2017 CRL Student Summer Poster Symposium

Thursday, July 27, 2017
1:30pm - 2:30pm

Session A

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1:30pm - 2:30pm

1. **Media Perceptions of Leaving a Youth Gang**

Kayla Young
School of Public and Environmental Affairs, IUPUI

The interpretation of gangs by media outlets typically involves many misconceptions that contradict what current research suggests. These misrepresentations may alter the way youth gangs aretreated in society and criminal justice institutions. The goal of this study is to highlight similarities and differences between media accounts of the motives, methods, and consequences of gang desistance and that of academic research. A content analysisof 990 articles from 1987 to 2017 was completed to examine the media accounts of gang desistance and results were compared to findings from gang desistance research. Results showed that there are inconsistencies in motives, methods, and consequences when compared to prior research, for example, criminal justice interventions and social institutions are found to be the most common motivations for leaving a gang, but this is not supported by previous research. My findingsled to the conclusion that media outlets can distort the gang desistance process, which can negatively impact individuals who are trying to disengage from gang life. Both researchers and journalists should work to bridge the gap between research findings and media reports.

2. **Impact of Colonialism on Regional Languages and the Dominance of the English Language: India as a Case Study**

Varshini Balaji,
Department of English, Indiana University School of Liberal Arts at IUPUI

This study explores the relationship between power and the English language in modern India. The purpose of this study is to understand how colonialism impacts languages andthe widespread usage ofthe English language in India. It also studies the evolution of languages with the advent of globalization, social media, and language hierarchy.This study attempts to recognize the impact of the dominance and prevalence of the English language on policy making, politics, and education systems in India. Much of the data in this study was gathered in the form of an anonymous survey sent to Indian Americans, Indian international students, and Indian students with international exposure in universities around the world.A few follow-up interviews were conducted to better understand the survey responses and delve deeper into some of the participant's perceptions. This study is proving to be consistent withexisting research about language and power in identifying that theEnglish language is an important predictor of financial access and success in the Indian society. This research shows how colonization continues to manifest in different forms and aims to contribute to decolonial work by attempting to understand issues ofaccess, power, privilege, and oppression and equip people in positions of power and privilege to be informed allies with the oppressed.

3. **Planar Planks: Building a Connection Between Digital Art Fabricationand Art Therapy for Children on the Autism Spectrum**

Cynthia L. Elkins1,Cory D. Robinson2,
1Art Therapy, HerronSchool of Art and Design, IU; 2Fine Arts Chair, Herron School of Art and Design, IU

The objectives of this project are a two-phase process of undergraduate research, in phase one the objective is: to design/fabricate and manufacture a series of Planar Planks, utilizing the TIMI Lab. Through generating basic shapes or Planar Planks the ability to work with an interlocking system, which can produce 3d artistic sculptures can then be used as a medium for creative expression in the therapeutic process of Art Therapy. Upon completion of the design, an interactive public exhibition would be presented, which not only displays the sculptures created from the planks, but also provides the interrelated elements to allow the public to build their own elaborate 3d sculptures from these basic shapes. The intention of this exhibition assistsin raising community awareness, demonstrating the diverse approaches of digital technology and how to integrate these processes for a therapeutic environment creating an artistic aesthetic and creating a viable medium to be used in art therapy for autistic children. In phase two aspect of the undergraduate research, an actual implementation of using these "Planar Planks" as a part of a study in an art therapy setting to monitor level of engagement the individual has in response of this particular medium.

Mentors: Dr. Cory Robinson, Fine Arts Chair, Herron School of Art and Design, IU

4. **The Conservative Conundrum: LGBTQ+ Sexualites and Religious or Spiritual Identities**

Kasen D. Welling
Department of Religious Studies, IUPUI School of Liberal Arts

The purpose of this research is to further understand the intersection between religiosity and spirituality and LGBTQ+ identifying people. This research is important because as homosexuality (among other identifies within the LGBTQ+ spectrum) is becoming more widely accepted within the public sphere, it is still viewed negatively in most religiously conservative communities. This research asks about the ongoing conversation onhow homosexuality is viewed in various types of religious communitiesand how this affects the person who must attempt tounderstand how theirLGBTQ+sexual or gender orientation intersects with the religion of their parents.The methodology for this project includes a qualitative study using semi-structured interviewsto gather data. Ten participantswho identify within the LGBTQ+ spectrumwere asked a series of questions which sparked conversation about the participant's experience with religion and spirituality.All participants were between the ages of eighteen and thirty.Interviews were recorded and analyzed and I notedemerging themes throughout the process. Results suggest that those who were raised in households with a heavy emphasis on religionwere likely to identify outside of the religious identity in which they were raised. I also found that participants who were raised in strictly religious householdsgenerallyhad a more difficult time understanding and accepting their sexual or gender identities. I conclude thatthose within the LGBTQ+ spectrum areless likely to identify as religious, but not necessarily non-spiritual, because of the negative association they hold between religious culture and heteronormative roles and values.The researchhere will contribute to existing scholarshipabout the clash between LGBTQ+ individuals and religiousidentity, while also shining a light on how conservative values manifest in forms of religious beliefs, which in turnaffectsthose who identify outside of these rigid norms and often as spiritual but not religious.

5. **3D Printing of Large ScaleCeramic Components**

Kassie Woodworth, Zack Hurst, Lesley Baker, Glorio Singui, Oyedotun Ayeni, Jeremiah Rhoades, James Hickey, and Jing Zhang,
Herron School of Art and Design and School of Engineering

Introduction:We are building a large scale 3D printer that will extrude ceramic material. This system will be able to extrude various clay body strengths and create larger products than the common Delta style 3D printer. Unique sculptural forms will be created with this printer that will then be fired in a kiln. Objective:Our six-foot-tall Delta 3D printer will be able to print larger scale products, more precise and higher quality prints, have less vibration at the base, and will be able to print more intricate forms. Methodology/Approach:Experiments were tested on the smaller, three foot, Delta printer that we already had made. We tested a hose extrusion system with a 3D part that we designed. Results:The overall outcome of our project is a solid, aesthetically pleasing design that has improved user interface, reduced the amount of handmade parts, improves the protection of motors and touch screen. Conclusion:The outcome of what we have created will benefit Herron School of Art and Design students and other departments throughout IUPUI.

6. **The Effect of Donor Similarity on Giving Behavior**

Nina Y. Ustymchuk1, Yuan Tian2
1Department of Neuroscience, IUPUI School of Science; 2Lilly School of Philanthropy, IUPUIIndiana University-Purdue University Indianapolis

How are donors affected by other people's donation behavior? Theories in psychology and economics provide competing predictions about how people react to other's prosocial behaviors, yet these competing predictions have not been reconciled.Using a sample of 140 participants, this lab experiment integrates these competing predictions by testing a non-linear model of how individuals' charitable giving is influenced by their perceived similarity to other donors. We use photo-morphing technology to manipulate facial similarity levels between donors. Findings suggest a curvilinear relationship between giving and donor similarity: people are more likely to give when there is moderate similarity between donors. High and low levels of similarity between donors both lead to lower giving behavior. This study contributes to existing literature by resolving tensions in previous research on prosocial behavior. The findings of this research can guide nonprofit managers in more effective fundraising strategies.

7. **Race-Based Stress, Self-Compassion, Psychological Distress, and Substance Use Among College-Age African Americans**

Micah T. Faidley1and Tamika C.B. Zapolski1
1Department of Psychology, Indiana University Purdue University –Indianapolis

Background: Self-compassion isdefined as being kind to one's self –especially during hardship, understanding that one'ssufferingis part of a common human experience –not cause for isolation, and relating to our suffering withopenness and nonjudgmental awareness.Higher levels of self-compassion have been associated with many positive health outcomes, including increased psychological well-being and lower rates of risky health behaviors, including substance use. However,to date, no research has examinedthe buffering effect self-compassion mayhave on health outcomes due tothe experience of interpersonal stress(e.g. trauma and discrimination). Methods: 82 college-age African Americans completedan online questionnaire onexperiences of various forms of race-based stress, trauma, substance use, psychological distress, and self-compassion.Results: Significant direct relationships were found between stress, and psychological distressand substance use, such that high levels of stress wereassociated with higher psychological distress and substance use. High levels of self-compassion were found to be significantlyassociated with lower psychological distress, but notsubstance use. Lastly, our hypothesisthat self-compassion wouldmoderate the relationship between race-based stress and both health outcomes (i.e., psychological distress and substance use) was not found to be significant. However, a trending effect was found for self-compassion as a moderator between trauma and psychological distress. Conclusion: Although hypotheseswere only partiallysupported, with a null result found for the moderating effect of self-compassionon substance use, this is speculated to be due to power. Post-hoc analysisconducted on a larger parent study with 452 participantsfounda significant moderating effect of mindfulness(which is highly correlated withself-compassion)onpsychological distress andboth forms of interpersonal stress. These findings indicate that self-compassion may be an important component in interventionprogramming for African American young adults to mitigatethe impact of interpersonalstress on psychological and behavioral health outcomes.

