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Environmental Monitoring in Free-Living *Mus spretus* by Means of Biochemical Biomarkers

Written by: Maya Bryant

Anthropogenic activities are dangerously releasing increasing amount of contaminants in our environment, threatening the viability of the ecosystem and the health of the organisms living there. The Algerian mouse *Mus spretus* is the best characterized aborigine mouse species native to open habitats around the western Mediterranean. It is a good candidate organism to be used as bioindicator of pollution in terrestrial ecosystems. The aim of this project is to study the biological effects of pollutants. For that reason, mice were exposed to different contaminants (heavy metals, organic pollutants) in our laboratory and their organs/tissues have been extracted for analysis. Some biochemical tools from a battery including: analysis of damage to biomolecules (DNA lesions as *i.e.* 8-oxoguanine or apurinic sites; lipid damage as *i.e.* malondialdehyde), levels of enzymatic and non-enzymatic antioxidants (*i.e.* catalase, metallothioneins, GSH), and the redox status of proteins were assayed. These test show that the presence of the contaminant DDE had a very clear effect on the mice. The mice that were exposed to this pollutant showed an increased concentration of reduced thiols, total glutathione, and glutathion reductase, and decreased concentration of catalase and malondialdehyde. This could infer that the organism has exhibited oxidative stress which cause the production and consumption of the enzymes tested. These results indicate that exposure to pollutants such as DDE have an impressive role in oxidative stress that effects wildlife as well and could potentially have similar effects in humans.

Eternally Yours: An Analysis of Post Operative Behavior and Personality in Organ Recipient Patients

Written by: Meigan Bryant

Organ donation is one of the most controversial medical practices to date. Conflicting religious beliefs and fear of lack of care in order to expedite donation are common issues surrounding the topic. The purpose of this study was to determine if behavior and personality of organ recipient patients parallel the history of their donors in South Africa. A qualitative and quantitative analysis study was conducted by using surveys. Parents of children who received donated organs completed a survey where they compared their child's behavior pre and post organ donation. This behavior was then compared to the behavior of the organ donors and from this results were drawn. The results support our hypothesis. Because this was a pilot study future studies should include a larger sample size and use innovative biomedical technologies to correlate findings with genetic profiles.

Comparison of Functional Analysis of Regulatory B Cells in Wild-Type and CD38KO Mice

Written by: Brianna Burlock

Systemic Lupus Erythematosus (SLE) is an autoimmune disease which causes long-term problems in many different organs of the body and has been associated with CD38 deficiency. Connections of the glycoprotein CD38 in B cells of the immune system are currently being studied. In a previous study, an increase in percentages of IL-10-producing B Regulatory cells (Bregs) was hypothesized to be shown in CD38KO mice (Richardson 2013) as compared to Wild-Type mice. Since CD38 is not expressed in CD38KO mice, the absence of CD38 within the B10 cell subset may have functional consequences, in particular regarding IL-10 production. This study attempts to investigate the previous hypothesis by performing functional analysis on the Bregs from both Wild-Type and CD38KO mice. The functional assay was performed to induce IL-10 production in Bregs. Upon this treatment, cells were surface stained to identify the B cells and, in particular, those that are IL-10-producing. These cells were analysed using FACSCalibur and FlowJo Analysis to allow the identification of the frequency of IL-10⁺CD19⁺ cells, which are the Breg cells. Thus, the proportion of Breg cells in the spleen of Wild-Type and CD38KO mice could be tested. Regarding the functional assay, the results show no statistical differences or correlations in the basal level of IL-10-producing B cells or induced IL-10-producing B cells in splenocytes between Wildtype and CD38KO mice. At this point, a relatively low number of mice has been analyzed, therefore these numbers are only orientative. Also, although this study shows that there are no differences in functionality of Breg cells between the naïve Wildtype and CD38KO mice, there is a possibility that differences will be seen in pristane-treated mice. Ultimately in studying the relationship between CD38 and Regulatory B cells, better diagnosis and treatment options could be found for lupus patients.

