may be useful for effectively combating the infections from these antibiotic resistant bacteria.

Escherichia coli is part of the normal flora of the intestines, however, some strains can cause an intestinal infection causing abdominal pain, fever, as well as bloody diarrhea. Other strains of *Escherichia coli* can also cause urinary tract infections. In this research, the essential oils cassia, cinnamon bark, oregano, as well as methylglyoxal (main ingredient in Manuka honey) were used in conjunction with three carrier oils (olive oil, jojoba oil, and coconut oil) to determine their efficacy in inhibiting the growth of *ESBL-EC.* Cassia, cinnamon bark, oregano, and methylglyoxal were chosen because they were used in previous studies at Monmouth University and showed to be effective in inhibiting the growth of MRSA and MSSA. The essential oils were diluted to lower concentrations to determine their minimal inhibitory concentration (MIC) because most essential oils are irritating to the skin in high concentrations. The results were then compared to traditional antibiotics, including colostin, tetracycline, ciprofloxacin, fosfomycin, azithromycin, and nitrofurantoin, to determine their effectiveness. It was determined that the MIC of the essential oils to effectively inhibit E.coli is 33% and the MIC of methylglyoxal is 12%. The dilutions were made using the carrier oils listed above, which are known to be safe on the skin. The effectiveness of essential oils and methylglyoxal emollients in carrier oils in inhibiting the bacterial growth was better than the currently used antibiotics for treating ESBL-EC. Multidrug-resistant bacteria have become a significant global health threat and the possible treatment of multidrug-resistant bacterial infections with proven bactericidal essential oils may help alleviate this problem.

Sandy High Water Mark Initiative

Marc Molé and Bryan Drew
Monmouth University

Faculty Mentor:
Professor James Nickels, Department of Biology

Funding Source:
Urban Coast Institute Marine Science and Policy Initiative

ABSTRACT

Superstorm Sandy swept through the Jersey Shore area on October 29, 2012. In many places residents did not know the extent to which the water would rise. Due to this, subpar preparations had been taken, which led to the majority of the damage caused. As communities are still rebuilding there has been some discrepancy about the true high water mark caused by the storm. Since the storm, many people have either relocated or renovated leaving the true high water marks from the storm up for question.

In hopes of creating flood zone awareness, Urban Coast Institute has volunteered its participation to any community in Monmouth County in demarcating the high water marks caused by the storm. Communities participating in the initiative will receive points toward Community Rating System sponsored by FEMA, which will in turn, lower the rates of flood insurance for the residents of the community as well as raise flood awareness in the areas affected. Fourteen communities throughout Monmouth County have participated in the program including Atlantic Highlands, Belmar, Keansburg, Middletown, Sea Bright, and Monmouth Beach. High water marks were extrapolated using standard surveying techniques along with the use of an auto laser level as well as RTK GPS equipment. The water levels from the area were determined by firsthand accounts from the municipality and through the use of the NAVD88 elevations provided by United States Geological Survey. Signs will be placed in the public eye in an attempt to increase flood zone awareness for individuals new to the area and to those who have relocated since the event.

Induction of pre-mRNA *Trans*-Splicing and Intronic PolyAdenylation in the EGFR Transcript to Form a Shortened Soluble Decoy in Human Glioblastoma Cells

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Faculty Mentor:
Dr. Martin J. Hicks, Department of Biology

Funding Sources:
Johnson & Johnson, Bristol-Myers Squibb, Independent College Fund of New Jersey and Monmouth University School of Science

ABSTRACT

Therapies for glioblastoma multiforme (GBM), the most common central nervous system malignancy, are limited by the blood-brain barrier and therapeutic persistence. Tyrosine kinase receptors (TKRs), such as epidermal growth factor receptor (EGFR), are overexpressed in GBM and drive cell proliferation. Previous research examining aberrant transcripts in cancers has identified alternative intronic polyadenylation in the EGFR transcript, resulting in truncated EGFR isoforms that function as soluble extracellular decoys and sequester EGF. To take advantage of this natural phenomenon, we engineered a pre-*trans*-splicing molecule (PTM) with simian virus 40 polyadenylation signal, U7 snRNA, and splicing elements to splice into and halt the EGFR transcript upstream of the transmembrane domain. The binding domain, a complementary target sequence playing a large role in *trans*-splicing efficiency, was designed according to splicing motifs in the EGFR pre-mRNA transcript. Three PTM versions were synthesized: double binding domain, single binding domain, and a bicistronic vector with two distinct antisense targets. These vectors will be tested to examine transmembrane domain skipping, enhancement of *trans*-splicing efficiency over *cis*-splicing, and activation of pseudoexons 15A and 15B with alternative intronic polyadenylation signals. Transfection of cancer cell lines A172 and U87 using the three versions of PTM in an adeno-associated virus plasmid shows expression and EGFR transcript interference.

