IUPUI Student Research & Engagement Day
Abstract Book

A

Effect of Mechanical Loading on Osteoblasts in vitro

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Mechanical loading has been shown to stimulate changes within bone structure, often characterized by collagen production and mineralization. A staple when studying bone, mechanical loading is most often done with whole bones on a holistic scale. Comparatively, little is understood on the microscale of the immediate response bone cells have when stimulated by mechanical loading. Cyclic loading causes fatigue in whole bone, accumulating microcracks that can result in catastrophic failure often seen in patients with degenerative bone diseases such as osteoporosis imperfecta (OI). While cyclic loading has the capability to fracture whole bone, it can lead to a formative response by modeling or remodeling the bone tissue. By studying the immediate pathways that are activated by a mechanical load, the knowledge bank on the cellular response can be expanded. Cyclic loading was done on murine bone cells to understand the immediate action that bone cells have in response to mechanical stimulation. In this study the Flexcell 5000 was used, radially stretching the cell substrate to 10% strain for 600 sinusoidal cycles over a 20-minute period and compared to plated but unstretched bone cells. Pronectin-coated 6-well plates were also used to identify how the extracellular matrix may play a role in cellular expression. After cyclic loading, the cell signals were then quantified using q-PCR. The aim for the research project is to understand the degree of the effect mechanical stimulation has on bone cells in vitro, focusing on the expression of collagen production.

Mentors: Joseph M. Wallace, Department of Biomedical Engineering, Purdue School of Engineering & Technology, Indiana University-Purdue University Indianapolis

LC-MS/MS Detects Urobilinoids from Feces in Fly Guts

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Blow flies are suspected to carry pathogens from one location to another due to the consumption of fecal matter leading to the contamination of food sources. Gut extracts of the blow flies were prepared and then analyzed to detect various tetrapyrrole urobilinoids, commonly found in fecal matter, using liquid chromatography-mass spectrometry. The flies analyzed were from three feeding treatments: unfed flies, liver fed flies, and feces fed flies. Confirmatory tests were run on fly extracts where different types of animal feces were consumed to verify that the urobilinoid compounds would be present regardless of the type of fecal matter consumed (omnivore, herbivore, carnivore). The blow flies were analyzed using a Thermo LTQ-XL mass spectrometer (San Jose, CA) coupled to an Agilent 1100 HPLC (Santa Clara, CA). We used reversed phase chromatography on a 100 x 2.1 mm C18 column at a flow rate of 200 uL/min to separate the urobilinoids of interest. The solvents used were 0.1% formic acid in water (solvent A) and 0.1% formic acid in 70:30 acetonitrile:methanol (solvent B). The data were acquired in positive ion mode using a gradient with an initial 1-minute hold at 30% B along with a 9-minute linear gradient from 30 to 95% B. Two compounds, urobilin and urobilinogen, were used to indicate the presence of the fecal matter with retention times of approximately 6.5min containing the m/z 343 and 8.5min containing the m/z 466 respectively. This was utilized to link the flies to pathogen transmission via fecal matter.

Mentors: Nicholas Manicke, Department of Chemistry, Indiana University-Purdue University Indianapolis; Christine Skaggs, Department of Chemistry, Indiana University-Purdue University Indianapolis.

Perinatatal Expression of DYRK1A in Male and Female Down Syndrome Mice

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Down syndrome (DS), a genetic disorder that affects 1/700 live births is caused by the triplication of human chromosome 21(Hsa21) and is characterized by cognitive and skeletal deficits. One of the trisomic genes involved in DS is Dual specificity tyrosine regulated kinase 1A(DYRK1A). Triplication of genes on Hsa21has been proposed to cause an increased gene product and hence protein over expression. However, preliminary data suggests expression is not the same across ages and tissues. The hypothesis of this study is that trisomic DYRK1Aexpressionis differentially regulated spatially and temporally at the perinatal stage, and exhibits sexual dimorphism at the perinatal stage, which may contribute to cognitive deficits in DS. To quantify the perinatal (embryonic day 18.5(E18.5) to postnatal day 6(P6)) expression of DYRK1A, the Ts65Dn DS mouse model was used. The Ts65Dn mouse model contains a freely-segregating segmental trisomy of mouse chromosome 16 (Mmu16) and carries half the gene orthologs from Hsa21, including DYRK1A.Ts65Dn is the most widely used mouse model of DS and exhibits similar phenotypes as individuals with DS. Protein from E18.5 and P6 Ts65Dn and littermate control mice was isolated from the hippocampus, cerebral cortex, and cerebellum. Genotyping of all mice was accomplished by PCR. Bradford assays and Western blotanalys is were used to quantifyproteinandDYRK1Aexpression.Resultingdata suggests similar DYRK1A expression at E18.5 and increased DYRK1A expression at P6 in Ts65Dn as compared to euploid litter mates. These results suggest that treatments targeting DYRK1A activity at these sensitive stages of development when DYRK1A is overexpressed in trisomy could result in a reduction of DS-related cognitive deficits.

Mentor: Randall J. Roper, Department of biology, IUPUI

Establishment of the Role of Aberrant Tau Oligomer Interactors on Toxicity In Vivo.

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The microtubule-associated protein tau is responsible for microtubule assembly in neurons. The hyperphosphorylation of tau is thought to be the cause of tau accumulation and aggregation in the form of oligomers. Connections between the accumulation of toxic tau oligomers and neurodegenerative tauopathies, including dementias such as Alzheimer's Disease (AD), have been established repeatedly, however it has yet to be determined whether or not the neurotoxicity observed in these diseases is solely produced by tau oligomers or these oligomers conjoined with other molecular interactors. The first goal of this project was to correlate a specific phosphorylation in tau with its accumulation in a mouse model for tauopathies that over-express human tau with the P301S mutation. To do so, immunohistochemical staining was performed using various antibodies that recognize tau phosphorylated sites. I used the AT8 antibody that recognizes tau phosphorylated at Ser202/Thr205, the PHF1 antibody that recognizes tau phosphorylated at Ser396/Ser404, the PHF6 antibody that recognizes tau phosphorylated at Thr231, and the S214 antibody that recognizes tau phosphorylated at Ser214. Staining revealed tau deposits present throughout the hippocampal and neocortical regions and prevalence was positively correlated with mouse age, indicating progressive neurodegeneration in these regions. Tau phosphorylated at Ser214 was found to correlate most closely with disease progression in the tauopathy mouse models.

Mentors: Cristian Lasagna-Reeves, Department of Anatomy and Cell Biology, IU School of Medicine

Influence of Astrocytes on Retinal Ganglion Cell Maturation andDisease When Derived from Human Pluripotent Stem Cells

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Astrocytes are the most numerous types of cell in the central nervous system and perform numerous roles such as supporting neurons, supplying nutrients, providing mechanical support, maintaining ion balance, and aiding in synaptogenesis. During retinal development, astrocytes enter through the optic nerve and migrate into the nerve fiber layer. Retinal astrocytes perform similar functions as listed above and reside in close association with retinal ganglion cells (RGCs). Human pluripotent stem cells (hPSCs)can be utilized for modeling retinal cell types, including astrocytes and RGCs.This is done by differentiating hPSCs into astrocytes and RGCs using established protocols. This protocol was used to observe wildtype (WT)astrocyte development and their characteristics compared to glaucoma astrocytes in order to determine any disease phenotypes. The growth of the astrocytes was measured using ICC through the expression of astrocyte-specific proteins including GFAP. Astrocytes can also be co-cultured with RGCs to study their effects on maturation and their potential role in degeneration. Initially, the maturation of RGCs was measured by cell survival and the complexity and length of neurites. When grown from glaucomatous sources, RGCs indicated morphological deficits after 4 weeks compared to WTRGCs. The co-culturing of RGCs and astrocytesindicatedenhancedmaturation of RGCs including morphology and functionality, with the ability to study their interaction with glaucomatous RGCs in future studies. Overall, the results of this research verify the importance of astrocytes for RGC growth as well as their potential role in the degeneration of RGCs in glaucoma.

Mentors: Kirstin Vander Wall, Department of Biology, IUPUI; Jason S. Meyer, Department of Biology, IUPUI; Stark Neurosciences Research Institute, Indiana University School of Medicine, Indianapolis, IN; Department of Medical and Molecular Genetics, Indiana University School of Medicine.

Oral Surgical Scope Clamp Support Device

Ahmed Almatooq
Engineering Technology

The project is about a medical device which helps in promoting quality in the theatre room during trachea tumor surgery by holding together the surgical equipment, rigid bronchoscope, on top of theatre bed. The analysis of the cost and implications for implementations results to minimize movement of the bronchoscope and reduce price of care once the tool is incorporated. The focus of our project is those who are on the patient beds with the age of 5 years or younger in need of trachea tumors treatment surgery. The surgical device must be mounted to the theatre bed appropriately to ensure sustainability, quality, and variation reconsidered a priority. Some of the issues that arise due to poor control of the medical processes are complications. For the project, the device is designed to increase the efficiency of the competence of the surgeon and give surgeons an easy time in the process of work. For a proper quality in the course of medical surgery, the surgeons need to use the medical device to hold the tumor treatment equipment together. Based on the analysis of our first design and prototype, the motion of the device for the surgeons for the medical procedures is reduced since the essential quality enhanced in the product design. It is therefore, recommended that the medical facilities start using the device to holdup the bronchoscope instead of holding it by hands since the device clamps all the equipment together and facilitates quality during the procedures.

Mentors: Dr. Paul Yearling

The Art of Mexico's Muralism and The Artists' Who Painted Them.

Aliyah Alvarez
Herron School of Art and Design

This research explores the art of muralism in the aftermath of the Mexican Revolution (1910-1946) and the artists that created them. As it starts with the history of the Mexican Revolution and the aftermath of it as well. While talking about the aftermath of the revolution, I

will try to explain the history of muralism in Mexico. Since we are looking at the art of muralism, we must know who the artists are as well. The paper will look closely at the artworks of the artists and their artwork and examining if artists had any relation to their artwork with their political beliefs. Since it was the aftermath of turmoil in Mexico, artists could have their own ideas of what the government and the politics of Mexico should be like. Artists can show their artwork to the audience and show their political beliefs in a different way.

Mentor: Patrick Kinsman, Department of Art History, Herron School of Art and Design

Dockless Scooter-Sharing in Indianapolis

John Strachan1, Jessica Bentley1, **Madison Anderson**[1], and Youngbok Hong[1]
[1]VisualCommunication Design Graduate Department, Herron School of Art and Design, IUPUI

In June of 2018, hundreds of dockless electric scooters were placed in the City of Indianapolis overnight by Bird and Lime, two California based scooter-share companies. Indianapolis became one of many cities across the country faced with the challenge of integrating and regulating this new technology and service. Despite the interruption of traffic patterns and other difficulties, this form of micro-mobility is inexpensive to build and extremely energy/fuel efficient when compared to automobiles and more common forms of transportation. The goal of this research was to envision a sustainable transportation system that integrates scooters through the development of a comprehensive solution model for leveraging this new technology in the City of Indianapolis. The research was conducted in the course setting, as part of the Visual Communication Design MFA program. Using the Human-centered design approach, our team began by addressing the needs of users and keeping those needs at the center of every step in the problem-solving process. Over the research period, we conducted context-based inquiry with qualitative methods to identify the emergent themes reflecting multiple perspectives involved in this issue. The final research document as an outcome aims to assist the Office of Metropolitan Development at the Indianapolis Office of the Mayor in policy re-design that is relevant to the needs and values identified through this study.

Mentors: Youngbok Hong, Visual Communication Design Graduate Department, Herron School of Art and Design, IUPUI

Maximal results with minimal effort: blow flies as vertebrate resource indicators

Owings, Charity; Banerjee, Aniruddha; **Travis Asher**; Gilhooly, III, William; Tuceryan, Anais; Huffine, Mary; Skaggs, Christine; Adebowale, Iyun; Manicke, Nicholas; Picard, Christine

This presentation is a study of the use of “biological drones” to remotely collect ecological data. The difficulty of collecting field data directly is explained; this leads to an explanation of the behavior specific species of flies, “carrion flies”, and how their behavior can be utilized by biological ecologists for data collection in an indirect manner. A study of three locations (Yellowstone, Indianapolis, and the Smoky Mountains) on the particular species “Blow Flies” is utilized for presentation purposes to conclude this presentation, utilizing field data collected by IUPUI Dr. Christine Picard and Charity Owings; in particular, this includes the display of site location neighborhood maps created by Dr. Rudy Banerjee as well as an example of a tutorial document for performing a statistical analysis of these data using the R package “INLA” written in the R Notebook syntax. In addressing this biology/ecological case study, the use and importance of organization for users of GIS is emphasized; particularly, the medium of R Notebook is explained in detail. An introduction to the origins of R Notebook beginning with the “Markdown” online formatting language precedes the discussion, serving to frame the entire discussion in a historical manner. This is followed with a brief explanation of the purpose of organizing programming documents, providing the audience with a motivation for looking into R Notebook for their GIS research purposes as well as its interesting (and useful!) features. After sufficient historical framing and motivation is established, the presentation provides a useful visual, displaying allof the syntax (and shortcuts) for the most useful features of R.

Mentors: Owings, Charity; Banerjee, Aniruddha; Asher, Travis; Gilhooly, III, William; Tuceryan, Anais; Huffine, Mary; Skaggs, Christine; Adebowale, Iyun; Manicke, Nicholas; Picard, Christine Notebook to the audience. A large example of the .html file output that results from many of these is displayed, helping to convey to the audience how “presentation-friendly” the use of R Notebook for their project will be.

Clinician Perspective-Taking in Ethics Consultation

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1Department of Biology, IU School of Science; 2Fairbanks Center for Meical Ethics, Academic Health Center of IU Health

Ethical dilemmas that arise during patient care are a commonplace in the healthcare system. These ethical dilemmas range from issues of miscommunication to the decision-making process of end-of-life care. Ethics consultations services are a part of every accredited hospital and seek to potentially resolve ethical problems between healthcare providers or between providers and patients when a consensus about treatment cannot be reached. Dr. Lucia Wocial is a nurse ethicist who specializes in the topic of moral distress that healthcare providers face when an ethical dilemma arises from a case. In an initial investigation on the presence of moral distress in ethics consultations, Dr. Wocial interviewed and coded 50 healthcare providers who were involved in cases where the ethics consult service for IU Health was called. Now, the investigators are involved in an initial qualitative content analysis process using an inductive approach to the review of the 50 interviews. Inductive method calls for a blind reading of the text by third party individuals in order to extrapolate themes and meaning from the text. One key theme that emerged is the apparent perspective the healthcare providers took in the recall of the cases. In each interview the interviewees would either focus on the distress and concerns faced by the patient or the healthcare providers or both. This raises interesting questions to be explored on how providers take on moral perspectives and how that may possibly relate to the clarity in which they can articulate the ensuing ethical issue.

B

Mentor: Jane Hartsock, J.D, Fairbanks Center for Medical Ethics, Academic Health Center of IU Health

Multibody dynamics modeling in Formula SAE handling analysis

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This work consists of a multi-body dynamic analysis of a Formula SAE vehicle (i.e., Formula 3 vehicle) comprising of front and rear suspension, steering system, vehicle tires and inertia acting on the vehicle. The model is designed and made in ADAMS Simulation software which takes into consideration all non-linear characteristics, including stiffness and damping of the suspensions in different road condition such as corner maneuvering. Corner maneuvering is considered as one of the important tests of vehicle when it comes to vehicle handling and ride comfort. The above-mentioned test is in reference to the SAE rules and regulations of the dynamic events during the Formula SAE student competition.

Advisor: Jing Zhang, Department of Mechanical and Energy Engineering, Purdue School of Engineering and Technology, IUPUI

Women in STEM Receive More Backlash After Delivering Negative Feedback

Dr. Peggy Stockdale & **Kerby Beliles**
Department of Psychology, Purdue School of Science, IUPUI; Department of Psychology, Purdue School of Science, IUPUI

This study examined bias against female STEM faculty in male -dominated STEM occupations, who give negative feedback. Providing critical feedback is important yet prior literature shows that students more harshly judge female faculty than they do male faculty. 260 adults (85 men, 115 women and 61 other or undetermined) with college experience recruited from Amazon Mturk completed an online study, where they were asked to write a 100 essay on how the brain is like a computer. They were told their essay would be graded by a faculty member who was assisting us with the study. Participants were randomly assigned to a condition defined by a 2 (Professor Gender: Male, Female) ´2 (Professor Discipline: Computer Science, Psychology) ´2 (Feedback valence: Positive, Negative) design. After receiving either the positive or negative feedback, participants rated the professor on scales measuring agency (e.g., ambitious, competent, independent) and communion (e.g., kind, warm, supportive), and rated the extent to which they would take a course from this professor and recommend him/her to others. ANOVAs on these dependent measures found only main effects for Feedback (Professors providing negative feedback were rated as less agentic, less communal, and less likely to take or recommend a course from this professor. The hypotheses were not supported. There appear to be no bias against female professors in this context. These data support other research by Stockdale and colleagues (unpublished) showing no negative stereotypes of female, compared to male, STEM faculty.

Mentor: Dr. Peggy Stockdale, Department of Psychology, Purdue School of Science, IUPUI

Unforgetting Poland's Forgotten Survivors: Critical Reflection on Survivor Narratives

Elzbieta Bidwell, Undergraduate in General Studies
School of Liberal Arts, IUPUC

Memory is considered to be an imperfect source of historical knowledge, yet narrative recollections may provide intimate details that could be forever lost. This project is a collection of first-person narratives in a web-folio format that captures previously unrecorded stories of Polish Holocaust survivors. The purpose of the digital collection is that it offers these stories to a new generation of readers who may not have been introduced to information about all the victims and survivors of World War II in Europe. The memory web-folio contributes primary research with a digital humanities delivery system. The creative non-fiction web-folio contributes hitherto lost/unfound stories of Polish non-Jewish survivors of the Holocaust. Readers for this memoir include World War II scholars and historians, students of Holocaust history, and those interested in creating a web-folio. My primary sources include personal recollections from my parents and their family members; a visit to Auschwitz-Birkenau Concentration camp in May 2018; research in literary texts and articles, as well as research at the U.S. Holocaust Memorial Museum in March 2019.Preserving their narratives in digitalweb-foliois a significant and timely contribution of primary narratives to the current discussion of Polish people and their complex and varied roles in the Holocaust.

Mentor: Dr. Katherine Wills. English Department, School of Liberal Arts, IUPUC

1890's Dystopian Fiction versus 1960's Utopian Heroes: A Study of the Time Machine and Doctor Who

Jerome D Bingham, History, School of Liberal Arts
History Department, IUPUI School of Liberal Arts

In this paper I compare the time periods of 1890's Britain and 1960's Britain. These periods bookend era of historical change for the country as the 1890's saw the peak of the British Empire while the 1960's were a decade on contracting as the country continued to rebuild following World War Two. I then use two notable works to highlight the differences in these decades. For the 1980's H.G Wells the Time Machine is an example of concerns of the decade as the class division grew. I argue that in this decade people turned to dystopian fiction to escape. However, Doctor Who serves as a catalyst for the 1960's as new movements grew in the country and people were more optimistic as the country began to see significant economic growth following the world wars.

Mentor: Erik L. Lindseth, History Department, IUPUI School of Liberal Arts

Identifying Influential Trisomic Genes in Addition to Dyrk1a that Contribute to Skeletal Phenotypes Found in Down Syndrome
Matthew P. Blackwell[1], Jared Thomas1, Jonathan LaCombe1, Eva Lana-Elola2, Sheona Watson-Scales2, Victor Tybulewicz2, Elizabeth M. C. Fisher3, Joseph M. Wallace4, and Randall J. Roper1
1Department of Biology, IUPUI, IN;2The Francis Crick Institute, London, UK, 3UCL Institute of Neurology, London, UK, 4Department of Biomedical Engineering, IUPUI, IN

Bone abnormalities including osteoporosis result from skeletal developmental deficits caused by Down syndrome (DS). DS mouse models have been shown to recapitulate deficits seen in humans with DS. The Ts65Dn mouse model has ~100 trisomic genes, and trisomic Dyrk1ahas been shown to have a causal role in bone phenotypes. Similar skeletal phenotypes and sexual dimorphism in how these phenotypes occur has been identified in Dp1Tyb mice (148 trisomic genes). A mouse mapping panel has been created from the contiguous segmental trisomic regions included in the Dp1Tyb mouse model and these Dp2Tyb, Dp3Tyb, and Dp9Tyb mouse models can be used to identify trisomic genes or regions involved in specific bone phenotypes. We hypothesize that trisomic genes in addition to Dyrk1amake important contributions to the skeletal traits characterized in DS. To test this hypothesis, we performed structural and mechanical analyses of femurs from male and female Dp2Tyb, Dp3Tyb, and Dp9Tyb mice. Trisomic candidate genes present in these strains include Dual-specificity tyrosine phosphorylation-regulated kinase 1A (Dyrk1a) onDp3Tyb, Regulator of calcineurin1 (Rcan1) and Runt related transcription factor 1 (Runx1) on Dp2Tyb, and Amyloid beta precursor protein (App) and Nuclear receptor interacting protein 1 (Nrip1) on Dp9Tyb, genes that may play important roles in skeletal formation and maintenance. This research will provide insight into the complex genetic and phenotypic interactions that contribute to the skeletal abnormalities found in DS.

Mentor: Dr. Randall J. Roper

Differences in Effects on Behavior of Silencing the Medial Amygdala-Lateral Septum Projection in Male and Female Wistar Rats
Brittany Bogan & Marian Logrip
Department of Psychology, IUPUI

To understand brain function, it is crucial to examine how cellular signaling specifies normal and pathological brain function. Modifications of neuronal connections and projections in the brain occur from incidents of trauma and stress yet the circuits that adapt and how these differ in males and females is unknown. Previous lesion studies have concluded that the projection between the medial amygdala and lateral septum are involved in the expression of anxiety-like and depressive-like behaviors. By inserting Designer Receptors Exclusively Activated by Designer Drugs (DREADDs) within the medial amygdala, the projection from this brain region to the lateral septum can be turned off to analyze the necessity for this circuit in the generation of anxiety-like and depressive-like behaviors in male and female rodents. We predict that infusing CNO in the lateral septum to inactivate this circuit will decrease anxiety-like and depressive-like behaviors. The impact of medial amygdala-lateral septum circuit inactivation on exploration of the elevated zero maze, defensive withdrawal test and forced swim test will be discussed.

Mentor: Marian Logrip, Department of Psychology, IUPUI

Using Dual Gene Knockdown of p65 (NF-kB, RelA) and PDK2 via siRNA to increase pancreatic cancer radiation sensitivity
Joseph Boone1, Helen Chin-Sinex1, Marc S. Mendonca1,2
1Department of Radiation Oncology; 2Department of Medical and Molecular Genetics, IU School of Medicine

Pancreatic ductal adenocarcinoma (PDAC) has a 5-year survival rate of 7%. The low survival rates of PDAC are attributed to detection at advanced stage and very high chemo and radiation resistance. Two major pathways that are involved in this resistance are activation of the NF-kB signaling pathway and Warburg cancer metabolism. NF-kB promotes cell survival, tumor progression, angiogenesis, and reduces susceptibility to apoptosis. Warburg cancer metabolism is an alternative metabolic pathway that uses aerobic glycolysis rather than oxidative phosphorylation for energy production. We have shown that the simultaneous inhibition of the pro-survival NF-kB signaling pathway and Warburg cancer metabolism by the dual drug combination therapy of Dimethyl-amino-parthenolide (DMAPT) and Dichloroacetate (DCA) was cytotoxic and sensitized pancreatic cancer cells to radiation-induced cell killing. To directly test whether inhibition of the NF-κB signaling and Warburg metabolism was involved we performed siRNA knockdowns directed against p65 (NF-kB, RelA) and pyruvate dehydrogenase kinase (PDK2), a regulator of Warburg metabolism that is targeted by DCA. We have successfully knocked down both p65 and PDK2 in pancreatic cancer cells and show that the simultaneously inhibition of these two genes induces cytotoxicity and enhances radiation sensitivity of pancreatic cancer cells.

