

Celebration of SCHOLARSHIP



THURSDAY, APRIL 11, 2019

Poster Presentation Program

IWU'S ANNUAL UNDERGRADUATE RESEARCH CONFERENCE

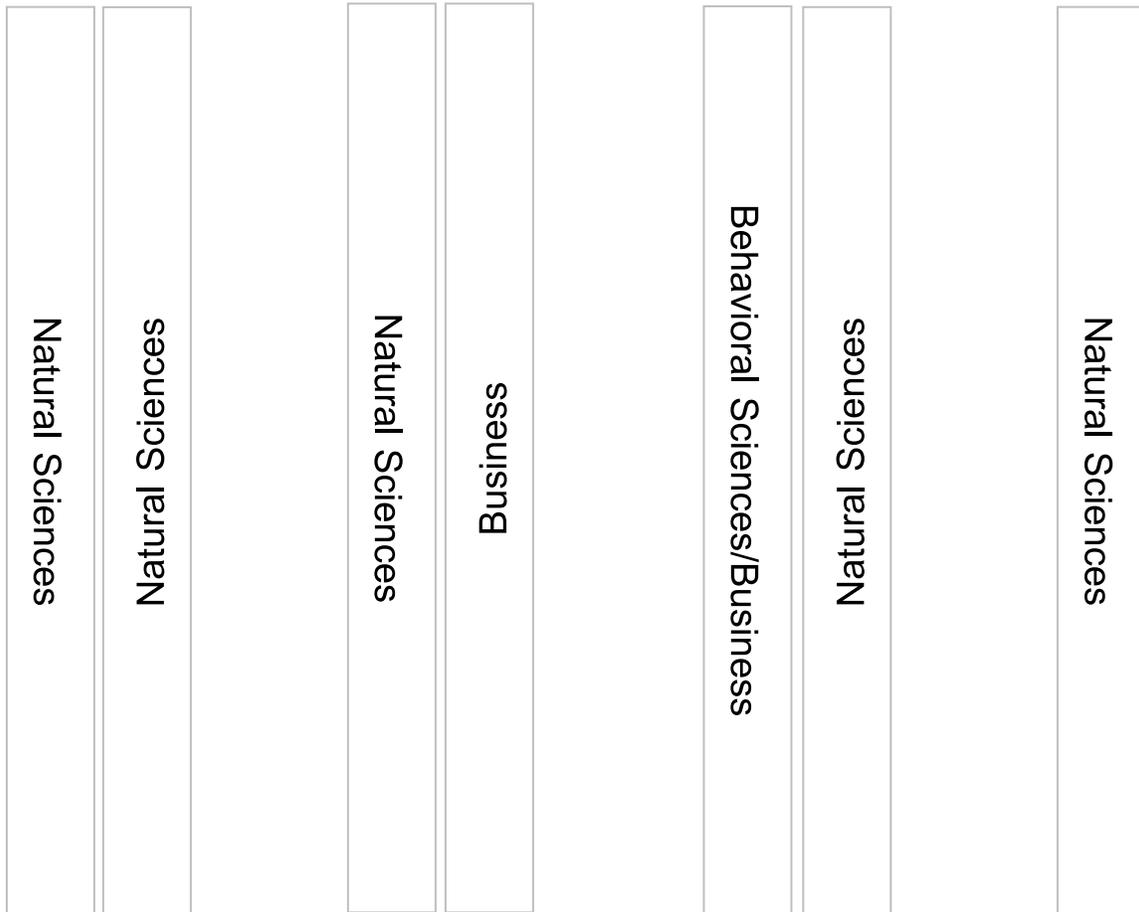
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Throughout the day (8am to 4:30pm) on Thursday, student researchers will be available to present and take questions at their posters during the times indicated in the program and listed on the posters. Natural Sciences presenters will present, in addition, between 3:00 and 4:00pm.

BARNES STUDENT CENTER COMMONS

[Stage]

Health & Human Performance/Mathematics



[Baldwin Windows]

A Neuropsychological Perspective of Empathy that Fuels Social Connection: A Literature Review

Hosanna Ramsdell, *10:00-11:00am, 1:00-2:00pm*

Empathy has been explored across diverse fields of study from philosophy to neuroscience. Broadly defined, empathy is the ability to share, feel, recognize, and understand the emotional states of others (Chen, 2018; Lü et al., 2017; Hogeveen et al., 2016). Empathy has been accepted as a major part of human motivations for altruism, morality, and compassion (Fry and Runyan, 2018) as well as, rodent motivation for prosocial behavior (Meyza et al., 2017). The neuropsychological perspective of empathy in rodents and humans tells a story about the neural systems involved in the various components of empathy: emotional contagion (sharing emotions), empathic concern, and empathetic perspective taking. This perspective helps to explain the specific capacity humans have for complex and higher degrees of empathy. Both the emotional (affective) and cognitive aspects of empathy will be explored, focusing mainly on the involvement of the inferior frontal gyrus and medial prefrontal cortex, as well as, various neural pathways and neurotransmitter systems involved in the different components of empathy discussed above. Multiple rodent studies have provided a basic for understanding of the neurophysiology required for higher forms of empathy and will be explored in this review. The purpose of this paper is to explore the neuropsychological systems underlying empathy to enhance the understanding of how empathy breeds social connection.

Music in the Brain from a Neuropsychological Perspective: A Review

Brillana TEMAAT, *9:00-10:00am, 2:30-3:30pm*

Dyslexia, a learning disability with 5% to 10% prevalence in children is “characterized as an inability to read fluently” (Diaz, B., Hintz, F., Kiebal, S.J., &Kriegstein, K. Von., 2012; Kimppa, L., Shtyrov, Y., Partanen, E., & Kujala, T., 2018). One of the primary underlying causes of dyslexia is deficits in phonological processing. (Kimppa et al, 2018). Two elements of phonological processing that are influenced by both dyslexia and music are speech encoding and auditory focus. Speech encoding involves a person’s ability to distinguish and process the words they hear. It is a foundational element to reading because, as a person reads, the medial geniculate body engages in much the same way as it does when someone talks to them. Music interacts with the medial geniculate body in the same way; however, encoding of auditory stimuli occurs at a slower rate with music than with typical speech encoding (Patel, A. D., 2014). This builds a foundation upon which a person can increase their speech encoding. Another fundamental aspect of phonological processing that is increased by musical training is the ability focus on a given auditory stimuli, picking it out from the other sounds in the environment (Patel, A.D., 2014). Research has found that musical training increases a person’s ability to process the sounds they hear, and distinguish which sound is pertinent for them to focus on (Strait, D. L., Parbery-clark, A., Hittner, E., & Kraus, N., 2012). This process, required for musical training, thus builds the ability of mental focus that is crucial in speech encoding. This review aims to describe the ways in which musical training can impact a person’s reading ability, focusing specifically on the ways music can help with phonological processing.

[†] Denotes a project also included on the oral presentation schedule

Accelerated Return to Play Following Early Detection of a Navicular Fracture

Ethan Hancock and Bri Westover, *10:00-11:00am, 2:00-3:00pm*

Navicular fractures are frequently misdiagnosed due to poor familiarity with the condition. These fractures are most commonly present in active weight bearing patients who regularly experience repetitive lower extremity stressors and have progressive pain in the dorsal midfoot regions. Management of navicular fractures is highly dependent on the timing and accuracy of the diagnosis. Reports of persistent mid-foot pain should be scrutinized for the possibility of stress reactions consistent with bone fracture. Referral for diagnostic testing should be pursued in a timely manner to identify pathology and reduce healing delays.

Accelerated Recovery following Thoracic Compression Fracture in a Collegiate Pole Vaulter: A Case Study

Andi L. Hull and Halee R. Williams, *Presentation Times TBD*

Axial compression due to head-first impact is the predominant mechanism that causes severe spine injuries during sports, including football, rugby, hockey, diving, wrestling, gymnastics, trampolining, and equestrian sports. Similarly, Allen's (1982) classification system is used to define common mechanisms of spine injuries. Six mechanisms are described, taking into account the direction of impact and the position of the head and neck at time of injury: compressive flexion, vertical compression, distractive flexion, compressive extension, distractive extension and lateral flexion. This case deals with a thoracic compression fracture due to a compressive flexion mechanism in a male collegiate pole vault athlete following a trampoline accident. Digital review, assessment, diagnosis, radiographic images, treatment, rehabilitation protocols, and time to return to activity are reviewed.

