MONMOUTH UNIVERSITY
SCHOOL OF SCIENCE

MONMOUTH UNIVERSITY
STUDENT SCHOLARSHIP WEEK

School of Science

Annual Student Research Conference

Friday April 23, 2021

Department of Biology

BY-1 IMAGES OF PHYTOPLANKTON WITHIN LOWER HUDSON-RARITAN ESTUARY AND MONMOUTH COUNTY COASTAL LAKES

Nicholas Box and Maria Riley
Faculty Mentor: Dr. Jason E. Adolf

https://youtu.be/z7A64mS-B98

BY-2 MEASURING THE ABUNDANCE OF PHYTOPLANKTON ACROSS DIFFERENT REGIONS OF THE LOWER HUDSON-RARITAN ESTUARY USING FLOW CYTOMETRY

Christine Gabbidon
Faculty Mentor: Dr. Jason E. Adolf

https://youtu.be/U-4govkg0BE

BY-3 QUANTITATIVE POLYMERASE CHAIN REACTION ASSAYS OF FECAL INDICATOR BACTERIA AT NEW JERSEY'S SURFING BEACHES

Rebecca Long
Faculty Mentor: Dr. Jason E. Adolf

https://youtu.be/sc3bcbSi74Q

BY-4 SPATIAL AND ENVIRONMENTAL VARIABILITY OF HAB ABUNDANCE AND TOXICITY IN MONMOUTH COUNTY COASTAL LAKES

Karly Nolan
Faculty Mentor: Dr. Jason E. Adolf

https://youtu.be/LuZWHErwwTg

BY-5 ANTI-COVID MICRORNA THERAPY TO BLOCK THE EXPRESSION OF THE SPIKE AND NUCLEOCAPSID GENES OF SARS-COV-2

Victoria DeMarco
Faculty Mentor: Dr. Martin J Hicks

https://youtu.be/K4MOTsgL_3s

BY-6 GENE THERAPY FOR BRAIN TUMORS: IDENTIFICATION OF NEW THERAPEUTIC TARGETS BASED ON RNA STRUCTURE

Laura C. Sine
Faculty Mentor: Dr. Martin J Hicks

https://youtu.be/CFIX93ZO8EA

BY-7 RNA THERAPEUTICS FOR THE TREATMENT OF BRAIN TUMORS AND COVID-19: DEVELOPMENT OF MOLECULAR BIOLOGY AND TISSUE CULTURE SKILLS TO GENERATE AND TEST NOVEL THERAPIES

Thomas M. Hintelmann, Noa I. Bass and Joseph Torkieh
Faculty Mentor: Dr. Martin J Hicks

https://youtu.be/DB0fRj0dQrI

BY-8 THE EFFECTS OF KUMQUAT OIL ON THE PROLIFERATION AND VIABILITY OF CANCER CELL LINES AND NORMAL HUMAN FIBROBLAST CELLS

Subah Soni and Mruga Parekh
Faculty Mentor: Dr. Dorothy Lobo

https://youtu.be/tZAX00juzDI

BY-9 CREATION OF A HYPOXIC STATE DECREASES THE PROLIFERATION OF HT-1080 FIBROSARCOMA CELLS

Joyce Almeida, Arianna DeCaro and Gabrielle Storino
Faculty Mentor: Dr. Dorothy Lobo

https://youtu.be/yHZNDNB82fY

BY-10 THE INHIBITING EFFECTS OF ESSENTIAL OILS (Eos) AND METHYLGLYOXAL ON THE GROWTH OF MULTIDRUG RESISTANT *Enterobacter cloacae* and *Pseudomonas aeruginosa*

Gabriella Cleven and Jackalyn Durante
Faculty Mentor: Dr. James P. Mack

https://youtu.be/EIsHF9l-stQ

BY-11 ALTERED CHOLESTEROL LEVELS IN ALCOHOL-ADAPTED LIPID RAFTS FROM ADOLESCENT BRAIN MEMBRANES

Grace L. Haemmerle
Faculty Mentor: Dr. D. E. Rhoads

https://youtu.be/xIhtIVeF0Dc

BY-12 AMPHETAMINE CO-CONSUMPTION ANTAGONIZES UPREGULATION OF RAFT-BASED NMDA RECEPTORS BY ALCOHOL IN ADOLESCENT BRAIN

Nicholas Pillarella
Faculty Mentor: Dr. D. E. Rhoads

https://youtu.be/Akf_MEH1EXA

BY-13 CHARACTERIZING EARTHWORM RELATIVE ABUNDANCE AT LONG-TERM STUDY SITES: A FIRST EVALUATION FOR SPARCNET

Angelina Ireland and Rebecca Berzins
Faculty Mentor: Dr. Sean C. Sterrett

https://youtu.be/Mep_pQAelr8

BY-14 ECOLOGY BIAS IN SCIENTIFIC JOURNALS

Christiana Popo
Faculty Mentor: Dr. Sean Sterrett & Dr. Pedram Daneshgar

https://youtu.be/0QoFrj7SVfc

BY-15 SPARCNET, NEW JERSEY: CAPTURE AND SITE CHARACTERISTICS OF ARTIFICIAL COVER BOARD PLOTS AT HUBER WOODS, 2019-2020

Jessica Maguire and Ralya Ragin
Faculty Mentor: Dr. Sean C. Sterrett

https://youtu.be/uRk4S6OS16o

BY-16 BENTHIC MACROINVERTEBRATES OF RARITAN BAY

Elizabeth Gill and Scott Pescatore
Faculty Mentor: Assistant Dean John Tiedemann

https://youtu.be/VLIHH_jw0A0

BY-17 Seals Population Of Sandy Hook Bay

Trinity Caratenuto
Faculty Mentor: Assistant Dean John Tiedemann
Joseph Reynolds, President, Save Coastal Wildlife

https://youtu.be/-pfLdWzY6v4

Department of Chemistry and Physics

CE-1 INVESTIGATING GRAVITY EFFECT ON SWIMMING PARAMECIA USING ELECTRIC FIELD

Colin Bosak
Faculty Mentor: Dr. Ilyong Jung

https://youtu.be/8N6Ro2K-q0U

CE-2 INTERMOLECULAR INTERACTIONS OF LIQUEFIED PETROLEUM GAS-ALCOHOL MIXTURES WITH PHYLLOSILICATES

Amanda Victoria Prascsak
Faculty Mentor: Dr. Yana Kholod Kosenkov and Dr. Dmitri Kosenkov

https://youtu.be/UTP54Eo3c8A

CE-3 PHYSICAL AND CHEMICAL LIMITATIONS REGARDING EXTRACTION METHODS OF MICROPLASTICS FROM CONSUMER AND COMMERCIAL SOAP PRODUCTS

Luke M. Collier
Faculty Mentor: Dr. Tsanangurayi Tongesayi

https://youtu.be/DCJCQfy3kpQ

Department of Computer Science and Software Engineering

CSSE-1 THE INFLUENCE OF RPAs IN THE BUSINESS FIELD: IN WHAT MANNER WILL ROBOTS AFFECT THE ECONOMY?

