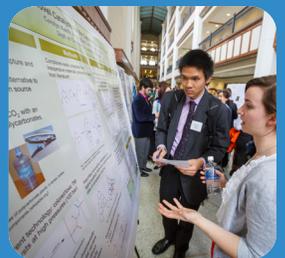
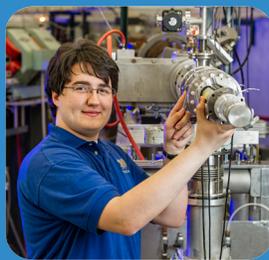


# COS JAM 2016

FRIDAY  
APRIL 29  
1-5PM  
JORDAN HALL

## COLLEGE OF SCIENCE JOINT ANNUAL MEETING ABSTRACT BOOKLET

The 10th College of Science Joint Annual Meeting (COS-JAM) is part of the 9th Undergraduate Scholars Conference. The intent of COS-JAM is to highlight the achievements of undergraduate students conducting scientific research.



UNIVERSITY OF  
NOTRE DAME

College of Science

**COLLEGE OF SCIENCE - JOINT ANNUAL MEETING**  
**Friday April 29, 2016**  
**Jordan Hall, University of Notre Dame**

**Schedule and Abstracts**

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## Schedule - Biological Sciences

### Oral Presentations I

1:00 - 2:30 p.m.

Jordan Room 105

Moderator: Diane Choi

- 1:00 Rebecca Blais - Tackling the Elephant in the Room: The Sri Lankan Elephant Conservation Project
- 1:15 Sophia Chau - Individual-based simulation modeling to predict Karner blue butterfly resource quality tradeoffs to inform conservation efforts
- 1:30 Lillian McGill - Use of an ecosystem-based model to predict the effects of non-native Pacific salmon spawning on stream-resident fish in the Great Lakes basin
- 1:45 Megan Uekert - Senescence and Plant Quality During the Growing Season of Wild Blue Lupine, *Lupinus perennis*
- 2:00 Zoe Volenec - Climate Change's Effect on Montana's Bunchgrass Prairie

### Poster Presentations

2:30 - 3:30 p.m.

Jordan Galleria

- Carolyn Ahlers - APC Regulation of Epithelial Membrane Protein 2
- Shaley Albaugh - Central Representation of Taste and Behavior: A Critical Review
- Philip Allen - StARD9 is a Novel Kinesin Required for Motility and Tubulation of Late Endosomes/Lysosomes Containing NPC1
- Laura Anderson - Investigating the increased attraction of agreement errors by invariant plural nouns
- Anne Arnason - APC regulation of tumor initiating cells in breast cancer
- Sharlo Bayless - To swim or not to swim; are *Escherichia coli* and coliform abundances related to distance from shore, pH, and dissolved oxygen in recreational lakes?
- Clayton Becker - Characterizing the Role of ADAM10a and ADAM10b in Zebrafish Retinal Regeneration
- Elizabeth Berg - Analyzing the spatial and temporal patterns of benthic biofilm development in 4 experimental streams with varying substrate at ND-LEEF
- Aislinn Betts - 3D Crystal Engraving as a Means to Visualize and Label Biomedical Tomographic Imaging Data
- Matthew Cervantes - Establishing techniques to measure intracellular calcium in the regenerating zebrafish retina
- Madeline Chandra - Examining the role of Adenomatous Polyposis Coli (APC) on cell-substrate and cell-cell interactions
- Josephine Chau - Is photosynthetic efficiency of wetland plants altered by carbon dioxide levels?
- Ruth Cooper - Critical Review of the Current Literature On the Interactions Between Taste, Olfaction, and Vision
- Atticus Coscia - Effectiveness of an Intensive Exercise Program for Parkinsons Disease
- Christopher Dethlefs - Positron Emission Tomography (PET) Imaging of Brown Fat Metabolism in GKN1 Knockout Mice
- Bryce deVenecia - Mosquito Specific Odorant Gene analysis through Crispr-Cas knockout in *Anopheles gambiae*

- Allison Dianis - PEA and Vetericyn as Treatments for Ulcerative Dermatitis in C57BL/6 Derived Mice
- Paulina Eberts - Three Dimensional Tissue Histology and Multiplex Imaging
- Ryan Engert - Generation of Aaop1 Visual Mutants by CRISPR/Cas9 Mutagenesis of *Aedes aegypti* Mosquitoes
- Kaitlin Frei - Managing malaria: evaluating new insecticides with the WHO susceptibility tests
- Anne Gandolfi - Generating Recombinant Fluorescent Proteins to Evaluate Protein Trafficking to Exosomes
- Matthew Goblirsch - qRT-PCR at MD Anderson: Summer 2015
- Alexis Griess - Effect of resource availability on protozoan communities within long-tailed macaques (*Macaca fascicularis*) in Singapore and Bali, Indonesia
- Matthew Grothaus - Phylogenetic Variation of Bacterial Protein Half-Life and Its Relationship with Growth Strategies
- Nicole Handa - Defining the role of the transcription factor mecom during renal stem cell development
- Mallory Hawksworth - Characterization of Neuropeptide F through RNA Interference in *Aedes aegypti* Mosquitoes
- Adam Haydel - Implications of nonlinearity between transmission and infection risk in the design of trials to assess interventions for mosquito-borne diseases
- John Higham - Establishing the Interaction of Calcium and Morphogen Pathways
- Caleb Johnson - Simulating the introduction of Rift Valley fever virus into the California Central Valley
- Jahmel Jordon - Calcium Signaling in Germ Band Retraction during *Drosophila melanogaster* Embryogenesis
- Sarah Khan - Actual and Perceived Use of Hand Sanitizer Dispensers among Hospital Staff, Patients, and Visitors
- Joseph Kinsella - Electrophysiology of *Drosophila suzukii* and chemical analysis of preferred fruits
- Savannah Kounelis - Plant based attractants for the malaria mosquito, *Anopheles gambiae*
- Maxwell Langer - Adenomatous Polyposis Coli Mediates Cellular Polarity, Size, and Migration Through C-terminus Binding Domains
- Dennis Lee - Metabolic Transcriptome Shifting Promotes Metastatic Proliferation
- Emily Leyden - Mcl-1 in APC-mediated chemotherapeutic resistance in breast cancer
- Sarah Linesch - T1 Transitions and Apoptosis in the *Drosophila* Wing Disc and Embryonic Epithelium
- Jeffrey Luchetti - Group A *Streptococcus* toxin Streptolysin S utilizes nucleic acid cofactor in blood hemolysis
- Erik Maag - Linking agricultural conservation effort to water quality in the Indian Creek Watershed
- Cristina Mancini - Effects of Double Stranded RNA Administration and Feeding Mechanism on *Aedes aegypti* Feeding Behavior
- Elizabeth McGough - Bone up: Craniomandibular development and hard-tissue biomineralization in neonate mice
- Amelia McReynolds - Food web structure of a recently restored Indiana wetland

- Lauren Michels - Prenatal and Infantile Risk Factors for Obesity
- Sneha Modi - Analysis of *Blastocystis* Parasites in *Macaca fascicularis*
- Joseph Mueller - Cover Crops Improve Soil Health in the Shatto Ditch Watershed, Kosciusko Co, IN
- Tiffany Nguyen - Identifying the function of transcription factor WhiB6 in the Esx-1 secretion system of *Mycobacterium marinum*
- Thomas Plagge - Identifying mosquito attractants using olfactory receptors as detectors
- Jason Rink - Betwixt and Between: Intracranial Perspective on Zygomatic Arch Plasticity and Function in Mammals
- Santiago Rolon - Demographics of Sand Fly Vector in Dry Season Sri Lanka
- Melanie Runkle - Diet differentiation in two Alaskan migratory bird species: implications for their response to climate change on the Copper River Delta
- Fernando Saavedra - Examining Mitochondrial Haplotype Diversity in Ancient and Modern Indigenous Caribbean Populations
- Keon Schmidt - Characterizing the role of DEDD on cell cycle regulation in Triple-Negative Breast Cancer
- Jennifer Shin - Modeling the Correlation between Cumulative Early Life Adversity and Parasite Load in Wild Baboon Populations
- Caitlin Smith - Do baboon offspring demonstrate similar parasite load trends as their mothers?
- Harisa Spahic - Negative Self-Perception in a Diverse Racial-Ethnic Sample of Patients with Head and Neck Squamous Cells Carcinomas: Roles of Psychosocial Correlates
- Ryan Sweeney - Gemitabine-Induced Cancer Associated Fibroblast Exosome Hypersecretion Increases Chemoresistance in PDAC
- Nicole Thielen - Baboon Group Size and Parasitism
- Abigail Tirrell - Fit to win: Competitive growth between artemisinin resistant *Plasmodium falciparum* isolates
- Rebecca Turcios - Fish Feed: Identifying which commercial laboratory diet is best for zebrafish
- David Weber - Ecological Effects of Non-native Pacific Salmon and Brown Trout on Native Brook Trout in Great Lakes Tributaries
- Zach Wiley - Down the rabbit hole: Computer-based modeling and validation of mandibular performance
- Kevin Wilkins - Using a lineage tracing system to investigate the dynamics of Müller glia and Neuronal Progenitor Cells (NPCs) proliferation in the regenerating retina of zebrafish
- Kourtney Woods - Female dominance relationships across populations and species of *Papio* baboons: a review
- Xiaoyu Yu - Polymerase Chain Reaction Pooling for Detection of *Plasmodium* in *Anopheles* Mosquitoes
- Helen Zhang - The Role of the mirn23a MicroRNA Cluster in Hematopoiesis and B-Cell Acute Lymphoblastic Leukemia

**Oral Presentations II**  
**3:30 – 5:00 p.m.**

**Jordan Room 105**

Moderator: Mark Brahier

- 3:30 Diane Choi - Spatial Repellents: Potential for a Multifaceted Strategy to Control Dengue
- 3:45 Sarah Philo - The calcium and glutamate effect on *Pseudomonas aeruginosa* motility
- 4:00 Luqun Shen - Developing a Novel Immunotoxin that Targets Cells Overexpressing ErbB2
- 4:15 Forrest Weghorst - JNK Signaling Modulates Expression of Genes Responsible For Morphological Change in a *Drosophila* Photoreceptor Model of Axonal Regeneration
- 4:30 Sawyer Williams - The Role of ZNF77 in Cisplatin Sensitivity and Its Effect on Pharmacoethnicity
- 4:45 Megan McGarel - Unexpected Roles for Stromal MMP3 during Breast Cancer

## Schedule - Chemistry and Biochemistry

### Oral Presentations I

Jordan Room 101

1:00 - 2:30 p.m.

Moderator: Dee Anne Goodenough-Lashua

- 1:00 Ellen Norby - Using computer simulations to understanding microtubule treadmilling in relation to dynamic instability
- 1:15 Catherine Knoverek - Exploring the Protein Folding Mechanism Using an Intrinsically Disordered Protein
- 1:30 Adam Holmes - Ablation of GluN2C Subunit of the N-methyl-D-aspartate Receptor Mitigates the Detrimental Effects of Ischemic Stroke
- 1:45 Megan Fabry - Regulation of the Oncogene ZNF217 by Cellular Localization during Breast Cancer Progression
- 2:00 Robert Stanley - Isolation of Antimicrobial Compounds from Red Oak (*Quercus rubra* L.) Acorns

### Poster Presentations

Jordan Galleria

2:30 - 3:30 p.m.

- Danielle Boley - An analysis of the developmental metabolome of *Xenopus laevis* by CE-ESI-MS and MALDI-TOFMS
- Seamus Brennan - Testing New Fluorescent Probes for Cell Imaging
- Melissa Budicini - Investigating Phospholipid Binding Residues in the C terminus of Ebola Virus Matrix Protein, VP40
- Jennifer Cimon - Optimization of Lentiviral Vector Transfection of Human T Cells
- Lauren Griffin - Designing a Paper Test for CaSO<sub>4</sub> Using Colorimetric Reactions
- Anne Grisoli - The influence of obesity and lipid regulatory factors FABP4 and SREBP-1 in ovarian cancer metastatic models.
- Valentine Henry deFrahan - Got Contaminated Milk? A Paper-Based Screening Method for Milk by MALDI MS
- Daniel Lee - Synthesis and Activation of Pd(II) and Ni(II) Metal Complexes with a Diphosphine Pincer Ligand
- Eric Lee - Analysis of lipid transport proteins SREBP-1 and PLIN3 in obese murine ovarian cancer models
- Christina Murphy - Does reduced EMAP II result in aberrant development of vasculature?
- Matthew O'Neill - Synthesis of Histone Deacetylase Inhibitors
- Matthew Onders - Synthesis of Phosphonate-Clip Derivatives for Mechanistic Insights on Hydrogen Abstraction from Hydrazobenzene
- Joseph Ong - Analyzing the effects of low concentrations of mutagen over time
- Ryan Phan - The Effect of Aging on Ovarian Cancer Metastasis
- Alexis Stefaniak - Augmentation of Response to Chemotherapy by MEK Inhibition in Pancreatic Cancer
- Tiffany Toni - Synthesis of Vigabatrin for Breast Cancer Brain Metastasis Chemotherapeutic Trials

Charday Ward  
Emily Zion

- The Prevalence of Lyme disease in Northern Indiana
- Production and biological evaluation of the polyketide naphthocyclinone from the bacteria *Streptomyces arenae*

## Schedule – Mathematics

### Oral Presentations I

Jordan 310

1:00 - 2:30 p.m.

Moderator: Sonja Mapes

- |                       |   |
|-----------------------|---|
| 1:00 Christian Gorski | - Rational Knots and the Kauffman Bracket Skein Module of the Four-Punctured Sphere |
| 1:15 Gregory Greif    | - Construction of a Space-Filling Curve   |
| 1:30 Eun Seuk Choi    | - Introduction to Brownian motion   |
| 1:45 Austin Rodgers   | - A Result on Ideals of Parametrizations of Plane Sextics                           |
| 2:00 Monica Gorman    | - Mathematical Analysis of Disease Spread on Networks                               |

### Poster Presentation

Jordan Galleria

2:30 - 3:30 p.m.

- |                     |  |
|---------------------|--|
| Paul Coletti        | - Comparing Google PageRank to other Ranking Systems in NCAA Basketball                  |
| Daniel Gorman       | - Restrictive Threshold Item Selection in Multidimensional Computerized Adaptive Testing |
| Melissa Krumdick    | - An Analysis of Volatility-based Option Trading Strategies                              |
| Jonathan Vandenburg | - A Motivation for Higher Categories: Topological Quantum Field Theory                   |

### Oral Presentations II

Jordan 310

3:30 - 5:00 p.m.

Moderator: Sonja Mapes

- |                        |   |
|------------------------|---|
| 3:30 Benjamin Hallberg | - Google PageRank and the Math Behind It  |
| 3:45 Benjamin Gunning  | - Necessary and Sufficient Conditions for Equilibria in Higher Dimensional Games                        |
| 4:00 Andrew Jena       | - The Dirac Formalism of Quantum Mechanics and the Basics of Quantum Computing and Quantum Cryptography |
| 4:15 Matthew Hagarty   | - An Introduction to p-adic Numbers   |
| 4:30 Tallis Bowers     | - Realizing the Fundamental Theorem of Algebra  |

## Schedule - Physics

### Oral Presentations I

Jordan 322

1:00 - 2:30 p.m.

Moderator: Randal Ruchti

- 1:00 Matthew Drnevich - Utilizing Deep Neural Networks to Analyze Collisions in High Energy Physics
- 1:15 Kaitlin Salyer - Analyzing Code for the CMS Upgrade
- 1:30 Patrick Shields - Effect of Pileup for the CMS Track Trigger Update
- 1:45 Patrick Fasano - Measurement of the 0.87 MeV Level Lifetime in  $^{17}\text{O}$  With a Low-Cost Plunger

### Poster Presentations

Jordan Galleria

2:30 - 3:30 p.m.

- Jay Carroll - iLocator: A NIR Doppler Spectrometer
- Colin Dablain - Deep Learning for Particle Physics
- Nicolas Dixneuf - Micro-Pattern Gas Detectors
- Michael Foley - Revised Uncertainties in Big Bang Nucleosynthesis
- Louis Jensen - Methods in Data Analysis of Nuclear Physics as Applied to a  $^{10}\text{C}$  beam run
- James Koci - Creating a Vacuum Chamber For Use With Micro-Pattern Gas Detectors
- Luke Maillie - The Effects of Electronic Health on Rural Healthcare Facilities in Tanzania
- Brady McLaughlin - Analysis of Energy Cost Optimization for Hospitals in Sub-Saharan Africa
- Jacob Miller - Testing the Optimization Algorithms for the Shirati Hospital's Microgrid
- James Miller - Radiocarbon Dating through AMS
- Elliott Runburg - iLocator: A Radial Velocity Doppler Spectrometer
- Kaitlin Salyer - Analyzing Code for the CMS Upgrade
- Patrick Shields - Effect of Pileup for CMS Track Trigger Update
- Robert Stiller - Fast Fourier transform of power load data

### Oral Presentations II

Jordan 322

3:30 - 5:00 p.m.

Moderator: Randal Ruchti

- 3:30 Sarah Russel - Mechanics of Bone Cutting and Application to a New Type of Distal Reamer
- 3:45 Christopher Ferari - Computational Analysis of Dissociative Electron Attachment to Thymine
- 4:00 Emily Kunce - The Effect of Plasma Radiation on Nucleobase Solutions

## Schedule – General Biology Laboratory Course

**Poster Presentations**  
**2:30 - 3:30 p.m.**

**Jordan Galleria**

- |  |  |
|--|--|
| Alexandra Henderson<br>and Erin McCune | - The effect of water level on stem height and dry biomass in<br><i>Schoenoplectus americanus</i>  |
| Sophia Kiernan and<br>Jens Verhey      | - Effect of salinity level on old and modern genotypes of <i>Schoenoplectus<br/>americanus</i>   |
| Jeffrey Nosek and<br>Kyle Sommerfield  | - Investigating the effects of carbon dioxide level on the growth of the<br>modern and old genotypes of <i>Schoenoplectus americanus</i> |

## Schedule – Molecular Cell Biology Research Course

**Poster Presentations**  
**2:30 - 3:30 p.m.**

**Jordan Galleria**

Katherine Koczwara, - Autophagy Impairment in Niemann Pick Type C Disease (NPC)  
Joshua Kolb, Arturo and the Effect of Rapamycin on Autophagy  
Perez Dolores, Mariah  
Snook, and Lillian Spatz

Shannon Leahy, - Investigating DEDD's Role in Cell Cycle Regulation  
Elizabeth Lawler,  
Barnes Werner,  
Thomas Kane, and  
Josephine Weymon

Robin Seay, Christina - Expression of the *irx2a* gene and its role in pronephros segment  
Cheng, Grace Gallo, specification  
Karen Chen, and Anna  
Levesque

## Schedule – Spirit of Science Award Winners

**Poster Presentations**  
**2:30 - 3:30 p.m.**

**Jordan Galleria**

Kerry Goodwine	- The Effect a Change in Voltage has on a Four-Bit Adder
Arianna Hardy and Anjelica Zitto	- The Science of The Bloodstream: Blood Vessels and Artery Constriction TEAM
Julia Jones	- Bending the Rules
Grace Weaver	- The Effect of Estrogen on Green Bean Plant Growth

**ABSTRACTS**  
**(in alphabetical order)**

## Poster Presentation

### *APC Regulation of Epithelial Membrane Protein 2*

Carolyn Ahlers  
College of Science  
Science Preprofessional Studies  
Alyssa Lesko  
College of Science  
Biological Sciences

Jenifer Prosperi, Indiana University School of Medicine – South Bend, Harper Cancer Research Institute, and Dept. of Biological Sciences

Advisor: Jenifer Prosperi, Indiana University School of Medicine – South Bend, Harper Cancer Research Institute, and Dept. of Biological Sciences

The Adenomatous Polyposis Coli (APC) tumor suppressor functions as a scaffolding protein associating with the polarity proteins Dlg and Scrib, microtubules, and the actin cytoskeleton through its c-terminal domain. Our laboratory demonstrated that APC down-regulation in Madin-Darby Canine Kidney (MDCK) epithelial cells results in loss of apical-basal polarity and a disruption of 3D-morphogenesis resulting in larger, non-spherical cyst formation. Assessing the molecular mechanisms responsible for these phenotypes, we observed that APC knockdown increased expression of epithelial membrane protein 2 (EMP2), which is up-regulated in multiple tumor types. Preliminary data shows that either restoration of the c-terminal fragment of APC or knockdown of EMP2 restores the APC-mediated misregulation of cyst size and polarity. Given the lack of information about EMP2 transcriptional regulation, we performed a screen using the contra-V2 web server to identify 32 potential transcription factors involved in EMP2 regulation. We have investigated the mechanism by which EMP2 is upregulated in APC-KD cells through luciferase reporter assays. We assessed activation of several potential transcriptional regulators of EMP2, such as TCF, activator protein 1 (AP1), signal transducer and activator of transcription 3 (STAT3), and NFκB. APC loss increases STAT3 expression but does not affect TCF, AP1 or NFκB transcriptional activity. To determine which binding domains of APC are necessary to regulate EMP2 expression, different fragments of APC (c-ter, mid, full length) have been reintroduced into the APC-KD cells, and EMP2 expression assessed via RT-PCR. Future studies will evaluate transcription factor activation upon APC loss through a protein/DNA binding array and EMP2 regulation by these transcription factors through CHIP assays. Given the prevalence of APC mutation in epithelial cancers, an understanding of how loss of APC mediates EMP2, 3D-morphogenesis, and polarity will be critical for a more thorough understanding of initiation of tumorigenesis in epithelial cancers.

## Poster Presentation

### *Central Representation of Taste and Behavior: A Critical Review*

Shaley Albaugh

College of Science

Neuroscience and Behavior

Advisor: Kristin Rudenga, Kaneb Center for Teaching and Learning

The sense of taste is important for survival: taste is essential for discriminating between nutritious food and toxic substances. Taste begins at the level of the tongue and periphery, with different taste receptors on the tongue transducing information from taste receptor cells into the primary gustatory cortex (GC). While research in periphery transduction and encoding have dominated taste research, the cortical representation of taste in the brain is just recently being elucidated. Recent studies have affirmed topographic organization in the GC; primary taste modalities, and similarly their associated behaviors, have been localized to different areas of the GC with some overlap. Moreover, Peng et al. has shown that perception of taste ultimately lies at the level of the cortex; activation of the bitter cortical field elicited an aversive taste response to water and activation of the sweet cortical elicited an appetitive taste response to water in the rodent model. Scientists have clearly shown distinctive maps of taste modalities, while previous research has been conflicting. The ultimately goal though of taste discrimination, and peripheral transduction, is appetitive and aversive behavior that enables survival. As seen in Peng et al., aversive taste responses, which were characterized by avoidance and face changes, ultimately lead to the avoidance of noxious stimuli, and appetitive taste responses, such as increased licking, insure ingestion of nutritious food. This poster will review how the central representation of taste connects to and gives rise to specific behaviors. Surveying the literature, this critical review ultimately looks at the possible connections between central representation of taste and behavior, and proposes future scientific endeavors needed to prove them.

## Poster Presentation

### *StARD9 is a Novel Kinesin Required for Motility and Tubulation of Late Endosomes/Lysosomes Containing NPC1*

Philip Allen  
College of Science  
Biological Sciences  
Jonathan D'Amico  
College of Science

Kevin Vaughan, Dept. of Biological Sciences  
Advisor: Kevin Vaughan, Dept. of Biological Sciences

Niemann-Pick Type C (NPC) disease is a pediatric neurodegenerative disease caused by mutations in two genes that encode lysosomal proteins (NPC1 and NPC2). NPC1 is a multi-pass transmembrane protein, and LE/Ls containing wild-type NPC1 protein display bidirectional motility along microtubules (MTs) but also project dynamic membrane tubules that provide a novel mechanism of cholesterol efflux. Mutant NPC1 also incorporates into LE/Ls, but these membranes fail to project membrane tubules and become engorged in cholesterol. This suggests that lysosomal tubules are responsible for cholesterol efflux from LE/Ls to the endoplasmic reticulum. Seeking the basis of this difference, we compared the proteomes of purified membranes containing NPC1 and identified StARD9 as a novel transmembrane kinesin in membranes containing wild-type but not mutant NPC1. Cloning and expression of StARD9 revealed MT-binding by the N-terminal kinesin domain but LE/L incorporation by full-length StARD9 containing the C-terminal START domain, dileucine signal and transmembrane segments. StARD9 depletion reduced both centrifugal LE/L motility and projection of membrane tubules. This induced lysosomal cholesterol accumulation and mimicked NPC1 mutants. StARD9-depletion defects were rescued by a full-length, shRNA-resistant StARD9 but not a P-loop mutant construct. Wild-type NPC1 colocalized with StARD9 in LE/Ls and membrane tubules. However, mutant NPC1 and StARD9 failed to incorporate into the same LE/Ls. These findings suggest that StARD9 is a novel kinesin responsible for motility and tubulation of LE/L membranes, a process required for intracellular cholesterol transport. They also identify StARD9 as a LAMP protein that could function with NPC1 in cholesterol transport.

## Poster Presentation

### *Investigating the increased attraction of agreement errors by invariant plural nouns*

Laura Anderson

College of Science

Biological Sciences and Psychology

Maria Mosley

College of Science and College of Arts & Letters

Neuroscience and Behavior and Philosophy

Advisor: Kathleen Eberhard, Dept. of Psychology

Prior studies have shown subject-verb agreement is influenced by multiple factors. Among these factors, the grammatical number of a noun has been shown to be more influential than the noun's notional number. Furthermore, the grammatical plural number associated with plural count nouns is more likely to attract agreement errors than the grammatical plural number associated with invariant plural nouns (Bock et al. 2001). This experiment tested the hypothesis that invariant plural nouns are more likely to be construed as notionally singular (i.e., referring to a single referent) whereas plural count nouns must be construed as notionally plural.

Participants listened to recordings of sentence fragments which they were instructed to repeat aloud and then complete. These fragments varied in the type of referent they contained, such as "The notebook under the scissors/staplers/stapler...". Clipart images depicting the phrases' referents accompanied the phrases. We predicted that plural agreement errors would occur equally often when pictures showed two referents of the invariant plural nouns and the plural count nouns. We also predicted that a small number of agreement errors may occur when phrases ending in an invariant plural noun occurred with pictures showing one referent.

Only 26 agreement errors occurred in total. Our results support the idea that the agreement process is more sensitive to the invariant plural nouns' grammatical number than notional number. However, the numerically higher number of errors following the phrases ending in invariant plural nouns compared to phrases ending in plural count nouns is inconsistent with Bock et al.'s (2001) findings. When the experiment was instead repeated without images, the results were consistent with previous findings. Presumably, the use of pictures reduced the occurrence of agreement errors and resulted in an insufficient sample size. To increase the amount of errors, we designed a new experiment in which the critical subject phrases with a distributive interpretation in which the subject noun is notionally plural. We are in the process of analyzing these results and expect that the increased power will be an improved test of our original predictions.

## Poster Presentation

### *APC regulation of tumor initiating cells in breast cancer*

Anne Arnason

College of Science

Science Preprofessional Studies

Jenifer Prosperi and Monica VanKlompberg, Indiana University School of Medicine – South Bend, Harper Cancer Research Institute, and Dept. of Biological Sciences

Advisor: Jenifer Prosperi, Indiana University School of Medicine – South Bend, Harper Cancer Research Institute, and Dept. of Biological Sciences

Cancer recurrence accompanied by chemotherapeutic resistance or metastasis is responsible for many breast cancer-related deaths. Tumor initiating cells (TICs) may be responsible for both chemotherapeutic resistance and metastasis because they grow slowly and spend much of their time in quiescence, allowing them to avoid death by drugs that target rapidly proliferating cells. Understanding TICs is an important aspect of developing effective treatments for breast cancer patients. In up to 70% of sporadic breast cancers, the Adenomatous Polyposis Coli (APC) tumor suppressor is mutated or silenced by hypermethylation. Our laboratory demonstrated that cells from MMTV-PyMT;*Apc*<sup>Min/+</sup> mice are resistant to doxorubicin and cisplatin, and have increased populations of TICs compared to MMTV-PyMT;*Apc*<sup>+/+</sup> cells. We hypothesized that treating cells with chemotherapy would increase the TICs in MMTV-PyMT;*Apc*<sup>Min/+</sup> cells, resulting in chemoresistance. Quantification of the TIC population was performed with an Aldefluor assay that measures changes in the enzyme aldehyde dehydrogenase (ALDH), where high ALDH indicates a higher proportion of TICs. We found that MMTV-PyMT;*Apc*<sup>Min/+</sup> cells treated with cisplatin had a decreased population of ALDH<sup>+</sup> cells compared to solvent control, and cells treated with doxorubicin and paclitaxel remained unchanged. Next, we studied how populations of ALDH<sup>+</sup> cells differentiate over time. The Aldefluor assay was used to sort MMTV-PyMT;*Apc*<sup>+/+</sup> and MMTV-PyMT;*Apc*<sup>Min/+</sup> cells into positive and negative populations. Weekly after sorting, in both cell lines, the ALDH<sup>+</sup> populations converted to their unsorted levels of ALDH, indicating differentiation. The MMTV-PyMT;*Apc*<sup>+/+</sup> ALDH<sup>+</sup> population remained negative. The MMTV-PyMT;*Apc*<sup>Min/+</sup> ALDH<sup>+</sup> population converted to the unsorted level of ALDH, appearing to have dedifferentiated. Mammosphere assays have confirmed TIC populations in these cell lines. Future studies will include *in vivo* tumor development of ALDH<sup>+</sup> versus ALDH<sup>-</sup> cell lines. Combined these data will help us to elucidate the mechanism of APC-mediated chemotherapeutic resistance as a result of TICs.