Mentors: Helen Chin-Sinex, Department of Radiation Oncology, IU School of Medicine; Marc S. Mendonca, Department of Radiation Oncology, Department of Medical and Molecular Genetics, IU School of Medicine

Psychological Factors in Exercise Goal Attainment
Anne C. Borden[1], Haejin Dadachanji1, Alyssa C. Fuller2, Perla Flores2, MohammedAl-Hamed2, Kevin Rand2, Kelly M. Naugle11Department of Kinesiology, IUPUI School of Health and Human Science; 2Department of Psychology, IUPUI School of Science

College students significantly gain weight over the course of a four-year degree, becoming overweight or obese. Prior research shows that the psychological constructs impact voluntary behavior, quality of life, and goal attainment. However, little is known regarding the effect of these psychological variables on physical activity (PA) levels in college students. PA mitigates weight gain, but approximately 23% of 18-34-year old's nationwide report not engaging in any PA. Objective. Thus, the purpose of this longitudinal study was to examine the association of psychological traits with exercise goal attainment in college students. Methods. Undergraduate students completed two online surveys within one Fall semester: one at the beginning and the other nearing the end. Of the 271 participants recruited, 169 were retained completing both surveys. The surveys assessed exercise goals, progress towards goals, physical activity levels, and psychological factors. Stepwise regressions determined predictors of exercise goal progress and success with predictors of

psychological traits of exercise self-efficacy and goal ratings of importance and outcome expectancy. Results. Progress towards exercise goal positively correlated with vigorous PA, exercise self-efficacy, satisfaction with life, goal enjoyment, and goal importance. Stepwise regression revealed vigorous PA (Beta=.352, p< .01), satisfaction with life (Beta=.299, p<.01), and goal importance (Beta=.208, p<.05) as predictors of goal progress. Stepwise regression revealed goal outcome expectancy (Beta=.303, p<.05) as the only significant predictor of goal success. Conclusion. Exercise goal progresses significantly impacted by PA, life satisfaction, and importance, while successful goal achievement is impacted by self-assessment of predicted outcomes.

Advisors: Kelly M. Naugle, Department of Kinesiology, School of Health and Human Science, IUPUI; Kevin L. Rand, Department of Psychology, School of Science, IUPUI.

The Science of Black Hair
Ciara C. Bullard[1] IUPUI Department of Education; 2 IU School of Medicine-Cytotechnology

Black hair has always been a sensitive topic. African American men and women choose to wear their hair in styles such as extensions (weaves), wigs, dreads, texturizers, permsorthe natural afro, but what drives them to do so? Often their style is associated with identity, power, beauty, or politics. Grade-school science curriculum has been developed to educate students ontheanatomy and physiology of Caucasians. However, these curricula do not address the African American anatomy, specifically African American hair. The objective of this study is to explain people's interest in black hair. IN this study, a survey administered to African Americans of different ages, genders and educational levels supports what they would be interested in learning about African American hair. This paper reports findings from a survey that asks multiple choice questions including: What influences you to wear your hair the way you do? And What would you like to learn about the science of black hair? IN addition to these questions we are giving respondents the Multidimensional Inventory of Black Identity (MIBI) test (Mike Seller). In learning the standard science curriculum, most people have not gained access to the science of African American hair or its cultural influence. Further research is needed to fully uncover and understand these concepts.

Mentor: Jomo Mutegi, Ph.D. Associate Professor of Science Education, Coordinator of the (ES)2Research Program, Indiana University

Engineering Virtual labs
Oscar Aca, [2]**Gillian Bundles**, [2]Derick Nkemzi, [2]Justin Barrows
1Department of Electrical and Computer Engineering, Purdue School of Engineering and Technology; 2Department of Mechanical Engineering, Purdue School of Engineering and Technology

Engineering programs cover many topics and require significant laboratory experience. The problem we are trying to solve is to provide equivalent laboratory experiences for more topics in engineering. Our task is to create virtual labs for the use of the engineering departments. In order to make this effective we tried to take a creative approach. We want an awe-inspiring experience that will be technically correct, but also increase the interest of future engineering students to stay in the field. We did research on what was available on the market. We wanted to be as original as possible and we wanted to target the young engineering students of tomorrow. We focused on current trends to get a better idea of what may appeal to the engineering audience. The outcome of the project was great in terms of gaining valuable experience. We were able to apply skills learned in a classroom environment into the project. We created the virtual environment from the ground up, requiring activities like three-dimensional modeling, texturing, and lighting and effects as well as integrating knowledge from engineering courses to create realistic scenarios. We were also able to begin the construction of virtual reality labs for engineering students. In a way the theory that is learned in class can now be applied in a virtual setting. There will be less restrictions on what students can do. Furthermore, the engineering departments would not have to limit themselves when doing experiments. The labs will allow students to perform experiments that would not be possible in a traditional laboratory setting. Students could perform more real-life experiments that would prepare them for the real would issues.

Mentors: Dr. Alan Jones, Department of Mechanical Engineering, Purdue School of Engineering and Technology; Patrick Gee, Department of Mechanical Engineering, Purdue School of Engineering and Technology

C

Preparation of Bio inks and Cells for 3D Bioprinting
Elijah Basile1, **Rachel Cadle**[2], Liz Edwards3, Katie Settergren3, Zoe Yang5, David Bustamante2, Bruce Ray4, Horia Petrache2,4, and Nicanor I. Moldovan4,
61Department of Electrical and Computer Engineering, 2Department of Biomedical Engineering, Purdue School of Engineering and Technology; 3Department of Biology, 4Department of Physics, School of Science;5Department of Computer & Information Science, Purdue School of Computer Science, Indiana University-Purdue University Indianapolis (IUPUI); 63D Tissue Bioprinting Core, Richard L. Roudebush VA Medical Center, Indianapolis, Indiana

As an interdisciplinary activity, bioprinting needs the optimization of its main components, namely the cells and the supporting materials ('bioinks'). Methods and Results: In this continuation MURI project, we prepared bioinks from alginate or from a PAA polymer, in water or in tissue culture medium. To make vascular-like channels in hydrogels, we tested the incorporation in hydrogels of threads made of PVA material, which is water-soluble. We also learned cell cultivation and freezing for preservation. Cell spheroids preparations, along with 2D cultures, were re-analyzed by NMR. We detected the glucose and aldose peaks in the NMR charts of culture media, of 2D cultures and of spheroids. To model the cell spheroids' behavior as dependent on the glucose nutrient, we used the open-platform software CompuCell3D (CC3D). We monitored composition of the constructs by counting the cells in three categories (normal, proliferating and necrotic) and confirmed that the available glucose impacts the fusion rate, via the combined effect of cell aggregation,

survival and proliferation. Conclusion: We advanced in preparing the 'building blocks' of bioprinting and in their better understanding by experimentation and modeling.

Mentors: Bruce Ray, Department of Physics, IUPUI; Horia Petrache, Department of Physics, IUPUI; Nicanor I. Moldovan, Department of Physics, IUPUI and3D Tissue Bioprinting Core, Richard L. Roudebush VA Medical Center, Indianapolis, IN

A role for lipid-lipid interactions in vitamin E's function as a membrane antioxidant
Samuel W Canner[1],2, Fangqiang Zhu1, Xiaoling Leng1, Scott E Feller3, Stephen R. Wassall1
Department of Physics, Indianapolis University-Purdue University Indianapolis2: Department of Computer Science, Indianapolis University-Purdue University Indianapolis3: Department of Chemistry, Wabash College

Vitamin E (α-tocopherol) is the principle lipid soluble antioxidant in cell membranes. Its purpose is to protect membrane lipids from oxidative damage. Whether unequal affinity for different lipids optimizes the proximity of vitamin E to polyunsaturated phospholipids, the lipid species most susceptible to oxidation, is the question that we address computationally with MD simulations on lipid bilayers. Our studies suggest a model that has cholesterol, ubiquitous in the cell membranes of animals, excluding vitamin E from saturated raft-like domains enriched in the sterol. Preferential affinity for polyunsaturated phospholipids is not indicated -vitamin E, like polyunsaturated phospholipids, is pushed towards non-raft regions depleted in cholesterol. The binding energy measured for vitamin E in umbrella sampling AA (all-atom) simulations is less for SDPC (a polyunsaturated lipid) than SOPC (a monounsaturated lipid). Adding cholesterol to SOPC eliminates the differential in binding energy. CG (coarse-grained) simulations run on PDPC (a polyunsaturated lipid) /SM (a saturated lipid)/cholesterol mixture in the presence of vitamin E indicate the vitamin locates at the boundary between SM-rich/sterol-rich (raft-like) and PDPC-rich/sterol-poor (non-raft) domains. The results of these studies will be presented.

Mentor: Stephen R. Wassall

Designing Food Prep & Management Apps for College Students
Jiva Capulong
Department of Human-Centered Computing IU School of Informatics and Computing

One in eight college students are at risk of food insecurity, which imposes wellness and education barriers. Prior literature shows that food insecurity risk stems from various attributing factors. One key factor is in lacking adequate food management skills due to the vulnerable transition toward independence and adulthood. Given the increased affordability of technology devices such as smartphones, as HCI practitioners we ask how technology can be designed to facilitate the development of such skills. Based on our preliminary data collected on the food and computing technology practices of college students, we propose and evaluate mobile application designs intended to assist with food procurement and preparation. We further evaluate the validity of these concepts by prototyping designs and conducting usability evaluations with target users on wireframe mockups simulating use. Feedback data collected from evaluation will be used to further iterate designs that suitably meet users' needs. Our findings will help point toward recommendations for designing future computing systems for building and facilitating independent skills for college students and other populations at risk of food insecurity.
Mentor: Lynn Dombrowski, Human-Centered Computing Department Indiana University–Purdue University Indianapolis

Older Woman and Discrimination at Work
Swapnali Chavan
Department of Sociology, IUPUI

Older people are working past the retirement age. However, women are leaving the work force earlier as compared to men. Given the economic and health benefits of staying in the labor force in later life, I wanted to examine whether older working women experience discrimination at work, which may contribute to their premature exiting of the labor force. I used Health and Retirement Study (HRS) data set which was analyzed using SPSS software. I conducted descriptive statistics for each measure, bivariate analyses for focal variables and multivariable regression analysis to assess whether age predicts work discrimination experiences among older women workers, net of all covariates. I found that Age was associated negatively with work discrimination at a bivariate and multi-variate level. Work environment is so bad that older women prematurely leave the work force

Mentor: Dr Kenzie Latham-Mintus

Prostaglandin E2Administered as a Radioprotectant Inhibits Development of Cardiovascular Delayed Effects of Acute Radiation Exposure
Supriya Chittajallu[1], Joseph L. Unthank2, Miguel Ortiz2, Carol H. Sampson3, Alexa Fisher3, HuiLinChua3, Artur Plett3,Louis M. Pelus4, ChristieM.Orschell3,Steven J. Miller2
Section 3: AuthorDepartmentandSchoolAffiliation1Department of Biology, IUPUI, Indianapolis, IN;2Department of Surgery;3Department of Medicine; and 4Department of Microbiology & Immunology, Indiana University School of Medicine, Indianapolis, IN

Exposure to high level radiation leads to the hematopoietic acute radiation syndrome (H-ARS), which if untreated results in death. H-ARSsurvivorsare plagued with delayed effects of acute radiation exposure (DEARE), characterized by organ pathology and dysfunction. We reported that 16,16 dimethyl-prostaglandin E2 (dmPGE2) administered before total body irradiation (TBI) increases 30-day survival in themurine H-ARS model. The current study investigated dmPGE2 as a medical countermeasure (MCM)against development of cardiac DEARE. Mice were injected subcutaneously with dmPGE2 (P) or vehicle (Veh) 30 min before irradiation (872cGy, 137Cs). Thirty-day survivors were injected monthly with either dmPGE2 (PP) or Veh (PV), whereas Veh survivors received monthly Veh (VV). Hearts (n=6) were analyzed at 6 or 12 mo post-TBI for DEARE markers and compared to non-irradiated mice (NI; n=3). Tissue was preserved in formalin for histology and immunohistochemistry, or in RNA preservation solution for RT-PCR analysis. Arteriole density

decreased in VV at6 and 12 mo vs.NI, PV, or PP. Coronary artery endothelial cell (EC) density decreased in VV vs. NIat 12, but not 6 mo. EC density in both PV and PPwas greater than in VV. Adventitial macrophages increased at 6 mo in VV vs.NI, but not inPV orPP. Expression of p16INK4a mRNA increased at 6 mo in VV vs.NI, but not in PV. The data show that prophylactic dmPGE2 (PV) protected mice from DEARE cardiovascular pathologies, inflammation, and early senescence. Thus, dmPGE2 may be an effective MCM for cardiovascular DEARE.

Mentor: Steven J. Miller, Department of Surgery, IU School of Medicine, IUPUI

Validity and Reliability of the SC sprint Test
Steve Christopher, Keefe M, Childers C, Naugle KE
Department of Kinesiology, IUPUI school of Health and Rehabilitation Sciences

Minimal research exists for drills that includes reactive stimuli. The purpose of this study was to test the validity and reliability of a new agility drill that incorporates; acceleration, deceleration, change in direction and reaction to a stimulus (SC Sprint drill). Nine subjects did a familiarization period (3 untimed trials at ~50 percent of maximal effort). Upon completing familiarization, subjects ran 3 timed trials of each drill. The drills included: 10-meter sprint, Pro-agility drill, and SC sprint drill. The absolute stability of each drill across trials was examined with repeated measures ANOVA. Interclass correlation coefficients (ICC) were calculated to determine reliability across trials Construct validity of the SC sprint drill was evaluated with spearman's bivariate correlations. Each drill showed good absolute stability, with no significant differences in scores between trials (p's >.05). The SC sprint drill showed excellent reliability across trials, ICC=0.83. The Pro Agility drill (ICC=0.81) and 10-meter sprint (ICC=0.82) showed excellent reliability across trials. The SC Sprint drill was significantly correlated with the Pro Agility (r=0.79, p=.011) and the 10-meter sprint (r=.89, p=.001), suggesting good construct validity. The results suggest excellent within session reliability of the SC sprint drill. The data also suggest good construct validity. Given the promising results for this reactive agility test, future research should examine reliability of the SC sprint test across multiple days. Establishing the reliability and validity of the SC sprint drill will enable coaches and researches an easy to use agility drill that incorporates a cognitive component.

Mentor: Dr. Keith Naugle

PT-SYMMETRIC ELECTRONICS WITH MEMINDUCTOR
Zachary A. Cochran1,
1Department of Physics, IUPUI School of Science PT-Symmetric

Electronics has been studied for several years in areas ranging from the basic system to dynamic gain/loss, as well as the passive/lossy system. In this research the static system has been modified to replace the constant coupling strength with a nonlinear, state-dependent coupling term by using a "meminductor, "or an inductor whose value depends on the history of the magnetic flux across it, in order to determine how the linear and nonlinear systems differ in operational point and regions of behavior. This nonlinear coupling element provides the potential to act, to a degree, as a self-regulated feedback, automatically adjusting the PT-threshold to attempt to compensate for imbalances in the system. In this research I develop a model for the meminductor based on the Spin Hall Effect (SHE), describe the behavior of the meminductive system when compared to the standard static system, and show through theoretical analysis and simulation that, due to the nonlinear nature of the coupling element, the system's overall region of operation –either the exact region in which there is no overall gain/loss rate or the broken region where there is either overall gain or loss–can be "shifted" based on the nonlinearity of the system, demonstrating the ability to balance the system.

Mentor: Dr. Yogesh Joglekar, Department of Physics, IUPUI School of Science

Repeated mild traumatic brain injury causes chronic glial activation in the cortex of adult male mice
Kalee Coe-White, Jared Smith and Fletcher A. White*
Department of Anesthesia, Indiana School of Medicine Indiana University-Purdue University Indianapolis

Pain-related problems account for up to 80% of visits to physicians. Current theories propose that a prolonged experience of acute pain combined with persistent inflammation may lead to permanent changes in the central nervous system (CNS) and contribute to chronic pain conditions. A deeper understanding of how long-term pain develops may provide better methods of prevention and treatment. Traumatic brain injury (TBI) is a debilitating health problem and one of the most common post-TBI symptoms is pain. Headache pain appears to be the most common type of pain that results from TBI. One manner in which this chronic pain is maintained may involve activation of CNS glial cells. To determine the degree to which mild TBI (mTBI) produces CNS glial activation, neuroanatomical experiments using immunocytochemistry markers of astrocytes (GFAP; glial fibrillary acidic protein) and microglia (Iba-1; Ionized calcium-binding adaptor molecule 1) were used to examine the long-term effects of injury. Heightened activity of cells is anticipated as demonstrated by gliosis and may be suggestive of an ongoing response to mTBI and potentially permanent damage to the nervous system tissue.

Mentor: Dr. Fletcher A. White, Department of Anesthesia, Indiana University

E-Learning Application Development Standards for a mobile Application: EASEL
Blaire Coleman[1], SamuelWells[2], EthanNetsch[2], ErinMerrill[2] 1Department of Technology Leadership and Communications, Purdue School of Engineering and Technology; 2Department of Computer and Information Science, Purdue School of Science

Online Learning and e-Learning have been studied copiously with the rise of the digital age. EASEL (Education through Application-Supported Experiential Learning) is a platform designed to provide just-in-time content and reflection opportunities to students using

their GPS location and time. In the past, our goal has been to review best practices in the fields of technical communication, pedagogy, and educational technology and integrate the mintoiterative EASEL designs. Previous research has revealed platforms must be built with multiple things in mind: functionality, experience, design, and intuitiveness. If any of these categories are weak, the perception of the application will be worse. Because of this another UX test was conducted to verify that our modified user interface e-design, shaped by previous usability tests, receive positive student reviews, and now the EASEL team is seeking to delve in to development practices and application features for educational applications that yield the most efficient learning from student users. Our team used results from the usability tests to begin development of alive version of the EASEL app. While much research has compared-learning to a traditional classroom setting, there are few studies analyzing the most effective development practices and features to aid student learning. This research should for mast and ardfore-learning application development.

Mentors: Corinne Renguette, Department of Technology Leadership and Communications, Purdue School of Engineering and Technology, IUPUI; Chris Rogers, Computer Information and Graphics Technology, Purdue School of Engineering and Technology, IUPUI

Mixed Reality for CNC Machine Training
Chris Collier, Nikko Mack, Patrick King, Varun Yadav
Indiana University School of Engineering and Technology

Due to the recent improvements in virtual reality and mixed reality environments, there is a growing opportunity for a blend of classroom teaching and physical laboratory training within the field of advanced manufacturing. The ability to provide physical machines to create effective training scenarios is often prohibited by the growing costs of such machines. A combination of physical and virtual environments can be used to create both an effective, and cost-effective alternative to either entirely classroom or laboratory-based training methods. The purpose of this research is to improve the existing Mixed Reality Advanced Virtual Manufacturing Lab to control and operate a CNC Machine in an effort to create a more effective Mixed Reality input method, improve the current Virtual Reality visuals and interaction, and to improve the tracking system of the Mixed Reality headset.

Mentor: Dr. Hazim A El-Mounayri

When Nice White Ladies Attack: The White Female Neoliberal Assault on Black Male K-12 Educators
Ronald Cunningham
Graduate School of Education

Over the course of 20 years as a K-12 educator at schools from DC to New Orleans and Oakland, I experienced a succession of spaces where white female neoliberals exercised privilege through microaggressions directed at Black male educators. In these institutions, White supremacist and capitalist values both fueled the ambitions of White women and were openly hostile towards Black men. These white women seemed unable to fathom even the possibility that they could be capable of prejudicial behavior. Yet, their actions were nonetheless harmful. This qualitative study will examine the hostile systemic practices employed by nice white ladies in K-12 settings. Its aim is to situate the experiences of Black male educators as counter-narrative to identity stories of White progressives who fail to recognize ways in which White female neoliberal action privileges and reaffirms one group while simultaneously oppressing another. This study challengesK-12 educators to consider the specific ways in which White female neoliberals author antagonistic and misandrous encounters confining Black mentor roles emphasizing behavior management while simultaneously impeding opportunities to assert themselves as content experts.

Mentor: Dr. Jomo Mutegi and Dr. Crystal Morton

D

Researching a Pharmaceutical Treatment for Hydrocephalus
Symphony Davis1, Alexander Hochstetler2, Daniel Preston2, Stefanie Simpson2, Bonnie Blazer-Yost2
1Neuroscience Department, School of Science; 2 Biology Department, School of Science

Pediatric hydrocephalus is a particularly devastating disease, affecting approximately 1 in 1000 births. The serious side effects include delayed development, loss of coordination, and cognitive difficulties. Commonly known as ‘water on the brain’, hydrocephalus is caused by the excessive buildup of cerebrospinal fluid (CSF). In the homeostatic process, CSF is formed by the choroid plexus of the brain ventricles and then absorbed back into the blood. However, this process is abnormally regulated in someone affected by hydrocephalus, causing a swelling/over-enlargement of the ventricles and pressure on the brain. We have found that by using an agonist to block the Transient Receptor Potential, Vanilloid Type 4 (TRPV4), a specific ion channel, there is a substantial decrease in the development of the disease within our rat model. The details of the antagonist’s biochemical mechanism of action are unknown. To further understand the mechanism, it is imperative to identify the secondary channels that TRPV4 activates. For the present study, one channel of interest is the Volume Regulated Anion channel (VRAC), which is expressed within the choroid plexus. Electrophysiological experiments using an inhibitor of VRAC are ongoing to determine what effect the channel has on trans epithelial ion flux in our PCP-R cell line, a tissue culture model of the choroid plexus epithelial cells. These studies will examine how a loss of VRAC will change TRPV4 stimulated ion and water movement and thereby CSF production. The results of this study can be used to characterize the pathways controlling CSF production.

Mentors: Bonnie Blazer-Yost and Alexander Hochstetler, Department of Biology, School of Science, IUPUI.

Exploring Small Molecule Interactions with APE1

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1Department of Chemistry & Chemical Biology, Purdue School of Science2Department of Biochemistry and Molecular Biology, Indiana University School of Medicine

Human Apurinic endonuclease 1 (APE1) is a protein with two main functions; it serves as a redox factor in cells and a DNA repair protein in base excision repair pathway. The main focus of this study was on APE1's function in base excision repair. There have been cancer-therapeutic drugs(inhibitors) made to regulate APE1 because it's one of many proteins that is upregulated in cancer cells. An important property of targeted therapies is target engagement, (i.e. the ability of a compound to interact directly with a specific protein). Two APE1 inhibitors, a novel macrocycle and APE1 Inhibitor III(ARIII), were studied for interactions with APE1. The method we used was the Thermal Shift Assay to determine whether incubation with an inhibitor affects the melting temperature of APE1 as evidence of direct interaction. APE1 and the molecule are mixed in a buffer and heated at different temperatures using a gradient block in a PCR machine and then analyzed by sodium dodecyl sulfate (SDS) polyacrylamide electrophoresis (PAGE). We compared the melting curves of APE1 in the presence and absence of the inhibitor to determine the melting point using GraphPad Prism. A compound that interacts directly with a folded form of APE1 would be expected to increase the melting temperature. Alternatively, a compound that decreases the melting temperature may stabilize a partially unfolded state of APE1, similar to redox inhibitors. In this study, we found that the macrocycle decreases the melting temperature.