Keywords: immunology, regulatory B cells, IL10, functional analysis, splenocytes

“Puff or Pass”: Comparing the Prevalence of Tuberculosis in Rastafarian Groups and Non-Rastafarian Groups in Informal Settlements in Cape Town, South Africa

Written by: Bianca Campbell

At this present time, there is an overall increase in use of marijuana, both recreational and medicinal. According to the CDC, approximately 21% of adolescents, male and female, between the ages of 12-17 years of age have tried marijuana (CDC, 2009). Also among the 21% of adolescents that tried marijuana, 32% used marijuana at least 20 more times in their lifetime (CDC, 2009). This suggests that in the United States teenagers and young adults use marijuana for a significant amount of time. To date little is known about the health literacy of the Cape Town population in South Africa. We hypothesize that if the prevalence of Tuberculosis is high in areas where the use of Cannabis is high, then the non-infected Tuberculosis patients could be at risk for obtaining Tuberculosis. The purpose of this study is to investigate the health literacy of Africans/Cape Townians regarding the use and risk of smoking marijuana and how this can lead to the spread of other infectious diseases (i.e. tuberculosis). Our cohort consisted of Rastafarians from Egoli and we compared the incidence and prevalence of its religious-based Cannabis use in that area compared to the incidence and prevalence in areas without the use of Cannabis. To perform this study conducted individual interviews among Egoli residents, which have Non-Rastafarian and Rastafarian communities, to determine which area displays a higher prevalence of tuberculosis and whether marijuana is a major cause of transmission. The study also examined the number of patients from Rastafarian communities in Egoli with diagnosed tuberculosis who were and were not exposed to cannabis. Our results suggest that of those assessed in our cohort, less than 50% were informed of the health consequences of smoking and the effects that it has on their respiratory systems. The majority of the Rastafarians had different beliefs about the health consequences of alternative and traditional herbal medications. In conclusion, the health literacy of marijuana use is a serious concern that needs to be addressed more effectively in South African townships and communities.

Collateral Sensitivity of Resistant MRP1-Overexpressing Cells to Flavonoids and Ferrocene Derivatives through GSH efflux.

Written by: Niwa Coleman

There have been many important developments in medicine over the years, but cancer remains a consistently growing problem around the world. This can, to a great extent, be attributed to the growing problem of multi-drug resistance (MDR) of cancer. Flavonoids were investigated in this study to understand if ferrocene would be an appropriate agent to reverse the MDR mediated by MRP1. Apigenin is demonstrated to modulate transport and ATPase activities of MRP1. In this study different synthetic derivatives of Apigenin were experimented through organic synthesis. The chalcone derivative was synthesized and the later aurone derivative was synthesized to obtain a ferrocene group at position 2 of the flavonoid core. As a result, two aurone derivatives and two flavone derivatives were designed and synthesized and will be biologically tested to provide further conclusions

Women and Their Role in Voluntary Counseling and Testing during the Epidemic of HIV in an Informal Settlement in Cape Town, South Africa

Written by: Brezana Cross

The purpose of this study was to identify whether there are any relationships between the stigmas, knowledge, attitudes surrounding HIV and voluntary counseling and testing (VCT) in women in Egoli, Cape Town, South Africa. This study solely focused on women in an impoverished community, with an assumed lack of resources for protection of HIV and other STIs and STDs. This study tested the knowledge, attitudes, and belief in stigmas through an administered survey to twenty women in an informal township. It was found that most of the participants had been tested for HIV; this was due to previous pregnancies and prenatal care that required testing. Knowledge of HIV and its transmission was relatively low in most of the participants. Overall, the majority of participants did not have negative attitudes or beliefs in stigmas surrounding HIV. However, there were a substantial number of people that believed that prayer could cure HIV and that people become HIV positive by being weak or foolish. In addition, 100% of the participants reported having never used a condom. This is attributed to the belief that in monogamous relationships condoms are not needed and a fear that if a woman suggests a condom, then she is committing adultery or accusing her partner of infidelity. VCT is the key to combating the epidemic of HIV in South Africa, but its efforts to decrease the rate of HIV is futile if the people of South Africa are not aware of the importance and knowledge of HIV prevention. Women in communities such as Egoli are often subjected to the power of their male counterparts and they have little to no voice in decisions that affect their health. Programs that encourage relationship and gender equality and more education about the transmission of HIV in these communities will decrease the rate of HIV and the prevalence of risky sexual behaviors.

Keywords: Voluntary Counseling and Treatment, HIV, knowledge, stigmas, attitude, women

Knots, Crossing Changes, and Surfaces in 4-dimensions

Written by: Kayla Davie

Knot theory is a branch of topology that focuses on the study of mathematical knots. We study 11 crossing knots and knot invariants related to smoothly immersed disks in the four-ball. The knot invariant we focus on is slicing number, which is the minimal number of crossing changes to a slice knot. Using known relationships between knot invariants, computer applications used to manipulate knots, and other advanced programming, we were able to determine the slicing number for 414 11-crossing knots (out of a total of 552). We also obtained information on the 4-ball crossing number (minimal number of crossing changes in a movie of a disk bounded by the knot) and the smooth 4-genus (minimum genus of a smooth surface embedded in the 4-ball with boundary the knot) of many of these knots.