8. **The Effects of a Mobile Intervention on Motivation and Value Maintenance in Schizophrenia**

George Coffin, Salyers M.P., & Luther, L
Departmentof Psychology, Indiana University-Purdue University Indianapolis

There are few treatments for motivation deficits in schizophrenia. Further, multiple motivation measures exist, and it is unclear how these measures are interrelated. This study aims to determine if self-reported and clinician-rated motivation are related to a behavioral task assessing value maintenance--the ability to appreciate and value future rewards--and to determine theeffect of a text-message intervention on thesesymptoms. To date, 27people with schizophrenia were randomly assigned to a goal setting group (n=14) or a text-message plus goal-setting group (n=13). All participants completed baseline and follow-up measures of motivation and value maintenance. Baseline value maintenancewas significantly associated with self-reported motivation (r=.43, p =.03) but not clinician-rated motivation (r=.31, p=.11). Clinician-rated motivation was significantly correlated with self-reported motivation (r=.45, p=.02). Participants in the text message intervention improved significantly on clinician-rated motivation (t=-2.93, p=.014) but declined significantly in value maintenance (t=2.28, p=.04); self-reported motivation (t=-.37, p=.72) stayed the same. Results indicate that the clinician-rated and self-reported motivation measures assessed similar underlying constructs. Value maintenance demonstrated greater convergence with self-reported motivation than clinician rated motivation.Also,the text-message intervention is potentially effective at increasing clinician-rated motivation but not necessarily value maintenance; perhaps the text messages actas external reinforcements for goal completion rather than directly improvingvalue maintenance.

Mentors: Michelle Salyers and Lauren Luther

9. **Digital Segregation: How Occupation Influences Access to Politics**

Tiffani Flick,
School of Liberal ArtsIndiana University –Purdue University Indianapolis

In the United States, women often show less interest in politics, and at times, perform worse on political knowledge tests than do men. In an age where education levels have reached parity,we suggest one of the explanations for the differencein political engagementis due to the effect gender (and race) have on theselection of occupations. Past research has shownwomen and mensegregate/self-select into occupations due to things such asearly gender socialization and differences in interest. It is possible due to this self-selection, that those women found in traditional female occupationsmay have less access to personal internet use and news sources during their work days. In this paper, we explore whether individuals in certain occupational sectors differ in their political engagement by focusingon occupational computer and internet use. This approach offers some different insight on how we think about the consequences of work on the relationships between class, gender and race in politics.
Mentors: Dr. Amanda Friesen, School of Liberal ArtsIndiana University –Purdue University Indianapolis

10. **Analyzing Methods to Account for Delay Discounting Trends in Children with ADHD**

Gifty Marfowaa1, Leslie Hulvershorn1
1Department of Psychiatry, IU School of Medicine

Understanding why some youth demonstrate exceptionally risky behavior can be enhancedby studying brain activity in pre-adolescents. Delay discounting (DD) is a task that assesses responses when subjects are presented with immediate and delayed monetary rewards. The neural basis underlying DD in pre adolescents must be understood with a method that realistically generates immediate or delayed choices within the constraints of MRI scanning, namely time. Developing an effective, adequately powered DD task is important because of the variation in "discounting curves" between subjects and the difficulty in predicting them beforehand. Prior research has shown that adult responses are relatively consistent during pre-scan and scan assessments of DD. Here we test the hypothesis that children will be able to perform consistently between pre-scan and scan DD runs. We report here that that consistent performance is not seen in high risk, impulsive children, but is found in our healthy comparison group. This research shows the importance of continued efforts to develop assessments that can evaluate neural activation that takes place when children make decisions.

11. **Parenting Advice and Health Topics: What Caregiversof TeensWant to Discuss with Healthcare Proviers**

Lindsey D. Jones1, Matthew C. Aalsma, PhD2,
1Department of Psychology, Purdue School of Science, 2Department of Pediatrics, IU School of Medicine

Few studies have identified specific topics thatcaregivers of teens want to discuss inpediatric care. We conducted phone surveys with 47caregivers of teens (ages 12-17) aboutthe parenting and healthcare topics most important to them.Eligible participants attended a healthcare appointment with their teen at a Marion County Eskenazi Health Clinic in June or July 2017 and responded to a health risk screener. Among a list of 12health topicspresented to participants (e.g., gender identity, body image, alcohol and drugs), we found that more than 70% of caregivers reported wantingpediatricians' insight on how to discuss mental health issues,sex, and stress management, withtheir teens. Less than 30% of caregivers reportedmobile technology as being an important topicfor discussion.When seeking parenting advice, caregivers were most interested in talking toa provider about communication with teens and conflict management. Caregiverswere less likely to report seeking advice from a provider aboutdiscipline or parental monitoring. These findings would help inform healthcare providers on how to improve pediatric visits with teens and their caregivers.

Mentor: Matthew Aalsma, Department of Pediatrics, IU School of Medicine, IUPUI

12. **Re-Conceptualizing Communication Skills for the College Curriculum: Brain Process and Social Interaction**

Christian Jenkins and John Parrish-Sprowl,
DS-UROPIndiana University-Purdue University Indianapolis

AbstractAt most universities in the United States, students are being taught basic communication skills to develop the ability to engage their critical thinking abilities effectively. Recently, a number of research studies in neuroscience and communication providea basis for reexamining the curriculum and the development of basic requirements sustained by current science. This study emerges from this the body of research and explores the question of whether or not there should be a change in the curriculum at universities that require communication skill development. By both considering the research done and by exploring the perspective of students regarding their communication skills, this study adds to the discussion how best to define and develop basic skills.

Mentors: John Parrish-Sprowl, DS-UROPIndiana University-Purdue University Indianapolis

13. **HANDS in Autism Intensive Training: A Comparison of Knowledge in Teachers inInclusion vs. Non-Inclusion Settings**

Erin C. Sullivan,1, 2Blaine Garman-McClain,1Tiffany J. Neal,1Naomi Swiezy1,
1Department of Psychiatry, IU School of Medicine, IUPUI; 2University of Notre Dame

Federal legislation (e.g.Individuals with Disabilities Education Improvement Act (2004), No Child Left Behind (2001), and Every Student Succeeds Act (2015))emphasizes the expectations for teachers to use evidence-based practices (EBPs) in the least restrictive environment for all students. There is a need forcomprehensive training of teachers in all educationalsettings to increase teacher knowledge and skills in effectively implementing EBPs. The HANDS (Helping Answer Needs by Developing Specialists) in Autism Intensive Training was developed to effectively increase the knowledge, application of knowledge, and skill of school personnel acrossvaried roles, disciplines and settings.In this study, the authors examined the extent to which teachers practicing within inclusion and more self-contained settings differed in scores on the Assessment of Knowledge-Expanded (AoK-E, 2012).This measurewas internally developed to assess knowledge of autism spectrum disorder and the application of EBPs to practical scenarios. The impact of years of experience forteachers across these settings was accounted for in the analyses.Participants of the intensive training filled out the AoK-E before, immediately following, and several months after training to assess maintenance. Analyzing the scores revealed that both groupssignificantlyimproved due to training, but no difference was found between follow-upscores. Secondary analysis revealed that years of experience and classroom type did not significantly affectfollow-up AoK-E scores. These analyses potentially demonstrate HANDS in Autism Intensive Training has value in training teachers across settings, working with a range of students and withvaried application of the principles and practices learned.