Mentor: Millie M. Georgiadis, Department of Biochemistry and Molecular Biology, IU School of Medicine

The effect of music on virtual reality induced postural sway

Shaquitta Dent, Kelley Burger, Skyler Stevens
Department of Kinesiology, School of Health and Human Sciences

The use of a moving virtual reality (VR) environment to induce postural sway is well established. The extent to which music presented with VR motion can enhance sway is unknown. PURPOSE: To determine if music, presented in modified and unmodified forms, will affect postural sway while standing in a moving VR environment. METHODS: Twenty-eight subjects (15 females; 13 males) aged 18-35 stood barefoot on a balance plate while wearing a VR headset. AP and ML center of pressure (COP) data was collected as the subjects experienced 3 visual conditions (VR scene translating in the AP direction at 0.1 Hz, no translation, and eyes closed) and 4 music conditions (music modified to scale loudness at 0.1 Hz and 0.25 Hz, unmodified music, and no music). AP and ML COP excursions, COP RMS, and COP velocities were calculated. RESULTS: A significant interaction effect ($p = 0.0439$) showed that combining scene translation with 0.1 Hz modified music increased AP COP excursion ($p < 0.05$) compared to all conditions except 0.25 Hz modified and unmodified music with scene translation. Main effects ($p = 0.009$ and $p < 0.001$) showed the 0.1 Hz modified music increased excursion compared to 0.25 Hz modified and unmodified music conditions and that scene translation increased excursion compared to other visual conditions. Similar effects were observed for RMS and velocities. CONCLUSIONS: VR induced sway may be enhanced by music presented in a manner to reinforce visual input. These findings could be used to optimize VR-based training protocols to improve balance.

Mentor: Jefferson Streepey

Using Lipidomic to Identify Biomarkers for Hyperglycemic Onset Breast Cancer

Nirupama Devanathan and Ann C. Kimble-Hill
Department of Biochemistry & Molecular Biology—IU School of Medicine

Type II diabetes is characterized by hyperglycemia, or increased glucose serum concentrations, which in turn has been correlated as a risk factor for the development of breast cancer through interactions with the PI3K signaling pathway. In order to further explore this relationship, breast tissue cell lines (normal, MCF10A; EGFR+, MCF7; and HER2+, SKBR3) were incubated in hyperglycemic to normal concentrations (50mM, 25mM, 10mM, and 5.5mM). The relative abundancies of the 3' phosphorylated phosphatidylinositol (PI) species—mono-phosphorylated PI3P, di-phosphorylated PI (3,4) P2, and tri-phosphorylated PIP3—were determined in each cell line through confocal fluorescence microscopy analysis. In the normal breast cell line (MCF10A), an increase of PI (3,4) P2 and PIP3 with increasing serum glucose concentration was observed, supporting the initial hypothesis that increasing glucose serum concentration would activate the PI3K pathway. In the EGFR+ breast cell line (MCF7), an increase in PI (3,4) P2 concentration was observed, possibly due to reported upregulation of SHIP2, a 5' -phosphatase, along with an increase in PIP3 concentration possibly due to increase down regulation of PTEN, a 3'-phosphatase, reported in literature. In HER2+ breast cell line (SKBR3), however, an increase in PIP3 concentration was observed, possibly due to downregulation of PTEN, while in contrast with the EGFR+ cell line, a decrease in PI (3,4) P2 concentration was observed. The results of the study suggest hyperglycemic conditions modulate PI, which in turn, furthers the potential of lipidomic to distinguish between various types of breast cancer.

Mentor: Dr. Ann C. Kimble-Hill

Creep Simulation of 3D Printed Inconel718

Harshal G Dhamade1, Jing Zhang1
Section 3: AuthorDepartmentandSchoolAffiliation: 1Department of Mechanical and Energy Engineering, Purdue School of Engineering and Technology, IUPUI

Thisresearchconsistsofcreatingasubroutineforsimulatingthecreepmechanism for 3D printed Inconel 718 components. A multi-regime creep model, such as the Kachanov-Rabotnov model, is used to determine a set of equations that will allow the Secondary and Tertiary creep to be simulated. MATLABisusedtofitthecurvesformedbythedataobtainedbyanalysisusingthe subroutine, at the same time a microstructure-based creep prediction model is formulated to generate a response of strain over a period of time for the given material and specified operating temperature. With respect to the actual testing data, the simulation models will be validated for accuracy.

Advisor: Dr. Jing Zhang

Modeling of Electron Beam Physical Vapor Deposition Process for Fabricating Thermal Barrier Coating Anvesh Dhulipalla
Anvesh Dhulipalla
Department of Mechanical and Energy Engineering, Indiana University Purdue University Indianapolis.

The objective of this study is to develop a validated high-fidelity model of Electron Beam Physical Vapor Deposition (EB-PVD) process that can predict the coating thickness of the sample on a rotating stage. A ray tracing (RT) technique will be used to find the coating thickness assuming a line-of-sight coating process and takes the shadowing effects into consideration. A case study of thermal spray of ceramic coating on a gas turbine blade will be demonstrated.

Mentor: Dr. Jing Zhang.

Inflationary and Output Effects of Price and Currency Exchange Controls in Venezuela
Daniel Di Martino
IUPUI Department of Economics, School of Liberal Arts

Venezuelans are suffering from hyperinflation and widespread shortages, which have resulted in the death of hundreds of thousands of children due to malnourishment and the exodus of between 3.4 and 5.5 million refugees. This paper expands an existing general equilibrium model of the Venezuelan economy to understand the effects of currency exchange and price controls on the inflation and shortages that plague the country. The model is expanded to include the negative labor supply effects of imposing price controls as well as including tax revenue as a variable. Using Venezuelan economic data, the model explains that the currency and price controls contribute to hyperinflation, but higher government spending is the driving cause. The model also suggests that the currency exchange control benefits arbitrage and import firms at the expense of workers and domestic firms. However, the model suggests that there are other factors not modelled such as a reduction in the demand for money that drive hyperinflation by the end of the period. Consequently, eliminating currency exchange and price controls will be insufficient to stop hyperinflation but it would significantly slow it in the short-term and help give temporary relief to those suffering from the humanitarian crisis. Essentially, any new Venezuelan government must reduce government spending to close the deficit and stop hyperinflation, and especially reduce the size of the government bureaucracy that constrains the private sector. A new government could close the deficit and increase output by taking measures to increase total factor productivity and oil production.

Advisor: Peter Rangazas, IUPUI Department of Economics, School of Liberal Art

Metal Organic Framework and Zeolite Conformal Coatings for Emission Control
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Department of Mechanical and Energy Engineering, Purdue School of Engineering and Technology, IUPUI

Metal organic frameworks (MOF) are 1, 2 or 3-dimensional polymers consisting of metal ions attached to organic ligands. They are rapidly gaining popularity and significance due to their structural diversity and porosity. The porosity acts as attractive sites for emission gases such as CO2to be adsorbed onto their surface. The major drawback with MOFs is their poor processability. In this work, conformal coatings of MIL-101 (Cr), a chromium-based MOF, were developed on 3D printed PETG substrates. The work demonstrates the feasibility of coating the 3Dprinted substrates with MOF coatings and use them for emission control and gas storage applications.

Mentor: Jing Zhang, Department of Mechanical and Energy Engineering, Purdue School of Engineering and Technology, IUPUI

Uplifting and Oppressive: Black Women's Religious Identities in Corporate America
Toni Dubrovensky
Department of Africana Studies and IU Kelley School of Business

Black women are a minority within corporate America, especially in the accounting field, partly due to a deprivation of social resources, such as power. Black women's layered identities coupled with requests for nontraditional accommodation due to their religious beliefs can deviate them from a company's culture. Thus, the focus of this research is problematizing the discrimination that Black women face, which is part of a persistent cycle, by examining how specific elements of identity affect their growth in the American accounting industry. Using the conflict paradigm, this literature-based research establishes and decodes the identity of the Black woman in America's exclusive white-collared society, while analyzing how religion impacts her experiences within the workplace. Despite laws promoting equality, religious-based discrimination is a prominent issue within modern society. Noteworthily, studies have revealed that Black women are more likely to be religiously devoted than Black men, White men, and White women, which makes them more susceptible to mistreatment and ostracism. Their susceptibility can serve as an obstacle in their climb up the proverbial corporate ladder. Further studies have laid bare that Blacks and women are more likely to be excluded from leadership and managerial positions. Yet, religion has been found to take on a dual role as a divider and a form of empowerment and resistance toward microaggressions within the workplace. Overall, Black women's layered identities as Black, female, and religiously devout drive negative experiences that can put them in a unique position to be more susceptible to and/or combative toward workplace discrimination.

Mentor: Patricia Jordan

E

LiftMe-A Motivational Application to Support Underrepresented Students in Informatics
Amanda Echegaray, Mathew Palakal, and Molly Morin
Department of Informatics, IU School of Informatics and Computing at IUPUI

Recent research shows that underrepresented students in STEM and students from low-income backgrounds are more inclined to experience a decreased sense of belongingness in the college environment thus affecting their academic performance and participation of their 1st year. Studies have also included that when students have positive mentoring experience, receiving interactions of invitation or inclusion, they are more apt to persist in college. Students from underrepresented backgrounds benefit from being involved in student support programs, peer mentoring, summer bridge program participation, etc. In this study, our purpose is to combine methods of mentoring and user-friendly avatars to support the student success of underrepresented minority (URM), low-income, and first-generation students in Informatics who are participants in the LiFT Scholars Program. Data from student academic and co-curricular performance, interviews and surveys will be utilized to develop a virtual motivational mentoring support. This research will provide insight on the extent to which virtual motivational mentoring support can enhance the student success of underrepresented students in STEM.

Mentor: Mathew Palakal, Department of Informatics, IU School of Informatics and Computing

Manufacturing of NdFeB/Nylon-12 Composite Magnets
Arinze Ekwealor[1], Cullen Shorey[1], Ajay Panuganti[2], Jing Zhang[1]
[1]Department of Mechanical and Energy Engineering, IUPUI School of Engineering and Technology
[2]Department of Biomedical Engineering, IUPUI School of Engineering and Technology

In this project, neodymium iron boron (NdFeB), is mixed with Nylon-12 to make a composite magnet This type of magnet is versatile due its low cost and high strength, making it widely used. The primary focus for this research was to establish a reliable method in which the neodymium-based magnets can be produced. In order to properly fabricate a sample of NdFeB, the combination with nylon-12 and the use of an injection molding machine is required. A specific volume percent of magnetic powder and nylon-12 (binder) pellets is incorporated to create a composite, then promptly melted at a specific temperature. Once the mixture is completely homogenous, it can then be molded to form the desired shape. Establishing a reliable method for the production of NdFeB magnets through molding process would greatly reduce the production time and waste material generated, while being able to meticulously design the magnet to suit the application.

Mentor: [1]Dr. Jing Zhang
[1]Department of Mechanical and Energy Engineering, IUPUI School of Engineering and Technology

Active Gaming: It's Not Just for Young People
Eric Evans[1], Tyler Owen[2], Keith Naugle[2], Kelly Naugle[2]
[1]Department of Health Sciences; [2]Department of Kinesiology: IU School of Health and Human Sciences, IUPUI

Active video games, which allow participants to become physically active while playing video games, has yet to be understood in how it affects cardiovascular outcomes in older and younger adults. The purpose of this study was to examine energy expenditure, ratings of perceived exertion, and enjoyment in younger and older adults while playing three active games Eighteen subjects (9 younger adults, 9 older adults) voluntarily enrolled in the study and completed four sessions: training session and three experimental sessions. Subjects played three active games (1 per session). Participants played two 15-minute periods per game, with self-selected intensity during period 1 and standardized instructions to maximize movement during period 2. Energy expenditure was measured via a wearable metabolic system and ratings of perceived exertion (RPE) and enjoyment were collected for each period of each game. Repeated measure ANOVA's showed that all outcome measures were higher in Period 2 compared to Period 1 ($p's<0.001$). Older adults had higher energy expenditure compared to younger adults across games ($p<0.001$). Older adults also had higher RPE and enjoyment than younger adults during all games. ($p<0.001$). Overall, results suggest that implementing standardized instructions for active video games can contribute to reaching physical activity recommendations for both younger and older adults while including the enjoyable aspects associated with video games. With energy expenditure being consistent with moderate to vigorous intensity during active game play, results from this study suggest that active video games could be used as a cardiovascular tool for older adults to obtain physical activity.

Mentors: Kelly Naugle, Keith Naugle; Department of Kinesiology, IU School of Health and Human Sciences, IUPUI

Creating Success: Investigating key areas of impact for black males diagnosed with high-functioning autism
Renita Evans
School of Urban Education

Introduction: Pre-service teacher training in curriculum development have long been an implicit element of effective teachers. However, little literature and research is surveilling lancing how pre-service teacher development facilitates success of black males diagnosed with autism. The effects of formal pre-service practice as an intervention for teaching autism learners in core high school curriculum is hampered by a lack of methods and research to address this deficiency. Core curriculum in this research is math, science, and English. This is important because black males diagnosed with autism currently receive a certificate of participation-not a high school diploma. Objective: Increase black male students diagnosed with autism high school diploma rates in Indiana. Approach: Three parts of influence have been identified as potential areas of impact: advocacy, pedagogy, and pre-service teacher training/development. Next Steps: Findings from this research will: (1) provide best practices for autism educators and researchers (2) create a framework for black males

diagnosed with autism to be successful academically (3) produce more high school diplomas for black males classified disabled. Conclusion: Existing autism research provides limited context to fully understand the nuances of meeting the needs of black males diagnosed with autism. This research provides context to this experience.

Mentor: Dr. Jomo

How Paper and Digital Children's Books Support Student Understanding
Maycie Asher, **Payten Ewing**, Kayla Pride, Laura Liu
Division of Education, IUPUC

Introduction/Objective: Our research explores the impact of paper and digital children's books on civic science conceptual learning for early readers, specifically 1st grade students. Methodology: This study involved (1) Collaborating with three first-grade teachers across three public schools with diverse SES and regional backgrounds (middle SES-suburban, middle-low SES-rural, low SES-rural), with similar ethnic and linguistic backgrounds (white, English speaking); (2) sharing teacher candidates' authored children's book in three forms to three groups of students (paper, digital author reading, digital animated viewing) to engage students in conceptual civic science learning; (3) collecting data through a student comprehension worksheet and teacher interview; (4) using a mixed methods approach to analyzing collected quantitative data (student worksheet results) and qualitative data (teacher interviews) to gain insight into how digitized and paper versions of an authored children's book impact student literacy and learning, particularly by promoting or challenging conceptual understanding of content presented; and (5) drawing implications for teacher practice and research. Results: The study's emerging findings are showing that digital children's books can reduce early reader concentration and conceptual learning, while paper books read in-person by teachers can enhance concentration and learning. Conclusion: Findings can help elementary teachers understand better how to integrate both print and digital children's books into curricula to affect meaningful learning.

Mentor: Laura Liu, Assistant Professor, Elementary Education, IUPUC, Division of Education

F

Comparing Thromboelastography (TEG) and Turbidity Measurements to Monitor Clot Formation of Native and FITC-Tagged Fibrinogen
Mahussi Fagnon[1]; Ziqian Zeng[2]; Nathan J. Alves, Ph.D.[2,3]
[1] Indiana University-Purdue University Indianapolis, LSAMP Scholar
[2] Purdue University, Department of Biomedical Engineering, West Lafayette, IN
[3] Indiana University School of Medicine, Department of Emergency Medicine, Indianapolis, IN

For this study, thromboelastographic (TEG) and turbidity, via a microplate reader, were used to measure fibrin clot strength. TEG results were reported as time to first clot formation (R), clot kinetics (K), rate of formation (Angle), and maximum clot strength (MA). Turbidity measurements were tracked over 20 min at 405 and 550 nm wavelengths in 96 well plates where increases in absorbance were utilized to track clot formation. Fibrin clots were formed by adding physiologically relevant amounts of bovine thrombin (1 U/mL) to bovine fibrinogen (1.5 – 4 mg/mL). Clot formation under conditions such as dialysis and FITC-tagging were used for fibrinogen preparation while thrombin was held constant. Results demonstrate that fibrinogen, prepared via dialysis, yields an increase in turbidity (61.7% absorbance at 550 nm) while the TEG remained nearly constant (2.2% increase in MA, 18.6±0.3 mm MA, 69.4±0.4 degrees angle). Large differences were observed on both the TEG and microplate reader when comparing native and low FITC-tagged fibrinogen (69.3% decrease in MA and 4.5 times increase in absorbance at 550 nm). Comparing low FITC-conjugated (~ 4) and high FITC-conjugated fibrinogen (~ 10) exposed to the same clot preparation conditions yields measurable differences (73.9% decrease in MA and a large decrease in angle) via TEG while yielding smaller differences (15.6% increase in absorbance at 550 nm, 0.76±0.08 absorbance) via turbidity. These results demonstrate that while turbidity is often the preferred method to track clot formation and fiber thickness, TEG, a direct measurement of clot strength, is a more reliable technique.

Mentor: Nathan J. Alves, Ph.D. Indiana University School of Medicine, Department of Emergency Medicine, Indianapolis, IN

Modeling Suitable Habitat for the Common Mudpuppy (Necturus maculosus maculosus) in Indiana, USA Utilizing Regional Data and Environmental DNA
Payton N. Fischer
Department of Geography, IUPUI School of Liberal Arts

The Common Mudpuppy (Necturus maculosus maculosus) is a completely aquatic salamander that occupies the eastern United States. Researchers state that populations of mudpuppies are declining. There is not a great understanding on the amount populations are declining or what is causing the decline. It is understood that the biggest problems facing mudpuppy populations are loss of suitable habitat, pollution, and siltation. It is important to preserve this species because its conservation helps the conservation of other species within an aquatic ecosystem. This study aims to model suitable habitat for mudpuppies by using geographic measures. Indiana is the target region for modeling suitable habitat, but there is not enough point data to accurately determine this. The geographic extent of this study is Illinois, Indiana, Michigan, and Ohio to create a larger dataset for modeling. Salamander Mussel (Simpsionais ambiguia) data will be used from Indiana to bolster the dataset as well since the mudpuppy is needed for their reproduction cycle. This project will use presence only data because there have not been studies that recorded presence-absence data for mudpuppies. The use of the programs ArcMap, MaxEnt, and the R-package EcoSpat will use existing data of mudpuppies to find other areas within the study region that is suitable for them to be present. After this is completed, data from an environmental DNA (eDNA) study will be used to validate the models. Upon completion, it will be submitted to the state agencies that supplied the point data to use for management and conservation strategies.

Mentors: Vijay Lulla, Department of Geography, IUPUI School of Liberal Arts; Aniruddha (Rudy) Banerjee, Department of Geography, IUPUI School of Liberal Arts; Jeffrey Wilson, Department of Geography, Associate Dean of Research, IUPUI School of Liberal Arts

G

Differential Effects of Varying Doses of Dietary Nitrate on Muscle Function and Blood Pressure in Older Subjects
Andrew R Coggan[1], Richard L. Hoffman[1], Derrick A. Gray[1], **Edgar J. Gallardo[1]**, Ranjani N. Moorthi[2]
[1]Department of Kinesiology, School of Health and Human Sciences and [2]Department of Internal Medicine, School of Medicine

Aging results in reduction in maximal muscular strength, speed, and power, which often lead to functional limitations highly predictive of disability, institutionalization, and mortality in the elderly. We have recently demonstrated that dietary nitrate (NO_3^-), a source of nitric oxide (NO) via the NO_3^- -> nitrite (NO_2^-) -> NO enterosalivary pathway, can increase muscle contractile function in older subjects. Nitrate ingestion has also shown to reduce blood pressure in older individuals. However, the optimal dose for eliciting these beneficial effects is unknown. Methods: We therefore performed a randomized, double-blind, crossover study to determine the effects of ingesting 3.3 mL/kg of beetroot juice (BRJ) containing 0, 212, or 425 μmol/kg of nitrate in six healthy older (age 69±3 y) subjects. Maximal knee extensor speed (Vmax) and power (Pmax) were measured 2 h after BRJ ingestion using isokinetic dynamometry; blood pressure was monitored periodically throughout each study. Results: Mean arterial pressure (in mmHg) was lower ($P<0.05$) after the high (80±4) vs. the low (84±3) or placebo (88±2) doses. Vmax (in rad/s) was higher ($P<0.05$) after the low dose (11.7±0.8), but not the high dose (10.8±1.0), compared to the placebo (10.5±1.0). Pmax (in W/kg) also tended to be higher ($P=0.11$) in the low (3.9±0.5) compared to the placebo (3.7±0.5) or high (3.7±0.5) trials. Five out of six subjects achieved a higher Vmax and Pmax after the low vs. the high dose. Conclusion: We conclude that dietary nitrate has differential effects on muscle function and blood pressure in older individuals. A high dose of nitrate intake further lowers blood pressure but does not enhance muscle contractility as much as a lower dose.

Mentor: Andrew R. Coggan

Use of Digital Image Correlation to Determine the Position of an Object in Motion with High Precision
Rutuj Gavankar[1], Adam Turk[2], C.D. Hoyle[2], Ricardo Decca[1]
[1]Department of Physics, School of Science, IUPUI; [2] Department of Physics & Astronomy, Humboldt State University.

The Newtonian gravitational constant G is the least known fundamental physical constant. Many measurements have been done using a torsion pendulum but there is a large discrepancy between all of them. The torsion pendulum setup involves using attractor masses that surround a torsional balance suspended with a fiber. The angular acceleration of the balance due to the attractor masses will be used to determine G. We want to determine the drift in the position of two oscillating cylinders with a certainty of 0.1 μm. To do this, we are using a technique used for stabilizing the focal drift in a microscope by using digital image correlation. Image correlation involves comparing images of an object to determine the displacement of that object. We simulated an ideal two-dimensional case of the cylinder using a cell phone camera sensor and verified that this technique could be used to extrapolate the displacement in both dimensions with the required precision. We were able to measure the drift in position with a certainty of ~0.2 μm with the current setup. Our estimates show that this technique can be scaled up, and a larger sensor can be used to measure the drift with greater precision. Future plans involve testing this method for a more realistic case with a smooth surface and smaller cross-section of the cylinder and extrapolating the drift in all the three dimensions.

Mentors: Ricardo Decca, Department of Physics, School of Science, IUPUI

Estimating the Effect of the Affordable Care Act on Unintended Teenage Pregnancies in the United States
Micaela S. Gaviola
IU Richard M. Fairbanks School of Public Health

The Patient Protection and Affordable Care Act (PPACA) expanded health care coverage to all Americans and included the mandate that all FDA-approved contraceptive methods are covered by plans in the Health Insurance Marketplace. To estimate the effect of improved contraception access on unintended adolescent pregnancy, we analyzed a series of cross-sectional surveys from the National Survey of Family Growth using a difference in difference (DiD) approach, wherein the exposure of interest was contraception use in the pre-PPACA (2006-2010) and post-PPACA (2011-2015) periods and the population was sexually active adolescents aged 15-19 years (n=1,970). Both pre- and post-PPACA contraception users were more likely to become pregnant than non-contraception users (prevalence ratio 1.9 and 1.3, respectively), likely due to confounding by indication. However, over the same period the overall pregnancy rate declined from 7.3% to 5.4%, and decreases were observed only among contraception users. The DiD estimator over the pre- and post-PPACA time periods was 9.6% (p-value=0.0132), suggesting significant declines in unintended pregnancy among contraception users after the PPACA mandate. Furthermore, DiD for unintended pregnancy exhibited three times the decline among African American contraception users compared to White users and two times the decline among those 0-100% of the federal poverty line compared to those above 100%. These findings suggest the PPACA's hormonal contraceptive mandate was most effective in improving outcomes on its target audience of those with lower socioeconomic status.

