

**MONMOUTH UNIVERSITY
SCHOOL OF SCIENCE**

**NINTH ANNUAL STUDENT RESEARCH CONFERENCE
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Wilson Hall**

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Faculty Mentor: Dr. Donald Dorfman

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Faculty Mentor: Dr. James P. Mack

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Statistics & Veterinary Surgeries: Statistical Analysis of a New Procedure for Repairing ACL Injuries of Dogs

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Coral Growth and Decline

Devon A. Hodge

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Faculty Mentor: Dr. Donald Dorfman

This study measured the growth rates of six different species of coral in a controlled laboratory environment. Conditions such as water temperature, UV light exposure, and nutrient and mineral composition of the water were closely monitored and maintained. Three members of each species were measured weekly over a period of nine months, and the results were carefully analyzed for significance and possible error. The research was conducted at the nearby Tropiquarium, under the supervision of Austin Sweerus and Dr. Donald Dorfman.

There is a great need for this type of research on normal coral growth rates due to the dismal situation of coral reefs around the world. As long as coral reefs have been studied, observations have indicated that they are declining at an alarming rate. In fact, extinction of 60% of all extant coral species is estimated to occur as early as 2050 (Coral Reef Task Force, 2000). The reasons for the rapid decline of these species are primarily human in nature. The known causes of widespread coral reef decline include human pollution, global warming, and changing sea levels. Each of the many species of coral has a unique rate and pattern of growth. Thus, this type of research is necessary for studying coral growth in natural environments, so that results may be compared to those expected for that particular species.

Highly Effective Essential Oils Prevent Spread of Methicillin Resistant Staphylococcus aureus (MRSA) and Methicillin Sensitive Staphylococcus aureus (MSSA) in Hospital Admitted Patients

Puja Sharma

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Department of Biology**

Faculty Mentor: Dr. James P. Mack

Background: Methicillin Resistant Staphylococcus aureus (MRSA) is a staph bacterium resistant to strong antibiotics classified as beta-lactams, such as oxacillin, penicillin and amoxicillin. Methicillin Sensitive Staphylococcus aureus is a type of staph infection that is moderately sensitive to antibiotics. Hospital acquired MRSA (HA-MRSA) is typically contracted by patients who have invasive medical procedures or weakened immune systems; HA-MRSA infections can cause severely life threatening complications, such as bloodstream and surgical site infections or pneumonia. Estimates from the CDC show that in 2005, out of 94,360 invasive MRSA infections, 18,650 (19.8%) infections were fatal.

Methods: Previous research conducted with 54 essential oils revealed excellent antibacterial activity with seventeen of these oils (Mack et. al., NJ Academy of Science, Vol. 44, p. 21, 1999 and Vol. 45, p. 17, 2000). The seventeen oils were further tested on four known strains of MRSA, as well as MSSA and Methicillin Resistant Staphylococcus epidermidis. Ten of these oils proved to have excellent antibacterial activity on three out of the four strains (Sharma et. al., ICID, I.S.E, p.35, 2010). These ten oils were also tested on 12 patient samples (JSUMC1), which included MRSA and MSSA. Plates with Mueller-Hinton II medium were overlaid with each of the 12 patient samples. Sterile blank discs (6 mm) saturated with .05 mL of each of the ten oils and a disc containing the antibiotic standard vancomycin (30 µg) was positioned on the plates. Diameters of zones of inhibition were measured after 24 hours of incubation at 37°C.

Results/Conclusions: Based on this study, all ten oils showed significantly higher effectiveness in inhibiting MRSA and MSSA growth from these patients than vancomycin, which is the currently used standard for treatment. Essential oils could be beneficial towards treating hospital patients in the United States infected with MRSA or MSSA. In addition, people infected with MRSA or MSSA in underdeveloped countries, where antibiotics are not readily available could also benefit from using these essential oils.

(JSUMC1)- Jersey Shore University Medical Center

DNA Binding Activity of the Transcription Factor HIF-1 in Normoxic and Ischemic Testis

