


Summer 2012

# Enhancing Global Research and Education in STEM at Spelman College: Abstracts 2011-2012

Spelman College G-STEM

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**ABSTRACTS**  
**Summer 2011**  
**Fall 2011**  
**Spring 2012**  
**Summer 2012**

# Summer 2011

## G-STEM Cohorts

### Research Project Name

1. An Ethnobotanical Survey of Medicinal Plant Usage in Salvador de Bahia, Brazil .....  
..... Ashli Cumberbatch
2. A Comparative Study of Health Practices and Attitudes and their Effect on the Number of  
Incidences of Reproductive Health Issues in Women ..... Courtney Sykes
3. Potential Causes of Color Dimorphism in the Species *Mischocyttarus Mastigophorus*  
(Vespidae:Hymenoptera) at Monteverde, Costa Rica..... Danielle Tucker



## **An Ethnobotanical Survey of Medicinal Plant Usage in Salvador de Bahia, Brazil**

**Written by: Ashli Cumberbatch**

### **Abstract**

Brazil is a country with a high amount of biodiversity, accounting for 10% of all species existing on the planet (Inoue 2004). Biodiversity is defined on three different levels; genetic diversity, species diversity and ecosystem diversity. All levels of diversity are present in Brazil and it is important to preserve this rich and vital environment (Motta 1996). Ethnobotanical research analyzes plant usage and how it relates to culture and the physical environment. This paper focuses on an ethnobotanical study in Salvador de Bahia, Brazil to analyze the use of medicinal plants by individuals ranging from ages 18 to 65. It was hypothesized that the population in Salvador de Bahia, Brazil will be aware of medicinal plants and their uses because of cultural practices and exposure to a variety plants in their environment. A total of 25 questionnaire surveys were distributed to volunteers and the results were tabulated. The surveys were first approved by the IRB committee at Spelman College and then they were translated from English to Portuguese. Before completing a questionnaire they were required to read and signed a consent form, confirming their understanding and interest in the study. The results indicated that 92% (23/25) of the participants used medicinal plants consistently. Also, over 10 different medicinal plants were identified by the volunteer participants. Culture influenced the participants because the majority of these practices were learned from elderly family members, such as grandparents. The most popular plant used was Bolda, a leaf used for digestion and constipation (Anonymous 2001). The majority of the medicinal plants used were to cure digestion and removal of parasites. This was probably due to the socioeconomic status of these participants and sanitary conditions in which they live in. They are more susceptible to parasites and digestive complications because of their environment. Examples of popular medicinal plants are Bolda leaf, Aurora Plant, and Cha Verde. These research findings can be further used for toxicology, pharmacology and ecological studies.

# **A Comparative Study of Health Practices and Attitudes and their Effect on the Number of Incidences of Reproductive Health Issues in Women**

**Written By Courtney Sykes**

## **Abstract**

Women of African descent worldwide suffer from a wide variety of problems related to income level that can lead to the difference in health care access and attitudes among this population. Health care access and health practices worldwide have different effects on reproductive health issues in women. Diseases such as breast cancer, cervical cancer, ovarian cancer, fibroid tumors, ovarian cysts, and breast cysts differ in incidence level in low-income and high-income countries. The purpose of this study is to gain an international perspective on reproductive health issues by comparing Black women in a high income country: the U.S and a low income country: Brazil. Using a survey, we were able to compare reproductive health related issues with income and health care access in Salvador, Bahia, Brazil and Atlanta, Georgia, United States. Ten women from both areas were given a survey based on demographics, health care accessibility, family history, personal history, and knowledge of gynecological health issues. The survey demonstrated an apparent divide in income between the two areas. The income difference correlated with the lack of health access in low-income countries compared to high-income countries. There is a higher incidence of breast cancer in the Atlanta area demonstrated in family history of subjects. Despite the fact that access to health care is less difficult in the U.S. than in Brazil, women's health related issues are more frequent in the U.S. The study also revealed less knowledge concerning the Human Papillomavirus (HPV) in Salvador than the U.S. and the limited distribution of the HPV vaccine in Bahia. This leads us to believe that the level of healthcare access contributes to detection levels and the difference in incidence numbers in U.S. than in Brazil. Also there is more reason to be cautious of an increase in cervical cancer cases in low-income countries that do not take precautionary measures with vaccines and screenings.