Mentor: Timothy D. McFarlane

Patient Perceptions of Erosive Tooth Wear

Micah Goldfarb[1], Anderson Hara[1], Adam Hirsh[2], Joanna Carvalho[3], & Gerardo Maupome[4]
[1]Cariology Department, Indiana School of Dentistry; [2]IUPUI Department of Psychology; [3]Catholic University of Louvain; [4]Richard M. Fairbanks School of Public Health

Current research examines patients' ability to recognize erosive tooth wear (ETW) relative to dental caries. Using Amazon's crowdsourcing service, we recruited 623 participants (295 men; 313 women; 15 did not report) from across the United States. Participants viewed standardized images of the buccal surface of teeth (sound, with ETW or caries) and reported whether a dental condition existed (yes/no), likelihood to seek care, and general attractiveness for teeth with no, initial, moderate, or severe signs of ETW/caries. We conducted paired samples t-tests comparing ETW ratings to those of caries and sound teeth. We found that participants were less accurate judging teeth with ETW compared to both sound and carious teeth ($t(622)=39.96$, $p<.01$; $t(622)=31.64$, $p<.01$, respectively). At similar severities, participants had poorer recognition of initial ETW than initial caries ($t(622)=39.12$, $p<.01$), moderate ETW than moderate caries ($t(622)=24.01$, $p<.01$), and severe ETW than severe caries ($t(622)=19.22$, $p<.01$). Participants were less likely to seek dental care when examining teeth with ETW compared to teeth with caries ($t(618)=29.32$, $p<.01$). At similar severities, participants were less likely to seek care for initial ETW than initial caries ($t(617)=27.30$, $p<.01$), moderate ETW than moderate caries ($t(617)=21.69$, $p<.01$), and severe ETW than severe caries ($t(617)=26.08$, $p<.01$). Participants viewed teeth with ETW as more attractive than teeth with caries ($t(612)=45.34$, $p<.01$). The same pattern of results existed at each level of severity. The public is less adept at recognizing ETW than caries at all levels of severity. Difficulties recognizing initial ETW is especially problematic for early detection and prevention.

Advisor: Anderson Hara, Cariology Department, Indiana School of Dentistry

Analysis of Common Adulterants of Cocaine Using Gas Chromatography-Vacuum Ultraviolet Spectroscopy

Heather Gordon, Zackery Roberson
Forensic and Investigative Sciences and School of Science

Analysis of impure drugs is a common but necessary practice for forensic chemists. Illicit drug samples submitted to a controlled substances section must be separated and analyzed. Almost all drugs contain diluents and/or adulterants; which are ingredients that are not the drug itself such as anesthetics, flour, or caffeine, that can be analyzed on their own. Gas chromatography-vacuum ultraviolet spectrophotometry (GC-VUV) can separate mixtures of illicit drugs in the column and analyze them using an extended region of the ultraviolet spectrum and provide distinct spectra. Adulterants are analyzed due to their use in illicit drugs and the potential of "profiling" a drug mixture. For this work, a few common adulterants were tested (e.g. guaifenesin, benzocaine, and triprolidine) for spectral analysis due to their similarities in chemical structure. This was done by dissolving standards in chloroform, acetone, or methanol and running them on an Agilent 7890B Gas Chromatograph with a dimethylpolysiloxane column and detected by a VGA 101-VUV detector. The results indicated that Procaine and Benzocaine share very similar spectra while the spectrum of lidocaine was very different despite similarities in chemical structure shared by all three. These three specific spectra show the extent of differences the GC-VUV can detect due to their chemical structure, as well as using specific peaks to identify adulterants despite their similarity in spectra to the naked eye. All the other spectra also show the ability to distinguish small or large differences in chemical structures and comparison in illicit drug samples.

Advisor: Dr. John V. Goodpaster

Skeletal Muscle Fatigue Curve Analysis Using MATLAB

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[1]Department of Kinesiology, School of Health and Human Sciences, IUPUI

Skeletal muscle fatigue is a common concern for exercise programming and can be fatigue responses can be modified by using different exercise parameters such as exercise duration and intensity. Recent studies have indicated that higher intensity interval training (HIIT) can have positive effects on muscle performance and adaptation, using a shorter duration than conventional continuous aerobic training. Rowing can be an excellent full-body aerobic workout, but muscle fatigue may limit some people from performing conventional rowing exercise. We hypothesize that HIIT rowing would create less muscle fatigue than conventional rowing, while performing the same amount of overall work. As a first step in testing this hypothesis, here we present optimization of skeletal muscle fatigue analysis using MATLAB for analysis of torque curves on an isokinetic dynamometer. Isometric fatigue testing was done on the knee extensors in two pilot subjects. Five repetitions of 30 seconds active with 60 seconds rest at a 90-degree angle were completed on three separate days to determine reliability. MATLAB was used to determine time to fatigue, peak torque, and time to peak torque. Now that validity and reliability of these methods have been proven, our next step is to test subjects before and after work-matched sessions of HIIT compared to conventional continuous rowing to support our hypothesis that HIIT rowing will produce less muscle fatigue than conventional rowing.

Mentor: Dr. Monica Hubal, Department of Kinesiology, School of Health and Human Sciences, IUPUI

Determining the Role of Amot130 NTD-ACCH Association in Regulating Membrane Association

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Angiomotins (Amot) are a family of adaptor proteins that regulate pathways involved in protein sorting and downstream signaling events including cellular differentiation, proliferation, and migration. Amot overexpression has been correlated strongly with tumorigenesis and metastasis in breast and other epithelial cell tissues. Previous studies have shown that the long splice form, Amot130, is constitutively bound to f-actin, and phosphorylation of the N-terminal domain (NTD) Serine-175 (S175) residue leads to actin dissociation and

activation of the neighboring coiled-coil homology (ACCH) domain membrane binding activity. Normal breast cell lines have shown increased proliferation and migration signaling when Amot130 was bound to actin, and the opposite effect when Amot130 was bound to cellular membranes. Therefore, we endeavored to understand the mechanism behind this inter-domain regulation. To describe this regulatory function, we designed experiments to test our hypothesis that 1) the NTD associates directly with the ACCH domain, physically blocking lipid binding while bound to actin; and 2) S175 phosphorylation prevents NTD-ACCH interaction, freeing ACCH for lipid binding activity. We used to pull down assays to determine the ability of NTD to bind directly to the ACCH domain, comparing its binding affinity to that of a phosphomimic S175E mutant and a phosphorylation preventative S175A mutation. Based on our hypothesis, we expect the S175E mutant to have a lower affinity for ACCH than the wild type and S175A mutant. The results of this study will help to define the regulatory mechanism, and to identify targets to prevent and treat adenocarcinomas.

Mentor: Ann Kimble-Hill, Department of Biochemistry, IU School of Medicine

Computational Modeling of Thermophysical Properties of Thermal Swing Coating
Abhilash Gulhane[1], Jing Zhang[1]
[1]Department of Mechanical and Energy Engineering, Purdue School of Engineering and Technology, IUPUI.

The present work is aimed to build a computational model of a Silica reinforced porous anodized aluminum based thermal swing coating to predict thermophysical properties and insulation performance of the coating on Aluminum substrate. In this research, a 3D finite element-based model of the porous structure of anodized aluminum oxide layer is developed based on the structure's morphology. Thermal properties including thermal conductivity and specific heat capacity is predicted and compared against the experimental results.

Mentor: Dr. Jing Zhang, Associate Professor, Department of Mechanical and Energy Engineering, Purdue School of Engineering and Technology, IUPUI

H

An Optimized Method of DNA Extraction from FTA™ Classic Card for Downstream Sequence Analysis
Clarissa M. Hartman[1]; Krystal Breslin[1]; Mirna Ghemrawi[1]; Emma Fort[1]; Sarah Alexander[1]
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The applications and benefits of FTA cards in a medical biobank or forensic setting have made long term storage of biological samples simpler and safer. Freezer space is freed up and DNA is stable for an extended period. The isolation and purification of DNA present on the FTA Classic™ cards calls for the use of the FTA Purification Reagent (Cat. No. WB120204) used to wash away inhibitors and other unwanted debris. A simple punch from the card with this reagent provides enough material for direct to PCR amplification, as that was their original design use. However, due to the advancement of sequencing technologies, vast quantities of DNA are now needed for high coverage genome analyses. Whatman™ has indicated that these cards require the use of proprietary Whatman™ products if typical extraction procedures are preferred; they also internally published a lengthy organic extraction procedure that can be used. Here, we not only show that the purchase and use of the FTA Purification Reagent is unnecessary but also that DNA can be reliably extracted with a simple modified organic extraction. In addition, our method is comparable to but less time-consuming than the Whatman™ internal protocol. By extracting the DNA and successfully performing a SNP array on the samples, we also demonstrate that cards used in the past for long-term storage can still be used today to obtain significant amounts of DNA without the need to collect additional biological material from study participants.

Mentor: Susan Walsh, Department of Biology, Purdue School of Science, IUPUI

Effects of Estrogen Loss on Type I Collagen in Rat Tendon
Jennifer M. Hatch[1], Joseph Wallace[1]
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Although the effects of estrogen-deficiency on bone are well-documented, the effects on tendon are less clear. It is known that tendon strength is reduced in states of estrogen-deficiency and that post-menopausal women experience tendon-related injury three times more frequently than pre-menopausal women. Type I collagen is a fibrillar protein which constitutes 60-80% of the dry weight of tendon and is also a key component in the extracellular matrix of skin and bone. Collagen imbues a tissue with tensile strength, a mechanical property that is chronically reduced in the tendon of estrogen-deficient models. One measurable property of a collagen fibril is the periodic spacing (D-spacing) of the molecular bonds which hold the tropocollagen fibers together. Changes in D-spacing have been linked to changes in collagen quality and can be analyzed to explore the quality of collagen. Atomic Force Microscopy (AFM) produces a topographical image of the surface of a sample from which the periodic D-spacing of individual collagen fibrils can be accurately measured using digital fast fourier transformation. For this experiment, female Sprague-Dawley rats were ovariectomized to simulate age-related estrogen loss, then treated with Genestein, an isoflavone and phytoestrogen, or estradiol to examine the difference between treatment with Genestein and traditional estrogen replacement therapy. Measurement of the periodic D-spacing of collagen fibrils harvested from tail tendon will serve as a marker of the change in collagen composition. The insight gained will advance the understanding of how Genestein, currently used in human trials, may intervene in the pathologic side-effects of estrogen loss.

Advisor: Joseph Wallace, Department of Biomedical Engineering, Purdue School of Engineering and Technology

Unraveling the Tapestries

Jennifer Hurley
Art History, Herron School of Art and Design, IUPUI

The interpretation of historic works of art requires that we try to understand it through the lens of its own time period, rather than applying our own views. It is challenging to reconstruct what must have been common knowledge in the past. This project studied the series of all seven late medieval tapestries in the Metropolitan Museum of Art in New York, known collectively as "The Hunt of the Unicorn." The significance of this cycle to its original patrons and viewers has never been fully understood. Traditional studies have interpreted it either as a simplistic narrative or as veiled Christian symbolism, and few have included every tapestry. My study takes an interdisciplinary approach and applies methods from both Art History and Folklore Studies. By analyzing the tapestries through this multifaceted lens, I have concluded that the tapestries generate meaning through the appropriation of folkloric hunting tales into a medieval Christian context, and through the disruption of traditional gender roles, shown by the prominence of the female figures in what was a male dominated activity. This analysis writes a new narrative for these famous tapestries and suggests their significance to their original female owner. At the same time, it demonstrates the potential of interdisciplinary collaboration for the interpretation of pre-modern art.

Mentor: Jennifer M. Lee, Art History, Herron School of Art and Design, IUPUI

J

Sleeping Less and Eating More: Is Insomnia Associated with Increased Attention to Food Cues?

Rachel A. Jackson [1,2], Aubrey L. Shell [1], Jesse C. Stewart[1], Joseph Defazio [2]
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Insomnia affects approximately 30% of U.S. adults. Insomnia is associated with cognitive dysfunction, appetite changes, anxiety, and an increased risk for cardiovascular disease. Insomnia is also associated with harmful effects of metabolic and endocrine function, as well as increased severity of age-related chronic conditions. Furthermore, research has identified insomnia as a risk factor for obesity. The present study aims to explore a candidate mechanism in the insomnia-to-obesity relationship, namely, food attentional bias. We hypothesized that higher insomnia severity would be positively associated with higher food attentional bias. We analyzed data from a sample of 95 undergraduate students enrolled in a cross-sectional study of psychosocial factors and eating behaviors (age M=20 years, 80% female, 74.7% non-Hispanic White, BMI M=23.35 kg/m^2, subjective hunger M=16.37). Insomnia symptom severity was assessed by the Insomnia Severity Index (ISI; M=7.80 points, SD=5.18, range:0-22), and food attentional bias was measured by the difference in correct response times to non-food and food-related words in a Stroop task (M=35.85 points, SD=166.25, range: -411.99-491.64). In the demographics-adjusted model (adjusted for age, sex, race/ethnicity, BMI, and subjective hunger), insomnia severity was not significantly associated with food attentional bias (β=0.08, p=.47). Our findings suggest that in a sample of undergraduate students' insomnia may not be related to food attentional bias. Thus, future reference should continue exploring food attentional bias as a candidate mechanism in the insomnia-to-obesity relationship.

Mentors: Aubrey L. Shell, Department of Psychology, Indiana University-Purdue University Indianapolis (IUPUI); Jesse C. Stewart, Department of Psychology, Indiana University-Purdue University Indianapolis (IUPUI); Joseph Defazio, Department of Media Arts and Science, Indiana University-Purdue University Indianapolis (IUPUI)

Spinophilin Protein-Protein Interactions in the Striatum Subsequent to Psychostimulant Administration

Crystal Johnson[5], Darryl S. Watkins[1, 3], Anthony J. Baucum II[2, 3, 4]
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Attention-deficit hyperactivity disorder (ADHD) is a neurodevelopment disorder that can persist into adulthood. Treatments are predominantly psychostimulant-based drugs, which act to increase monoamine concentrations within the central nervous system. Psychostimulants such as amphetamine act at multiple loci to drive increases in synaptic neurotransmitter levels. ADHD along with many neurological diseases including obsessive-compulsive disorder and drug addiction, report perturbations in dopaminergic regulation and aberrant synaptic transmission. The striatum receives a substantial amount of dopamine inputs. A majority of the neurons within the striatum are medium spiny neurons (MSNs), which contain either dopamine D1 or dopamine D2 receptors. Proper neuronal communication and function is dependent upon the dynamic regulation of reversible protein phosphorylation. Spinophilin, the major protein phosphatase 1 (PP1) targeting molecule, is highly enriched in dendritic spines and has been shown to regulate protein phosphorylation by targeting PP1 to, or inhibiting PP1 activity at, myriad substrates. Our lab previously reported that 6-hydroxydopamine lesioned animals, an animal model of dopamine depletion, leads to global decreases in spinophilin protein-protein interactions in the striatum; however, changes in spinophilin protein-protein associations in a hyperdopaminergic milieu are less understood. Here we report greater increases in spinophilin protein-protein interactions under a psychostimulant-induced behavioral sensitization paradigm.

Mentors: Anthony J. Baucum II, Department of Biology, Indiana University-Purdue University; Stark Neurosciences Research Institute; Department of Pharmacology and Toxicology, Indiana University School of Medicine, Indianapolis, Indiana; Darryl S. Watkins, Indiana University School of Medicine Medical Neuroscience Graduate Program, Stark Neurosciences Research Institute

The Effects of Transcranial Direct Current Stimulation on Conditioned Pain Modulation in Healthy Older Adults and Healthy Younger Adults

Jia Jones[1], Brandon Wind[1], Anthony Meek[2], Mutsa Godza[3], Zachary Riley[1], Kelly Naugle[1]
[1]Department of Kinesiology, School of Health and Human Sciences; [2]Department of Health Sciences, School of Health and Human Sciences; [3]Department of Physical Therapy, College of Public Health and Health Professions

Recent evidence suggests aging is associated with reduced endogenous pain inhibitory capacity, placing older adults at risk for developing persistent pain. Transcranial direct current stimulation (tDCS) is a non-invasive brain stimulation technique capable of modulating excitability of cortical and cerebellar neurons. Recent work shows tDCS of the motor cortex (M1) improves pain inhibitory capacity in healthy young adults. The purpose of this study was to examine the difference of anodal tDCS of the motor cortex and cerebellum on descending pain inhibition in healthy older adults compared to younger adults. This study enrolled 11 older adults (55-79 years) and 20 younger adults (18-35 years). Subjects completed three randomized sessions on separate days that included one of the following 15-minute experimental conditions during each session: (1) anodal M1 tDCS, (2) anodal cerebellar tDCS, and (3) sham tDCS. TDCS was applied at 1mA during the M1 and cerebellar conditions. A dynamic quantitative sensory test called conditioned pain modulation (CPM) was used to assess endogenous pain inhibitory capacity pre and post tDCS. A mixed model ANOVA compared CPM scores across age groups, time, and tDCS conditions. Results showed a significant age by time interaction, p=0.025. Regardless of experimental condition, older adults demonstrated a significant decrease in pain inhibition on the CPM test from pre to post tDCS. These results suggest that anodal tDCS applied at 1mA to the cerebellum or motor cortex does not alter pain inhibitory capacity on the CPM test in younger or older adults.

Mentor: Kelly Naugle, Department of Kinesiology, School of Health and Human Sciences, IUPUI

K

Transferrable skills gained from experience as a peer-leader in a PLTL program: Development of a quantitative instrument from qualitative data

Gabrielle Kline, Manning, I., Chase, A., Varma-Nelson, P.
SEIRI

Instrument development is a challenging task especially in areas that have not been explored with much quantitative research. Specifically, the long-term effects of being a peer leader in a peer-led team learning (PLTL) course have not been quantitatively examined with statistically validated instrumentation. This study shows the development of a quantitative instrument that examines the value of being a peer leader as it relates to one's current position. Questions were derived from thematic analyses of interviews indicating that former peer leaders recognize transferrable skills such as leadership skills, the ability to cope with many challenges (including not having the right answer), collaboration/teamwork skills, self-confidence, and problem-solving skills all as being relevant and frequently used in their current work. In this exploratory sequential mixed-methods design, transferable skills are identified from qualitative interviews and then further developed into a quantitative instrument. Results from instrument piloting and reliability testing are presented. The survey has been redeveloped and redistributed. New survey and new results will be presented.

Mentor: Dr. Anthony Chase

The Association Between Bullying, Weapon Carrying, and Mental Health – Results from a Nationally Representative Survey of High School Students

Amber C. Kriech
Sociology, IU School of Liberal Arts

Using data from the 2007-2017 cycles of the national Youth Risk Behavior Survey (YRBS), this researcher aimed to understand how weapon carrying mediates the association between bullying and mental health outcomes. I dichotomized four bullying outcomes to create one new carried a weapon after bullied (CWB) (no/yes; e.g. did not carry a weapon post-bullying vs. did carry a weapon post-bullying) for each bullying type. Mental health outcomes included (all dichotomized, past 2 weeks, no/yes): felt sad or hopeless, seriously considered suicide, had a plan for suicide and attempted suicide. I used descriptive statistics and binary logistic regression adjusted for YRBS sampling methods and weighting (Stata 15.0). Initial results showed that weapon carrying has a complex relationship with mental health after bullying. One notable finding is that that individuals who had been in a physical fight were the most likely to carry a weapon (N = 268), followed by those who had been threatened at school (N = 233). Additionally, more students who had been bullied at school (N = 185) carried a weapon than those who were victims of cyberbullying (N = 166). Another interesting result found that across all bullying types, males were 2 to 3 times more likely to carrying a weapon as a result of being bullied. In terms of mental health, being threatened at school was the most significant bullying type in relation to suicidal ideation.

Mentor: Devon J. Hensel

Electrochemical Detection of Chlorate Using Paper-based Devices for Crime Scene Investigation

Kiyomi Kukoyi[1], Carolina Vega[1], and Frédérique Deiss[1]
Department of Chemistry & Chemical Biology, Purdue School of Science

In recent years, more and more improvised explosive devices are made with chlorate salts. This is due to chlorate salts being easier to use and buy, submitted to less regulations than other common oxidizing agents such as ammonium nitrate. For forensic applications, in-field presumptive sensing capabilities are needed. Microfluidic paper-based analytical devices are low-cost, portable, flexible, and simple to produce and to use, and can be used for sample collection. We are developing an electrochemical paper-based device to

detect and quantify the presence of chlorate using a molybdate sensing layer. The redox reactions of the molybdate are catalyzed by chlorate and, thus, chlorate shifts potential of the redox peaks and increases the current. We can observed those changes by electro-analytical techniques such as cyclic voltammetry. Our current work is focused on optimizing the conditions for the electrodeposition of the molybdate layer and the detection of chlorate, such as the scan rate and design of the design. We are also exploring various methods of data analysis to highlight the impact of chlorate on the sensing layer. After achieving the optimization of the paper-based devices, we will start testing real samples, such as pipe bomb post-blast debris. This project aims to permit a convenient collection and analysis of samples (explosives mixture or debris) for investigators at crime scenes.

Mentor: Frederique Deiss

Research to determine the optimal blend of recycled plastics and additives to be used in additive manufacturing
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The objective is to find the optimal recycled blend of plastics and the necessary parameters and conditions that enhance the quality of the additively manufactured products, ultimately assess the viability of recycled plastics for extrusion based additive manufacturing. Recycled HDPE was chosen as the base plastic. The recycled HDPE was prepared for testing by shredding followed by thorough cleaning to eliminate microscopic particles. Recycled HDPE has a melting point of 266 degrees Fahrenheit; hence the toaster oven was utilized to create melted bases of the plastic. Coupon designs (of different orientations) were traced onto these bases and cut using a band saw. The universal testing machine (UTM) is to be utilized to measure the tensile strength of the coupons created. The machine records the change in length and elastic components of the coupon. Results were unable to be obtained since the processes used to prepare samples of other plastics (Polypropylene, pure HDPE type 2) failed to work when using recycled HDPE type 2. Alternate ways to make samples, to determine mechanical properties, had to be considered and determined if viable. While working with recycled HDPE type 2, it was observed qualitatively that additives in the plastic made it much stiffer than pure HDPE type 2. With the knowledge of the mechanical properties of recycled HDPE type 2, additives can then be considered to adjust the properties to make the plastic malleable enough for additive manufacturing.