Mentors: Naomi Swiezy, Department of Psychiatry, IU School of Medicine, IUPUI; Tiffany J. Neal, Department of Psychiatry, IU School of Medicine, IUPUI

14. **Qualitative Coding, Community Engagement, and Decision Making in Healthcare**

1Amira Nafiseh, 2Janet Panoch, 3Nerissa Bauer, 2Elizabeth Goering,
1Department of Biology, IUPUI; 2Department of Communication Studies, IU School of Liberal Arts;3Department of Pediatrics, IU Schoolof Medicine

Qualitative research approachesare often utilized in education and health care settings as a way to analyze themes that arise from interviews and focus groups on varioustopics. One issue resulting from physician visits is that patients are not trained on how to effectively communicate with their providers, soare not as likely to fully understand or ask questions. In order to teach patients how to actively speak with their doctors, the PACE-talk patient training video series that was developed to inform students on how to become actively engaged in their health care, was presented at a focus group conducted for students at Pike High School and discussed using an interview guide. The students provided their thoughts on how to translate the videos into an interactive game to assist individuals in practicing and solidifying the learned skills. Once the feedbackwascoded, themes relating to personal stories and implicit and explicit suggestions were identified to be incorporated into the game that is being developed in collaboration with Yale University's Center for Health and Learning Games. Additional interviews are also being performed with parents of children with ADHD who attend support group sessions and with nontraditional students who have interrupted their studies. These transcripts being qualitatively coded as well to provide suggestions for improving the group visit topics and developing an outreach program. Overall, these research projects in process are contributing to the development of different interventions that will strive to improve decision making in the community.

Mentor: Janet Panoch, Department of Communication Studies, School of Liberal Arts, IUPUI

15. **Link Prediction in Dynamic Networks through Temporal Node Embeddings**

Tate Maki-Waller,Thomas Williams,Nick Varberg, Mohammedal Hasan,Tanay Kumar Saha;
DataS cience REU at IUPUI Indiana University-Purdue University Indianapolis

Social network analysis has become key topic for study in the field of data science since the rise of social networks. One key social network analysis task, the link prediction problem, has beenstudied extensively since its conception about a decade ago. This problem involves predicting future connections between individuals in a social network, whether that be connections through mentions on Twitter or wall posts on Facebook. Previously the link prediction problem had been approached in a static sense. We began our research by exploring established methods for link prediction in static networks. These methods include the use of topological network features and feature embedding of nodes in a network. However, these methods fail to take into account the time that connections between users were created. Because social networks change rapidly overtime, it is crucial that time is taken into account when developing methods to solve the link prediction problem. At present, there are few established methods for link prediction on dynamic social networks. Building off methods for static link prediction through node embedding, we propose a method that takes into account a node's embedding in the previous time period and updates that node's embedding based on past and current information about it sconnections.

16. **mHBS Powered by DHIS2: Development of an Integrative Training and Educational App to Support andTrackNeonatal Educational Initiatives among Health Workers in Low and Middle Income Countries.**

Elisabeth Meyers1, Taylor Childers1, Siva Addepally1, Kalfala Sannoh2, Jose Francisco3*;* 1IUPUI School of Informatics and Computing. Department of Health Informatics;2IU Richard M. Fairbanks School of Public Health. Indiana University-Purdue University Indianapolis;3Purdue School of Engineering and Technology. Indiana University-Purdue University Indianapolis

Background: Annually, there are millions of preventable neonatal deaths in low/middle Income countries (LMICs), due to a paucity of skilled healthcare workers (HCWs), well-equipped health facilities, and health data. One key barrier is the lack of an integrated platform for HCWs to access training, educational, and reporting materials. Mobile Helping Babies Survive (mHBS) and DHIS2 are existing digital health platforms to support HCWs in LMICs. The aim of this project was to integrate mHBS and DHIS2.Methodology:Collaboration and frequent team meetings, beginning with extensive literature review and resource mapping, catalyzed iterative code development efforts by the informatics students. Coding tasks (i.e., "issues") were assigned, tracked, and documented on Github, a global open source community platform used by collaborators to maintain and modify open-source projects. Results:Informatics students generated and presented, to the larger team, multiple mock-ups of a training/educational app. Using agile, iterative processes, key design features and functionalities from each mockup were identified; these were fused to develop an integrated, high fidelity prototype. Subsequently, a functional prototype of the integrated mHBS powered by DHIS2 app was built, including: a login page, resource portals, linkages to educational videos/materials.Conclusion:mHBS powered by DHIS2 will allow a variety of end-users and partners in LMICs to access neonatal training, educational, and reporting functions to support evidence-based newborn care, with the goal of reducing global rates of neonatal mortality. mHBS powered by DHIS2is the first known digital health tool purposefully developed to support large-scale neonatal education and training programs in LMICs.

Mentors: Dr. Sherri Bucher, Indiana University School of Medicine, Department of Pediatrics; Dr. Saptarshi Purkayastha, Indiana University School of Informatics and Computing, Department of Health Informatics

17. **Digital Preservation of Cultural Dance Using Animated Anthropology**

Eric Durr1, ZebulunWood2, Agnieszka Piekarzewska3, Department of Media Arts & Science, School of Informatics & Computing1,IUPUIDepartment of Media Arts & Science, School of Informatics & Computing2,IUPUIInternational Relations Coordinator, Wyzsza Szkola Komunikacji i Zarzadzania3,Poznan, Poland

The underlying concept of our research proposal is to develop a standardized technique for capturing national folk dances as a method of digitally preserving national and world heritage for education of youth and reference for other researchers.To achieve this objective,we have focusedon the motion capturing of dances in Poland. We will also present how implementation of emerging digital technology benefits and improves the process of motion capture (recording). Our method shows that the technique to catalogue motion capture data of traditional dances is a cost-efficientmethod to preserve aspects of dancealbeit unreliable when it comes to data collection.The study compares the technique we are developing in this project to prior attempts researchers have made torecord and catalogue national and folk dances. The studyhas alsobeen toidentify the relation between older variations(performing styles) of the national / folk dances andtheir more modern ones. Our prediction is that folk dances in Poland, such as the Polonez, have not changed over decades, as they stem from a verylong tradition passed on from generation to generation.Near the conclusion of the research, the findings are showing some problems in the data collection process (depth sensors not working correctly). My results will show other researchers in this fieldthat using Sony eye cameras is not entirely reliable. However, future researches wishing to catalogue and preserve dance will still see the potential of using motion capture suits with infrared.

Mentors: Zebulun Wood

18. **Digital Immunization Surveillance: Monitoring Influenza Vaccination Rates Using Twitter**

Susie Song(Cornell University)and Zina Ben Miled(IUPUI);
NSF REUSchool: Indiana University-Purdue University Indianapolis

Widespread and timely influenza immunizations within the United States are critical for preventing deadly and costly outbreaks. However, flu vaccination coverage across the United States annually remains low. Thus, sustained flu vaccination surveillance isimportant for detecting faltering vaccination rates. Early detection of anomalies in flu vaccination rates can allow faster communication between public health agencies and local governments, facilitating rapid deployment of flu vaccination campaigns.Traditional flu vaccination rate tracking systems suffer information lags due to federal agencies' reliance on reports submitted by medical practices and since surveillance data is publicly updated only once a week. Furthermore, these approaches have limited scope as data collection is confined to Medicare beneficiaries. Yet, more patients are turning to social media platforms, such as the microblogging service Twitter, to casually report their vaccination experiences. While vaccination rates spike during times of frequent vaccine campaigns and imminent influenza spread, these vaccinated individuals often use Twitter to speak about 'getting a flu shot'. In this paper, we offer a low-cost and fast alternative surveillance method to the flu vaccination rate surveillance system of the United States Department of Health and Human Services (HHS). We evaluate the level of concordance between the rate of Twitter posts mentioning flu vaccinations and HHS data on flu vaccination rate.