**Potential causes of Color Dimorphism in the Species *Mischocyttarus mastigophorus* (Vespidae:Hymenoptera) at Monteverde, Costa Rica**

**Written By: Danielle Tucker\*, Alycia Gardner, Sam Newland, Kate Owens, and Sneha Thakur**

**\*Spelman College student**

**Abstract**

The wasp species *Mischocyttarus mastigophorus* possesses both light and dark morphs. It has been hypothesized that these two morphs are adaptations either to help the animal thermoregulate body temperature across elevational gradients or as a mimicry defense against predators. It is possible that the wasps' coloration deviations are to mimic two different species of the more aggressive wasps from the genus *Agelaia*. The coloration distribution was tested across elevations to test the hypothesis of the thermoregulation mechanism. Our results show that there was no difference between coloration across elevation, but that there was a greater abundance of dark morph colonies across all elevations. No relationship was found between mimicked organism coloration and coloration of the *M. mastigophorus*, so it is unlikely that the coloration divergence of *M. mastigophorus* is due to a mimicry mechanism. The large number of dark morph colonies suggests that thermoregulation may be the cause of the dimorphism. This could be because of decreasing daytime temperatures in the Monteverde region, thus giving the dark morph *M. mastigophorus* an advantage in absorbing solar heat energy.

**Fall 2011**

**G-STEM Cohorts**

**Research Project Name**

1. Potential Regulatory Region in the Mouse Brain ..... Taisha Blair
2. Tracking the Implementation of the Sexual Education Integral Law No.26.1150 in the Autonomous City of Buenos Aires, Argentina .....Alaina Dixon
3. Analysis of Oxidized and Reduced Compounds in the River Leith ..... Dana Ward-Robinson
4. Structure and Function of the Plant Alternative Oxidase Studied by Site-Directed Mutagenesis ..... Chelsy Webb



## Potential Regulatory Region in the Mouse Brain

Written By: Taisha Blair

### Abstract

A region upstream from the DLX5 and DLX6 genes in the brain is thought to be a potential regulatory region, regulated by FGF signaling. Disruption or deletion of the regulatory elements can lead to abnormalities such as hearing loss, craniofacial defects, and limb defects. Studies done on a family whose phenotype presented this deregulation showed deletions of certain base pairs in the DNA were vital in the development of regulatory elements (Brown et al., 2010). Experiments ran on the DNA of mice showed the deleted regulatory regions drive expression in the ear and developing bones of embryos (Courtenis et al., 2005). To investigate this, two oligonucleotides named break-forward and break-reverse were created to determine the most suitable condition for DNA amplification for creation of a clone to be used to test the regulatory site. Assessment of the 3kb band found on the .9 % agarose gel after experimentation would have depicted the conditions for DNA amplification were successful, therefore ensuring a usable vector and DNA band. Determining where regulatory regions are located on specific genes in the ear, as well as how the deletion of regulatory elements can lead to disease, may help scientists understand the relationship between genes, the expression of the genes, and the roles they play in the development of embryos.



## **Tracking the Implementation of the Sexual Education Integral Law No. 26.150 in the Autonomous City of Buenos Aires, Argentina**

**Written By: Alaina R. Dixon**

### **Abstract**

From 1976-1983 Argentina was ruled by a military dictatorship. During this time, the sale of contraceptives and family planning were banned and clinics which provided health services to the public were closed. After the seven year reign, Argentina began adopting international policies that emphasized human rights and the promotion of cultural identity within Argentina. However, issues related to the sexual health and education of young people still occupy an invisible place on the public agenda. In 2006, the Sexual Education Integral (ESI) law (N°26. 150) was passed, which mandates that all children should have access to sexual and reproductive health education, and have the right to express and experience their own sexuality. This research project investigated whether the ESI law is being implemented in schools in Buenos Aires, and whether students obtain formal sex education in their classrooms. A questionnaire that explored the attitudes and views of ten adolescents attending public and private schools in Buenos Aires was developed. Details about the project were emailed to a convenience sample of parents, and those that were willing to have their child participate forwarded their child's name and email address to the researcher. The researcher then contacted the adolescents via email, providing details of the study as well as the survey. Surveys revealed 90% of the participants indicated they were not currently receiving comprehensive sexual education in school. Results will be presented and discussed in terms of the implementation of the ESI law and the progress of sexual education in Buenos Aires.

## Analysis of Oxidized and Reduced Compounds in the River Leith

Written By: Dana Ward-Robinson

### Abstract

This research study is derived from testing agricultural water and finding eutrophic amounts of  $\text{NO}_3^-$  within hyporheic zones of groundwater-surface water. There are various concentrated amounts of  $\text{NO}_3^-$  that are found within the Red Sand Stone of the River Leith located in Cumbria, UK. Kate Heppell's research team from Queen Mary's University of London has focused on the flow of the hyporheic zone of groundwater in order to understand the process of denitrification and to determine the presence of several pollutants and their concentration levels. The central question in this paper is if there is any relationship among the concentrations of  $\text{NO}_3^-$ ,  $\text{O}_2$ , and  $\text{Fe}^{2+}$  within this aquatic system? The aims of this work are to 1) to determine possible reasons that denitrification is occurring, 2) to determine whether the concentration of dissolved  $\text{O}_2$  is related to the concentration of  $\text{Fe}^{2+}$  3) to determine whether each SU (are the regions or sites where a piezometer was placed to collect sample) is an oxidized or reduced environment by noting the concentration of  $\text{NO}_3^-$ ,  $\text{O}_2$ , and  $\text{Fe}^{2+}$  and 4) to disclose the methods and techniques used to analyze samples and create the resulting data charts and graphs. Furthermore, one of the main purposes of this work is to determine whether an oxidizing environment, encourages the formation of an oxidized form of nitrogen (nitrate) and discourages the formation of reduced species like iron  $\text{Fe}^{2+}$  compounds. (Grimaldi & Chaplot, 2000). If so, the opposite should also be true in a reducing (oxygen deficit) environment. The samples that will be tested include water and sediment samples collected from the River Leith located in England. These samples are tested for this behavior, and the results are used to determine whether there is a difference between upstream and downstream concentration levels of  $\text{NO}_3^-$  due to denitrification. (Bohlke, Wanty, Tuttle, Delin, & Landon, 2002).