Pollination in Preschool Classrooms

Katlyn Nielsen
Monmouth University School of Education

Faculty Mentor:
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Additional Mentors:
Dr. John Henning, Dean, School of Education
Dr. Kerry Rizzuto, School of Education

Funding Sources:
Monmouth University School of Science

ABSTRACT

Pollinators and bees are responsible for one-third of the food that the human population eats. Moreover, due to the role that bees play in food production, they provide valuable economic services as well. Native bees are also threatened and are critical to some important crops. In the last 4 years there has been a rapid decline in honeybee colonies, thus leaving fewer pollinators here in the US. Factors such as mites, viruses, pesticide residue, fungicides, and loss of natural habitats have had massive negative impacts on bee populations, both native and honeybee, within the last 40 years. If the problem is not addressed the food supply could be critically endangered.

Teaching preschool students at an early age about pollination and the importance of the bee population is a great first step in addressing the problem of pollinator decline. When students have an understanding of pollination it helps make related topics more relevant and creates a personal connection with the students. By teaching students the role that bees play in the production of their food, and all of the many jobs the bees have, students are more inclined to take charge and help make a difference in the future.

In collaboration with the School of Education, Monmouth Conservation Foundation and the School of Science, we created a curriculum for preschools regarding the importance of pollination in the Monmouth County area. The curriculum was taught to several different preschools in the area to promote the importance of the subject in the early childhood setting. We used an inquiry based learning approach with hands on activities that helped students comprehend the scientific method as well as the process of pollination.

The Effect of Essential Oils and Methylglyoxal with Carrier Oils on Inhibiting the Growth of *Pseudomonas aeruginosa*

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Faculty Mentor:
Dr. James P. Mack, Department of Biology

Funding Sources:
Pfizer, Global Essence, Kevin W. Young '89 and Monmouth University School of Science

ABSTRACT

Due to global overuse of antibiotics, some bacteria have evolved to become resistant to drugs normally used to treat their respective bacterial infections. Since traditional antibiotics are ineffective to treat infections caused by antibiotic-resistant bacteria, alternative methods are sought to combat the emergence of these bacteria. One such method is the use of natural products derived from plants to effectively inhibit the growth of multidrug-resistant bacteria. Essential oils from plants are known to be highly potent and have natural antibacterial properties that may be useful to treat infections due to drug resistant bacteria.

In this experimentation, three highly potent essential oils - cassia, cinnamon bark, and the aldehyde methylglyoxal (the main active antibacterial ingredient in Manuka Honey) - were used in conjunction with three carrier oils (olive oil, jojoba oil, and lanolin) to determine their efficacy in inhibiting the growth of *Pseudomonas aeruginosa*, a multidrug-resistant bacterium.

Pseudomonas aeruginosa is a gram-negative, aerobic, and coccobacillus bacterium that infects open airways and wounds. *Pseudomonas aeruginosa* infections have become a serious problem for patients who have weakened immune systems. The Kirby-Bauer disk diffusion method was used to test the efficacy of the essential oil and carrier oil mixture. The essential oils used were diluted to lower concentrations with carrier oils to determine their minimal inhibitory concentration (MIC) as essential oils can be irritating if used independently. The results were compared to colistin, which is an antibiotic that can be used to treat *Pseudomonas aeruginosa* infections.

The essential oils and methylglyoxal were diluted and tested at 100%, 75%, 50%, 25%, and 12.5% concentrations in carrier oils. The results were compared to the colistin for relative effectiveness. It was determined that at a 50% concentration, the essential oils and methylglyoxal were more effective than colistin in inhibiting the growth of *Pseudomonas aeruginosa* in the Petri dish experiments. The results show a potential topical treatment that can be used in health care facilities to effectively treat infections caused by this bacterium.

Genetic Delivery of a miRNA Cluster with Polycistronic siRNAs Reduces mRNA Expression of Epidermal Growth Factor Receptor in Human Glioblastoma Cells.

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Faculty Mentor:
Dr. Martin J. Hicks, Department of Biology

Funding Sources:
Mr. Dennis G. Urbaniak '90 and Mrs. Diane E. Urbaniak '91, Bristol-Myers Squibb and Monmouth University School of Science