19. **Gelatin-Silk Fibroin Hybrid Hydrogels**

Jon D. Stoller
Department of Biomedical Engineering, Purdue School of Engineering& Technology, IUPUI

Hydrogels have been used in many biomedical applications, such as drug deliveryand tissueregeneration. These gels can be prepared from synthetic polymers (e.g., poly(ethylene glycol) diacrylate or PEGDA) or natural macromers (e.g., gelatin, hyaluronic acid, silk fibroin(SF), etc.) through photocrosslinking, enzymatic crosslinking, or physicalcrosslinking.For example, the presence of tyrosine residues on SF permits the formation of di-tyrosine linkages, which yield chemically crosslinked SF hydrogels. However, the use of SF alone may not be sufficient in supporting the proliferation of cells.This project aims at increasing the bioactivity of silk-based hydrogels through co-polymerization of SF with gelatin-hydoxyphenylacetic acid (Gt-HPA) or gelatin-4-(2-aminoethyl) benzene-1,2-diol(Gt-DOPA).In addition,physically crosslinked (via sonication)SFand gelatin werecombined-along with an enzyme(e.g., Laccase or Tyrosinase)to encourage further enzymatic crosslinking of HPA or DOPA forformingstable cytocompatible hydrogels. After performing multiple trials starting with photo-click chemistry and now studying the characteristics of thesepre-polymer solutions in the presence of enzymes, information has been gather to presentfurtherdirection towards alternatemethods in forming gelatin-SFhybrid hydrogels. The resulting hydrogels willprovide a tunable three-dimensional (3-D) cell-laden matrix for tissue engineering applications.

Mentors: Hung-Yi Liu, Weldon School of Biomedical Engineering, Purdue University; Chien-Chi Lin, PhD. Department of Biomedical Engineering, Purdue School of Engineering& Technology, IUPUI

20. **Ultra-Thin Flexible Battery Cell**

Jack Mershon1;Nojan Aliahmed2,3; Yadong Liu2; Bhavya Sri Pakki2; Mangilal Agarwal2,
31Department of Physics, College of Wooster; 2Department of Mechanical Engineering, 3Integrated Nanosystems Development Institute Indiana University-Purdue University Indianapolis

The purpose of this project is the development of an ultrathin battery cell based upon standard lithium-ion technologies with the exploitation of nanomaterials to improve performance. The final product is to be a battery cell whose thickness is roughly that of standard printer paper, with reasonable capacity and high flexibility. The current collector material is a mat of Vanadium Pentoxide and Graphene nanofibers to maximiaze surface area and improve the conduction. In order to construct current collector material it was necessary to establish a means of generating Vanadium Pentoxide and Graphene Oxide. These chemicals aremixedsuch that electrospinning produces the desired fiber size, the ideal proportion is currently under evaluation. The nanofiber mat is constructed by electrospinning this mixture, where a needle is used for chemical introduction, and the collection substrate is aluminum foil. This mat is then ground and made into a paste which, when dried, serves as the current collector for the ultrathin batteries. An additional design issue for these batteries is the packaging. It must be strong enough to resist piercing, as well as thin and flexible enough to maintain the initial purpose of the ultrathin battery. To this end several possible methods were analyzed for their viability. Vacuum packaging is a reasonable method however it has been difficult to achieve high vacuum pressure, which is necessary as this pressure assures good contact between the battery layers. It has also been shown to be adverse to high flexibility. Lamination presents a more viable means of packaging, however concerns over reactivity of the laminate and electrolyte permeability may present significant limitations as the project develops. Additionally an internal epoxy construction as the basic means of packaging is currently under evaluation.

Mentor: Nojan Aliahmed(Graduate Student) and Mangilal Agarwal(Faculty)

21. **3D Printing of Zirconia Ceramic Components**

James Hickey, Oyedotun Ayeni, Jeremiah Rhoades, Glorio Singui, Jing Zhang;
Indiana University-Purdue University-Indianapolis Department of Mechanical Engineering

Zirconia (ZrO2) is a ceramic material with adequate mechanical properties for manufacturing of devices. Due to its high melting temperature (2,715°C), it is challenging to form zirconia components. In this work, we study fabrication of zirconia components using 3D printing or Additive Manufacturing (AM). AM has been successful for polymers and metals, the progress in ceramic materials has beenlimited. This is partially due to high melting temperature and good mechanical properties of ceramic materials which prevents us from using the heat treatment methods used in typical polymer and metal AM process. Ceramic components are more challenging due to microstructure inhomogeneity and longer printing time. The objectives of this research are to develop technology to print ceramic components using a customized extrusion-based 3D ceramic printer and to understand the process-property-performance relations in 3D printed ceramic parts. We achieved the goals by modifying a 3D ceramic printer with a larger nozzle and platform for large components, understanding the printing parameters on quality of the printed components, and finding the normal mixing proportion for zirconia slurry. In conclusion, this research project has resulted in success; we printed different components with zirconia slurry such as a c-ring and a hollow and solid cylinder.

22. **Ultra-High Specific Energy Vanadium Oxide Based Cathode Material and Its Preparation for Lithium Ion Batteries**

Asel Habarakada Liyanage, AbdallahTahir,CollynDodge,Nathanael Edou, MurtadaShaaban*;*
Purdue University School of Engineering and TechnologyIndiana University-Purdue University Indianapolis

Graphene is an essential tool that will revolutionize energy storage in the future. As a matter of fact graphene has a honeycomb lattice of hexagonally arranged carbon atoms. Also, graphene uses 3 of its 4-valence electron to form covalent bonds and the remaining electron to form a delocalized π bond. This property of the graphene makes it highly conductive. However, graphene is thermodynamically unstable and the single sheets of graphene have a strong tendency to restack. Unsuccessful researches have been done in the past to solve this issue using R2O5, Pt, and polyaniline. To avoid restacking we used Nano-sized functionalized carbon black (FCB), which increases the space between graphene sheets. These integrated materials are used as electrodes for Li-ion batteries and supercapacitors. Also, in this research solutions of Vanadium Oxide (V205), Boric oxide (B2O3), Phosphorus pentoxide (P2O5), and Silicon dioxide (SiO2) were made and then mixed with graphene Oxide to see if there were any major improvements in the efficiency of the batteries. That efficiency was measured using a Lanhe Battery Cycler to charge and discharge the batteries and a high energy synchrotron X-ray diffraction machine at the Argon Lab in Chicago.Section 5: Research Project Mentor or AdvisorJian Xie, Yadong Liu, Lei Li

Mentors: Jian Xie, Yadong Liu, Lei Li

23. **A Project in AFM-based TIP-based Nanofabrication**

***A*amna Jangda; Rapeepan Promyoo2; Hazim-El-Mounayri**,
1Deaprtment of Engineering, Houston CommunityCollege; 2Department of Mechanical Engineering, 3Integrated Nanosystems Development Institute Indiana University-Purdue University Indianapolis

The concept of nanofluidics has been around for some time but only recently has it has gained momentum, primarily due to the increasing technological advances of tools such as the atomic force microscope (AFM). The AFM ispowerful tool which can generate images at an atomic resolution.It's revolutionary because no other technology before has been able to conduct powerful microscopy at such an extremely small scale. This project involves AFM-based fabrication of nanofluidic devices. Nanofluidic applications come in handy in many real-world applications, e.g. DNA analysis.The nanochannels allow for DNA molecules to enter the nanochannel individually, which allows the capability of analyzing it more in depth than ever before. The process to create these nanofluidic devices begins with developing microchannels. Microchannels are made on both sides of the nanochannels usingthe photolithographyprocess. Photolithography is a 10-step process consisting of: Surface Preparation, Photoresist Application, Soft Bake, Align & Expose, Develop, Hard Bake, Inspection, Etch, Resist Strip, and Final Inspection. This process etches the mask pattern onto the gold-coated silicon substrate and creates the microchannels using photo resist, UV light, developing solution, and gold etchant. Nanochannels are then fabricated by directly scratching on the substrate surface with different applied forces, scratching length,and feed rate.After that, we used PDMS bonding to closethe top surface of the deviceand have an affordable sealant. To open the inlet and outlet for the fluid to pass through, we created small holes with a needle and tubes were inserted. Then, flow test was conducted on the devices to ensure that the nanochannel was open and the bonding sealed. Finally, we pumped water through an internal pipe connected to the microchannels at a rate of 50 micrometers/second and the water successfully made it to the outlet microchannel, thus concluding that our device was successful. All in all, due to the newnanotechnological tools available this day in age, we have, for the first time, been able to precisely controlliquid flow and molecular behaviorat the nanoscale.Nanofluidic devices could beused to better understand the transportationof nanoparticles inside a variety of fluids, which allows for better analyzation at an atomic scale.