Haemah Akhtar and Ashley Zingillioglu
Faculty Mentor: Gil Eckert

https://youtu.be/nmt5B6noM68

Department of Mathematics

MA-1 ADJUSTING PELVIC MEASUREMENTS TO ACCOUNT FOR SIZE

Samantha Colucci and Andrew Portaro
Faculty Mentors: Dr. Richard Bastian, Department of Mathematics
Dr. Darmon, Department of Mathematics
Dr. DelPrete, Department of History and Anthropology

https://youtu.be/YLS9ZToouz4

MA-2 COVID-19 TREATMENT IN AN ETHNICALLY DIVERSE AREA

Lilia Crew and Fatima Gohar (Statistical Analysis)
Saraanne Maia (Originator and Data Collection)
Faculty Mentors: Dr. Richard Bastian, Department of Mathematics
Dr. David Darmon, Department of Mathematics
Dr. Jeffrey Weisburg, Department of Biology

https://youtu.be/HADAqWx89iA

MA-3 EFFECTS ON WATER QUALITY FROM ENVIRONMENTAL CONDITIONS ON HILO BAY

Odalys Barrientos and Brianna Cirillo
Faculty Mentors: Dr. Richard Bastian, Department of Mathematics
Dr. David Darmon, Department of Mathematics
Dr. Jason E. Adolf, Department of Biology

https://youtu.be/7-5QCndqiS0

MA-4 GUITAR HERO: LEGENDS OF RANDOMNESS

Odalys Barrientos, Burke Gray and Emily Tumbaco
Faculty Mentor: Dr. Richard Bastian

https://youtu.be/wpkdPLbrgIM

MA-5 STATISTICAL ANALYSIS OF DIET AND LOCATION IMPACT ON HOUSE MICE GROWTH

Lorena Mancino and Emily Tumbaco
Faculty Mentors: Dr. Richard Bastian, Department of Mathematics
Dr. David Darmon, Department of Mathematics
Dr. Megan Phifer-Rixey, Department of Biology

https://youtu.be/nKS5BXmHlFc

DEPARTMENT OF BIOLOGY

BY-1

IMAGES OF PHYTOPLANKTON WITHIN LOWER HUDSON-RARITAN ESTUARY AND MONMOUTH COUNTY COASTAL LAKES

Nicholas Box and Maria Riley
Department of Biology

Faculty Mentor: Dr. Jason E. Adolf

ABSTRACT

Phytoplankton are photosynthetic aquatic organisms found in both oceanic and freshwater ecosystems. They form the base of most aquatic food webs and account for about half of the atmospheric O2 we breathe. Although these species are important, they can sometimes have negative environmental impacts. Harmful Algal Blooms (HABs) occur when colonies of phytoplankton undergo a period of uncontrolled and rapid growth or accumulations leading to toxic conditions. This project involves microphotography of phytoplankton found within the Lower Hudson-Raritan Estuary and various coastal lakes within Monmouth County. Water samples are placed under a Nikon Diaphot 300 microscope and the images where captured with a Diagnostic Instruments HR100-CMT camera. These images serve several purposes, but the main focus is on tracking biodiversity in estuarine and coastal lake environments, cataloging potentially harmful species and developing a tool that can be used by other students and researchers addressing regional phytoplankton questions.

BY-2

MEASURING THE ABUNDANCE OF PHYTOPLANKTON ACROSS DIFFERENT REGIONS OF THE LOWER HUDSON-RARITAN ESTUARY USING FLOW CYTOMETRY

Christine Gabbidon
Department of Biology

Faculty Mentor: Dr. Jason E. Adolf

ABSTRACT

Phytoplankton are an important component of marine, estuarine, and freshwater ecosystems providing a critical input of primary production that fuels ecosystem productivity. However, in contaminated environments, it is possible that excess phytoplankton growth, Harmful Algal Blooms (HABs), can form and later negatively affect marine life worldwide. Although, some phytoplankton are relatively large (20 to 100 microns) and easily seen under the microscope, others are small (0.5 –20 microns) and are more easily counted with instruments like the flow cytometer. In the lab, I have been testing the phytoplankton that are present in ocean water collected from the lower Hudson-Raritan Estuary using a flow cytometer. Six different groups of samples have been collected and I am testing a sample each week. Each group of samples has 12 different tubes that account for different parts of the ocean, deep and shallow levels. The goal of this study was to measure the abundance of these small phytoplankton across different seasons and regions of the Lower Hudson-Raritan Estuary in order to identify 'hot spots' of high abundance that could indicate regions of high primary production and or potential Harmful Algal Blooms which could potentially reduce the level of oxygen in the ocean.

BY-3

QUANTITATIVE POLYMERASE CHAIN REACTION ASSAYS OF FECAL INDICATOR BACTERIA AT NEW JERSEY'S SURFING BEACHES

Rebecca Long
Department of Biology

Faculty Mentor: Dr. Jason E. Adolf

ABSTRACT

Monmouth County's beaches attract local and out of state visitors throughout the year. Microbial surf pollution, measured as the quantitative presence of the fecal indicator bacteria (FIB) *Enterococcus*, can enter the surf zone through municipal stormwater discharge and create unsafe conditions for swimmers. Despite year-round threats of microbial surf pollution, the New Jersey Department of Environmental Protection (NJDEP) does not monitor water quality during fall, winter, and spring months, which includes the prime surfing season. As such, these beaches are in use while stormwater discharge continues due to ongoing precipitation. The Surfer's Environmental Alliance (SEA) partnered with Monmouth University to test local beaches for *Enterococcus* over the 'surf' season. *Enteroccocus* can be accurately measured through the use of growth-dependent assays (IDEXX), but these assays require 24 to 48 hours for completion. In the current project, filtered water from these samples is used for DNA extractions and quantitative polymerase chain reaction (qPCR) assays, which allow for an estimate of the total number of *Enteroccocus* gene copies that were in the original filtered sample, regardless of their ability to metabolize the applied medium. By comparing IDEXX and qPCR assays, we will be able to assess the effectiveness of the two methods in comparison to one another and validate the use of qPCR for additional FIB monitoring efforts. If processed qPCR assay results are comparable to those found through plate assay analysis, qPCR could present a faster and more efficient method for monitoring and determining the levels of FIB at New Jersey's surfing beaches.