## Poster Presentation

*To swim or not to swim; are Escherichia coli and coliform abundances related to distance from shore, pH, and dissolved oxygen in recreational lakes?*

Sharlo Bayless

College of Science

Environmental Sciences

Advisor: Sara Benevente, Dept. of Biological Sciences

Fecal contamination assessments, often measured by indicator bacteria such as *Escherichia coli* and coliform, are required by the Environmental Protection Agency to evaluate water quality. While much is known about plants and animals affecting fecal contamination, the influence of pH and dissolved oxygen (DO) is less frequently studied. This study looked at 4 lakes in Northern Wisconsin with differing morphologies—Tenderfoot, Roach, Morris, and Bay—to determine if fecal contamination was lower in recreational lakes and varied with pH, DO, and distance from the shore. 100mL water samples were taken from two distances on each lake on 5 sampling events and 1mL replicates were incubated on Petrifilms at 37°C for 24 hours. The results showed that 1) the samples closer to the shoreline had higher coliform abundance, 2) Roach had significantly more coliform than other lakes and *E. coli* presence was significantly higher in Bay Lake, and 3) coliform abundance had a positive relationship with pH, but not DO. The results suggest that *E. coli* and coliform levels were probably influenced by lake morphology, such as discharge patterns and shoreline development. Furthermore, bacterial tolerance to slightly basic environments could explain coliform abundance in lake samples with higher pH levels. Future research can look at isolating fecal coliform from total coliform as a more accurate indicator of fecal contamination and measure it in conjunction with *E. coli* to further assess recreational safety.

## Poster Presentation

### *Characterizing the Role of ADAM10a and ADAM10b in Zebrafish Retinal Regeneration*

Clayton Becker  
College of Science  
Biological Sciences

Jingling Li, Dept. of Biological Sciences  
Advisor: David Hyde, Dept. of Biological Sciences

Zebrafish (*Danio rerio*) are an excellent model for studying retinal regeneration because of their capacity to replace neuronal cell types that are lost due to injury or disease. Retinal regeneration in zebrafish is mediated by Müller glial cells, which re-enter the cell cycle and proliferate to replace damaged or lost tissue. Previous studies have shown that Müller glial cells express N-cadherin, which is a transmembrane protein involved in cell-cell adhesion (Goldman, 2014). N-cadherin is selectively cleaved by A Disintegrin And Metalloproteinase 10 (ADAM10), a member of the ADAM family of proteins, which is implicated in ectodomain cleavage of many proteins (Reiss, et al. 2005). ADAM10 has two paralogs in zebrafish, ADAM10a and ADAM10b. Quantitative Real-Time PCR performed over a course of light treatment shows that ADAM10a/b expression levels increase in the regenerating retina, with a peak of expression at 36 hours of intense light, suggesting that ADAM10a/b may be involved in the process of Müller glial proliferation. *In situ* hybridization shows that ADAM10a/b are expressed primarily in the ONL in the undamaged retina. ADAM10a/b expression is seen in the INL after 16 hours of intense light treatment, when photoreceptor death reaches its peak. After 36 hours of intense light treatment, ADAM10a/b expression is localized almost exclusively to the INL, where Müller glial cells are located. Western blot analysis of light-treated retinas revealed that N-cadherin is cleaved after exposure to 36 hours of intense light, implying that N-cadherin may be functionally relevant to the processes of Müller glial proliferation and retinal regeneration. Because ADAM10a/b are specifically responsible for cleaving N-cadherin, it is possible that ADAM10a/b cleave N-cadherin on the membrane of Müller glial cells during retinal regeneration. Future experiments will examine inhibition and activation of ADAM10a/b and the subsequent effect on levels of N-cadherin cleavage and Müller glial proliferation in the regenerating retina.

## Poster Presentation

### *Analyzing the spatial and temporal patterns of benthic biofilm development in 4 experimental streams with varying substrate at ND-LEEF*

Elizabeth Berg  
College of Science  
Environmental Sciences

Brittany Hanrahan, Ariel Shogren, and Jennifer Tank, Dept. of Biological Sciences  
Advisor: Brittany Hanrahan, Dept. of Biological Sciences

Stream biofilms (e.g. algae, bacteria, and fungi) are critical to ecosystem function in headwater streams, yet the effects of stream substrate, which acts as their habitat, has not been fully studied. Autotrophic and heterotrophic components of biofilms have a close relationship; therefore, we conducted an experiment that analyzed spatial and temporal patterns of algal biofilm development with differing substrates in order to determine the influence of these algal biofilms on heterotrophic activity as part of a larger study. At the Notre Dame Linked Experimental Ecosystem Facility (ND-LEEF), we examined the use of resazurin conversion ( $K_c$ ) as an integrative metric to compare ecosystem function in experimental streams with varying benthic substrates. ND-LEEF holds 4 groundwater-fed experimental streams ( $Q=1.5L/s$ , 50m long) with substrates differing in size (pea gravel vs cobble) and heterogeneity (alternating sizes vs well-mixed). In each of the 4 streams, we conducted short-term additions of resazurin and collected benthic biofilm samples ( $n=10$ ) on 6 dates from June-November 2015 to examine how substrate and biological characteristics (i.e., biofilm development) influence heterotrophic activity. My project quantified both the ash-free dry mass (AFDM) and chlorophyll a content of each biofilm sample to determine changes in biofilm biomass over time, as well as differences among the 4 streams. Preliminary results show that biofilm biomass generally increases over time in all 4 streams. We plan to correlate these biological characteristics with resazurin conversion ( $K_c$ ) to examine the role that substrate and biofilm development play in controlling heterotrophic activity.

## Poster Presentation

### *3D Crystal Engraving as a Means to Visualize and Label Biomedical Tomographic Imaging Data*

Aislinn Betts

College of Science

Science Business

Justin Ceh

College of Science

Biological Sciences and Peace Studies

Christian Knight

College of Engineering

Civil Engineering

Matthew McGoldrick

College of Science

Biological Sciences and English

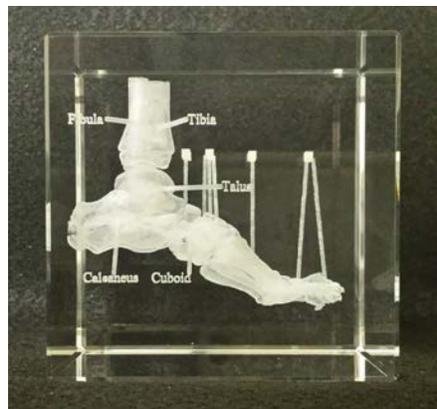
Matthew Leevy, Dept. of Biological Sciences

Steve Gerstler, Saint Joseph Regional Medical Center

Jeff Maki, Michael Pokuta, and Kody Organ, Models Plus

Advisor: Matthew Leevy, Dept. of Biological Sciences

Imaging modalities, such as X-Ray Computed Tomography (CT) and Magnetic Resonance (MR), have transformed how biomedical data is collected and utilized in research and clinical settings. Visualization of biomedical imaging data has previously been restricted to computer display and 3D printed models. Complete comprehension of a specimen is limited using a computer screen. 3D printed models, while effective tools in education and patient-physician communication, are unable to be mass produced due to high costs, extensive production times, and need for support material in empty spaces. An alternative approach for viewing biomedical data is 3D crystal engraving. In this process, data acquired from clinical collaborators is converted from DICOM to STL files and modified with computer software. A laser at an industrial manufacturer, Models Plus, engraves the data point-by-point into a crystal with predetermined dimensions. Data sets can be to scale (as in a human wrist), scaled up (sheep bone core), or scaled down (human foot). Complex structures are quickly generated as parts are made in free space without support material. Anatomical labels can be attached to corresponding parts, enhancing the educational value of the models. Since 3D crystal engraving can produce both bone and soft tissue models with high resolution, it is currently being utilized to create a gallery of human anatomical structures. Mass production will allow these crystals to be widely used as educational tools in classroom and clinical settings.



## Oral Presentation

### *Tackling the Elephant in the Room: The Sri Lankan Elephant Conservation Project*

Rebecca Blais  
College of Arts & Letters  
Peace Studies and Political Science  
Advisor: Anre Venter, Dept. of Psychology

The goal of this project was to examine the human-elephant conflict between the rural farmers and the native elephants in Sri Lanka, specifically in the Wasgamuwa region, and develop innovative and sustainable solutions to the conflict that can be applied to regions facing similar issues.

The purpose of collecting data on migration patterns – as well as on dietary habits, herd behavior, population sizes, and human-elephant interaction, to name a few – was to provide insight into the baseline situation of the Wasgamuwa region so that the Sri Lankan Wildlife Conservation Society (SLWCS) and those working with the Elephant Conservation Project would have the data and means necessary to implement change in their education methods, as well as in their two primary initiatives: the Beehive Fence Project and Project Orange.

Methods of data collection included the daily collection of elephant droppings – which provided information on the elephants such as their size, relative age, gender, and diet – as well as empirical observations on a heavily human- and elephant- trafficked roads.

Data collection was useful for the long-term effort of evidence compilation, but direct interaction with locals and field guides from the SLWCS proved most effective in gaining a holistic perspective on the conflict. Consideration of the unique culture and landscape of the region are vital to the success of the fledgling Projects, and most importantly, the SLWCS needs to focus their efforts moving forward on two aspects: education for the local villagers on sustainable solutions for the human-elephant conflict and what their part can be, and the continued building of relationships with the locals who are responsible for the maintenance of the Beehive Fence Project and Project Orange. These two projects have potential for success in being models for other regions to use if they are provided proper resources and focus.



## Poster Presentation

### *An analysis of the developmental metabolome of *Xenopus laevis* by CE-ESI-MS and MALDI-TOFMS*

Danielle Boley  
College of Science  
Biochemistry  
Elizabeth Peuchen  
College of Science  
Chemistry

Jennifer Arceo and Nicole Schiavone, Dept. of Chemistry and Biochemistry  
Advisor: Norman Dovichi, Dept. of Chemistry and Biochemistry

Metabolomic analyses provide an understanding of downstream effects of cellular pathways and play a role in identifying potential biomarkers. We aim to perform capillary electrophoresis coupled to electrospray ionization-mass spectrometry (CE-ESI-MS) and matrix-assisted laser desorption ionization time-of-flight mass spectrometry (MALDI-TOFMS) for metabolomic analysis of *Xenopus laevis* embryos in different stages of development. CE-ESI-MS is ideal for metabolomic analysis because it can separate and detect a wide variety of analytes while offering advantages in speed, efficiency, and limited sample consumption. MALDI-TOFMS is useful for determining the locations of specific metabolites in different regions of the embryos. We chose *Xenopus laevis* because it is a traditional model system for studying the cell cycle and cell death and has recently been expanded to studying metabolic phenotypes present in tumor cells and spinal cord regeneration. Our preliminary results showed a clear increase in the number of features present as the *Xenopus laevis* embryos matured and preferential ionization for some analytes in positive vs. negative ion mode. The embryo cross-section images appeared to have metabolite localization that corresponds to different biological layers. Future work could include studying later stage embryos and transferring the experiments to the autosampler to improve sample throughput.

## Oral Presentation

### *Realizing the Fundamental Theorem of Algebra*

Tallis Bowers  
College of Science  
Mathematics

Advisor: Jeffrey Diller, Dept. of Mathematics

The goal of this lecture is to prove the very important Fundamental Theorem of Algebra using methods approachable to underclassmen. The proof we will present relies mainly on De Moivre's Theorem of roots and the Maximum Value Theorem, and we will try and prove these theorems in the lecture. In the end, we analyze the magnitude of a polynomial to prove that it must take its minimum value, and this value must be zero. The final proof of the Fundamental Theorem of Algebra is a proof that assumes this minimum value can be nonzero and reaches a contradiction. This method requires no knowledge of algebra.

## Poster Presentation

### *Testing New Fluorescent Probes for Cell Imaging*

Seamus Brennan  
College of Science  
Biochemistry

Advisors: Scott Shaw and Bradley Smith, Dept. of Chemistry and Biochemistry

The Smith group is working to create a library of multivalent RGD-conjugated fluorescent squaraine dyes that target integrin receptors commonly upregulated in certain cancers to allow for selective imaging of these cancer cells. In order to demonstrate that the uptake of the squaraine-RDG is an active process, several blocking assays using integrin positive OVCAR4 cells were performed including low temperature and ATP depletion as well as inhibition of specific endocytotic mechanisms. So far, these studies have shown that uptake is indeed an active process. In addition to evaluating the targeting of squaraine-RGD, a new generation of squaraine dyes was also evaluated. The rapid loss of fluorescence upon exposure to excitation light, known as photobleaching, has always been a critical obstacle in the application of fluorescent dyes outside of the laboratory, and the squaraine dyes of the Smith group are no exception. To counter this phenomenon, the group has developed a new generation of squaraine dyes that show enhanced photophysical properties including increased fluorescence and photostability. The increased photostability (and brightness) comes from replacing the thiophene in the squaraine dye with a phenolic group, restricting non-fluorescent modes of relaxation. To compare the performance of the traditional thiophene squaraines with the new phenolic-squaraines, a 10  $\mu\text{M}$  solution of each of the dyes and the corresponding complexes of both dyes with Tony Davis macrocycle to CHO cells and, after allowing them to incubate for 3 hours and washing the cells several times with PBS, imaged them under a Cy5 filter. In conclusion, the new phenolic dyes are indeed brighter and more photostable than their thiophene predecessor, making them much better for this application (imaging endosome trafficking) and by extension, making them better for any other application found for these squaraines.

## Poster Presentation

### *Investigating Phospholipid Binding Residues in the C terminus of Ebola Virus Matrix Protein, VP40*

Melissa Budicini  
College of Science  
Biological Sciences

Advisor: Robert Stahelin, Indiana University School of Medicine - South Bend  
and Dept. of Chemistry and Biochemistry

Ebola virus (EBOV) is a lipid-enveloped virus that causes hemorrhagic fever and a fatality rate of 50-90%. Though EBOV only has 7 genes in its genome, one, VP40 is the main driver of viral egress. VP40 localizes to the plasma membrane where it forms virus like particles (VLPs). While the mechanism of the viral egress is not completely understood, previous studies have found that phospholipids phosphatidylserine (PS) and phosphatidylinositol 4,5-bisphosphate (PIP2) are required for plasma membrane localization, self oligomerization, VLP formation and VLP budding from the cell. VP40 transforms through self-oligomerization from a dimer to a hexamer and eventually a longer filament. PS likely induces the dimer to hexamer transition while PIP2 is required for larger oligomers (n=12 or more). In an effort to understand the process of oligomerization, which drives VLP formation we have identified a likely PIP2 binding pocket on the C terminus of VP40; the C terminus of VP40 is hypothesized to interact with the PM. This pocket shares structural similarity to the PIP2 binding pocket of viral matrix protein HIV-GAG from HIV-1. In order to study this hypothesized binding site, we are using site directed mutagenesis to mutate potential binding residues and control residues to alanine. We are transfecting live COS7 cells with plasmid DNA of the WT VP40 and point mutant VP40 constructs. Next, we use confocal imaging to observe the phenotype of each mutant compared to WT. We are specifically interested in VP40's ability to localize at the plasma membrane, where it forms VLPs. We quantify the percent PM localization of each mutation compared to WT. This information will increase our understanding of the role of each residue in the hypothesized binding pocket to direct further VP40-lipid binding studies. A greater understanding of how VP40 binds to the membrane may provide more information on the process of viral egress and lead to a potential drug target in the future.

## Poster Presentation

### *iLocator: A NIR Doppler Spectrometer*

Jay Carroll  
College of Science  
Physics

Advisor: Justin Crepp, Dept. of Physics

iLocator is a diffraction limited spectrometer that works in near-infrared wavelengths to detect earth-like exoplanets orbiting around M-dwarf stars. iLocator can be viewed as a follow-up to NASA's Kepler probe mission, where Kepler was able to confirm 246 planets out of a pool of 3,601 planet candidates. More significantly, however, iLocator will also be a follow-up instrument for the upcoming TESS (Transiting Exoplanet Survey Satellite) mission. Both Kepler and TESS use the transit method to detect exoplanets, which involves analyzing light curves, and recognizing dips in intensity that correspond to planetary orbits. iLocator uses the radial velocity technique, which allows follow-up on much smaller planetary targets. With the transit method, the planet and the star need to be big enough where the overall light intensity is detectable by a satellite. With the radial velocity technique, where planets are detected by analyzing wobbles in a star's radial velocity curve, smaller targets are more viable. While iLocator can detect planets orbiting around smaller stars, it is a valuable tool for detecting exoplanets around all stars. This poster will focus on the design of the acquisition camera with the intention of explaining the design methodology, the testing process, and the assimilation of the instrument at the LBT. Particularly, the intention of this poster is to demonstrate the progress that iLocator has made and illustrate the possibilities of a finalized instrument. In presenting the progress of the instrument, the goal is to generate excitement for the project and anticipation over the exploration of a variety of science cases, such as the Rossiter-McLaughlin effect, exoplanets in binary star systems, and atmospheric spectroscopy.

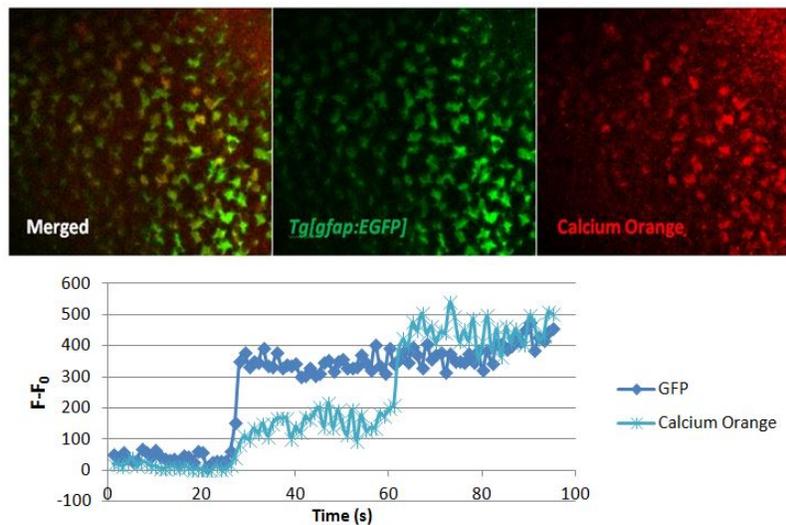
## Poster Presentation

### *Establishing techniques to measure intracellular calcium in the regenerating zebrafish retina*

Matthew Cervantes  
College of Science  
Biological Sciences

Manuela Lahne Dept. of Biological Sciences  
Advisor: David Hyde, Dept. of Biological Sciences

Zebrafish possess a natural ability to regenerate damaged retinal tissue. During retinal regeneration, Müller glia are the stem cells that re-enter the cell cycle to produce neuronal progenitor cells (NPCs) that amplify and subsequently differentiate into lost neurons. Müller glia and NPCs undergo a process termed interkinetic nuclear migration (IKNM), which is the movement of nuclei along the apical-basal axis of epithelia. S-phase of the cell cycle occurs in the inner nuclear layer (INL), followed by apical nuclear migration of proliferating cells to the outer nuclear layer (ONL), where they undergo mitosis, and then the arising nuclei return to their basal positions in the INL. The mechanisms facilitating IKNM during adult zebrafish retinal regeneration are not well understood. During retinal development, increases in the number of  $\text{Ca}^{2+}$  signaling events have been shown to correlate with nuclear migration. We hypothesize that  $\text{Ca}^{2+}$  signaling events also occur during IKNM of Müller glia and NPCs in light-damaged zebrafish retinas. A protocol for measuring intracellular  $\text{Ca}^{2+}$  levels in Müller glia/NPCs in the adult regenerating retina has not been established. Here, we tested different techniques to load  $\text{Ca}^{2+}$ -indicators into retinas. Initially, retinal explants from *Tg[*gfap*:EGFP]<sup>m11</sup>* transgenic zebrafish, which express EGFP in the Müller glia, were incubated with the cell permeable  $\text{Ca}^{2+}$ -indicators, Calcium Crimson AM and Fura-Red AM, which contain acetoxymethyl ester (AM) moieties. Calcium Crimson AM and Fura-Red AM showed excellent uptake into neuronal cell types, including amacrine, photoreceptor, and some ganglion cells, however Müller glia were not labeled. I next attempted to electroporate the  $\text{Ca}^{2+}$ -indicator Calcium Orange, a non-cell permeable  $\text{Ca}^{2+}$  indicator, into the Müller glia of *Tg[*gfap*:EGFP]<sup>m11</sup>* transgenic retinas. This technique allowed robust uptake of Calcium Orange into Müller glia and the observation of spontaneous  $\text{Ca}^{2+}$  signaling events. In conclusion, I established methods to monitor intracellular  $\text{Ca}^{2+}$  levels and this technique will now be a powerful tool to understand the role of  $\text{Ca}^{2+}$  signaling in IKNM.



## Poster Presentation

### *Examining the role of Adenomatous Polyposis Coli (APC) on cell-substrate and cell-cell interactions*

Madeline Chandra  
College of Science  
Biological Sciences  
Alyssa Lesko  
College of Science  
Biological Sciences

Advisor: Jenifer Prospero, Indiana University School of Medicine – South Bend, Harper Cancer Research Institute, and Dept. of Biological Sciences

Adenomatous Polyposis Coli (APC) is a scaffolding protein with a tumor suppressor role and is known for being mutated in epithelial cancers such as colorectal, breast, pancreatic, and lung cancer. APC has been widely characterized as a negative regulator of the Wnt/B-catenin pathway, but less is known about the role of APC in Wnt-independent functions. Our laboratory previously discovered that APC knockdown in Madin Darby Canine Kidney (MDCK) cells results in Wnt-independent changes in polarity, increased cyst size in three-dimensional cultures, and increased migration in wound healing assays. This study investigates the role of APC in cell-substrate and cell-cell interactions by exploring the tumorigenic events that occur when APC is lost in MDCK cells. If cell adhesion to the extracellular matrix is disrupted, non-transformed cells typically undergo cell death, termed “anoikis.” Tumor cells avoid anoikis, enabling them to metastasize throughout the body. Because of APC’s role in cell motility, we hypothesized and found that knockdown of APC result in larger anchorage independent colony formation. We are continuing to examine differential interactions between APC knockdown cells and multiple matrix proteins to investigate this disruption in cell-matrix adhesion. This study also continued previous findings about the effect of APC knockdown on the disruption of epithelial cell polarity by investigating ciliogenesis, the final stage in MDCK polarization. Primary cilia are solitary, non-motile organelles that have cell signaling roles via both mechanical and chemosensation. They coordinate cell migration and polarization, both of which are affected upon APC loss. Our studies have found no difference in primary cilia structure in APC knockdown in two-dimensional culture, but have found alterations in primary cilia in three-dimensional cultures. Overall, this study examined the tumorigenic potential of APC knockdown in MDCK cells by investigating anchorage-independent growth, analyzing cell-matrix interactions, and exploring changes in cilia structure.

## Poster Presentation

### *Is photosynthetic efficiency of wetland plants altered by carbon dioxide levels?*

Josephine Chau

College of Science

Environmental Sciences

Carmella Vizza and Gary Lamberti, Dept. of Biological Sciences

Advisor: Dominic Chaloner, Dept. of Biological Sciences

Increasing atmospheric carbon dioxide (CO<sub>2</sub>) concentrations is an important component of environmental change that can alter plants' photosynthetic efficiency. Plants incorporate atmospheric CO<sub>2</sub> during photosynthesis and thus, can alter how an ecosystem responds to environmental change. Wetland plants' response to increased CO<sub>2</sub> is important because of the consequences for plant abundance and distribution. Plants' photosynthetic response can be assessed from their carbon stable isotopes ( $\delta^{13}\text{C}$ ) because carbon-fixing enzymes create distinctive isotopic patterns in C<sub>3</sub> and C<sub>4</sub> plants. Our objective was to establish whether plant species differ in their carbon fixation under past, present, and future CO<sub>2</sub> concentrations. Under glass, a combination of plants, including lily (*Nymphaea* sp., floating C<sub>3</sub>), sedge (*Schoenoplectus americanus*, emergent C<sub>3</sub>), saltmarsh cordgrass (*Spartina alterniflora*, emergent C<sub>4</sub>) and milfoil (*Myriophyllum pinnatum*, submerged), were grown in three microcosms, each with different manually controlled CO<sub>2</sub> levels. Treatment CO<sub>2</sub> levels were representative of future (~ 800 ppm), historic (~ 300 ppm), and ambient (~ 500 ppm) atmospheric concentrations, while other environmental factors including light, temperature, and humidity were monitored. At the end of 9 weeks, plant growth was determined and tissue samples were collected for  $\delta^{13}\text{C}$  analysis. ANOVAs on log-transformed growth data and untransformed  $\delta^{13}\text{C}$  were used to test the effects of CO<sub>2</sub> level and species identity. Results suggest that growth and  $\delta^{13}\text{C}$  only differed among species ( $P < 0.05$ ), and not among CO<sub>2</sub> levels. Specifically, milfoil growth was significantly different from that of sedge, saltmarsh cordgrass, and lily, and  $\delta^{13}\text{C}$  was significantly different between all species. Our study emphasizes the differences in growth response and  $\delta^{13}\text{C}$  among plant species. However, the effect of atmospheric CO<sub>2</sub> levels on these wetland plants' growth and photosynthetic efficiency, if any, was unclear. Understanding this relationship is important in considering future shifts in plant communities and subsequent ecological implications.

## Oral Presentation

### *Individual-based simulation modeling to predict Karner blue butterfly resource quality tradeoffs to inform conservation efforts*

Sophia Chau  
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Environmental Sciences

Lainey Bristow, Dept. of Biological Sciences

Advisors: Stuart Jones, Dept. of Biological Sciences

Jessica Hellmann, Dept. of Ecology, Evolution & Behavior, University of Minnesota

The Karner blue butterfly (*Lycaeides melissa samuelis*, KBB) is a federally endangered subspecies native to the Midwest, East Coast, and Canada. Historically found in a continuous band from eastern Minnesota to southern Maine and the Canadian province of Ontario, the KBB is now only found in fragmented populations within its former range. Primary reasons for its decline are oak savanna habitat loss, fragmentation, and lack of natural disturbance. Studies seeking to inform habitat management have focused on nectar sources and wild blue lupine (*Lupinus perennis*), the obligate host plant for Karner blue larvae. While there is knowledge on KBB nectar species preferences, habitat use, and oviposition (egg-laying) strategy, little is known about how nectar and host plant quality and spatial arrangement influence oviposition site selection. Knowledge on resource tradeoffs will inform habitat and resource management for the endangered KBB, and improvements to local habitat quality can improve the long-term viability of KBB populations. A greater understanding of how habitat and resource quality affect KBB oviposition site selection can elucidate whether the KBB chooses oviposition sites to optimize adult fitness, larval fitness, or faces a tradeoff between the two. In preparation for my field study this summer, I created an individual-based computer model with literature and lab data using NetLogo. My goal in creating this framework model is to simulate female KBB resource tradeoffs under varying habitat quality and spatial arrangements. This talk will lay out the importance of knowledge on resource quality tradeoffs for conserving KBB populations, cover key steps in building an individual-based model, and demonstrate how simulation models can be used to illustrate and predict ecological dynamics.