Amanda Siegel, Department of Chemistry and Chemical Biology, IU School of Medicine, IUPUI; Andres Tovar, Department of Mechanical and Energy Engineering, Purdue School of Engineering and Technology

L

Dyrk1a-Related Appendicular Skeletal Phenotypes in Ts65Dn Down Syndrome Mice Arise Prior to Adolescence
Jonathan LaCombe[1], Jared Thomas[1], Matthew Blackwell[1], Kourtney Sloan[1], Joseph M Wallace[2], and Randall J. Roper[1]
[1]Department of Biology, IUPUI; [2]Department of Biomedical Engineering, IUPUI

Every individual with DS presents with skeletal abnormalities and will experience the onset of osteoporosis at an earlier age than normal individuals. Skeletal abnormalities observed in DS are a consequence of three copies of human chromosome 21. Our lab has demonstrated that three copies of Dyrk1a contributes to several skeletal defects in the Ts65Dn DS mouse model, the most widely studied mouse model of DS. Returning Dyrk1a to two copies by genetic knockdown in an otherwise trisomic Ts65Dn mouse corrects some skeletal abnormalities by adolescence, but late embryonic skeletal defects are not corrected in these mice. Although embryonic, adolescent, and adult trisomic skeletal defects have been explored, a six-week period of development spanning embryonic day 17.5 (E17.5) to postnatal day 42 (P42) remains undescribed. To test the hypothesis that Dyrk1a-related skeletal defects arise during early postnatal development, femurs of perinatal mice were subjected to microcomputed tomography (μCT) and Dyrk1a gene expression analysis. Preliminary data suggest that defects present from P12 to P18 are inconsistent with the phenotypes observed at P42 in Ts65Dn mice. Additionally, trisomic Dyrk1a expression was inconsistent across all time points and suggest that expression fluctuates throughout this period. Taken together, these data suggest that Dyrk1a-related appendicular skeletal defects arise between P24 and P42. This work will contribute to determining a treatment window for improving bone strength and delaying the onset of osteoporosis in individuals with DS.

Mentor: Randall Roper, Department of Biology, IUPUI

Examining the Effectiveness of a Community Lecture on Black Racial Identity
Howard Lance

Lecture has long been a vehicle used for influencing people's beliefs and behavior. This vehicle has historically been one of the prominent tools used by African American community advocates. It may also hold promise as a means of advancing socially transformative STEM curriculum. The purpose of this study was to assess the degree to which a community-styled lecture was able to impact the racial identity of viewers. Seventeen African American college students viewed one of two community lectures. Working in viewing groups of four of fewer, students completed pre- and post- assessments using the Multidimensional Inventory of Black Identity (MIBI) developed by Sellers and colleagues (Sellers, Rowley, Chavous, Shelton & Smith, 1997), concluding with a focus group discussion. Preliminary results indicate that on average racial identity scores on items categorized as Humanist and Assimilationist decreased, while scores on items categorized as Minority and Nationalist increased. These general results are consistent with the lecturer's intention. They are also consistent with the goal of conscientization as described by Freire (Freire, 1970) and advocated by Mutegi's (Mutegi, 2011) socially transformative STEM curriculum model. This suggest that for African American students, directly addressing systemic racism through lecture might be a viable instructional approach.

Quantitative Analysis of Stereocilia Lengthening in Mice During Development

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Stereocilia are actin-based protrusions located on the apical surface of sensory hair cells present in the sensory epithelium of the inner ear apparatus. The mechanosensitive function of these hair cells serves as the basis for vestibular and auditory function in the cochlea. Auditory hair cells are categorized into two different groups: outer hair cells (OHCs) and inner hair cells (IHCs). Both cell types are arranged in a staircase bundle of three rows, where row one is the longest and row three is the shortest. This specific arrangement of the stereocilia bundle places tension on tips of row two and three stereocilia through tip links, which are located between the tips of shorter-row stereocilia and the shaft of longer-row stereocilia. Proper tip-link tension and length regulation are interdependent and important for the mechanosensitive properties of the cell. The precise bundle morphology is critical for auditory and vestibular function, yet much remains elusive about structural changes throughout early postnatal development. Here, we aimed to quantify the difference in length of row one and row two stereocilia in both IHC and OHC bundles in the middle turn of the organ of Corti in early postnatal mice. Analysis of bundle morphology was conducted with images of cochlear samples collected through scanning electron microscopy. Quantification seemed to reveal an increase in step size between rows 1 and 2 of IHCs and OHCs throughout development. This data serves as an important standard for evaluating the effects of mutant proteins associated with stereocilia degeneration.

Mentors: Benjamin J. Perrin, Department of Biology, Purdue School of Science, Indiana University-Purdue University Indianapolis; Jamis McGrath, Department of Biology, Purdue School of Science, Indiana University-Purdue University Indianapolis

Genome Engineering Human Stem Cells for In Vitro Modeling of Neurodegenerative Diseases

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[1]Department of Biology, Indiana University-Purdue University Indianapolis

Glaucoma is a progressive neurodegenerative disease that causes damage to retinal ganglions cells (RGCs), leading to an irreversible loss of vision. There are several risk factors that can lead to the development of glaucoma, genetic and environmental; in this experiment, a specific risk allele known as E50K was investigated. E50K was introduced into the Optineurin (OPTN) gene in human pluripotent stem cells (hPSCs) using clustered regularly-interspersed short palindromic repeats (Crispr/Cas9). DNA from retinal organoids grown in culture were then tested using polymerase chain reaction (PCR) and gel electrophoresis to identify and confirm E50K-expressing cells. hPSC derived retinal organoids with and without the E50K mutation were then stained using immunofluorescence staining techniques, in order to study protein expression in both control and E50K-expressing organoids. Day 30 and day 60 retinal organoids were studied, and at this relatively early stage of development, control and E50K organoids showed no significant differences in protein expression throughout the organoid. Using Crispr/Cas9 to introduce the E50K mutation into the OPTN gene of hPSCs allows organoids at various stages of development to be studied. By studying organoids with and without the E50K mutation during various periods of development, a better understanding of the cellular processes involved in glaucoma is provided. A similar method utilizing the Crispr/Cas9 editing system can be applied to study various other glaucoma risk alleles, as well as other neurodegenerative diseases.

Mentors: Jason S. Meyer, Department of Biology, IUPUI; Kang-Chieh Huang, Department of Biology, IUPUI

Assessment of TLR-2 Expression in Salivary Epithelial Cells for Early Identification of Periodontitis

Alison Lindsay*
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Periodontitis is an inflammatory disease of the gingiva and the tissues surrounding the tooth. The disease is prevalent affecting greater than 20% of adults in the United States. Severe periodontitis leads to the destruction of the tooth supporting tissues and tooth loss. It is more common in people with other chronic diseases such as diabetes and cardiovascular disease. The current methods of identification of progression of the disease are physical in nature that measure the tissue damage but provide no background on the actual disease activity. The disease is mediated by the interaction between the dental plaque biofilm, the oral epithelial cells and the host immune cells. Due to the physiological turnover, the oral epithelial cells are exfoliated into the saliva. Hence epithelial cells in saliva are a viable option for studying periodontitis progression. These cells recognize and respond to bacterial via toll like receptors. TLR-2 and TLR-4 mediate disease response to the pathogens associated with periodontitis. The objective of this study is to investigate the TLR-2 and TLR-4 expression in the salivary epithelial cells in periodontitis. By better understanding progression, the re-infection and disease of the tissue can be better understood and eventually better managed. Archived saliva samples collected in accordance with the ethical board of the Indiana University Purdue University at Indianapolis from periodontitis patients reporting to the IU School of Dentistry was used. The TLR-2 and 4 mRNA in salivary epithelial cells were determined by quantitative real time polymerase chain. Results showed that the TLR-2 mRNA was significantly lower in the periodontitis group, suggesting the presence of activated responsive epithelial cells. In conclusion salivary epithelial cell phenotype measurement may help identify highly relevant biomarkers for disease progression in periodontitis.

Mentor: Mythily Srinivasan

M

Understanding variable reduction of a biophysically realistic cortical network model
Veer Mahal[1], Alexey Kuznetsov[2]
[1,2]Department of Mathematics, School of Sciences, Indiana University-Purdue University Indianapolis

Recent physiological studies using behaving monkeys have revealed that reaction time was correlated with ramping of spike activity of lateral intraparietal cortical neurons. This is investigated by using a simplified two-variable version of a biophysically realistic cortical network model of decision making. The reduction involves various assumptions including the mean field approach, constant activity of Non-selective excitatory cells and various others. However, one of the most important assumption that we tried to explain better was that all fast variables of the system reach steady states earlier than that of NMDA receptor. In order to justify this reduction, I started to analyze the simpler rate and spiking models using MATLAB. The reduction involves the use of effective coupling constants which are mediated by both AMPA and NMDA receptors. The goal was to explain the dependence of synaptic current using the effect of these coupling constants on the model and how this assumption limits our knowledge of the decision-making model. We tested the model developed by Wong Wang (2006) and developed some insights into the assumptions of the slow gating NMDA receptor along with the coupling constants.

Mentor: Dr. Alexey Kuznetsov

The Genomics of Development Rate Variation in Chrysomya rufifacies and Phormia regina
Christina B. Martin[1,2], Sarah Lewis[2], and Anne Andere[1], Christine J. Picard[1,2]
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The blow fly is the most common invertebrate used in forensic entomology to estimate the minimal postmortem interval (PMI_{min}) of decaying bodies. PMI_{min} estimates are determined by measuring the size of the blow fly; however, due to the development rate variation of blow flies, these estimates are not entirely accurate. If one can identify the genetic markers that impact the development rate variation within the blow fly's genome, then the effectiveness of PMI_{min} estimates will increase.
This research focuses on the development rate variation in two species of blow flies: Chrysomya rufifacies and Phormia regina. Phormia regina has two standard genomes: a male and a female, however, Chrysomya rufifacies is different, with two different female genomes (one giving rise to male offspring and one giving rise to female offspring) and the male. For this work, we queried the Drosophila melanogaster genome for ten known genes that have been associated with development rate variation. These genes are: Babo, EcR, Eip74EF, InR, Itgbn, Ras, Raptor, rin, Smad2, and Tsc. The genome of this model insect is used to determine the developmental genes within the five blow fly genomes. For the associated genes, we isolated and characterized these genes to determine their structure, and any associated polymorphisms that may determine how the specific genes cause rate variations in the development of the blow flies.

Mentor: Christine J. Picard, Department of Biology School of Science, IUPUI

Magnetically Levitating Magnet over Elliptical Hole in Superconductor
Grace Mattingly[1], Ricardo Decca[1], Jordi Prat-Camps[2], Adrian Ezequiel Rubio Lopez[3], Oriol Romero-Isart[3]
[1]Department of Physics, Indiana University-Purdue University Indianapolis, [2]University of Sussex, [3]Institute of Quantum Optics and Quantum Information

It has been shown that a superconductor with a hole can trap a magnet where the gravitational force and the magnetic repulsion are at equilibrium. If this hole is elliptical, the magnet has a preferred direction along the major axis of the ellipse and the system could oscillate from the trapping position with some frequency. This given frequency allows the system to be used as a highly sensitive force sensor because of its isolation from the environment. The frequency of the oscillations in three spatial (x, y, z) and two angular (α, β) directions is given by the second derivative of the magnetic potential of the system at its minimum. This potential and the resulting frequencies are characterized for a range of parameters: height of the magnet, ellipse aspect ratios, thicknesses of the superconductor, and London penetration depths. The relationship between the changes in frequency and the free parameters is important for selecting a trapping potential with the desired frequency. The integrity of the superconductor is confirmed with an analysis on the penetration of the magnetic field into the superconductor. Because of the prediction for very high sensitives, there are many technical applications and possible advances in precision measurement. One motivation for the system is to act as a torsional pendulum with which the gravitational constant, the least well-known fundamental constant, could be determined with greater precision.

Mentor: Ricardo Decca, Department of Physics, IUPUI

Performance of a dexterous timing-based video game with complementary transcranial direct current stimulation of the primary motor cortex and the cerebellum
Anthony W. Meek[1]; Joselyn Perez[2]; Mackenzie E. Wolfe[1]; Kyle Harbison[1] ; Courtney Lasher[1]; Zachary A. Riley[1]
[1] Department of Kinesiology, IUPUI School of Health and Human Sciences; [2] Office of Chancellor of Research, IUPUI

Transcranial direct current stimulation (tDCS) applied to the primary motor cortex (M1) and cerebellum (CB), can facilitate learning of dexterous motor skills. Although stimulation of each site independently can influence motor learning through different mechanisms, it is unknown whether complementary stimulation of both sites simultaneously will influence motor learning. The purpose of this study was to determine if complementary stimulation of M1 and CB would facilitate learning of a dexterous timing-based video game compared to practice without stimulation. Thirty-one adults were randomized into an active stimulation or sham control groups. Subjects pressed appropriate keyboard arrow keys when scrolling icons overlapped on a computer screen. Subject performance was assessed by timing accuracy (i.e. optimal keystroke timing) and movement errors (i.e. incorrect key strikes). Baseline scores were obtained from 2

familiarization trials. Subjects completed 5 practice trials with ~2 minutes of rest after each trial for 20 total minutes of practice. Post-test scores were obtained 5 and 10 minutes after practice. During practice 2 mA anodal tDCS was applied to M1 and 2mA cathodal tDCS was applied to CB. The stimulation group had significantly higher timing scores on practice trial 5 ($p = 0.01$) and the 10-minute post-test ($p = 0.04$). There were no significant differences between groups for total errors. The results suggest that complementary M1 and CB tDCS can lead to greater performance gains after 20 minutes of practice compared to practicing without stimulation due to an effect on timing accuracy.

Mentor: Dr. Zach Riley

Deviating from the Standard Protocol Meal in Gastric Emptying Studies Effect on Gastric Emptying Rates
Kelly A. Mellene[1], Cybil Nielsen[1]

[1]Department of Nuclear Medicine, IU School of Medicine
The purpose of this study was to evaluate how deviating from standard protocol meal impacted gastric emptying rates. Methods: Gastric emptying rates were collected from 300 patients from three different hospitals, each of which used different meal content for their gastric emptying. Gastric emptying rates at hours 1, 2, and 4 were recorded in a data collection sheet for each hospital. Hospital A followed the standard protocol meal. Hospital B used a banana and one whole egg. Hospital C used cooked eggs. A two tailed t-test with unequal variances was performed. A p-value less than 0.05 represented a statistical significance. Results: Only one of the six t-tests showed statistical significance. At hour one between hospital A and hospital B, the p-value was 0.02. The remaining five t-tests were not statistically significant. Conclusion: There was no statistically significant difference in most of the emptying rates when deviating from the standard protocol meal.

Mentor: Cybil Nielsen, Department of Nuclear Medicine, IU School of Medicine, IUPUI

Process Optimization of Laser Powder Bed Fusion Using Gaussian Process Based Machine Learning Model
Lingbin Meng, Yi Zhang, Jing Zhang
Department of Mechanical and Energy Engineering, Purdue School of Engineering and Technology

In this work, a Gaussian process (GP) based machine learning model is developed to assist the process optimization of laser powder bed fusion (L-PBF) additive manufacturing. The first part of this study focuses on developing a GP regression model which is able to predict the remelted depth of single tracks in L-PBF process at any combinations of laser power and laser scan speed within the design space. The predictions made by the GP regression model, which is trained by simulation data from a coupled fluid-thermal model, are in good agreement with experimental observations. The error magnified by the GP model is considerably small, indicating the adequacy of the GP model. The second part of this paper demonstrates the applications of the GP model in process optimization of L-PBF technique. The GP model trained by experimental dataset is able to predict the preferred conduction mode region in laser additive manufacturing. The GP predicted region is then used to compare with the region predicted by an empirical method using normalized enthalpy and help calibrate the method. Overall, the GP regression model enables designers to determine optimal processing parameters.

Mentor: Dr. Jing Zhang

Engaging with Urban Congregations: People-Centered Design, Health Equity, and the Healthy Indiana Plan
Maria Meschi[1], Pamela Napier[1], David M. Craig[2]
[1]Department of Visual Communication Design, Herron School of Art and Design; [2]Department of Religious Studies, IU School of Liberal Arts

The Healthy Indiana Plan (HIP) is intended to connect low-income Hoosiers to health care. However, its potential is limited; HIP members and HIP-eligible people may confront inequities navigating the HIP program and health care system and living in health-challenged neighborhoods. This research, with funding from the Indiana Minority Health Coalition (IMHC), and support from IUPUI's Center for Service and Learning Service Learning Assistant (SLA) scholarship, aims to 1) evaluate people's experiences with HIP and 2) examine two Indianapolis congregations' healthy community programs as alternative supports for achieving HIP's values of personal wellness, responsibility, and empowerment. The research team is a collaboration between Herron School of Art and Design's Visual Communication Design MFA program, and the IU School of Liberal Arts Department of Religious Studies. This team is focusing on using a people-centered design approach to engage HIP-eligible members of two urban congregations, First Baptist Church North Indianapolis (FBCNI) and Shepherd Community Center, in interviews and participatory design sessions. Participants are exploring their lived experiences with HIP and envisioning improvements to the program. Pending the conclusion of this study in September 2019, the findings and recommendations for improvements to HIP and HIP-support services will be reported to each congregation and the Indiana Family and Social Services Administration. This poster will highlight the approach, process, and initial findings of this ongoing collaboration.

Mentors: Pamela Napier, Department of Visual Communication Design, Herron School of Art and Design; David M. Craig, Department of Religious Studies, IU School of Liberal Arts

Parametrizing Low Frequency Alternating Current Nerve Block
Ivette Muzquiz[1], Landan Mintch[1], Ken Yoshida[1]
[1]Department of Biomedical Engineering – Purdue School of Engineering & Technology IUPUI

Activation of nerve fibers using electricity has been known since antiquity. Methods to block propagating action potentials (AP) are a more recent discovery. This paper describes a method to reversibly block nerve conduction using a low frequency (1 Hz) alternating

current (LFACb) waveform. An in-situ electrophysiology setup was used to assess the LFACb on propagating action potentials (APs) within the cervical vagus nerve in 6 anaesthetized Sprague-Dawley rats. Two sets of hook electrodes were used. The rostral hook was used to generate a volley of APs while the LFACb waveform was presented to the caudal hook. This efferent volley, if unblocked, elicits acute bradycardia and hypotension. Block was assessed by ability to reduce this bradycardic drive by monitoring the heart rate (HR) and blood pressure (BP) during LFACb alone, LFACb and vagal stimulation, and vagal stimulation alone. Using the LFACb technique 82 ± 15% conduction block was achieved with current levels 100 ± 36 μAp.

Mentor: Ken Yoshida, Department of Biomedical Engineering, Purdue School of Engineering & Technology, IUPUI

N

Hydroclimate Trends in the Midwest During the Transition from the Late Glacial Period to the Modern Holocene Era Revealed Through Analysis of Lacustrine Sediments

Alek Baker[1], Sarah Merrow[1], **Cameron Nealy[2]**, Cassandra Sluis[1]
[1]Purdue School of Science, [2]Indiana University School of Liberal Arts

Hydrologic aberrations across the Midwestern United States - flooding and extreme precipitation events in the east and prolonged droughts in the west – have increased over the past ~100 years, raising the question: are these hydroclimatic trends within the range of natural Holocene variability, or have anthropogenic influences shifted the regional hydroclimate regime? Despite the agricultural and economic importance of this question, the relationship between climate and regional precipitation is poorly understood because high-resolution paleo-hydroclimate reconstructions are sparse and instrumental records only span the last ~100 years. This project provides critical paleoclimatic context in the form of a 13.5 Ka lacustrine sediment core from Martin Lake in northern Indiana. Here, we provide preliminary results that are part of an ongoing study focused on the reconstruction of Midwestern hydroclimate that spans the Holocene and into the late glacial period of the Pleistocene. Multiple proxies, including carbonate $O^{18/16}$ ratios, sediment bulk density/loss on ignition, magnetic susceptibility, and grain size analysis provide high-resolution (decadally-resolved) insight into past hydroclimate trends in terms of precipitation sources and magnitudes. Because the Midwest hosted several important pre-Columbian Native American civilizations, these data also provide key information regarding prehistoric human settlements and migrations.

Mentors: Derek Gibson, Department of Earth Sciences, School of Science at IUPUI; Broxton Bird, Department of Earth Sciences, School of Science at IUPUI; William Gilhooly, Department of Earth Sciences, School of Science at IUPUI; Jeremy Wilson, Department of Anthropology, Indiana University School of Liberal Arts, IUPUI

Design, 3D-Print, and Test Modular Mouthpiece for Effective Radiation Therapy

Timothy Nisi[1], Brian Overshiner[2]
[1]School of Engineering and Technology, IUPUI; [2]Radiation Oncology, IU Health

The purpose of this project is to engineer a modular 3D-Printed mouthpiece that can repeatedly and accurately position the mandible and tongue throughout multi-session radiation therapy. Accurate, repeatable positioning of the mandible and tongue throughout radiation treatment would allow for the maximum possible dose of the radiation to reach the intended target while by-passing healthy bone/tissue. Current techniques involve the use of one or more foam bite blocks and do not provide accurate repeatable positioning of the mandible and tongue. This causes unintended targets to absorb the radiation. IUPUI and IU Health have worked together to design a modular mouthpiece which positions the mandible, has detachable side panels to push the lips out as needed, and includes a reversible fin that gently guides the tongue to either side of the mouth. Iterative design methodology was used in conjunction with PolyJet 3D-Printing technology to design, build, and test the mouthpiece. Each iteration of the mouthpiece was 3D-Printed so it could be used as a benchmark for properly re-dimensioning the mating components of the next iteration. We have successfully 3D-Printed a modular mouthpiece with properly fitted mating-components. As next steps, we plan to test the hypothesis that using this device will decrease the amount of radiation absorbed by unintended targets, effectively reducing the likelihood of osteoradionecrosis.
Mentors: Paul Yearling, School of Engineering and Technology, IUPUI; Brian Overshiner, Radiation Oncology, IU Health

O

UV-NBS Photocrosslinking of Antibodies Utilizing Various Light Intensities

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The nucleotide binding site (NBS), found in the Fab variable domain of all antibody isotypes, can be utilized for site-specific functionalization of antibodies. UV exposure (254nm) to a small molecule, indole-3-butyric acid (IBA), that has high affinity to the NBS can be used to photocrosslink ligands to antibodies. Here, we demonstrate a method to modify antibodies by photocrosslinking with various intensity UV light sources: UV crosslinker XLE-1000 (40-watt), handheld EF-160C (6-watt), and MiniMax UV-5NF (5-watt). The different sources possess different power levels and by modulating both time of UV exposure and distance from the source crosslinking at the NBS for affinity tags (IBA-Biotin) and fluorescent molecules (IBA-FITC) was optimized. Application of the UV-NBS photocrosslinking technique is possible by first incubating the antibodies, Rituximab [chimeric anti-CD20] and Tocilizumab [chimeric anti-IL-6R] (12-15μM), with IBA-FITC (300μM) followed by defined exposure times and distances from the UV sources in triplicate experiments. Conjugation efficiency was determined via absorbance/fluorescent measurements to quantity conjugated IBA-FITC/Antibody. Through modulating time and distance from the UV source, conditions were optimized to allow for efficient crosslinking at the NBS with all 254nm sources while maintaining antibody antigen binding activity and Fc recognition. This study demonstrates that

the UV-NBS site-specific antibody modification technique can be accomplished using UV light sources with differing light intensities expanding its implementation potential by making the crosslinking technique more widely accessible. Ultimately, the UV-NBS method is a reproducible, efficient, and site-specific technique for functionalizing antibodies with significant potential to advance biomedical technologies in diagnostic and therapeutic settings.