ABSTRACT

Glioblastoma multiforme (GBM), the most common central nervous system malignancy, is clinically documented as a grade IV astrocytoma. Therefore, GBM is one of the most rapidly growing and invasive types of glial tumors of the central nervous system. The standard therapy includes surgical removal, radiation and chemotherapy with a survival of about one year. In addition, systemic therapies are limited by the blood-brain barrier. To bypass the barrier, we are constructing a delivery strategy that inhibits the gene expression of tyrosine kinase receptors (TKR), which are commonly upregulated in GBM. One TKR, epidermal growth factor receptor (EGFR), is overexpressed in GBM leading to uncontrolled growth and proliferation. Our approach is to enlist the RNA interference pathway. Although small interfering RNAs (siRNAs) are often utilized to silence gene expression, exogenously expressed siRNAs are not an effective strategy to treat human disease due to both extracellular and intracellular nucleases as well as activation of cellular immunity against foreign nucleic acids. To bypass these degradatory mechanisms, we are using a natural miRNA cluster genetic background to effectively deliver the DNA encoding multiple anti-EGFR siRNAs by cloning them into the structure of the miRNA cluster, miR-17-92. The anti-EGFR polycistronic miRNA cluster (pAAV-miR-IP1) expresses six siRNAs directed against EGFR specifically targeting the extracellular ligand binding domain, transmembrane domain, intracellular tyrosine kinase domain and 3' untranslated region of the EGFR gene. The therapy vector, pAAV-miR-IP1, was transfected into the human GBM cell line, A172. Results show that pAAV-miR-IP1 was expressed at high levels in the A172 cell line with a subsequent reduction in EGFR mRNA expression. Future strategies include using the polycistronic delivery mechanism to target multiple TKRs in addition to EGFR.

Comparing Finfish and Decapod Abundance in New Jersey Coastal Estuaries

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Faculty Mentor:
Dr. Keith J. Dunton, Department of Biology

Funding Sources:
Urban Coast Institute Heidi Lynn Sculthorpe Summer Research Grant, Santander and Monmouth University School of Science

ABSTRACT

The coastal estuaries of central New Jersey are used as nursery grounds for many specific commercially and recreationally finfish and decapod species. These diverse habitats provide a protected environment for species to spawn, and early life stages to develop. Four coastal estuaries, Sandy Hook Bay, Navesink River, Shark River, and Manasquan River, were sampled weekly or biweekly to examine the abundances and diversity of species. Each one of these estuaries had access to the ocean and fresh water sources, but their water compositions and salinities varied, which provided a range of slightly different habitats to examine growth and distribution of the various species we were studying. In 113 beach seines, we captured 46,055 individuals and identified a combined 46 unique species of finfish and decapods. Top finfish species captured included *Menidia menidia* (n=23,874), *Brevoortia tyrannus* (n=18,848), *Fundulus majalis* (n=4,064), *Fundulus heteroclitus* (n=455), and *Pseudopleuronectes americanus* (n=444) while the top decapod was *Callinectes sapidus* (n=359). Sandy Hook Bay was the numerical abundant site fish and decapods (n=15,867) combined while the most diverse estuary was Manasquan Inlet with a diversity value of 1.2001.

This study contributed baseline data on the spatial and temporal trends of species within these different coastal estuaries. To our knowledge, there has not been a published seine survey for these estuaries. This information can be crucial to determining the health of the commercial and recreational fisheries, and could provide clues to environmental factors, which affect growth rate and species distribution.

Assessment of Vertebrate and Microbial Diversity in Local Ecosystems Using Environmental DNA (eDNA)

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Faculty Mentor:
Dr. Martin J. Hicks, Department of Biology

Funding Sources:
Monmouth University School of Science and Monmouth University Urban Coast Institute

ABSTRACT

Oceans and waterways are vast with life. The global preservation of biodiversity in marine environments begins at the local level. The challenge is that life underwater is not easily observable and traditional methods to survey the ecosystems can be disruptive, invasive and time consuming. Advances in DNA sequencing, specifically, next generation sequencing and the tools of genetics and bioinformatics, have made it possible to more easily and non-invasively detect the distribution and abundance of the vertebrates and the microbial world that makes up these aquatic systems. We have begun preliminary experiments collecting eDNA water samples from local environments, Lake Takanassee and the waterway that connects to the adjacent ocean environment of Long Branch, NJ. Water samples (1L) were collected in January and June-July of 2016, eDNA was filtered onto nylon membranes, using PowerWater eDNA purification kit, we isolated eDNA from all samples. To detect, identify and differentiate between species, primers with Illumina tag adapters for the 12s ribosomal subunit were added to the eDNA samples via polymerase chain reaction (PCR). After gel electrophoresis verification of amplicon sizes, Illumina tags were added with a second PCR in preparation for Next-Generation sequencing. The sequences were then characterized using the National Center for Biotechnology Information Basic Local Alignment Search Tool (BLAST), which identifies and compares nucleotide sequences to existing sequenced genomes of various species. With a threshold of ≥99% similarity, we were able to identify the eDNA of Common Carp, Atlantic Menhaden, American Eel, Harbor Porpoise, Canada Goose, and many other species, including land mammals. It is expected that this novel methodology will become an easily approachable and common tool to be used among students and colleagues in the Monmouth University and Urban Coast Institute research community to survey and evaluate the local aquatic environment.