BY-4

SPATIAL AND ENVIRONMENTAL VARIABILITY OF HAB ABUNDANCE AND TOXICITY IN MONMOUTH COUNTY COASTAL LAKES

Karly Nolan
Department of Biology

Faculty Mentor: Dr. Jason E. Adolf

ABSTRACT

Harmful algal blooms (HABs) are a known and increasing environmental threat in freshwater systems such as coastal lakes. Researchers believe that climate change-driven increases in temperature and precipitation as well as increasing human development and populations drive increasing HABs. The presence of HABs can result in harm to the environment and lead to regulatory responses that limit community access to coastal lakes because the organisms that cause HABs, cyanobacteria, can make potent neuro- and hepatotoxins. The aim of this research was to gather data on HAB abundance in Monmouth County coastal lakes by measuring cyanobacteria and toxin abundance in each lake and observing how these variables may change alongside environmental and spatial variability. This research was an extension of the Coastal Lakes Community Observing Network (CLONet), which includes ten coastal lakes that have previously demonstrated evidence of HABs. It was hypothesized that spatial and environmental variability (e.g. rainfall) explain summer variability in coastal lake HAB and toxin abundance. Certain lakes, such as Deal Lake, presented a significant difference in HAB abundance and turbidity. A pattern evolved during the weeks of observation in which changes in rainfall were followed by correlated changes in HAB abundance. Chlorophyll abundance and toxin abundance were also observed via qPCR assays of selected samples. The information gleaned from this research could be used to predict freshwater HAB events in Monmouth County in the future. Understanding the origin of local environmental concerns can inform steps to preserve lakes so that they may continue to be a valued resource for the surrounding community.

BY-5

ANTI-COVID MICRORNA THERAPY TO BLOCK THE EXPRESSION OF THE SPIKE AND NUCLEOCAPSID GENES OF SARS-COV-2

Victoria DeMarco
Department of Biology

Faculty Mentor: Dr. Martin J Hicks

Funding Sources: Bristol-Myers Squibb

ABSTRACT

Emerging viral diseases have increased in recent decades. In December 2019, an epidemic with low respiratory infections emerged in Wuhan, China. The disease, Covid-19 was found to be caused by a novel coronavirus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). As of February 10, 2021, WHO has confirmed 107,300,544 global cases and 2,352,098 deaths worldwide, 471,195 in the USA. Fortunately, a vaccine has recently been approved, yet there are no therapeutics for infected individuals, and the threat of emerging vaccine-resistant strains remain. From advances in biotechnology, the genome and structure of SARS-CoV-2 is known. Three proteins are anchored in the viral envelope, Spike (S), Envelope (E), and Membrane (M), which is linked to the Nucleocapsid (N) protein connecting to the viral RNA genome. Our lab is developing an innovative therapy that delivers multiple therapeutic microRNAs to simultaneously block the expression of these distinct viral proteins. In the current work, we propose an anti-Covid microRNA therapy designed to degrade each of the mRNA transcripts of these critical genes, stopping viral assembly, and reducing the severity of infection. The design of the anti-Covid microRNAs 1) mimics human microRNA cluster 17-92a structural stability, 2) forms guide-RNA substrates for the RNA induced silencing complex, and 3) are complementary to specific regions of the SARS-CoV-2 RNA genome without off-targets effects in the human genome. Twenty-one microRNA sequences were designed to target the S gene, six for N, two for M, and one for E. These were cloned into our microRNA-17-92 therapy vector which expresses six distinct anti-Covid RNA therapeutics simultaneously. We are stably transfecting the S and N gene into our tissue culture model to measure the efficacy of the anti-Covid microRNA therapy to down-regulate the S and N protein expression.

BY-6

GENE THERAPY FOR BRAIN TUMORS: IDENTIFICATION OF NEW THERAPEUTIC TARGETS BASED ON RNA STRUCTURE

Laura C. Sine
Department of Biology

Faculty Mentor: Dr. Martin J Hicks

Funding Sources: Bristol-Myers Squibb

ABSTRACT

Individuals diagnosed with glioblastoma multiforme (GBM) have a short life expectancy of 12-15 months. This project is to develop therapies for effective and continuous drug delivery to the brain, targeting cancer-driving genes. Tumor cell proliferation in GBM is often stimulated by epidermal growth factor receptor (EGFR) and is important for tumor cell survival. In our lab, we are developing RNA therapies to alter the splicing mechanism of EGFR to block its activation, thus stop tumor cell growth. Our approach uses an adeno-associated virus gene transfer vector encoding RNA therapeutics targeting critical elements of the EGFR pre-mRNA transcript. We have examined the 'pre-mRNA structurome' of EGFR to evaluate the accessibility of targetable regions. To advance our therapeutic strategy, we have analyzed the secondary structure of the EGFR transcript using selective 2' hydroxyl acylation and primer extension followed by mutational profiling (SHAPE-MaP). SHAPE-MaP reactivity profiles were generated revealing the structure of splicing and cryptic polyadenylation signal (PAS) elements within the targeted region. We identified enhancer binding motifs surrounding the 5' splice site and hidden elements of a cryptic polyadenylation signal. Based on these structural profiles, we generated RNA therapies interact with structural elements to unravel the hidden polyadenylation signal with the potential to activate expression of the short therapeutic isoform. My project is to clone these therapies into our therapeutic deliver platform and test their efficacy to downregulate EGFR gene expression in tissue culture cell. In the future, I will be generating a DNA template to transcribe the novel RNA therapeutics and working with collaborators I would like to evaluate their in vitro interaction with the target sequence of the EGFR pre-mRNA transcript.