[†]The Glass Billiards Problem

Morgan Bounds, *Presentation Times TBD*

A new twist on classical mathematical billiards, the glass billiards problem examines what happens when a mass-point starts making elastic collisions in an arena with edges that vanish once struck. Does every arena have a billiard trajectory that guarantees all edges vanishing? This research identifies key patterns that emerge in response to this question.

[†] Denotes a project also included on the oral presentation schedule

[†]Developing a Rutherford Backscattering Spectrometry Station for TUNL

Andrew Wantz, 3:00-3:30pm

Rutherford backscattering spectrometry (RBS) is a technique used to characterize solids via surface-layer analysis. RBS is performed at TUNL to better understand the targets that are used in experiments. The RBS chamber located at TUNL was upgraded by increasing the number of detectors and improving the vacuum. The baseline vacuum was reduced from 2E-5 to 7E-7 torr. The number of detectors was increased from one to four to allow for better characterization of complicated targets. These were integrated into the existing data analysis system. Silicon dioxide targets were produced and RBS analysis was performed. The RBS data was fit with SIMNRA software. The experimental cross section was compared to the theoretical cross section given by the Rutherford formula. Our results show good agreement between the two.

[†]The Effect of Humidity and Purity on Vitamin Degradation Kinetics

Leah Potts, 3:30-4:00pm

Research supports a clear relationship between temperature and the reaction rate of a compound; however, the relationship between humidity and reaction rate is observable but largely debated. The rate of degradation varies depending on the compound's purity, crystallinity, hygroscopicity, as well as the humidity and temperature in which the compound is contained. Beyond this primary layer of focus lies variables that are not only more challenging to control for, but that also form a complex web of relationships that alter degradation. Such a large number of variables makes it difficult to study individual alterations to a compound but makes the importance of this research clear. Our research is working toward solidifying our knowledge of the relationship between humidity, purity, and reaction rate by testing the discussed variables on pharmaceuticals, namely niacinamide (Vitamin B3) and ascorbic acid (Vitamin C). This project is striving for a more thorough understanding of degradation kinetics and a more accurate prediction of medicinal shelf-life incorporating humid environments.

[†]Development of selective and potent bivalent inhibitors of the tyrosine phosphatase SHP2

Marissa O'Hair, 3:00-3:30pm

Protein tyrosine phosphatases (PTPs) are responsible for regulating cellular signaling pathways within the human body by catalyzing the removal of the phosphate group from a phosphorylated tyrosine. When mutated or misregulated, PTPs have been linked to many diseases including LEOPARD Syndrome, Noonan Syndrome, diabetes and various cancers. By making a selective inhibitor for SHP2, the PTP can be prevented from misregulating cellular signaling pathways. Creating a discriminatory inhibitor for SHP2 is challenging due to the highly similar active site structures of the 107 phosphatases found in human cells. One approach is to generate a bivalent inhibitor composed of a generic PTP inhibitor for potency coupled to a SHP2-targeting peptide for selectivity. These pieces are assembled in situ by the self-labeling enzyme SNAP-tag. Alternatively, a traditional medicinal chemistry route can be utilized by developing a small molecule library of inhibitors to test for SHP2 selectivity. In order to test the efficacy and selectivity of each approach, all inhibitors would need to be tested in an activity assay against both SHP2 and SHP1 phosphatase.

[†] Denotes a project also included on the oral presentation schedule

† Antimicrobial Use and Extraction of Essential Oils

Julie Webster, Alyssa Nugent, and Kenzie Hayward, *3:30-4:00pm*

With the growing popularity of alternative medicine, essential oils have become commonplace in the American home. Diffusers pump the oils into the air, some use them as cleaning products, and some parents prescribe them for their children's headaches. In a world searching for new medications with the ability to fight antibiotic-resistant bacteria, the general acceptance of essential oils inspired many to turn to them as the next solution. This research project investigates the antibacterial properties of two essential oils – basil and lavender – and how extraction technique influences their use as antimicrobial agents. By measuring the zones of inhibition of each oil against both gram-positive and gram-negative bacteria as well as bacteria that naturally occurs on the skin, we were able to measure the effectiveness of these oils in defending against bacteria like *S. epidermis* and *S. typhimurium*. Analysis of the oils' antimicrobial properties with a Kirby-Bauer Disk Diffusion Test, serial dilutions, and growth assays helped to create an accurate picture of the potential for these oils as agents of inhibition.

†Rescue of Osteoblasts from Zoledronate-Induced Apoptosis, Necrosis, and Senescence

Ethan Blake, *3:00-3:30pm*

Zoledronate (ZOL) is a nitrogen-containing bisphosphonate (NBP) used in the treatment of bone diseases such as osteoporosis, Paget's disease, and cancer metastasis to bone. ZOL is the most potent of the NBPs, many of which, especially ZOL, have recently been linked to bisphosphonate-related osteonecrosis of the jaw (BRONJ), a disease in which oral lesions occur in the maxillofacial region, particularly after oral surgery. Geranylgeraniol (GGOH) has been shown to have a rescue effect on some cells negatively affected by ZOL, likely by providing an alternate route in the mevalonate pathway, a critical pathway necessary for viability in cells. ZOL blocks the mevalonate pathway in osteoclasts to inhibit their activity, but as to how this mechanism leads to BRONJ and the inability of oral wounds to heal is currently unproven. This study investigated potential ZOL-induced cell death effects, including apoptosis, necrosis, and senescence, on MC3T3-E1 osteoblasts, as well as the possible rescue effect provided by GGOH when used in combination with ZOL. APOPercentage® dye apoptosis assays and LDH release assays on these cells revealed a significant increase in both apoptosis and necrosis, respectively, with the addition of 50 μ M ZOL. Furthermore, the results indicate a significant decrease in necrosis with the addition of 10 μ M GGOH used in combination with 50 μ M ZOL. In addition, these results suggest greater rescue from both apoptosis and necrosis when an additional 10 μ M GGOH was added 24 hours after the initial treatment. Finally, confocal fluorescence microscopy was used to visualize the effects of ZOL on MC3T3-E1 cells, with the expected results being pyknotic nuclei reminiscent of apoptosis. However, more prevalent were expanded actin cytoskeletons, suggestive of cellular senescence. The absence of apoptotic nuclei was possibly the result of procedural methods, but further studies must be done to support this hypothesis. A return to normal cell size was seen in ZOL-treated cells exposed to GGOH, suggesting a rescue from senescence.

†The Role of the PER/CRY Heterodimer in Mammalian Circadian Rhythm

Shannon Morrison, *10:00-11:00am, 3:00-4:00pm*

Most organisms display a daily rhythmic variation in physiological responses known as circadian rhythm. While the circadian rhythms of cells in the central nervous system and, specifically, the central "clock" in the suprachiasmatic nucleus are regulated by light, the circadian rhythms of peripheral organs such as the liver and pancreas are primarily regulated by food intake. There are two primary limbs of circadian rhythm in all

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cells, a positive and a negative limb. The positive limb consists of the proteins CLOCK (Circadian Locomotor Output Cycles Kaput) and BMAL1 (Brain and Muscle ARNT like protein 1). These proteins heterodimerize and activate the genes for Period (Per) and Cryptochrome (Cry), transcription factors that form the negative limb. The PER/CRY heterodimer builds up in the cytoplasm until it reaches a high enough concentration to move back into the nucleus and inhibit the CLOCK/BMAL1 heterodimer. The purpose of this literature review is to describe the current knowledge on the roles of PER and CRY and their regulation. This review of scientific literature suggests that CRY1 expression is increased during the transition from feeding to fasting. The overexpression of this gene resulted in decreased blood glucose levels and improved insulin sensitivity, especially in diabetic db/db mice. In CRY1/CRY2 knock-out mice, glucose intolerance and decreased body weight were observed, suggesting that CRY plays a role in glucose uptake. In liver cells, CRY1 inhibits the transcription of PEPCK (phosphoenolpyruvate kinase), the primary enzyme in the rate-limiting step of gluconeogenesis. CRY KO mice are also more susceptible to diet-induced obesity and diabetes mellitus. This review also suggests that PER2 expression is greatest during the fasting-feeding transition, and thus is strongly driven by food signals. It promotes liver glycogen storage during the refeeding period by activating Gys-2 expression, and its activity is opposed by BMAL1 during the fasting period. PER2 regulates glycogenolysis during the fasting period by activating GL and PTG expression. Its most important function, then, is to promote liver glycogen storage during the refeeding period.