Testing Spliceosome-Mediated RNA *Trans*-Splicing on EGFR Expression in Human Glioblastoma Cell Lines

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Funding Sources:
Bristol-Myers Squibb, Independent College Fund of New Jersey,
Johnson & Johnson and Monmouth University School of Science

ABSTRACT

Glioblastoma multiforme (GBM), the most common central nervous system malignancy, is characterized by overexpression of the tyrosine kinase receptor epidermal growth factor receptor (EGFR). EGFR dimerization activates GBM tumor proliferation and growth pathways. In the strategy presented, we have designed a pre-*trans*-splicing molecule (PTM) engineered to deliver a polyadenylation signal (PAS) into the EGFR pre-mRNA transcript upstream of the transmembrane domain, interfering with GBM tumor proliferation. The use of a double antisense binding domain and a U7 snRNA with SmOpt localization signal will enable the PTM to outcompete the native 3' splice site of the Intron 15-Exon 16 junction, and result in the creation of a shortened EGFR mRNA transcript as the delivered PAS splices in upstream of Exon 16. This shortened transcript translates into a soluble extracellular peptide decoy lacking a transmembrane domain, which inhibits activation of the EGFR pathway by sequestering epidermal growth factor. The PTM was cloned into an adeno-associated viral plasmid vector and delivered to A172 glioblastoma cell lines. Total RNA was isolated from cells, and cDNA was synthesized from reverse transcription reactions using Random Primer Mix and oligo-specific primers. Various primer sets targeting regions of the EGFR gene, namely Exon 14 through Exon 16, were used in PCR reactions to detect for alternative EGFR transcripts in A172 cells. PTM vector expression and treatment induced *trans*-splicing within the target region were also investigated using this strategy.

Determining the Presence of the Endangered Atlantic Sturgeon (*Acipenser oxirynchus*) In Sandy Hook Bay

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Faculty Mentor:
Dr. Keith J. Dunton, Department of Biology

Funding Sources:
Urban Coast Institute Heidi Lynn Sculthorpe Research Grant, Santander and Monmouth University School of Science

ABSTRACT

The Hudson River currently supports one of the largest spawning populations of the federally endangered Atlantic Sturgeon, *Acipenser oxyrinchus,* with large seasonal coastal aggregations well documented in the New York Bight. Sandy Hook Bay is located within close proximity to these areas of known Atlantic sturgeon coastal aggregation and freshwater spawning sites. While Atlantic sturgeon have been historically documented to occur in Sandy Hook Bay, no formal surveys have been conducted to identify their presence/absence.

Sandy Hook Bay is an urbanized embayment important for commercial and recreational fishing, trafficked by high speed ferries, serving as a hub for NYC transport, and is the location of Naval Weapons Station Earle, a weapons loading terminal for the US Navy. The purpose of this project was to determine the presence/absence of A. *oxyrinchus* within Sandy Hook Bay through the use of acoustic telemetry.

This project takes advantage of the large effort in recent years to acoustically tag *A. oxyrinchus* along its range. Acoustic telemetry offers advantages over traditional sampling techniques since it allows the environment to be continuously monitored for the presence of tagged fish. Five acoustic receivers were deployed in late May, and downloaded in June and July. A total of 30 uniquely tagged individual Atlantic sturgeon were detected (n=1,606 detections) over the course of 56 days with some sturgeon spending as much as 24 days within the region. Sturgeon largely came from the New York Bight Distinct Population segment but some came as far as south as Chesapeake Bay (MD) and Edisto River (SC), indicating that multiple DPSs utilize the area. Receivers located along Naval Weapons Station Earle had the highest number of sturgeon detections. This suggests that Sandy Hook Bay may be an important late spring – early summer habitat so proper protection may be needed to protect against localized threats.

DEPARTMENT OF CHEMISTRY AND PHYSICS

ABSTRACTS

Adsorption of Lead and Zinc on Microplastics from Hand, Facial, and Body Cleansers

Momna Ayub, Emily Beyer, Chioma Gabriel, Hannah Hilbrandt and Andrea Mora
Monmouth University

Faculty Mentor:
Dr. T. Tongesayi, Department of Chemistry and Physics

Funding Source:
Monmouth University School of Science

ABSTRACT

Consumer products such as hand, facial, and body cleansers are some of the major sources of microplastics in the natural aquatic system. Besides being water contaminants, microplastics transport chemical and biological pollutants from wastewater to natural aquatic environments through adsorption. By adsorbing chemical pollutants and microorganisms on their surfaces, mircoplastics can also influence the biogeochemistry of metal (loid)s and hence the speciation, mobility, bioavailability, and toxicity of the chemical pollutants in water. In this study we investigated the adsorption of lead and zinc by microplastics extracted from various hand, facial and body cleansers to determine conditions and mechanisms of binding under simulated natural conditions. Our data shows significant binding of both heavy metals under certain pH conditions.