## Structure and Function of the Plant Alternative Oxidase Studied by Site-directed Mutagenesis

Written By: Chelsy Webb

### Abstract

All higher plant mitochondria, fungi, trypanosomes, and non-fermentative yeast contain a non-protonmotive alternative oxidase (AOX) that couples the oxidation of ubiquinol to form ubiquinone directly to the reduction of molecular oxygen to form water. Ubiquinol plays an essential role in the electron transport chain leading to the synthesis of ATP. In this process AOX acts as a catalyst. AOX acts as the terminal electron acceptor in the electron transport chain and is found between complex II and III. In addition to plants, the AOX protein can be found in many pathogenic organisms and intestinal parasites. The oxidase is thought to play a more fundamental role in the regulation of energy metabolism in plants. It acts as a respiratory enzyme that diminishes energy production in plant mitochondria (McDonald, 2008). To investigate the structure-function relationship, we expressed site-directed mutagenesis of mutant Cys-172 (highly conserved cysteine residue) in a heme-deficient strain of E.coli. Assessment of AOX activity reveals that mutagenesis of Cys-172 to alanine not only resulted in a decrease of maximum AOX activity but also caused a significant decrease in the enzyme's affinity for oxygen. These results could have an industrial application, since the alternative oxidase has been determined to be a potential target for both phytopathogenic fungicides and anti-parasitic pharmaceuticals.

**SPRING 2012**

**G-STEM Cohorts**

**Research Project Name**

1. Computing in Discrete Subgroups .....Shekiaya Gowans
2. Organic/Synthetic Chemistry ..... Kamille Williams



## COMPUTING IN $PSL(2,Z)$

Written By: Shekiaya Gowans

### Abstract

This paper will explore action on the upper half complex plane via  $PSL(2,Z)$  acting as the modular group. A program that solves the explicit membership problem for the modular group is produced using an algorithm whose implementation is unique to C++. (This code is presented in the Appendix on page 15). The explicit membership problem is the issue of determining whether an element  $g \in U$ , is also an element of  $G = PGL(2,Z)$ , a finitely generated subgroup of  $U$ . The problem solved is a special case of an explicit solution to finding the Smith of a matrix<sup>1</sup>. The algorithm used for this solution, therefore, uses different principles and generalizes in dissimilar directions; it showcases behaviors of  $PSL(2,Z)$  acting as the modular group.

As a result of this research, more questions naturally arise regarding other properties of  $PSL(2,Z)$ . Even further, questions regarding individual characteristics of all subgroups generated by any given finite subset. For instance, given a subgroup  $H$  generated by some finite subset, is  $H$  of finite index? If so, what is the index? In regards to the algorithm and computing aspect, what is there to gain from further examination of the validity of the code for larger coefficients of the input? How would this algorithm hold up when translated into another computer language like GAP? These questions are not explored in this instance of research. However, further study is encouraged for interested parties.

## Synthesis and Characterization of an Amine- based Monomer for a Fluorescent Molecularly Imprinted Polymer

Written By: Kamille Williams

### Abstract

Molecular imprinting is used in various applications for sensors, environmental remediation, and targeted drug delivery. It is a chemical synthetic technique in which a chemical monomer is etched on a polymer substrate for the purpose of creating a polymer substance that can be used to specifically trap a molecule of interest in a complex sample matrix. Molecularly imprinted polymers (MIPs) resemble miniaturized golf balls in the sense that the polymer (the golf ball) is dimpled at regular intervals, with each dimple representing the imprinted cavity that will trap the molecule of interest. A functional monomer is needed to create the template for molecular imprinted polymers. This research project focused on the synthesis of a fluorescent chemical monomer that could be used to target the selective detection of citrinin, a mycotoxin that is given off by fungi in food products. The advantage of a fluorescent MIP is the increase in sensitivity that is gained to analyze small amounts of citrinin in a contaminated sample, since fluorescence signals characteristically strong even at the trace level.