Keywords: knot invariants, slicing number, 4-ball crossing number, smooth 4-genus

Escher's Tessellations and the Classification of the 17 Wallpaper Groups

Written by: Kayla Echols

Maurits Cornelis Escher was a Dutch artist who became obsessed with painting tessellations in the early 20th century. Through his work, and a few suggestions from his brother, he realized that he could only create 17 unique tessellations. Though many mathematicians, chemist, and physicists knew and used the fact that there are only 17 possible wallpaper structures, many do not know why. The research in this paper aims to give an uncomplicated description of how wallpaper patterns, defined as periodic 2-dimensional tiling of a pattern over a plane where there is no overlapping or gapping, are classified. Here we will use group theory and linear algebra to note an inconsistency in Morandi's definition of a lattice as well as observe how to classify wallpaper patterns by lattice type, group actions, and whether or not they obtain a split group extension.

Detection of epigenetic alterations in human colon and breast cancer using minimally invasive methods

Written by: Stranjae Ivory

Epigenetics is the regulation of gene expression caused by factors other than change in nucleotide sequence. One sub factor is DNA methylation. A change in DNA methylation is implicated in altered gene expression and is associated with many human diseases. In particular, abnormal methylation of cytosine in DNA is common in the development of many cancers. Methylation (addition of methyl group) of cytosine at carbon 5 of the pyrimidine ring is an epigenetic mark for transcriptional gene silencing. Its effects on cells play important roles in controlling cellular differentiation and progression. Majority of DNA methylation in mammals occurs in 5'-CpG-3' dinucleotides or CpG-rich stretches of DNA within the promoter region. To deeply analyze how epigenetic alterations contribute to tumorigenesis this particular research focused on identifying differences in methylation patterns of DNA samples derived from individuals and patients with colorectal and breast cancer. To analyze methylation profiles in different samples, sodium bisulfite treatment, quantitative methylation specific Polymerase Chain Reaction (qMSP PCR), and Gel Electrophoresis were performed. Having converted cytosine residues on un-methylated DNA into uracil and leaving 5-methylcytosine on methylated DNA unchanged allowed for the first detection of methylated DNA later used in various downstream analyses. Primers selected for the study included the beta-Actin primer used to normalize the quantity and quality of DNA present in the samples. Results from the use of beta-Actin primer confirmed DNA was successfully isolated from the plasma samples. Un-methylated DNA of normal cells was detected at a greater rate of specificity than methylated DNA of tumor cells. Expectations of specificity from particular samples were challenged by some methylated samples exhibiting un-methylated specificity and un-methylated samples exhibiting methylated specificity. There developed a greater concern for the quality of plasma used for the isolation of DNA. In future research to better the presence of tumor cells, there will be an increase in the initial volume of plasma before the isolation of DNA and/or utilization of the Nested PCR technique. Presumably, changes in methylation patterns are seen in cancer cells and has become of clinical interest. Therefore, better

understanding methylation patterns and/or frequency can help in diagnosis and cancer treatment.

Keywords: epigenetics; DNA methylation; DNA un-methylation; tumorigenesis

The Effect of Endocrine Disruptors on the Sexual Development of Amphibians

Written by: Blair Johnson

Variety in external hormone exposure has previously been correlated with manipulation of the sexual development in amphibians. Depending on the point of exposure of endocrine disruptors, amphibians may or may not be affected by aquatic contaminants. In order to better understand the effect of these contaminants on amphibians, we examined the life span and sexual development of 160 *Bufo bufo* toads that were exposed to different concentrations of bisphenol A. The four different concentrations included the control (absence of bisphenol A), 10^{-10} , 10^{-8} and 10^{-6} M. Bisphenol A has been previously noted as an endocrine disruptor and as a plasticizer. The contaminant can be traced in a variety of American waters. We hypothesize that the varying concentrations of Bisphenol A exposed to the *Bufo bufo* toads beginning at their larval stage of living has an effect on their adult weight, snout-to-vent length, and gonad size.