Microplastics in Wastewater and the Marine Environment

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Faculty Mentor:
Dr. T. Tongesayi, Department of Chemistry and Physics

Funding Source:
Monmouth University School of Science

ABSTRACT

The presence of microplastics in the aquatic environment has recently generated high profile scientific discourse. Microplastics are comprised of synthetic polymer products manufactured as additives in various consumer products such as hand, facial, and body cleansers; small pieces from degrading industrial and domestic polymer products; polymeric fibers released by washing of synthetic clothing and plastic abrasion during dishwashing; and preproduction pellets that are used in plastic production. They occur mainly as spheres, fibers, and fragments and enter the aquatic environment primarily via waste disposal and urban runoffs. Microplastics adsorb other chemical pollutants and harbor pathogenic organisms which they then distribute in freshwater and marine environments. In this study, wastewater and marine sampling was undertaken to determine the main sources of microplastics in the aquatic environment. The samples are in the process of being analyzed.

Collection and Analysis of Physico-Chemical Parameters of Water for Assessment of Intertidal Coastal Ecosystems

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Dr. Pedram Daneshgar, Department of Biology

Funding Source:
Urban Coast Institute

ABSTRACT

Atmospheric warming has the potential to cause evident change in the salinity of seawater, due to evaporative loss of surface waters. Much marine life live in a certain salinity range and any significant changes can cause them to migrate elsewhere, causing invasive species in marine ecosystems, or even succumb to the changes in their environment. Mangrove and coastal ecosystems can also be impacted. These ecosystems are important to humans and Earth for various reasons including: nutrient cycling, gas and climate regulation, and bioremediation of waste. This project is very beneficial because it is crucial that we protect our aquatic ecosystems. The first step in preserving these ecosystems is to understand how any changes can negatively affect them. Hence, the goal of this project is to assess how global warming is affecting the salinity of intertidal coastal ecosystems.

The experiment is being carried out using a data station assembled with both temperature and salinity probes to obtain data for about 20-40 hours. This information will be stored in a database for further analysis. The experiment is first being executed in a laboratory setting using dilutions of salt water made from a stock solution. Different environments will be stimulated in the lab such as increasing temperatures and recording salinity as it cools and also recording salinity evaporating solution over time. Once the experiment is tested and finalized in the laboratory it will then be performed in a green house and left overnight to collect data. The stations will then be left over night in various lakes. Our hypothesis is that the results will show an increase in overall salinity and a correlation will be made between increased salinity and atmospheric warming.

Pursuit of a Bidentate Ligand for an Eight-Coordinate, Dodecahedral Rhenium(V) Center

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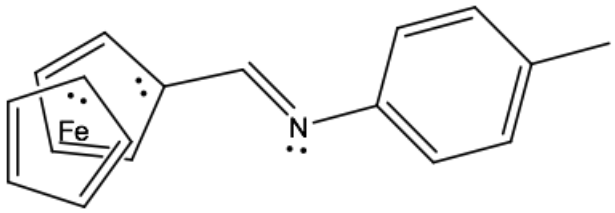
Faculty Mentors:
Dr. Gregory A. Moehring, Department of Chemistry and Physics

Funding Source:
Monmouth University School of Science

ABSTRACT

The goals of this research were twofold; to prepare a compound with a single rhenium(V) eight-coordinate center that supports a second metal center and to reduce the symmetry of certain eight-coordinate rhenium(V) centers supported by a chelating imine ligand by introducing a nonsymmetrical imine into the rhenium coordination sphere. The material that was used to reach these goals was an imine-substituted derivative of ferrocene (Figure). The nonsymmetrical nature of the ferrocene derivative also presented an ideal ligand to test the nature of eight-coordinate rhenium(V) centers supported by a single imine ligand.



In our work we analyzed tetrahydride imine molecules, in particular ReH4[η^2-(C5H5)Fe(C5H4)CH=N(p-tolyl)](PPh3)2 which is a molecule that forms two bonds with the rhenium center in a way that makes a five member ring. In a reaction with a symmetrical imine the triphenylphosphine ligands on the rhenium are in B sites of one trapezoidal plane. The five member ring is formed on the second trapezoidal plane. Tetrahydride ferrocenyl imine will form in two isomeric forms where the first isomer would have a mirror plane symmetry element if it were not for the ferrocene group and the second is unsymmetrical regardless of the imine. Because of the very large ferrocene molecule that is a substituent on the five member ring the symmetrical structure is less favorable sterically and the unsymmetrical structure is formed in a larger amount which can be determined from phosphorous NMR.