## Oral Presentation

### *Spatial Repellents: Potential for a Multifaceted Strategy to Control Dengue*

Diane Choi  
College of Science  
Biological Sciences

Advisors: Nicole Achee and John Grieco, Dept. of Biological Sciences

*Aedes aegypti* is a primary vector for several arthropod-borne viruses such as dengue (DENV), yellow fever, chikungunya, and Zika. Specifically, DENV is of growing global importance with incidence growing to estimates of 390 million dengue infections a year, with approximately 67-136 million manifesting clinically. Although efforts are underway to develop a DENV vaccine, current dengue prevention strategies rely on vector control through the use of indoor and outdoor application of insecticides, specifically pyrethroids. Pyrethroids that are classified as spatial repellents are highly volatile at ambient temperatures and have received interest as a novel delivery system for adult vector control. This includes transfluthrin, a chemical widely used in household mosquito control products. Understanding the full range of behavioral effects spatial repellents elicit on target mosquito species will be critical to understanding the overall impact on vector populations and guide expectations of efficacy against DENV transmission. The current study quantified changes in attraction of gravid *Ae. aegypti* to experimental oviposition sites following exposure to the spatial repellent transfluthrin. Responses were measured through two-choice bioassays using 'sticky-screens' covering cups to prevent contact with the treatments. Two cups contained a bacterial attractant composed of four species of bacteria in calcium alginate beads in water and two cups contained deionized water alone. Results from 40 replicates (n=780 females total per treatment) indicated an estimated difference in attraction of  $9.35\% \pm 0.1855$  ( $p \leq 0.004$ ), implying that the transfluthrin exposed mosquitoes were more attracted to landing in the experimental oviposition sites than the non-exposed mosquitoes. The enhanced response of exposed female *Ae. aegypti* suggests a role for spatial repellents in combination with gravid traps (push-pull strategy) for dengue vector control. Findings from this study will further characterize the role of spatial repellents to modify *Ae. aegypti* behavior and encourage innovation in vector control product development more broadly. Future experiments to test resistant *Ae. aegypti* strains are planned.

## Oral Presentation

### *Introduction to Brownian motion*

Eun Seuk Choi  
College of Science  
Mathematics

Advisor: Nancy Stanton, Dept. of Mathematics

Brownian motion is the random motion of particles suspended in a fluid resulting from their collision with the atoms in the gas or liquid. Surprisingly, there are applications of Brownian motion in Finance. The fact that the seemingly random motion of particles can be explained mathematically drew my attention to write a senior thesis about it. Brownian motion was first discovered by the botanist Robert Brown in 1827 and later explained by Albert Einstein in 1905. In this talk, I will explain two building blocks of Brownian motion, stochastic processes and symmetric random walks.

## Poster Presentation

### *Optimization of Lentiviral Vector Transfection of Human T Cells*

Jennifer Cimons  
College of Science  
Biochemistry

Lance Hellman, Dept. of Chemistry and Biochemistry  
Advisor: Brian Baker, Dept. of Chemistry and Biochemistry

Cytotoxic T cells have the ability to attack foreign or malignant cells in the body. T cell receptors (TCRs) on the surface of the T cell have the ability to recognize antigens in complex with major histocompatibility complex (MHC) class 1 molecules, which are presented by all nucleated cells in the body with the exception of red blood cells. A subset of TCRs that is known to attack melanoma cells, known as DMF5, has been isolated from a melanoma patient. The DMF5 TCR recognizes the melanoma MART-1 antigen (AAGIGILTV) in complex with the HLA-A2 MHC allele. DMF5 mutants have been engineered through structure-guided design to have a higher affinity for the MART-1 peptide in complex with HLA-A2. The strength and specificity of the immune response against the peptide-MHC complex mounted by these engineered T cell receptors can be characterized through cell culture experiments. Our work involves optimizing the efficiency of both time and cost of the transfection process used to express these DMF5 TCR mutants in human T cells, which includes a separate transfection of the DMF5 construct into a stable viral packaging cell line before transfection of the T cells. The fluorescent mCherry marker protein was added to the DMF5 construct as a more accurate marker than the previously used CD34 marker protein, which is expressed in low levels in the target T cell line. Each step of the transfection process can be monitored by fluorescence microscopy to ensure successful transfection before moving on to the next step. The use of mCherry as a marker protein has also eliminated the need for fluorescent antibody to be used in FACS sorting.

## Poster Presentation

### *Comparing Google PageRank to other Ranking Systems in NCAA Basketball*

Paul Coletti  
College of Science  
Information Technology and Mathematics  
Advisor: Anne Pilkington, Dept. of Mathematics

The main focus of this thesis is to apply the Google PageRank (GPR) algorithm to the basketball teams in Division I of the NCAA. We analyze and compare different rating systems (Massey, Colley, Keener, and Google PageRank) by applying each of them to data from previous seasons. For each season, we focus on the “March Madness tournament” using the ESPN Bracket Challenge scoring method as a measure of the accuracy of our ranking systems, and to find optimal parameters for each ranking system.

## Poster Presentation

### *Critical Review of the Current Literature On the Interactions Between Taste, Olfaction, and Vision*

Ruth Cooper

College of Arts & Letters

Neuroscience and Behavior

Advisor: Kristin Rudenga, Kaneb Center for Teaching and Learning

My project is focused on a critical analysis of the current literature regarding the interaction of taste, olfaction, and vision. This review poster will discuss the brain areas that are activated both by vision and olfaction, and how the vision system can override olfactory stimuli given certain conditions, as well as the evolutionary benefit of this override. The review poster will also focus on how both the olfactory and the vision systems influence the sense of taste, in both humans and rats, and how this combination and interaction of senses contributes to the phenomenon known as “flavor”. I will cite multiple recent scientific studies focused on these interactions, discuss the conclusions drawn from these studies, and propose future experiments to further our scientific knowledge on this topic. This poster will highlight recent studies ranging from the effect of color on the taste of wine to the effect of the inhibition of olfaction on the taste of bitter foraged foods, with a critical analysis of the author’s methods and assumptions. This will be an interesting and informative review poster that will successfully present all of the current resources on the interaction of taste, olfaction, and vision, along with the background information on these three important senses.

## Poster Presentation

### *Effectiveness of an Intensive Exercise Program for Parkinson's Disease*

Atticus Coscia  
College of Science  
Science Business

Advisor: Elizabeth Zauber, Dept. of Neurology, Indiana University School of Medicine

Parkinson's disease (PD) is a common neurological disease with no known cure. Rock Steady Boxing, a community-based exercise program for individuals with PD was studied to analyze the effects that this program has on its participants. Baseline evaluations of general strength, flexibility, coordination, balance, motor skills and quality of life were conducted when participants entered the program. Participants were then re-evaluated using the same measures at six-month intervals for up to 24 months to determine the effect of the exercise program on PD symptoms and general fitness. For the 91 subjects that participated, at the 1 and 2 year follow-ups there were statistically significant improvements in upper and lower body strength, coordination, balance, and motor skills. General flexibility and quality of life were unchanged. Despite the expected worsening over time that traditionally accompanies a neurodegenerative disease such as PD, the Rock Steady participants who completed these assessments not only maintained physical function but showed improvements on the majority of the measures. While there are some limitations to the study design, these results suggest that exercise may be affecting neuroplastic changes to occur in the PD brain, with possible neuroprotective effects.

## Poster Presentation

### *Deep Learning for Particle Physics*

Colin Dablain  
College of Science  
Physics

Advisor: Kevin Lannon, Dept. of Physics

The particle colliders employed by high-energy physicists to probe the properties of the fundamental constituents of matter produce an astounding volume of collisions, and, consequently, data. Identifying the particles in a particular collision involves solving signal-background classification problems that are intractable for humans. To solve these classification problems, various machine-learning methods are typically employed; though no particular machine learning method has yet proved markedly superior to the others. Recent work by machine learning researchers on the field of deep learning, particularly on deep neural networks, has produced state-of-the-art results on image recognition and natural language processing tasks. The scope of my work has been to use simulated collision data from the Compact Muon Solenoid (CMS) experiment at the Large Hadron Collider (LHC) to train deep neural networks with the goal of producing state-of-the-art classification accuracies on a variety of standard collision datasets.

## Poster Presentation

### *Positron Emission Tomography (PET) Imaging of Brown Fat Metabolism in GKN1 Knockout Mice*

Chris Dethlefs  
College of Science  
Mathematics

Sarah Chapman, Dept. of Biological Sciences

Anne-Marie Overstreet and Lisa Abernathy, Indiana University School of Medicine - South Bend  
Advisor: Matthew Leevy, Dept. of Biological Sciences, and David Boone, Indiana University School of  
Medicine - South Bend and Dept. of Biological Sciences

This ongoing study seeks to better characterize the phenotype of GKN1 knockout mice using Positron Emission Tomography (PET), a non-invasive bio-imaging technique. The Boone Lab at the IUSMSB has generated a GKN1 knockout mouse that is unable to produce the stomach protein gastrophilin 1. Histological observation indicated that these mice are unique in having significantly more brown adipose tissue in their interscapular regions than wildtype littermates. These deposits, which serve as a heat source for the animals, have a high metabolic signature. This makes them ideal for PET imaging using Fluorodeoxyglucose (FDG), a sugar probe that is drawn to metabolically active sites. As anticipated, initial results indicate that GKN1 knockout mice exhibit a dramatically different metabolic profile than wildtype mice under FDG PET. Furthermore, data analysis using the software PMOD (Version 3.306, PMOD Technologies Ltd., Zurich, Switzerland) has allowed for a much more detailed quantification of the amounts and concentrations of brown fat deposits in these mice. PET imaging was supplemented by simultaneous X-Ray CT imaging and Quantitative Magnetic Resonance imaging to provide overall body composition statistics. These initial results show great promise in the use of these modalities to improve the phenotypic characterization of the GKN1 knockout mice. An ongoing longitudinal study seeks to measure changes in brown fat composition over time using PET. This will hopefully further elucidate the relationship between the gastrophilin 1 protein and fat composition in these mice.

## Poster Presentation

### *Mosquito Specific Odorant Gene analysis through Crispr-Cas knockout in Anopheles gambiae*

Bryce deVenecia

College of Science

Biological Sciences and Spanish

Advisors: Paul Hickner and Zainulabeuddin Syed, Dept. of Biological Sciences

Odorant Binding Proteins (OBP's) belong to a multigene family hypothesized to play a critical role in mosquito olfaction. These proteins are implicated in shuttling hydrophobic odorants molecules across the aqueous lymph surrounding the olfactory receptor neurons (ORN's). In insects, the major olfactory organs are antennae that are adorned with many hair-like epicuticular structures called sensilla that house ORN's. OBP's are expressed in large amounts in these sensilla. Recent transcriptome data from major mosquito species indicated that one such soluble protein, Mosquito Specific Antennal Protein (MSAP), is among the highest transcribed soluble proteins in the antennae. This OBP related protein appears to be specific in the mosquito lineage among insects, and is transcribed primarily in the antenna. We aimed to dissect the role of the MSAP in the olfaction of *Anopheles gambiae* mosquito where MSAP is abundant. We employed a gene editing technology, Crispr-Cas to knockout MSAP and performed electrophysiological measurements from the antennae to test if, and how, the odorant induced responses are affected. Since OBP's and related proteins are implicated in the transport of odorant molecules that are not readily soluble in water, I tested a range of odorants with varying degree of water solubility. Dose-response curves were generated and compared between knock-outs (homozygous and heterozygous) and the wild types. Preliminary data indicates a significant reduction in the responses in knock-outs as compared to the wild type (populations not edited by Crispr-Cas). In addition, homozygous knockouts demonstrated the weakest amplitude in the electroantennogram assay. This observation was consistent for both hydrophobic and hydrophilic odorants suggesting that MSAP protein has a broader role than earlier hypothesized. We aim to test MSAP knockout mosquitoes for possible behavioral impairment using wind tunnel assays in the future.

## Poster Presentation

### *PEA and Vetericyn as Treatments for Ulcerative Dermatitis in C57BL/6 Derived Mice*

Allison Dianis  
College of Science  
Biological Sciences

Kay Stewart, Dept. of Biological Sciences  
Mark Suckow, University of Minnesota

Advisor: Kay Stewart, Dept. of Biological Sciences

Ulcerative dermatitis (UD) is a skin disease that arises spontaneously in C57BL/6 and C57BL/6 derived mouse strains. The etiology remains unknown, but it is believed to be a multi-factorial genetic disease that interacts with the itch-scratch cycle. The disease presents as alopecia, intense pruritus, and single or multiple dermal ulcerations. Lesions appear primarily on the back of the neck, torso, shoulders, ears, and face. The disease is progressive, spreading across the body and causing excoriation, necrosis, and degloving. Two novel treatments and one standard treatment have been selected as treatments – Palmitoylethanolamine (PEA), Vetericyn, and Derma-Aid (4% chlorhexidine gluconate). PEA (n = 17 treatment periods) was used to treat mice from a colony dedicated to UD study, receiving 0.2 ml IP injections of 1 mg/kg PEA in a 10% SLS solution SID for 5 days a week for 2 weeks. Vetericyn (n = 46 treatment periods) and Derma-Aid (n = 21 treatment periods) were used to treat mice in an active breeding colony. Both treatments were applied BID for 5 days per week until UD symptoms resolved. The average age of UD onset for all mice was 153 days. PEA treatments resolved 0% of cases, while Derma-Aid treatment resulted in the resolution of UD symptoms in 33% of treatment periods and a recurrence rate of 0%. Vetericyn treatment caused UD resolution in 50% of treatment periods, with a recurrence rate of 26%. This data suggests that PEA does not affect the aspects of the itch-scratch cycle involved in UD, making it an unsuitable treatment. Derma-Aid does not provide high enough resolution rates to be used at an institutional level. Vetericyn may be suitable, but the recurrence rate prevents it from being a suitable treatment option. The frequency of treatment applications also makes it difficult to implement on an institutional level.

## Poster Presentation

### *Micro-Pattern Gas Detectors*

Nicolas Dixneuf  
College of Science  
Physics

Advisor: Tan Ahn, Dept. of Physics

In the field of nuclear physics, the development of methods to precisely determine key parameters in nuclear reactions is an important area of research. One of the methods that has been developed recently is the active-target method where charged particle tracks inside of a gas volume are imaged using a PCB. The images are created from the measurement of the electrons that are created in the ionization of the gas by the traversing charged particles and are detected by what are called Micro-Pattern Gas Detectors (MPGD). We are currently developing the electrode pattern using Altium Designer, a PCB design software for our own MPGD that will allow us to image nuclear reactions that produce multiple tracks by increasing the number of anode electrodes. Our initial design consists of 50 electrodes and we are now expanding this number to 1000. This would allow us to more precisely image tracks of charged particles, which is needed for the study of nuclear structure.

## Oral Presentation

### *Utilizing Deep Neural Networks to Analyze Collisions in High Energy Physics*

Matthew Drnevich

College of Science

Mathematics and Physics

Advisor: Kevin Lannon, Dept. of Physics

At the forefront of experimental particle physics is the Large Hadron Collider in Geneva, Switzerland. There, protons are collided at nearly the speed of light, with a rate of over 600 million collisions per second. Due to computing and resource limitations, the raw data that these collisions produce cannot be recorded at such a rate. Therefore, there is a drastic need to discern the importance of a collision in the Large Hadron Collider very quickly and efficiently in order to selectively record events (collision data). The significance of an event is currently determined using a boosted decision tree algorithm. However, due to recent advances in machine learning, there is reason to believe that using deep learning techniques, such as neural networks, could improve both the speed and accuracy of analyzing an event. This is particularly useful in increasing the rate at which we confidently find exotic collisions, such as those involving the Higgs boson. One such collision, the production of a Higgs boson paired with a top quark, is of particular interest to us. This research into a better algorithm should enable us to analyze these collisions quickly, efficiently, and accurately.

## Poster Presentation

### *Three Dimensional Tissue Histology and Multiplex Imaging*

Paulina Eberts  
College of Engineering  
Chemical Engineering

Cody Narciso  
College of Engineering  
Chemical Engineering

Advisor: Jeremiah Zartman, Dept. of Chemical and Biomolecular Engineering

For over a century, paraffin has been used to preserve and store patient biopsy specimens. It is common practice for pathologists to perform hematoxylin and eosin (H&E) stains for condition diagnosis on slices of these preserved tissues. Paraffin removal is required before other diagnostic stains are conducted. Current deparaffinization methods have only been validated for thin slices of tissue, which limits analysis to two dimensions. Utilization of thin sections, 5-10 $\mu$ m, necessitates destructively slicing the tissue that hinders the interrogation of valuable patient tissue biopsies. The successful application of deparaffinization methods on unsliced tissues has not been characterized. Prevailing 3D imaging modalities do not provide cellular resolution. There exists the need for deparaffinization methods for whole biopsy specimens in order to extend traditional histology to three dimensions. Microfluidics provides an ideal platform for this method development. The primary aim is to develop a gentle, whole-tissue deparaffinization method contained within a chip that preserves gross morphology and is compatible with subsequent immunohistochemistry (IHC) and molecular analysis. The development of these methods would present the potential for obtaining spatial information for diagnostic biomarkers within a sample. Application of these methods would unlock an abundance of patient specimens preserved in paraffin at hospitals and tissue banks across the globe. Automation of retrospective studies with multiple rounds of biomarker labeling would be feasible and allow for a greater understanding of the complex relationships between biomarker expression patterns, disparate treatment regimens, and subsequent patient outcomes.

## Poster Presentation

### *Generation of Aop1 Visual Mutants by CRISPR/Cas9 Mutagenesis of Aedes aegypti Mosquitoes*

Ryan Engert  
College of Science

Science Preprofessional Studies

Cheryl Kucharski, Joseph O'Tousa and Michelle Whaley, Dept. of Biological Sciences

Alison Dawson

College of Science

Science Preprofessional Studies

Maddison Staff

College of Science

Biological Sciences

Malcolm Fraser, Dept. of Biological Sciences

Advisors: Michelle Whaley and Joseph O'Tousa, Dept. of Biological Sciences

*Aedes aegypti* is the mosquito vector for dengue fever, yellow fever, and Zika virus that are responsible for diseases with a major impact on global human health. Our laboratory seeks to understand the importance of the visual system in mosquito behaviors that can be exploited in novel vector control strategies. In this project we have developed a strategy using the CRISPR-CAS9 system to knock out Aop1, the major rhodopsin of the adult eye. Our goal is to create a mutant mosquito line with limited visual capability that then will be analyzed for behavioral traits and vector competence. Our strategy utilizes a transgenic strain in which the Cas9 protein is expressed exclusively in the mosquito germ line. This strain was generated by collaborators in the Fraser laboratory here at Notre Dame. We plan to first work with Cas9 heterozygotes until a homozygous, true breeding strain suitable for the mutagenesis experiments is established. Cas9 embryos at the syncytial blastoderm stage are microinjected with a plasmid for expression of an Aop1-specific gRNA and the Aop1 homology-directed repair (HDR) plasmid. The gRNA directs the Cas9 protein to cause a double stranded break within the Aop1 gene. The HDR plasmid is designed so that repair of this break results in a mutant Aop1 gene easily detected by DsRed expression. In preliminary studies, we established an embryo injection protocol yielding a 10-20% survival rate. Thus, we are now well positioned to begin mutagenic experiments. The DsRed-positive offspring will be selected and homozygous mutants generated by genetic crosses. These Aop1 mutants will be analyzed for differences in the light response and light-driven behaviors relative to the wild type. We are developing behavioral assays suitable for analysis of the Aop1 mutant. A box landing assay shows that white-eyed mosquitoes prefer white landing surfaces during the daytime and no color preference at dusk. In contrast, wild-type animals always prefer the black surfaces.

## Oral Presentation

### *Regulation of the Oncogene ZNF217 by Cellular Localization during Breast Cancer Progression*

Megan Fabry  
College of Science  
Biochemistry  
Beth Facchine  
College of Science  
Biochemistry

Matthew Messina, Dept. of Chemistry and Biochemistry  
Advisor: Laurie Littlepage, Dept. of Chemistry and Biochemistry

Tumors are thought to arise from individual cells with multiple mutations, including amplification of genomic regions that provide a growth advantage. A region on human chromosome 20 called 20q13 is increased in ~25% of early stage human breast cancers and correlates with poor prognosis in patients. We have studied a novel oncogene, ZNF217, within this region. ZNF217 is not only a prognostic indicator of breast cancer progression in patients who have the worst prognosis, but also is itself a drug target and/or marker of patient response to therapy. We find that ZNF217 protein is expressed most strongly in a small subset of cells within normal mammary epithelium and localizes predominantly in the nucleus of mammary epithelial cells. In contrast, the localization of ZNF217 is heterogeneous in breast cancer cell lines and breast tumors, with localization in both the nucleus and cytoplasm. Moreover, post-translationally modified forms of the protein localize to the cytoplasm. We hypothesize that post-translational regulation of ZNF217 affects its function during cancer progression and can be used to predict poor prognosis and response to treatment in breast cancer patients. To determine which regions of ZNF217 are required for its localization, we used time-lapse microscopy to observe ZNF217-GFP fusion proteins over time in breast cancer cell lines as well as NRK2 H2B cells. Breast cancer cell lines were also synchronized at different stages of the cell cycle, and the endogenous ZNF217 localization patterns were analyzed by Western blotting to determine if the changes in ZNF217 localization are coordinated with the cell cycle.

## Oral Presentation

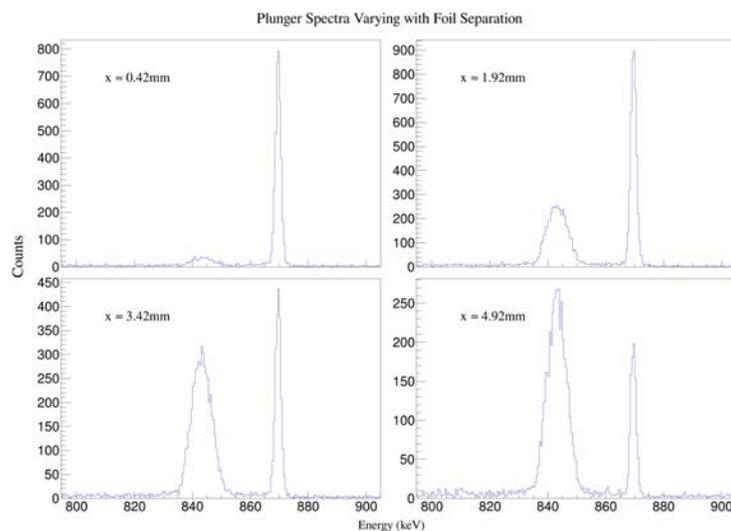
### *Measurement of the 0.87 MeV Level Lifetime in $^{17}\text{O}$ With a Low-Cost Plunger*

Patrick Fasano  
College of Science  
Classical Civilization and Physics  
Trenton Kuta  
College of Engineering and College of Science  
Electrical Engineering and Physics  
Sabrina Strauss and Mallory Smith, Dept. of Physics  
Advisors: Wanpeng Tan and Ani Aprahamian, Dept. of Physics

The plunger technique provides a valuable tool for measuring lifetimes of excited states in the 1 ps to 1 ns range. The plunger consists of a thin foil target and stopper foil separated by some controllable distance; beam-induced reactions occur in the target and the resulting excited nucleus of interest leaves the target foil and is completely stopped by the stopper foil. Photons from de-exciting nuclei are detected with high-purity germanium detectors and may be Doppler-shifted in energy if emitted in flight. The lifetime of a state can be extracted from the relative intensity of shifted and unshifted peaks.

The Notre Dame Nuclear Science Laboratory has a plunger device that is approximately 30 years old. In the Notre Dame plunger apparatus, the separation between foils is measured via capacitance between the foils and is used to control the position of three dc motors. Our work has focused on a complete rebuild and modernization of the plunger vacuum systems and control electronics including a low-cost microcontroller-based feedback loop for precisely controlling servo motors with quadrature encoder outputs. The re-commissioning experiment measured the lifetime of the 0.87-MeV state of  $^{17}\text{O}$  via the  $^{16}\text{O}(\text{d},\text{p})$  reaction in inverse kinematics. The experiment was performed at Notre Dame's Nuclear Science Lab with a 16 MeV  $^{16}\text{O}$  beam. We report a lifetime of  $247 \pm 12$  ps, in agreement with the accepted value of  $258 \pm 2.6$  ps.

This work has been funded in part by the National Science Foundation under grant number PHY-1419765; and the generosity of Diane and Bryant Hichwa, administered through the University of Notre Dame College of Science.



## Oral Presentation

### *Computational Analysis of Dissociative Electron Attachment to Thymine*

Christopher Ferari

College of Science

Neuroscience and Behavior

Sylwia Ptasińska, Dept. of Physics

Advisor: Sylwia Ptasińska, Notre Dame Radiation Laboratory and Dept. of Physics

The high-energy photons of ionizing radiation are known to cause damage to various biomolecules. Low energy electrons produced as radiation pass through body tissues can attach to these molecules to yield a transient, unstable negative ion, which then dissociates into a radical and a negative ion. A group of molecules in which this process is very important is the nucleobases of DNA, with applications in DNA fragmentation and radical formation leading to cell damage. Thymine is one of the four nucleobases incorporated in DNA, and is the focus of the computational analysis performed. Using theoretical calculations, we have examined the process of dissociative electron attachment to gas-phase thymine and attempted to identify the ionic and radical products upon low energy electron impact. To perform this study, the supercomputers at the Notre Dame Radiation Laboratory (NDRL) were used, running the Gaussian computational program. The six most prevalent masses, determined from a previous study of electron attachment to thymine, were computationally analyzed. We calculated the absolute energy for every possible conformer resulting from each prevalent mass. The resulting energies were compared and used to predict the most stable conformer at each mass using the lowest energy calculated.

## Poster Presentation

### *Revised Uncertainties in Big Bang Nucleosynthesis*

Michael Foley  
College of Science  
Mathematics and Physics  
Nishanth Sasankan, Dept. of Physics  
Advisor: Grant Mathews, Dept. of Physics

Fusion in stars explains the presence of heavier elements in the universe, such as iron, but it cannot explain the existence of the light elements in older stars – hydrogen, helium, and lithium – at least in total present abundances. The theory of Big Bang Nucleosynthesis (BBN) fills this void of understanding. It describes the light nuclides – primarily D,  $^3\text{He}$ ,  $^4\text{He}$ , and  $^7\text{Li}$  – mere seconds to minutes after the Big Bang. New advancements in astroparticle and nuclear physics have allowed for unprecedented precision in the calculation of abundances and their corresponding uncertainties. For example, the neutron lifetime has recently been updated to 880.3 seconds using ultracold neutrons and detection of inelastically up-scattered ones. This particularly affects the calculation of  $^4\text{He}$ . Further, WMAP and Planck data has fixed a limit on the number of neutrino types. Additionally, NACRE-II provides updated reaction rates for the weak interactions present during Big Bang Nucleosynthesis. Using these updated numbers, we present revised uncertainties at the 95% confidence level of the four primary light nuclides. Using the updated neutron lifetime, neutrino type limit, and reaction rates, we developed a unique Monte Carlo analysis to present new uncertainties at the 2-sigma level. In particular, we utilized the Box-Muller transform to create a Gaussian-distributed random number. Then, taking the upper and lower reaction rate limits set by NACRE-II to be 1-sigma level, we took the sigma level of the Gaussian number to correspond to a particular reaction rate of the same sigma level. This process was implemented throughout the standard Kawano BBN code. Our analysis was then run at Notre Dame's Center for Research Computing. We then isolated only the data with 2-sigma bounds since this proves to be the most statistically significant. These constraints will present new insights into Big Bang Nucleosynthesis and our knowledge of light element formation.

## Poster Presentation

### *Managing malaria: evaluating new insecticides with the WHO susceptibility tests*

Kaitlin Frei  
College of Science  
Biological Sciences

Advisors: Mary Ann McDowell and Douglas Shoue, Dept. of Biological Sciences

Insecticides play a key role in controlling mosquito-borne diseases, such as malaria; however, with elevated levels of resistance to commonly used insecticides, this control mechanism is becoming less effective. New compounds, with new modes of action, must be discovered that can effectively combat mosquito populations and minimize the spread of mosquito-borne diseases. Twelve compounds were created by the University of Notre Dame Warren Family Research Center for Drug Discovery and Development to identify insecticides with new modes of action. One method for testing the effectiveness of these potential insecticides is the World Health Organization (WHO) susceptibility test, which with slight modification was utilized in this study. One compound, LG-8, was found to be an effective insecticide as it was able to knock down *Aedes aegypti* Liverpool and *Anopheles gambiae* Kisumu1, pyrethroid sensitive strains. LG-8 was also effective against pyrethroid resistant strains, *Aedes aegypti* Puerto Rico, and *Anopheles gambiae* RSP mosquitos. To maximize the long-term effectiveness of an LG-8 insecticide, the compound can be mixed with a second insecticide that knocks down mosquitos using a different pathway. By mixing LG-8 with a second compound, there is a lower probability that mosquitos will develop resistance to the insecticide, resulting in improved control of mosquito-borne diseases.