BY-7

RNA THERAPEUTICS FOR THE TREATMENT OF BRAIN TUMORS AND COVID-19: DEVELOPMENT OF MOLECULAR BIOLOGY AND TISSUE CULTURE SKILLS TO GENERATE AND TEST NOVEL THERAPIES

Thomas M. Hintelmann, Noa I. Bass and Joseph Torkieh
Department of Biology

Faculty Mentor: Dr. Martin J Hicks

Funding Sources: Bristol-Myers Squibb

ABSTRACT

The Hicks Lab focuses on the development and testing of gene therapy vectors that encode novel RNA therapeutics for the treatment of glioblastoma multiforme (GBM) and Covid-19. We have developed RNA Therapeutic platforms that may be directed against oncogenic RNA transcripts in cancers as well as critical sequences of the SARS-CoV-2 Genome. In the first year of laboratory research in the Hicks Lab, we have completed a series of labs with the objective to use molecular cloning to make a novel gene therapy vector. These therapies are designed to either inhibit the overexpression of oncogenes in brain tumors or target genes of SARS-CoV-2. We were introduced to PubMed and Genbank to research the background of a target genes. We learned to use DNA analysis software, Serial Cloner, as an interactive tool to evaluate DNA sequence motifs and visualize the design of an antisense gene therapy. Using the platform system, we generated a vector with a novel and unique therapy. We have learned the skill and techniques of tissue culture and transfection into mammalian tissue culture cells and subsequently collect RNA to verify the effect of the therapy vector on the target gene. We will be presenting the molecular cloning and experimental protocols that we carried-out during the fall, winter and spring. We have generated new clones to use in gene therapy, we have begun developing stably transfected cell lines perfecting our tissue culture skills and have begun testing some of these novel therapies in tissue culture cell lines. We will be presenting our results that include verification of novel therapeutic plasmid clones, transfection of these therapies into human cells, and evaluation of these novel therapies to alter RNA expression.

BY-8

THE EFFECTS OF KUMQUAT OIL ON THE PROLIFERATION AND VIABILITY OF CANCER CELL LINES AND NORMAL HUMAN FIBROBLAST CELLS

Subah Soni and Mruga Parekh
Department of Biology

Faculty Mentor: Dr. Dorothy Lobo

ABSTRACT

Kumquats are small citrus fruits produced by the *Fortunella japonica* tree. In addition to its aroma, kumquat essential oil may have anti-proliferative effects, however research on the effects of kumquat essential oil on human cell lines is limited. A variety of human cell lines (HT-1080 fibrosarcoma cells, HeLa cervical adenocarcinoma cells, and CUA-4 normal human fibroblasts) were treated with kumquat essential oil at different concentrations and the effects on cell proliferation were ascertained. Proliferation was quantified by direct cell counting utilizing trypan blue dye exclusion, and viability was also measured using an MTT assay. As the concentration of essential oil increased, proliferation decreased, with a concentration of 500 □g/ml kumquat essential oil significantly decreasing the proliferation of all three cell lines tested. High concentrations of kumquat oil (500 µg/ml) also significantly decreased MTT activity in all three cell lines. To determine if the decreased cell number was the result of apoptosis, PARP cleavage was detected through western blot analysis of fibrosarcoma cells treated with kumquat essential oil (500 µg/ml). Treated cells demonstrated significant PARP cleavage in comparison to untreated cells. The JNK mitogen-activated protein (MAP) kinase signaling pathway has been implicated in the response to a variety of cellular stresses. Compared to untreated cells, HT-1080 fibrosarcoma cells exposed to a concentration of 500 µg/ml of kumquat essential oil exhibited an increased presence of phosphorylated JNK, indicating activation of the MAP kinase signaling pathway in response to cellular stress.

BY-9

CREATION OF A HYPOXIC STATE DECREASES THE PROLIFERATION OF HT-1080 FIBROSARCOMA CELLS

Joyce Almeida, Arianna DeCaro, and Gabrielle Storino
Department of Biology

Faculty Mentor: Dr. Dorothy Lobo

ABSTRACT

Hypoxia is characterized as a state in which tissues become oxygen deprived. Under hypoxic conditions, proteins called Hypoxia-Inducible Factors (HIFs) become activated to turn on the expression of important genes (Kaelin, 2019). This stimulates the production of new blood vessel networks to increase circulation and vascularization (Kaelin, 2019). The role of HIFs and their signaling pathway has led to current understanding regarding cancer cells and hypoxia. Cancer cells and tumors have the ability to interfere with the HIF signaling pathway, allowing for growth and proliferation even in hypoxic environments (Muz, 2015). Thus, HIFs, particularly HIF-1α, serve as markers in studying hypoxia.

Cobalt chloride ($CoCl_2$) has been used in many cell types to stimulate the activation of HIF-1α and thus chemically mimic creation of a hypoxic environment (Sanchez and Cardenas, 2019). The purpose of this study was to determine if $CoCl_2$ could create a hypoxic environment in HT-1080 fibrosarcoma cells, and how this would affect proliferation. Confluent cultures of HT-1080 cells were treated with either 100 µM or 250 µM of $CoCl_2$ for 1 hour, 4 hours, or 24 hours. Using western blot analysis, it was determined that HIF-1α expression could be detected at 1 hour with 250 µM of $CoCl_2$ and at 4 hours with 100 µM of $CoCl_2$. Maximal expression of HIF-1α occurred after 24 hours. To study the effect pf $CoCl_2$ treatment on proliferation, HT-1080 cells were plated onto 24-well plates and were treated with 100 µM or 250 µM of $CoCl_2$ for 24 hours. Untreated cells served as the control. All cells were counted using trypan blue dye exclusion. 100 µM $CoCl_2$ treatment decreased proliferation by 9%, while cells treated with 250 µM $CoCl_2$ resulted in a 40% decrease of proliferation. Therefore, $CoCl_2$ creates a hypoxic environment for HT-1080 cells, and decreased proliferation of these cells.