Evaluation of Selectivity of Binding of Diminazene and its Alkyne Analogs to DNA

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Funding Source:
Sparta Systems and Monmouth University School of Science

ABSTRACT

The binding of organic ligands to telomeric G-quadruplex DNA (gqDNA) may act as an anti-cancer therapy. The stabilization of gqDNA using polycyclic aromatic ligands, in particular, diminazene (DMZ) and its alkyne analogs, has been shown to prevent the rapid cell division that ultimately leads to cancer.[1] However, these ligands, when placed into an environment that contains double stranded DNA (dsDNA) and gqDNA, have displayed possible toxic effects due to their high affinity to dsDNA. A higher binding affinity to dsDNA may interfere with gene replication depending on the place of binding. The modeling presented here has been to test the relative affinities (binding energies) of DNA-ligand binding in order to establish the ligand structure that will provide the best selectivity for gqDNA. By simulating a natural molecular environment, an efficient assessment can be made using several computational trials conducted through various methodologies (e.g. molecular docking, molecular dynamics simulations). This work is focused on the testing of interactions of recently synthesized polycyclic aromatic ligands, namely DMZ and three of its analogs.

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Intramolecular Hydrogen Exchange at Rhenium (V) Pentahydride Centers Supported by a Primary Amine Ligand with or without a Dangling Functional Group

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Faculty Mentor:
Dr. Gregory A. Moehring, Department of Chemistry and Physics

Funding Source:
Monmouth University School of Science

ABSTRACT

Previous work has documented the hydrogen exchange that occurs between the hydride ligands of rhenium heptahydride compounds and benzene. Since rhenium heptahydrides aid in the transformation of small molecules, they are reported as catalysts which is why there is a continuing interest in rhenium heptahydrides. There was only one form of hydrogen exchange that has been reported for heptahydrides involving the complex and the solvent molecules such as, benzene, methanol, aniline, or water. Nothing has been previously documented with the intramolecular hydrogen exchange in rhenium pentahydrides. In this study, rhenium pentahydrides containing a primary amine ligand also show hydrogen exchange. Rather than a hydrogen exchange with the solvent, it is an intramolecular hydrogen exchange. The exchange occurs with the ortho protons, the amine protons, and the hydrides which are shown through NMR spectroscopy. Our group explored diamino propane, ethylene diamine, n-butylamine, and ethanol amine as ligands which have all expressed the exchange with the exception of ethanol amine which reacts differently because of the dangling hydroxyl. The results for all four molecules will be shown along with their corresponding spectrum.

DEPARTMENT OF COMPUTER SCIENCE
AND
SOFTWARE ENGINEERING

ABSTRACTS

DYNAMO (Dynamic Mobile Object Identification and Location)

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Faculty Mentor:
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Funding Sources:
Johnson & Johnson, Independent College Fund of New Jersey, Monmouth University School of Science and Monmouth University Department of Computer Science and Software Engineering

ABSTRACT

DYNAMO is applied research, the core of which is fueled by data created by Wireless Network Sensors. DYNAMO used GPS, active and passive RFID, and drone video sensors. Data from these actual sensors plus data from a DYNAMO Simulation Toolkit, built as part of the project, was used to illustrate systems and applications that would derive value from this sensor data. These applications include monitoring athletes competing in the Rio Olympics triathlon, tracking 1st responders in an active shooter incident at Monmouth University, and conducting a water search for remnants of an air disaster.

The student researchers explored DYNAMO by:

- Creating a prototype of the three applications
- Compiling data from a ThingMagic RFID system and video from the operation of a YUNEEC quadcopter drone
- Empirically determining the best location algorithm for the passive RFID data in a defined space
- Experiencing the importance of both communications and teamwork on a project
- Developing a Database that would house all necessary data to execute the prototype
- Researching pattern recognition techniques and the development of software modules to recognize objects automatically from video
- Developing an extensive User Interface for the DYNAMO prototype
- Creation of a DYNAMO Simulation Toolkit that allows researchers to create simulated data sets for active and passive RFID and GPS

HARDBALL
Monmouth University's Answer to Fantasy Baseball

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Faculty Mentor:
Professor Gil Eckert

Funding Source:
DefinedLogic and Monmouth University School of Science

ABSTRACT

Fantasy Sports is a wildly popular pastime that lends itself well to simulation. The research for this project centered on selecting the most meaningful indicators of Major League Baseball (MLB) player performance then building a scoring system around them. When the game begins, teams for each game player for each week of the season are randomly selected. Points are awarded to all game players each week based on how the MLB players on their teams have actually performed. The leaderboard shows the weekly standings of all HARDBALL game players. The final week of the shows cumulative point totals, 1st, 2nd, and 3rd place winners and payouts.