## Poster Presentation

### *Generating Recombinant Fluorescent Proteins to Evaluate Protein Trafficking to Exosomes*

Anne Gandolfi  
College of Science

Science Preprofessional Studies

Advisors: Yong Cheng and Jeffrey Schorey, Dept. of Biological Sciences

Exosomes are nanoscale membrane vesicles with a size between 50 to 150 nm produced by most nucleated cells in multicellular organisms. Exosomes, which function in intracellular communication, likely play critical roles in the pathology of human diseases, including tuberculosis, one of the three most deadly infections in the world. In our lab, we previously identified *Mycobacterium tuberculosis* (MTB) proteins in exosomes from macrophages infected with MTB, the causative agent of tuberculosis. To understand MTB protein-containing exosome biogenesis, a live-cell imaging technique is required. In recent studies, Ag85A-DsRed, a fluorescent fusion protein containing MTB protein Ag85A and fluorescent protein DsRed, was detected in exosomes from macrophages infected with MTB overexpressing Ag85A-DsRed. However, we failed to detect the Ag85A-DsRed signal in live host cells by fluorescent microscopy likely due to its low expression in MTB. In order to follow proteins as they are trafficked to the multivesicular bodies and into exosomes, we will generate recombinant Ag85A-DsRed in *E. coli* and add the purified protein to macrophages. Previous studies indicate that Ag85A, when endocytosed by macrophages, is trafficked to exosomes. We hypothesize that Ag85A-DsRed will also be endocytosed and trafficked to exosomes, and we will be able to follow this transport by live cell imaging through imaging of DsRed. We aim to engineer and purify from *E. coli* two versions of the recombinant fluorescent fusion protein Ag85A-DsRed (native Ag85A and DsRed) and mAg85A-DsRed (Ag85A lacking the transmembrane domain and DsRed). Three DNA fragments encoding the fluorescent protein (DsRed, Ag85A-DsRed, and mAg85A-DsRed) were amplified using polymerase chain reaction (PCR) from the plasmid pMV261-Ag85A-DsRed. The PCR products were cloned into pGEM-T Easy vector and confirmed by sequencing. The fragments were then cloned into the protein expression vector, pET-15B, to generate plasmids pET15B-DsRed, pET15B-Ag85A-DsRed, and pET15B-mAg85A-DsRed. The resulting plasmids will finally be used to transform the *E. coli* strain BL21 for protein expression, and the fusion protein will be purified using nickel ion affinity chromatography.

## Poster Presentation

### *qRT-PCR at MD Anderson: Summer 2015*

Matthew Goblirsch  
College of Science  
Chemistry and Philosophy  
Advisor: Martin Pichler, Medical University of Graz, Austria

qRT-PCR is an analytical technique that has many uses. Over the course of a summer spent at MD Anderson, these techniques were explored in depth for their uses in cancer research. A series of experiments were carried out to assess the different readings that can be obtained from qRT-PCR, and to use qRT-PCR to study gene expression in cells. These studies illustrated a very important use for qRT-PCR in cancer research. Its uses span from detecting tumor suppressor genes to studying genes involved in the EMT pathway. These projects were among many performed over the summer.

## Poster Presentation

### *The Effect a Change in Voltage has on a Four-Bit Adder*

Kerry Goodwine  
Christ The King School, South Bend, IN

Introduction- My experiment was to determine the range of voltage during which a four-bit adder will correctly function. This information would be important when using an electronic device like an adder or a phone because if you are using it outside of the correct range of voltage you could be receiving incorrect answers due to the malfunctioning of the adder or the phone. This would occur because the device would not be receiving enough or too much voltage. Something that would help would be to find a way to make the device work correctly over a broader range of voltage. That would be problematic because you would be receiving wrong answers when you are using the adder. I hypothesized that the adder would work correctly between the voltages of 4.0 to 6.0 because I knew that it would work at 5.0 volts so I hypothesized that it would work in a range around that area of voltage. To find out if I was correct I used the adder with different voltages to find out when it was giving correct answers. I would change the amount of voltage by .5 each time and checked the adder by doing the same additions each time. Doing this I was able to find the amount of voltage the adder needed to work correctly, and the range in which it would malfunction. I found out that my hypothesis was partially right. Below 5.0 volts the adder would begin to malfunction and would stop giving all correct answers. When I began to test the adder above 6.0 volts the voltage divider began to smoke and I had to stop collecting data from above that voltage. The information I gathered during my experiment is helpful because if I ever need results from an adder I will know if it is giving correct answers or not by checking that it is receiving the right amount of voltage. One way that you could change the device that you are using so that the device will work on a broader range of voltage would be to experiment in changing the resistors and making them lower or changing the transistors and seeing if different types of transistors take up more energy than other ones.

## Poster Presentation

### *Restrictive Threshold Item Selection in Multidimensional Computerized Adaptive Testing*

Daniel Gorman

College of Science

Applied and Computational Mathematics and Statistics

Advisor: Alan Huebner, Dept. of Applied and Computational Mathematics and Statistics

One of the most important aspects governing the performance of a computerized adaptive test is the method in which items are selected for administration at each stage of the exam. The item selection procedure should estimate the examinees' ability, and, in high-stakes testing, limit excessive exposure of items. Many different methods have been proposed over the last few decades to achieve these ends. In this study, for the first time, the restrictive threshold method of item selection is combined with item bank stratification for multidimensional computer adaptive tests. The performance of this selection procedure in terms of estimation precision and exposure control was evaluated in a simulation study. Additionally, the restrictive threshold method with stratification is examined using two different item banks and implementing item eligibility for certain test conditions. The results of the simulation study suggest that the restrictive threshold method can attain suitable precision and exposure measures while providing practitioners with more flexibility in exam performance by exogenously manipulating the relative importance of estimation precision and balanced item exposure.

## Oral Presentation

### *Mathematical Analysis of Disease Spread on Networks*

Monica Gorman  
College of Arts & Letters  
Chinese and Mathematics  
Advisor: David Galvin, Dept. of Mathematics

This is a comparison of compartmental and network models in epidemiology. More traditional compartmental models can explain a wide variety of disease outbreaks, including factors such as seasonal transmission, while network models are better for comparing different populations in terms of the structure of their contact networks. Among network models, I compare Erdos-Renyi random networks with scale-free networks, including a numerical examination of the probability of a large epidemic.

## Oral Presentation

### *Rational Knots and the Kauffman Bracket Skein Module of the Four-Punctured Sphere*

Christian Gorski  
College of Science  
Mathematics

Advisor: Neal Stoltzfus, Dept. of Mathematics, Louisiana State University

The Kauffman bracket skein module (KBSM) is a 3-manifold invariant closely related to knot and link theory. However, the structure of the KBSM is still not very well understood for many 3-manifolds, in particular, knot exteriors. In this talk, I first give brief overview of the KBSM for 3-manifolds. Then I discuss a method for constructing any rational knot exterior from the Cartesian product of the four-punctured sphere with an interval. Finally, I discuss a first step toward relating the KBSM of the former space to the better-understood KBSM of the latter space via the aforementioned construction.

## Oral Presentation

### *Construction of a Space-Filling Curve*

Gregory Greif

College of Science

Mathematics and Physics

Advisor: Jeffrey Diller, Dept. of Mathematics

One of the most surprising results in Real Analysis is the existence of so called space-filling curves: continuous functions from the real line to a higher dimensional space passing through every point in a subset of that space. These functions are simple examples of fractals, and their existence was first demonstrated by Giuseppe Peano in 1890. Though space-filling curves are easily understood intuitively, it is more difficult to prove their existence or develop a mathematically rigorous example of such a curve. In my talk, I will discuss the necessary background knowledge to constructing a space-filling curve, including the notion of distance created by metric spaces, uniform convergence of functions, continuity, and surjectivity. These concepts allow the construction of a space-filling curve as the limit of a set of functions that grow increasingly complex through repeated iteration of a simple pattern. I will describe a particular example of this method of construction in detail, and I will also provide a short description of several famous examples of space-filling curves including the Peano and Hilbert curves.

## Poster Presentation

### *Effect of resource availability on protozoan communities within long-tailed macaques (*Macaca fascicularis*) in Singapore and Bali, Indonesia*

Alexis Griess  
College of Science  
Science Preprofessional Studies  
Justin Wilcox, Dept. of Biological Sciences  
Advisor: Hope Hollocher, Dept. of Biological Sciences

Despite parasites constituting a major component of eukaryotic diversity, presently little is known about their ecology. It has been proposed that parasite communities should fall under the same ecological paradigm as free-living organisms and be regulated by top-down and bottom-up processes. Top-down regulation is driven by species occupying the highest trophic level exerting a controlling influence on species at lower trophic levels. Bottom-up regulation relies on energy moving up the food web, and is limited by resource availability. Bottom-up regulation may be particularly important to microparasites, as they reproduce within their host. Bacteria are a major resource for predatory protozoa, while grazing protozoa absorb nutrients within the gut, and intracellular protozoa absorb resources directly from the cell in which they reside. Using microscopy, we are identifying and quantifying the bacteria found within fecal samples from long-tailed macaques (*Macaca fascicularis*) in Singapore and Bali, Indonesia, to evaluate the competitive interactions between predatory microparasites in the context of bacteria (resource) availability. We are testing 1) whether there is evidence of competitive interactions between microparasites in different functional guilds, and 2) whether these apparent competitive interactions are linked to resource availability. Preliminary findings suggest that resource availability may influence parasite diversity. At high species richness, predatory and grazing microparasites show decreased shedding, suggesting the potential for competition. Intracellular parasites did not show decreased shedding with increasing species richness and are not expected to given they absorb their resources directly from cells. Our findings suggest a role for antagonistic competitive interactions in structuring parasite communities, and support the application of the ecological paradigm to the study of parasites.

## Poster Presentation

### *Designing a Paper Test for CaSO<sub>4</sub> Using Colorimetric Reactions*

Lauren Griffin  
College of Science  
Chemistry Business

Advisor: Marya Lieberman, Dept. of Chemistry and Biochemistry

Falsified drugs are a major problem across the globe and many people have limited resources to verify that their medication is what it is presumed to be. I worked in Dr. Lieberman's lab to develop a lane on a paper test card that would test for CaSO<sub>4</sub>, more commonly known as gypsum. Gypsum is a powdery white compound that is commonly found in wallboard and used as a filler in the above mentioned falsified drugs. Gypsum is an insoluble mineral, so the test was based on dye absorption. To develop the gypsum test, more than thirty dyes were studied to see if there was an observable color change when bound to gypsum. Out of the dyes that showed potential for detecting gypsum, varying concentrations were made of each to see which best showed the presence of gypsum. The dye bromophenol red was found to work best. The test easily shows the presence of gypsum, by indicating a purple color on the card, whereas if none is present, a pale yellow color will appear. The purpose of developing this test is that it will contribute to the card by detecting gypsum as a filler in any drug that would be tested using the test card, in conjunction with the other lanes on the card that test for varying compounds. Creating this card would allow for the verification that people need that their medication is what it is supposed to be. This will aid in combating the problem of falsified drugs globally.

**Poster Presentation**

***The influence of obesity and lipid regulatory factors FABP4 and SREBP-1  
in ovarian cancer metastatic models***

Anne Grisoli  
College of Science  
Neuroscience and Behavior

Kyle Carey  
College of Science  
Biological Sciences

Yueying Liu, Dept. of Chemistry and Biochemistry

Eric Lee  
College of Science  
Science Business

Sharon Stack, Harper Cancer Research Institute and Dept. of Chemistry and Biochemistry

Advisor: Sharon Stack, Harper Cancer Research Institute and Dept. of Chemistry and Biochemistry

As the fifth leading cause of cancer death in women in the United States, epithelial ovarian cancer is usually discovered in late stages after intraperitoneal metastasis that contributes to its high mortality. Obesity has been linked to ovarian cancer metastasis through increased lipogenesis, consistent with metabolic reprogramming as a hallmark of cancer. However, the mechanism through which adipocytes contribute to cancer progression remains unclear. In order to identify relationships between adipocyte-rich tumor microenvironments exacerbated by obesity and rapid tumor growth, ovarian cancer metastasis was evaluated in diet-induced and genetic-induced mouse obesity models. Histologic analysis shows enhancement of sterol regulatory element binding protein 1 (SREBP-1), a transcription factor controlling de novo lipogenesis, in tumors from DIO treatment and genetically-induced ob/ob mice compared with controls. Fatty acid-binding protein-4 (FABP4), a lipid transport protein highly expressed in adipocytes, was also found in immediately adjacent tumor cells suggesting adjacent adipocytes provide energy via fatty acids for rapid tumor growth. The findings of this study lay the foundation for future research in the role of obesity and lipid metabolism in adipocyte-rich tumor microenvironments common in many cancers.

## Poster Presentation

### *Phylogenetic Variation of Bacterial Protein Half-Life and its Relationship with Growth Strategies*

Matthew Grothaus

College of Arts & Letters and College of Science

Biological Sciences, Philosophy, and Spanish

Advisors: Hildamarie Caceres-Velazquez and Stuart Jones, Dept. of Biological Sciences

Bacteria are the most abundant life forms on the planet, in no small part, due to their ability to inhabit many starkly diverse environments. This ability comes from the wide range of nutrients that different bacteria are able to uptake and utilize. Like most organisms, the complement of cellular proteins represents the phenotype each individual. These proteins produced by the bacterium control a large part of bacterium's interaction with the environment, nutrient uptake and catabolism. In order to interact with the environment there is a need for the breaking down of old proteins and the translation of new ones, making this process energetically costly. We believe that bacterial protein turnover rate is key for bacterial response when environmental changes occur, even when this process is energetically costly. Bacteria will show higher or lower rates of protein turnover in a way that it is rapidly responding to the environment or doing so in a slower rate in order to save energy, respectively. A way to measure this protein turnover is to estimate a bacterium's protein half-life, the amount of time it takes for a bacterium to degrade the amount of protein present at a given time. We hypothesize that protein half-life is a conserved trait across bacterial taxa and that mediates a trade-off between environmental responsiveness and growth efficiency. To prove our hypothesis protein half-life, environmental responsiveness and growth efficiency traits must be measured. My work has focused on measuring protein half-life and establishing any phylogenetical conservatism of the trait. To estimate protein half-life we grow strains to mid-logarithmic phase and destructively sample for 12 hours their total protein after disrupting synthesis of new proteins with chloramphenicol. Total protein concentrations obtained at each time point is used then to make an estimation of protein half-life. We have completed a set of 15 strains of bacteria across 6 phyla.

## Oral Presentation

### *Necessary and Sufficient Conditions for Equilibria in Higher Dimensional Games*

Benjamin Gunning  
College of Arts & Letters and College of Engineering  
Computer Science and Mathematics  
Advisor: Jeffrey Diller, Dept. of Mathematics

Game theory is a field of mathematics that utilizes mathematical modeling to analyze and optimize decision making in a strategic setting involving multiple parties. Game theory has extensive applications in a myriad of fields from economics and business to logic and psychology. A significant question that game theory seeks to address is when optimal strategies exist and what said strategies are. This presentation examines various answers to this question that have developed over the last century. The talk would survey a number of theorems relating to these questions from a mathematical perspective.

## Oral Presentation

### *An Introduction to $p$ -adic Numbers*

Matthew Hagarty

College of Science

Advisor: Jeffrey Diller, Dept. of Mathematics

Number theory is a vast and interesting subject, and contained within that subject is a band of numbers called the “ $p$ -adic numbers”. These numbers, together with the  $p$ -norm, are strikingly different from the way we normally look at real and rational numbers. For example, in the 2-adic numbers, 3 and 5 are farther apart than 3 and 8, since the difference between 3 and 5 is divisible by 2, while the difference between 3 and 8 is not. While this may initially seem confusing and extremely unnecessary, this line of thinking is actually very useful in upper level mathematics. This presentation serves as a cursory overview into what the  $p$ -adic numbers are, how they interact with the rational numbers and with each other, and a brief look into what the  $p$ -adic numbers can be used for.

## Oral Presentation

### *Google PageRank and the Math Behind It*

Benjamin Hallberg  
College of Science  
Mathematics

Advisor: Jeffrey Diller, Dept. of Mathematics

The name Google has become synonymous with internet searching in recent years, as everyone seems to be using Google's search engine to find information over the internet. Compared to other search engines, Google seems to be the best at finding the most useful and relevant information with little effort required by the user. This is in no doubt due to Google's searching algorithms, the first and most well-known being Google PageRank. The PageRank algorithm quantifies the importance of a web page by giving it a score, thus allowing the more "important" pages to show up first in searching results. The PageRank algorithm computes a pages score based on the backlinks, or links to a page from other pages, that a web page has, which in a way lets the internet decide what pages are the most relevant. The PageRank algorithm is at its core a linear algebra application, and is essentially an eigenvector problem for the eigenvalue of 1. It relies heavily on the Perron-Frobenius Theorem, which deals with matrices with only positive entries and states that its dominant eigenvalue is real-valued and that the eigenspace corresponding to this eigenvalue has a multiplicity of 1. In my talk, I seek to explain how the Google PageRank algorithm works, as well as some of the mathematical theory behind this amazing application of linear algebra.

## Poster Presentation

### *Defining the role of the transcription factor mecom during renal stem cell development*

Nicole Handa  
College of Science  
Biological Sciences

Bridgette Drummond, Dept. of Biological Sciences  
Advisor: Rebecca Wingert, Dept. of Biological Sciences

The nephron is the functional unit of the kidney that is important in the filtration of metabolic waste and maintenance of fluid balance. Within each nephron there are distinct segments and cell types, but the genetic pathways leading to their development have not been well characterized. To study these genetic pathways, the zebrafish is used as a model organism because of the simplicity of its pronephros and conserved segment patterning it shares with the kidneys of higher vertebrates. One particular gene of interest in the distal late (DL) segment formation is *mecom*. Morpholino knockdown of *mecom* expression leads to a reduced DL and it has been shown that *mecom* acts upstream of the Notch signaling pathway in zebrafish renal development. To further characterize the genetic pathway active in DL formation, I am investigating the relationship between the transcription factor *mecom* and *tbx2a/b*, T-box transcriptional repressors, which also lead to reduction of the DL when knocked down. Preliminary data suggests that the genes may function in the same pathway and that *mecom* acts upstream of *tbx2a/b*. I have been investigating changes in the expression domain of *tbx2a/b* in *mecom* morphants. I will continue to investigate the interaction between the genes by conducting double knockdowns of *mecom* and *tbx2a/b*, rescue studies, and overexpression studies. Understanding the interaction between these genes will help to further characterize the genetic pathway necessary for proper DL formation and may inform the development of more refined kidney organoid models in the future.

## Poster Presentation

### *The Science of The Bloodstream: Blood Vessels and Artery Constriction TEAM*

Arianna Hardy and Anjelica Zitto  
Schmucker Middle School, Mishawaka, IN

Introduction- In this experiment, we tested multiple different sized needle tips to simulate artery constriction. This topic branches out from a more broader topic in which is Biomedical science. At first, we were able to see that the needle tips we were testing were far too small for us to compile reasonable data. In the end, we decided to use 18, 19, 20, and 23 gauge needles which allowed for a quicker flow of the solution compared to the far smaller needles of 25 and 27 gauge. We used needle tips to simulate artery constriction because the needle tips were the best visual diagram we could have provided for the viewers of our experiment. Also, the needles would provide the constant flow of the saline solution that we needed to maintain accurate results. The results of our experiment supported our hypothesis with its expected results. This interpretation of artery constriction is relevant because it can be very helpful in understanding the process of blood flow in an altered state such as a change in blood pressure that goes into artery constriction. The needles represent the arteries and the IV bag represent where the blood in your body is coming from. The size of the needles shows the arteries health and state of plaque build up. In conclusion, we found that when a person has unhealthy plaque build up in the arteries (needles), than it takes longer the blood (saline) to flow through the arteries.

## Poster Presentation

### *Characterization of Neuropeptide F through RNA Interference in Aedes aegypti Mosquitoes*

Mallory Hawksworth

College of Science

Biological Sciences and Spanish

Mary Ann McDowell and Douglas Shoue, Dept. of Biological Sciences

Advisor: Mary Ann McDowell, Dept. of Biological Sciences

Mosquitoes-borne diseases are responsible for over one million deaths and hundreds of millions of illnesses each year. In particular, the mosquito species *Aedes aegypti* is responsible for the vector-borne transmission of dengue fever, chikungunya, yellow fever and other viruses. In response to this public health issue, there have been research efforts investigating various methods to control the spread of vector borne diseases. One such method of control includes insecticides that often target G-protein coupled receptors (GPCRs), which play a role in a wide variety of the mosquito's physiological processes, such as sensory perception, metabolism and nerve transmission. This specific study looks at the neuropeptide F (NPF) GPCR and its associated ligand. While neuropeptide GPCRs are not as well characterized as other GPCRs, neuropeptide F has an important role in locomotion, flight and feeding behavior in mosquitoes. Thus, NPF provides a potential target for the control of vector borne diseases. Here, the neuropeptide F receptor and its ligand are knocked down via RNA interference through the injection of dsRNA into *Aedes aegypti* mosquitoes. The resulting feeding behavior is investigated through a sugar-feeding assay followed by a quantification of knockdown using quantitative Real-Time PCR. In the future, a blood-feeding assay may also be performed to further study the effect of NPF receptor and ligand knockdown on mosquito feeding behavior. The investigation of NPF will hopefully lead to enhanced characterization of a potential target for vector control and to a reduction in the spread of various diseases that negatively impact numerous lives each year.

## Poster Presentation

### *Implications of nonlinearity between transmission and infection risk in the design of trials to assess interventions for mosquito-borne diseases*

Adam Haydel  
College of Science  
Science Business

Advisor: Alex Perkins, Dept. of Applied and Computational Mathematics and Statistics  
and Biological Sciences

Assessing the efficacy of interventions for the control and prevention of infectious diseases depends on measuring changes in epidemiological metrics that summarize the intensity of transmission in the context of a field trial. An important part of study design involves choosing an anticipated effect size of the intervention, which is then used to determine the number of samples required to detect an effect of that size or larger for a given power and significance level. Focusing on interventions applied to mosquito-borne diseases, we used first principles of transmission to derive a nonlinear mathematical relationship between the size of an effect on transmission parameters and the size of the associated effect on infection risk. We then applied this relationship to the design of hypothetical trials of interventions that reduce either mosquito population density or infection prevalence in humans. To evaluate the implications of this nonlinear relationship on study design, we performed simulations of parallel cluster-randomized trials with varying numbers of clusters and effect sizes and evaluated the required sample size in order to achieve a specified power. By reducing mosquito density or human prevalence we achieved more realistic and variable effect sizes than is obtained by assuming a uniform effect size, since mosquito density, infection prevalence in humans, and infection risk have a nonlinear relationship. Using a Poisson regression model with a quasi-likelihood correction, simulations were run over a three-year period with 100 people per cluster. Our results indicate that without taking into account these nonlinear relationships between transmission parameters and infection risk, the power of the test will be overestimated and the number of clusters needed will be underestimated.

## Poster Presentation

### *The effect of water level on stem height and dry biomass in Schoenoplectus americanus*

Alexandra Henderson  
College of Science  
Science Business and English  
Erin McCune  
College of Science  
Science Pre-Professional  
Sayanty Roy, Dept. of Biological Sciences  
Advisor: Jennifer Robichaud, Dept. of Biological Sciences

A predicted rise in sea level has prompted research into the response of saltmarsh ecosystems to the changing environment. We conducted an experiment to analyze the effects of rising water levels on *Schoenoplectus americanus*, using both plants derived from soil core seeds and modern *S. americanus* plants. We predicted that the modern plants would produce more biomass and grow taller than old plants in response to higher flooding levels. Four old and four modern plants were placed at each of three water levels: 7.5 cm, 17.8 cm, and 30.0 cm. Over the course of six weeks, selected stems were measured for each plant and average stem height was recorded. At the end of the experiment, the aboveground portion of the plants were dried and biomass values were recorded. Modern plants were significantly larger than old plants at all three water levels for both stem height and dry biomass. Water level had a significant positive effect on dry biomass, but no effect on stem height. Future experiments should be done using water levels that more accurately mimic natural flooding levels. Results of such studies will play an important role in predicting how marsh ecosystems, which provide rich habitats and protection from storm surges, will respond to rising sea levels in the future.

## Poster Presentation

### *Got Contaminated Milk? A Paper-Based Screening Method for Milk by MALDI MS*

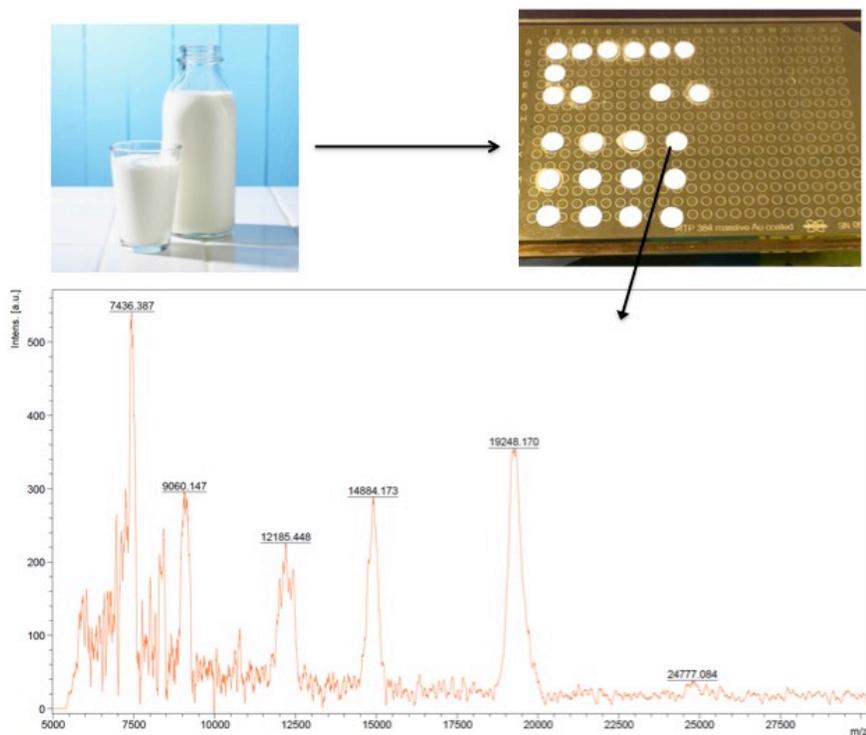
Valentine HenrydeFrahan

College of Science

Biochemistry

Advisor: Michelle Joyce, Dept. of Chemistry and Biochemistry

Milk contamination is a global phenomenon. In many developing countries, milk is diluted with water and adulterants, such as starch, detergents, and other chemicals that are used to improve the milk's viscosity and increase its shelf life. These contaminants pose obvious health risks for consumers. The goal of this project is to optimize an efficient and inexpensive way to screen cow's milk for proteins and adulterants by Matrix Assisted Laser Desorption Ionization Mass Spectrometry (MALDI MS) that can analyze small and large molecules. A paper-based screening method allows for milk to be spotted in the field and sent to a laboratory for direct MALDI MS analysis. MALDI MS was used to obtain a mass spectral profile for the protein composition of known milk samples. The profile data will be compiled in a spectral library to identify differences in the profiles of adulterated milk samples. The matrix-sample dropping method on paper was optimized for the detection of the milk proteins  $\alpha$ -Casein,  $\beta$ -Casein,  $\kappa$ -Casein,  $\beta$ -Lactoglobulin A,  $\beta$ -Lactoglobulin B and  $\beta$ -Lactalbumin. A degradation study was conducted on the cow's milk samples on paper in order to analyze the stability of the milk proteins on the paper spots under high temperature, mimicking future field tests in hot climates. The milk proteins were found to be more stable on the paper spots than in solution, supporting the use of a paper-based screen to minimize spoilage due to the transportation of milk.



## Poster Presentation

### *Establishing the Interaction of Calcium and Morphogen Pathways*

John Higham

College of Engineering

Chemical Engineering

Qinfeng Wu

College of Engineering

Advisor: Jeremiah Zartman, Dept. of Chemical and Biomolecular Engineering

The calcium ion ( $\text{Ca}^{2+}$ ) is a ubiquitous second messenger that plays vital roles in the development of organisms. This tightly regulated ion integrates information by interacting with many signaling pathways to regulate the growth of tissues. Morphogens are molecules that are secreted in specific regions of tissues and form gradients by diffusion. These gradients specify cell fate, pattern tissues, and control organismal growth. However, whether  $\text{Ca}^{2+}$  interacts with morphogen pathways to regulate growth remains unknown. This study aims to demonstrate the interaction between  $\text{Ca}^{2+}$  and morphogen pathways by using the model epithelial organ of *Drosophila* wing imaginal discs. In this project, the *Drosophila* pathways Decapentaplegic, MAD, epithelial growth factor (EGF), Wingless, Hedgehog, and Notch will be each independently perturbed by knocking down signaling transduction components by RNA interference (RNAi). The  $\text{Ca}^{2+}$  level will then be visualized through a confocal microscope using genetically encoded calcium ion sensors. We hope to find that calcium ion concentration and oscillation frequency in the wing discs were significantly altered when certain morphogen pathways are perturbed. Such results will establish the interaction between the two important signaling pathways,  $\text{Ca}^{2+}$  and morphogens, and contribute a better understanding of calcium's potential role as the signal integrator of morphogens during development.