Understanding Postural Orthostatic Tachycardia Syndrome in Adolescents

Kathryn Shaffer, *3:00-3:30pm*

Postural Orthostatic Tachycardia Syndrome (better known as POTS) is a condition in young adults that is a form of orthostatic intolerance. POTS is diagnosed based on observance of low blood pressure, lightheadedness, and increased heart rate upon standing upright. The extreme result of this is passing out simply upon standing too fast. Research indicates that this occurs most often in young adults and can last into adulthood if maintenance treatment is not performed properly. There is a small field of research to support POTS as becoming more prevalent in adolescents and children and investigative work shows that this is a growing concern amongst pediatric doctors. In order to fully understand incidence of this condition in children, literature analysis shows a variety of reasons why this is a need for continued study. Research supports a variety of risk factors and testing procedures that support this hypothesis. In addition, the discovery of high comorbidities plays into the incidence of occurrence of adolescents.

ATP (P₂Y₁) Receptor Drives Glial Cell-Mediated Acidification of Retina

Hannah Caringal, *8:00-9:00am, 3:30-4:00pm*

There has been rapid increase in interest for understanding the active role glial cells play in brain signaling. Some of these roles focus on regulation of brain activity fundamental to abilities like learning and memory or, when dysregulated, have been implicated in Alzheimer's Disease, traumatic brain injury, and Amyotrophic Lateral Sclerosis. A study in our lab characterized a novel pathway by which retinal glia called Müller cells regulate extracellular levels of H⁺, an especially potent mechanism of modulating synaptic transmission and cellular excitability. This study utilized calcium imaging with Oregon Green BAPTA-1, along with a technique called self-referencing, to measure H⁺ fluxes from Müller glia. Isolated from tiger salamander retina, these glia were used to characterize a novel pathway through which ATP induces a pronounced extracellular acidification. Bath application of ATP γ S, a non-hydrolyzable form of ATP, resulted in an intracellular calcium increase and resulted in an extracellular acidification suggesting ATP, rather than a conversion product like adenosine, was the causative agent. Application of ADP and MRS236 (P₂Y₁ agonists) also resulted in an intracellular calcium rise and extracellular acidification, and the effects of MRS2365 could be abolished by

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the presence of the P2Y1 receptor antagonist, MRS2179. Collectively, this strongly points toward ATP acting on P2Y1 receptors, likely working through an IP3 pathway to trigger the extracellular acidification. The findings reported here shed further light on an important regulatory mechanism by which glia in the retina shape extracellular pH, and we suggest that proton flux mediated by ATP-activation of Müller cells and perhaps other glia may be a key mechanism modulating neuronal signaling in the vertebrate retina and throughout the brain. (Additional Authors: Michael Gongwer¹, Lexi Shepherd¹, Borianna K. Tchernookova², Robert P. Malchow², & Matthew A. Kreitzer¹; ¹Department of Biology, Indiana Wesleyan University; ²Department of Biological Sciences, University of Illinois at Chicago)

Insulin Dysfunction in Equine Metabolic Syndrome-associated Laminitis

Spencer Seabeck, 3:00-3:30pm

Insulin Dysregulation and Laminitis are two clinical components of a common metabolic disorder found in equids known as Equine Metabolic Syndrome (EMS) (Cite: Introduction: Lane et al). Equine veterinarians have observed numerous cases of EMS and are currently noticing insulin dysregulation to play a role in developing laminitis. Insulin Dysregulation has been characterized by hyperinsulinemia and increased insulin secretion (insulin resistance) after oral or intravenous glucose administration. Most often, non structural carbohydrates (NSCs) have been known to contribute to hyperinsulinemia as NSCs contain the most starch and sugar content. NSCs are highly prevalent in lush pastures during the spring. Today, hyperinsulinemia is directly associated with developing Laminitis in horses and ponies through insulin resistance and endothelial dysfunction in equine digital vessel rings (Insulin resistance in equine digital vessel rings). Laminitis is a disease affecting the laminae tissue of the hoof. Specifically, the distal phalynx of the hoof becomes detached from the inner wall of the hoof typically resulting in lameness of the horse (Lane et al). Using corn syrup, Oral glucose tests (OGTs) and Intravenous Glucose Tolerance Tests (IVGTTs) are two ways to measure insulin and glucose concentrations. A prolonged euglycaemic hyperinsulinaemic clamp (p-EHC) technique was also used to measure prolonged insulin concentrations en vivo while glucose concentrations were altered to maintain a euglycaemic state within the horse (Equine laminitis: induced by 48 hr). Hoof wall surface temperature (HWST) was recorded to observe any correlation between vascular temperature and laminitis. Future preemptive measures to avoid insulin deregulation and laminitis can include improving insulin sensitivity (monitoring caloric intake, increased exercise, using pharmacologic agents), reducing exposure to pasture during spring, and limiting grain intake in diet (metabolic predispositions).

Characteristics of ATP-induced extracellular acidification from retinal Müller (glial) cells.

Thomas Leuschner, 3:30-4:00pm

Within the retina, acidification of synaptic environments has been shown to significantly attenuate synaptic transmission. This study characterizes a novel non-neuronal pathway in the retina that evokes an extracellular acidification. In this pathway, Müller glia, upon activation by the signaling molecule ATP, acidify the extracellular environment. Measurements of proton fluxes from the apical (photoreceptor) end of isolated salamander Müller cells were performed using H⁺ sensitive self-referencing microelectrodes, an effective method for measuring relative ion fluxes from cells (see Kreitzer et al., 2007). Calcium imaging experiments using Oregon Green implicate that ATP binds to a P2Y1 receptor, and in combination with self-referencing experiments point toward the ATP-dependent acidification requiring Ca²⁺ release through an IP3 pathway. We report here a dependency of the acidification on the presence of extracellular Na⁺. Removal of Na⁺ was shown to significantly attenuate the ATP-induced extracellular acidification. Attenuation of the acidification by the sodium transport blocker amiloride and the sodium-hydrogen exchanger blocker cariporide were also observed. Surprisingly, the ATP-induced extracellular acidification was sensitive to extracellular K⁺.

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Reintroduction of K⁺ from a nominally 0 K⁺ solution significantly potentiated the ATP-induced acidification. However, this K⁺ sensitivity was dependent upon the presence of Na⁺. We hypothesize that Müller glia are potent acidifiers of the extracellular space. This extracellular acidification induced by ATP is mediated by a P2Y1 receptor calcium-dependent pathway and is highly sensitive to the presence of Na⁺ and K⁺ outside of the cell. Our findings also point to a potential role for Na⁺/H⁺ exchange in driving this acidification. We hypothesize glial cell based extracellular acidification may be an important regulator of signaling throughout the nervous system.

Muller Cell ATP-induced acidification is shaped by extracellular pH and carbonic anhydrase activity.

Brock Goeglein, 3:00-3:30pm

The study of glial cells as regulators of synaptic transmission is a budding field in Neuroscience. An especially potent and underappreciated mechanism of modulating synaptic transmission involves small alterations of extracellular levels of H⁺. Measurements of H⁺ flux from isolated Muller glial cells were made using a self-referencing approach with H⁺ selective microelectrodes. The present study builds upon a recently characterized pathway by which exogenous ATP causes a calcium-dependent extracellular acidification through activation of a GQ coupled P2Y receptor. This acidification is directly dependent on the H⁺ gradient. Changing the H⁺ gradient by making the extracellular pH more acidic (6.8) or alkaline (8.2) attenuated or potentiated, respectively, the ATP-induced acidification. Surprisingly, in the absence of a CO₂ – HCO₃ buffer, the ATP-induced acidification was suppressed by carbonic anhydrase inhibition. This suggests H⁺ extrusion may have a close relationship with carbonic anhydrase independent of HCO₃. The present study sheds further light on a mechanism by which glial cells potently regulate extracellular pH and by extension shape neuronal signaling.