Keywords: sexual development; amphibians; Bisphenol A; amphibians; endocrine disruptor; gonad

PIN2 Localization in Arabidopsis PP2A-C Mutants

Written by: Erin Johnson

Protein phosphorylation and dephosphorylation are key components in a plethora of cellular signal transduction networks of all organisms controlled by the protein kinases and protein phosphatases. The functions of protein kinases have been widely studied and functionally characterized, but it has been difficult to ascribe specific physiological roles to plant phosphatases. The protein phosphatase 2A group (PP2A) is the most abundant factor in eukaryotes, responsible for dephosphorylation of serine/ threonine residues. PP2A is a heterotrimer, made up of scaffolding, regulatory and catalytic subunits. PP2A is divided into PP2A-A, the scaffolding subunit, PP2A-B, the regulatory subunit, and PP2A-C, the catalytic subunit. Specifically in Arabidopsis, the catalytic subunit, PP2A-C, is further divided into two subfamilies depending on their sequence conservation. With the analysis of different combinations of genes in subfamily II, it has been shown that mutated PP2A-C3 and -C4 genes controls auxin distribution and directs plant development. Auxin gradients are generated by the spatial distribution of a family of auxin transporters (PIN) whose polar localization, either apical or basal, is determined by their phosphorylation status. The objective of this project is to further ascribe precise cellular roles in plant phosphatases and to assess whether PP2A-C3 and PP2A-C4 regulate PIN2 localization. We hypothesize that the Arabidopsis phosphatases PP2A-C are involved in the phosphorylation and dephosphorylation of PIN2, which are essential for establishing the auxin gradients that guide many aspects of plant development. To study PIN polarity, PIN2_{pro}:PIN2-GFP marker was introduced into PP2A-C3 and PP2A-C4 mutants. PCR was used to genotype the mutated plants. Plants homozygous for PIN2_{pro}: PIN2-GFP were used for experimentation. The effects on PIN2 localization in the plants homozygous for PIN2_{pro}:PIN2-GFP was further monitored by confocal laser microscopy to assess the distribution of the PIN2_{pro}:PIN2-GFP. Polarity was assessed using the relation of signal strength at the apical/basal membrane to signal strength at the lateral membrane in cells expressing the transgene. In wild-type seedlings, a stronger polar signal is observed. Initial characterization of PIN2 localization in PP2A-C3 and -C4 mutant lines suggests that

these subunits could also contribute to the establishment of auxin gradients for proper plant development. In conclusion, we show that the catalytic subunits, PP2A-C3 and -C4 have an affect on the PIN2 proteins and auxin distribution in plants. With these findings, we are a step closer to functionally characterizing the physiological roles of plant phosphatases.

Characterization of preadipocytes associated to metabolic disease in obesity

Written by: Justice Johnson

The goal of this study was to characterize how preadipocytes differentiate under conditions of obesity. Accordingly, adipocyte staining using oil red O was conducted using differentiating 3T3-L1 cells. The cytoskeleton increases and accelerates the process of adipogenesis. Therefore, cytoskeletal proteins septin 11, vimentin, tubulin, and actin were also extracted from adipocytes on day 0, 3, 6, 8, 10 of differentiation and examined via western blot. Results from the analysis verified the identity of each of the proteins being present in the cytoskeleton. The results from the adipocyte staining with oil red O showed how preadipocytes differentiate into mature adipocyte cells. Thus, these results have contributed largely to research on metabolic syndrome in obesity.

Synthesis and Characterization of Fe₃O₄ Nanoparticles on Graphene Oxide

Written by: Mekhakhem Kheperu

In this research, graphene oxide was laced with nanoparticles of magnetite Fe₃O₄ via co-precipitation technique using the metal precursors ferrous and ferric chloride. This was done with the goal of realizing the potential of graphene-based nanomaterials. The material was prepared by oxidizing natural flake graphite and by adding iron compounds to the resulting functional groups in stoichiometric proportions. The synthesized product was characterized by physico-chemical methods to understand the mechanism by which the metal particles are attached to the functional groups of the graphene oxide. Characterization by X-ray reveals a Bragg's angle of ~36 degrees - a small shift with respect to pure graphene - indicating that magnetite particle is indeed attached to graphene. Preliminary ⁵⁷Fe Mössbauer results suggest that magnetite particles are attached to graphene as seen by the disappearance of the magnetic spectrum typical of magnetite. Temperature dependent studies are currently underway. The results show that graphene, a record-breaking material new to the scene of nanotechnology, can indeed be easily laced with functional groups and other metal compounds to create useful nanomaterials with tunable properties.