Christine Dugan and Marie Karpodinas

**Monmouth University
Department of Biology**

Faculty Mentor: Dr. Michael A. Palladino

Testicular torsion is a condition in which the twisting of the spermatic cord, supplying blood to the testis, can result in ischemia (reduced blood flow), which can eventually lead to hypoxia (reduced oxygen levels), germ cell damage, and reduced fertility or infertility. Activation and inhibition of oxygen-dependent genes and proteins determines the degree of tissue damage in the ischemic testis, or conversely, provides protection of certain cells from damage. One protein that may protect cells from ischemic damage is HIF-1 (Hypoxia Inducible Factor-1). HIF-1 is a transcription factor, a regulator of responses to hypoxia, and a stimulator of genes in response to hypoxia. In previous experiments, it was determined that HIF-1 in the testis is abundant in the testosterone producing cells called Leydig cells, and the levels of HIF-1 mRNA and proteins were unregulated by hypoxia and ischemia. Unlike the majority of tissues, HIF-1 protein levels remained unchanged in normoxic (normal oxygen levels) and ischemic testis. The goal of this project was to determine if HIF-1 in normoxic or ischemic testis is an active transcription factor by using an Electrophoretic Mobility Shift Assay (EMSA) to evaluate the DNA-binding activity of testicular HIF-1. Nuclear and cytoplasmic proteins from normoxic rat testis were isolated. The presence of HIF-1 α was detected by Western Blotting. EMSA experiments were carried out by incubating protein extracts with a consensus HIF-1 α oligonucleotide containing a Hypoxia Response Element (HRE) binding site and to a mutant oligonucleotide, both biotin labeled. An unlabeled oligonucleotide for actin was used as a control. Oligo-protein complexes were incubated with a HIF-1 α antibody and separated by non-denaturing Polyacrylamide Gel Electrophoresis (PAGE). Shifts were detected by enhanced chemiluminescence. Studies are too preliminary to determine HIF-1 α binding, but research is in progress.

Sub-lethal Effects of Methylmercury on the Predator Avoidance Behavior of Mummichog, *Fundulus heteroclitus*

Nicole Starinsky

**Monmouth University
Department of Biology**

Faculty Mentor: Dr. Ursula Howson

Enhanced by bioaccumulation, estuarine contaminants, such as methylmercury, arsenic, and dioxins, can be linked to physiological, morphological, and behavioral changes in estuarine fish. These sub-lethal effects can be examined by studying the estuarine mummichog, *Fundulus heteroclitus*, due to its prior usage in related contaminant studies as the model organism to provide baseline data and evaluate methodologies concerning the effects of contaminants on estuarine fishes. Behavioral studies examining the effect of contaminants are often utilized because an animal's behavior is representative of its inclusive response to its environment. Specifically, methylmercury has been found to decrease serotonin levels in larval fish, decreasing their overall predator avoidance ability. This study examines the effect of a vibration stimulus on different levels of methylmercury contaminated larval *F. heteroclitus*. By learning the various degrees to which *Fundulus* are affected by methylmercury contamination behaviorally, the ecological impact of contaminants accumulating in the nation's estuaries can be better defined.

Current and Future Therapy in Multiple Myeloma

Justin Hanenberg

Monmouth University

Department of Chemistry, Medical Technology, and Physics

Faculty Mentor: Dr. William Schreiber

Multiple Myeloma accounts for 13% of all hematological conditions affecting 20,000 new patients in the U.S. each year. Numerous cytogenetic aberrations have been associated with the neoplastic proliferation of B-cells. These genetic alterations, along with other physiological findings, are being closely examined to determine how a patient will respond to various therapy regimens. Chemotherapy, stem cell and bone marrow transplants, and other more recently developed methods such as interleukin therapy are all subject to different outcomes based on the genetic and physiological symptoms of a patient. This article discusses the advantages and shortcomings of different classes of chemotherapy agents, autologous stem cell transplantations, and more recent options. In addition, the work analyzes the more common cytogenetic mutations that cause the plasma cell malignancy and how it affects the molecular cellular functions. With improved knowledge of molecular mechanisms at work both in the genetic functions and the function of individual treatment regimens, medical advancements will bring forth better treatment with higher rates of recovery. New techniques in molecular testing also provide a significant improvement in the protection and prevention in relapsing myeloma cases.

Levels of Selected Heavy Metals in New Jersey Sanitary Biosolids That are used as Fertilizer

Patricia DaSilva, Katharine Dilger, and Tristan Hollingsworth

**Monmouth University
Department of Chemistry, Medical Technology, and Physics**

Faculty Mentor: Dr. Tsanangurayi Tongesayi

Most wastewater treatment plants perform primary and secondary treatment before the water is discharged into surrounding water bodies. The treatment reduces the biochemical oxygen demand (BOD) of the water to 10% of the original value but generate tons of sanitary sludge. In New Jersey there are 451 wastewater treatment plants which generate millions of dry metric tons of sludge per year. Some of the sludge is used as fertilizer and there is a significant danger of contaminating groundwater, surface water and agricultural produce through this practice. The main objective of this work was therefore to determine the levels of heavy metals in New Jersey biosolids. Pelletized biosolids were collected from one of the wastewater treatment plants in New Jersey and analyzed using XRF and FAAS. The following results (mg/kg) were obtained: Ti (3356 ± 68), V (95 ± 28), Cr (26 ± 8), Mn (2275 ± 18), Fe (33991 ± 89), Co (348 ± 20), Cu (567 ± 5), Zn (1087 ± 6) Zr (299 ± 2), Cd (34 ± 4) and Pb (27 ± 1). A Montana Soil certified reference standard (2710a) was used to validate the results. The extractable levels were determined using the EPA 3051/3051a method and FAAS. The levels in both biosolids and the reference sample were comparable to those obtained using XRF.