Mentor: Nathan J. Alves, PhD

Sabanero Culture and Farming in Guanacaste, Costa Rica
Abigail P. Gasparovic, **Emily J. Osborn**
Department of Biology, Purdue School of Science; Department of Anthropology, IU School of Liberal Arts; IUPUI Honors College

Guanacaste is a province located in the northwestern region of Costa Rica, this province is named after the nation tree of Costa Rica, the Guanacaste tree, or more commonly referred to as the "ear tree" due to the production of ear shaped seed pods. The Guanacaste province is renowned for many reasons that attract tourism, such as the pristine beaches, abundant rainforests, and a variety of other geographical features. For decades, Guanacaste has been the forefront of the "sabanero" (cowboy) tradition of working the land for the production of coffee, bananas, sugar cane and well as the cattle farms and horse ranches. This culture is preserved in the famous painted ox carts, once used to transport goods such as coffee, bananas, and sugarcane, the remnants of this iconic cart can be seen at an souvenir shop or at the ox cart festival. Yet sense of pride, history, and tradition can still be seen deeply rooted into the communities of today.

Mentor: Kristina Sheeler, IUPUI Honors College; Tamekia Anderson, IUPUI Honors College; Ian McIntosh, IUPUI Honors College

Causes of Sudden Cardiac Death in Central Indiana from 2013-2017
Gabriela Ovalle[1], George Sandusky[1], Alfie Ballew[2], LeeAndrea Sloan[2]
Dept. Pathology, IU School of Medicine[1]; Marion County Coroner's Office[2]

Cardiovascular (CV) disease has been the major cause of death in the USA for the past 60 years. CV disease consists of many subtypes including: ischemic cardiomyopathy (coronary artery disease (CAD), myocardial infarction (MI), and atherosclerosis CV), congestive heart failure (CHF), hypertensive CV, and heart miscellaneous (aortic dissection and myocarditis). The first study at the Marion County Coroner's Office from 1987 to 2003, focused on hypertensive cardiomyopathy and hypertrophic cardiomyopathy, found 165 and 134 deaths, respectively, in 14,913 deaths. In the second study, there were 13,038 deaths with 2,946 deaths due to CV disease between 2004 through 2012. Ischemia comprised the majority with 1,939 cases. This was followed by hypertensive cardiomyopathy (571), congestive heart failure (189), hypertrophic cardiomyopathy (89), and heart miscellaneous (131) which made up the remaining cases. In this study we examined the deaths between 2013 through 2017, there were 10,939 deaths with 1,734 deaths due to CV disease. Ischemia was the most common (852), followed by hypertensive CV (371), and ischemia/hypertensive CV (229). Comparing these three studies, the incidence of hypertensive CV was slightly increased, ischemia decreased; however, diabetes (87) has increased compared to the previous studies. Overall CV disease/death is decreasing due to early detection methods, better drug treatment, and medical devices.

P

Mentor: George Sandusky, Department of Pathology, IU School of Medicine
Designing, Fabricating & Testing a Device to Eliminate the Use of Anesthesia During External Beam Radiotherapy
Prapti Niteen Parab[1], Paul Yearling[1], Brian Overshiner[2]
[1]Department of Engineering Technology, Purdue School of Engineering & Technology, IUPUI; [2]Department of Radiation Oncology, IU School of Medicine

Designing a device that would eliminate the use of anesthesia during EBRT (External Beam Radiation Therapy) without attenuating the radiation beam and affecting the radiation dosage. Anesthetic drugs are generally used for decreasing or blocking the pain sensation. Radiation cannot be felt thereby making EBRT a painless therapy. However, anesthesia is still used for pediatric radiation treatment to relieve patients' stress and keep them motionless. AVATAR (Audio-Visual Assisted Therapeutic Ambience in Radiotherapy), a device that allows the patient to view a video of their choice, keeps them engaged and immobile throughout the treatment. The equipment was restricted to a position on the treatment bed and lacked adaptability to any other location or attachments. Material and thickness selection for fabrication needs to accommodate higher penetration of X-rays to deliver planned doses. The new equipment designed and analyzed using Solid works includes a C-clamp which enabled the equipment to be mounted at any end of the table, the telescopic arm allowed adjusting the screen height between the patient and linear accelerator and the ball joint support provided flexibility to the projector required to adjust the image angle. The equipment was tested during the treatment of 4 children at IU Health, saved approximately 1.5hr of treatment time for each patient and required no recovery time, consequently reducing the treatment costs for the hospital. More importantly, the use of this device avoided the potential risks corresponding to the use of anesthesia.

Paul Yearling, Department of Engineering Technology, Purdue School of Engineering & Technology, IUPUI; Brian Overshiner, Department of Radiation Oncology, IU School of Medicine

Localization of Magnetic Nanoparticles in Ophthalmologic Surgery

Jordan Springman[2], **Evan Parker[2]**, Alan Washington[2], Rasoul Akbari[2], Amir Reza Hajrasouliha[1], and Afshin Izadian[2]
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This study explores the nature of the localization of magnetic nanoparticles using various electromagnet circuits and magnet designs. With theoretical analysis, computer simulations via Finite Element Method Magnetics (FEMM), and experimental trials, devices that have the accuracy and sufficient power to propel nanoscale particles through various ocular media are optimized. Electromagnet designs prove to be ineffective due to the lack of power at the scale desired for surgical implementation. Magnetic circuits also lacked the needed magnetic strength due to complications of the magnetic coupling materials. However, neodymian permanent magnet devices with longer widths and shorter heights proved to be the most effective method of controlling the motion of magnetic nanoparticles while maintaining dimensions that would allow surgeons manual control.

Mentors: Dr. Afshin Izadian, Purdue School of Engineering and Technology, Indianapolis, IN; Dr. Amir Reza Hajrasouliha, Deparment of Ophthalmology, Indiana University School of Medicine, Indianapolis, IN

Evaluating Online Information on Dysmenorrhea

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Menstrual pain impacts 45-95% of women of reproductive age and is the leading cause of school and work absences among women. Women often seek online information on dysmenorrhea; however, little is known about the information quality. Objective: To evaluate online information on dysmenorrhea, including readability, credibility, and quality. Methods: We imitated search strategies of the general public by employing the three most popular search engines worldwide—Google, Yahoo, and Bing, and using lay search terms, “period pain” and “menstural cramps.” We screened 60 webpages. Following removal of duplicates and irrelevant webpages, 25 met the eligibility criteria. Two team members independently evaluated readability, credibility, and quality of the included webpages using standardized tools. Results: For readability, the mean Flesh-Kincaid level was 10th grade. For credibility, 8% of webpages referenced scientific literature and 28% stated the author’s name and qualifications. For quality, no webpage employed user-driven content production; 8% of webpages referenced evidence-based guidelines, 32% had accurate content, and 4% of webpages recommended shared decision-making. Conclusion: Online information on dysmenorrhea has generally low readability, mixed credibility, and variable quality. Strategies to improve health information on dysmenorrhea include avoiding complex terms, incorporating visual aids, and presenting evidence-based information. With this information, nurses can better educate patients and communities about how to navigate online health information.

Mentor: Chen X Chen, IU School of Nursing, IUPUI

The Effect of Lipid Structure on Membrane Domain Formation

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The coexistence of liquid-disordered (l_d) and liquid-ordered (l_o) phases in the phospholipid bilayer of cell membranes is believed to play a role in regulating cellular processes. How polyunsaturated fatty acid (PUFA)-containing phospholipids affect this fluid-fluid phase coexistence is proposed to contribute to the numerous health benefits associated with dietary intake of PUFA in fish oils. Our aim is to develop a method to study this behavior. Ternary mixtures of 1,2-dioleoyl-sn-glycero-3-phosphocholine (DOPC, a PUFA-like lipid), 1,2-dipalmitoyl-sn-glycero-3-phosphocholine (DPPC, a saturated lipid) and cholesterol (2:2:1) were prepared. Solid State ^{2}H NMR spectroscopy of a deuterium labeled analog of DPPC (DPPC-d_{62}) was used as a non-invasive probe of molecular organization. Spectral components attributed to DPPC-d_{62} in cholesterol-rich l_o and cholesterol-poor l_d phases were observed on the NMR timescale within a certain temperature range. These phases were characterized by determining the order of DPPC-d_{62}, and the relative amount of DPPC-d_{62} in them. The results demonstrate that this approach is a viable method by which fluid-fluid phase coexistence can be studied. In future experiments, DOPC will be replaced with 1-palmitoyl-2-docosahexaenoyl-sn-glycero-3-phosphocholine (PDPC, a PUFA-containing lipid). A similar approach will then be employed to study the effect of PUFA-containing lipids on molecular organization within a physiologically more realistic system.

Mentor: Stephen R. Wassall, Department of Physics, IUPUI School of Science.

Variant Target Effects on Motor Learning through tDCS

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Transcranial direct current stimulation (tDCS) is a non-invasive brain stimulation that has been utilized to stimulate the motor cortex (M1) and has been shown to enhance motor learning. Previous studies have indicated that performance of a motor task improves significantly when individuals’ M1 is stimulated with tDCS. There is a gap in the literature regarding how tDCS affects learning in a motor task requiring individuals to perform the task in various positions and angles. Therefore, the purpose of the study is to investigate if variant targets will affect motor learning when tDCS is applied to the M1. To examine this, participants will be randomized into a sham or anodal group and complete a dart throwing task. In the pre-test, participants will aim to hit the bull’s eye. During practice, participants will throw at bull eye’s sized targets positioned in a variety of location around the dart board while receiving either anodal or sham stimulation. During the post-test, participants will repeat the pretesting procedures. Participants will repeat the task one hour and 24 hours later to assess motor retention. We expect to demonstrate that those in the anodal group improved their dart throwing significantly more than those in the sham group and that the anodal group had a higher retention rate. Learning how tDCS affects motor learning, in regards to

real world applications, is key to understanding how to aid those that have impaired motor skill learning, such as those who have suffered from a stroke or a traumatic brain injury.

Mentor: Dr. Zachary Riley, Department of Kinesiology, Health and Human Sciences

Unsaturated Lipid Structure and Effects on Membrane Domain Formation
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Cell membranes are composed of an enormous variety of lipids and proteins that laterally organize into patches, or domains, of unique composition and function. The lipid raft concept is the most developed model. According to this model, disordered (non-raft) regions composed of primarily unsaturated lipids surround ordered (raft) domains that are enriched in saturated lipids and cholesterol. To study disordered domains, conventional all-atom molecular dynamics (MD) simulations were performed on PLPC (1-palmitoyl-2-linoleoyl-sn-glycero-3-phosphocholine, 16:0-18:2PC) and analyzed to study the structure and interactions of this unsaturated lipid that creates a disordered environment. Umbrella sampling was performed on cholesterol in PLPC to determine the binding energy of cholesterol and further evaluate the interactions in a disordered environment. Additional studies were conducted using coarse grained MD simulations on a mixture of membrane lipids comprised of DPPC (1,2-dipalmitoyl-sn-glycero-3-phosphocholine, 16:0-16:0PC), DLPC (1,2-dilinoleoyl-sn-glycero-3-phosphocholine, 18:2-18:2PC) and cholesterol. It was observed that the membrane separated into DLPC-rich/cholesterol-poor (non-raft) and a DPPC-rich/cholesterol-rich (raft) domains. The results of these computational studies will be presented.

Mentor: Stephen R Wassall

Residential Energy Management System
Corey Schoene, Basim Nasser Al Fuhidah, Weigang Wang, Russel Akbari, and **Nick Pohlman**
Purdue School of Engineering and Technology

A low-cost 6 KW energy management system for residential use with low installation, operating and maintenance has been proposed, designed and built. Electric power is instantaneously supplied by utilities and demanded by customers. The amount of power demanded varies throughout the day. Times of high demand are called peak hours. A customer is charged for electric usage according to the electric utilities rate structure. Some electric utilities charge residential customers more per kilowatt-hour consumption during peak hours and charge less during off peak hours. The residential energy management unit provides a means for customers to buy electricity during times of low demand and store it in a battery. During times of high demand, the unit would provide power to the house. The difference in cost between the peak and off-peak charges is what the customer saves on daily bases. A cost-effective residential energy management unit requires control over charging and discharging of the storage units and an ability to convert direct to alternating current. The power conversion is accomplished by a bi-directional inverter. The amount of converted power must be controlled so that no power is injected back to the power grid. The control action to regulate the power flow is through adjusting the phase angle and magnitude of the AC voltage supplied by the inverter. This should minimize the reactive power consumption. Power flow from the grid will be measured with a novel current transducer using XBEE wireless system.

Mentors: Dr. Afshin Izadian, Dr. Robert Weissbach

Social Welfare in Costa Rica: Exploring the Healthcare and Education Systems
Eva Kimberly, Mikayla Parrott, **Lily Pollard**
IUPUI Honors College

While visiting Costa Rica, we served in two schools providing dental care and English education to children of varying ages. During our time serving, it was noted that Costa Rica is a country committed to serving its citizens, the Ticos. Since Costa Rica has been without a military since 1948, the government is able to spend a large percentage of its GDP on both healthcare and education in order to better the lives of its citizens. In 2015, 10.1% of the annual GDP was spent on healthcare, while 7% of the GDP was spent on education. Healthcare is free for children, pregnant women, and the elderly, while everyone else is given the ability to purchase low-cost government funded healthcare. Education is free and mandatory in Costa Rica. However, the funding for schools can differ based on whether they are in a rural or urban setting. The country is dedicated to providing rich knowledge to its students, and a board of education designs curriculum best suited for each grade level.

Kristina Sheeler and Tamekia Anderson

A New Cretaceous-Paleogene Impact Spherule Locality from the Hell Creek Formation in South Western North Dakota, USA
Lindsey Powell[1], and Catherine Macris[1]
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Spherules from the Cretaceous–Paleogene (K-Pg) extinction are small (usually ≤ 1 mm diameter) glass spheres formed from solidified melt or condensed vapor as a result of the Chicxulub impact that caused the extinction of dinosaurs. This type of impact ejecta was distributed worldwide as molten and vaporized rock that were ejected from the impact site, pushing aside the atmosphere and traveling as far as the other side of the Earth within a matter of hours. This study characterizes K-Pg spherules from a site in the southwestern region of North Dakota, USA, that is relatively unstudied. We used a scanning electron microscope (SEM) with an energy dispersive x-

ray spectrometer (EDS) to investigate the morphology and degree of chemical alteration of these spherules. The characterization of the spherules enables them to be compared to K-Pg spherules from other sites, as well as spherules and microtektites from the more recent Australasian impact in the Cenozoic (700,000 ka). Preliminary data shows that the Hell Creek spherules' compositions display a minor amount of alteration to smectite, a common glass alteration product. The presence of smectite, and evident glass characteristics imply that the spherules form this location underwent minimal alteration from their original composition and form throughout the past 65 million years. Characterizing K-Pg spherules from this new locality provides insight into their formation, deposition, and alteration environments, leading to a better understanding of the Chicxulub impact processes and the dramatic environmental changes it imposed.

Advisor: Catherine Macris, Department of Earth Sciences, Purdue School of Science, IUPUI

Potential Role of Sire Age Affecting Birth Weight of Offspring in Down Syndrome Mice
Kelsey Cave, **Kristina Powlen**, Laura Hawley, and Randall J. Roper
Department of Biology, Indiana University-Purdue University Indianapolis

Infants with Down Syndrome (DS) have three copies of human chromosome 21 (Hsa21) and commonly have a lower birth weight compared to infants without DS. The only known cause of Trisomy 21 is increased maternal age. Ts65Dn is a mouse model of DS that has three copies of roughly half of the orthologous genes found on Hsa21. It has been postulated that the weight of trisomic pups is lower and may display a pattern of increase or decrease based upon the sire's age. We therefore hypothesize that the age of sires may alter the average weight of both trisomic and euploid offspring from Ts65Dn mothers. To obtain sufficient Ts65Dn mice for use in our experiments, we breed Ts65Dn females carrying the extra, freely segregating chromosome to B6C3F1 males to maintain a viable model. Mice age, weights, and litters have been gathered to examine the relationship between the age of the sires and the weight of the trisomic and euploid male and female offspring to determine differences in mass related to a specific sire's age. To date we have gathered information from 41 litters representing 236 offspring with 123 males and 113 females. Emerging evidence indicates there is a correlation between the sire age and the trisomic male pup weight. Future efforts include gathering more sire information in order to add statistical power to these findings. This work is important because finding how age affects birth weight of trisomic mice will allow for future developments in determining which sire age is best to produce the most stable and healthy trisomic offspring. This research also poses the question as to whether or not males contribute to low birthweight of their trisomic offspring.

Mentor: Randall J Roper, Department of Biology, IUPUI School of Science

R

TLR3 deficiency exacerbates the loss of epithelial barrier function during genital tract Chlamydia muridarum infection.
Ramesh Kumar[1], Haoli Gong[1,3], Luyao Liu[1,3], **Nicole Ramos-Solis**[1], Cheikh I. Seye[2], and Wilbert A. Derbigny
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Long-term Chlamydia trachomatis infections are commonly associated with pelvic inflammatory disease (PID), chronic pelvic pain, ectopic pregnancy, and tubal infertility in women. We previously reported that TLR3 is a major contributor to the Chlamydia-induced synthesis of IFN-β and a plethora of other inflammatory mediators, and that TLR3 has a protective role in the immune response to Chlamydia infection in mice. As epithelial cells are the major cell type productively infected during genital tract Chlamydia infections, we investigated whether Chlamydia has any impact on the integrity of the host epithelial barrier as a possible mechanism to facilitate the dissemination of infection, and examined whether TLR3 function modulates its impact. Here, we used oviduct epithelial (OE) cells derived from the genital tracts of wild-type and TLR3-deficient mice to ascertain whether C. muridarum infection had any effect on the formation and stability of cellular tight junctions. Quantitative real-time PCR (qPCR) and western blot analyses examining the transcription and protein expression of candidate cellular tight-junction (TJ) genes, transwell permeability assays, and trans-epithelial resistance (TER) studies show that Chlamydia has a definite impact on the function and stability cellular TJs throughout the course of infection in murine OE cells, and that TLR3 signaling significantly alters this effect. Our data show that TLR3 plays a role in modulating epithelial barrier function during Chlamydia infection of epithelial cells lining the genital tract, and TLR3-deficiency promotes a more rapid ascension of Chlamydia into the upper genital tracts of TLR3-deficient mice.

Mentor: Wilbert Derbigny

Indiana Jones and the Temple of Food: The effect of Peer Teaching on Assessment Scores
Brittney M. Rearden, Keith Naugle, Nancy Barton
Department of Kinesiology, IU School of Health & Human Sciences

This project was created to investigate eating habits from other cultures and search for options to improve lifestyle wellness and enhancing benefits. The project: Indiana Jones and the Temple of Food. The purpose of this study was to compare quiz scores from spring 2013 to fall 2018. An assessment was taken by each student ~5 weeks into semester; questions consisted of six knowledge based multiple-choice questions that covered global nutrition and eating patterns, followed by three opinion questions concerned with the students' openness to explore new diets. The same assessment was used again ~5 weeks later. In between assessments, students completed the Indiana Jones and the Temple of Food project. Pre and post test score (out of 6) were inputted into SPSS. A dependent t-test analyzed differences in all the pretest and posttest (time 1) scores (n=471). The t-test was significant, $p<.001$. Posttest scores at time 1 ($M=4.9$, $SD=1.1$) were significantly higher than pretest ($M=4.0$, $SD=1.2$). A repeated measures 1-way ANOVA was conducted to determine if differences existed across all three time points (n=92). The ANOVA was significant, $p<.001$. Scores significantly increased from the pretest ($M=4.0$, $SD=1.2$) to posttest 1 ($p<.001$; $M=4.8$, $SD=1.2$) and posttest 2 ($p<.001$; $M=4.6$, $SD=1.3$). No significant differences existed between the two posttest scores ($p=.511$). In conclusion the project intervention provided a significant increase in

students' knowledge about specific eating patterns. This project opens the door to learning about new and healthy alternative eating habits not common in Western diet.

Mentors: Nancy Barton, Department of Kinesiology, IU School of Health & Human Sciences, IUPUI
Keith Naugle, Department of Kinesiology, IU School of Health & Human Sciences, IUPUI

Developing Synthetic Methods for the Preparation of Unnatural, Unsaturated Fatty Acids for Elucidation of the Structure and Functions of Desaturase and Acetylenase Enzymes

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Acetylenic natural products are characterized by an alkynyl functional group and originate in many different organisms. These bioactive natural products have been shown to have many beneficial properties, such as antibacterial, anti-fungal, anti-tumor, HIV-inhibitory, and immunosuppressive capabilities. However, these products are often unstable, which introduces difficulty in the preparation, isolation and characterization of these compounds. In this project, organic synthesis was used to develop a viable synthetic method for the preparation of unnatural, highly unsaturated fatty acids. The targeted strategy used a late-state copper catalyzed $sp\text{-}sp^3$ coupling, allowing the linkage of protected, stable intermediates. A major challenge was the synthesis of alkyl nonaflates; efforts to prepare these species will be presented. When successful, these synthetic methods will be used to synthesize compounds to help elucidate the unknown steps of the desaturase and acetylenase enzymes in the metabolic pathways that produce acetylenic natural products.

Mentor: Robert E. Minto, Department of Chemistry and Chemical Biology, IUPUI School of Science

Determining accurate DYRK1A Levels in Down Syndrome mice

TyLynn Roberts, Laura Hawley
IUPUI School of Science Biology
IUPUI School of Science Psychology

Down syndrome (DS) is the triplication of human chromosome 21, also known as Trisomy 21, and is the leading genetic cause of intellectual deficits in the United States. Ts65Dn mice have an extra chromosome consisting of genes on mouse chromosome 16, which are orthologous to the genes triplicated on human chromosome 21. Ts65Dn mice have similar cognitive deficits to individuals with DS, therefore this mouse model is used to understand when and how these cognitive deficits occur. Dyrk1a is found on human chromosome 21 and encodes a protein that is involved in neurological development. We hypothesize that Dyrk1a expression is altered during different developmental time points and in different areas of the brain in Ts65Dn as compared to normal mice. Our preliminary data indicate that trisomic Dyrk1a is during the first two weeks of postnatal life in Ts65Dn mice. However, we don't know how different concentrations of Dyrk1a in each brain region affect the quantification of the protein. In tissue concentration studies, we are examining the linearity of Western blot Dyrk1a signals to determine the optimal Dyrk1a protein concentration from the linear portion of tissue concentration curves to use on Western blots. The knowledge gained from these data will help us attain maximal sensitivity and reliability to detect potential differences in Dyrk1a protein expression between trisomic and euploid mice. These can then guide optimal times for treatment with Dyrk1a inhibitors to potentially rescue cognitive development in DS mouse models, with the goal of translating these results to individuals with DS.

Charles Goodlett and Randall Roper

Exploring the Need for Quantifiable Soft Tissue Manipulation in Experienced Manual Therapists

Josh Roy[1], Abhinaba Bhattacharjee[2], Terry Loghmani[3]
School of Liberal Arts[1], Purdue School of Engineering and Technology[2], Department of Electrical and Engineering[2], School of Health and Human Sciences[3]

A common treatment administered by physical therapists world-wide is soft-tissue manipulation (STM). A problem with STM is that there has not been a clinically practical way to quantify the forces applied in a real-time, dynamic manner. This need led to the development of Quantifiable Soft Tissue Manipulation (QSTM™). Through our prior research and surveys, it became evident that there is a need for QSTM, but the initial reliability and consistency tests were performed on novices. The QSTM research and development team has been evaluating the variability of inter- and intra- therapist treatments in order to further explore the need for QSTM among all therapist levels, including experienced therapists. The QSTM team evaluated this problem by performing two trials, one without visual monitoring and one with visual monitoring. In the trial without visual monitoring the therapists were told to administer what they perceive as "high" clinical pressure against a smooth, hard padded surface. When doing it with visual monitoring they were told to apply an average high force of 15 N. These trials were done by two experienced (25+ years of training) therapists. Without visual monitoring there was a 25% difference (~5 N) between the examiners' average peak forces applied. But when administering with visual monitoring of the force, this difference minimized to 3% (~0.5 N). These results further validate the need for QSTM, not just as a training method for novice therapists, but also as a method to improve consistency of treatment forces among experienced therapists.