## Oral Presentation

### *Ablation of GluN2C Subunit of the N-methyl-D-aspartate Receptor Mitigates the Detrimental Effects of Ischemic Stroke*

Adam Holmes

College of Science

Science Preprofessional Studies

Ning Zhou

College of Science

Biological Sciences

Rashna Balsara, Dept. of Chemistry and Biochemistry

Advisor: Francis Castellino, Dept. of Chemistry and Biochemistry

The N-methyl-D-aspartate receptor (NMDAR) is a glutamate and voltage-gated cation channel expressed throughout the central nervous system and plays a crucial role in learning, memory, and various neuropathologies including stroke. NMDAR is implicated in ischemic stroke when loss of blood to an area of the brain causes an accumulation of extracellular glutamate and hyperactivation of the receptor. This results in an aberrant influx of intracellular  $\text{Ca}^{2+}$  that initiates a cascade of cellular events causing neuronal dysfunction and cellular apoptosis. Here we focused on a specific subunit of the NMDAR, the GluN2C subunit, and its role in ischemic stroke. We employed the Middle Carotid Artery Occlusion (MCAO) model to induce stroke in the right hemisphere in wild type (WT) and GluN2C knockout (GluN2C<sup>-/-</sup>) mice. It was observed that both edema and infarct area were significantly reduced in GluN2C<sup>-/-</sup> mice. Additionally, the average number of degenerated neurons and cells in the ipsilateral region of GluN2C<sup>-/-</sup> mice brains was significantly less compared to WT mice brains. Furthermore, phosphorylation of Tyr1336 of the GluN2B subunit [P-Tyr1336(GluN2B)] was significantly diminished in the ipsilateral region of the GluN2C<sup>-/-</sup> mice brains compared to WT mice brains. Our data suggests that a lack of the GluN2C subunit abrogates the detrimental effects of ischemic stroke via a mechanism that involves GluN2B phosphorylation at Tyr1336. These studies provide novel insights into potential pathways for pharmacological targeting of NMDARs for future investigation.

## Oral Presentation

### *The Dirac Formalism of Quantum Mechanics and the Basics of Quantum Computing and Quantum Cryptography*

Andrew Jena

College of Arts & Letters

Latin and Mathematics

Anthony Hoffman, Dept. of Electrical Engineering.

Advisor: Jeffrey Diller, Dept. of Mathematics

Quantum mechanics is a field of growing interest for physicists, engineers, and mathematicians alike, and quantum computing is believed to be the next generation of computation and of scientific progress. When quantum computers are actualized, exponential speed-ups will lead to new fields of research. One such field is quantum cryptography, which it seems will inevitably be one of the most important fields of research in the following decades. Since a theoretical approach has already been proved to crack the RSA encryption algorithm, the most widely used form of encryption in classical computers, new forms of encryption, for both classical and quantum computers alike, are being theorized to resist a quantum brute force attack.

My talk will begin with a brief explanation of the Dirac formalism of quantum mechanics to set a foundation for the mathematics around which the rest of the talk is centered. My talk presupposes an understanding of linear algebra and vector/matrix manipulations along with a willingness to accept the unorthodox realities of quantum mechanics and superpositions. I shall then explain the proven quantum attack against the RSA encryption algorithm and shall describe the current theories for future systems of encryption, one of which takes advantage of the collapse of observed quantum states and seems to be secure against eavesdroppers.

## Poster Presentation

### *Methods in Data Analysis of Nuclear Physics as Applied to a $^{10}\text{C}$ beam run*

Louis Jensen  
College of Science  
Physics

Advisor: Tan Ahn, Dept. of Physics

Understanding the properties of radioactive beams is a crucial part of understanding nuclear physics using experiments with unstable nuclei. In order to maximize our knowledge of a radioactive beam, beam tests and preparation runs are often performed prior to a final experiment. These preparatory experiments usually involve determining beam composition and count rate given accelerator settings, primary stable beam, and target. This summer such a preparatory experiment was performed on a C-10 beam. In order to analyze the data from this experiment several data conversion and analysis techniques were employed. These methods are necessary for other similar preparatory experiments. This summer, we developed a data format conversion software from the raw binary to a standard data analysis format in order to make such experiment data easier to analyze. We also used beta and gamma decay detectors to understand the beam's composition and count rate. These tools will facilitate future such development runs.

## Poster Presentation

### *Simulating the introduction of Rift Valley fever virus into the California Central Valley*

Caleb Johnson

College of Science

Applied and Computational Mathematics and Statistics and Biological Sciences

Advisor: Alex Perkins, Dept. of Applied and Computational Mathematics and Statistics  
and Biological Sciences

Rift Valley Fever Virus (RVFV) is a vector-borne disease endemic to west-central Africa and has not been identified farther away than the Middle East. RVFV infects livestock causing high death rates in newborns and high abortion rates in pregnant animals while remaining inapparent in other adult animals. A question of interest to many in the U.S. government and agricultural sectors is what would be the consequences if the Central Valley of California were to be exposed to Rift Valley Fever Virus, specifically the very active dairy industry located there. The possibility of livestock in the Central Valley being exposed naturally is very low; the most viable way for an exposure to occur is through the intentional release of infected livestock or infected mosquitoes to the area. I used an epidemiological simulation model to determine the rate at which RVFV might spread through the Central Valley. Taking data for rainfall and temperatures in the Central Valley from 2003-09 allows for an accurate way to simulate the life cycle of mosquitoes in that time frame, which gives the model a way to generate infection patterns that might be observed in livestock in the event of an outbreak. Developing and testing the software necessary to make this model work comprised the majority of my research activity. Another important component of my work on this project was figuring out how to have the model run in a high-throughput environment through the Center for Research Computing and then output data in a way that is both easily understood and ready to use when analyzing on a large scale. The final statistical results of the model once analyzed could help in determining whether the overall likelihood warrants investing the money and resources into preparing the area for a possible outbreak.

## Poster Presentation

### *Bending the Rules*

Julia Jones

New Prairie Middle School, New Carlise, IN

Introduction- The purpose of my experiment is to understand how quickly and easily people can read words in various colors. This information may be useful in helping people develop cognizance skills and understand their abilities, so as to help them with their skills in various industries or public service areas. My project questions is as follows: will the warping of colored words affect the outcome of the Stroop effect? For my procedure, I used notecards and a timer to determine how long it took for people to read various colored words written normally and in a circular format. The results of my project indicate that it will always be harder to identify the color a word is written in than it is to identify the word in color. To answer my project question, the warping of colored words did not affect the outcome of the Stroop effect, disproving my hypothesis. If I were to complete this experiment again, I would se the time and place to be more consistent, have an equal gender quantity, and more participants, so as to reflect a better dichotomy of the populations, thereby improving the experiment.

## Poster Presentation

### *Calcium Signaling in Germ Band Retraction during *Drosophila melanogaster* Embryogenesis*

Jahmel Jordon

College of Science

Biological Sciences and Studio Art and Design

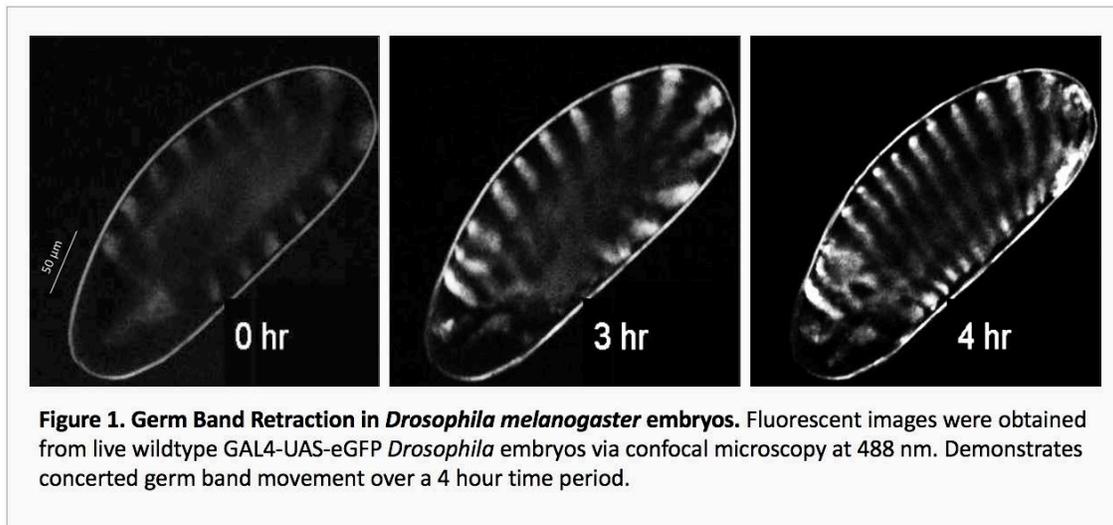
Louisa Antonelli

College of Science

Biological Sciences and Studio Art and Design

Advisor: Jeremiah Zartman, Dept. of Chemical and Biomolecular Engineering

The main aim of this project is to determine **putative roles of calcium ( $\text{Ca}^{2+}$ ) signaling in germ band retraction (GBR) during *Drosophila melanogaster* embryogenesis**. Calcium is a key second messenger in several cell signaling pathways due to its immense versatility. By combining the different signaling functions of  $\text{Ca}^{2+}$ , various **spatial** and **temporal** gradients can be established throughout the cell.  $\text{Ca}^{2+}$  is a key component in signaling processes involved in **morphogenesis, proliferation, differentiation**, and even **apoptosis**, substantiating calcium's versatility. Previous studies in the Zartman lab have demonstrated that **changes in mechanical cellular compression** can activate  $\text{Ca}^{2+}$  signaling in *Drosophila* wing discs. The lab has also recently identified the **Hedgehog (Hh) pathway**, which is **required for proper segmentation and boundary formation during embryogenesis**, also modulates  $\text{Ca}^{2+}$  signaling in *Drosophila* wing discs. In addition,  $\text{Ca}^{2+}$  has been identified as the **“central integrator of metabolic and proliferative signals”** in *Drosophila* intestinal **stem cells**. Although it is known that  $\text{Ca}^{2+}$  signaling is crucial for embryogenesis,  $\text{Ca}^{2+}$  signaling has not been characterized at later stages of development. **We hypothesize that  $\text{Ca}^{2+}$  signaling plays a major role in GBR and will help us to further elucidate how epithelial tissues respond to compressive forces**. Fluorescent imaging via confocal microscopy will be used to visualize germ bands during GBR. By comparing quantitative parameters of GBR such as retraction velocity and band width in wildtype embryos and key knockout mutants, in conjunction with measuring  $\text{Ca}^{2+}$  signaling, the relative importance of  $\text{Ca}^{2+}$  signaling can be deduced.



**Figure 1. Germ Band Retraction in *Drosophila melanogaster* embryos.** Fluorescent images were obtained from live wildtype GAL4-UAS-eGFP *Drosophila* embryos via confocal microscopy at 488 nm. Demonstrates concerted germ band movement over a 4 hour time period.

## Poster Presentation

### *Actual and Perceived Use of Hand Sanitizer Dispensers among Hospital Staff, Patients, and Visitors*

Sarah Khan

College of Science

Science Preprofessional Studies

Advisor: Kimberly Rollings, School of Architecture

This study examined actual and perceived use of hand sanitizer dispensers by 373 hospital staff, patients, and visitors. Frequency of hand sanitizer dispenser use was documented via observations of the hospital lobby, elevator waiting area, and surgery waiting area. A 10-item online survey was additionally administered to 3,000 hospital staff (496 complete responses) to document perceived hand sanitizer usage in the hospital, recommendations for increasing use, and demographics. Observation results showed that dispenser usage was low with <1% in both the front lobby and elevator waiting area, and 20% of only 10 people in the surgery waiting area. Survey results showed that 94% of respondents reported using hand sanitizer in the hospital for reasons including supporting already good hand hygiene practices, maintaining clean hands and when hands need to be sanitized quickly, and, the most important factor, sanitation. Common reasons for not using hand sanitizer were that the participant used soap and water instead of hand sanitizer (42%) and that the participant disliked the smell/feel of the sanitizer (35%). Only 2.3% of survey respondents indicated that lack of time was a reason for not using hand sanitizer. Respondent recommendations for increasing hand sanitizer use included changing from gel- to foam-based sanitizer, adding more signage to increase visibility of dispensers, replacing current dispensing stations with hands-free dispensers, and making sure that all dispensers are filled and working properly.

## Poster Presentation

### *Effect of salinity level on old and modern genotypes of Schoenoplectus americanus*

Sophia Kiernan

College of Arts and Letters

Sociology and Arts and Letter Pre-Health

Jens Verhey

College of Science

Science Business

Li Li, Dept. of Biological Sciences

Advisor: Jennifer Robichaud, Dept. of Biological Sciences

Essential to the health of fisheries, coastlines, and communities, salt marshes provide a source of food and a nursery habitat for greater than 75 percent of fisheries species that are critical to our economy and culture. These communities are stabilized and supported by salt marsh vegetation, including the sedge, *Schoenoplectus americanus*. This study investigates whether environmental change has led to an evolutionary adaptive response of *S. americanus* to increased salinity. Modern *S. americanus* sedges along with an older genotype germinated from sediment core seeds (dated approximately 1920) were taken from populations in Delaware Bay, New Jersey. Twenty-four plants total, 12 old and 12 modern, were randomly assigned into three levels of salinity (0 g/L, 3 g/L, and 6 g/L) and grown in greenhouse conditions. The results do not support the hypothesis that modern replicates of *S. americanus* are better suited to higher concentrations of salinity relative to the old replicates; however, it is apparent that increases in salinity have negative effects on both genotypes of *S. americanus*. The accumulation of Na<sup>+</sup> and Cl<sup>-</sup> in the cell wall leading to cell dehydration is the most likely mechanism for the growth inhibition exhibited by sedges in high saline environments. Quantifying the response of *S. americanus* to increases in salinity may allow us to determine a model for the ability of vegetation to respond to environmental change and protect salt marsh communities.

## Poster Presentation

### *Electrophysiology of Drosophila suzukii and chemical analysis of preferred fruits*

Joseph Kinsella  
College of Science  
Biological Sciences

Advisor: Zainulabeuddin Syed, Dept. of Biological Sciences

*Drosophila melanogaster* and *D. suzukii* are two species of fruit flies that are close phylogenetically, yet differ in one key trait: *D. suzukii* lay their eggs in fresh fruit instead of rotten fruit like *melanogaster*. This behavior poses a large economical problem for farmers. A critical understanding of this trait can be exploited to develop odor baited traps that selectively attract *D. suzukii*. I performed electrophysiological measurements from the olfactory organs of flies by utilizing a technique called Gas-Chromatography linked electroantennographic detection (GC-EAD). Odors from the fruits preferred by *D. suzukii* (ripe and overripe strawberries, raspberries, and blackberries) were collected by solvent extraction method or Solid-phase microextractions (SPME) and analyzed. Preliminary data from the GC-EAD analysis indicated that strawberry odors induced highest number of responses whereas raspberry induced least. This was true for both the sexes. However, male responses were stronger. Biologically active fruit odor constituents from GC-EAD were identified by using GC-mass spectrometry (GC-MS). Final, verification of biologically active constituents will be done by using synthetics of those compounds on both the GC-EAD and GC-MS. This information can be used to design an ideal odor baited trap specific to *D. suzukii* and control the pest problem that farmers are facing.

## Oral Presentation

### *Exploring the Protein Folding Mechanism Using an Intrinsically Disordered Protein*

Catherine Knoverek  
College of Science  
Biochemistry and Philosophy

Emily Kaye  
College of Science  
Biochemistry and Spanish

Micayla Bowman, Dept. of Chemistry and Biochemistry

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Advisor: Patricia Clark, Dept. of Chemical and Biomolecular Engineering,  
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Proteins are involved in all important biological reactions and processes. In order to perform their function, many proteins fold into a three-dimension conformation. Despite the importance of protein conformation, and thus the process in which proteins achieve their conformations, little is known about how a protein transitions from an ensemble of unfolded states to a specific, native fold. Here we describe an intrinsically disordered polypeptide, used as a model to study the earliest conformations populated during protein folding. In the cell, the passenger domain of the autotransporter protein pertactin adopts a 16-rung, right-handed  $\beta$ -helical structure. However, when the 334 amino acid N-terminal portion (PNt) is separated from the rest of pertactin, it does not adopt any regular structure but instead behaves as a monomeric random coil. This has been shown using tryptophan emission fluorescence, far-UV circular dichroism (CD), nuclear magnetic resonance (NMR), and small angle x-ray scattering (SAXS). By shuffling the order of amino acids in PNt without changing the overall composition, we can test our hypothesis that the lack of hydrophobic clustering is what allows PNt, an overall fairly hydrophobic polypeptide, to remain extended. Additionally, PNt can be used to help settle a discrepancy in the literature concerning how protein folding begins. SAXS data suggests that most, but not all, proteins *do not* undergo an initial collapse when transferred from high to low denaturant conditions before folding. This is contrary to Förster resonance energy transfer (FRET) experiments, which have consistently demonstrated polypeptides *do* collapse after dilution from denaturant and before folding. As PNt is unfolded independent of denaturant concentration, it can act as a negative control for collapse and allow us to test technique-dependent factors, such as the addition of hydrophobic fluorophores required for FRET measurements.

## Poster Presentation

### *Creating a Vacuum Chamber For Use With Micro-Pattern Gas Detectors*

James Koci  
College of Science  
Physics

Advisor: Tan Ahn, Dept. of Physics

The development of instrumentation in nuclear physics is crucial for advancing our ability to measure the properties of exotic nuclei. One limitation of the use of exotic nuclei in experiment is their very low production intensities. Recently, detectors, called active-target detectors, have been developed to address this issue. Active-target detectors use a gas medium to image charged-particle tracks that are emitted in nuclear reactions. Last year, I designed a vacuum chamber to be used in developing Micro-Pattern Gas detectors that will upgrade the capabilities of an active-target detector called the Prototype AT-TPC. With the exterior of the chamber complete and tested to hold vacuum, I have since used an electric field modeling program, Garfield, developed by CERN to design a field cage to be placed within the vacuum chamber. The field cage will be a box-like apparatus consisting of two parallel metal plates connected with a resistor chain and attached to wires wrapped between them. The cage will provide a uniform electric field within the chamber to drift electrons from nuclear reactions down to the detector in the bottom of the chamber. These signals are then amplified by a proportional counter, and the data is sent to a computer. Most recently, I have designed the physical pieces of the cage with the goal of assembling it in the near future. For the long term, we would like to incorporate a Micro-Pattern Gas Detectors in the interior of the chamber and eventually use the AT-TPC to examine various nuclei.

## Poster Presentation

### *Autophagy Impairment in Niemann Pick Type C Disease (NPC) and the Effect of Rapamycin on Autophagy*

Katherine Koczwar

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Biological Sciences

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Biological Sciences

Advisor: Kevin Vaughan, Dept. of Biological Sciences

Niemann-Pick Type C disease (NPC) is a pediatric, neurodegenerative, lysosomal storage disorder caused by mutations in either NPC1 or NPC2. Although lysosomal problems are apparent in the spleen and liver, NPC patients succumb to loss of Purkinje neurons in the cerebellum. Why the pathology is so specific to Purkinje cells remains unknown. In this investigation, we characterized cholesterol accumulation and the effects on autophagy in cells depleted of NPC1 by shRNA treatment. Filipin staining of NPC1-depleted cells revealed accumulations of cholesterol that mimicked NPC disease. Using LC3-II as an indicator of autophagy initiation, and mitochondrial imaging (ChromoA staining) to measure the completion of autophagy, we observed the initiation of autophagy in NPC1-depleted cells compared to controls. However, small mitochondrial fragments continued to accumulate in the NPC1-depleted cells, indicating a failure to complete autophagy. Because rapamycin is known to stimulate autophagy, we treated serum-starved cells and measured the impact on autophagy initiation and completion. Both control and NPC1-depleted cells displayed evidence of autophagy initiation. However, only the control population was able to clear mitochondrial fragments. These studies suggest that NPC1-depleted cells exhibit a failure to clear mitochondrial fragments, despite retaining the ability to initiate the autophagy pathway. They also indicate that short-term rapamycin treatment is not effective in rescuing this problem, at least in cells depleted of NPC1.

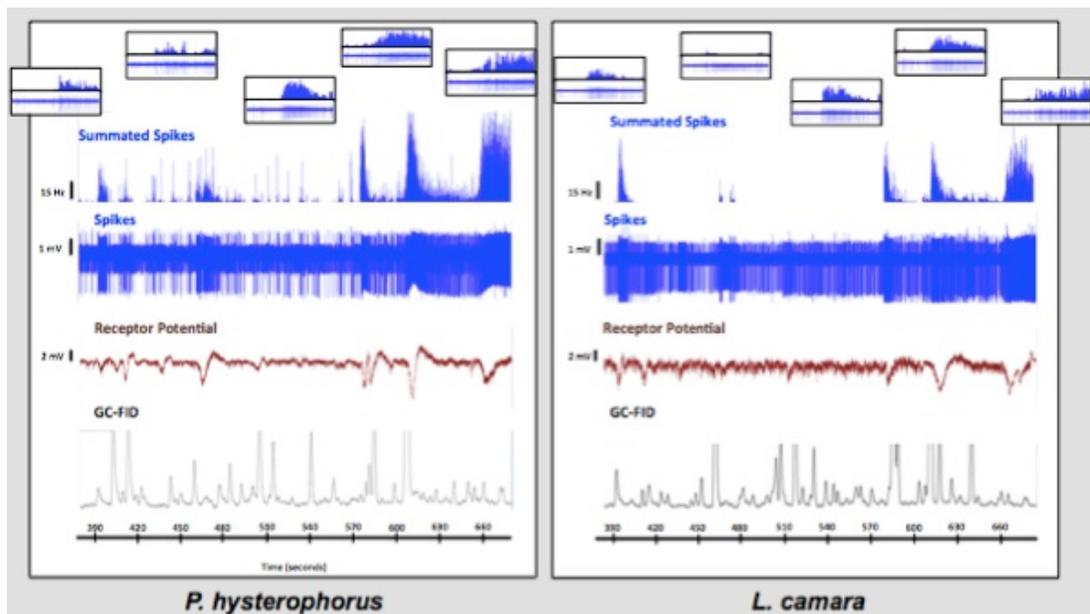
## Poster Presentation

### *Plant based attractants for the malaria mosquito, Anopheles gambiae*

Savannah Kounelis  
College of Science  
Biological Sciences

Advisor: Zainulabeuddin Syed, Dept. of Biological Sciences

Recent decline in malaria due to wide-scale implementation of long-lasting insecticide-treated nets (LLINs) and indoor residual spraying (IRS) in Africa is promising, but such intensive and sustained applications of LLINs and IRS do not offer a long-term control strategy due to the rapid development of insecticidal resistance. This warrants multi-pronged strategies that explore and expand on innovative control methods, and can be embedded into the existing vector control strategies. Sugar feeding (from plants) is a highly conserved trait among most of the mosquito genera. Olfaction plays a critical role in mediating this behavior. A large and divergent family of proteins, Odorant Receptors (ORs), is expressed in the dendrites of Olfactory Receptor Neurons (ORNs) housed in sensilla on the antennae and maxillary palps of mosquitoes. The ORs detect and discriminate the odorants from potential hosts, mates, and oviposition sites. Among a handful of ORs that are conserved across various mosquito genera, one of the most highly conserved is Or2, which has been hypothesized to play a key role in attraction to plants among the disease transmitting mosquitos *Anopheles gambiae*, *Aedes aegypti*, and *Culex quinquefasciatus*. We used bioassay guided methods to isolate and identify biologically active odor constituents from two plants, *Lantana camara* and *Parthenium hysterophorus*, that are extensively used by *An. gambiae* as a sugar source. These compounds have been identified as benzaldehyde, salicylaldehyde, naphthalene, benzothiazole, and indole. These findings pave the way for the development of plant based attractants as baits that can be used in Odor Baited Traps (OBT) with an added potential as unisex bait since both the sexes seek sugars from plants.



## Poster Presentation

### *An Analysis of Volatility-based Option Trading Strategies*

Melissa Krumdick

College of Science

Applied and Computational Mathematics and Statistics

Advisor: Huy Huynh, Dept. of Applied and Computational Mathematics and Statistics

In recent years, the overall size of the derivatives industry has quadrupled. As these instruments become more widely circulated, it is increasingly important for both professional traders and retail investors to understand how to utilize these securities to optimize the performance of their portfolios. Derivatives can be used to achieve a variety of goals, including increased leverage, higher returns, and lower downside risk. In financial trading, the flexibility and versatility of these contracts is especially advantageous. My research examines volatility-based option trading strategies that aim to generate profit by trading mispriced options. To achieve this objective, an option's estimates for historical and implied volatility are compared, and when the market view appears to be incorrectly estimating the option's volatility, these mispricings are exploited by trading a delta neutral portfolio of an option and its underlying. The focus of my research is on the mathematical and statistical techniques that underlie this strategy, with an emphasis on the variety of approaches to measuring an option's volatility.

## Oral Presentation

### *The Effect of Plasma Radiation on Nucleobase Solutions*

Emily Kunce

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Major: Physics in Medicine

Advisor: Sylwia Ptasinska, Notre Dame Radiation Laboratory and Dept. of Physics

Plasma, the fourth state of matter, is generated when gas is flowed between two high voltage electrodes and becomes ionized. The resultant mixture contains a variety of ions, radicals, neutrals, electromagnetic radiation, and magnetic fields. Among these species, reactive oxygen and nitrogen species have been found to selectively induce apoptosis, controlled cell death, when biological samples are exposed to the plasma jet. Through induction of the apoptosis pathway, cells die without creating extensive inflammation and their components are recycled by neighboring cells. Because plasma irradiation reopens the apoptotic pathway in mutated cancer cells more effectively than in healthy cells, plasma has potential within the medical field to be used as a treatment for both epithelial and oral surface cancers. Additionally, previous research has shown that treatment with plasma restores the functionality of some chemotherapies.

While plasma is known to induce apoptosis, this study aims to elucidate the reactive species produced upon exposure of various aqueous nucleobase solutions to the plasma source. Both reactive oxygen and nitrogen species are known to induce apoptosis through DNA damage, so hydrogen peroxide, nitrate, and nitrite will be measured in these experiments to understand how they are produced in solution. With increased plasma exposure, it was observed that the concentration of these reactive species increases linearly with time. While hydrogen peroxide and nitrate production was not affected by the presence of the nucleobase in the solution, nitrite production was greatly increased compared to the control. This study suggests that the nucleobases are involved in the production of the reactive species and may in fact be damaged through plasma exposure. Future studies aim to further clarify this mechanism and observe the effects of plasma treatment on plasmid DNA solutions.

## Poster Presentation

### *Adenomatous Polyposis Coli Mediates Cellular Polarity, Size, and Migration Through C-terminus Binding Domains*

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College of Science

Science Preprofessional Studies

Alyssa Lesko

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Biological Sciences

Jenifer Prospero, Indiana University School of Medicine – South Bend, Harper Cancer Research Institute, and Dept. of Biological Sciences

Advisor: Jenifer Prospero, Indiana University School of Medicine – South Bend, Harper Cancer Research Institute, and Dept. of Biological Sciences

Adenomatous Polyposis Coli (APC) is a multi-functional protein lost in many epithelial cancers. Perhaps most well-known for its role as a negative regulator of the Wnt/ $\beta$ -catenin signaling pathway, APC also binds to microtubules and polarity proteins in its c-terminal domain suggesting added functions in the regulation of epithelial polarity and cellular migration. The APC c-terminus contains several unique binding domains for polarity proteins and the cytoskeleton including the basic domain (binds  $\beta$ -tubulin, actin, and mDia), the EB1-binding domain (binds microtubules and the +TIP protein EB1), and the PDZ-binding domain (binds polarity proteins Scribble and Dlg). Our lab has shown that APC knockdown in Madin-Darby Canine Kidney (MDCK) cells demonstrated increased cyst size and inverted epithelial polarity in 3D culture, as well as increased migration during wound-healing assays compared to wild type controls. Introduction of either the full length or c-terminal fragment of APC showed a partial restoration of these phenotypes, while introduction of the truncated  $\beta$ -catenin binding domain showed no effect suggesting that these phenotypes are regulated via Wnt/ $\beta$ -catenin independent mechanisms. We hypothesize that APC c-terminus mediates cellular polarity, cyst size, and migration through Wnt/ $\beta$ -catenin independent mechanisms involving the basic, EB1, and PDZ binding domains of the APC c-terminus. Current studies in the laboratory focus on reintroducing truncated fragments of the APC c-terminus containing isolated basic, EB1, and PDZ binding domains and observing their effects on cell polarity, cyst size, and migration. Investigating the effects of these truncated gene fragments will help us to better understand which interactions of the APC c-terminus with the cytoskeleton and polarity proteins are vital for the regulation of apical-basal polarity, cyst size, and cell migration.