Keywords: graphene, graphene oxide, nanoparticles, Hummer's Method, co – precipitation, X rays, diffraction

The Influence of dietary lipid composition on autophagy and apoptosis markers in skeletal muscle from mice following calorie restriction

Written by: Faith Kirkland

Aging in muscular tissue is associated with sarcopenia, an age-related loss of muscle mass and function. The goal of this study is to examine the effects of calorie restriction and lipid composition on apoptosis and autophagy markers in muscle. In order to achieve this aim, 64 male C57BL/6 mice were assigned to four groups based on diet: ad libitum-soy, calorie restriction-lard, calorie restriction-soy and calorie restriction-fish oil. These groups were fed experimental diets for 6 or 18 months and then sacrificed. Muscle tissue was taken and mitochondrial and total homogenate fractions were analyzed for p16, Bax, LC3, BECN1, and mTOR expression. The results indicated a trend towards lower levels of p16 expression under calorie restriction conditions in young and old animals. The calorie restriction-lard group had a significantly higher expression of p16 than the calorie restriction-soy and -fish groups. There was no significant difference shown between soy ad libitum and calorie restriction in relation to phosphorylation. Overall there was a significant difference between *ad libitum* and calorie restriction groups for total mTOR but there was no significant difference between *ad libitum* and calorie restriction in relation to mTOR phosphorylation. Mitochondrial levels of Bax expression were significantly lower in calorie restriction group. Based on these findings it could be concluded that the polyunsaturated fatty acid composition of lard effected the expression of p16 in muscle tissue. Also calorie restriction was shown to lower the levels of Bax in the mitochondrial fractions of muscle tissue. This was novel information, because the evaluation of Bax in these diets had only been previously done in total homogenates.

Keywords: autophagy, dietary lipids, energy restriction, mitochondria, skeletal muscle

Synthesis and Analysis of Graphene Iron Doped Nanomaterials

Written by: Ebone Monk

Nanoscale materials are useful to fabricate electronic devices of very small size. The newly found super material, graphene, has many extraordinary properties. The physical properties are found to be completely different compared to the bulk size of the same material. Carbon nanotubes and graphene are two examples of materials that have been found to be extremely useful. In this study, a ferric triacetylacetonate ($\text{Fe}(\text{acac})_3$) intercalated graphene system is synthesized, and characterized through X-Ray diffraction and Mössbauer spectroscopy. During this study, graphene and an intercalated composite of $\text{Fe}(\text{acac})_3$ sheets are produced through a chemical method. The synthesis of $\text{Fe}(\text{acac})_3$ and graphene involved a high-temperature reaction of $\text{Fe}(\text{acac})_3$ with graphene oxide in 1-methyl-2-pyrrolidone. X-Ray diffraction and Mössbauer spectroscopy analysis were used to confirm the successful attachment of $\text{Fe}(\text{acac})_3$ nanoparticles to the graphene sheets. While, X-ray studies indicate the diffraction peak at a Bragg angle of ~ 26 degrees, which is characteristic of monolayer graphene sheet, the isomer shift deduced from the Mössbauer analysis indicates that iron is in a +3 state.

Keywords: Iron Doped Graphene; Iron Oxide; Graphite Oxide; Mossbauer; XRD

Characterizing Recovering Bird Populations of Small Island Conservation Areas

Written by: Asia Mosee

Species distribution modeling involving the current occurrences of selected invasive species and relevant environmental data was conducted to produce potential distribution maps that depict the suitability of New Zealand to these invasive species. Distribution maps of individual species were used to describe potential ranges as well as illustrate areas affected by environmental conditions under current and climate changed based spatial scenarios. Further, efforts in restoration and conservation for the past decades have resulted in several small islands having invasive species eradicated with a resulting recovery in native flora and fauna, particularly birdlife. The species distribution modeling efforts were compared with the range and distribution of recovering populations of important bird species to highlight the various aspects of management strategies in a unique and isolated archipelago.

Modelling the range of potential invasive species to New Zealand

Written by: Christina Pollonais

Invasive species are of particular importance to New Zealand because its significant period of isolation from significant landmasses has resulted in a unique collection of species found nowhere else. Predicting the invasion, spread and possible distribution of invasive species is essential for effective conservation planning. Future climate change complicates any predictions, but can be modelled using spatial analysis software. Species are likely to invade for a number of reasons, including: proximity (already in Australia); have clear invasion pathways (via high frequency shipping, imported goods etc.); they are already being picked up at the border; or have previously invaded been eradicated. This work selects, prioritises and develops distribution models of those species with adequate literature covering their ecological requirements (temperature, rainfall, geology, presence of host species, etc.) and impact (economic, environmental and/or social/cultural). Species distribution modelling involving the current occurrences of selected invasive species and relevant environmental data were conducted to produce potential distribution maps that depicted the suitability of New Zealand to these invasive species. The distribution maps of individual species were used to describe potential ranges as well as illustrate areas affected by environmental conditions under current and climate changed based spatial scenarios.