Mentors: Ali Daneshkhah, Rapeepan Promyoo, and Hazim-El-Mounayri(Faculty)

We would like to thank National Science Foundation for their support through the Research Experience for Undergraduate Students (REU) program (Award # 1659688). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the

24. **Electromagnetic Simulation for the Diagnosis Lipoprotein Density in Human Blood, a Non-Invasive Approach**

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With the rise in prevalence of Type II diabetes throughout the world, an increasing need for a portable monitoring system for both blood glucose and lipoprotein concentrations is in demand. Recent work has led to non-invasive wearable devices for monitoring changes in blood glucose concentrations using electromagnetic (EM) waves. However, this still fall short as a means of monitoring cholesterol levels in diabetic patients. The EM study on human tissues emphasized here may also relate to the safety guidelines applied to cellular communications, power lines, among others. The specific absorption rate (SAR) for the power of the non-ionizing frequency is important not to exceed a threshold as it impacts the DNA and can lead to cancerous tissues. In this study, we used COMSOL software for the investigation of the viability of usingEM within the frequency range of 1 MHz –10 GHz as a means of monitoring the transmission properties via human blood. In this approach, wave equations were solved within blood and lipoprotein boundaries. Research parameters, including frequency range, Power input (SAR), tissue sizes, and lipoprotein densities, were investigated. The transmission properties, produced by the electrical and thermal characteristics of these physiological parameters, have led to proper diagnosis of lipoprotein density. Within the frequency range of 10 MHz to 5 GHz, and for a power range of 0.1 to 0.6 SAR, lipoprotein density from 1.00 g/mL to 1.20 g/mL was considered. Three different sized 2D models, with an antenna source that supplied the electromagnetic waves to human tissues, were created for the simulations. These were used for the study of the transmission properties of the EM energy into the blood and lipoprotein tissues. For a 0.3 SAR magnitude, and within the 10 MHz frequency range, a differential magnetic/electric field, ΔE, from -2.47 to -12.63 W/m was observed. Lipoprotein density ranging from 1.00 g/mL to 1.20 g/mL, was reflected in a change in the electric field by a value of -2.41 W/m. The results obtained in this study can be accommodated non-invasively by human tissues, and can be produced in a practical model using wearable devices. A practical model is proposed for future consideration.

Mentors: Monika Kakani and Maheer Rizkalla (Faculty) We would like to thank National Science Foundation for their support through the Research Experience for Undergraduate Students (REU) program (Award # 1659688). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the

25. **Designing an ENGR 19600 Project That Promotes Innovation and Critical Thinking Among Freshmen Engineering Students.**

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For several years now Freshman Engineering courses have utilized three major topics: Computer-Aided Design (CAD), Electric Circuits, and a project. The project idea is focused to strengthen students' skills, give confidence training to undergraduates, and gain experience in group work. This project involves the creation of a quadcopter that only moves in the vertical direction. This project is more involved and students will apply what they learned in the class to design a quadcopter base and construct an electrical circuit by building a device to obtain measurements. The device will measure voltage, current, power, time, and energy of the quadcopter during flight. Furthermore, the data will be monitored and logged to an Excel spreadsheet, to examine the performance of the quadcopter design. By giving the students full rein over the project, they will be fully immersed in the engineering design process. This will give them a real taste of how engineers must be able to work efficiently in teams and beable to brainstorm new and improved ways to combat any issue that may arise. There were many obstacles that we had to confront, but with the creation of a lab manual, the students will have a more streamlined project. Since many engineering freshmen become discouraged when they are unable to overcome problems that will inevitably occur, this project ensures that they are using the most of the creative process.

Mentor: Michael Golub, Department of Mechanical Engineering, IUPUI

26. **Predicting Zillow Estimation Error Using Linear Regression and Gradient Boosting**

Darshan Sangani and Kelby Erickson
NSF REUSchool: IUPUI

Owning property is one of the most important investments that a person can make in their lifetime. Therefore, being able to accurately know the real-time value of any property is crucial to making wise sales and purchases. Since the online real estate database company Zillow first developed a machine learning system to predict property sale prices in real time, Zillow has continually worked to improve the accuracy of this prediction mechanism. In this paper, we describe our work to decrease the error of Zillow's price estimation by examining the effectiveness of several machine learning models at making property related forecasts. Specifically, we used property data to train linear regression and gradient boosting models with which we then made predictions about other properties. Since the gradient boosting model has numerous parameters, each with a wide range of possible values, we used grid search to optimize these parameters. Finally, we examined the effectiveness of data preprocessing techniques such as normalization, dimensionality reduction, and flattening categorical features into binary ones. While previous research in machine learning has found that normalization and dimensionality reduction generally improve forecast accuracy, we found that they did not improve the accuracy of predictions for this particular problem.

27. **Predictive policing via space-time and demographic analysis**

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University of California, BerkeleybBrown Universityc University of San Franciscod Indiana University –Purdue University Indianapolis

Police departments seek to reduce criminal occurrences by allocatingpatrol units to areas in which criminal activity is predicted to occur. Current predictive policing approaches invoked by police departments seek to minimize a social harm index by ranking criminal hotspots and normalizing by the area spanned (this is referred to as the PAI –predictive accuracy index). Criminal activity may be characterized as space-time events. Clustered event sequences are observed when filtering criminal activity by crime type, such as assault and burglary. Here we apply machine learning techniques to improve the PAI of current approaches. In particular, we examine the effects of demographicand seasonaldata on crime prediction. Coupled with spatial and temporal density estimation of crimes and self-exciting point processes, we train several models on these data and discuss the fluctuation in PAI. As distinct crime types exhibit different spatial and temporal patterns, we construct models by crime type andaggregate over these to obtain a single estimate of areas which should be patrolled. We validate our findings using data provided by the Indianapolis Metropolitan Police Department (IMPD) collected over 2012-2013.

28. Assessment of Mixed Reality Virtual Environment for STEM Learning

John Grove3,Mateus Jose1, Mauricio Ambrosio1, Alyssa Burke1, Hassan Obaidan2,Asimiyu Tiamiyu2
Department of electrical and computer engineering, 2Department of mechanical engineering, Department of Computer Information and Graphics Technology3, Purdue School of Engineering and Technology; Indiana University Purdue University Indianapolis

This research project the development of an augmented reality system using the Microsoft HoloLens with inputs simulated using a Fadal CNC multiprocessor controller. There were several problems during the process of connecting the CNC controller machine and the computer. After several trials, we were able to connect the CNC controller with the computer by using RS232 to RS232 cable and RS232 port PCI card. However, the data we received was unusable. This lead us to another possible input solution. We could create our own Bluetooth keyboard using the existing Fadal multiprocessor and connect it directly to the HoloLens for proper muscle memory cnc training. The other part of the project involves porting an existing Oculus Rift Unity environment and optimizing the experience for use with HoloLens. This part of the project is still active and poses many hurdles including things like outdated scripts and HoloLens hardware glitches. HoloLens development is still young and therefore some experimentation is necessary to solve problems within Unity. Currently we have a real size Fadal CNC machine hologram with a ray cast cursor in the Unity environment. The ultimate goal of this research is to have a functional app using the HoloLens so we can determine if this new technology is a viable way to conduct STEM training. We will do this by conducting usability studies with real a real cnc machine, Oculus, and the HoloLens.Mentor: Hazim El-Mounayri, Department of mechanical engineering, Indiana University Purdue University Indianapolis; Jesse Satterwhite, Department of Electrical and Computer Engineering; Indiana University Purdue University Indianapolis

29. Computational Modeling and Functional Validation of Cell Spheroids Used for Scaffold-Free 3D Bioprinting

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The 3D Bioprinting Core is equipped with the bioprinter 'Regenova', opening new opportunities for research and education. In a continuation MURI project, we are applying computer modeling to spheroids fusion, the basic step of this form of bioprinting, and to assess the effects of metabolites on this mechanism. Spheroids from human ovarian cancer cells HeyA8 were prepared from 20,000 cells placed in non-adhesive U-shaped wells in RPMI 1640 medium with 10% bovine serum. After 3 days, we transferred spheroids pairs in fresh medium for fusion assay; alternatively, the spheroids were solubilized, along with 2D cultures, for NMR analysis; for detecting oxygen, we continued the setting up and calibration of the EPR instrument; we simulated the spheroids and their dependence on glucose with the open-platform software CC3D. HeyA8 tumor cells readily formed spheroids in ~24 h.After transfer in the fusing wells, they aggregated over time, while maintaining a separation border. The CC3D model also indicated that limiting the available glucose may promote cell death at the interface between fusing spheroids, a process eliminated by increasing glucose concentrations. We also detected the glucose peaks in theNMR charts of 2D cultures and spheroids, and progressed towards oxygen quantification. HeyA8 tumor cell spheroids are usable as building blocks for scaffold-free bioprinting. However, the in vitroand in silicofusion analysis suggest the sensitivity of their fusion to limiting glucose, which deserves further explorationwith the additional help of NMR metabolomics and EPR oximetry.