In the research, the synthesis of the functional monomer followed a five-step process that modified the startup material (a naphthalic anhydride base) through several reactions that added several different functional groups to the startup chemical. Column and thin-layer chromatography were used for the purification of the intermediate compounds in the synthetic process, and the characterization of the products at each step in the process was done using proton and carbon nuclear magnetic spectrometry (NMR) and infrared spectroscopy (IR). The synthetic pathway that was investigated in this project resulted in a functional monomer with amine-based (quinoline and piperazine) substituents that emitted a strong fluorescence similar to citrinin. The purification of the intermediate steps of the synthesis was noted to have a significant effect on the recovery of the final product.

# SPRING 2012 G-STEM Cohorts

## Research Project Name

1. Global Health Issues in South Africa ..... Daria Clegg
2. Field Observation and Interpretation of the Ecosystems ..... Erica Ferguson
3. Deep Subsurface Life ..... KaNesha Gillyard
4. Field Observation and Interpretation of the Ecosystems ..... Antonia Gore
5. Novel Drugs for Breast Cancer ..... Kendra Hearn
6. Public Health ..... Kayla Lane
7. Generation of Hydrogen from Organic Residues ..... Jenine N. McKoy
8. Cristography and Structural Biology ..... Olivia McReynolds
9. Field Observation and Interpretation of the Ecosystems ..... Jasmine Parker-McDuffie
10. Field Observation and Interpretation of the Ecosystems ..... Kandyce Perry
11. Tropical Ecology ..... Aforkor Quaye
12. Transmission Mechanisms of Activation signals by membrane ..... Kymber Rias
13. X-Ray Spectroscopy of Chemicals ..... Christina Sparks
14. Global Health Issues in South Africa ..... Jasmine Taylor

## Know your parasite: Awareness of malaria in Limpopo Province, South Africa

Written By: Daria Parice Clegg

### Abstract

The purpose of our study was to explore the awareness of malaria symptoms, treatment, transmission, and prevention in the Maludzhawela community. We performed a correlative study to determine if prior diagnosis impacted awareness. Awareness was defined based on the recommendations of the World Health Organization and the Limpopo Provincial Department of Health. Thirteen households were randomly chosen to complete a cross-sectional survey. Respondents were grouped into two categories based on whether or not they presented a prior history of the disease. Results according to the group-wide analysis showed there was no appreciable difference in responses referring to symptoms, transmission, and prevention of malaria; both groups were equally aware of symptoms and transmission and neither group was aware of preventative methods. Both groups were also aware of treatment methods; however, those with a prior history of malaria were more aware of the treatment methods than the group who had no prior diagnosis. Overall, the Maludzhawela community proved to be aware of symptoms, treatment, and transmission of malaria in accordance with the World Health Organization and the Limpopo Provincial Department of Health, but the community was not aware of approved preventative methods. As part of a series of studies in HaMakuya district, the results of our study were compared to those of previous studies conducted by students of the Organization of Tropical Studies in the nearby villages of Tshambuka and Dotha in order to better understand the overall degree of malaria awareness in the HaMakuya district.



## **The Comparison between 3 Fresh Water Lagoons & the Effect of Water Qualities on Stable Environments**

**Written By: Erica Ferguson**

### **Abstract**

Water parameters such as pH, turbidity, and dissolved oxygen in terms of percentage and milligrams per liter determine the living qualities of all water systems. Therefore, researching these parameters and seeing how each individual parameter interacts with each other to create a stable living environment for aquatic life. A Horiba multi parameter probe was used in order to get the most accurate reading of the lagoons. This instrument is able to measure temperature, oxidation-reduction potential, electrical conductivity, turbidity, dissolved oxygen, total dissolved solids, and salinity. This research focuses on the parameters of dissolved oxygen, turbidity, temperature, and pH. The combination of these parameters creates an indication of the aquatic life that is able to survive in each particular environment. The objective of this research is to take readings from several points from three individual lagoons, two from the research compound and one from a residential area to compare and contrast them with each other. The hypothesis was that the lagoons located outside of residential areas would have more hospitable conditions versus the lagoon located in a residential area. Once the comparisons were made using charts and tables a conclusion was formed that determined which lagoon had more hospitable living conditions. Each parameter has normal ranges that the water should be within based on the size and the location of the lagoons. However after the readings were taken there were abnormalities found in the parameters at each lagoon. These abnormalities proved that the lagoon located in the residential area rendered more stable living conditions