Better B+-Tree with Extra Cache

Huy Quang Do

**Monmouth University
Department of Computer Science and Software Engineering**

Faculty Mentor: Dr. Cui Yu

In this project, we propose a further improved indexing structure from the Cache Coherent B+ -tree (CCB+ -tree) which can improve search performance compared to the traditional B+-tree. CCB+ -tree makes use of the unused space in the higher levels of internal nodes for caching; however the space is not always available. In my proposal, part of available main memory is reserved for caching. The reserved space is populated and maintained as a buffer that caches all the most popular leaf nodes of the indexing tree. This structure can inherit full benefits from the CCB+ -tree while there is no need to worry how much space left in the B+ -tree's internal nodes for caching and there is no complicates of handling different types entries in one internal node. Further, the new proposed indexing structure should be able to save even more I/O cost, if a needed leaf node is in cache.

Integrated Digital Campus Map

Huy Quang Do, Vandana Ratakonda, and Charles Reed

**Monmouth University
Department of Computer Science and Software Engineering**

Faculty Mentor: Dr. Michiko Kosaka

The Digital Campus Map can replace the current paper (manual) map and is integrated with information that is useful for a small to medium sized university community such as Monmouth University. The map allows the user to click an item in a menu, and see immediately where the desired building is located by circling it in red and shows the user's current position by circling it in green. In addition, the user can also look up an event, click it, and the map marks the location and displays details of the event. A photograph of the building is provided so as to make it easy for the user to identify the building he is looking for.

Emergency flags identify emergencies and their locations on the map, as well as the nature of the emergency (fire, incident, road construction). When there is an emergency on campus, the map automatically marks the emergency area, and informs the user of the nature of the emergency.

There are three different types of user accounts, depending on the permission levels. All users can search over the Digital Campus Map. A naïve user (students, faculty, visitors) has only the search permission. Police have limited edit privileges to enter emergency data or to delete them. Administration has extended privileges. They include add/delete buildings, events, emergency notification, and manage user accounts. A normal user can only use the map to find the building/place, to look for events and receive emergency notices.

The current implementation is a web page version that is written in PHP with a MySQL backend. The Digital Campus Map is accessible with standard browsers. A second version (in planning stages) is an executable version that can be written in C++ or C# and can be installed on fixed information kiosks around the campus. The PHP version is done and working and is made available for demos.

Other features might be added to the program in the future including locating specific rooms in a building, and providing real-time information on the available parking spaces to guide the visitors and students.

Security Enhancement for UDDI

Alexander J. O'Ree

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Department of Computer Science and Software Engineering**

Faculty Mentor: Dr. Mohammad S. Obaidat

UDDI, the Universal Description, Discovery, and Integration OASIS standard, was designed for storing, publishing, and advertising information about XML web services. Commonly used in Service Oriented Architecture (SOA) infrastructures, the security of UDDI is often overlooked. Embedded within the specification are “optional” security measures that are commonly not implemented or enforced. The following describes the UDDI security model, potential security related concerns, and mitigation strategies. Finally, an example of the registry with additional security constraints is evaluated for performance.

**Statistical Analysis of Incontinence in Spayed Female Dogs:
Preliminary Findings of 917 Cases**

Ashley Holstein and Kaitlin Poracky

**Monmouth University
Department of Mathematics**

Faculty Mentor: Dr. Richard Bastian

The purpose of this study is to determine a more accurate rate of incontinence in female spayed dogs and test certain variables to see if they are related to the rate of incontinence. Current research suggests there is a twenty percent rate of incontinence. With a population of 917 cases, forty seven dogs were considered to be incontinent, giving approximately a five percent rate of incontinence. Some of the variables that have been tested for association with incontinence include whether the dog was an emergency spay, if the dog had any litters before the spay, the dog's age at spay, and the weight of the dog. So far, tests have shown that there is no actual significance between incontinence and emergency spay, litters before spay, or age at spay. The average age at spay was 1.43 years. Running a chi-squared test showed that there was a significant association between incontinence and weight of the dog. Large dogs, considered in this study to be dogs over sixty pounds, have an incontinence rate of 8.24%, which is significantly larger than the incontinence rates of the small and medium dogs.

Statistics & Veterinary Surgeries: Statistical Analysis of a New Procedure for Repairing ACL Injuries of Dogs

Kyle Gavin, Emily Pumphrey, and William Scott

**Monmouth University
Department of Mathematics**

Faculty Mentor: Dr. Richard Bastian

Not only athletes tear their ACL, dogs do too! And when they do it's as painful for them as it is for us. Recently a new technique for helping dogs with ACL injuries has been developed, but as yet has not been analyzed for its efficacy or complication rate with significant sample sizes. A team of MU students from math and biology, and veterinary surgeons from Garden State Veterinary Specialists have worked together to analyze data from this new surgery and build a statistical model that predicts the odds of a dog having a complication. Come hear about how statistics is used in the real world to help pet owners and veterinarians make decisions about the health of their dogs.