Mentors: NicanorI. Moldovan,Department of Biomedical Engineering, IUPUI School of Engineering and Technology; Horia Petrache and Bruce Ray, Department of Physics, IUPUI School of Science

30. **Visualization and Quantification of Electrochemical and MechanicalDegradation of Sn Anode Lithium Ion Battery**

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In pursuit of high energy density batteries with limited surface area for efficient operation of electric cars and numerous other mechanical applications, scientists must qualify material capabilities and hindrances of alloying anodes. Substantial volume fluctuations of electrodes during operation greatly limit battery lifetime due to severe microstructural damage and the resulting capacity depletion. To further comprehend the evolution and failure mechanisms of electrode materials on the nanoscale, batteries must be imaged during operation using x-ray tomography. With this technique, the size, shape, and electron density fluctuations can be analyzed in 2D and 3D on the nanoscale. We observe a significant change in morphology based on the cycling characteristics of Sn and demonstrate for the first time, to our knowledge, the pulverization of an alloying Sn anode into smaller, completely disjointed particles. This phenomena is especially prevalent in the first delithiation and subsequent lithiation of the anode, after which the particles obtain a structural equilibrium in which these morphological changes are no longer significant. This reveals that the initial delithiation and following lithiation play a substantial role in the structural instability that causes mechanical degradation. This in-situ 2D and 3D quantitative visualization and analysis of the microstructural unfolding of the Sn anode should advance our understanding of energy materials for the purpose of refining their synthesization and systematically advancing the search for feasible high capacity anode materials.

Mentors: Huixiao Kang (Graduate Student), Cheolwoong Lim (Ph.D. Student) and Likun Zhu (Faculty)We would like to thank National Science Foundation for their support through the Research Experience for Undergraduate Students (REU) program (Award # 1659688). Any opinions, findings, conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the National Science Foundation.

31. **Determining Reaction Rates and Intermediate Distributions in Active-Site Variants of Benzoylformate Decarboxylase**

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2Franklin Community High School, Franklin, IN, 3Butler University, Indianapolis, IN, 4Department of Physics, 5Department of Chemistry and Chemical Biology, Indiana University-Purdue University Indianapolis (IUPUI), Indianapolis, IN

Benzoylformate decarboxylase (BFDC) is a thiamin diphosphate (ThDP)-dependent enzyme, initially isolated fromPseudomonas putida,that catalyzes the decarboxylation of benzoylformic acid to benzaldehydeand carbon dioxide. As a side reaction, BFDC also exhibitscarboligase activity enabling the formation ofstereospecific α-hydroxy ketones. Understanding the mechanisms of thestereoselective synthesis catalyzed by BFDC could lead to ecological and economic advantages for the pharmaceutical industry, and also be useful for the study of enzyme evolution. The putative mechanism of BFDC activity, in essence,involves four intermediate steps. From previous site-directed mutagenesis studies, it is known that the active site residues, Ser26, His70 and His281 play important roles in the catalytic mechanism of BFDC. In this project, we explore the specific contributions of the His70 and His281 residuesto the individual catalytic steps using arecently developed NMR spectroscopy technique. Variants containing mutations at His70 and His281 were over-expressed in E. coliand purified using nickel affinity chromatography. Kinetic parameters (Kmand kcat) for each of the variants were determinedusing a NADH-linked coupled assay. Subsequently, the variants were mixed with benzoylformate and, after a short time period (1-5 s),the mixture was quenched to trap intermediates of the reaction. The ratios of intermediates in the overall reaction were determined through NMR spectroscopyand subsequently used to determine the rate constants of the intermediate steps. Here we report those results and discuss their implications for the role of His70 and His281 in the BFDC reaction mechanism.

Mentors:Michael J. McLeish, Department of Chemistry and Chemical Biology, Purdue School of Science, IUPUI; Bruce D. Ray, Department of Physics, PurdueSchool of Science, IUPUI

32. **MHBS powered by DHIS2: Resource Mapping, Digitization of Data Forms, and Development of Health Indicators Reporting and a Digital Dashboard to SupportNeonatal Training Initiatives among Health**

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Background: Annually, there are millions of preventable neonatal deaths in low/middle income countries (LMICs); key barriers to reduction of global newborn mortality include a lack of standardized indicators and a reliance on inefficient paper-based data collection methods. Currently, District Health Information Software (DHIS2) is an open source digital health platform used in 47 LMICs to collect and report key health indicators; mobile Helping Babies Breathe (mHBS) is a newborn care app. The goal of this project is to integrate mHBS and DHIS2.Methods: Literature review of the complex mHealth landscape and resource mapping of the mHBS ecosystem were conducted. Public Health students then digitized existing mHBS paper-based training and reporting forms, developed standardized newborn health indicators, and created a digital dashboard. Weekly team meetings and Github, a global open source community platform used by collaborators to maintain and modify open-source projects, were utilized.Results: Public Health students completed a comprehensive mapping exercise of mHBS educational videos, training materials, and paper data collection tools; results were shared with informatics students. A total of 7 mHBS data collection and reporting forms were digitized, including 5 for training and 2 for clinical care/quality improvement. A standardized set of newborn health Indicators was defined, and coding conducted for a digital dashboard. Conclusions:The project outcome will significantly improve data collection processes for HCWs in LMICs, increase their access to key digital training and reporting forms, and also enable end-users and partners to instantly access reports regarding relevant neonatal indicators via an integrateddigital dashboard.

Dr. Sherri Bucher, Indiana University School of Medicine, Department of Pediatrics; Dr. Saptarshi Purkayastha, Indiana University School of Informatics and Computing, Department of Health Informatics

33. UV Nucleotide Binding Site Photocrosslinking of Antibodies at Various Light Intensities

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The nucleotide binding site (NBS), found in the Fab variable domain of all antibody isotypes, is utilized in UV photocrosslinking methods for site-specific functionalization of monoclonal 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 propose 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 UV sources possess different power levels and by modulating both time of UV exposure and distance from source site-specific crosslinking at the NBS, for affinity tags (IBA-biotin) and fluorescent molecules (IBA-FITC/Alexa-647) was optimized. Application of the UV-NBS photocrosslinking technique is possible by first incubating the antibodies with IBA-Biotin or IBA tagged ligand followed by 0.5-1.5J/cm2of UV exposure. Conjugation efficiency was determined via Western Blot analysis of IBA-Biotin and absorbance/fluorescent measurements for the presence and quantity of conjugated IBA-Alexa-647. The UV-NBS technique is a reproducible method of photocrosslinking antibodies. Optimization of UV energy exposure resulted in an increase of conjugations per antibody with maximized photocrosslinking efficiency, while antibody antigen binding activity and Fc recognition were preserved. This study demonstrates that theUV-NBS site-specific antibody modification technique can be accomplished using UV light sources with differing light intensities expanding its implementation potential through making the technology more accessible. Ultimately, the UV-NBS method is an efficient, practical, and accessible method of functionalizing antibodies in diagnostic, pharmaceutical, and therapeutic settings.