# **The Microbial Diversity of the Deep Subsurface: Characterization and Identification of Thermophiles**

**Written By: KaNesha Monique Gillyard**

## **Abstract**

Previous phylogenetic studies have shown high abundance of thermophiles in extreme environments. In addition, 16S ribosomal RNA libraries have confirmed the presence of the thermophiles in the South African deep mines. Culture-dependent and culture-independent methods were used to analyze the microbial diversity of the deep mine community. Therefore, we attempted to characterize and identify thermophiles from the soil and to conduct biodiversity studies of fissure water collected from the deep mine using culture-dependent and culture-independent techniques, respectively. Isolation relied heavily on bacteria cultivated in rich media and identification of the pure isolates using a molecular approach. Preliminary results obtained suggest a diversified bacterial environment in the soil with the presence of both Gram positive and Gram negative bacteria. Furthermore, the microbial biodiversity studies of the fissure water sample solely based on denaturing gradient gel electrophoresis method suggests the presence of eukarya and bacteria, and possibility of the absence of archaea. As thermophiles have been known to demonstrate great importance in revolutionary global technology, the isolation and identification of thermophiles conducted in this study may be relevant to future revolutionary publications.

# Comprehensive Ecological Condition Analysis Based on Abiotic and Biotic Indicators of Three Lagoons in Unidunas, Brazil

Written By: Antonia Gore

## Abstract

When dealing with nature one has to be very careful not to upset the balance that is in effect. Observation of the surrounding area as well as the body of the habitat will give us facts as to whether the area is truly being preserved or not. Examining the different indicators including biotic and abiotic might help understand the ecological condition of a given habitat. The goal of this study is to examine the ecological conditions of three lagoons based on the abiotic and biotic factors. The three lagoons the focuses of this study are found in UNIDUNAS, Brazil. It is important to examine the lagoons because they are part of the ecosystem. Each bio indicator was examined at five different points in every lagoon. The results showed the physical and biological parameters studied corroborate my hypothesis in which the ecological conditions of two lagoons, Cameroon and Victoria, were better than Fleming. The information collected is very relevant to our ecological footprint and is an example of what is happening in the ecosystem of Brazil.

in STEM at Spelman College

## Lapatinib and Neratinib: Using combination drug therapy to advance the effect of the treatment of HER2 Positive Breast Cancer

Written By: Kendra Hearn

### Abstract

There are 4 receptor tyrosine kinases (RTKs) in the 'HER' or ErbB family: EGFR, HER2, HER3, and HER4. This family of receptors is involved in many cellular functions including growth, division and apoptosis. The regulation of ErbB can occur in subregions of the membrane and are vital to the continued health of the cell. These RTKs are known for their involvement in many forms of cancer. The study of HER2 positive breast cancer accounts for approximately 20% of breast cancers, and has been noted as one of the most aggressive forms of the disease. In this study, 3 different pharmaceuticals, trastuzumab, a monoclonal antibody, as well as lapatinib and neratinib (intracellular inhibitors), are used in various concentrations to assess the aggressiveness of each. Using two cell lines known for their HER2 positive receptors, SKBR3 and BT474, these drugs were tested to find which solutions are most effective. For each cell line present, different concentrations were tested in the same environments for 3 days. After 3 trials for each concentration and cell line, data was collected and results have shown combination treatments have proved more effective in cell death.

## HIV/AIDS Stigma Influence on Cape Town, South Africa Community

Written By: Kayla Lane

### Abstract

Rates of HIV/AIDS cases continue to increase across the world. AIDS related stigmas or discrimination have a vast impact on participants willingness to receive testing and are one of the *primary barriers to effective HIV prevention as well as to the provision of treatment, care, and support.* (Shisana et al., 2005) Stigma is considered to be a result of fear and blame, rather than ignorance and could be overcome with educational intervention. (Goffman 1963) It is of great importance that we evaluate some of the current efforts on the path to the depletion of this Pandemic. The purpose of this research is to understand the influence of HIV/AIDS stigma on the willingness of participants to receive HIV testing, attend focus groups, and reach a comfort level accepting their status and sharing with their partner. This study was conducted in Cape Town, South Africa with a cohort of 20 participants. Participants were interviewed using an HIV/AIDS Stigma Influence questions shown in Figure 1. The following findings bring awareness to the many improvements that can be made when implementing varying treatment methods and focuses on the identity of the test distributor, the location of the testing center, and the effects of the media and current awareness campaigns.

# Hydrogen Gas from Waste Aqueous Solution: The Study of How Organic Waste Can Be Repurposed as Renewable Energy

Written By: Jenine N. McKoy

## Abstract

While hydrogen electrolysis from water has been considered to be a potential alternative energy solution, the lack of cost efficiency prevents this process of producing hydrogen gas from being effective and affordable. This research focuses on an innovative method of extracting hydrogen gas from waste aqueous solutions, which is an efficient and cost effective way of producing hydrogen gas.