HARDBALL uses MLB player statistics from a website called FANGRAPHS. Statistics are downloaded for each week of the MLB baseball season and imported to the *fantasy_baseball* database in MySQL. This process was automated using a browser tool called iMacro, Microsoft Excel Macros, and SQL, all run as batch commands. The key MLB player statistics used by HARDBALL to award points were BABIP and ERA (for pitchers) and wOBA (for batters). Batting Average on Balls In Play (BABIP) measures how often a ball in play goes for a hit. Weighted On-Base Average (wOBA) is a rate statistic which attempts to credit a hitter for the value of each outcome (single, double, etc.) rather than treating all hits or times on base equally. Earned Run Average (ERA) is a statistic used to measure a pitcher's effectiveness, obtained by calculating the average number of earned runs scored against the pitcher in every nine innings pitched.

HARDBALL was developed on, tested on, and runs on a self-contained Windows laptop computer. Programming consists of HTML, CSS, PHP, Javascript, and SQL in the MAMP environment.

Analyzing Big Company Data for Meaningful Results

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Faculty Mentor
Dr. Raman Lakshmanan, Department of Computer Science and Software Engineering

Funding Source:
The Macaluso Group

ABSTRACT

Analyzing and presenting collected data for meaningful results is a complex problem when the audience has different requirements. Providing the same analysis to all users doesn't meet the needs, while customizing for each user is cost prohibitive. The goal of the project was to research, identify, evaluate and select the appropriate data analytics tool for analysis and presentation of large volume of data in a healthcare services application.

The Macaluso Group administers patient copay services on behalf of major pharmaceutical companies. The cloud-based application collects large amounts of data from patients, healthcare providers, health insurers and pharmacy prescription fulfillment.

The project evaluated several tools and selected Micro Strategy Business Intelligence and Analytics tool. The primary task was to architect meta data definitions and relationship model for analytics from collected data in a relational database schema. The meta data was used to create various business analytics and intelligence dashboards to meet requirements of various users and answer "what if" questions in a highly interactive manner using reports, charts, maps, and intuitive filters.

Rx-Terminal
Improved Patient Care Using Custom Terminal Application

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Faculty Mentor:
Dr. Raman Lakshmanan, Department of Computer Science and Software Engineering

Funding Source:
The Macaluso Group

ABSTRACT

Patient copay assistance programs offered by pharmaceutical companies offset the high cost of life-saving prescription medications. The Macaluso Group runs cloud-based software systems to efficiently administer these programs. Copay cards are issued to patients for use at physicians' offices, hospitals and treatment clinics. The cards are currently processed on a standard credit card processing terminal where the interaction is limited to the only the copay amount transaction.

The goal of this project was to design and develop a custom interactive terminal application to present and collect much more data associated with patient copay service. The application operates on a highly secured network and the data collected will measure the effectiveness of these programs in real time. These specialized terminals will be provided to thousands of physician offices and clinics to process copay cards.

The custom terminal application was developed in C-language under the Linux operating system and interacts with cloud service using HTTPS protocol and XML for data exchange.

Software Test Automation

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Monmouth University

Faculty Mentor:
Professor Edwin R. Torres, Department of Computer Science and Software Engineering

Funding Source:
WorkWave

ABSTRACT

The objective of this research is to explore ways to improve the testing of web-based software. Manual software testing is a time-consuming process performed by a human sitting in front of a computer, carefully navigating application screens, trying various input combinations, comparing results to expected behaviors, and recording test results. However, with automated testing tools, a tester can create reusable tests, automatically execute tests, and easily compare actual outcomes with expected results. This special software can play back prerecorded and predefined actions, compare the results to expected behaviors, and report the results to a tester. Once automated tests are created, they can be repeated easily and extended to perform tasks not possible with manual testing.

In order to accomplish these testing improvements, an automated testing tool called Selenium was selected to provide recording, editing, and debugging capabilities. Combined with Firebug, the most popular and powerful web development tool which facilitates live debugging, editing, and monitoring of a website's CSS, HTML, DOM, XHR, and JavaScript files, Selenium allows a tester to programmatically communicate directly with a browser, fill in forms, test functions of the various elements in the web page, reduce the time needed to create test cases, and minimize test execution times as much as possible.

To assist with the creation of Selenium test cases, a new software tool was developed to identify and categorize HTML elements from a URL or local file. Using the JSoup library, this software tool automatically retrieves elements and their properties from a web document. The resulting list will help testers easily identify the elements of web page and minimize the time needed for test case creation.

DEPARTMENT OF MATHEMATICS

ABSTRACTS

Small Sample Analysis

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Faculty Mentor:
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Funding Sources:
Monmouth University School of Science and Monmouth University Math Learning Center

ABSTRACT

We are interested in discovering and learning about techniques to tackle small sample sizes. Clients often have come to Dr. Bastian with datasets that have small sample sizes, which usually break the assumptions of the parametric tests, so the results of these tests might not be valid. We have researched different statistical methods that are relatively unknown and could be proven useful for small sample analysis.

Parametric tests rely on the assumption that the data in the sample can be assumed normal (among other assumptions), which is a judgement call and is based on your opinion of normality. Non-parametric tests would be the next choice if data is not normal, but they require independent random samples, and may require you to edit your original hypothesis. Randomization Tests, Bootstrapping, and Monte Carlo Methods are a few methods of statistical analyses that we discovered for small sample sizes.