Effect of Extraction Method and Solvent on Chemical Composition of Essential Oils

Bethany Gammon and Jessica Sprinkles, 10:00am-3:00pm, 3:30-4:00pm

An essential oil is a volatile solution made of aromatic organic compounds that have been extracted from a plant's leaves, stems, or flowers through various extraction techniques. Some of these oils have been known to show antibacterial and antifungal properties that can be tested within a laboratory setting. Many essential oils contain similar major components, but it is not known which compounds elicit these antimicrobial effects; it is possible that the unique combination and ratio of these compounds makes the properties of each oil distinct from the others. The three unique herbs used for this research—basil, cinnamon, and eucalyptus—can be seen to have similar constituents, yet in unique ratios. Oils from these herbs have been extracted using various methods and solvents and analyzed for their constituents in preparation for the testing of their possible antibacterial properties.

The effect of light-emitting-diode irradiation on the accumulation of lycopene in tomatoes

Katie Silvius, 3:00-3:30pm

Lycopene is the major carotenoid found in tomatoes. Lycopene is the pigment that gives the ripe fruit its characteristic deep red color. It is also a potent antioxidant and has been associated with a decreased risk of developing cardiovascular disease and certain cancers (Helyes et al, 2008). The accumulation of lycopene in fruit tissue is in part affected by the means of light production (Deram et al, 2014). To these ends, the use of LEDs has recently emerged as a potential source of supplemental lighting in a greenhouse setting. The aim of this study was to create a carotenoid and sugar content profile of tomatoes grown in treatments of LED lights with varying red/blue light ratios. The data obtained suggests that tomatoes supplemented by

[†] Denotes a project also included on the oral presentation schedule

LED irradiation have nutritional profiles that are similar to those of specimen produced using only traditional methods, and that the future of LED utilization is promising within the agricultural industry.

Development of a Library of Selective SHP2 Inhibitors

Ashley Springer and Aaron Scott, *8:30-10:45am, 2:30-3:00pm, 3:30-4:00pm*

Protein tyrosine phosphatases (PTP) are responsible for regulating cellular signaling pathways within the human body. There are often adverse effects when PTPs are misregulated. For example, when mutated or misregulated, SHP2 (PTPN11) has been linked to diseases such as LEOPARD Syndrome, Noonan Syndrome, Diabetes, Metachondromatosis, and many cancers. Our research team set out to create a specific inhibitor for SHP2 that would prevent the PTP from incorrectly stimulating cellular signaling pathways. This part of our undergraduate research team is using organic chemistry to create a multitude of possible selective inhibitors for SHP2, called library molecules. These inhibitory molecules are then tested for potency against SHP2 and will be examined for similarities. Creating a specific inhibitor will allow for further study of pathways SHP2 regulates.

Rescue of Zoledronate-Induced Senescence in Human Oral Keratinocytes

Preston Rippe, *3:00-3:30pm*

Bisphosphonates are used to treat osteoporosis, Paget's disease, cancer that metastasizes to bone, and other bone resorption diseases. An adverse side effect occurs within roughly 12% of bisphosphonate-treated oncology patients: bisphosphonate-related osteonecrosis of the jaw (BRONJ). Zoledronate (ZOL) is a nitrogen-based bisphosphonate that functions by blocking farnesyl pyrophosphate synthase in the mevalonate pathway. This pathway plays an important part in synthesizing sterol isoprenoids (cholesterol), promoting prenylation of CAAX proteins, and maintaining osteoclast function. Geranylgeraniol (GGOH) is a mevalonate pathway intermediate that is a potential rescue agent for the ZOL-induced death effects of BRONJ. In the oral mucosa, ZOL can cause excessive senescence characterized as the decline of DNA replication, resulting in lower cell density and delayed wound healing. In this study, we compared 10 microM GGOH to other agents in terms of their relative ability to rescue from 72 hour, 50 microM ZOL-induced keratinocyte senescence. Overall, ZOL induced senescence in normal human oral keratinocytes (NHOKs, 2.8-fold, $p < 0.05$) and immortalized OKF6/TERT2 keratinocytes (5.6-fold, $p < 0.05$). Significant senescence recovery occurred in both keratinocyte lines in response to 10 microM GGOH and an additional booster of 10 microM GGOH 24 hours after initial treatment. In OKF6/TERT2 cells, exposure to 2 millimolar Etidronate, 100 microM citrate, and 10 microM melatonin each rescued ZOL-induced senescence to a level comparable to that of GGOH.

Rescue of Human Oral Keratinocytes from a Bone Cancer Drug Side Effect: Zoledronate-Induced Apoptosis Rescue

Jesse Maguire, *3:30-4:00pm*

Zoledronate (ZOL) is a nitrogen-containing bisphosphonate. It is commonly used as an osteoclast inhibitor in diseases such as bone cancer and osteoporosis. It works by binding to hydroxyapatite, decreasing calcium release, and thereby increasing bone density. ZOL has a side effect most common in cancer patients—osteonecrosis localized to the actively remodeling bone and to the soft tissue of the jaw. This occurs because ZOL has a high binding affinity for the calcium in bone hydroxyapatite due to its R2 side chain's dissociation potential. The accumulation of ZOL in the bone combined with oral trauma causes many patients to have exposed necrotic bone and soft tissue. When this occurs for at least 8 weeks, it is considered

[†] Denotes a project also included on the oral presentation schedule

bisphosphonate-related osteonecrosis of the jaw (BRONJ). ZOL is also known to block completion of the mevalonate pathway, leading to cell death. Geranylgeraniol (GGOH) is a naturally occurring intermediate of the pathway and has been proven to rescue cells damaged by ZOL. Other possible rescue mechanisms include the use of citrate, melatonin, and etidronate. The purpose of this study was to compare the four treatments in terms of rescue from ZOL-induced apoptosis (programmed cell death) in a well-accepted model of oral epithelium, the immortalized OKF6/TERT2 cell line. Apoptosis was measured by two different methods: 1) determination of caspase 3 (the executioner of apoptosis) levels in treated cells and 2) determination of the number of treated cells displaying phosphatidyl serine (a cell marker for apoptosis) on their surfaces through the Nexin assay. In addition normal human oral keratinocytes (NHOK) were assayed for ZOL-induced apoptosis. Experiments revealed that the NHOK cell line shows an increase in apoptosis when treated with ZOL. However, the OKF6/TERT2 line showed no significant increase in apoptosis with ZOL treatment, and no rescue when paired with GGOH or any other rescue mechanism.

T Preliminary genome analysis of the alkaliphilic and minimalistic phototrophic bacterium *Heliorestis convoluta*

Emma Dewey, Lynn Stokes, and Janessa George, 3:00-3:30pm

Heliobacteria are the only phototrophic representatives of the bacterial phylum Firmicutes. Despite significant interest and past work to elucidate the phylogeny and photochemistry of heliobacteria, genomic analyses of these organisms have been minimal, with only one species, *Heliobacterium modesticaldum*, having a published genome to date. Here we present the preliminary genome sequence analysis of a second member of the heliobacteria, *Heliorestis convoluta*, an alkaliphilic and morphologically distinct species of this unique family of phototrophs. The genome is a single 3.2 Mb circular chromosome containing 3268 open reading frames. As suspected from physiological studies of heliobacteria that failed to show photoautotrophic growth and insights from the *Hbt. modesticaldum* genome, genes encoding enzymes of known autotrophic pathways are not present in the *Hrs. convoluta* genome; thus, this bacterium is phototrophic but not photosynthetic. Although some cellular activities, including nitrogen fixation, have a full complement of genes in *Hrs. convoluta*, other processes (e.g., carbon metabolism and phototrophy) are genetically streamlined compared to the nutritional flexibility of many anoxygenic phototrophs.

Gut Flora and Correspondence to Stress Relief Pathways

Justin Noah Miller, 3:30-4:00pm

There is a notable amount of evidence defending the mutualistic relationship between the bacteria of the human GI tract and the regulation of brain mechanisms. To outline this evidence, my project begins by describing the anatomy that links the GI tract to the brain and by defining the pathways that develop the neurotransmitters associated with this relationship. Multiple experiments are shown to demonstrate tangible correlation of healthy GI flora levels and low stress levels. To conclude, the poster provides additional experimental data on prenatal development and nutritional supplementation to provide lifestyle changes correlated with improved health involving the gut-brain axis.