Mentor: Nathan J. Alves, Department of Emergency Medicine,IU School of Medicine,Department of Biomedical Engineering, Purdue University

34. Localization determination of five protein phosphatases inToxoplasma gondii

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Toxoplasma gondiiis an obligate intracellular parasite that can invade any nucleated cell of nearly all warm-blooded animals, including humans, and can cause severe disease in immunocompromised individuals and the congenitally infected. The uncontrolled lytic cycle of T. gondiiis the main driver of pathogenesis and has been extensively investigated to determine the regulation of each step, including host cell attachment, invasion, parasitophorous vacuole (PV) formation, replication, and egress. Phosphorylation contributes to the regulation of the lytic cycle, especially regarding the central roles of apicomplexan-specific calcium-dependent protein kinases (CDPKs). Contrastingly, the phosphatases that reverse the effects of inducible phosphorylation have not been identified; therefore, the primary interest of this study is to identify and characterize protein phosphatases which are regulators of the T. gondiilytic cycle. The molecular machinery that drives parasite invasion and egress, as well as kinases, localizes to the space between the plasma membrane and a series of flattened sacs called the inner membrane complex (IMC). Accordingly, we focused on putative phosphatases that are predicted to localize to the same space. Previously, we endogenously tagged two myristoylation site-containing PP2C subfamily protein phosphatases (PPM2A and PPM2B) with hemagglutinin (HA) epitope tags, and showed that both seem to localize to the cytoplasm and possibly to the plasma membrane by immunofluorescence assay (IFA). Our first objective is toconfirm their localization to the plasma membrane using the detergent Triton-114 to partition membrane proteins from cytosolic proteins, followed by western blotting with anti-HA antibodies to determine if the phosphatases are present in the detergent partition. We bioinformatically identified another potential membrane-localized PP2C protein phosphatase (PPM3D), which contains a single copy of a transmembrane domain. Thus, our second aim is to determine the localization of PPM3D by endogenously tagging PPM3D with HA epitopes and performing IFA once a tagged parasite line is established. Furthermore, we determined the localization of two additional protein phosphatases, EFPP and PPKL, using the same methods. EFPP is a phosphatase that only exists in apicomplexans; likewise, PPKL is not present in animals. The previous genome-wide CRISPR knock-out study showed both are essential for parasites, which makes them suitable anti-parasitic drug targets; therefore, it is advantageous to characterize the functions ofthese two specific phosphatases. Their localization determination is the initial step of a long-term study.

Mentors: Gustavo A. Arrizabalaga, Associate Professor, Department of Pharmacology and Toxicology and Department of Microbiology and Immunology, IU School of Medicine; Chunlin Yang,Post-doctoral fellowDepartment of Pharmacology and Toxicology, IU School of Medicine; Tonya Shelton, Program Manager, Diversity Scholars Undergraduate Research Opportunities Program, Center for Research andLearning, IUPUI.

35. Actin Turnover in Stereocilia of Mice with Fascin-2 R109H Mutation

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1Department of Biology, IUPUI School of Science

Stereocilia, organelles of hair cells that sense mechanical movement due to sound, have incredibly stable actin cores, which can be attributed to various actin cross-linking proteins, such as fascin-2. Mutation in fascin-2 causes progressive stereocilia degeneration and hearing loss in mice. Hair cells deficient either in β or γ actin (actin isoforms) also result in progressive hearing loss in mice. The objective of this study was to determine if fascin-2 R109H effects actin turnover and the ratio of β or γ actin with age. Auditory brainstem recordings (ABR) were used to assess hearing thresholds in order to determine if fascin-2 R109H perturbs auditory function with age. Immunofluorescence microscopy was used to determine the localization and intensity of β and γ actin throughout the stereocilia at 5 weeks and 6 months of age. This approach will track changes in endogenous actin proteins thus providing insight into the stability of the actin core in fascin-2 mutant mice as they age. In order to collect quantitative data that is directly comparable from sample to sample, we incorporated standardized fluorescent reference beads into our preparation. Using this improved technique, we will analyze β or γ actin isoforms in control and R109H mice at different time-points. If the R109H mutation is found to alter the β or γ actin isoform ratios, gene therapies could one day be used to treat the mutation in people to prevent hearing loss.

Mentors: PallabiRoy, Department of Biology, IUPUI School of Science, IUPUI; Benjamin J. Perrrin, Department of Biology, IUPUI School of Science, IUPUI

36. Characterizing the proteolytic activity of yeast α4 subunits produced recombinantlyinEscherichia coli.

Harshita Kondeti1, Lindsay J. Hammack1,Andrew R. Kusmierczyk1;
1.Indiana University-Purdue University Indianapolis; School of Science; Department of Biology

Eukaryotic 20S proteasomes contain αand βsubunits that assemble into a coaxial stack of four seven-membered rings. Proteasomes are proteases and exhibit several types of proteolytic activity, able to catalyze hydrolysis of proteins and peptides. Three of the seven βsubunits are known to be proteolytically active, while none of the seven αsubunits are. However, we have recently demonstrated that the α4 subunit assembles into a complex that exhibits peptide hydrolysis activity. In order to characterize this unexpected activity, the α4 complexes will be recombinantly expressed in bacteria and a mutagenesis study will be carried out to determine which residues are involved. To achieve this, various mutants of the pET42 plasmidharboring the α4 gene were transformed into bacteria and therecombinant protein was purified. It was found that the 4 subunit complexes from both humans and E. colishowed activity, even with modifications to the amino acid sequencesthought to contribute to activity.This work is important because the discovery of peptide hydrolysis activity in a proteasome αsubunit challenges thirty years of proteasome research that states only βsubunits possess activity. Consequently, this work raises important questions about proteasome function and evolution.

Mentors: AndrewR. Kusmierczyk

37. RNAPII Interactomeinabre1ΔStrain in saccharomyces cerevisiae

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Indiana University-Purdue University Indianapolis

Transcription activation is regulated by several mechanisms includingpost-translational modifications andepigenetic factors. In our study,wewill analyze the impact(s) ofdisruption of theubiquitinligase,Bre1, on the protein-protein interactions required for RNA Polymerase II (RNAPII)transcription. RNAPIIperformsthe transcription of DNA to producemRNA and most snRNA and microRNA.Post-translationalmodifications (PTMs) regulate the structure and function ofthe corehistones. Monoubiquitination of histones H2A and H2B perform majorroles in managinggene expressionalthough the precise mechanisms through which this occurs are unknown.The RINGdomainE3 ligase, Bre1, catalyzes monoubiquitination of H2B by recruiting the E2ubiquitin-conjugating enzyme, Rad6. We will investigatethe protein-protein interaction networkofRNAPII whenwe perturb transcription activationby making aBRE1deletionstrain. To investigate the role ofBre1,we have added a3Cprotease cleavage sequence to thelinker region of the C-terminal domain (CTD) ofRpb1 subunit of RNAPII which allows us to purifythe CTD from the globular coreof RNAPII(hence CTDless). We are interested in the CTD becauseit actsas a stage tobring aboard additional proteinsinvolved intranscription. The 3Cproteasecleavesthe CTDwithin the bre1Δstrain afterpurifying RNAPII through pull-down of an epitope tagged Rpb3(specifically, Rpb3-FLAG).The CTDless and the CTD samples were digested and prepared to analyzeon a mass spectrometerusing multidimensionalprotein identification technology (MudPIT). Analysis of our MS data will identifyproteinsthat interact with RNAPII as a result of deleting the ubiquitin ligaseBRE1.We expect that RNAPII willinteract with more elongation factorsas a consequence ofa slowed elongation ratedue to the loss of Bre1. Through our study,we can better understand the underlying mechanisms and alternative pathways that the cell takes to activate or regulatetranscription.

38. Modeling cancer cell transport through the vascular system

Dr. Jared Barber1, Dr. Luoding Zhu1and Jose Celaya-Alcala2;
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The study of cancer cell transport through the vascular system is of interest for various reasons.Principle among them is the fact that metastasis (cancer spreading to a secondary infection site)is associated with 90% of cancer related deaths in the United States. Thus, it is important tounderstand the mechanisms which allow cancer cells to successfully move through the vascularsystem. Through this understanding we may be able to identify ways to inhibit successful cancercell translocation. In this study we implement a computational model to work towards this goal.We model a cell simply as a circular membrane immersed in viscous fluid undergoing Stokes' flow.We represent the membrane as a collection of node points and segments connecting these nodes. Wethen use a finiteelement based immersed boundary method to solve the partial differential equations(PDE) governing flow and to simulate the movement of the cell in the fluid. This method consistsof first calculating the tension force on the membrane, and transferring this force to the surroundingfluid. We then use these forces when numerically solving the PDE governing the flow. This gives usvelocities for the surrounding fluid, which we then interpolate back to the membrane. Using thesevelocities we can update the membrane position. And these processes are repeated for each timestep. The computational results will be compared with existing experimental results.