In our study we used two sample datasets and compared the results of three tests: a parametric test, a non-parametric test, and a randomization test. The datasets had sample sizes of 10 and 20, which are less than desired, since a sample size of 30 is required to assume normality. The parametric test that we applied was a two sample t-test, and the non-parametric test was the Mann-Whitney test. We continued to use these tests even though normality cannot be assumed. For the randomization test, we wrote code for a test of two samples in R Studio. The results of the randomization test showed that it was more accurate: The second dataset had a very obvious difference in means, 66.8 vs 274.8, but only the randomization test caught this difference, most likely due to the fact that the size of the sample was only 10.

Transfer of Gene Encoding on anti-EGFR Monoclonal Antibody for the Treatment of GBM

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ABSTRACT

Glioblastoma treatment has not changed in the past 30 years, creating the demand for new therapy options. Located in the brain is a blood-brain barrier that inhibits successful treatment therapies. What has been discovered is an alternative method to prevent the spread of precancerous cells in the brain. During resection of the brain tumor, a therapy is injected into the affected area. The therapy consists of a gene (or DNA) that codes for anti-EGFR (Epidermal Growth factor receptor) antibodies (Cetuximab). This allows for the binding of the EGFR and prevents the growth of any precancerous cells. The goal of this study was to test if these new therapy methods were successful in the prevention of precancerous cells.

In order to test this new therapy, a survival analysis completed on three different mice groups as well as the control group of mice. In this experiment, two groups of mice were injected with a tumor called U087MD; following the implantation, one group of mice was given a simultaneous AAV-anti-EGFR while the other group received an 8-day post Xenograft AAV-anti-EGFR. There was also a third group injected with a different tumor called 0709, this group then received a 3-week post-Xenograft AAV-anti-EGFR.

It was concluded through the survival analysis that the mice who received both the simultaneous AAV-anti-EGFR and the 8-day post Xenograft AAV-anti-EGFR lived longer than the mice who received the U087MD tumor without any treatment. This experiment was limited to animal trials, however it remains to be a significant discovery that can potentially be monumental to society.

Sexual Dimorphism in the Human Pelvic Bones

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ABSTRACT

The lifestyle in which an individual grows up can greatly impact the way his or her body and bones develop. Dr. Hilary DelPrete is a Biological Anthropologist who is interested in studying how environmental factors can affect the human skeleton. She collected various pelvic measurements from four different locations. The data that we analyzed consisted of five different pelvic measurements and six populations. The focus of our analysis was to answer the question: are sexually dimorphic traits within one population the same across different populations?

To answer our research question various steps were taken. The data had to be checked for normality before any further tests were conducted. After the normality assumption passed an ANOVA, Analysis of Variance, was ran. An ANOVA was used to determine whether there are any significant differences between the means of three or more independent measurements. We recoded our data to make the analysis run more smoothly. Each variable consisted of a location, gender, and ethnicity. For example, 210 means Coimbra, Portugal, Female, White. Also, a univariate test was used to see if there were interactions between gender and collection.
As a result, we discovered that for all locations the measurements of the PS of the Inlet, the PS of the Midplane, the Bi-Spinous, and the PS of the Outlet all have a statistic difference for males and females. The average measurement of the AP Inlet for males does not have a significantly statistical difference among the six populations. Across the six populations there is no trend of differences. Only the PS of the Inlet had interactions between gender and collection.

A Comparison of the Effectiveness of Internal and External Acoustic Telemetry Tags in Atlantic Sturgeon *(Acipenser oxyrinchus)*

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ABSTRACT

Atlantic sturgeon are a federally protected species of fish on the Atlantic coast that are monitored using acoustic telemetry. Up to this point, tags have been surgically implanted in fish. A new method of external tagging was tested to compare effectiveness. Dr. Keith Dunton tagged 40 Atlantic sturgeons with both internal and external tags. Data was collected from receivers along the Atlantic coast that received a signal whenever a fish came within range.

The objective of our research was to determine and conduct the most effective methods of statistical analysis for this experiment. Effectiveness of internal and external tags was measured by how long the tag picked up signals before it stopped working and the total number of readings per tag. The null hypothesis was that there would be no difference between the tag types.

A Kaplan-Meier survival analysis was used to determine if there was a significant difference between the survival time of internal and external tags. A paired t-test was used to compare the total number of recordings from internal and external tags to determine if one type of tag was picking up more signals than the other. The null hypotheses were accepted in that there was no significant difference between the survival time of internal and external tags, nor did one type of tag pick up more signals than the other. These findings suggest that external acoustic telemetry tags are equally as effective as internal tags for short-term studies on Atlantic sturgeon of up to 7 months.