Culturing and Recording Extracellular Acidification of Cryopreserved Rat Glial Cells

Alyssa Powell and Rachel Stevens, 3:00-3:30pm

An increasing number of studies point toward glia playing a more active role in shaping neuronal signals in the CNS including the retina. This study aims to examine whether a specific glial cell mediated regulatory mechanism first observed in the retina is also observed more broadly in the brain. Understanding the breadth of this pathway could sharpen understanding of glial-neuronal interaction and could be beneficial in treatment

† Denotes a project also included on the oral presentation schedule

of neural health conditions. Past work characterizing this regulatory pathway focused almost exclusively on retinal glial cells from tiger salamanders. This study shifts to working with cortical glial cells from rats, trying to maintain a focus on astrocytes in an attempt to see if the mechanism studied in the salamander retina extends to other glial cells of the CNS. Cryopreserved rat glial cells were received, thawed, plated, and cultured. To compare previously observed ATP-induced acidifications observed from retinal glia, extracellular pH dynamics from cultured glia, grown over a period of five weeks, were characterized using an electrophysiological approach called self-referencing. From preliminary trials, a clear extracellular acidification was observed which was similar to that of retinal cells studied previously. If studies continue to show consistent extracellular acidifications, like those viewed in the retinal cells, this could suggest that the mechanism is conserved throughout the CNS and increase understanding of the interactions between glia and neuronal cells.

Age, Sex, Diet, and VPAC2R-Deficiency May Be Variables That Affect Glucose-Stimulated Insulin Secretion In Isolated Mouse Islets

Hannah Hartzler, 3:30-4:00pm

Vasoactive Intestinal Peptide Receptor Types 1&2 (VPAC1R and VPAC2R) are two G protein-coupled receptors that are linked together by two peptides, vasoactive intestinal polypeptide (VIP) and pituitary adenylate cyclase activating peptide (PACAP). To study the function of the VPAC2R, VPAC2R-deficient mice were created. Previous studies of these VPAC2R-deficient mice (Knock Out mice, or KO) have revealed that these mice have a different circadian rhythm compared to the wild type (WT) mouse which includes an advance in the time in which they feed. Respiratory quotient analysis of these KO mice show that they preferentially burn fat. Since signaling through the VPAC2R causes augmented insulin release in the presence of glucose, we wanted to investigate what effect the loss of this receptor has on glucose-stimulated insulin secretion. To do this, Islets of Langerhans (islets) were isolated from WT and KO mice, and used in glucose-stimulated insulin secretion (GSIS) assays to determine the amount of insulin released when the islets were challenged with different glucose concentrations. Insulin levels, determined by enzyme-linked immunosorbent assays (ELISA), of the media during the different challenges generally increased as the amount of glucose in the media increased. The data from the 57-week old female mice shows that there might not be a difference in insulin release between WT and KO islets using mouse islets of an age much older than we have used before. To be sure of this, more study groups of similar aged females must be done to verify the data. The 23-week old male study group on a low fat diet (5001) showed an overall trend of the KO mice secreting on average more insulin compared to their WT counterparts. To assess the data better, more study groups of older males on the 5001 data must be done. The younger, 13-week old male study group on a high-fat diet (5015) showed about the same values for insulin being secreted by the islets between the KO and WT mice. The data we have seen from similar study groups in the past shows a greater decrease in the amount of insulin being released by the KO mice compared to the WT mice, which is not seen in this data.

Development of biochemical tools for analysis of HIV-1 Nef-dependent Hck activation and viral packaging

Malorie Weldy, 3:00-3:30pm

Nef is an accessory protein of HIV which assists the virus to increase infectivity and pathogenesis. Nef does this by binding with the Hck's – a Src family tyrosine kinase – SH3 domain. This complex then gives a promising target for anti-HIV therapies. Little is known, however, about the mechanism by which the Nef-dependent Hck activation assists in HIV infectivity. In order to assess the requirements for Hck packaging in

[†] Denotes a project also included on the oral presentation schedule

virion, a series of Hck expressing mutants were created from a 293 cell line, an in vitro assay was explored, and an immunoprecipitation for Nef-Hck binding was attempted. There were two mutants created; one was a cloning of a K296M negative control and the other was a recloning of the novel Rte Mutation created the year before. The assay development showed that p-73, a known Hck target, is expressed in the 293 cell line however the attempt to develop a p-73 antibody was unsuccessful. Finally, the immunoprecipitation attempted to pull out Hck from the 293 Hck-Wt cell line via the V5 tag placed on the mechanism so that there would be pure Hck available for further testing. Both the p-73 assay and the V5 immunoprecipitation were unable to be finished due to an unknown problem with the Western Blot experimentation process. (Additional Authors: Hannah Hartzler, and Rebekah Drew)

Parameterization, Docking, and Molecular Dynamics Generated Binding Affinity for SHP2 in silico

Justin Hazel and Zac Faitz, 3:30-4:00pm

In order to find optimal inhibitors of SHP-2, small organic molecules were parameterized using CHARMM General Forcefield. AutoDockFR was used to find docking affinity and orientation and optimal docking orientations were used as inputs for steered molecular dynamics simulations to find protein-ligand binding energy. Parameterization of novel molecules remains a challenge, but successful molecular dynamics simulations of already parameterized ligands and relative docking affinity scores show promise.

Rising Resistance to Antibiotics in Livestock: Contributing Practices and Multiple Resistance Genes

Jessie Ferree, 3:00-5:00pm

Bacterial resistance to antibiotics has become an increasing problem. One contributor to the trend is the livestock industry, specifically practices such as widespread usage of antibiotics as a prevention rather than a treatment, providing free-choice medicated grain to promote rapid weight gain, and improper dosage (both under and over). Bacterial resistance not only means that antibiotic usage will lead to failed animal treatment, but it also can have a direct adverse effect on humans when they come into contact with the bacteria through the consumption of animal products, crops fertilized with animal waste, or animal waste disposal. Studies on livestock waste looking at bacterial DNA structure have isolated antibiotic resistant genes, mobile genetic elements, and gene cassettes that provide resistance to entire classes of antibiotics. Two of the largest cases of illness directly linked to bacterial resistance to antibiotics involve the bacteria *Campylobacter* and *Salmonella*.

In Vivo Temporospatial Imaging of Excitation-Contraction Coupling in a Cnidarian Neuromuscular System

Curtis Yovichin and Dr. Russell Schwarte, 3:30-4:00pm

Concerted neuromuscular impulses enable organisms to survey and traverse the many obstacles encountered within any particular environment. All responses to stimuli must be coordinated, and due to the vast array of neuronal pathway possibilities, coordination can be accomplished without the need for extensive processing centers such as a brain. *Aurelia aurita* (Moon Jellyfish) are among the simplest of organisms within the animal kingdom; yet, features of its radially symmetrical neuromusculature allow for navigation within the water column. The propagation of neuronal depolarizations result in muscular contractions that serve to propel the organism forward while also providing course corrections. Thus, the underlying mechanisms behind *Aurelia*'s behavior and swimming capabilities have been explored via potentiometric and

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immunofluorescent dyes paired with high-speed imaging and confocal microscopy techniques. Spatially averaging the intensity of light emitted by potentiometric dyes within momentary excited states is a powerful tool for visualizing and quantifying the propagation of action potentials – whether neuronal or muscular. While contractile motion of each individual specimen (limited due to slide placement techniques) serves as a logistical barrier, the movement of ROI (“region of interest”, a Zen Microcopy software feature) windows throughout film progression has worked to combat this effect – yielding stark graphical spikes that represent a traveling, membrane-associated voltage. Because of the two proposed modes of pulsation/circuitry within these jellyfish (asymmetric and symmetric), ROI software proves to be useful when “fingerprinting” each type based on temporal mapping of action potential propagation – graphically predicting each mode.

Coffee Consumption and its Preventative Effects

Abe (Ike) Wharton, 3:00-3:30pm

The health benefits of coffee drinking and its long-term benefits including: reduced occurrences of cardiovascular disease (CVD), type II diabetes, etc. It has been shown that those who drink just one cup of coffee daily have a 5-6 percent reduced rate of death than those who do not drink coffee. The percentages are even higher when one drinks up to 6 cups daily. The hidden health benefit has been linked to the presence of polyphenols found in both caffeinated and decaffeinated coffee blends, but not instant coffee (lacks naturally occurring polyphenols). The underlying biology for this reduced death rate as well as polyphenols role in the reduction of CVD, type II diabetes, cancer, and other diseases that are responsible for the majority of deaths through humanity will be investigated.