Photocatalytic Production of Hydrogen from Isopropanol

Written by: Faith Reid

Alternative sources of energy are important to investigate as the population of the world increases and energy demands also increase. Hydrogen is a plausible alternative resource to fossil fuels as it can be produced from biomass using the carbon dioxide neutral mechanism of photocatalysis. The purpose of this investigation was to optimize the production of hydrogen from a photocatalytic reaction and investigate the influence of particle size, metal loading identity, reaction temperature, and reduction on hydrogen production. The catalyst titania was loaded with various percentages of platinum and gold under four different reaction temperatures and two reduction temperatures. The loaded titania catalyst was synthesized using three different techniques including deposition precipitation, impregnation, and photodeposition. Gas phase products from the reaction were analyzed by mass spectrometry and the catalysts' particle size was characterized using transmission electron microscopy. The highest percentage of hydrogen production was 12.4%, which occurred from titania loaded with 0.5% impregnated platinum and corresponded to a particle size of 1.1nm. Instances of high production of hydrogen, such as 11.9% from 0.5% platinum loading synthesized by deposition precipitation, also occurred with a corresponding low particle size of 1nm. Larger particles were not accompanied by such high rates of hydrogen production. Comparing the different loading metals incorporated into the catalyst, platinum resulted in the highest production of hydrogen. Increase in reaction temperature had the greatest influence on activity in the catalyst loaded with gold, and reduction at 673 K was detrimental to activity of platinum loaded catalysts. It can be concluded that smaller particle sizes correspond to increased production of hydrogen when platinum is used as the loading metal on the catalyst titania.

Keywords: hydrogen production, photocatalyst, particle size, isopropanol, gold, platinum, reaction temperature, reduction

An Examination of the Correlation between Women's Risky Sexual Behaviors and HIV/AIDS: Examining the Commonality and Contributions to their Re-occurrence in Subsequent Generations within the Informal Settlement of Egoli.

Written by: Christeva Smith

The current study examined the relationship between HIV/AIDS prevalence and familial reoccurrence, education, and financial backgrounds and how these factors affect the women of Egoli's view on HIV/AIDS and sexual behaviors through a split interview and survey method. It also investigated the women of Egoli's views on healthcare and how it could contribute to its reoccurring nature throughout subsequent generations as well as gauging the normality of certain risk behaviors that could increase the prevalence of HIV/AIDS. The results showed that the majority of the women were well versed in safe sexual practices and were raised in strong, two parent households. Aside from their shortened educational background, the women of Egoli showed to be fully aware of the risk and consequences that can be paired with unprotected and early sexual behaviors. The results were not conclusive as far as determining a specific cause however they did eliminate lack of sexual education as one of the causes of the prominence and reoccurrence of HIV/AIDS and early teenage pregnancy within Egoli.

T6SS Assembly of *Pseudomonas aeruginosa* Studied by Microscopy Approaches

Written by: Lindsay Stanford

Pseudomonas aeruginosa (*P. aeruginosa*) is an important opportunist human pathogen known as one of the most frequent causes of nosocomial infections. In the recent years, the number of multidrug-resistant isolates have been significantly increasing. It has been found that *P. aeruginosa* can kill competing bacteria within environment of the biofilm by deploying the Type VI secretion system (T6SS) and delivering Type VI specific toxins. This macromolecular machinery is composed of contractile syringe-like structure and membrane anchoring complex. The purpose of this project is to characterize the function of the T6SS components in order to better understand the cytotoxicity of *P. aeruginosa*. It was hypothesized that the TssK and TssE proteins may function in anchoring and/or the assembly/disassembly of Type VI contractile syringe. In order to test this hypothesis we generated sfGFP-tagged constructs of these components and expressed them in wild type *P.aeruginosa* strain PAO1 from inducible promoter of integrative or non-integrative plasmid and then visualized the localization of the proteins using fluorescence microscopy and time lapse imaging. The results from the experiment were found to be inconclusive but it was found that there was an association between arabinose concentration and gene expression amongst the constructs. New experiments are being performed with new plasmids containing a red fluorescent protein, -mCherry, to enhance the visualization of the protein localization.

Keywords: *P. aeruginosa*, Pseudomonas, secretion system, T6SS, microscopy, fluorescence microscopy, scanning, Time laspse imaging, TssK, TssE.