BY-10

THE INHIBITING EFFECTS OF ESSENTIAL OILS (EOs) AND METHYLGLYOXAL ON THE GROWTH OF MULTIDRUG RESISTANT *Enterobacter cloacae* and *Pseudomonas aeruginosa*

Gabriella Cleven and Jackalyn Durante
Department of Biology

Faculty Mentor: Dr. James P. Mack

ABSTRACT

In recent years, the overuse of antibiotics has resulted in many bacteria evolving to become resistant, rendering many of these drugs ineffective in modern medical treatment of bacterial infections. Two specific bacteria highlighted in the 2019 Antibiotic Resistance Threats Report from the Center for Disease Control and Prevention (CDC) include: Enterobacter cloacae (E. cloacae) and Pseudomonas aeruginosa (P. aeruginosa). These bacteria primarily infect immunocompromised people in nosocomial settings such as the intensive care unit (ICU). Six commercial antibiotics are currently used to treat these nosocomial infections which were tested to determine their inhibitory effects on the growth of these two multidrug resistant bacteria, E. cloacae and P. aeruginosa. The antibiotics included in this study were: colistin, ceftazidime/avibactam, ampicillin/sulbactam, amikacin, ceftriaxone, and imipenem. In addition, one hundred two (102) essential oils (EOs) obtained from dōTERRA have been tested individually against each of these bacteria at 100% concentration on Muller Hinton II agar, using the Kirby-Bauer Disk Diffusion Susceptibility Test to determine which EOs had inhibitory effects on the growth of E. cloacae and P. aeruginosa. Of the 102 EOs tested, arborvitae, cassia, cinnamon bark, cumin, oregano and thyme proved to have significant effectiveness in inhibiting the growth of these bacteria compared to the currently used antibiotics. We determined the minimum inhibitory concentration (MIC) of these six EOs by performing dilutions using Jojoba oil. Cinnamon bark was found to inhibit E. cloacae and P. aeruginosa at the lowest concentration and is the leading EO among the tested EOs to inhibit the growth of these two bacteria. The goal of our future research is synergistic testing of: arborvitae, cassia, cinnamon bark, cumin, oregano and thyme to assess these six EOs in combination to determine whether the effect of two EOs is greater than the sum of their individual activities.

BY-11

ALTERED CHOLESTEROL LEVELS IN ALCOHOL-ADAPTED LIPID RAFTS FROM ADOLESCENT BRAIN MEMBRANES

Grace L. Haemmerle
Department of Chemistry and Physics

Faculty Mentor: Dr. D. E. Rhoads

ABSTRACT

The human brain undergoes important developmental changes that begin in adolescence and continue into early adulthood. Ongoing brain development appears to make adolescents more susceptible to binge alcohol consumption and there is a strong correlation between alcohol use during adolescence and lifelong susceptibility to alcohol dependency. Despite its importance, adaptive brain changes during adolescent alcohol consumption remain poorly understood. Work in our lab demonstrated significant upregulation of receptors for the excitatory neurotransmitter glutamate following adolescent alcohol consumption. This upregulation may be attributed to changes in lipid raft dynamics, most notably the appearance of lower buoyancy raft fractions. The central hypothesis of the present study is that these "alcohol-adapted" lipid raft fractions will differ in biochemical properties associated with levels of cholesterol and/or sphingomyelin, known to be enriched in membrane lipid rafts. In the present study, adolescent rats were fed a liquid diet with and without alcohol (ethanol). Raft fractions were isolated from brain membranes using their insolubility in the detergent Triton X-100 and buoyancy during ultracentrifugation in a discontinuous sucrose gradient. Three fractions positive for the raft marker protein flotilin were isolated. Using spectroscopic analytical procedures and colorimetric assays, concentrations of protein, cholesterol, and sphingomyelin were determined. Ratios of cholesterol/protein, sphingomyelin/protein and cholesterol/sphingomyelin were calculated to compare raft fractions differing in buoyancy. Initial analysis indicates differences in cholesterol/protein ratios with the lower buoyancy rafts having lower cholesterol/protein ratios. This result supports the hypothesis that changes in biochemical composition account for the appearance of different raft fractions following alcohol consumption. Cholesterol is known to have a strong influence on the physical properties of membranes. Recognizing that alcohol consumption changes membrane raft properties provides a new focus for studies seeking to better understand the cellular level adaptability of the adolescent brain to alcohol and its role in alcohol dependency.

BY-12

AMPHETAMINE CO-CONSUMPTION ANTAGONIZES UPREGULATION OF RAFT-BASED NMDA RECEPTORS BY ALCOHOL IN ADOLESCENT BRAIN

Nicholas Pillarella
Department of Biology

Faculty Mentor: Dr. D. E. Rhoads

ABSTRACT

The non-medical use of stimulants prescribed for treatment of attention deficit disorders and the combined use of stimulants with alcohol are growing concerns on college campuses. These include amphetamine, the active ingredient in Adderall©. The still-developing brain of adolescents represents a unique target for alcohol and other drugs, and alcohol abuse during adolescence can contribute to lifelong alcohol use disorders. Recent studies from our lab have suggested amphetamines can mask cues of alcohol dependence, causing the adolescent to continue without recognition of the growing addiction and associated damage to the body. The main hypothesis of the present study is that antagonism of the upregulation of NMDA subtype of glutamate receptors, especially those associated with lipid rafts, could provide a mechanism by which amphetamine alters outcomes associated with alcohol consumption. Upregulation of this receptor plays a key role in alcohol withdrawal symptoms. Based on published methods, adolescent Long Evans rats were fed a liquid diet supplemented with alcohol (ethanol), amphetamine or a combination of alcohol and amphetamine. Hippocampus, front cortex, and subcortical forebrain were analyzed by Western blotting to determine the levels of the NMDA receptor. NMDA receptors were upregulated following alcohol consumption, but downregulated when alcohol was consumed with amphetamine. Lipid rafts were isolated from brain membranes by resistance to solubilization in mild detergent and identified by expression of the raft marker flotilin. When rats consumed alcohol, there was an increase in a lower buoyancy raft fraction that expresses NMDA receptor and additional components of glutamate signaling. This increase did not occur when amphetamine was co-consumed with alcohol. These results support the hypothesis that amphetamine antagonizes the alcohol-induced upregulation of raft-associated glutamate receptors. This antagonism may underlie the proposed “masking” of alcohol withdrawal symptoms and awareness of growing alcohol dependency when amphetamine is used regularly with alcohol.