Mentor: Dr. Terry Loghmani

Towards low activity silica gas-solid 20 µm micropacked capillary gas chromatography
Ashur Rael[1], **Magnus Rydberg**[1,2], and John Goodpaster, PhD[1,2]
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Most samples that are subjected to chemical analysis are made up of multiple components. Gas chromatography (GC) is used to separate the individual components from one another prior to qualitative or quantitative analysis. GC works through the dynamic and continuous partitioning of molecules between a gas phases and a non-gas phase, which results in separation based on molecules' unique structures and properties. Traditional packed column GC uses columns with large inner diameters (ID) (e.g., 4 mm ID) and large particle diameters (dp) (e.g., 250 µm dp). These provide poor and slow separations. For many applications these columns have been replaced by open tubular capillary columns (e.g., 0.25 mm ID) which provide dramatic improvements. However, the low surface area of open tubular columns greatly decreases sample capacity and places limits on how efficient a useful column can be. Micropacked capillary (µPC) columns with small ID (e.g., 0.32 mm ID) and dp (e.g., 20 µm dp) may provide extremely efficient separations and high carrier gas velocities without reducing sample capacity, which overcomes the limitations of both previous column types. Surface activity of the packing material can negatively impact chromatography via strong intermolecular interactions and fluid choice for slurry packing can make significant differences in the column packing process. Here we investigate chemical methods for silica µPC column surface passivation and relationships between slurry fluids and silica particles for µPC column packing.

Mentor: John Goodpaster, Ph.D

S

Synaptic Expression of NP2 and AMPA receptor in contextual and cued fear conditioning
Juan M. Sanchez, Castro, Marian L. Logrip
Psychology Department, School of Science

Stress-related disorders are severe psychiatric conditions that affect people around the world and are of high cost to public health. Evidence indicates that repeated traumatic experiences can alter stress-responsive brain areas, leading to mental illness. One stress adaptation altering brain function is the addition of AMPA receptors at the synapse, which may be regulated by neuronal pentraxin 2 (NP2), moving AMPA receptors from extra-synaptic locations into the postsynaptic density through lateral diffusion. We hypothesized increased hippocampal (HIPP) expression after contextual and basolateral amygdala (BLA) expression after cued conditioning. To test this hypothesis, male and female Wistar rats (n=8-9 per group) were randomly assigned to contextual or cued fear conditioning training, and within training group to shock or control groups. All shock groups received 60 foot-shocks in 30-minute sessions, with or without 5-sec shock predictive light cues; control rats were exposed to matching light conditions without shock. Brains were collected 24 hours after conditioning, and synaptically enriched fractions isolated. Contrary to our hypothesis, no statistically significant differences were observed for NP2 or AMPA receptor subunit GluA1 between control and fear conditioned rats following either contextual or cued fear conditioning. The only significant difference observed in hippocampal GluA1 was between conditioning type, with higher GluA1 levels in cued fear conditioned rats. Overall, this suggests that neither training paradigm employed generated persistent changes in synaptic expression of GluA1 or NP2 on the day after the final conditioning.

Mentor: Marian L. Logrip

From Summer Orientation to Spring Finals: Tracking First-Year IUPUI Students as they Transition into College to Monitor their Utilization of Resources, Level of Involvement and Engagement, and Overall Success
Kristin L. Scriven
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As the number of students enrolling in college increases each year, so does the need for resources to accommodate and support student needs. First though, it is important to determine if students are aware of the resources available to them, and if not, how to better promote resources so that they are more accessible. Additionally, student success is likely affected by involvement with available resources. To study these areas, we conducted a mixed method longitudinal study that involved surveying first-year students five times during their first year at IUPUI and conducting interviews with on-campus and commuter students. We assessed how on-campus versus off-campus living affects not only awareness of resources but also students' involvement, engagement, and feelings of connectedness to IUPUI. To date, our findings align with existing research across the country. With the information gathered, we are more aware of the needs of IUPUI students and are able to offer the following recommendations: (1) advise first-year students of available resources in a consistent manner throughout the academic year, in addition to the surge of information disseminated at summer orientation; (2) train individuals who have high levels of contact with first-year students, such as resident assistants, instructors/professors, and academic advisors, to be more knowledgeable, transparent, and forthcoming with the promotion of on-campus resources; and (3) increase the level of ongoing support for first-year students throughout the entirety of the academic year. These findings provide evidence for adjusting our institution to fit student demographic needs to foster student success.

Mentor: Maria Brann, Department of Communication Studies, IU School of Liberal Arts, IUPUI

Determining the Residues that Mediate Angiomotin Coiled-Coil Homology Domain Vesicle Fusion Activity

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Angiomotins (Amot) are a family of adaptor proteins that control cellular signaling responsible for cellular differentiation and proliferation. These cellular events have been liked to regulation of invasive ductal carcinoma, the most common form of breast cancer. Their characteristic coiled-coil homology (ACCH) domain is of particular interest because of its capability to selectively bind phosphatidylinositol lipids (PI). These binding events subsequently lead to lipid membrane reorganization/deformation and vesicle fusion, which is seen in cellular contexts as juxtanuclear endosomal vesicle fusion to the apical membrane. As this fusion activity is important for maintaining normal cellular polarity, we looked to determine the residues that mediate this function. Therefore, we screened our library of arginine and lysine residue mutations in the ACCH domain for a loss of vesicle fusion activity and characterized hits for their vesicle fusion activity by determining the kinetic rate of vesicle fusion. This lead us to focus on 3 classes of mutations: 1) reduced (K72E, K187E, R234G); 2) higher concentration onset (K49E, R103G); and 3) obliterated (R40T, K76E, K111E, K136E, R221Q, R224E). Next we endeavored to determine if the lipid reorganization is a result of the vesicle fusion activity. Here, we utilize our mutations with obliterated vesicle fusion activity to determine if lipid mixing can occur as measured by fluorescence resonance energy transfer (FRET) probes. We hypothesized that vesicle fusion is required for complete lipid mixing to occur. Therefore, we expect that incubation of our mutants with vesicles containing lipid phase separating mixtures will not have an increase in FRET intensity as seen the probes will remain segregated from one another. Careful analysis of this data will provide insight into the ACCH domain structural elements that drive membrane fusion events.

Mentor: Ann Kimble-Hill

Issues in Tissue Processing and Identification for Genomic Sequencing in Riley Hospital for Children Pediatric Sarcoma Patients

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Pediatric sarcomas make up 13% of cancers in patients under the age of 20. Overall five-year survival rate is around 60%. A large percentage of pediatric sarcomas are Ewing sarcoma, rhabdomyosarcoma, synovial sarcoma, osteosarcoma, and others. Biomarker studies are being conducted to understand the underlying mechanisms and advance targeted therapies. Studies have turned to focus on genomic sequencing at the DNA level. The Precision Genomics Program at Riley Children's Hospital at Indiana University Health was created with this focus in mind. The program uses genetic testing to identify DNA, RNA and proteins that can be targeted with various treatments. Identification of high-quality tissue samples is imperative for this endeavor. Over 100 sarcoma cases were reviewed and followed pathology guidelines that were created by the GTEx (normal tissue) and TCGA projects (tumor) in 2012. The guidelines are as follows: H&E slides were QC'd for % of tumor (=60%), necrosis (<20%), stroma (<10%), and inflammation (<10%). This guideline was set by NCI Total Cancer Genome Atlas (TCGA). Additionally, the tissues were analyzed for number of viable cells for the genomics study (>400). Decalcified slides were removed from this genomics study. Out of the 79 deceased cases that were analyzed, 7 were decalcified and unavailable for genomic analysis. In 49 living cases 16 were decalcified and not viable for the study. Samples containing limited tissue such fine needle aspirations and blood smears were removed from the study.

Mentors: Sandusky, GE; Pandya, PH
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Machine Learning Methods for Image-Based Transcriptomics at Single-Molecule Resolution

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Recent developments in single-cell RNA sequencing (scRNA-seq) can precisely and quantitatively interrogate the genomic and transcriptomic profile of individual cells. However, the spatial profile of the transcriptome in a single cell is currently undervalued; the workflow of scRNA-seq unavoidably causes loss of positional information of gene expression. Image-based transcriptomics at single-molecule resolution has the potential to provide this valuable information lost regarding the subcellular localization of mRNA transcripts. At the same time, the size of datasets acquired through fluorescence imaging of mRNA and other biomolecules are immense and require a high-throughput computational pipeline to perform automated analysis of acquired point patterns. Therefore, in this project, a highly robust computational pipeline capable of measuring the spatial variables defining the spatial organization of mRNA transcripts and other biomolecules was developed. These spatial variables then serve as input to both supervised and unsupervised machine learning algorithms capable of performing common machine learning tasks such as class prediction and mathematical clustering. As a proof of principle, diffraction-limited images of the GAPDH transcript were acquired in HEK293 WT and U2OS WT cells through Fluorescence in situ Hybridization (FISH) and analyzed using the developed pipeline. Results indicate that the spatial organization of the GAPDH transcript are non-random amongst the phenotypes tested. Ultimately, the developed pipeline is sufficiently flexible for its application in image-based transcriptomics as well as other biological domains which generate fluorescence images requiring spatial analysis.

Mentor: Jing Liu, Department of Physics, IUPUI

Revisioning the Rococo through the Art of Maurice Quinten De La Tour

Clare Sheehan
Art History: Herron School of Art and Design

The current consensus regarding the Rococo period of France is that the art consists of decadent ornamentation, depictions of lavish lifestyles, and superficially beautiful portraiture. Although appreciated for its formal beauty, Rococo art has largely been accused of lacking soul and expression. Due to its direct association with the opulence of the French monarchy, Rococo has been chastised for its link to the excessive frivolity and hedonistic tendencies practiced by the French aristocracy of the 18th century. In direct contrast to Rococo's reputation of soulless frivolity, the Rococo portraitist Maurice Quentin De La Tour strove to create insightful portraits that go beyond superficiality. La Tour's portraits act as a direct pushback against the longstanding Art Historical opinions of the Rococo period. La Tour's artwork is neither frivolous nor superficial but rather focuses on expressing the inner-psyche of his sitters. Often celebrated as the greatest French pastel portraitist, La Tour's art has much to offer in terms of formal, emotional, and intellectual merit. However, under the influence of Enlightenment criticism La Tour's art has fallen victim to a paradigm which characterizes Rococo art as silly and idealistic. Therefore, to revitalize the reputation of Rococo art, a focus must be placed upon artists such as La Tour whose intentions directly combat the criticisms of the Rococo period. Through closer observation of La Tour's work, it becomes apparent that Rococo art should not be characterized as mere pandering to the French Aristocracy.

Mentor: Dr. Patrick Kinsman

hPSC-derived RGCs Display Target Specificity Towards dLGN Explants

Priya K. Shields[1], Clarisse M. Filgor[1], Jason S. Meyer[1,2]
[1]Department of Biology, IUPUI; [2]Stark Neurosciences Research Institute, IU School of Medicine

Retinal ganglion cells (RGCs) serve as a vital connection between the eye and the brain and as such, the loss of RGCs due to neurodegenerative diseases and injury can often lead to blindness. Due to their ability to differentiate into any desired cell type, including RGCs, human pluripotent stem cells (hPSCs) are attractive candidates for cell replacement therapies. However, in order for successful replacement of RGCs to occur, axons must be able to find, extend to, and synapse upon the lateral geniculate nucleus (LGN) of the thalamus. a major relay of the geniculostriate pathway. To test the potential for target specificity, uniformly chopped RGC organoids and LGN explants were cocultured for one week, allowing for neurite outgrowth from the RGCs to the LGN. A Western blot analysis was used to view relative synaptic protein expression of the RGC-LGN aggregates. RGC neurites identified by tdTomato expression reached lengths of over 1 mm in the first 24 hours of growth. Sholl analysis was conducted to reliably quantify the outgrowth of RGC neurites towards LGN explants by accounting for complex outgrowth patterns. RGCs also displayed recognition of appropriate targets, with the longest neurites projecting towards LGN explants as compared with control explants or RGCs grown alone. Overall, these results will facilitate the replacement of RGCs following their loss due to disease and degeneration, as axonal outgrowth and recognition of appropriate local targets will be critical for the development of personalized transplant therapies for optic neuropathies.

Mentor: Jason S. Meyer, Department of Biology, IUPUI; Stark Neurosciences Research Institute, IU School of Medicine

Room Temperature Quantum Memory Array

[1]**Orthi Sikder** and [2]Peter J Schubert
[1] Graduate Student, Department of Electrical and Computer Engineering, Indiana University-Purdue University Indianapolis;
[2] Professor, Department of Electrical and Computer Engineering, Indiana University-Purdue University Indianapolis.

From atoms to photons, the ability to store and utilize information using the laws of quantum mechanics is crucial to the future advancement of quantum computation. Quantum memory can hold multiple pieces of information at the same time. Thus, it promises significant boost in computational power by offering exponential scaling of bits. But such a memory requires a system which typically demands a very exotic hardware environment. In our work, we have proposed a memory array based on quantum principles which can be operated at ambient temperature, without the need for cryogenic systems. We are creating externally detectable conditions based on the presence or absence of a single hydrogen (H) atom mediated on the surface of a novel silicon structure (< 5nm). We are optimizing the design for achieving electrical and mechanical stability. However, for proper functionality it is crucial to consider the sensitivity of the device with respect to photon energy. Therefore, we are analyzing the detailed energy band structure of the proposed device for two distinct cases depending on the precise position of an adsorbed H atom on the surface. The electronic configuration determines conductivity through the device and controls the absorption spectrum of photons. By using both electronic and optical principles of this atomic-scale system, we have designed reading and writing procedures of the quantum memory bit. The most vital aspect of this work is to evaluate the performance of the proposed device. functionality at or around room temperature which offers the potential of moving one step closer to the ultimate visionaries of quantum computation to reality.
Mentor: Peter J Schubert, Professor, Department of Electrical and Computer Engineering, Indiana University-Purdue University Indianapolis.

Site-Directed Mutagenesis of a Fatty Acid Elongase Condensing Enzyme

Johnathon R. Simpson and Brenda Blacklock
Department of Chemistry and Chemical Biology, Indiana University-Purdue University Indianapolis

The first step in fatty acid (FA) synthesis is the condensation step, where a C_2 unit derived from malonyl-CoA is condensed with an acyl primer. This reaction is known to be catalyzed by two families of condensing enzymes; 3-ketoacyl-CoA synthases (KCS) and elongase (ELO)-like condensing enzymes. In recent years, KCSs have been well described and shown to use a reaction mechanism analogous to the familiar Claisen condensation. ELO has been shown to independently catalyze the condensation step of malonyl-CoA with an acyl-CoA, however, very little is known about its reaction mechanism. ELO has no conserved Claisen-like condensing enzyme catalytic triad,

the only conserved motif that is familiar is a LHXXHH histidine box. Here, we use a highly active ELO, EloA, from cellular slime mold Dictyostelium discoideum. EloA has a substrate specificity for monosaturated and unsaturated C_{16} and catalyzes the elongation of $16{:}1\Delta^{9}$ to $18{:}1\Delta^{11}$. Highly conserved residues in the LHXXHH histidine box were mutated via site-directed mutagenesis to examine their role in the condensation reaction. One highly conserved residue in the LHXXHH histidine box, H147, were replaced with an arginine residue to probe whether a positive charge was required for activity. Mutant EloA were expressed in saccharomyces cerevisiae and fatty acid methyl ester prepared were examined by gas chromatography/mass spectrometry. When compared to the wild-type EloA, the mutant EloA, H147 to an arginine residue, showed little to no production in $18{:}1\Delta^{11}$.

Mentor: Brenda Blacklock

The Effects of Raloxifene-Analog on Murine Bone Architecture and Fracture Toughness
Cayla G. Skaggs[1]; Katherine M. Powell[1]; Joseph M. Wallace[1]
[1]IUPUI Department of Biomedical Engineering, Indianapolis, IN

The drug Raloxifene (RAL) is currently used to treat osteoporosis in postmenopausal women to improve bone mechanical properties. The drug works as a selective estrogen receptor modulator (SERM). This estrogen therapy can cause undesired side effects and makes its use unfit for at risk populations, such as children with the genetic disease Osteogenesis Imperfecta. Recently, RAL has been shown to improve mechanical integrity through a secondary cell-independent mechanism by binding to collagen and enhancing bone quality at the microscopic tissue level. To further target this cell-independent mechanism, a Raloxifene-Analog (RAL-A) was synthesized such that the drug's affinity for the estrogen receptor was reduced. RAL-A was hypothesized to have similar mechanical effects as RAL but with decreased estrogen signaling activity. For this study, male wildtype (WT) and heterozygous (Het) mice from the Osteogenesis Imperfecta murine (OIM) model were given 0.5 mg/kg of RAL or RAL-A subcutaneously for 5x/week beginning at 8 weeks of age (n=7 to 10 per group). Animals were euthanized at 16 weeks of age. Right tibiae were scanned by micro-CT at a 10 μm resolution. Cancellous and cortical regions at the proximal metaphysis and mid-diaphysis, respectively, were analyzed using CTan software. Tibiae were then notched at the mid-diaphysis with a scalpel and tested to failure under 3-point bending. The fracture location was imaged with scanning electron microscopy to obtain crack angles, which were used to evaluate fracture resistance along with the mechanical data. A One-Way ANOVA with post-hoc Dunnett's test was used to statistically analyze the effect of each treatment versus control within each genotype.

Mentor(s): Katherine M. Powell[1]; Joseph M. Wallace[1]

Comparative Analysis of the Educational Systems of the United States and Costa Rica
Christopher L. Brophy [1, 2], Jacob M. Miller [2, 3], **Jaden T. Smith** [2, 4]
1. Department of Kinesiology, IU School of Health and Human Sciences, IUPUI; 2. IUPUI Honors College; 3. Department of History, IU School of Liberal Arts, IUPUI; 4. Department of Management, IU Kelley School of Business, IUPUI

The educational system of a country is the backbone of its social, economic, and political wellbeing. For a country to thrive, its educational system must do an adequate job of providing the population with the necessary resources to be competent and competitive in the social, economic, and political realms. The purpose of this project is to comparatively analyze the educational system of Costa Rica to that of the United States. The project will compare the distribution of wealth for education, the presence of the teachers, and the availability of materials in the schools to those of the United States. The group completed observational research in two primary schools in Guanacaste, Costa Rica, as well as analytical research about the two countries' educational systems. The poster will include photos of this experience, as well as information and data gathered through experience and research regarding the educational system of the two countries. The results of the research are still pending, as is the conclusion, at the time of submission, but both will be provided within the poster presentation.

Mentor: Kristina K. Horn Sheeler, Executive Associate Dean, IUPUI Honors College

Development of Aminooxy Reagents for Analysis of Carbonyl-Containing AHAS and ALS Biosynthetic Products
Maggie Stinnett,[1] Alexander Latta,[1] Michael McLeish,[1] Sébastien Laulhé[1]
Department of Chemistry & Chemical Biology, Indiana University-Purdue University Indianapolis[1]

To meet the increasing demand in the world's food supply, crop production may be maximized using herbicides. Acetohydroxyacid synthase (AHAS) and acetolactate synthase (ALS) are two enzymes capable of forming (S)-acetolactate, a compound required for valine biosynthesis. Additionally, AHAS can form (S)-acetohydroxybutyrate, a precursor to isoleucine, while ALS cannot. Therefore, selective inhibition of AHAS prevents synthesis of isoleucine and valine, systematically leading to plant death. Introduction of an ALS mutant capable of fulfilling the biosynthetic role of AHAS into a plant genome could yield an herbicide-resistant species analogous to Roundup® resistant crops. Importantly, since the biological pathway that includes AHAS is not found in humans, such an herbicide could be innocuous to farmers and fauna. Current methods for isolating (S)-acetolactate and (S)-acetohydroxybutyrate from AHAS and ALS require a chemical decarboxylation step that is time consuming, involves special equipment, leads to loss of product, and fails to retain the original stereogenic information of the product. Our aim is to create a series of chemoselective derivitization reagents to analyze (S)-acetolactate and (S)-acetohydroxybutyrate production by our ALS mutant enzymes. Previous literature demonstrates that an aminooxy moiety will selectively react with carbonyls to yield stable oxime ether compounds. Design features of our two aminooxy-containing reagents include elements to facilitate analysis by gas chromatography-mass spectrometry (GC-MS) and liquid chromatography-mass spectrometry (LC-MS).

Mentor: Sébastien Laulhé, Department of Chemistry & Chemical Biology, IUPUI

Mental Accounting in the Gig Economy

Sasha Strzeszkowski
Marketing Department, IU Kelley School of Business

As employees in the gig economy gain more autonomy over their work and payment schedules, their mental accounting becomes more complex. Marketers will benefit from this research because income type (money earned from traditional or gig jobs) has shown to have an effect over hedonic or utilitarian consumption. This poster strives to discover the underlying feelings and attitudes that motivate this difference in consumption so that marketers can more effectively target these different consumers. Study 1 looks at ego-depletion as a possible explanation for the increased hedonic consumption of the gig economy. Study 2 tests the perceived importance of various expenditures based on income source. Study 3 assesses the difference in consumer spending with regards to the ability of the participant to cash out her earnings, as is a new payment method of gig jobs such as Uber and Lyft. Study 1 ran on Sona, meaning the sample consisted of undergraduate students, while studies 2 and 3 ran on Amazon's Mechanical Turk, yielding a more diverse sample. There were no significant differences in tiredness between conditions in study 1, however, more participants dropped out of the gig condition than the traditional condition. Study 2 found that individuals in the cash-out condition perceived their commitments and expenses to be more important than those in the payday loan condition. For study 3, again there were only directional differences between consumer spending and the conditions. Future research will build upon the difference in perceived importance of spending based on income type.

Mentor: Helen Colby, Marketing Department, IU Kelley School of Business, IUPUI

Analysis of Osteoporosis Research

Katie A. Swafford[1] and Carol Shieh[1]
Department of Nursing, Indiana University[1]

Osteoporosis is a progressive, debilitating, and prevalent disease, both physically and financially. Preventive interventions across different populations are needed but scarce. A literature search utilizing keywords (i.e., osteoporosis, prevention, treatment, interventions, medications and risk) via CINAHL and Ovid was conducted to identity observational and randomized controlled studies. This abstract reports findings from analysis of five selected studies focusing on educational initiatives, preventative measures, and pharmacological regimens of osteoporosis. Interventions providing education, counseling, and workshop for skeletal physiology, bone health, risk factors, and prevention measures (calcium intake, vitamin D, physical activity) showed positive impacts on increasing knowledge, self-efficacy, calcium intake (343.2 mg/day (95% CI= 337.4 to 349.0, $p < .0005$), and duration of load-bearing moderate to vigorous physical activity (55.6 min/week,95% CI = 54.5 to 56.6, $p < .0005$) compared to the standard care group. Three of the five interventions were conducted on young women, women of breast cancer, and employees of a workplace. Outcomes were measured from two weeks to six months after an intervention. Pharmacological regimens of vitamin K2 and risedronate on older population of 65 or older did not show favorable outcomes in bone mineral density and incidence of fracture at 6, 12, and 24 months after the intervention. Insufficient iron intake was associated with osteoporosis and more significant in women than men. In summary, while the diagnosis of osteoporosis often occurs later in life, knowledge of risk factors and lifestyle modifications in one's early years is useful towards decreasing the unfavorable effects of osteoporosis.