The Effect of miRNA on Calcium Metabolism

Written by: Alexandria Sutton

MicroRNAs are small non-coding RNAs of approximately 22 nucleotides in length that serve as post-transcriptional regulators of gene expression. Many different microRNAs and their functions have been reported; however, much remains to be learned about the cellular pathways regulated by microRNAs. Recently, microRNAs have been proposed to regulate gene expression during the stress response when cells need to rapidly adjust to adverse conditions. In previous research investigating the effect of microRNAs on the stress response, it was found that microRNAs are important for regulating calcium metabolism in the endoplasmic reticulum (ER). Building on this finding, this study investigated the effects of miR-20 and miR-491 on the regulation of calcium metabolism. DNA vectors were constructed to test the function of these microRNAs. The strategy used in this investigation involved PCR, digests, cloning, and transformation. Data revealed that microRNAs 20 and 491 were found to be good candidates for ER calcium homeostasis interplay.

Keywords: stress response; miRNA; post-transcriptional; gene expression; calcium metabolism

“Promoting Children’s Health Begins at Home” ‘Examining the Health Status of Black Children Living in Informal and Formal Areas in Cape Town.’

Written by: Alexis Sykes

The health of the South African people is of great concern for the nation. The social structure enforced by the apartheid regime has created a situation where most of the population lives below the poverty line and does not have access to quality health care. This study focuses on the children who have no control over the living conditions, which their parents have been economically forced to raise them in. Such conditions have affected their health, growth, and development. With concurrent public health challenges such as HIV and Tuberculosis that can complicate the immune system beyond repair, preventative measures of how to remain healthy can combat the reoccurrence of these diseases. This study reveals that children living in poverty-stricken areas such as the shantytown of Egoli, face more health threats than children living in formal settlements such as the Lotus River community, a short distance away. Children in Egoli have higher instances of digestive illness, respiratory, and bacterial related illnesses but also, cannot make it to a clinic as easily as children who have money for transportation and fees. The children in both communities attend the same schools so they are receiving the same educational information, but with drastically different living scenarios, the implications of their knowledge need to be more targeted toward diseases that are specific to each community. In addition to the extent of public health in each community the increasing tuberculosis rates have become a major concern in the area. Tuberculosis, which is an airborne disease makes community borders non-existent; meaning what happens in Egoli can affect the Lotus River especially when the children are interacting at school. Public awareness and education should be the first response to environmental health threats to our children.

Evaluation and Application of *Escherichia coli* genetic Markers for Tracking the Sources of Fecal Pollution in Environmental Waters

Written by: Cheryl Triplett

Escherichia coli (*E. coli*) have been widely used as an indicator of fecal pollution in the environmental water. The major limitation of *E. coli* is that they cannot be assigned to their source(s) of origin due to their presence in wide range of animal feces. In this study, we evaluated the host-specificity and -sensitivity of human wastewater associated *E. coli* genetic markers from ten target- and non-target host groups. The overall sensitivity of the H8, H12, H14 and H24 markers in human wastewater samples were 1.0 (maximum of 1.0). The overall specificities of these markers to differentiate between target (human wastewater) from non-target (non-human) host groups were 0.94 (H8), 0.85 (H12), 0.72 (H24) and 0.57 (H14) (maximum of 1.0). Based on the host-specificity values, H8 and H12 markers were chosen for field study. The prevalence of the H8 and H12 markers were determined among wastewater *E. coli* isolates, Among the 97 isolates tested, 44 (45%) and 14 (14%) were positive for the H8 and H12 markers, respectively. In all, 58 (60%) of 97 isolates were PCR positive for either the H8 or H12 markers. Similarly, a total of 307 environmental *E. coli* isolates were tested from several environmental water samples in Brisbane, Australia of which 21 (7%) and 61 (20%) were positive for the H8 and H12 markers, respectively. The H8 markers were detected in all sites and the prevalence was highest (30%) in Brisbane River site. The remaining sites had relatively low prevalence of the markers ranging from 1-8% of the total isolates tested. The H12 marker was detected in all sites with prevalence ranging from 11-33% except Pine River. The prevalence of H12 markers were much higher compared to the H8 markers for all sites except Pine River site where H8 markers were detected but H12 could not be detected. Overall, the prevalence of the H12 marker was significantly ($p < 0.001$) higher compared to the H8 marker as shown by chi-square test. According to our results, these markers can be useful as an additional marker in combination with existing markers for source tracking studie

Keywords: *Escherichia coli*; Genetic markers; Microbial source tracking; Fecal pollution; Public health risks.