## Poster Presentation

### *Investigating DEDD's Role in Cell Cycle Regulation*

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Elizabeth Lawler  
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Biological Sciences  
Barnes Werner  
College of Science  
Biological Sciences  
Thomas Kane  
College of Science  
Biological Sciences  
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Yingjia Ni, Harper Cancer Research Center

Advisors: Siyuan Zhang and Michelle Whaley, Dept. of Biological Sciences

DEDD is a pro-apoptotic protein implicated in cell cycle regulation due to its association with the G1 regulator pRb. Literature demonstrates that DEDD has three nuclear translocation domains and nuclear translocation is required for DEDD's function. Interestingly, it has been found that DEDD is overexpressed in triple-negative breast cancer cells. The goal of our research was to better understand DEDD's role in cancer cells by determining phenotypic effects of DEDD overexpression on the cell cycle. We hypothesized that DEDD would alter the G1 phase of the cell cycle due to its association with pRb and nuclear translocation of DEDD was necessary for the alteration in cell cycle transition. To study DEDD, we used 293FT non-cancerous human embryonic kidney in order to minimize the confounding variables often observed in cancer cell lines. The pLOVE lentiviral system was used to overexpress DEDD in 293FT cells. We also used a mutant form of DEDD with disrupted nuclear translocation domains to prevent it from entering the nucleus, which allowed us to study its possible nuclear function. The subcellular locations of our overexpressed wild-type and mutated DEDD were verified via immunofluorescence. Flow cytometry allowed us to determine that overexpression of DEDD was affecting the G1/S phase checkpoint and the process was not dependent on the nuclear function of DEDD. Western Blot analysis suggested an alteration in expression of cell cycle regulators pRb and Cyclin D3 in response to both wild-type and mutated DEDD overexpression. Altered expression of these G1/S regulatory proteins suggests a possible mechanism for accelerated cell cycle transition at the G1/S checkpoint. Future experiments include an immunoprecipitation assay to investigate interaction mechanisms between DEDD and cell cycle regulators as well as to conduct these experiments in a triple-negative breast cancer model.

**Poster Presentation**

***Synthesis and Activation of Pd(II) and Ni(II) Metal Complexes  
with a Diphosphine Pincer Ligand***

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Anthropology and Chemistry  
Dominic Babbini, Dept. of Chemistry and Biochemistry  
Advisor: Vlad Iluc, Dept. of Chemistry and Biochemistry

The synthesis of novel metal complexes that activate or functionalize inert small molecules allow for new pathways to utilize undesired compounds such as methane or CO<sub>2</sub> as chemical precursors for energy demands. Since the novel metal complexes synthesized provide unique reactivity and catalytic potential, they may hold the necessary properties to take advantage of latent reactivity and aid rising energy requirements. With the right catalyst, reactions such as the formation of methanol from methane could be possible. The coordination chemistry of a novel ligand, bis(2-di-*iso*HP)MCl<sub>2</sub>P)PdCl resulted from the activation of the carbon backbone by lithiation of the ligand followed by addition of [Pd(COD)Cl]<sub>2</sub>.

## Poster Presentation

### *Analysis of lipid transport proteins SREBP-1 and PLIN3 in obese murine ovarian cancer models*

Eric Lee

College of Science

Science Business

Sharon Stack, Yueying Liu, Ashley Jean-Pierre, Harper Cancer Research Institute  
and Dept. of Chemistry and Biochemistry

Advisors: Sharon Stack and Yueying Liu, Harper Cancer Research Institute  
and Dept. of Chemistry and Biochemistry

Epithelial ovarian cancer (EOC) is a leading cancer in women. This cancer is particularly lethal due to its early metastasis and aggressive disease progression. Therefore, understanding the mechanisms that regulate metastasis is of clinical interest, as methods that ensure earlier detection could find and treat tumors before they spread to an uncontrollable degree.

Obesity is another worldwide epidemic that has received clinical attention. Recent data suggests that almost half of all women in the United States are obese. New evidence indicates that higher levels of obesity contribute to increased EOC metastasis. However, the mechanisms responsible for this association remain unknown. Thus, this research aims to discover the proteins and processes responsible for the relationship between obesity and EOC.

Two proteins that play key roles in lipogenesis pathways are sterol regulatory element-binding protein-1 (SREBP-1) and perilipin 3 (PLIN3). SREBP-1 is a master transcription factor that controls lipid metabolism. Levels of SREBP-1 are higher in obese patients and mice, suggesting their role as transcription factors contributing to chronic conditions. Recent research also suggests that SREBP-1 may serve as a link between oncogenic signaling and tumor metabolism. PLIN3 is a lipid transport protein necessary for the production of cytosolic lipid droplets, which are involved in membrane biosynthesis and lipid metabolism.

To assess the role of these lipoproteins in cancer metastasis, tissues from the liver were obtained from three murine models of overweight and obese individuals. Levels of SREBP-1 in the liver samples were visualized using immunohistochemical staining and are being quantified via Aperio software and associated macros. PLIN3 is known as a coat protein for lipid droplets, so liver samples were dyed with Oil Red O to visualize lipid drops and identify the presence of PLIN3. Quantification of PLIN3 is currently underway using Aperio software and macros. Analysis of SREBP-1 and PLIN3 levels across the three murine models will determine whether lipid content levels influence the presence of these lipid regulatory proteins, and the extent to which these lipoproteins are responsible for ovarian cancer metastasis. Thus, this study will lay the groundwork for future mechanistic research on tumor lipid metabolism and metastatic success.

## Poster Presentation

### *Metabolic Transcriptome Shifting Promotes Metastatic Proliferation*

Dennis Lee

College of Science and College of Arts & Letters  
Biological Sciences and Psychology

Siyuan Zhang, Dept. of Biological Sciences

Patricia Schnepf, Dept. of Biological Sciences

Advisor: Siyuan Zhang, Dept. of Biological Sciences

Cancer metabolism has been well documented to influence primary tumor development and success; however, the role of metabolism in the metastatic tumor is not well understood. Current evidence suggests brain metastatic cells display a distinct metabolic profile compared to their primary tumor counterparts. Here, we propose that metabolic shifting during metastatic evolution is crucial for the metastatic success of cancer cells in the brain microenvironment. We identified a global metabolic shift in the metastatic tumor cells including loss of the classic Warburg effect signature. Metabolic changes directly affect cellular proliferation. To determine whether the metastatic metabolic shifting results in a proliferation difference in tumor cells grown in either the brain metastatic microenvironment or primary tumor microenvironment, tumor cells were co-cultured with either glial or cancer associated fibroblasts (CAF) to mimic the brain metastatic microenvironment or primary tumor microenvironment respectively. Our results indicate that tumor cells have higher proliferation rate when grown in brain metastatic microenvironment compared to the primary tumor microenvironment. To visualize the metabolic shifting based on the tumor microenvironment, we utilized biosensors to monitor glycolytic flux and metabolic product fluctuations. We observed a greater usage of NADH in tumor cells in response to glutamine after co-culture with glial cells compared to tumor cells co-cultured with CAF cells. Taken together, these results suggests the metabolic shifting that occurs in brain metastasis decreases the majority of metabolic pathways including the Warburg effect and increases dynamic utilization of glutamine in the brain microenvironment to produce necessary metabolic products for metastatic proliferation.

## Poster Presentation

### *Mcl-1 in APC-mediated chemotherapeutic resistance in breast cancer*

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Jenifer Prosperi, Indiana University School of Medicine – South Bend, Harper Cancer Research Institute, and Dept. of Biological Sciences

Advisors: Jenifer Prosperi and Monica VanKlompenberg, Indiana University School of Medicine – South Bend, Harper Cancer Research Institute, and Dept. of Biological Sciences

Breast cancer is the most commonly diagnosed cancer in women in the United States, with over 250,000 new cases each year. In aggressive breast cancers, cells become resistant to multiple chemotherapeutic agents through changes in signaling pathways. The Adenomatous Polyposis Coli (APC) tumor suppressor gene is mutated or silenced by hypermethylation in up to 70% of sporadic breast cancers, causing changes to a variety of cellular processes. Apc mutation using the ApcMin/+ mice resulted in aggressive breast cancer when crossed to the Polyoma middle T antigen (PyMT) transgenic model (MMTV-PyMT;ApcMin/), resembling triple negative breast cancer. Using cell lines derived from MMTV-PyMT;ApcMin/ tumors, we previously found that Apc-mutant cells are resistant to doxorubicin or cisplatin-induced apoptosis, and that signal transducer and activator of transcription 3 (STAT3) is hyperactivated in the PyMT;ApcMin/+ cells. Given that the anti-apoptotic BCL-2 family members, Bcl-2 and Mcl-1 are downregulated when STAT3 is inhibited, we hypothesized that Apc-mutant cells will have increased Bcl-2 and Mcl-1 expression. Western blot analysis showed that Bcl-2 was up-regulated in MMTV-PyMT;ApcMin/+ cells, potentially preventing chemotherapy-induced cell death. We noted decreased expression of Mcl-1 and p-STAT3 (active STAT3), with no effect on Bcl-2, in cisplatin treated MMTV-PyMT;ApcMin/+ cells compared untreated cells. Cisplatin also decreased pSTAT-3 in the MMTV-PyMT;Apc+/+ cells, but to a significantly lesser degree than in the Apc-mutant cells. These studies have been confirmed using STAT3 reporter assays. We have observed that this effect of cisplatin occurs rapidly, within 6 hours of treatment. Future studies will investigate whether activation of STAT3 is responsible for changes in Mcl-1 expression after treatment with cisplatin. Furthermore, we will determine how decreased Mcl-1 expression, suggesting increased apoptosis, is present in the cisplatin-resistant MMTV-PyMT;ApcMin/. A stronger understanding the expression of Mcl-1 may suggest a mechanism behind chemotherapeutic resistance in cisplatin-treated MMTV-PyMT;ApcMin/ cells.

## Poster Presentation

### *T1 Transitions and Apoptosis in the Drosophila Wing Disc and Embryonic Epithelium*

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Chemical Engineering

Advisor: Jeremiah Zartman, Dept. of Chemical and Biomolecular Engineering

Elucidating the mechanisms of growth control in epithelial tissues is important for tissue engineering applications. The fruit fly was chosen for this research because they are easy to obtain, have a short life cycle, and have many genes homologous with humans. The *Drosophila* embryo is a good model system for size control in epithelia because it is comprised of multiple segments of predetermined size along the length of the body that depend on epidermal growth factor receptor (EGFR) signaling. The interest of the lab is to use genetic control mechanisms in the EGFR pathway to examine the morphological differences in compartment dimensions and topology. The way in which individual cells divide and grow is important for understanding cancers and other growth control diseases. The lab has obtained both wing disc and embryo data from DE-Cadherin-GFP *Drosophila*, which show the boundaries of individual cells dividing, dying, and transitioning over time. An open source image processing software for epithelial tissues named EpiTools is used to track and quantify cell divisions and rearrangements in videos of developing embryo and wing disc. One of the main focuses of cell tracking is to observe how the cells undergo apoptosis and T1 transitions. Apoptosis is a programmed cellular death, which occurs in all tissue morphologies, even when the growth patterns are irregular. T1 transitions occur when the cells rearrange with their neighbors and the boundaries change. Although there is research available on the mechanisms of apoptosis and T1 transitions, there is little known about how cells interact with their neighbors when undergoing these transitions. Careful kinematics is an important first step for identifying conserved biophysical mechanisms driving cell-rearrangements in proliferating tissues. By understanding how these mechanisms work in the *Drosophila* model system, we can gain a greater understanding of tissue growth controls, which has many uses in the field of cancer research.

## Poster Presentation

### *Group A Streptococcus toxin Streptolysin S utilizes nucleic acid cofactor in blood hemolysis*

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Science Preprofessional Studies  
Shaun Lee, Dept of Biological Sciences  
Advisor: Shaun Lee, Dept. of Biological Sciences

Group A *Streptococcus* (GAS) is a bacterial pathogen that can cause a myriad of invasive syndromes such as impetigo, pharyngitis, toxic shock syndrome, and necrotizing fasciitis. GAS disease is a global health burden with an estimated 18 million severe cases and 500,000 deaths worldwide reported annually. A major contributor to GAS virulence is the beta-hemolysin, Streptolysin S (SLS). SLS has proven elusive to study over the past 100 years due to difficulties in isolating and stabilizing it, but its clinical hallmark has always been red blood cell hemolysis. It is proposed that SLS exerts its lytic activity through RBC membrane disruption, but the exact method of action is still unknown.

Due to the instability of SLS, its activity is observed only in the context of certain high molecular weight “stabilizer” molecules. Purified SLS samples (from bacterial fractions) show hemolytic activity but only in the presence of these carriers, so it is hypothesized that some of these agents may be important cofactors involved in SLS activity. Here, we explore a potential nucleotide co-factor necessary for SLS hemolytic activity.

Both separate and combined RNase and DNase treatment of SLS preparation samples led to a loss in hemolytic function. In addition, steric inhibition via nucleotide intercalation with Ethidium Bromide treatment revealed a loss of hemolytic function. Though the SLS peptide is estimated to be roughly 2.8 kDa, loss of hemolytic function in SLS samples prepared with a 3 kDa molecular weight cut-off concentrator further suggests that there is a cofactor complex necessary for SLS hemolytic function. This evidence provides potential proof for a nucleotide co-factor necessary for hemolytic function of the SLS toxin. These results offer insight into the mechanism of SLS-mediated hemolysis and have implications for the development of treatments against GAS.

## Poster Presentation

### *Linking agricultural conservation effort to water quality in the Indian Creek Watershed*

Erik Maag

College of Arts & Letters and College of Science  
Environmental Sciences and German

Matthew Trentman, Jennifer Tank and Ursula Mahl, Dept of Biological Sciences  
Advisor: Ursula Mahl, Dept. of Biological Sciences

It is vital to understand how land management practices affect nutrient input to streams because high nutrient loads can have adverse effects on water quality and downstream ecosystems. We used water quality data from the Indian Creek Watershed (IL) to examine whether enrollment of >50% of the watershed land area in agricultural conservation practices has influenced nutrient loading over 6 years. We analyzed nitrate data from grab samples collected at 5 sites across the watershed from 2010-2015, and high-frequency data from a nitrate sensor deployed at the watershed outlet from 2012-2015. Surface water nitrate concentrations and export depended on discharge, and up to 80% of export occurred during large storms (when flow was 95% greater than base flow). High-resolution data from nitrate sensors, during both low and high flow conditions, significantly improved watershed load estimation. Despite high annual variation in flow and NO<sub>3</sub><sup>-</sup>, including a 2012 drought, we detected a trend of decreasing NO<sub>3</sub><sup>-</sup> export from 2013-2015. Additionally, we observed greater NO<sub>3</sub><sup>-</sup> export in 2013 than 2015 for similar sized storms. Our research suggests that increases in agricultural conservation practices, particularly those that decrease runoff, have the potential to improve water quality.

## Poster Presentation

### *The Effects of Electronic Health on Rural Healthcare Facilities in Tanzania*

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Physics in Medicine

Advisor: Abigail Mechtenberg, Dept. of Physics

In July of 2009, the Tanzanian Ministry of Health and Social Welfare (MOHSW) released their third Health Sector Strategic Plan (HSSP III) to be in effect until June of 2015. This call for an increase in capacity building in ICT was followed up on in 2012 when the first Tanzanian National eHealth Strategy was released. Calls were made in the Strategy to use eHealth for a variety of activities to improve the quality of care universally throughout Tanzania, including disease reporting, expanding specialty care (often referred to as telemedicine), a health information system, and continued medical education (CME). The document, in effect until 2018, provided a comprehensive list of necessary elements for implementing electronic health (eHealth) throughout the country, including the acknowledgement of rural implementation strategies being different than those in urban contexts. Of the six strategic goals, strategic goal four was dedicated entirely to this issue, and strived to enable electronic access to appropriate healthcare services for patients in remote, rural, and disadvantaged communities. While the eHealth Strategy provided a nearly comprehensive strategy for rural implementation, the policy failed to suggest how to overcome an issue critical to the implementation of eHealth in rural contexts: the lack of electrification. Reports suggest that as few as 5% of the rural population in Tanzania use electricity, and efforts to extend the national grid to rural areas are not expected to happen anytime in the near future. The words electricity, electric, and energy appear zero times in the Tanzanian National eHealth Strategy. I demonstrate that rural electrification must coincide with implementation of eHealth in rural contexts for two main reasons: the increased power load on a hospital potentially increasing hospital-wide power outages, and the dependence on uninterrupted eHealth for successful provision of healthcare to all patients. I also explain how this rural electrification can be done in a sustainable way.

## Poster Presentation

### *Effects of Double Stranded RNA Administration and Feeding Mechanism on Aedes aegypti Feeding Behavior*

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Science Business

Advisors: David Severson and Matthew Eng, Dept. of Biological Sciences

The *Aedes aegypti* mosquito poses a significant threat to public health, being the main vector for dengue virus (DENV) that affects as many as 400 million people annually. Current research on *Aedes aegypti* vector control has focused increasingly on oral uptake of double stranded RNA (dsRNA) and insecticides, both of which have the potential to reduce DENV transmission rates to the human population. Specifically, dsRNA is being assessed for its ability to knockdown gene expression of the genes that regulate dengue infection and transmission in the mosquito population. An assay was created to examine the amounts of dsRNA needed and the optimal feeding conditions for knockdown of gene expression. Mosquitoes were placed in scintillation vials and fed solutions of dsRNA (dsBgal and dsIAP1) with or without lipofectamine on a piece of parafilm, and then tested for knockdown using qPCR. Mosquitoes fed dsRNA containing lipofectamine showed significant knockdown in both dsBgal and dsIAP1. To test whether the mechanism by which mosquitoes are fed impacts the amount they feed, mosquitoes were placed in different types of cages (scintillation vials, centrifuge tubes, glass lab jars, and large paper cups) and administered a sucrose solution through capillary tubes over a 24-hour period. Cages varied in size and amounts of mosquitoes, and it was found that mosquito feeding behavior correlated with cage size and availability of surfaces to latch onto near the opening of the capillary tube, with mosquitoes feeding an average of 3.5  $\mu\text{l}$  per 24 hours in the most efficient feeding mechanisms. These results will aid in future research on oral uptake of double stranded RNA, allowing for more accurate amounts and concentrations to be given to mosquitoes.

## Oral Presentation

### *Unexpected Roles for Stromal MMP3 during Breast Cancer*

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Ricardo Romero Moreno and Emilia Ivanova, Maria Cristina Miranda-Vergara, Dept of Chemistry and  
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Charley Jang  
College of Science  
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Advisor: Laurie Littlepage, Dept. of Chemistry and Biochemistry

Matrix metalloproteinases (MMPs) are a family of proteases that have been shown to contribute to the degradation of components of the extracellular matrix and other substrates to promote cancer progression and metastasis. Stromelysin / matrix metalloproteinase-3 (MMP3) is one member of the matrix metalloproteinase family that is overexpressed in human breast cancer. During breast cancer, MMP3 is expressed primarily by stromal cells but also by cancer cells. Overexpression of MMP3 induces an epithelial-to-mesenchymal transition (EMT), promotes hyperplastic growth, and expands a mammary gland stem cell population. In addition, MMP3 is required for the mammary gland stem cell population. In this study, we determined if stromal MMP-3 is required for breast cancer progression for primary and metastatic lung tumor growth. To study this, we transplanted mammary epithelial cancer cells (V0PyMT) into the mammary glands of MMP3 knockout and heterozygous syngeneic mice. We quantified the tumor burden of both primary and metastatic tumors over time and discovered that elimination of stromal MMP3 increased the tumor burden. The tumor pathologies, proliferation rate, and apoptosis were similar between cancer and not cancer tissue. In contrast, the vasculature density decreased. These data suggest that stromal MMP3 inhibits, but is not required for, the development of the primary breast tumor. However, in contrast to our primary tumor data, we interestingly discovered that stromal MMP3 was required for visible lung metastases. These experiments begin to distinguish between the contrasting roles of stromal and epithelial MMP3 during breast cancer. Our data reveal that MMP3 contributes to the metastatic tumor formation within the lungs. This study will help to elucidate new mechanisms through which MMP3 functions within particular microenvironmental contexts during breast cancer progression.

## Oral Presentation

### *Use of an ecosystem-based model to predict the effects of non-native Pacific salmon spawning on stream-resident fish in the Great Lakes basin*

Lillian McGill

College of Science

Environmental Sciences

Brandon Gerig and Gary Lamberti, Dept. of Biological Sciences

Advisor: Dominic Chaloner, Dept. of Biological Sciences

Pacific Salmon (*Oncorhynchus* spp.) have been introduced to the Great Lakes, where they mature and then return to tributary streams to spawn and die. Spawning salmon can biotransport contaminants, such as polychlorinated biphenyls (PCBs), that they accumulate in the Great Lakes to stream and rivers. Little is known about salmon spawner influence on contaminant concentrations in the Great Lakes tributary biota, including native Brook Trout (*Salvelinus fontinalis*) and non-native Brown Trout (*Salmo trutta*). To evaluate contaminant biotransport by spawning Pacific salmon, we developed a mass-balance trophic model for a typical Michigan stream using the ecosystem modeling software Ecopath with Ecosim (EwE) and Ecotracer (a contaminant tracking component of the EwE software). We ran a baseline simulation reflecting salmon input to the stream system and compared predicted concentrations with empirical values. We also ran simulations to reflect only contamination of direct and indirect enrichment (i.e., only contamination of eggs and only contamination of carcasses). We predicted that Brook and Brown Trout would exhibit similar contaminant concentrations due to similar diets and uptake efficiencies, and that direct consumption of salmon material is the main pathway of contaminant transfer. We found that predicted concentrations matched empirical values at both  $t=1$  and equilibrium. The direction of Brook and Brown Trout response to salmon spawners was similar, but Brown Trout concentration was 134% higher than Brook Trout concentration at equilibrium, likely due to differences in growth rate. Additionally, for Brook and Brown Trout, contaminant changes were ~13 and ~9 times larger for direct than indirect enrichment. This study suggests, first, that Ecopath with Ecosim can be used to model the effects of biotransport of contaminants due to spawning salmon Pacific salmon. Second, that the species-specific differences in contaminant bioaccumulation we found should be an important consideration for stocking decision and management of Great Lakes tributaries.

## Poster Presentation

### *Bone up: Craniomandibular development and hard-tissue biomineralization in neonate mice*

Elizabeth McGough

College of Science

Anthropology and Biological Sciences

Khari Thompson and Matthew Ravosa, Dept. of Biological Sciences

Advisor: Matthew Ravosa, Dept. of Biological Sciences

Recent work on the mechanobiology of the mammalian skull documents regional variation in cellular activity and load-induced responses underlying bone formation, possibly due to differences in embryological origin, ossification mode and loading patterns. However, little is known about whether intracranial variation in osteogenesis characterizes hard-tissue mineralization in the mammalian skull during perinatal development.

Here, cortical bone from four strains (hHPC, EPCR, Sphk1, S1P1-lox) of 1, 3, 5, 9, and 13-day-old neonate mice was analyzed from six skull sites (calvarial: frontal and parietal; basicranial: basisphenoid and basioccipital; and mandible: lateral and medial; n=5 at each site/age; n=30 per strain total). Site-specific biomineralization from microCT images was quantified in each age and strain. Mean data were analyzed via correlation analysis ( $\alpha=0.10$ ) to assess age-specific variation in tissue mineral density.

Across all four mouse strains, mean biomineralization levels increased significantly with age for 7 of 8 calvarial sites and 6 of 8 mandibular sites. In contrast, basicranial sites showed no significant change in biomineralization as a function of age for any strain. Biomineralization values were lowest in calvarial sites controlling for age, while basicranial and mandibular sites exhibited similar mean tissue mineral density values from days 1-5. By day 13, however, biomineralization levels were lowest in calvarial sites, intermediate in basicranial sites, and greatest in mandibular sites.

These findings implicate the role of forces exerted by the expanding brain, and behavioral shifts to post-weaning feeding activities as factors underlying age-related increases in mineralization of the calvarium and mandible, respectively. Relatively high levels of biomineralization in the developing mandible likewise highlight the growing influence of adult-like masticatory behaviors. The lack of change in basicranial mineralization, which is initially similar to mandibular levels, implies that this uniquely endochondral structure likely experiences an earlier onset of osteogenesis versus intramembranous regions such as the mandible and calvarium.

## Poster Presentation

### *Analysis of Energy Cost Optimization for Hospitals in Sub-Saharan Africa*

Brady McLaughlin  
College of Science  
Physics in Medicine

Advisor: Abigail Mechtenberg, Dept. of Physics

How could a hospital, whose ability to save lives depends on its energy access meet its needs and save lives in the most cost efficient way? It is unfortunately true for hospitals everywhere that the cost of equipment can be a real issue in being able to function as fully as a hospital may need to serve people. However in many areas, there is a more pressing issue that, even if they had the basic equipment they need, could still prevent hospitals from using it. This would be that the hospital does not have access to reliable energy. This project will answer that by analyzing the energy load necessary for a hospital located in Uganda, and more specifically, how it could be best met using a variety of on-site renewable resources, with backup generators, and, how it could be met in the most cost-efficient way possible. This would be addressed using the “Homer Energy” software. This software focuses on cost optimization and allows one to design a power system based on costs of components in the region. It also analyzes the weather and environmental characteristics of the region, so that the most effective renewable resources in that region are used, such as factoring average daily sunlight into how productive solar energy would be. As well, Homer will be forced to consider other, non-traditional types of energy that are not built into the software, and that could be built on site, showing even more cost efficient manners of meeting the power load, as opposed to methods that require bringing materials, such as photovoltaic (PV) cells. The project would also establish a general modality to consider such processes, allowing for the results to be restructured for other given areas or facilities through the same process, in order to better serve the needs of other hospitals or essential services, and the people that would be assisted by those services.

## Poster Presentation

### *Food web structure of a recently restored Indiana wetland*

Amelia McReynolds

College of Science

Biological Sciences

Katherine O'Reilly, Dept. of Biological Sciences

Advisor: Gary Lamberti, Dept. of Biological Sciences

Roxana Marsh is a recently restored wetland located on the historically heavily impacted Grand Calumet River in northwestern Indiana. A \$52 million restoration effort completed in 2012 involved dredging 235,000 cubic yards of contaminated sediment, capping deeper sediments with sand, and planting native vegetation. The objective of this study was to construct a post-restoration food web for Roxana Marsh using stable carbon and nitrogen isotope analysis. Water, algae, aquatic vegetation, macroinvertebrates, and fish were collected in the summers of 2014 and 2015. We found evidence of both native and invasive fish species inhabiting and breeding in the wetland, including the oriental weatherfish (*Misgurnus anguillicaudatus*), a non-native loach not previously recorded in Roxana Marsh. Stable C and N isotope ratios were used to estimate trophic position of each taxonomic group. Elevated  $\delta^{15}\text{N}$  in macrophytes may be related to exposure to wastewater enriched in  $^{15}\text{N}$  from nearby wastewater treatment plants. Enrichment of  $^{13}\text{C}$  and  $^{15}\text{N}$  in all trophic levels relative to comparison systems reflects relatively high concentrations of nitrate, ammonium, and orthophosphate in the wetland. Based on sediment and macrophyte isotope ratios, invertebrate and fish consumers do not utilize macrophytes as a major energy source, but instead rely on benthic resource pathways. Variation in both  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  of fish indicates a mainly generalist assemblage that utilizes resources from a range of habitats and trophic levels. Results of this project will assist in monitoring and management of Roxana Marsh and other riverine coastal wetlands, as well as inform future restoration efforts.

## Poster Presentation

### *Prenatal and Infantile Risk Factors for Obesity*

Lauren Michels

College of Science

Neuroscience and Behavior

Advisor: Kristin Rudenga, Kaneb Center for Teaching and Learning

Chronic obesity is a life-threatening but preventable condition likely moderated by various genetic and environmental risk factors with strong implications on lifetime health and disease development. Evolutionarily-based survival mechanisms for caloric conservation which were adaptive for our early hominin ancestors with limited access to calories are now contributing to obesity in the context of contemporary Western cultures' relative easy access to calories. Recent rises in childhood obesity prevalence, particularly in the United States and similar Western societies, implicate the significant role of early life environmental modulators of early-onset chronic obesity. A critical developmental period exists from prenatal to early infantile years during which access to adequate calories and specific nutritional components is causally indicative of metabolic programming including hypothalamic, hormone, and insulin thresholds and response mechanisms. Specifically, consumption of adequate but not excess calories is vital in permanent hypothalamic-pituitary-gonadal (HPG) axis responses to caloric intake. Prenatal diet, breast milk nutritional content, and early life exposure to a diverse set of nutritious food flavors all have long-term modulating effects on flavor preferences and likelihood of consuming healthy, nutritious options in both childhood and adulthood. Early exposure to diverse and healthy foods increases preferences and tolerance of healthful and nutritious foods which can decrease the dominance of innate evolutionarily-based predispositions for acquiring especially calorie-dense preferences. Finally, early exposure to high levels of artificial sweeteners drives learned resistance to leptin and insulin, causing increased hunger and fat storage leading to long-term obesity and its health implications. By identifying and avoiding prenatal and infantile risk factors for later-life obesity, mothers can promote healthy weight and decrease risk for obesity and its associated complications in children.