The goals of this research are to extract hydrogen gas from waste aqueous solutions, and to identify the optimal waste composition yielding a high production of hydrogen gas. In this research the waste aqueous solutions were analyzed for the following: the amount of hydrogen gas produced by each solution by volume, the molar quantity of hydrogen gas and the maximum amount of electrical flow or current that can be generated per solution. To accomplish the analysis, chromatography gas analysis and direct volumetric gas measurements were performed. The data generated specifically honed in on the quantity and efficiency of the hydrogen gas production process as the waste aqueous solution varied. Ultimately, the results showed that the cases that had the ability to produce a significant amount of hydrogen gas were the waste aqueous solutions containing the basic additive. The most efficient experimental case was Case I, where waste A, an organic waste aqueous solution containing the basic additive, produced the maximum amount of hydrogen gas, approximately 3000 cubic centimeters. After completing this analysis, it was found that the efficiency of hydrogen electrolysis from waste water is significantly depended on the amount of basic additive added to the solution. The energy efficiency graph even displayed that producing hydrogen gas from waste aqueous solutions have the ability to have over 100% efficiency and therefore have the ability to be successfully implemented as a promising renewable energy source for the future.

## The Effects of Abscisic Acid on the Structure of a Plant Protein\*

Written By: Olivia McReynolds

### Abstract

Agriculture in areas of unfavorable conditions has created a need for scientists to manipulate plants. In this sense the stress hormone receptor pathways could be targeted as a way of manipulation in order to increase crop yields during times of environmental stress. One of the ways that the hormone receptor pathways have been manipulated is by altering the receptor. The receptors for abscisic acid belong to a family of receptors called pyrabactin resistance 1 (Pyr1) and Pyl (PYR-like) receptors. A protein involved in the stress response of a plant has been experimentally proven to form a complex with abscisic acid. The protein alone has also been previously reported to form a dimer with itself. The purpose of this experiment is to use x-ray crystallography to characterize the structure of the protein and the complex that it forms with abscisic acid (ABA). The structural characterization of the protein is crucial to understand and, ultimately, to control the cellular response to stress. The structural characterization of the protein can be performed by the use of the protein crystal analysis. Using standard protein crystallization techniques such as vapor diffusion hanging-drop and vapor diffusion sitting-drop methods the optimal conditions for the crystallization of the protein and the protein-ABA complex were derived. The protein with no added abscisic acid formed very angular crystals in conditions of neutral pH and 3.5 M ammonium sulfate. Abscisic acid, a known plant stress hormone, was not only shown to form a complex with the protein, but was also shown to have marked differences in crystal structure in comparison to the protein by itself. The crystals formed by the abscisic acid-protein complex showed much less angular crystals while using the same conditions as the protein. The crystal structures of the protein and the resulting protein-ABA complex provide insight into the structural and conformational differences between the two molecules. Using these observations and a number of different experiments, it can be said that ABA causes a conformational change in the protein.



## **The Effect of Water Pollution on the Biodiversity of Three Lagoons Comprised of Aquatic Insects**

**Written By: Jasmine Parker-McDuffie**

### **Abstract**

Pollution in lagoons is a major problem in the environment. Plants, parameters and insects are indicators of complications that can impact biodiversity in a lagoon. Monitoring the lagoons will aid in the decrease of pollution rates by utilizing bioindicators. Research was conducted in Parque das Dunas through the program Unidunas. The location of this research was in Salvador de Bahia, Brazil during their winter season. This experiment focused on the effect of water pollution on the biodiversity of three lagoons comprised of aquatic insects. The amount of aquatic insect orders in each lagoon presented a correlation between the environment and pollution. The three lagoons observed were Vitoria, Camarão, and Flamengo. Each lagoon had a light pan trap applied to their area and the aquatic insects were captured in this container. Once the collection of aquatic insects was complete, the examination of physical characteristics was done. The use of microscopes and an identification key helped in the placement of the aquatic insects into families. Brazil has several families of aquatic insects because it is a tropical region. Eleven of these orders of aquatic insects were found in this study. They were Ephemeroptera, Odonata, Plecoptera, Hemiptera, Coleoptera, Neuroptera, Megaloptera, Trichoptera, Lepidoptera, Diptera, and Blattodea. One of these particular orders was found in at least one of the lagoons in this experiment. The families of insects found by the lagoons contained the information needed to observe the diversity of that particular area. This research concluded that Vitoria and Camarão had a high number of families which indicated that these lagoons have great biodiversity. Also, Flamengo had low abundance of families in the lagoon which indicates low diversity in this area. Since Vitoria and Camarão have similar surroundings inside the park, pollution is not a big factor in their environment. Yet Flamengo which is located outside of the park had external influences which caused pollution in its surroundings. This is the reason why the biodiversity in Flamengo was low. A conclusion can be made that Vitoria and Camarão had less pollution than Flamengo. The biodiversity of an isolated lagoon is higher



than a lagoon that has external interaction with the world.