Mentor: Advisor: Carol Shieh, IU School of Nursing, IUPUI

T

Design, Build, and Test Nanoparticle Delivery Systems in Head and Neck Cancers

Dua Tariq[1], Mark P. Langer[1]
Department of Radiation Oncology, IU School of Medicine[1]

The application of radiation and chemotherapy in head and neck cancers often leads to damage to the surrounding tissue during passage of beams and agents, respectively. The goal of this project is to develop customized tagged nanoparticles to deliver diffusible cytotoxic agents directly into tumors. With the help of the IU 3D printing lab we designed a model of a human mouth and trachea with a small notch near the back of the gel tongue where we would place the tumor. Using red grapes as our primary test material we have been using the Injection of Isoview 370 intravenous contrast dye. Using the Carefusion Alaris PC IV pump and manual hand injection allowed 0.2ml-0.5ml of dye to be fully immersed in the model. The programmed injection rate of IV pump was set to 30ml/hr (maximum allowed). Each grape was injected using a BD Precision Glide Needle 30g connected to a 1ml graduated syringe. Grapes were then injected (with the residue wiped clean from surface), and CT scanned with the IU "Head & Neck" CT protocol. We are currently looking into the use of hydrogel polymers that can wrap around the "tumor" model, so we can avoid leakage of the nanoparticle and maintain osmotic pressure. With our project in its initial stages much more needs to be done but our research can potentially help rid of the harmful side effects of chemotherapy and radiation focusing only on specific targeted delivery to the tumors in hopes of increased shrinkage or eradication altogether.

Mentors: Mark Langer, Department of Radiation Oncology, IU School of Medicine, IUPUI; Paul Yearling Department of Engineering Technology, Director of Mechanical Engineering Technology, IUPUI;

Sexual Dimorphism in Skeletal Abnormalities in Down Syndrome Mice
Jared Thomas[1], Adam Knox[1], Eva Lana-Elola[2], Sheona Watson-Scales[2], Elizabeth M. C. Fisher[3], Victor Tybulewicz[2], and Joseph M. Wallace[4], Randall J. Roper[1]
[1]Department of Biology, Indiana University-Purdue University Indianapolis, Indianapolis, IN
[2]The Francis Crick Institute, London, UK

Three copies of human chromosome 21 (Hsa21) causes Down syndrome (DS) and phenotypes including craniofacial dysmorphology and skeletal deficits. Sexual dimorphism in DS skeletal deficits has been hypothesized, however, differences in age, methodology, and tissue in human studies have impacted interpretation of these results. DS mouse models exhibit skeletal abnormalities similar to those found in humans but differences between male and female mice are not well understood. The Dp1Tyb DS mouse model contains three copies of all the Hsa21-orthologous genes found on Mmu16 (~148), both trisomic males and females are fertile, and may be a better model to study DS phenotypes. We hypothesized that femurs from trisomic Dp1Tyb male and female mice at 6 and 16 weeks would exhibit distinct differences in microarchitecture, cellular composition, and strength. Female Dp1Tyb mice exhibited weaker bones and perturbed microarchitecture compared to male mice at both 6 and 16 weeks, exhibiting a sexual dimorphic phenotype. Additionally, trisomic mice showed deficits in both architecture and mechanical properties compared to euploid mice. Static and dynamic histomorphometric analyses indicate skeletal deficits observed between female and male mice appear to result from changes in cellular activity. Overall, it appears male vs. female mice have stronger bones across age and genotype, suggesting trisomy disrupts bone homeostasis resulting in skeletal abnormalities. Understanding the genetic and cellular mechanisms of skeletal deficits in DS mouse models provides a basis for further investigating sexual dimorphism in humans with DS and proposing novel treatments to correct these deficits.

Mentor: Randall J. Roper, Department of Biology, IUPUI School of Science

Decreasing Infant Mortality and Increasing Prenatal Care
StaSanna Thomas-Morris
IU School of Nursing
This research is being conducted to determine if prenatal care has an impact on the reduction of infant mortality rates in African-American women. As there is an increase of infant mortality rates amongst African-American women, with no determined cause, this research will pin point a probable cause. In this research I will collect data from numerous articles, books, and faculty research mentors. Along with the research portion of it, I will look at prenatal care vs non-prenatal care and each one's rates of infant mortality. I strongly believe that prenatal care decreases the rates of infant mortality. With prenatal care being a possible factor reducing infant mortality rates, it will impact more African American women to seek prenatal care in order to possibly prevent infant mortality. With this finding, black populations will no longer have to seek answers on why their children are dying, and it saves them money for prevention death after birth.

Mentor: Patricia Jordan, Department of Africana Studies, IU School of Liberal Arts, IUPUI

Renewable Energy's Present and Future Outlook
Elysa Thompson[1]
[1]Department of Mechanical and Energy Engineering

Today's technology is continually adapting and overcoming its previous limitations – including renewable technology. The author has built an understanding of today's renewable technology to build and construct a forecast of the role that renewables will play in tomorrow's society. An understanding is being developed by the author of the current green technologies with the purpose to then inform the audience of where America stands in the global perspective of renewable technology. Also, inform of the different kinds of technologies and the perspective developments and integration of these technologies throughout the world are addressed. A discussion of how to better integrate energy efficiency using renewable technology coupled with other methods such as auditing of one's energy usage are too addressed. The author strives to present the history, growth, and outlook of energy not only in America but globally to further break down the trends and future renewable technology.

Mentor: Ali Razban, Department of Mechanical and Energy Engineering

U

Effect of Nicotine on Fusobacterium nucleatum Biofilm Formation on Titanium Surfaces
Carter Ulrich[1], Richard L. Gregory[2]
[1]Department of Biology, Indiana University-Purdue University Indianapolis; [2]Department of Biomedical and Applied Sciences, Indiana University School of Dentistry

Fusobacterium nucleatum is a gram-negative anaerobic bacterium that is prevalent in the oral cavity and dental plaque. It has been shown to play a central role in formation of dental plaque and is associated with multiple periodontal diseases. The ability of F. nucleatum to form biofilm and adhere to so many microorganisms associated with periodontal diseases makes it a good target in the treatment of such diseases. Peri-implantitis is one disease that F. nucleatum has shown to be found in higher concentrations in biofilm associated with affected titanium implants. This disease is centered on the infection and inflammation of the area around a dental implant, which is usually made of titanium alloy. Bacterial infections have an important role in the failure of dental implants, but smoking is also thought to be a contributor to the development of peri-implantitis. The objective of this study was to determine the effect different nicotine concentrations had on the ability of F. nucleatum to form biofilm on the surface of titanium discs. F. nucleatum was incubated with titanium discs in Brain Heart Infusion +Yeast Extract medium supplemented with 5% vitamin K and Hemin at the following nicotine

concentrations: 0, 0.25, 0.5, 1, 2, 4, 8, 16, and 32 mg/mL. The biofilm on the discs was removed by sonication, the bacteria were plated on Blood Agar plates, and the colonies were counted. The results suggest nicotine-treated cultures, up to 16 mg/mL, significantly increased ($p<0.05$) the number of F. nucleatum cells up to 3-fold on titanium surfaces.

Mentor: Richard L. Gregory, Department of Biomedical and Applied Sciences, Indiana University School of Dentistry

V

Short-term pharmacologic inhibition of RAGE suppresses bone
Sinai Valdez[1], Hannah M. Davis[2] and Lilian I. Plotkin[2]
[1]Indiana University School of Science, Indiana University-Purdue University Indianapolis [2]Department of Anatomy & Cell Biology Indiana University School of Medicine

Osteocytes, cells embedded in the bone matrix, are key in regulating bone turnover by controlling the function of bone-forming (osteoblast) and -resorbing (osteoclast) cells (Burr & Allen, 2014). Research from previous work indicates a specific gap junction protein called connexin43 was observed to be an important component of the signaling pathway controlling osteocyte survival Bivi, 2012 (JBMR). Further, aging decreases connexin43 and deletion of this protein was found to mimic the skeletal phenotype of old mice (Davis,2017). Based on these findings we sought to further examine link between osteocyte apoptosis and osteoclast differentiation. Previous studies have shown that high mobility group box 1 protein (HMGB1), a pro-inflammatory cytokine that activates the receptor for advanced glycation end products (RAGE), is released by dying osteocytes and mediates osteoclast recruitment/differentiation (Plotkin, 2016). In order to address the role of these molecules in the skeleton, we injected mice with a small molecule RAGE inhibitor in order to prevent HMGB1-RAGE activation. The data collected so far further confirms the role of RAGE signaling in osteoclast differentiation as evidenced by the decreases in osteoclast number/bone surface in animals treated with the RAGE inhibitor.

Mentor: Dr. Lillian I Plotkin

Optimizing Aerosolized Intranasal Drug Delivery at the Preclinical Level using Multifunctional Nanocarriers and Advanced Neuroimaging
Madison Velchek[1], Jacob Peters[1], Jorge Ortiz[2], Melody Hsieh[1], Agatha Beier[3], Brynelle D'Rosa[4,5], Riley Bottoms[6], Yooran Im[7]
Indiana University Purdue University – Indianapolis (IUPUI) Departments of:
Biomedical Engineering[1], Mechanical Engineering[2], Health Services Managment[3], Neuroscience[4], Biology[5] Chemistry[6], Biochemistry[7]

The purpose of this research project is to optimize a prototype aerosolized intranasal nanoparticle (NP) delivery and interface with a positron tomography (PET) imaging system for in vivo intranasal delivery assessment in a living animal. Many drugs, including nanoparticles (NPs), that could potentially treat central nervous system diseases are not available orally or intravenously due to the blood brain barrier (BBB). Intranasal drug delivery (INDD) can potentially overcome BBB limitations because the nasal environment contains a direct transporting mechanism from the mucosal surface of the nasal cavity to the brain. A prototype 3D printed aerosolizer combined with simple electronics and tubing was developed previously but the aerosolizer was not optimized from a fluid dynamics or biomedical engineering standpoint. Various design applications were implemented to ensure accurate and reproducible delivery of NPs onto the nasal mucosa for absorption. NPs were and measured using transmission electron microscopy and dynamic light scattering. Finally, an anesthesia induction chamber was designed to hold the aerosolizer and interface with our PET scanner for in vivo assessment of nose to brain uptake following INDD of our NPs via the aerosolizer. We both reduced nanoparticle size by refining experimental methods, characterized spray patterns of the INDD to find proper spray duration and magnitude of air pressure, and modified the induction chamber for integration with INDD as well as the MR-PET unit. These optimizations of nanoparticles, INDD, and induction chamber will allow advisors to perform rat imaging to further validate and explore intranasal administration of drug nanoparticles.

Dr. Michael C. Veronesi, M.D., Ph.D., Department of Radiology and Imaging Sciences, Indiana University School of Medicine; Dr. Yeonhee Yun, Ph.D., Department of Radiology and Imaging Sciences, Indiana University School of Medicine; Dr. Julie Y. Ji, Ph.D., Department of Biomedical Engineering, IUPUI

W

Accuracy of Attenuation Correction in SPECT/CT, Myocardial Perfusion Imaging
Justina Weiss, Kathy Granger, Cybil Nielsen
Department of Nuclear Medicine Technology, IU School of Medicine

The purpose of this research was to determine whether the algorithm that is currently being used for attenuation correction in SPECT/CT is accurately returning the counts lost in varying levels of attenuation. Method: We ran 15 non-gated myocardial perfusion imaging (MPI) acquisitions on a Siemens SPECT/CT for the phantom without adipose, the phantom with 1 layer of adipose, the phantom with 2 layers of adipose, and the phantom with 3 layers of adipose. Each acquisition involved obtaining images of a cardiac phantom containing 185 megabecquerel (MBq) of pertechnetate and a standard activity of 37 MBq in a point source, simulating background lung activity. The acquisitions were run on the phantom without adipose, and again with one, two, and three layers of adipose secured to the outside of the thorax phantom. An LHR was collected after each myocardial perfusion imaging acquisition was processed. A two sample t-test was used to analyze LHRs. Results: All three samples (1-layer, 2-layer, and 3-layers of adipose tissue) yielded a p-value of less than 0.05 when compared to the phantom with 0 layers of adipose tissue. Conclusion: The algorithm used in hybrid Siemens SPECT/CT for myocardial perfusion imaging may not accurately represent the counts absorbed by adipose tissue.

Mentor: Cybil Nielsen, Department of Nuclear Medicine Technology, IU School of Medicine

Analysis of Trace Explosives Using Gas Chromatography/Vacuum Ultraviolet Spectroscopy
Payton M. West[1,2], Courtney Cruse[1], John Goodpaster[1,2]
[1]Department of Chemistry & Chemical Biology, IUPUI School of Science; [2]Forensic & Investigative Sciences Program, IUPUI School of Science

This project concerns the analysis of trace evidence of explosives using a technique called gas chromatography/vacuum ultraviolet spectroscopy (GC/VUV). The VUV is a new detector with potential to complement the common method for forensic analysis of explosives which is mass spectrometry. The objective of the project is to assess the ability of the GC/VUV to analyze explosives for application in forensic science. This research works towards determining the limits of detection (LODs), linear ranges, and the sensitivity for various explosive compounds. Calibration curves have been constructed using concentrations ranging from 5 ppm to 1000 ppm. The calibrants were run using two different inlet liners including straight without glass wool and double taper with glass wool. Current results indicate that the splitless inlet liner without glass wool has a lower calculated LOD for both 2,4-DNT and 2,6-DNT. The LODs of the following compounds have been calculated: 2,6-dinitrotoluene, 2,4-dinitrotoluene, 2-nitrotoluene, 3,4-dinitrotoluene, 3-nitrotoluene, 4-nitrotoluene, and 1,3-dinitrobenzene. The second component of the project is developing the VUV reference library with the spectra of explosive compounds of interest that have yet to be analyzed. This is done by running the compounds and adding the VUV spectra to the VUV library for future matches by the software.

Mentor: Mentor: John Goodpaster, Department of Chemistry & Chemical Biology and Forensic & Investigative Sciences Program, School of Science, IUPUI

Photobiomodulation of Fibroblasts
Taylor A. Whitaker
Department of Biomedical Engineering in Purdue School of Engineering and Technology

This research aims to investigate the behavior of fibroblasts in response to light. Fibroblasts are an essential cell in the wound healing process. They make up proteins such as elastin and collagen that provide structure to organs. It is becoming recognized that red light whose spectrum is between 600-1100 nm affects a variety of cellular functions including cell viability, proliferation, migration, and protein synthesis. The effect of various parameters involved in this light therapy (i.e., photobiomodulation) on cell functions such as light intensity, irradiation time, and irradiation frequency that will be investigated during this experiment was determined. The light intensity used was 0 to 5 J/cm^2, the irradiation time was 10 minutes, and the irradiation frequency was every 12 hours. The primary objective of this project was to examine cell viability of fibroblasts in response to light and identify the optimal photobiomodulation condition that promotes wound healing. In this project, fibroblasts were grown and light was applied with different doses under the guidance of Dr. Na. Then, cell viability was examined at different time points. Finally, the optimal photobiomodulation condition that stimulates wound healing was determined. This project contributed and will continue to contribute to a better understanding of the role of photobiomodulation in fibroblast-driven wound healing.

Mentor: Dr. Sungsoo Na

Perceptions of volunteering as a means of career advancement
Jamani Williams
Purdue School of Engineering and Technology, IUPUI

Lilly Global Day of Service (LGDOS) is an annual event where Lilly employees spend time out of the office helping their local community. Following the 2018 LGDOS, a survey was sent out to participants to learn more about their perceptions of impact, implications of team building, strengthening the community, and their motivation for participation. For this research, we look at what extrinsic factors encourage employees to volunteer and discuss how these findings can be used to leverage increased employee participation.
Utilizing descriptive analysis and chi-squared tests for independence, the motivation factor “I wanted to add volunteer experience to my resume” is explored in relationship to volunteering and career advancement. Additional variables such as: volunteer hours, years employed at Lilly, years in the workforce, employee age, employee level of education, and employee job level are included in the analyses. Based upon these findings, we suggest that workers who are at earlier stages in their career, or in lower positions in an organization, are more likely to include career advancement as a motivation for volunteering than those who are more established within their career trajectory.

Mentor: Brandon H Sorge, Katrenia Reed Hughes

The Crosstalk Between Neurons and Osteocytes for Mutual Growth
Christian Winter[1], Jung Min Hong[1], Junmei Wang[1], Chandler Walker[1], Angela Bruzzaniti[1]
[1]Department of Biomedical and Applied Sciences, IU School of Dentistry

The nervous system is important for bone development and repair, and spinal cord injuries negatively impact bone mass. Conversely, damage to bone affects osteocytes, the bone cells embedded in mineralized bone, which secrete growth factors that may act on neurons. Neurons lacking Kalirin (Kal-KO), a GDP/GTP-exchange factor, show decreased neurite outgrowth and communication with neighboring neurons. Similar to neurons, osteocytes form dendrites, and Kal-KO osteocytes have shorter dendrites, and a low bone mass phenotype. The hypothesis of this study is osteocytes and nerve cells can communicate through paracrine signaling factors which regulate dendrite lengthening. Osteocytes isolated from long bones of WT and Kal-KO mice were cultured for 7 days and the

conditioned medium (CM) was collected. NSC-34 cells were injured with a pipette, then treated for 24 hours with the CM from WT or Kal-KO osteocytes. Conversely, primary osteocytes from mice were cultured for 2 days with 50% or 25% CM prepared from NSC-34 cell cultures. The dendrite phenotypes of the neurons and osteocytes were then analyzed by microscopy. Our results indicate that osteocyte CM increases dendrite outgrowth of NSC-34 cells. NSC-34 cells treated with CM from Kal-KO osteocytes, but not WT osteocytes, showed decreased neurite length. We conclude that crosstalk between osteocytes and neurons may mutually regulate their activity. Moreover, osteocyte secreted signaling factors increase the growth of neuronal dendrites, with Kal playing an important role in this process. These findings have implications for the regeneration of both neurons and bone.

Mentors: Angela Bruzzaniti, Department of Biomedical and Applied Sciences, IU School of Dentistry; Chandler Walker, Department of Biomedical and Applied Sciences, IU School of Dentistry

Cerebellar tDCS improves performance of a timing-based video game more than M1 tDCS or practice alone.
Mackenzie E Wolfe, Skyler R Stevens, Joselyn Perez, Anthony Meek, Zachary A Riley
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Transcranial direct current stimulation (tDCS) is a brain stimulation technique that has been applied to the motor cortex (M1) to facilitate learning of skilled, dexterous hand tasks. However, when there is a timing component to the motor skill, tDCS is usually applied to the cerebellum (CB). The purpose of this study was to compare M1 tDCS and CB tDCS to determine which resulted in better performance and timing accuracy of a motor skill involving dexterous finger movements and timing. 97 healthy adults (age: 18-33 ± 3.1) were randomized into M1 anodal (n=25), CB anodal (n=24), CB cathodal (n=24), or CB sham (n=24) stimulation groups. The task used the Step Mania video game that is timing-based and involves pressing the correct arrow keys on a keyboard at specific times when scrolling icons overlapped on a computer screen. Each subject practiced the task at least two times to obtain a pre-practice score. Each key press corresponded to a time relative to the optimal key pressing time. This put each key press into bins corresponding to an accuracy score. If the subject pushed the key optimally they were given a score of 1, and the score decreased as they were further away from the target (0.75, 0.5, 0.25, 0, and a complete miss, -1). Scores for each trial were an average these numbers. Each subject completed ~2 minutes of practice followed by ~2 minutes of rest and repeated these 5 times for 20 total minutes of practice. Post-test scores were obtained 5- and 10-minutes following practice. During practice, tDCS electrodes placed over the M1 cortical area for the non-dominant hand and the contralateral supraorbital area and for the CB conditions, the electrodes were centered 1cm below inion and over masseter muscles. These electrodes delivered a current of 2mA in the anodal or cathodal conditions. Sham stimulation was applied according to established blinding procedures with a brief ramp in current followed by the current ramping back down. There was an improvement in performance over time and condition while adjusting for baseline performance ($p=0.001$). Improvements in performance occurred sooner in the CB – anodal group at practice trial 4 ($p=0.046$). Significant improvements in performance did not occur until trial 5 for CB – cathodal ($P=0.40$) and trial 6 for both M1 – anodal ($p=0.035$) and sham ($p=0.005$) conditions. Gain scores (score – baseline) were calculated for errors of each condition. Error gain scores did significantly improve over time ($p<0.001$). CB – cathodal gain scores produced significantly different gain scores during the 5-minute ($p=0.021$) post-practice while the CB – anodal condition did not result in any improvements in minimizing errors. The sham error gain scores did significantly differ at the 5-minute ($P=0.002$) and 10 minutes ($p=0.017$) post-practice. In the context of motor learning, these results show that CB – anodal tDCS may elicit greater improvements in performance while CB – cathodal tDCS may reduce the number of errors produced during the timing-based video game.

Identification of amino acids essential to the structure/catalytic properties of ELOs though site directed mutagenesis
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The far-reaching abundance and diverse functionalities of fatty acids and their derivatives has led to extensive research on the compounds for decades. Further studies into a specific derivative known as Very Long Chain Fatty Acids (VLCFAs) showed that VLCFAs were synthesized separately from other fatty acids, by a dehydrase, a pair of reductases and a condensing enzyme forming a complex of enzymes found at the membrane of the endoplasmic reticulum. As an understanding of these enzymes was being developed, a family of condensing enzymes known as ELOs was observed to be drastically different from other condensing enzymes. ELOs lacked a catalytic triad essential to the mechanistic explanation of condensing enzymes and bear no topological or primary sequence resemblance to familiar condensing enzymes. These differences suggest ELOs catalyze condensation reactions using novel chemistry. Through the site-directed mutagenesis of highly conserved residues across the ELO family, amino acids that are vital to the catalytic properties of ELO will be identified. One highly conserved residue H148 was replaced with arginine to test whether the positive charge was required for proper ELO function. Studies going forward include the site-directed mutagenesis of K123 to histidine and H177 to arginine to determine these residues importance in VLCFA production.

Mentor: Brenda Blacklock

Y

Additive Manufacturing of Polymer Derived Oxides
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Polymer derived ceramic (PDC) provides a novel additive manufacturing approach to produce complex ceramic components. Preceramic resin (mercaptopropyl) methylsiloxane (GELEST) with particle reinforcement materials and photoinitiator TPO were used to

produce PDC samples. The resin was printed by an SLA 3D printer and was then pyrolyzed in a furnace. Blending of the polymers and SILRES® 604 were studied to optimize the additive manufacturing process and properties. The thermal and shrinkage stabilities were improved with the SILRES® 604. The PDCs demonstrate high geometric accuracy in the porous structure and hollow venation patterns. By adding the SILRES® 604 materials, the ceramics compositions show good properties on heat resistant.

Mentor: Jing Zhang

Z

Removal and Repair Methods for Damaged Thermal Barrier Coatings
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In this work, several methods to remove and repair the top ceramic thermal barrier coatings are summarized. The individual methods are presented. In addition, all the process principles are comprehensively summarized followed by the assessment of the pros and cons of each method. Removal methods for thermal barrier coated components: grit Blasting, chemical stripping, water jet and laser ablation were studied. At the same time, repair methods for thermal barrier coated components: plasma spraying, chemical paste were survived. The possible calculation and simulation methods are mentioned. The results will be compared with experiment results.

Mentor: Jing Zhang