39. Modeling cancer cell transport through the vascular system

Dr. Jared Barber1, Dr. Luoding Zhu1and Alexa Kovacs2;
1Department of Mathematical Sciences, IUPUI2Department of Mathematics, Rose-Hulman Institute of Technology

The capability of predicting the movement of cancer cells through the vascular system is vital for the advancement of cancer cell research. Cancer cells travels from the primary site to the secondary site, which causes metastasis, also known as secondary cancer. The cancer cell flows through the vascular system in order to attach onto this secondary site. In the United States, metastasis is associated withfor 90 percent of cancer patient deaths. Therefore, it is important to study how the cancer cell will flow through the vascular system, which may provide insights in helping eliminate secondary cancer. In this study, we use a two-dimensional, circular membrane immersed in a fluid to model the cancer cell motion in the blood flow. We implement forward Euler's and improved Euler's formulas to approximate the movement of the cancer cell through the vascular system. This method is used to avoid collisions between the cell and the vascular wall. We use an explicit scheme whose time step size can be affected by different parameters.These parameters include fluid internal pressure, tension, bending, and viscoelastic forces of the membrane. We conduct a numerical stability analysis, studying the effect of each and all of the parameters compared to the stress of the fluid on the membrane using Newton's second law. This demonstrate which parameters the model has a higher sensitivity to. An equation for the radius of the membrane is also obtained by solving the same differential equation used for the numerical analysis. The numerical results using the appropriate time step will then be compared to the experimental results.

40. The Effects of Subunit Concentration on Proteasome Assembly

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The 20S proteasome is made up of four seven-membered rings arranged coaxially. Two inner β subunit rings are surrounded by two α subunit rings. Yeast provide an ideal model for research on proteasome assembly because the pathway for proteasome assembly in yeast is well studied, highly regulated, and parallels proteasome assembly in humans. At present,the relationship between α subunit concentration and proteasome assembly remains unexplored. This research project is aimed at furthering our understanding of subunit concentration on assembly by deleting one copy of each of the seven α subunits from the diploid state in yeast. The deletion of one copy of an α subunit should lower the concentration of that subunit which could impact assembly. In this experiment, the deletion of the α3 subunit had no readily discernible effect on proteasome assembly when observing the proteasome on Native and SDS gels. This could mean that either the feedback mechanism which controls proteasome levels in the cell prevents the deletion of α3 from having an effect on the assembly of the proteasome, or that α3 levels are not limiting for assembly even when present at reduced levels. Testing the other six α subunits in similar fashion will help address this. Nevertheless, this study is significant because it is the first attempt to understand the effect of subunit stoichiometry on the assembly of the proteasome.

Mentors: AndrewR.Kusmierczyk; Lindsay J. Hammack

41. A paired geochemical and molecular study of anoxygenic photosynthesis in modern lake sediments.

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The purpose of this project was to investigate conditions that promote anoxygenic photosynthesis. Lime Blue Lake (Washington, USA) is a meromictic lake that haspermanently stratified oxygenic and anoxygenic layers which contain specific types of microbial communities. Previous studies of Lime Blue Lake have revealed that more green sulfur bacteria (GSB) are present in anoxic layers as compared to purple sulfur bacteria (PSB). Both GSB and PSB use anoxygenic photosynthesis to fix CO2, without producing O2, and they both utilize hydrogen sulfide (H2S). However, each type of bacteria follow different carbon and nitrogen cycles, and thus possibly produce different geochemical results. Therefore, the aim of this phaseof the project was to characterize bacterial communities according to depth (which is analogous to time) of the lake sediment. 12S rRNA sequencing of bacterial DNA extracted from the sediment was analyzedfor different diversity measures, as well as itsrelationship with the geochemical data obtained in the geologicalphase of this project. Our data showthat 1) PSB is present in greater abundance than GSB in the top two layers of the sediment, 2) GSB relative abundance increases greatly with depth, 3) theoverall diversity of family-level GSB and PSBdecreases with depth. Therefore, our data seem to align with previous studies that show GSB occurring in greater abundance than PSB in the anoxic layers of the lake.Including geochemical data will further shed light on the environment conditions that promote anoxygenic photosynthesis in meromictic lakes.

Principal mentor: William Patrick Gilhooly III-Assistant Professor, School of Science, Earth Sciences DepartmentCo-mentor: Alice Bosco Santos-Postdoctoral Scholar, School of Sciences, Earth Sciences Department Co-mentor: Christine Johanna Picard-Assistant Professor, School Sciences, Department of Biology and Forensic and Investigative Sciences ProgramCo-mentor: Charity Owings-Ph.D. in Forensic Entomology

42. Detection of Carbonyls Compounds in Human Breath:Development of an Electrochemical Breathalyzer for Prognosis and Diagnosis

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Studies have shown that an excess of various small carbonyl metabolites generated from oxidative stress can successfully be used as biomarkers for diseases such as lung cancer. Minimally invasive methods of detecting such volatile compounds within the body have become more popular in recent years. The current method to analyze patients'breath is done using gas chromatography mass spectrometry (GC-MS)after collection of the samples. WhileGC-MS provides accurate identification of the metabolite biomarkers, it is expensive to purchase and maintain, and it is not portable. The development of a portable breathalyzer could be a cost efficient and accessible tool for early diagnosis. Our approach aims at trapping carbonyl metabolites from breath and then oxidize them using electrochemistry. The current generated from the chemical transformation would serve as a quantifiable signal of oxidative stress. For the past 2 months, we have explored the reduction potentials of carbonyls and their derivatives; specifically, we have synthesized a library of oxime ethers and imines. Simultaneously, we have lookedatcellular responses to metabolites that are generated through oxidative stress. Preliminary results from our studies will be presented.

Mentors: Sébastien Laulhé and Lata Balakrishnan

43. Using a mathematical model of sepsis to predict survivability conditions for an infection

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Sepsis is a very serious and life-threatening illness caused by the body's response to an infection. Experiments conducted in rats have shown that once a bacteria load exceeds a certain level, the rats do not survive. The presence of bacteria in the blood leads to a significant inflammatory response which in turn causes rapid damage to the body's tissues that triggers a self-sustaining loop of damage and inflammation, eventually leading to either septic (bacteria-driven) or aseptic (inflammation-driven) death. The objective of this study is to use a mathematical model to predict thesurvivability range for an infection given varying doses or degrees of virulence of a bacterial infection. A model consisting of five ordinary differential equationsis developed that tracks (i) the populationof pathogenic bacteria in the intestinal lumen, (ii) the population of bacteria in the blood, (iii) damage caused to the intestinal tissue, (iv) a pro-inflammatory immune system cell population, and (v) a anti-inflammatory immune system cell population. Experimental data from rat sepsis studies are used to estimate several model parameters. The model is used to predict conditions that lead to disease or health outcomes when endogenous bacteria is present alone or in combination with an external infection.

44. Metal-Catalyzed Silylation of Aryl Boronic Derivatives

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Organosilicon compounds are important molecules in applications as diverse as material science, agrochemical production, and the pharmaceutical industry. The introduction of silicon bioisoteres are used to improve the properties of drugs such as their lipophilicity. Additionally, carbon-silicon bonds have synthetic applications as reagents for cross-coupling reactions and functional group interconversion transformations. Chemical reactivity can also be affected since the use of silylation in terms of aryl substitution can have dramatic impact, allowing for electrophilic aromatic substitution in otherwise unreactive moieties. Traditional silylation of aromatic compounds often requires the use of halogenated starting materials, stoichiometric amounts of metals, and harsh reaction conditions such as organolithium and Grignard reagents. Here, we propose a mild, palladium-catalyzed transformation of aryl boronic derivatives into aryl silylated compounds. This method would provide greater functional group compatibility and orthogonal reactivity compared to current methods. Preliminary results and competitive reactions will be presented.

Mentors: Sébastien Laulhé, Department of Chemistry and Chemical Biology,Indiana University-Purdue University Indianapolis