BY-13

CHARACTERIZING EARTHWORM RELATIVE ABUNDANCE AT LONG-TERM STUDY SITES: A FIRST EVALUATION FOR SPARCNET

Angelina Ireland and Rebecca Berzins
Department of Biology

Faculty Mentor: Dr. Sean C. Sterrett

ABSTRACT

The salamander population and adaptation research collaboration network (SPARCnet) is a community of researchers and citizen scientists across North America. SPARCnet's objectives are to study salamander ecology, focusing on one species across its range to understand how environmental conditions influence demography. The red-backed salamander (*Plethodon cinereus*), a small woodland salamander, is the focal species of SPARCnet with 49 study sites across its range from Virginia to Canada. Forest floor macroinvertebrates may influence *P. cinereus* in multiple ways as prey, ecosystem engineers, or even through sharing predators. Earthworms are a large group of forest floor macroinvertebrates that feed on decomposing organic matter and burrow in the soil, sharing territory with *P. cinereus*. We will study native and non-native earthworm populations and their effects at Huber Woods, a temperate deciduous forest on the edge of the Navesink River in Middletown, New Jersey. We will sample earthworms using cover boards and mustard vermifuge extractions to investigate the relative abundance of all earthworms, as well as classify them as native or non-native species to compare abundance of these subgroups. Mustard vermifuge is often used to sample earthworm populations because of its efficacy and non-harmful nature. When mustard is applied, earthworms come to the surface, allowing researchers to sample individuals within the study area. Given varied capture of salamanders at plots, we expect that the earthworm capture will also vary. A higher abundance of non-native earthworms is expected at the plots in which salamanders were sparse. This study will create a better understanding of how the diversity and density of earthworms may affect salamander populations, specifically through the examination of native versus non-native relationships. While this examination will deepen the understanding of invasive species and ecosystem engineers, further research, including experimental approaches, may be needed to fully understand the impacts they have on salamander ecology.

BY-14

ECOLOGY BIAS IN SCIENTIFIC JOURNALS

Christiana Popo
Department of Biology

Faculty Mentor: Dr. Sean Sterrett & Dr. Pedram Daneshgar

ABSTRACT

New Jersey contains multiple types of unique ecosystems within its 22,608 square km including the sandy dunes on the coast, pine barrens of the southern counties, and forested habitats in the northwestern part of the state. Many wildlife groups depend on this diversity of ecosystems to survive. Even with all of the ecosystem diversity, New Jersey receives low recognition on a large scale basis for its abundance of ecological variety. Is it because there are no scientists studying ecology in New Jersey? Or is it because large journals are selectively picking and choosing what they want to publish in order to captivate readers with interesting, or attention-grabbing topics? Biases can be present in all aspects of science, from hiring positions to granting funds to suitable research labs. But are they present when a research article is being submitted for publication in a scientific journal? I analyzed over 500 ecology-based articles in two of the highest impact journals in the field of science (*Science* and *Nature*) and two of the higher impact journals in the field of ecology (*Ecology* and *Oecologia*). From each of the reviewed articles, I noted the location of the author and study site, ecosystem type as well as other spatial factors relevant to each study. I analyzed this data in Microsoft Excel and R-Studio to find global distribution and biases that may be present within the journals. The results of this project will indicate whether or not there are geographical bias to certain countries or certain areas of the U.S., and taxonomic bias towards a certain phylum or species. This analysis will allow for scientists to evaluate if journal editors are selecting articles in order to increase their audience, or allowing each region or taxa to receive fair representation in scientific literature.

BY-15

SPARCNET, NEW JERSEY: CAPTURE AND SITE CHARACTERISTICS OF ARTIFICIAL COVER BOARD PLOTS AT HUBER WOODS, 2019-2020

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Faculty Mentor: Dr. Sean C. Sterrett

ABSTRACT

The Salamander Population and Adaptation Research Collaboration Network (SPARCnet) is a research network that focuses on expanding our knowledge on the effects that environmental impacts can have on the ecology of the red-backed salamander (*Plethodon cinereus*). SPARCnet currently has 49 collaborators; all using standardized cover board methods, and its primary research objective is to study the demographic changes in populations across the range of *P. cinereus*. As part of SPARCnet, we studied *P. cinereus* populations during the fall season of 2019-2020, at Huber Woods, a deciduous forest with 145+ hectares of land, including multi-use trails used by the public. We used artificial cover boards in a spatial capture-recapture (SCR) framework, which is the standard SPARCnet protocol. Each captured salamander was identified, with sex and morphotype determined, measured and uniquely marked using visual implant elastomer. We also report on soil temperature profile (0-50cm) at salamander capture sites as this is critical because they spend half the year living underground and soil temperature is predictive of phenology of surface activity. Across 2 seasons, we made 297 total captures of 217 individuals with a mean of 36 salamander captures across six sites (± 28.8). Annual capture varied with 129 captures in 2019 and 158 captures in 2020. The majority of captured individuals were adults (94%). 43% of captured individuals were female across sites, which was comparable across all sites. Morphotype ratios were biased towards red-striped individuals (62.7%). The average snout-vent-length (SVL) across all 6 plots was 36.0 mm (± 7.2). During the sampling period, soil temperature ranged from 12.3°C at the surface to 15.1°C at 50cm below ground. We note here that our plots are positioned on an elevational gradient which is potentially confounded by moisture, temperature and earthworm invasion; all factors that require further study.

BY-16

BENTHIC MACROINVERTEBRATES OF RARITAN BAY

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Faculty Mentor: John Tiedemann, Director
Marine and Environmental Biology and Policy Program

ABSTRACT

As the foundation of many marine systems, benthic macroinvertebrate biodiversity is critical for an ecosystem's health. Since benthic macroinvertebrates typically have a high biodiversity and are easily sampled, they are an ideal indicator for judging the health of ecosystems. For this particular study, we are focusing on the Raritan Bay and collecting qualitative and quantitative data on the distribution and abundance of benthic macrofauna. Our project entails seasonal collection of grab samples at six stations along a transect from the mouth of Raritan Bay west to the mouth of the Raritan River. After collection each grab sample is rinsed and sieved onboard the research vessel and the resultant organisms are preserved in formalin stained with rose Bengal for processing in the lab. In the lab, samples are sorted and specimens are identified to the lowest taxonomic level practicable and enumerated. The data collected in our surveys will be used to characterize the benthic community in the reaches of the estuary sampled and allow for future comparisons with historical surveys of the area that will aid in determining if changes in the biodiversity of the area have occurred over the years and provide insight into the overall health of the system.