Pot1 and Pat1 Construct Assembly using Gibson Cloning to make a Gene Knockout in *T. thermophila*

Julianna Korn, 3:30-4:00pm

Telomeres contain a shelterin complex at their ends in order to maintain length and normal function through the protection of different proteins. The protection of telomeres 1 protein (Pot1) is found in this complex and assists in the maintenance of telomere length and overall chromosome integrity. Pot1 also assists in the DNA damage response mechanisms that try to invade chromosome ends, and it regulates the actions of telomerase by interacting with each protein in the shelterin complex. The Pat1 protein found in *Tetrahymena thermophila* is closely associated to its Pot1 protein and assists in the maintenance of telomere length and chromosome integrity. For each of these proteins to be further investigated, a gene knockout can take place to study the protein’s effects specifically on telomeres but also on the overall effects of the cells each protein inhabits. PCR and a Gibson cloning procedure can be used to assemble the gene construct for a gene knockout. Overall effects on telomere length can be monitored which can lead to attributes that cause aging or cancer.

Cultivation and Characterization of Icebound Microorganisms from the South Pole

Austin Huntington, 3:00-3:30pm

Little is known about microbial ecosystems of inland Antarctica, if indeed such ecosystems exist. Although considerable research has been carried out on microorganisms indigenous to the warmer coastal regions of Antarctica, only one species, a strain of the bacterial genus *Pseudomonas*, has ever emerged from culture-based studies of South Pole ice. Molecular studies have revealed that a diversity of bacteria exists in polar ice samples, but whether these organisms compose an active ecosystem or are simply a random assortment of microbes imported by air currents is unknown. To investigate this question, we began the process of cultivating microorganisms from ice samples collected by Dr. Michael T. Madigan (Southern Illinois University

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Carbondale). In recent months, our team has been able to successfully isolate several strains of bacteria, as well as a strain of cold-adapted yeast. Ensuing characterization of the isolates has included experiments to determine optimal growth temperature, salinity tolerance, and carbon source utilization. We have also begun phylogenetic analyses of the bacterial isolates by obtaining genomic DNA for 16S rRNA gene sequencing. This information, along with further experimentation, will expand our understanding of the diversity, metabolic activities, and ecological contributions of icebound microorganisms.

Article review: Coral Microfragmenting and the success seen in regrowth of coral reefs

Tara Kelly, 3:30-4:00pm

There has been a drastic loss of coral in the Caribbean, along with other places around the world. This loss has endangered different animal species which can mean the loss of an entire ecosystem. Researchers have been propagating or microfragmenting coral in order to restore the ecosystem. This technique has been successful in several different species of coral, including *Orbicella faveolata*, *Montastrea cavernosa*, *Dendrogyra cylindrus*, and *Acropora cervicornis*. Propagating coral can help the coral grow 25% faster than normal¹. Propagating coral with the success seen in these articles could be the solution to the degradations of Coral reefs.

Hyperglycemia Caused by VPAC2R Deficiency is Exacerbated by High Fat Diet

Carissa Adrianson, 1:00-2:00pm, 3:00-3:30pm

In order to determine the role of the VPAC2 Receptor protein in the control of glucose and fat metabolism, VPAC2R-deficient mice (henceforth, "MUT") mice were generated. Initial studies of these MUT mice on a mixed genetic background (C57BL/6:129/Ola) indicated that they were leaner, preferentially burned fat, and had fasting blood glucose levels similar to their wild type littermate control mice (henceforth, "WT") (1). We wanted to confirm these results using mice that are congenic with C57BL/6-Tac mice accomplished by backcrossing to that strain, to determine repeatability. We birthed and weaned an age-matched group of 5 WT and 5 MUT male mice on a high-fat diet (5015, 12% fat) and then a separate group (n=6 each WT and MUT) on normal chow (5001, 5% fat) and weekly tracked their fasting blood glucose and insulin levels. We have found that MUT mice are consistently hyperglycemic compared with WT mice. The magnitude of the separation between WT and MUT mice fasting blood glucose is increased by a higher fat diet, but a significant difference is also reached at a later age on a lower fat diet. Insulin data indicates that there is no difference between MUT and WT mice on 5015 chow, meaning that there was no difference in insulin sensitivity. Insulin output being similar while blood glucose levels are different is important to note. MUT mice also generally weighed less than WT counterparts, yet this data has not yet attained statistical significance.

Complete Genome Sequence of the Thermophilic Purple Sulfur Bacterium, *Thermochromatium tepidum* strain MCT

Brad Burchell, 3:30-4:00pm

Thermochromatium tepidum is a thermophilic purple sulfur bacterium that has emerged as a model organism for the study of photosynthesis. Formerly known as *Chromatium tepidum* before reclassification into a novel genus, the organism has been well studied over the years, but up to this point, such studies have been carried out without the benefit of a genome sequence. We report here the preliminary results of the complete genome analysis of *T. tepidum* strain MCT. Reduced inorganic sulfur sources, such as sulfide and elemental sulfur, serve as electron donors for photosynthesis in *T. tepidum*, and in this connection, the *dsrMKJOP* gene cluster necessary for sulfide oxidation was identified. However, unlike close relative *A. vinosum*, the absence of *soxXABDW* genes renders *T. tepidum* unable to use thiosulfate as an electron donor, a

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conclusion consistent with culture-based observations. Also in contrast to *A. vinosum*, genes supporting the assimilation of sulfate were not identified in the *T. tepidum* genome. Thus, it seems likely that *T. tepidum* uses sulfide for both energy generation and as a biosynthetic sulfur source. In addition to photosynthesis, another major characteristic observed in close relatives of *T. tepidum* is the ability to fix atmospheric nitrogen. However, as shown in physiological studies, *T. tepidum* is unusual in this regard because it does not grow diazotrophically. Although genome sequence analysis has revealed that *T. tepidum* encodes many of the genes required to fix nitrogen, the absence of *nifUSM*, genes that encode proteins that play a major role in assembling the Fe-S clusters required for FeMo-co biosynthesis, likely explains the deficiency for nitrogen fixation. This study provides an essential genomic resource for future work that will help define the nuances of phototrophic metabolism in hot spring and other geothermal habitats.

The Effects of Environmental Enrichment on 1.1 Thick-Billed Parrots' (*Rhynchopsitta pachyrhyncha*) Activity Budgets

Rebecca Evey, 3:00-3:30pm

1.1 Thick-billed parrots were observed to determine the efficacy of two treatments aimed to increase the parrots' space usage of their habitat and decrease their stereotypic behaviors. Parrots were observed in 15-minute instantaneous scan sampling sessions, with behavior, social proximity, and location (both horizontal and vertical, right) recorded at 30-second sampling intervals. Treatment one included the addition of ropes hanging from branches to the ground and from branches to other branches, wood chips on the ground, and low perches on the ground. Treatment two included the provision of a bathing dish, pinecones (natural food source), and varied food presentation (e.g., produce placed on perches). From the implementation of the two treatments, both parrots increased their usage of the habitat, including both vertical and horizontal usage, and treatment one increased the parrots' manipulation of their habitat.

Characterization of Nutrient Mediated Regulation of Metabolic Enzyme Gene Expression in *Tetrahymena thermophila*

Amanda Heino, Megan Kraus, and Julianna Korns, 3:30-4:00pm

Tetrahymena thermophila is a model organism that is eukaryotic, single celled, and has an easily manipulated genome. Its genome has been sequenced, however the annotation of the genome is still underway. While some impacts of specific effectors on gene expression are known, there are still many variables that have not been analyzed. To further solidify the annotations, a procedure was set up to analyze genes of interest and eventually determine their function. To complete the procedure, *Tetrahymena* cells were grown in media with or without nutrients and the RNA from the cells was extracted. The RNA was then reverse transcribed to cDNA for analysis. Semiquantitative PCR was run on the cDNA to amplify target genes and quantify their expression. The genes of interest were those that are thought to play a role in carbohydrate metabolism, while genes believed to play housekeeping roles within the cell were used as control genes. Variables that were tested using this procedure were different nutrients, specifically different carbohydrates, and different growth times in a specific media. There were visible effects on the gene expression using these variables. The results were quantified and fit the predicted gene expression models.