## **Comparative Study of the Aquatic Plants as Bioindicators to Identify Water Quality of Three Lagoons in and near Parque das Dunas in Salvador, Bahia, Brazil.**

**Written by: Kandyce Perry**

### **Abstract**

Pollution within the environment is an everyday occurrence. While pollution may occur out of spite to the environment, pollution usually happens as a result of negligence. If the action is indirect and the source of the pollution is unknown—like acid rain or runoff—it is difficult to remedy an ecosystem. It is quite easy to overlook ecosystems that are damaged. However, nature provided many warning signs or indicators to tell society about the quality of a particular ecosystem. These warning signs are called bioindicators. This study examines the water quality of three lagoons inside Parque das Dunas in Salvador, Bahia, Brazil by studying the aquatic plants at each lagoon. Parque das Dunas is a protected national park that preserves one of the last dunes ecosystems in Brazil. Two lagoons, Camarao and Flamengo are located inside the fenced-in park, while Flamengo is a lagoon located right outside of the park in a residential neighborhood. Aquatic plants were identified at five different points at each lagoon using a key provided by Parque Das Dunas. Research was done to assess the indicating functions of each plant. Results show that aquatic plants that indicate rather good water quality were found at Camarao and Vitoria while aquatic plants that indicate poor water quality were observed at Flamengo. Eutrophication, the process of invasive species covering the surface of bodies of water and inhibiting gas exchange and photosynthesis, was observed at quite a few points at Flamengo. It can be concluded that the water quality at Camarao and Vitoria is better than that of Flamengo.

## Effect of Human Trails on Ground Nest Predation in a Neotropical Cloud Forest in Monteverde, Cost Rica

Written By: Aforkor Amelia Quaye

### Abstract

Forest trails are created for many different uses, including hunting and recreation. Recreational trails are used in ecotourism to give species tours, for hiking, or for tourist attractions like zip lining. These human made recreational trails are often times crucial for ecotourism, which is the main source of economy in several tropical countries. With the growing popularity of ecotourism across the world, there will be an inevitable increase of manmade trails in otherwise primary forest. These trails are thought to be harmless to the environment, but it is important to study what effects these trails have on the species that occupy these habitats. In this study, artificial nests were used to assess avian nest predation in neotropical cloud forest. My purpose was to examine the variation of predation frequency and the species composition of the nest predation on and away from the human created trails. Data was generated from ground nests that were placed on trail edges and from nests that were placed 20m into the forest. The number of quail eggs eaten, artificial eggs removed, and artificial eggs with dental markings were recorded daily from each nest for nine days. Data analyses showed that species composition of animals that preyed on the nests did not vary dependent on location of the nest ( $\chi^2 = 1.12$ ,  $df = 3$ ,  $p = 0.75$ ). Although the nests on the trail had a higher number of preyed eggs overall and more eggs were taken from the trail nests for the majority of days, there was not a statistically significant trend. Predation intensity also did not vary dependent on location ( $\chi^2 = 0.078$ ,  $df = 2$ ,  $p = 0.96$ ). This study concludes that human created trails do not significantly affect the amount of ground nest predation in secondary forest. When considering this method of data collection, a change in the variation of nest predators or intensity of nest predation would require a greater land disturbance. Also, the trend shown in raw data suggests that a longer time period of data collection may have shown a statistically significant relationship.

## Using Osteoclast Differentiation to Determine the Expected Degree of Arthritis

Written By: Kymber Rias

### Abstract

It was of interest to determine whether splenocytes and bone marrow (BM) cells from B6wt or CD38 deficient (CD38ko) mice would display a higher level of osteoclast differentiation. It was examined how osteoclasts were formed in B6wt and CD38ko mice in response to various stimuli: M-CSF, RANK-L, CXCL12, and AMD3100. It was hypothesized that CD38ko mice would display a higher level of differentiation from osteoclast precursors to osteoclasts. A second hypothesis was that the treatment of MCSF + RANK-L + CXCL12 would cause the greatest degree of differentiation in cells from CD38ko mice. For each experiment, either the splenocytes or the BM cells were given the signaling cocktails that made them transform to osteoclasts, and they were kept in a culture at 37C. After several days of incubation, the degree of differentiation was assessed. Osteoclast formation was determined by staining these cells for Tartrate Resistant Acid Phosphatase (TRAP). The stimulation mixture that would produce the most bone resorption was also to be determined. In order to determine this, a well-plate coated with a calcium phosphate film was used as a bone substitute. Von Kossa staining procedure was used to assess the bone resorption. Experimental data indicated that the highest degree of osteoclast differentiation was, in fact, in the spleen cells of B6wt mice treated with the combination of M-CSF, RANK-L, and CXCL12. In BM cells however, the most differentiation was seen in both B6wt and CD38ko mice treated with the combination of M-CSF and RANK-L only. There seems to be a difference in the number of osteoclast precursors in non-immunized versus immunized mice. The cells treated with both M-CSF and CXCL12 displayed the highest degree of activity. In the presence of AMD3100 the BM cells displayed the least activity, even less so than the cells treated with M-CSF alone. Future direction includes performing similar experiments in B6wt and CD38ko arthritic mice, where maximal expansion of inflammatory CD11 b+ cells and osteoclasts occur.