## Poster Presentation

### *Testing the Optimization Algorithms for the Shirati Hospital's Microgrid*

Jacob Miller

College of Engineering

Electrical Engineering

Advisor: Abigail Mechtenberg, Dept. of Physics

The Shirati Hospital in Shirati, Tanzania is dependent on a microgrid of diesel generators, photovoltaic cells, and energy storage devices for its energy needs; this combination is unreliable and often does not meet the load needed. More reliable algorithms for the microgrid can be found using HOMER Energy software; however, a method for testing these algorithms is needed. Using standard diodes, 330 ohm resistors, and an input voltage regulated at 5 volts, we can set each load diode to have a power usage of 1 mW. Using 20 diode loads, we can simulate the max power needed by the hospital (12.43 kW) at a scale of 1mW per 0.6215 kW. Using transistors, each load can be turned on and off, allowing us to simulate a more realistic load requirement over the course of an average day. Storage solutions (batteries, capacitors, and hydrogen fuel cells) are placed in parallel with the loads. Transistors are used to control when each receives or delivers power. A generator and a photovoltaic cell are used as energy sources, simulating the same devices on the true microgrid. Once again, each is controlled with a transistor, allowing us to control which delivers power. Every transistor is controlled by Arduino microcontrollers. The methodology the microcontrollers use to determine where power goes and comes from is determined by the optimization algorithms found using HOMER Energy, while the amount of load being used is determined by data from the hospital about how much energy it needs at any given time during the day. Success of any given algorithm will be measured by percentage of time the load required is met.

## Poster Presentation

### *Radiocarbon Dating through AMS*

James Miller  
College of Science  
Mathematics and Physics in Medicine  
William Wolf  
College of Science  
Physics  
Steven Jepeal  
College of Science  
Physics  
Jay LaVerne, Dept. of Physics  
Advisor: Philippe Collon, Dept. of Physics

Initial experiments conducted by our group have proven that the technique of  $^{14}\text{C}$  measurement for radiocarbon dating through accelerator mass spectrometry (AMS) is viable in the Nuclear Science Laboratory using the FN Tandem Accelerator. Subsequent experiments measured the  $^{14}\text{C}$  concentrations of organic material provided by the Department of Biological Sciences, University of Notre Dame, in order to assist in a research project studying the influence of glacial material on ponds in Alaska. Standard material provided by TIRI and FIRI have also been analyzed to validate the measurements. This project consists of obtaining measurements for the  $^{14}\text{C}$  abundance in several samples. The project begins with the preparation of the sample material, transforming samples of organic carbon to cathodes containing graphitized carbon. The cathode preparation consists of two steps, the graphitization of the sample material through a process that has been developed by James Miller, and the construction and filling of the metal cathodes. Once the cathodes have been prepared, the ratio of  $^{14}\text{C}$  to  $^{12}\text{C}$  is measured using the FN accelerator. These measurements are then analyzed, after a date for the sample is calculated using the  $^{14}\text{C}$  concentrations and the Calibration Curve. The talk will present both the details of the upcoming measurements as well as how reliable dates can be determined from the carbon 14 measurements. The long-term goal of the  $^{14}\text{C}$  AMS project is to develop a procedure for the radiocarbon dating of organic material through AMS. This procedure would allow carbon-dating projects to be performed in collaboration with other academic colleges of Notre Dame such as anthropology and biology. These projects would be performed completely by Notre Dame Undergraduates, who would be responsible for performing every step from the collection of sample material to the analysis and interpretation of the results.

## Poster Presentation

### *Analysis of Blastocystis Parasites in Macaca fascicularis*

Sneha Modi

College of Science

Science Preprofessional Studies

Justin Wilcox, Dept. of Biological Sciences

Advisor: Hope Hollocher, Dept. of Biological Sciences

*Blastocystis* is a globally distributed stramenopile parasite that can be an opportunistic pathogen in immunocompromised individuals and has been implicated as a causal agent of irritable bowel disease. The transmission dynamics of this parasite are not well understood, but zoonotic transmission has been proposed to be a major contributor to human *Blastocystis* infections; therefore, studies on *Blastocystis* transmission in wild animals are essential for determining potential sources of *Blastocystis* infection. Our research explores the factors affecting *Blastocystis* population structure and transmission in *Macaca fascicularis*, the long-tailed macaque, which may act as an important reservoir for *Blastocystis* due to its close interface with humans. Specifically, we investigate the influence of environmental and anthropogenic variables on the genetic structure and prevalence of *Blastocystis* in long-tailed macaques in Bali. We hypothesized that an increase in anthropogenic food sources would lead to an increase in parasite prevalence and genetic diversity. Prevalence was strongly related to anthropogenic factors such as urbanization and macaque population size, which is primarily determined by the level of human provisioning. Macaque population size was the also overall best predictor of *Blastocystis* allele richness at each site. It has been suggested that different lineages of *Blastocystis*, termed subtypes, display variation in zoonotic potential and ecological behavior, as such, we analyzed two subtypes, subtype 1 and subtype 3, separately. Our findings support this hypothesis by demonstrating that the allele richness and prevalence of these subtypes were influenced by differing environmental variables. Host genetic structure and physical distance are traditional predictors of parasite genetic structure, but neither significantly predicted genetic distances between *Blastocystis* populations. Taken together, our results suggest a particularly important role for anthropogenic factors in *Blastocystis* transmission and imply that human provisioning may increase zoonotic disease risk.

## Poster Presentation

### *Cover Crops Improve Soil Health in the Shatto Ditch Watershed, Kosciusko Co, IN*

Joseph Mueller  
College of Science  
Biological Sciences

Erik Maag  
College of Science and College of Arts & Letters  
Environmental Sciences and German

Jennifer Tank, Ursula Mahl, Sheila Christopher-Gokkaya, Dept. of Biological Sciences  
Advisor: Sheila Christopher-Gokkaya, Dept. of Biological Sciences

In Indiana and Midwestern agricultural systems, tile drainage is a necessary management tool that permits production of crops through drainage of excess water on fields. However, this practice facilitates runoff of excess fertilizer nutrients like nitrogen (N) and phosphorus (P) into adjacent streams, which subsequently enters associated downstream water bodies. This in turn results in environmental repercussions, including loss of biodiversity, contaminated drinking water, and algal blooms with hypoxic “dead zones”, such as in the Gulf of Mexico and Lake Erie. Planting cover crops during agricultural fallow periods after cash crop harvest in the fall offers a potential mechanism to reduce nutrient leaching from agricultural fields to surface waters. We are studying the effects of cover crops on soil health (e.g., nutrient and organic matter content) and cover crop nutrient uptake within agricultural fields in the Shatto Ditch Watershed, IN. Preliminary results suggest during fall (2013 and 2014) and spring (2014 and 2015), when cover crops were growing on fields, soil  $\text{NO}_3^-$ , N, and water extractable phosphorus were lower in cover crop fields compared to those without (ANOVA,  $p < 0.0001$ ) while there was no change in soil organic matter content. We predict that in the long term (>2 years), organic matter content will increase in field with cover crops. We also predict that nitrogen uptake in above and below ground cover crop biomass will account for the reduction in soil nutrient in cover crop fields and these nutrients will be available for cash crop growth when cover crops are terminated in late spring. Given these results, year-round study of soil and cover crop nutrient interactions is warranted in order to definitively link soil and water quality benefits of cover crops.

## Poster Presentation

### *Does reduced EMAP II result in aberrant development of vasculature?*

Christina Murphy  
College of Arts & Letters  
Neuroscience and Behavior

Advisor: Margaret Schwarz, Indiana University School of Medicine - South Bend  
and Dept. of Chemistry and Biochemistry

Coronary heart disease, including acute myocardial infarction, remains the leading cause of death in the United States in adults (Center for Disease Control). During development, Endothelial-Monocyte Activating Polypeptide II (EMAP II) has ubiquitous expression but context-dependent function across epithelial tissue. It is strongly implicated as a negative regulator of neovascularization in embryonic lung morphogenesis (Schwarz et al., 2000). EMAP II is an anti-angiogenic protein that displays an organized increase in local expression following myocardial infarction (MI), which suggests a functional role for this protein in the process of revascularization following MI (Schwarz et al., 2004). Therefore, we predict that EMAP II knockdown models will develop aberrant vasculature. This study of EMAP II involvement in vascularization is meant to inquire into the mechanism by which EMAP II regulates vascularization. The magnitude and duration of post-infarct inflammatory response is largely responsible for left ventricular remodeling. Conversion of fibroblasts into myofibroblasts occurs with mediation in microenvironment after MI. Repressing heightened early inflammatory response has shown experimental success in decreasing infarct size, but so far has not been clinically translated to an approach in decreasing infarct size in humans (Frangiannis). Neutralization of EMAP II protects against chronic, MI-induced fibrosis and left ventricular function is rescued. This is in part due to EMAP II's effect of reducing revascularization in noninflammatory repair processes (Schwarz et al., 2004). With an EMAP II-transgenic hemizygous murine model, the role of EMAP II in remodeling will be studied. First, we verified not only an absence of allelic compensation but also reduction in EMAP II protein expression. Expecting reduced recruitment of macrophages, we will examine remodeling and fibrosis in EMAP II knockdown mice using Masson's Trichrome staining. We plan to characterize subtypes of resident cardiac macrophages with immunohistochemistry for normal markers such as CD-14. We will also look for markers, such as IL-6, that indicate recruitment after an ischemic infarct.

## Poster Presentation

### *Identifying the function of transcription factor WhiB6 in the Esx-1 secretion system of Mycobacterium marinum*

Tiffany Nguyen

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Neuroscience and Behavior

Rachel Schluttenhofer

College of Science

Biological Sciences

Advisor: Patricia Champion, Dept. of Biological Sciences

Tuberculosis is a human disease primarily caused by *Mycobacterium tuberculosis*. To combat this pathogen, it is important to understand the mechanisms of mycobacterial pathogenesis. The export of proteins by the Esx-1 secretion system is required for virulence. This system is functionally conserved in the mycobacterial model system *Mycobacterium marinum*. The protein WhiB6 has been identified to code for a putative transcription factor that regulates the Esx-1 secretion system of *M. tb*. Previous studies have concluded that mutations in the promoter region of *whiB6* downregulate the expression of Esx-1 genes downstream. To determine whether the function of WhiB6 as a transcriptional regulator is conserved in *M. marinum*, we created a *whiB6* knockout strain. Functional assays for Esx-1 showed intermediate phenotypes compared to both wild-type and Esx-1 deficient strains. Future directions will focus on determining how WhiB6 regulates other Esx-1 genes by looking at their expression through Reverse Transcriptase PCR. Elucidating the function of WhiB6 in *M. marinum* will further characterize the homology between *M. tuberculosis* and *M. marinum*.

## Oral Presentation

### *Using computer simulations to understanding microtubule treadmilling in relation to dynamic instability*

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Biochemistry

Jared Scripture and Erin Jonasson, Dept. of Chemistry and Biochemistry  
Chunlei Li, Shant Mahserejian, and Ava Mauro, Dept. of Applied and Computational Math. and Statistics  
Advisors: Holly V. Goodson, Dept. of Chemistry and Biochemistry, and  
Mark Alber, Dept. of Applied and Computational Mathematics and Statistics

The microtubule (MT) and actin cytoskeletons are responsible for the maintenance of cell shape, internal organization and cell motility. Both MT and actin polymers utilize the energy from nucleotide hydrolysis to exhibit dynamic polymerization behaviors and accomplish their specific cellular tasks, including chromosome segregation by MTs and cell motility by actin. Dynamic instability (DI), the principal MT behavior, uses random transitions between growth and shrinkage to explore cellular space. Treadmilling, a characteristic behavior of actin, allows filaments to translocate through the cell by means of net polymerization at one end and net depolymerization at the other. Interestingly, plant MTs have been seen *in vivo* to simultaneously undergo DI and treadmill. To better understand the principles of these two characteristic steady-state polymer behaviors, we used a simplified stochastic simulation of dynamic microtubules with two free ends and investigated the relationship between the amount of tubulin subunits in the system, the behaviors of individual filaments (dynamic instability and treadmilling) and the steady-state amount of polymer. We tuned the input kinetic parameters so that the simulated MTs replicated the *in vivo* DI and treadmilling behavior of the plant MTs, then used the simulation to explore over what tubulin concentration range the behavior of treadmilling would occur. The textbook definition of treadmilling states that treadmilling will occur when tubulin concentration is above the critical concentration required for elongation at the plus-end and below the critical concentration required for elongation at the minus-end. Our simulations show that MTs will only treadmill when the concentration of tubulin is high enough that plus-end escapes classic DI and becomes biased to grow, but low enough that the minus-end undergoes net shortening. Thus, steady-state polymers that undergo simultaneous treadmilling and DI require a new definition of treadmilling based on growth biases rather than elongation.

## Poster Presentation

### *Investigating the effects of carbon dioxide level on the growth of the modern and old genotypes of Schoenoplectus americanus*

Jeffrey Nosek  
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Neuroscience and Behavior  
Kyle Sommerfield  
College of Science  
Science Business  
Allison Hendershot, Dept. of Biological Sciences  
Advisor: Kristin Lewis, Dept. of Biological Sciences

Plant life is vital to sustaining life on Earth, and the evolutionary responses of plants to changing environmental conditions are crucial to support life. As carbon dioxide levels continue to rise, it is possible that plants have evolved to regulate their carbon dioxide intake and thus their resulting growth. In this study, old genotypes of *Schoenoplectus americanus* propagated from soil core seeds and modern genotypes of *S. americanus*, were grown in lowered and ambient carbon dioxide levels to test for possible evolutionary responses to carbon dioxide concentration. Old and modern plants were randomly assigned to a tented greenhouse growth chamber with ambient carbon dioxide conditions or a chamber with soda lime added to reduce carbon dioxide levels. The old plants produced more dry biomass than the modern plants in both ambient and lowered carbon dioxide conditions. Old *S. americanus* produced more stems per pot, but modern *S. americanus* had longer stems. This implies that the larger biomass of old plants came from the increased number of stems they produced. Carbon dioxide levels did not have a significant effect on growth. These findings suggest that *S. americanus* may have modified its pattern of growth to better suit their surroundings and outcompete nearby plants. By reducing stem number and increasing vertical growth, modern *S. americanus* plants may be competing for sunlight, and attempting to centralize and cluster their stems, decreasing the amount of above-ground area needed for growth. These results demonstrate that morphological differences exist between old and modern forms of *S. americanus*, and future studies may look at mechanisms by which *S. americanus* has adjusted its growth, such as stoma size or below-ground changes in root structure.

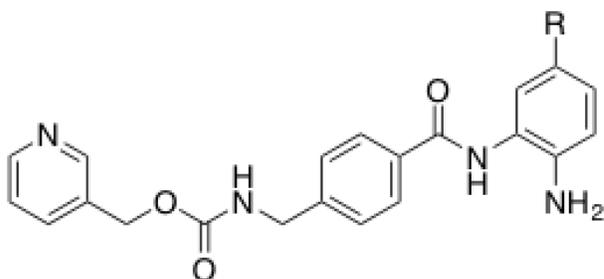
## Poster Presentation

### *Synthesis of Histone Deacetylase Inhibitors*

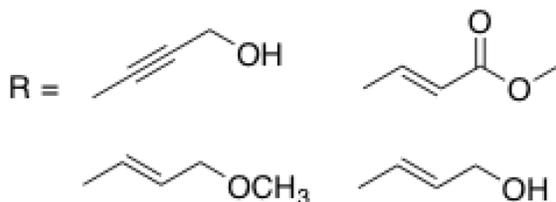
Matthew O'Neill  
College of Science  
Biochemistry

Advisors: Olaf Wiest and Paul Helquist, Dept. of Chemistry and Biochemistry

Histone deacetylase (HDAC) inhibitors have recently demonstrated utility as therapeutics in a large number of diseases, as evidenced by the FDA approval of 4 drugs of this class. HDACs function by affecting the epigenetic modifications of DNA, a process that provides a mechanistic foundation for certain disease pathogenesis. To further examine the utility of HDAC inhibitors as treatments for cancer and other rare diseases, the synthesis of new HDACs with improved isoform selectivity and pharmacological properties is being pursued. These molecules were chosen for synthesis because of their improved ability to interact with the HDAC, as revealed by computational modeling. The synthesis of these HDAC inhibitors utilizes a variety of organic transformations. A modular synthesis is being pursued to allow for rapid diversification. An amide bond formation disconnects the core scaffold, with subsequent elaboration via powerful Suzuki and Sonogashira couplings.



Improved Isoform Selectivity  
Better Pharmacological Properties



Previously prepared Merck  
candidates

## Poster Presentation

### *Synthesis of Phosphonate-Clip Derivatives for Mechanistic Insights on Hydrogen Abstraction from Hydrazobenzene*

Matthew Onders  
College of Science  
Biochemistry

Advisor: Seth Brown, Dept. of Chemistry and Biochemistry

Research in the Brown group has shown that Pd(Clip) is capable of abstracting the two hydrogen atoms in hydrazobenzene to form azobenzene; however, the mechanism of this reaction remains uncertain. Synthesis of a phosphonate-clip derivative will create an analogue of the ligand with diastereotopic hydrogens. Monitoring of the reaction of this new ligand via NMR can then increase the understanding of the hydrogenation. This knowledge could have importance in selecting catalysts for oxidation reactions. Furthermore, the addition of phosphonate groups should contribute to good water solubility for the metal complex, increasing its potential applications. This will allow for additional methods of analysis including the creation of a Pourbaix diagram, a plot of voltage potential versus pH. Current progress in the synthesis of this ligand will be discussed.

## Poster Presentation

### *Analyzing the effects of low concentrations of mutagen over time*

Joseph Ong  
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Chemistry

Advisor: Holly Goodson, Dept. of Chemistry and Biochemistry

The rise in the production of novel chemicals has resulted in a need to reliably determine the carcinogenic and mutagenic potential of compounds. The Ames test, a common test for mutagenicity, is inexpensive and easy to perform but uses a high concentration of mutagen and a low exposure time, parameters that generally do not correspond with expected human exposure. We hypothesize that yeast grown in a series of parallel continuous cultures can serve as the basis for an improved test for mutagenicity. Yeast grown in continuous culture systems have greater sensitivity because the effects of low levels of mutagen can be seen over a long period of time. Our current results with a plate-based assay indicated our method can detect mutagens at concentrations at least 20x lower than the Ames test. We looked to improve upon these results via whole genome sequencing. Whole genome sequencing is a technique that allows for a sensitive and comprehensive look at the genome and how it changes with respect to time and mutagen. Yeast (strain DBY10148) were grown in four concentrations of MMS, an alkylating agent, for a period of 4 weeks. To assess the mutagenic potential of the MMS, whole genome sequencing was performed on both individual colonies and whole populations from both the seed culture and from each level of mutagen after 9 days of growth in continuous culture. Reads were mapped against the S288C reference genome with BWA, processed with SAMtools, and somatic variants were called with VarScan. Somatic variant calling in VarScan outputs variants between our seed culture (“normal tissue”) and our mutagenized strains (“tumor tissue”). This method allows for identification of variants unique to our experimental conditions and not due to the inherent differences between lab and reference strains. Interestingly, our results demonstrate stable aneuploidy within the DBY10148 strain.

## Poster Presentation

### *The Effect of Aging on Ovarian Cancer Metastasis*

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College of Science

Anthropology and Science Preprofessional Studies

Elizabeth Loughran

College of Science

Biochemistry

Annemarie Leonard

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Marwa Asem, Dept. of Chemistry and Biochemistry

Matthew Ravosa, Dept. of Biological Sciences

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Laura Tarwater, Harper Cancer Research Institute

Yuliya Klymenko, Dept. of Biological Sciences

Jeffrey Johnson and Zonggao Shi, Dept. of Chemistry and Biochemistry

Matthew Leevy, Dept. of Biological Sciences

Advisor: Sharon Stack, Harper Cancer Research Institute and Dept. of Chemistry and Biochemistry

Epithelial ovarian cancer (OvCa) is the most common subtype of ovarian cancer. OvCa often goes undetected until metastatic stages of the disease, contributing to the high mortality rate of OvCa patients. OvCa exhibits a unique form of metastasis initiated by the shedding of tumor cells or multicellular aggregates from the primary tumor into the peritoneal cavity. The peritoneum is a serous membrane that lines the abdominal cavity, consisting of a single layer of mesothelial cells supported by a collagen-rich extracellular matrix (ECM). It has been observed that aging increases ovarian cancer risk in women, but no studies have investigated the effect on OvCa metastasis. To test the hypothesis that age increases the metastatic success of OvCa, a study was designed using young (3-6 months) and aged (20-23 months) C57BL/6 mice. Young and aged cohorts of mice were intraperitoneally injected with RFP-tagged ID8 cells, a mouse ovarian cancer cell line syngeneic to C57BL/6. Live imaging was performed at 4, 5, 6, and 7 weeks post injection. At 8 weeks post injection, mice were sacrificed and abdominal organs were imaged. Using ImageJ, tumor burden analysis was carried by measuring both the tumor area and the intensity of the RFP-tagged tumor. While no significant difference in metastasis to the omentum was observed, the aged animals showed a significant increase in tumor burden in the gonadal fat depots. Future studies will investigate factors that may be responsible for this increase.

## Oral Presentation

### *The calcium and glutamate effect on Pseudomonas aeruginosa motility*

Sarah Philo

College of Science

Biological Sciences

Advisor: Joshua ShROUT, Depts. of Biological Sciences, and Civil Engineering  
and Geological Sciences

The bacterium *Pseudomonas aeruginosa* is ubiquitous in the environment but also an opportunistic pathogen that causes infections in immune compromised individuals. *P. aeruginosa* infections in the lungs of Cystic Fibrosis (CF) patients are chronic and difficult to treat because they produce a dense biofilm that renders many antibiotic regimens unsuccessful. While these infections are well known, little is understood about the environmental cues for *P. aeruginosa* behavior during the transition from the environment to human host. Because biofilm infections are difficult to treat with antibiotics, understanding this transition may allow for improved treatment. It has been shown that calcium affects bacterial attachment, the structure of biofilms, and secretion of virulence factors, but the effects of calcium on *P. aeruginosa* motility have not been investigated previously. Increases in calcium concentrations were found to decrease swarming motility in a clinical CF isolate of *P. aeruginosa*. While swarming requires flagellar motility, appendages called type IV pili have recently been shown to influence flagellar mediated swarming. Collective results from these experiments suggest that calcium affects both flagellar and type IV pili function during swarming. Additionally, the carbon source used in motility assays was shown to have an effect on the motility phenotype. When glutamate was used concurrently with increased calcium levels, swarm assays showed a distinct ring formation around the point of inoculation. These results suggest there is an interaction between carbon and calcium that affects bacterial motility. In order to understand how these and other environmental constraints affect *P. aeruginosa* motility, future experiments aim to generate a strain that can only exhibit type IV pili motility by knocking out key flagellar and quorum sensing genes. Twitch assays will be carried out on this mutant strain to characterize how calcium and carbon affect type IV pili motility. Further determination of the specific mechanism by which calcium influences flagellar and type IV pili function may provide amenable targets for therapeutic intervention to prevent and treat *P. aeruginosa* biofilm development and infection.

## Poster Presentation

### *Identifying mosquito attractants using olfactory receptors as detectors*

Thomas Plagge  
College of Science

Neuroscience and Behavior

Advisor: Zainulabeuddin Syed, Dept. of Biological Sciences

Mosquitoes transmit various life threatening diseases while feeding on vertebrates. Historically some of the most successful campaigns against vector-borne diseases have been those targeted against the vectors. Mosquitoes rely heavily on their sense of smell to locate suitable hosts, habitats, oviposition sites and conspecifics. A distinct and limited range of volatiles from these sources are parsimoniously used in various contexts eliciting strong olfactory-driven behaviors. Volatile chemicals are detected and discriminated by olfactory receptors (ORs), a large and divergent family of proteins. A comparison of mosquito OR families among three important mosquito vectors – *Anopheles gambiae*, *Aedes aegypti*, and *Culex quinquefasciatus* – revealed interspecific divergence and species-specific expansions. We aimed to understand the significance of such variations in the olfactory genome in the context of their adaptation to unique niches. We built an extensive library of extracts derived from various sources such as plants for sugar feeding, mates, and oviposition sites. In addition, we collected host-derived odors from multiple sources. Active constituents from this wide range of extracts were isolated by using gas chromatography linked single sensillum recordings (GC-SSR) method wherein ORs from mosquitoes were heterologously expressed in a fly system and served as biological detectors. These constituents were chemically identified by GC linked mass spectrometry (GC-MS). Four novel ligands from preferred mosquito oviposition sites were identified as phenols, using a set of Culicinae specific ORs. Further analysis revealed a high degree of selectivity in ORs for several chemical isomers. The powerful approach of employing ORs as sensing tools to isolate and identify novel natural ligands not only provides a new understanding of how evolutionary forces shape ligand-receptor interactions, but also can lead to the exploitation of ligands as baits in odor baited traps (OBTs) that target mosquito vectors.

## Poster Presentation

### *Betwixt and Between: Intracranial Perspective on Zygomatic Arch Plasticity and Function in Mammals*

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Psychology

Kevin McAbee, Dept. of Biological Sciences

Erin Franks

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Jeremiah Scott, Dept. of Anthropology, Southern Illinois University

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Joseph Scollan and Meghan Eastman, Dept. of Biological Sciences

Advisor: Matthew Ravosa, Dept. of Biological Sciences

The zygomatic arch is a morphologically complex skeletal structure, providing a key interface between the face and braincase. It also serves as an attachment site for muscles of mastication, linking it to the feeding apparatus. Though morphological variation related to differential loading is well known for many craniomandibular elements, the adaptive osteogenic response of the zygomatic arch remains to be investigated. Here, experimental data are presented that address the influence of masticatory loading on the postweaning development of the zygomatic arch and other cranial elements. Given the similarity of bone strain levels among the zygomatic arch and maxillomandibular elements, a rabbit and pig model were used to test the hypothesis that variation in cortical bone formation along the zygomatic arch and feeding structures is linked to increased masticatory stresses. It was also hypothesized that neurocranial structures would be minimally affected by varying loads. Thirty New Zealand white rabbits and four Hanford strain minipigs were raised for 48 weeks and 8 weeks, respectively, on diets of differing mechanical properties. In the rabbits, cortical bone thicknesses were measured at four time points throughout the experimental period, whereas thicknesses were measured at two time points in the pigs. In both models, CT analyses indicated that elevated masticatory loading did not induce differences in cortical-bone formation along the zygomatic arch, though hypotheses were supported for maxillomandibular and neurocranial elements. Lack of an osteogenic response suggests that variation in skeletal performance may reside at another level of bony architecture, such as biomineralization or mechanical properties. Alternatively, it is possible that phenotypic diversity in the zygomatic arch is due more singularly to natural selection (vs. plasticity). This has implications for fossil hominids and other mammals characterized by robust arches. Moreover, our findings underscore the complexity of the zygomatic arch and, more generally, determinants of skull form.

## Oral Presentation

### *A Result on Ideals of Parametrizations of Plane Sextics*

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Mathematics

Advisor: Claudia Polini, Dept. of Mathematics

A technique that has been studied in great detail since the 70s has been the theory of linkage. Linkage, or liaison, is a method for classifying projective varieties that goes back to Severi, Cayley and M. Noether. Due to work of Peskine and Szpiro it has become an important tool in commutative algebra and algebraic geometry. Two curves in projective space are linked if their union is the intersection of two surfaces. At the core of the theory is the desire to understand an ideal by linking to another one with the hope that their residual is simpler to work with. Often times, linkage can hint at deeper geometric properties that would not otherwise be evident of two geometric objects. In this talk, we prove that the set of balanced Hilbert Burch matrices as defined in “A Study of Singularities on Rational Curves via Syzygies” by Cox, Kustin, Ulrich, and Polini that define parametrizations of plane curves have self-linked ideals and that this is not possible for unbalanced Hilbert Burch matrices.

## Poster Presentation

### *Demographics of Sand Fly Vector in Dry Season Sri Lanka*

Santiago Rolon  
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Biological Sciences and Latin

Advisor: Mary Ann McDowell, Dept. of Biological Sciences

Kinetoplastid protozoa *Leishmania donovani*, responsible for 50,000 deaths and over 2 million annual incidences, is spread by the sand fly vector *Phlebotomus argentipes* in Sri Lanka. Recent conclusion of a 30 year civil war in Sri Lanka led to the return of war refugees from the Indian subcontinent. This migratory wave may increase the prevalence of *L. donovani* in a country where leishmaniasis has already been declared as endemic. The present study structures a vector demographics based on stratified sampling of the sand fly population in Sri Lanka and looks for variance based on location, time of collection, climate and environmental conditions, and type of collection.