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Investigation into the Effect of Extraction Methods and Chemical Composition on the Antimicrobial Properties of Essential Oils

Alex R. Lovins, *2:00-4:00pm*

Essential oils come from plants and embody the “essence” of that plant’s fragrance. Due to their fragrance, essential oils have been used since ancient times for their potential healing properties. Though the oils have been used for treating medical issues throughout history and are currently gaining popularity, there is significant speculation as to the real benefit obtained through the use of essential oils. It is only recently that these oils have been studied to identify and understand their chemical and medical nature and the studies are far from complete. Some of the biggest issues include the highly diverse growing conditions for the plants and the varied processing conditions used to obtain the oil. The goals of this project are to (a) investigate how the extraction process to obtain the oil from the plant material affects their chemical composition and (b) examine how the composition, in turn, affects the antibiotic properties of the oils. Throughout this investigation, extraction method has been studied thoroughly. The data shows that through three different extraction methods, each give different constituents, which in turn has an effect on the properties of the oil. Due to this changing effect, antibacterial testing along with determination of the active ingredients of the oil are being conducted.

Rescue of Zoledronate-Induced Death in Normal Human Oral Keratinocytes

Jacob Kirby, *3:30-4:00pm*

Zoledronate (ZOL) is used to treat osteoporosis and cancer metastasis to bone. ZOL inhibits the mevalonate pathway, a pathway that produces cholesterol as well as farnesyl pyrophosphate, the latter needed for prenylation of GTP-binding proteins such as Rho, Rac, Rab, and Ras. This prenylation is required to appropriately localize these proteins, ensuring osteoclast differentiation and survival. ZOL blocks the mevalonate pathway by binding to farnesyl pyrophosphate synthase, resulting in decreased osteoclast function and therefore decreased bone resorption. Although the therapeutic function of ZOL is known, the debilitating side effects are not understood. An adverse effect is bisphosphonate-related osteonecrosis of the jaw (BRONJ), characterized as exposed, necrotic bone that, along with overlying soft tissue, does not heal and persists longer than 8 weeks. Geranylgeraniol (GGOH) is an intermediate of the mevalonate pathway that bypasses the ZOL block, producing rescue of ZOL-induced apoptosis in vitro. The purpose of this study was to expand our understanding of cell death mechanisms (apoptosis, necrosis, and senescence) in BRONJ induced by ZOL at 6, 24, 48, and 72 hours of treatment. A further purpose was to determine whether GGOH rescues from these phenomena. Normal human oral keratinocytes (NHOKs) from the oral mucosa of a patient were used to test senescence via senescence-associated beta-galactosidase staining. Necrosis was evaluated using an LDH release assay. The assays revealed significant increases in senescence and necrosis by both 10 and 50 mM ZOL, but no significant rescue with 10 mM GGOH. Apoptosis was measured using flow cytometry. There was significant induction of apoptosis at both doses of ZOL as well as significant rescue with GGOH at the 48 hour time point. Additional doses of GGOH and other oral topical agents should be investigated in the future for improved cell death rescue profiles.

Moringa's effect on water purification

Noah Miller, *3:00-3:30pm*

Deaths from unclean drinking water are particularly high in developing countries in tropical regions. These areas correspond to areas that can support the growth of moringa, a nutritional plant with antimicrobial properties. This project recreates the viable method of combining moringa's natural flocculent and

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antimicrobial properties with sand filters to create a f-sand filter to a more highly effective as well as cheaper and sustainable option for water purification.

The Effects of Caffeine and Ethanol on Telomere Homeostasis in Tetrahymena

Alexander Breytenbach, *3:30-4:00pm*

Tetrahymena has long been a model organism for many eukaryotic proteins and enzymes. Most notably, it has served as one of the most used examples of homologous regulation at the telomere to humans. Although not perfect, an understanding of tetrahymena telomeric proteins and pathways give a lens into predicting outcomes for similar complications in humans. This was the premise of our research into the nature of the effects of caffeine and ethanol on the telomere. Both are common beverages consumed by the average human, and therefore insight given by a single celled ciliate could point to potential investigations worth exploring more carefully. Both caffeine and ethanol altered the homeostasis of the telomere as judged by the difference in telomere length vs a control group of tetrahymena. This indicates potential stimulus adaptation and response that could prove harmful to the cell over a long-term exposure. The amount of time proved to also increase the impacts seen on the cellular DNA, although the extent of this is not yet fully known.

EXTRACELLULAR PH CHANGES MEDIATED BY RETINAL MULLER GLIA ARE SHAPED BY TWO DISTINCT MOLECULAR PATHWAYS.

Alexis Shepherd, *3:00-3:30pm*

Extracellular H⁺ dynamics are correlated with significant changes in the release of neurotransmitter in the retina. This has led to a number of recent studies examining the role extracellular H⁺ dynamics play in shaping visual signals. However, few studies have directly measured H⁺ fluxes from individual identified cells. Self-referencing H⁺ selective microelectrodes have proven to be ideally suited for sensing extracellular pH changes from isolated cells. Two recent studies utilized self-referencing to measure H⁺ fluxes from retinal Müller glia from tiger salamander retina and characterized two pathways by which Müller cells regulate extracellular pH. In the first pathway application of high KCl produces a large HCO₃⁻ dependent extracellular acidification at the endfoot. In the second pathway extracellular ATP induces a large HCO₃⁻ independent acidification. The present study directly examines overlap of the two previously reported pathways by measuring extracellular H⁺ fluxes and intracellular calcium levels. The pathways could be distinguished by their calcium dependency and the involvement of anion transport in the extracellular acidification, and collectively, these findings point toward a multifaceted ability of Müller cells to regulate pH, and by extension, shape synaptic transmission in the retina. (Additional Authors: Matthew A. Kreitzer¹, Boriana K. Tchernookova², David Swygart¹, Chad Heer¹, Michael Gongwer¹, Lexi Shepherd¹, Hannah Caringal¹, & Robert P. Malchow²; ¹Department of Biology, Indiana Wesleyan University; ²Department of Biological Sciences, University of Illinois at Chicago)

[†] Denotes a project also included on the oral presentation schedule

†Educational Success of First Generation Students

Jeff Marshall, Johnny Rhodes, and Evan Wilcox, *10:00-11:30am*

This study was designed to measure the relationship between the success rates of first-generation college students and all other college students. The bar of success was measured using semesters completed with a GPA of above 3.5. Having family members with prior experience in higher learning may give students certain advantages which could lead to having more academic success. On the one hand, different family demographics may make it more difficult to adapt to college. On the other hand, the idea of being the first person in a family to have the privilege and capacity to attend college may cause students to have an instilled drive that brings them to success. The results of this study provide insight into how the different challenges of adjusting to college between first-generation students and other students might cause different academic effects.

Changing Boy/Girl Hours

Nathaniel Pugh, Jaelyn Kimball, Elaina Ededuwa, and Michael Fitch, *10:00-11:30am*

Throughout the past several decades there have been various changes implemented into the IWU Student Handbook, making Indiana Wesleyan's private school life slowly mimic its public school constituents. However, some students are still dissatisfied. Students are outspoken about several policies fairly unique to IWU, such as required chapel, off-campus living, and, more recently, IWU's policy on open hours for the residential halls. Using Survey Monkey, it was discovered that of the 91 respondents, 39.56% (36) chose the option of removing all limitations for opposite-sex visitation hours in general. 56.04% (51) chose to extend the visitation hours from their current state. This left only 4.40% (4) to choose the option of keeping visitation hours the same. Given this information, it would appear that the student body of IWU would be very receptive to the change of the hours. The survey pulled data from students of different genders, age ranges, residence halls, and relationship statuses. We believe this data provides the necessary components to begin looking at the visitation hours policies across campus.

Fine Arts as a Required General Education Class

Daniel Wolgemuth and Jamie Bagley, *10:00-11:30am*

The purpose of this study is to see whether students believe Fine Arts is a helpful or interesting class that should be a required general education class. Liberal Education is widely debated between school. Many see the value of them while others think it is wasting the students time and money. Indiana Wesleyan University requires all the students to complete a General Education study. Because of this, we decide to focus on Fine Arts for our study because it being a required class is hard to rationalize than some of the other required classes. A random sample of Indiana Wesleyan students were sent a questionnaire asking about their experience with this class. Data is being collected currently although limitations of this study may be a small sample size. This study shows the student's interest and attitude towards the required Fine Arts class.