Statistics with the Human Face

Written by: Moriah Wallace

This study examined the effects that orthodontic braces have on the average European female face. To determine if women with braces have a similar structure to a 'normal' face, ten women of a mature age had two pictures taken of their face by a stereo camera system. This camera system collected the pre image "with-braces" face and the post image "afterbraces" face in three dimensions. Once the images had been captured and placed in the computer data system, it was predicted that with each subject the pre images and the post images would differ in the mouth's shape. The faces were compared using a statistical analysis method known as Ordinary Procrustes Analysis in a programming language called R. With this method, the landmarking points were matched on top of each other so the points variations of the pre and post mouth will be visually evident. Although there were changes shown in a visual aspect, mathematical changes also needed to be captured. A code was formulated to evaluate the facial changes numerically and graphically. The findings revealed that the pre and post faces were indeed different. The results suggest that orthodontic braces change the structure of the average European female face.

The Relationship between Race, Alcohol Consumption, and Fetal Alcohol Syndrome in South Africa

Written by: Jade Warfield

In South Africa today the level of alcohol consumption that is occurring on a regular basis by the people (specifically the women) is drastically increasing. This abuse of alcohol is hurting the health of mothers and their unborn children, but specifically those of Black/African descent. The purpose of this study was to distinguish if there is a relationship between race and alcohol metabolism rates as it relates to the prevalence of Fetal Alcohol Syndrome cases in South Africa. A Thirty South African women, in which 10 were of African/Black descent, 10 were of white descent, and 10 were of Colored (mixed) race descent, all of which were of the same general socio-economic background, and went to the same healthcare provider were asked to take part in a questionnaire. This questionnaire asked questions related to the topic of alcohol consumption throughout their daily lives and during pregnancy, which included an evaluation of Fetal Alcohol Syndrome related cases at the Red Cross Children's Hospital in Cape Town, South Africa. The findings suggest that Race/Genetics coupled with alcohol consumption, do in fact play a role in the alcohol tolerance or alcohol metabolism that the mother has, leading to an increase in Fetal Alcohol Syndrome cases. The racial group whose alcohol metabolism had the great affect, as it relates to having the highest percent of Fetal Alcohol Syndrome cases, was the Black/African mothers because, compared to their white/European descent counterparts, their alcohol tolerance levels and alcohol metabolism rates were lower. This causes the alcohol to stay in the blood longer causing a higher chance for Fetal Alcohol Syndrome. Race alone does not appear to be a factor that leads to Fetal Alcohol Syndrome, but when coupled with alcohol consumption and metabolism it becomes a big contributor. Race/genetics, alcohol consumption, and alcohol metabolism ability all appear to contribute to the prevalence of Fetal Alcohol Syndrome in South Africa.

Keywords: Race, Alcohol consumption, Alcohol tolerance, Alcohol Metabolism, South Africa, Fetal Alcohol Syndrome.

Health, Culture and Religion: An Investigative Study of the Correlation among Health Practices, Culture, and Religion in the Cape Town, South African Townships Egoli and Lotus River

Written by: Keira Williams

An individual's culture and religion can affect the way he or she may behave, think, and function in today's society. Furthermore, culture has often been correlated with one's views of health. In this study, the effects of culture and religion on people's attitudes about health and medicine were investigated with the inhabitants of the Cape Town, South African settlements Lotus River and Egoli. In an interview format, participants were asked a total of 10 questions about their involvement in their community church, their thoughts on health, and the ways in which the church and their health practices intertwine. After being interviewed, each participant was grouped into one of two categories: a group of people who believe that God heals all, and practicing healthy habits is not essential because of this, and a group of individuals who believed that God is a healer, but healthy habits are necessary. The results revealed a pattern in the way that the leaders of the church such as the deacons and pastors responded. All of the church leaders fit into the category emphasizing the importance of a healthy lifestyle along with a strong belief in God. Those that were not church leaders, however, were more likely to believe that just trusting in God to heal one's body is enough. These results indicate that the more involved one is in the church, the more likely he or she is to be aware of the importance of a healthy lifestyle. However, because practices such as going to the doctor were avoided by nearly all of the participants, it is clear that the norms and common practices of the people in the community influence those that were surveyed, even those that were informed of the importance of healthy habits. This investigation may allow one to further understand the reasoning behind the prevalence of preventable disease in some Cape Town, South African settlements like Egoli and Lotus River.

Keywords: Egoli; Lotus River; culture; religion; health; disease; Cape Town; South Africa