BY-17

SEALS POPULATION OF SANDY HOOK BAY

Trinity Caratenuto
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Faculty Mentor: John Tiedemann, Director
Marine and Environmental Biology and Policy Program

Additional Mentor: Joseph Reynolds, President
Save Coastal Wildlife

ABSTRACT

As a keystone species in marine environments, seals play an important role by maintaining the balance in food webs. Seals are consumers in marine ecosystems; they consume squid, fish, and crustaceans. They also are a food sources for larger predators, such as sharks and orcas. However, despite their importance, seal populations are decreasing along the New Jersey coast. This is the case in the Sandy Hook Bay ecosystem where Save Coastal Wildlife has been monitoring seal populations in recent years. The seal monitoring program contributes long-term monitoring data of Harbor seals (*Phoca vitulina*), Harps seals (*Pagophilus groenlandicus)*, and grey seals (*Halichoerus grypus*). The comprehensive surveys are conducted by volunteers who gather information on the environmental conditions, tidal patterns, status of seals health and human disturbances. Seals spend a great amount of time during low tide on land at haul-out sites around Sandy Hook Bay to digest their food, rest, and bath in the sun, allowing them to be visible to count in the surveys. There are 4 main haul-out sites that are monitored, the Tip of Skeleton Hill Island, Sand bar west of Skeleton Hill Island, Rock Island and Fort Hancock. Volunteers are required to attend a seal monitoring training to learn basic-information on the species and Marine Mammal Protection Act. Moreover, the volunteers account for the number of seals that are injured from boat propellers, shark bites, entanglement, minor wounds, and lack of movement. This information contributes to our knowledge of the current health status of the seal populations in Sandy Hook Bay. Volunteers also document the human disturbances, such as wind surfers and motorboats and how they affect the seal populations. The results of this study will be presented and discussed at the School of Science Student Research Conference.

DEPARTMENT OF CHEMISTRY AND PHYSICS

CE-1

INVESTIGATING GRAVITY EFFECT ON SWIMMING PARAMECIA USING ELECTRIC FIELD

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Faculty Mentor: Dr. Ilyong Jung

ABSTRACT

Gravity has had an effect on the life of living organisms. For example, advances in long duration stellar travel have provided new obstacles such as how humans can maintain normal cellular function with the absence of gravity. In particular, we are interested in gravikinesis of swimming paramecia which allows the organisms to both sense and manipulate the gravity around it by varying their swimming properties. In this study, we have developed single paramecium culturing method and designed a primarily transparent swimming chamber in order to use so called galvanotaxis that aligns swimming trajectory of paramecia with the direction of gravity. Also, viscosity and cylinder size will be varied to observe the different gravikinesis response of paramecia to changes in their sedimentation speed in order to understand the underlying mechanisms of gravikinesis.

CE-2

INTERMOLECULAR INTERACTIONS OF LIQUEFIED PETROLEUM GAS-ALCOHOL MIXTURES WITH PHYLLOSILICATES

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Faculty Mentors: Dr. Yana Kholod Kosenkov and Dr. Dmitri Kosenkov

ABSTRACT

Recently, with fracking, the issue of borehole failures arising from shale instability has been increasing. Shale instability is caused by the intermolecular interactions of polar water-based drilling fluids (DFs) with shale minerals. Therefore, DFs formulated from liquefied petroleum gas (LPG) have been proposed as an alternative to those water-based DFs used in fracking. LPG is a mixture of propane, butane, isobutane, and other nonpolar substances that can be safely recovered from the borehole. This project aims to solve the issues of shale instability by improving upon this waterless fracking method via polyol alcohol additives, like ethylene glycol and glycerol, which can be incorporated with the LPG to advantageously increase its polarity. Intermolecular interactions between components of LPG-alcohol mixtures and phyllosilicates were identified and analyzed using computational chemistry methods, such as density function theory (DFT) and fragment molecular orbital theory (FMO). Quantum DFT calculations provided the geometric optimizations for each of the six orientations of the LPG component-phyllosilicate systems in the gas-phase. Following optimization, the FMO investigation employed pair interaction decomposition analysis (PIEDA) to calculate the energy values of non-covalent interactions, which included Coulomb, polarization, dispersion, quantum exchange repulsion, and charge transfer in solvation under the polarizable continuum model (PCM). PIEDA was utilized to predict which intermolecular interactions are most prevalent in each of those six orientations of the LPG component-phyllosilicate systems. These intermolecular interactions were studied further by examining the bond length and bond angles between the LPG-component and phyllosilicate in all six configurations. The results obtained reveal that interactions of the nonpolar LPG components with domination of dispersion-driven and weak electrostatic interactions (C–H…O) have little preference to a particular phyllosilicate face, while polar molecules with domination of hydrogen bonding (O–H…O) have higher affinities to faces of the phyllosilicate cluster that represent imperfections or cracks in an ideal crystal.

CE-2

PHYSICAL AND CHEMICAL LIMITATIONS REGARDING EXTRACTION METHODS OF MICROPLASTICS FROM CONSUMER AND COMMERCIAL SOAP PRODUCTS

Luke M. Collier
Department of Chemistry and Physics

Faculty Mentor: Dr. Tsanangurayi Tongesayi

ABSTRACT

Each year, over 300 million tons of plastic are produced and added to our planet. Comprehensive research on how to extract and treat microplastics that are developed for use in consumer and commercial soaps, such as hand soaps and body scrubs, has not been conducted. Microplastics, defined as plastic fragments less than five millimeters in length, contribute to significant pollution to both plants and animals in aquatic environments, and are a human health hazard. Due to their size, the ability to extract microplastics from soap samples has proven difficult. Multiple methods of separation and their limitations are discussed in this study. Density separation using different salt solutions and digestion methods were carefully analyzed and examined for highest extraction yield. The results of this project will include the most effective methods, chemicals, and procedures for extracting microplastics found in consumer and commercial soap products. In addition to providing the most reasonable extraction methods, the results of this study will allow further investigation to occur regarding the biogeochemistry of microplastics, as well as provide separation methods that can be applied to large-scale operations, such as wastewater treatment plants.

DEPARTMENT OF COMPUTER SCIENCE

AND

SOFTWARE ENGINEERING

CSSE-1

THE INFLUENCE OF RPAs IN THE BUSINESS FIELD: IN WHAT MANNER WILL ROBOTS AFFECT THE ECONOMY?

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Faculty Mentor: Professor Gil Eckert

ABSTRACT

The growth of technology has contributed to the rise of innovations and inventions of interdisciplinary technological fields of robots, contributing to the success and massive popularization in several employment domains. Robots are machines resembling that of a human being and can complete certain human movements and functions through programming. Recently, researchers have found a way to utilize robots more often in the business field through the cultivation of RPAs. Known as Robotic Process Automation is the utilization of 'robots' specifically in the business field to operate tedious digital tasks. Previous research has primarily relied on mechanical manipulations of symbols, the interdisciplinary field of robots was known to be mainly in the fields of engineering. The recent advances have now allowed it to be possible for robots to be able to copy and paste data, file, open emails and extra data from documents have allowed interdisciplinary fields of robots to prosper in instances such as the business field. The purpose of this study is to analyze the advantages and possible disadvantages of the functionalities of RPAs, along with companies that actively partake in this rise of robotic automation by an application.