† Denotes a project also included on the oral presentation schedule

Chapel Attendance

Maddie Fox, Allison Laubach, and Patrick Riggs, *10:00-11:30am*

Chapel attendance remains a divisive issue on the Indiana Wesleyan University campus. This study identifies what aspects of chapel affect student opinions and attendance rates. As Groce, Willis, Sonner, and James have found, while mandatory attendance can require students to be present, it does not require that they engage with its intents or purposes. A survey was sent out to collect data on the students and their opinions regarding the issue. Questions range from topics discussing chapel standing to factors that influence how students view chapel and whether or not it should be mandatory at a Christ-centered university. Our goal was to identify why chapel attendance is as polarizing as it is, and what can be done to help alleviate pressure on the issue.

Alcohol Policy

Hunter Terrell, Robert Dunbar, and Joshua Humerickhouse, *10:00-11:30am*

The intention of this study is to bring forth accurate data pertaining to the student and professor perspective of the current Indiana Wesleyan alcohol policy. This study involved surveying both students and professors about their acceptance of alcohol consumption at IWU, being the presence of alcohol, and if they found the current policies effective. The last question addresses whether the students or professors are familiar with the Wesleyan Church's policy pertaining to alcohol. These questions provide an indication of whether or not students and faculty at IWU are in general agreement with current policy and if they find it to be an effective policy that students and faculty are following. The last question related to Wesleyan Church policy will be used to assess a correlation between religious views and the assessment of the IWU alcohol policy. The goal of this study is to provide accurate information that will be used to reaffirm or promote change in the current IWU alcohol policy.

How Likely You Are to Change Your Major

Brandon McKee, Seth Liburd, and Josh McMillan, *10:00-11:30am*

This is a study on the thought process behind college students changing their majors in an attempt to discover what percent of students change their major and what some of the reasons are for the change. The data we collect will give us a look into the mind of students who are thinking about changing their major and those who have changed their major already. We hope to gather data regarding whether college students change their major based off of three major categories: the coursework was too difficult, the student simply didn't enjoy the major, or they felt God calling them to a different major. We also hope to gather information on the issue of how many times student change their major and if there are some who wish to change their major but do not because of fear.

IWU Parking

Marci Thurman, Mark Flanagan, James Beyioku, and Ethan McLeRoy, *10:00-11:30am*

As cars have become the main source of transportation over time, certain issues have followed. Parking is one such issue. Whether there is a lack of parking spaces or parking passes on college campuses cost extraordinary amounts of money, parking has become an issue. Here at IWU, the main issue is the current dissatisfaction with the new rules that were put into place before the 2018-2019 academic year. "The biggest change to student parking is the removal of the underclass and upper-class parking designation. Students will be allowed to park in any student designated parking lot." (Beights, 2018). The purpose of our research was to discover whether the IWU community is truly dissatisfied with the new parking rules, as well as trying

[†] Denotes a project also included on the oral presentation schedule

to discover whether students are able to park close to their dorms. In our study, we surveyed 97 students and staff using an online survey through Survey Monkey. While this is only a small sample of the IWU population, we believe there is enough data to help us determine student satisfaction with the parking setup. Our results may allow us to develop a new idea for parking that will better satisfy the IWU community.

Student Thoughts on the Healthy Eating Options Provided at Indiana Wesleyan University

Destiny Davisson, Tyler Snodderly, Caleb Schultz, and Jaqueline Fernandez Alvarez,

10:00-11:30am

The purpose of our current study was to investigate if Indiana Wesleyan University is providing enough healthy options to students, to fuel their bodies during long school weeks. Everyone has their own idea of what “healthy” includes, so it is important to make sure the needs of all students at Indiana Wesleyan University are being met. As students transition from high school graduates to college students, one thing that changes with age is one’s awareness of health. College is the first-time students are approached with endless options of foods, without their parents telling them what they can and cannot have on their plates. The unlimited supply of burgers, pizza, fries, and desserts can lead incoming freshmen to what is known as the “Freshman 15.” Without an assortment of healthy options on campus, students may fall into bad food habits. A survey conducted in October 2015 by the Harris Poll found that 18% potential college applicants indicated that a college’s health and wellness offerings were “likely” or “extremely likely” to alter their decisions of whether to apply to that college. And 23% felt that access to such offerings would be “essential when deciding where to apply” (Lee, 2018). The need for this study was highlighted by research findings that suggest the lack of healthy options available for students at universities around the country. Our strategy to gain research on the Indiana Wesleyan University campus was to create a survey and allow students to access it through SurveyMonkey. We posted the survey on our social media profiles and sent them out to current students. We created interactive and intriguing questions in our questionnaire to engage our audience. This study shows data trends that support further research of schools not doing an adequate job of providing healthy options, based on the contribution of side options they have provided for students. Students expressed poor to average rankings on how well Indiana Wesleyan University is doing with providing a healthy diet.

Review of IWU Meal Plans

Dylan Whitlow, Morgan Cook, Zach Singer, and John Lothery, *10:00-11:30am*

With food plans being a huge cost to students attending Indiana Wesleyan University (IWU), this study was done to see the effectiveness of the current meal plan. Many students at other universities, such as Miami University of Ohio, University of Southern Mississippi, and others, have started petitions to change mandatory school meal plans (2016, Pappano). At IWU, students use their meal plans to buy things at Mcconn Coffee Co., the Campus Store, and Trader James, as well as Baldwin and Wildcat. At the beginning of the 2018-2019 school year, McConn Coffee Co. raised its prices and added a 30% upcharge when using a meal plan to pay for their products. As a result, the meal plan and Pioneer College Caterers have been a hot topic on campus. Thru surveys, the opinion of students at IWU was given and analyzed.

Student Engagement with Alcohol Consumption at Indiana Wesleyan University

Lydia Morgan, Logan Kraft, Isaac Lenon, and Jack Mennen, *10:00-11:30am*

Alcohol policies vary from each academic institutions. Research has shown that most college students find it “unnecessary to make major restrictions” when it comes to universities implementing drastic alcohol policies (Larsen). In adherence to the Wesleyan Doctrine, Indiana Wesleyan University has held its students to a

[†] Denotes a project also included on the oral presentation schedule

certain standard, prohibiting those of legal age to consume alcohol during the academic school term. The purpose of this study was to analyze possible influences of student behavior regarding alcohol consumption as well as determine where students stand on the current university policy. The structure of the study was created to determine whether Indiana Wesleyan's alcohol policy affects student alcohol consumption, on and off campus premises. A survey was created and completed by 70 undergraduate students at Indiana Wesleyan University (Survey Monkey). Descriptive statistics were used to analyze the data. For example, it was found that the majority of IWU students have broken the alcohol policy. 91.4% of respondents believe the alcohol policy is "fairly strict" to "very strict." Based on the results of the study, it can be concluded that the IWU policy is ineffective. For more reliable results, a detailed study containing a larger sample size would prove to be more effective.

An Analysis of How to Improve the Meal Plan for Students at IWU

Triston McNaughton, Ali Smith, Grant Prible, and Elizabeth Carlson, *10:00-11:30am*

The purpose of the current study was to investigate how the meal plan at Indiana Wesleyan University could be improved. The need for this study was highlighted by the results from our survey that showed the dissatisfaction the student population has with their current options when it comes to meal plan options. One way to improve the meal plan at IWU is to partner with restaurants in the community to allow students to use meal swipes at those restaurants. This will bring a variety of choices to the students and benefit the business in the community. Indiana Wesleyan University would also benefit from this deal. The Stevens Institute of Technology implemented an off campus meal plan and saw an increase of twelve percent in participation of students opting into the meal plans (Crain, 2018). IWU would be the first Christian school in the midwest to offer this type of meal plan. It would become another attraction for future potential students and increase the student population. The need for this new meal plan option will be highlighted by the results of our survey. Within our survey, students are asked to rate their satisfaction with their current meal plan and to provide input on new meal plan options. The survey will also help us determine which restaurants in the community are the most popular among the student body. Through this we can determine which restaurants would be best to partner with. Our survey asked current students at Indiana Wesleyan University of their satisfaction with their meal plan, and how it could be improved. Our idea for improvement was to add an off campus meal plan. This would strengthen community between IWU and Marion, while profiting both parties. The limitations of this study include the sample size being maxed at 100 responses. In addition, in order to get a more in depth study we would need to reach outside sources to see which restaurants and people would be more willing for meal swipes and points at local establishments. The survey shows the willingness of IWU students to pay more for this option and how dissatisfied they are with the current IWU food services.

[†] Denotes a project also included on the oral presentation schedule