## X-Ray Spectroscopy of Aqueous Salt Solutions: Explaining the Double Peak

Written By: Christina Sparks

### Abstract

The observation of a double peak in the X-ray spectra of water, presumably an anomalous behavior, has been the subject of interest to many scientists. To investigate this phenomenon, we undertook the X-ray spectroscopy study of aqueous salt solutions. The BESSY II synchrotron facility at Helmholtz-Zentrum Berlin, in Berlin, Germany, was used for this study as it enables us to reach our target energy range of 535 eV to 540 eV. A part of the current study also addresses the design needs such as tube dimensions, concentration of the aqueous solutions and the behavior of the fluid in vacuum suitable for performing the necessary experiments at the synchrotron facility. An optimized combination of inner diameters of the two tubes, connected by with a convertor that accommodates a shift in the size of the outer diameter, were found to be 0.030 mm and 0.010 mm respectively. Similarly, a suitable concentration of the aqueous solutions of sodium and magnesium chloride was found to be in the range of 2M to 4M. Solvents such as acetone, methanol, ethanol, and propanol revealed that the liquid jet behavior can be influenced by certain physical properties such as viscosity and the freezing point of the solvents. Though ice formation cannot be avoided, the pattern of growth was studied extensively so that the role of these factors could be accounted for in the final experiment. Using the optimized conditions, X-ray absorption measurements are made and the analysis of the recorded spectra is currently in progress. However, preliminary data analysis indicates that the salts added to water are not responsible for the formation of the double peak.

## **Making it work: the regulations and strategies of water access in the village of Guyuni**

**Written By: Jasmine L. Taylor\*, Kelsey Anderson, Juliette Logan, Daniel Mansfield**

**\*Spelman College student**

### **Abstract**

The aim of the study was to explore the regulations and strategies of water access in the arid, water-stricken village of Guyuni. The research employed a 'bottom up' approach in order to fully understand the relationship between residents and actions taken to capitalize on available water resources. Through data collection including methods such as verbal interviews, photography, mapping, and participant observation, we studied how water was obtained and managed by households in the landlocked village. In efforts to sustain available water and capitalize on supplemental resources, residents of Guyuni use various regulations and strategies to maximize water collection. There was only one government rule and several community imposed rules reported for water tap collection. All participants reported that water collection, via taps, is only allowed Friday thru Sunday. For that time period, there are community imposed rules at taps such as: no washing, no children under the age of 12 may collect, and if there is a queue, each person is restricted to fill three 25L buckets at a time. Residents primarily obtain water from government taps installed throughout the village. When this water resource is scarce, residents have found ways to gather more water through the use of rainwater, government provided water, or the purchase of water through other means. The government recognized the importance of rainwater and has provided households of a certain structure, square homes with slanted metal roofs, with a free tank for rainwater run-off.

Through a participatory research model, we were able to observe the inconsistency between regulations and behaviors toward water conservation in the community. Our data suggests that further communication is needed between citizens and government regarding water access, while the government should explore possible alternatives such as groundwater integrated water systems to eliminate some or all of the water scarcity in Guyuni.

## Synthesis and Characterization of an Amine- based Monomer for a Fluorescent Molecularly Imprinted Polymer

Written By: Kamille Williams

### Abstract

Molecular imprinting is used in various applications for sensors, environmental remediation, and targeted drug delivery. It is a chemical synthetic technique in which a chemical monomer is etched on a polymer substrate for the purpose of creating a polymer substance that can be used to specifically trap a molecule of interest in a complex sample matrix. Molecularly imprinted polymers (MIPs) resemble miniaturized golf balls in the sense that the polymer (the golf ball) is dimpled at regular intervals, with each dimple representing the imprinted cavity that will trap the molecule of interest. A functional monomer is needed to create the template for molecular imprinted polymers. This research project focused on the synthesis of a fluorescent chemical monomer that could be used to target the selective detection of citrinin, a mycotoxin that is given off by fungi in food products. The advantage of a fluorescent MIP is the increase in sensitivity that is gained to analyze small amounts of citrinin in a contaminated sample, since fluorescence signals characteristically strong even at the trace level.

In the research, the synthesis of the functional monomer followed a five-step process that modified the startup material (a naphthalic anhydride base) through several reactions that added several different functional groups to the startup chemical. Column and thin-layer chromatography were used for the purification of the intermediate compounds in the synthetic process, and the characterization of the products at each step in the process was done using proton and carbon nuclear magnetic spectrometry (NMR) and infrared spectroscopy (IR). The synthetic pathway that was investigated in this project resulted in a functional monomer with amine-based (quinoline and piperazine) substituents that emitted a strong fluorescence similar to citrinin. The purification of the intermediate steps of the synthesis was noted to have a significant effect on the recovery of the final product.