DEPARTMENT OF MATHEMATICS

MA-1

ADJUSTING PELVIC MEASUREMENTS TO ACCOUNT FOR SIZE

Samantha Colucci and Andrew Portaro
Department of Mathematics

Faculty Mentors:
Dr. Bastian, Department of Mathematics
Dr. Darmon, Department of Mathematics
Dr. DelPrete, Department of History and Anthropology

ABSTRACT

Dr. DelPrete collected sample measurements from 119 skeletons from a museum in Cleveland and has been working on answering several research questions using this data. Currently, she is attempting to find an answer in the common debate over whether pelvic measurements should be adjusted for body size, pelvic size, or should be left unadjusted. Dr. DelPrete sees a benefit in accounting for body size, but the method that should be used remains unclear. In this project, we will attempt to compare how measurements vary within each method of adjustment and additionally see how this compares to the unadjusted data. We will attempt to use a Principal Component Analysis, among other methods, to do this. This is an ongoing project so the analysis of the results has not been fully completed yet.

MA-2

COVID-19 TREATMENT IN AN ETHNICALLY DIVERSE AREA

Lilia Crew & Fatima Gohar (Statistical Analysis)
Saraanne Maia (Originator and Data Collection)
Departments of Biology & Health Studies

Faculty Mentors:
Dr. Richard Bastian, Department of Mathematics
Dr. David Darmon, Department of Mathematics
Dr. Jeffrey Weisburg, Department of Biology

ABSTRACT

COVID-19 is a highly relevant topic of the times. Its effects are widespread and striking as it has impacted everyone either directly or indirectly. This project focused on the direct effects of COVID-19 in an ethnically diverse community of Freehold NJ. All patients that tested positive, from the first patient in March to the last positive patient in January of the Freehold Urgent Care Clinic, had their vitals record. On top of vitals, the researcher also gathered information such as job and insurance. This data was compiled, organized, and anonymized. We will be looking for correlation between variables and their outcomes by both grouping the variables and looking at each variable individually. The specific variables we will be looking at are; chief complaint, sex, age, type of treatment received, and ethnicity, with the response variable being recovery time. The benefits from this study are additional COVID-19 data for ethnic communities, strengthening vaccine validity in ethnic communities, and better understandings of the effect that age, sex, ethnicity, etc., has on one's recovery time

MA-3

EFFECTS ON WATER QUALITY FROM ENVIRONMENTAL CONDITIONS ON HILO BAY

Odalys Barrientos & Brianna Cirillo
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Faculty Mentors:
Dr. Richard Bastian, Department of Mathematics
Dr. David Darmon, Department of Mathematics
Dr. Jason E. Adolf, Department of Biology

ABSTRACT

Hilo Bay is a large bay located on the eastern coast of the island of Hawaii. Hilo Bay is fed by the Wailuku River, and sheltered by breakwater. The water quality of the bay is typically poor. This data was collected in Hilo Bay using a buoy with probes that collected 4 samples an hour. The probes were able to measure turbidity, chlorophyll, temperature, salinity, and rainfall. We will be analyzing data to determine the relationship between water quality in Hilo Bay and the environmental conditions in/around the bay. We will conduct a time series analysis to show how turbidity, chlorophyll, temperature, and salinity are affected by rainfall and river flow based on when storms occur. This project could help modify the breakwater for better circulation and help Hilo understand how to improve its water quality.

MA-4

GUITAR HERO: LEGENDS OF RANDOMNESS

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Faculty Mentor: Dr. Richard Bastian

ABSTRACT

Any Guitar Hero player, expert or beginner, knows that songs in the game tend to fluctuate in difficulty as one plays them. Some sections of the song may be easier while others are quite challenging. While the song is running, the game keeps track of the player's hits and misses. Let's assume for a moment that the game keeps track of a string of numbers such that every hit is recorded as a 0 and every miss as a 1. Knowing this information, would one be able to tell if misses occur at random during the song? In order to answer this question we came up with an original test statistic, to define randomness. Using RStudio, we applied our test statistic to seven full-length songs, containing over five hundred observations each. We used three resampling techniques such as, parametric, nonparametric, and permutation bootstrapping in order to obtain a confidence interval for our test statistic. In addition to this, hypothesis testing was done on each song to test for randomness. To ensure the accuracy of our test, we asked ourselves how well it measures randomness and how prone is it to making errors. Empirical alphas and powers were calculated to determine this. We then visualized these by plotting curves relating the theoretical alpha and power to our empirical alpha and power. Our results show the power of our test and suggest which of the seven songs had random misses and those which our test concluded to be nonrandom. A possible topic of future research would be implementing parallel computing into our code. This would allow us to run our function coef_test() using multicore computing; ultimately allowing for a larger number of simulations and bootstraps to be run, further increasing our test's power.

This research was carried out based on a paper by Drs. Ivan Ramler and Jessica Chapman of St. Lawrence University, originally published in the Journal of Statistics Education, Volume 19, Number 3, (2011), and used with permission of the authors.

STATISTICAL ANALYSIS OF DIET AND LOCATION IMPACT ON HOUSE MICE GROWTH

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Department of Mathematics

Faculty Mentors:
Dr. Bastian, Department of Mathematics
Dr. Darmon, Department of Mathematics
Dr. Phifer-Rixey, Department of Biology

ABSTRACT

The recent introduction of house mice into North America from Europe provides an opportunity to analyze environmental adaptation in a genetic model system. This study focuses on the statistical analysis of data collected on mice from different parts of the world being fed regular and high-fat diets. The mice's weight, length, and food intake were measured frequently, for a total of twelve weeks. Our research question is how do mice from different locations respond to diet with respect to body size? First, growth curves will be created to visualize the change in body weight and body length in each strain and sex, by diet (high-fat vs regular). Growth curves help determine the type of growth pattern of the quantity - whether it is linear, cubic, etc. Next, ANOVA will be conducted to determine whether there is a significant difference between the weights/lengths of each strain and gender on the different diets. Lastly, interaction plots will also be constructed, specifically between diet and location strain, in order to observe their relationship closely. The benefits to this study include knowing whether or not there is genetic variation for responding to the diet, and plasticity. Plasticity is how the mice acclimate to the diet; it is essentially their response. Mice are models for humans, so the existence of genetic variation/plasticity is able to give us insight for human development.