Samples were collected from 8 different loci across Sri Lanka for a period of 3 weeks using CDC light and cattle-baited traps. Collections were separated by gender, location, and collection method. Sand fly genus was identified morphologically by observing cibarium, male style spines, and wing lengths. Sand fly species and probable subspecies were identified by female dissection of head, spermatheca, and antennal flagellomeres.

A total of 599 samples were collected; *Phlebotomus* genus samples (n=592) were found across Sri Lanka and *Sergentomyia* genus (n=7) was found only in Pannala (northwest) and in Mmadala (south). The largest sand fly populations were found in the south and central regions of the country (n=168, n=153), which coincided with the largest amount of blood-fed females per collection (n=19) and an increase in the female: male ratio (88:90 compared to reported 1:20). All *Phlebotomus* samples resembled *P. argentipes* subspecies A, even in north VVaddukoddai, where subspecies B collection was expected. Reported subspecies B near VVaddukoddai suggests a small vector influx from south India and its prevalence only in the Indian subcontinent. Higher vector yields in south and central regions as well as more household individuals with Leishmaniasis could be explained by greater amounts of humidity, lower temperatures, greater vegetation and greater number of house animals. This study shows a demographic overview of a sand fly population predominated by subspecies A in Sri Lanka.

## Poster Presentation

### *iLocator: A Radial Velocity Doppler Spectrometer*

Elliott Runburg  
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Mathematics and Physics  
Advisor: Justin Crepp, Dept. of Physics

The iLocator instrument is a Doppler radial velocity spectrometer that is diffraction-limited, and works at near-infrared wavelengths. A single-mode, fiber-fed spectrograph that will achieve incredible precision, iLocator will be installed at the Large Binocular Telescope in Arizona, where it can be used on a wide variety of projects to look for Earth-like exoplanets. iLocator's software needs to handle a large amount of data, collected from both the instrument and the Large Binocular Telescope, and it needs to be able to present the data in a clean and efficient manner. In this poster, we present iLocator's control software architecture, which will be implemented using the Instrument Neutral Distributed Interface (INDI). INDI is a communications framework that controls the flow of messages between the individual drivers and the user interface. INDI works by declaring properties in which information and data values are stored, and these are communicated via XML messages to other components and the user interface. Using C++ and Python, we can create drivers to control the instrument that follow the INDI protocol, streamlining our back-end system and all communications. iLocator's software will be intertwined with the Large Binocular Telescope's implementation of INDI, and it will be run on Linux machines running CentOS 7, controlled through a web interface.

## Poster Presentation

### *Diet differentiation in two Alaskan migratory bird species: implications for their response to climate change on the Copper River Delta*

Melanie Runkle  
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Biological Sciences

Carmella Vizza, Dominic Chaloner, Michael Brueseke and Gary Lamberti, Dept. of Biological Sciences  
Advisor: Gary Lamberti, Dept. of Biological Sciences

The rusty blackbird (*Euphagus carolinus*) and dusky Canada goose (*Branta canadensis occidentalis*) are two species of concern that breed on the Copper River Delta (CRD) of southcentral Alaska. Both species feed upon arriving to the CRD in late April, but may obtain the nutrients needed to produce eggs from different sources. We hypothesized that blackbirds gain these nutrients from insects consumed after arriving on the CRD, while the geese accumulate these nutrients from vegetation present on wintering grounds, along migration routes, and on the CRD. To determine the food items that compose each species' diet, we measured the carbon and nitrogen stable isotope ratios of the birds' eggshell membranes along with CRD vegetation, aquatic invertebrates, and fish. We then used *IsoSource*, a mixing model program, to estimate dietary contributions for each bird species. Lastly, we compared the variation in stable isotope ratios of blackbirds and geese to determine how diet varied within each species. Our results suggest that blackbirds are specialist insectivores, feeding mostly on dragonfly larvae, while geese are generalists, feeding on several vegetation types. In addition, the blackbirds' diets are less variable than those of the geese, which may reflect the species' different breeding strategies; geese may be capital breeders that consume food from different sites along their migration path, while blackbirds may be income breeders that feed extensively once they arrive on their breeding grounds. As the CRD faces warmer temperatures, there may be an increase in aquatic insect production; however, their emergence may shift earlier in the season. Moreover, the CRD blackbird population, the only one currently thriving for that species, could be drastically affected by shifting resource availability. Since the geese have more variation in their diet, which is less vulnerable to timing, climate change is less likely to affect their population.

## Oral Presentation

### *Mechanics of Bone Cutting and Application to a New Type of Distal Reamer*

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Physics in Medicine

Advisors: Philippe Collon, Dept. of Physics  
and Steven Schmid, Dept. of Aerospace and Mechanical Engineering

Cutting of bone is commonly performed during orthopedic surgical operations. Surgeons commonly utilize bone cutting when preparing a site for prosthesis implantation or for the setting of a fracture. To form or enlarge a high precision hole, orthopedic surgeons must ream a pre-existing cavity in bone before insertion of the necessary tool. When non-cylindrical prostheses will be used, broaches are used to further cut and shape the cavity to the desired form. As such, reamers and broaches are used widely in orthopedic operating rooms. However, these devices are expensive, and for this reason they are used for multiple surgeries. Cleaning, refurbishing and sterilizing these tools and then repackaging and delivering them to the operating room, is a complicated and unreliable process. A disposable tool would eliminate these hazards, but to be economically feasible, the cost of the tools would need to be greatly reduced. To form these tools more cheaply, hydroforming can be used to shape tubular metal blanks close to the desired shape. Rubber bulging then applies a large internal pressure to these shaped blanks, which then bursts into a die with the desired reamer design. This allows rapid and inexpensive formation of reamers. This approach has been experimentally verified at Notre Dame, and finite element based tools have been developed to computationally predict which cutting edge geometry will allow for most efficient bone cutting. Results from these computational models can then be implemented in die design to provide optimum tool performance.

## Poster Presentation

### *Examining Mitochondrial Haplotype Diversity in Ancient and Modern Indigenous Caribbean Populations*

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Anthropology and Science Preprofessional Studies  
Jada Benn Torres, Dept. of Anthropology  
Advisor: Jada Benn Torres, Dept. of Anthropology

During the colonial era in the Caribbean, Africans, Europeans, and Asians each left their mark upon the region's diverse biocultural milieu. However, indigenous heritages of the Caribbean islands are also important legacies that should be emphasized. This study compares published data of Native American haplotype diversity in the mitochondrial HV-I region from ancient and modern Caribbean individuals in order to examine the relationship between past and current indigenous populations.

Regions represented in the ancient sample include Cuba, the Dominican Republic, and the Guadeloupe Islands. The modern sample was comprised of individuals from Cuba, Puerto Rico, Dominica, Trinidad, St. Vincent, the Dominican Republic, and Jamaica. We calculated summary statistics and produced a distance matrix via multi-dimensional scaling in order to explore the affinities between the study populations. An analysis of population differentiation revealed significant differences between the pooled ancient and pooled modern Caribbean samples. However, there was not a significant difference between the modern and ancient Lesser Antillean populations. Our results also indicate an overall increase in haplotype diversity between ancient times and the present. Migration from circum-Caribbean regions may account for this difference in diversity, or possibly that the ancient samples lack the regional representation captured in the modern samples. Our results highlight regional differences in variation between the Greater and Lesser Antilles. These findings support the idea that the genetic diversity present in pre-Columbian Caribbean was disrupted with European colonization and is a testament to the significant biological and social change that occurred in indigenous Caribbean populations.

This work was generously supported by the Institute for Scholarship and Learning in the College of Arts and Letters at the University of Notre Dame.

## Oral and Poster Presentation

### *Analyzing Code for the CMS Upgrade*

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College of Science  
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Within the next decade, the Large Hadron Collider (LHC) will be upgraded to the High Luminosity LHC (HL-LHC). The upgrades will increase the number of particles in the accelerator in order to produce more collisions. The Compact Muon Solenoid (CMS) will require an enhanced trigger system to manage all of these interactions and determine which events to save. Primarily, we are trying to apply the tracking detector algorithms to the Level 1 Trigger. Our project relied on event simulations using an FPGA Emulation code developed by a team of physicists. The first half of this research involved evaluating the effectiveness of the algorithm to correctly identify particle tracks, provided samples with or without pileup. The other studies search for answers to a series of questions about the geometry of the detector and which seeding options were best at reconstructing the full tracks of particles after collisions. Much of this resulted from studying resolution of four track parameters and efficiency after restricting  $\eta$ .

## Poster Presentation

### *Characterizing the role of DEDD on cell cycle regulation in Triple-Negative Breast Cancer*

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Sindy Ni, Dept. of Biological Sciences  
Advisor: Siyuan Zhang, Dept. of Biological Sciences

Death Effector Domain-Containing DNA-binding protein (DEDD) has been studied primarily for its role as a scaffold protein in regulating cell death pathways. Interestingly, the Cancer Genome Atlas identified gene amplification of DEDD in 78% of triple-negative breast cancer (TNBC) patients. The TNBC subtype is associated with resistance to anti-proliferative targeted therapies and poor patient prognosis. However, the effect of significant DEDD gene amplification in TNBC has not yet been explicated. Preliminary data strongly suggests that DEDD expression is inversely correlated to Retinoblastoma (Rb) protein expression. Rb is a cell cycle regulatory protein, which inhibits G1- to S-phase transition. We hypothesize that overexpressed DEDD assumes a pro-proliferative function through cell cycle regulation in TNBC cells. Characterizing overexpressed DEDD as a negative regulator of Rb and a promoter of cell cycle acceleration in TNBC would indicate a contradistinctive role of DEDD. Elucidating the underlying mechanism of DEDD regulation on the cell cycle in proliferative states could provide a general model for dichotomous functions of death-effector domain-containing proteins. Complementary results from gain- and loss-of-function experiments will suggest that overexpressed DEDD significantly contributes to the drug resistance phenotype of TNBC. Thus, DEDD overexpression holds potential to serve as a clinical biomarker for malignancy and anti-proliferative drug resistance in TNBC. Understanding this mechanism could ultimately provide physicians a predictive model for TNBC patient responses to anti-proliferative drug therapy.

## Poster Presentation

### *Expression of the irx2a gene and its role in pronephros segment specification*

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Advisor: Rebecca Wingert, Dept. of Biological Sciences

In order to advance kidney regenerative medicine in response to demand from kidney disease, it is necessary to identify genes responsible for differentiating renal progenitors into the various cell types that comprise nephrons—the organ’s functional excretory units. Due to anatomically simplistic kidneys and rapid development, *Danio rerio* (zebrafish) is a good model system for investigating genetic control of kidney segmentation. Certain genes in the Iroquois gene family, which encode several evolutionarily conserved transcription factors, are involved in patterning the intermediate tubule of the nephron, including *Iroquois homeobox 2a* (*irx2a*). To elucidate the role of *irx2a* in the specification of nephron segments in the embryonic zebrafish kidney, its spatiotemporal expression pattern in renal progenitors was assessed using whole mount *in situ* hybridization (WISH). Double WISH was conducted on wild-type zebrafish embryos at multiple timepoints using riboprobes to delineate cells expressing *irx2a* transcripts, alongside riboprobes that detected either *myoD* or *smyhc1* in the adjacent mesoderm. *irx2a* transcripts were localized to the proximal straight tubule and distal early segment during nephrogenesis. To determine the relationship between *irx2a* and retinoic acid (RA), a signaling factor that determines transcription factor domains within the pronephros, wild-type embryos were treated with either exogenous RA or RA inhibitor diethylaminobenzaldehyde (DEAB). Upon experiment completion, it is expected that WISH of RA-treated embryos will distalize the *irx2a* expression domain that corresponds to the DE segment, and the expression domain in DEAB-treated embryos will become more proximal and expanded in the DE segment. Next, *irx2a* overexpression will be performed to determine if *irx2a* is capable of dictating tubule cell fate. Additionally, knockdowns of *irx2a* alone and in conjunction with *irx3b* will be conducted to determine if *irx2a* function is necessary for segmentation. Overall, this study will inform our understanding of mammalian kidney development, moving closer to renal therapies for disease.

## Oral Presentation

### *Developing a Novel Immunotoxin that Targets Cells Overexpressing ErbB2*

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Advisors: Shaun Lee and Zachary Schafer, Dept. of Biological Sciences

Immunotoxins are chimeric proteins comprising a specific cellular targeting domain linked to a cytotoxic factor. Here we describe the design and use of a novel, peptide-based immunotoxin that can initiate selective cytotoxicity on ErbB2-positive cells. ErbB2 is a receptor tyrosine kinase that is overexpressed in the tumor cells of approximately 30% of breast cancer patients. Immunotoxin candidates were designed to incorporate a targeting ligand with affinity for ErbB2 along with a membrane lysin-based toxin domain. The use of a membrane lysin as the toxin domain distinguishes our immunotoxins from numerous others in that internalization of the toxin is not required to induce cell death. One particular peptide candidate, NL1.1-PSA, demonstrated selective cytotoxicity towards ErbB2-overexpressing cell lines. We utilized a bioengineering strategy to show that recombinant NL1.1-PSA immunotoxin expression by *Escherichia coli* also conferred selective cytotoxicity towards ErbB2-overexpressing cells. Our findings hold significant promise for the use of effective immunotoxins in cancer therapeutics. While Herceptin treatment has been effective in patients with ErbB2 positive breast cancer, our novel immunotoxin may ultimately prove to be a novel and efficacious addition to the arsenal of approaches used to eliminate Herceptin-resistant breast cancer cells.

## Oral and Poster Presentation

### *Effect of Pileup for the CMS Track Trigger Update*

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Advisors: Michael Hildreth and Kevin Lannon, Dept. of Physics

Located in Geneva, Switzerland, CERN is the world's leading research facility in particle physics and is responsible for some of the most monumental discoveries and developments in particle physics in recent history. The Large Hadron Collider (LHC) at CERN is currently the largest and most powerful particle collider in the world. The Compact Muon Solenoid (CMS) experiment is one of the four major detector experiments set up throughout the circumference of the LHC. Following the discovery of the Higgs-Boson in 2012, the goal has been to upgrade the LHC to work at higher luminosity (more collisions per second in the detector) and higher energy in order to look for new physics. Over the past two semesters, we have been assisting in research and development for the CMS tracking detector to prepare for the High Luminosity LHC (HL-LHC). To this end, we have been researching the effect of pileup on tracking resolution and efficiency using an emulation of CMS events. Pileup simply refers to the situation in which a particle detector is affected by multiple collision events happening at the same time. This requires extra processing done by the tracking detector in order to separate these events into meaningful output. While we are still currently gathering data on this front, we hope to eventually optimize the tracker code to distinguish among events with a higher efficiency. This code is designed to mimic the hardware actually used in the CMS detectors. As such, our work should go a long way toward preparing for the upgrades currently underway at CERN, allowing for the immediate use of the HL-LHC upon the upgrades' completion.

## Poster Presentation

### *Modeling the Correlation between Cumulative Early Life Adversity and Parasite Load in Wild Baboon Populations*

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Unfavorable environmental conditions and parasites have profound effects social interactions and individual health in multiple vertebrates. These effects are especially strong in early life. For instance, in baboons, juveniles experiencing the most early adversity lead shorter lives than those experiencing less adversity. Adversity could affect parasitism as the presence of parasites reduces tolerance for infection and may increase mortality of an animal. Although a larger cumulative adversity index (sum of specific early life adversities in a single baboon) in wild baboons indicates higher mortality, it is still unknown if higher counts of adversity correlates to higher loads of parasites. In this study, we used the data from 905 samples, from 213 wild baboons at Amboseli National Park, Kenya that were observed from birth. Using cumulative adversity counts and parasite data from the wild baboons, we created models to test if there was indeed a correlation between the two. However, we found no relationship between early adversity and multiple measures of parasitism, even controlling for age and seasonality. This suggests that wild baboons with higher counts of early life adversity do not necessarily have higher parasite loads, and thus parasite loads may not significantly influence higher rates of mortality. This relationship raises questions as to whether parasites strongly affect baboon health or if baboons have higher tolerance to parasites.

## Poster Presentation

### *Correlation does not confer causation: Interpreting the relationship between mother and offspring parasite susceptibility trends*

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Advisor: Elizabeth Archie, Dept. of Biological Sciences

The influence of genetics on an individual's immune system is a hugely under-researched phenomenon. Previous studies have established that a number of other factors like age, environment, sex, and rank in society affect one's disease susceptibility. It's also known that immune related bacteria are passed between mother and offspring during the birthing process. What is unclear is the link between disease susceptibility and an individual's relation with others. This study attempted to determine the origin of patterns of similarity between the parasite loads of an individual baboon with that of his or her mother. An individual's degree of susceptibility to disease, as measured by fecal parasite load, was hypothesized to be dependent on maternal degree of susceptibility to disease. Fecal parasitic load data of Amboseli Basin baboons was collected, categorized and compared to establish any existing patterns of similarity. Preliminary results indicated that relatedness explained a significant portion of the parasite load trends, but further elimination of confounding variables reduced the influencing factor. Analysis of data determined that the maternal parasite counts were not significant in predicting offspring parasite counts. Additionally, the data illustrated that in any one year and season, the parasite trends of the population predict the trends of the individual. The median age of the individual and the median rainfall of the three months prior to data collection were also significant influencing factors. Further studies should be conducted to determine the influence of sibling relatedness or if the similar results can be produced by comparing other factors of the immune system.

## Poster Presentation

### *Negative Self-Perception in a Diverse Racial-Ethnic Sample of Patients with Head and Neck Squamous Cells Carcinomas: Roles of Psychosocial Correlates*

Harisa Spahic

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Anthropology and Biochemistry

Advisor: Pascal Jean-Pierre, Dept. of Psychology

**Introduction** Head and neck squamous cell carcinomas (HNC) account for 3-5% of all cancers in the United States. Due to the location and aggressive treatment of HNC that typically result in disfigurements, HNC patients generally experience psychological distress. HNC-related psychological distress and associated sociodemographic factors can impact patients' psychosocial functioning and quality of life. New strategies to identify and mitigate the negative impacts of HNC are needed.

**Objective** To investigate the relationships among psychological distress and socio-demographic characteristics in HNC patients.

**Methods** Data from a sample of 150 English-fluent and mostly male HNC patients (20 to 88 years old) was analyzed. Participants completed questionnaires that assessed their socio-demographics information, psychological states (Hospital Anxiety and Depression Scale, HADS) and self-perception (Measure of Body Apperception, MBA). A standard multiple regression analysis was completed, using scores on the HADS subscales, age, sex, race, education, income, and employment status, to predict self-perception based on aggregated scores on the MBA.

**Results** Our analysis revealed a significant model ( $R^2 = 0.264$ ,  $F = 6.311$ ,  $p < 0.001$ ). Education (Standardized Coefficient Beta (SCB) = -0.20,  $t = 2.078$ ,  $p = 0.04$ ), race (SCB = 0.156,  $t = 2.084$ ,  $p = 0.04$ ) and anxiety (SCB = 0.199,  $t = 2.078$ ,  $p = 0.04$ ) were statistically significant predictors of negative self-perception. Age, sex, employment status, income and depression did not make a statistically significant contribution to the prediction of self-perception (all  $p > .05$ ).

**Conclusions** HNC patients are at risk for psychological distress. Data from the present study showed that negative self-perception in HNC patients is influenced by race, education and anxiety. Despite increased interest to improve quality of life for cancer survivors, studies on HNC-related psychological distress and quality of life are still lacking. Future research should expand the sample populations to include more women and look at distress longitudinally to address change over time.

## Oral Presentation

### *Isolation of Antimicrobial Compounds from Red Oak (Quercus rubra L.) Acorns*

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Biochemistry

Advisor: Jeanne Romero-Severson, Dept. of Biological Sciences

Every year over 75,000 people become infected with Methicillin-resistant *Staphylococcus aureus* (MRSA) in the US alone. These bacterial infections are resistant to most current antibiotics, and are developing resistance to others faster than new antibiotics are produced. This loss of viable antibiotics has caused researchers to revisit traditional sources of antimicrobial compounds; plants, animals and fungi. This research project is focused on investigating new antimicrobial compounds from the acorns of the northern red oak (*Quercus rubra* L.). Extracts of powdered acorns in water, ethanol, and ethyl acetate have all demonstrated activity against a variety of bacteria including MRSA and streptococcus sp. The ethyl acetate extract possessed the most activity, and was partially purified through Column Chromatography. Three separate fractions contain activity and are being further purified through High Pressure Liquid Chromatography (HPLC) separations. These fractions will be tested for antimicrobial activity, and the most active portions will be further purified. Analytical data was recorded through Liquid Chromatography Mass Spectroscopy (LCMS) and Nuclear Magnetic Resonance (NMR). Multiple fractions of the Ethyl Acetate extract have shown strong inhibition of MRSA implying that there are multiple antimicrobial compounds. Future work will focus on isolating the active compounds and devising a method of synthesis.

## Poster Presentation

### *Augmentation of Response to Chemotherapy by MEK Inhibition in Pancreatic Cancer*

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Roderich E. Schwarz and Niranjan Awasthi, Indiana University School of Medicine - South Bend and

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Advisor: Niranjan Awasthi, Indiana University School of Medicine - South Bend

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Pancreatic ductal adenocarcinoma (PDAC) is a highly lethal cancer, for which mortality closely parallels incidence. PDAC is associated with a very poor prognosis and 5-year survival remains as low as 6%. Gemcitabine (Gem) remained the standard treatment for PDAC since 1997 despite limited clinical benefits. Nanoparticle albumin-bound paclitaxel (Nab-paclitaxel, NPT) combination with gemcitabine has recently shown efficacy in advanced PDAC. This combination is now the standard treatment for PDAC. Mutationally activated KRAS is present in >90% of PDAC tumors but direct targeting of this oncogene has proven clinically challenging. Therefore, alternative strategies focus on inhibition of downstream effectors of KRAS signaling pathways such as the RAF-MEK-ERK (MAPK) signaling pathway that is a well-described mediator of KRAS induced transformation and tumorigenesis. Trametinib (Tra) is a MEK inhibitor with antineoplastic activity. We evaluated antitumor activity of the standard chemotherapeutics with trametinib to define a novel therapeutic strategy for PDAC. In peritoneal dissemination PDAC model, median animal survival over control (20 days) was improved by NPT (33 days, a 65% increase,  $p=0.0004$ ), Gem (26 days, a 30% increase,  $p=0.002$ ), NPT+Gem (39 days, a 95% increase,  $p=0.0001$ ) and Tra (31 days, a 55% increase,  $p=0.0004$ ). Survival was further increased by addition of trametinib to chemotherapy: NPT+Tra (37 days, a 85% increase,  $p=0.0001$ ), Gem+Tra (34 days, a 70% increase,  $p=0.0001$ ) and NPT+Gem+Tra (49 days, a 145% increase,  $p<0.0001$ ). In subcutaneous PDAC xenografts, chemotherapy and trametinib caused tumor growth inhibition. Net tumor growth in different therapy groups: controls (432.6 mm<sup>3</sup>), NPT (105.3 mm<sup>3</sup>), Tra (184 mm<sup>3</sup>), NPT+Tra (81 mm<sup>3</sup>), NPT+Gem (37.3 mm<sup>3</sup>), and NPT+Gem+Tra (-8.1 mm<sup>3</sup>). The tumor weights in grams in different groups were as follows: controls  $0.38\pm 0.06$ , NPT  $0.23\pm 0.06$ , Tra  $0.31\pm 0.03$ , NPT+Tra  $0.23\pm 0.06$ , NPT+Gem  $0.15\pm 0.05$  and NPT+Gem+Tra  $0.11\pm 0.05$ . In vitro studies demonstrated inhibition in PDAC cells proliferation by NPT+Gem, trametinib, and combination treatment. Immunoblot analysis revealed that trametinib effects were accompanied by decrease in phospho-ERK and increase in apoptosis-related cleaved caspase-3 protein. These findings suggest that the antitumor effects of the standard chemotherapeutics can be enhanced through specific inhibition of components of the MAPK signaling pathway, which clinically could yield in improved antitumor results.

## Poster Presentation

### *Fast Fourier transform of power load data*

Robert Stiller  
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Physics

Advisor: Abigail Mechtenberg, Dept. of Physics

People generally use more energy in the summer than any other season because of how much power air conditioners require. People also use more energy during the day than at night, for obvious reasons. There is even data for energy consumption that shows power usage for each minute in a year. Ragone plots will also be included to show the advantages for using different ESD at different times in the day. For example, capacitors are better than fuel cells at producing a large power output but much worse at outputting energy over a long period of time. This project will show power data for a whole year and the data will be fast Fourier transformed to show the most common frequencies is power consumption. This will show which energy storage devices (ESD) should be used during each day each year.

## Poster Presentation

### *Gemcitabine-Induced Cancer Associated Fibroblast Exosome Hypersecretion Increases Chemoresistance in PDAC*

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Biological Sciences  
Ann Zeleniak  
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Biological Sciences  
Katherine Richards  
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Biological Sciences

Melissa Fishel, Indiana University Simon Cancer Center  
Advisor: Reginald Hill, Dept. of Biological Sciences

Pancreatic ductal adenocarcinoma (PDAC) is the 3rd most common cause of cancer-related deaths, due to its highly metastatic nature, delayed detection and robust chemoresistance. Current drug treatments are thought to be impeded by the dense desmoplastic stromal environment, comprising up to 90% of tumor bulk. Stromal-depletion therapies have been unsuccessful, since the dense stromal environment seems to also play a helpful role in restraining tumor growth. This study examines the role of the stromal microenvironment on the chemoresistance and cancer epithelial cell proliferation upon treatment with gemcitabine, the mainstay PDAC drug. We found that upon gemcitabine treatment, cancer-associated fibroblast (CAF) cell lines exhibited greater chemoresistance compared to epithelial resistant cell lines, and this chemoresistance is not merely a consequence of proliferation inhibition. Treatment of cancer epithelial cells with CAF-conditioned media revealed increased proliferation of cancer epithelial cells, suggesting a role of CAF-secreted factors in modulating epithelial cells. Specifically, we found that gemcitabine treatment induces CAF cells to release more exosomes relative to untreated CAFs. This therapy-induced hypersecretion of CAF exosomes led to 4-fold upregulation of Snail and miR-146a in cancer epithelial cells in vitro, ultimately promoting the chemoresistance of the cancer epithelial cells. These findings thus suggest the active role of the stromal microenvironment in mediating chemoresistance via therapy-induced CAF exosome hypersecretion, which should be considered while developing more effective treatments for PDAC patients.

## Poster Presentation

### *Baboon Group Size and Parasitism*

Nicole Thielen  
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Anthropology and Biological Sciences  
Advisor: Elizabeth Archie, Dept. of Biological Sciences

The evolution of social group size is often studied in a cost-benefit framework. In the case of social primates, individuals living in large social groups receive considerable benefits, but these benefits probably come at the cost of higher risk of parasite transmission. In this study, we tested the hypothesis that individuals living in larger groups would experience greater parasite intensity, prevalence, and diversity as compared to individuals living in smaller social groups. We tested this hypothesis in a well-studied population of wild baboons in Kenya using a total of 1245 fecal samples from 286 individuals. We analyzed fecal samples for parasite egg content as a proxy for parasite content when the group size of the individual baboon was known. Controlling for season and age of the individual, we found a positive correlation between group size and parasite load for *Trichuris trichuria*, a fecal-oral transmitted parasite that was found most often in the fecal samples. No significant relationship was found between group size and the prevalence of the other parasites (*Strongylus*, *Abbreviata casucasica*, *Strepto pigmentatus*, *Enterobius vermicularis*), which are vector transmitted and/or at a lower concentration in the population. This significant trend in *Trichuris trichuria* implies that parasite load is a constraining variable in baboon group formation.

## Poster Presentation

### *Fit to win: Competitive growth between artemisinin resistant P. falciparum isolates*

Abigail R. Tirrell  
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Biological Sciences

Lisa A. Checkley, Eck Institute for Global Health, Dept. of Biological Sciences  
Marina McDew-White, Texas Biomedical Research Institute, San Antonio, TX

Ashley M. Vaughan, Center for Infectious Disease Research (formerly Seattle Biomedical Research Institute), Seattle, WA

François H. Nosten, Shoklo Malaria Research Unit, Mahidol-Oxford Tropical Medicine Research Unit, Mahidol University, Thailand

Timothy J.C. Anderson, Texas Biomedical Research Institute, San Antonio, TX

Advisor: Michael T. Ferdig, Dept. of Biological Sciences

Infections by multiple genetically distinct *Plasmodium falciparum* parasites are common in cases of human malaria. The dynamic interactions of parasites in mixed infections leads to competition between co-infecting strains that selects for parasites with fitness advantages. With reports of slower clearance rates to artemisinin treatment, it is essential to understand the relative fitness of parasites with the delayed clearance phenotype that could influence their spread in populations. In this study, sets of two genotypically distinct parasites were co-cultured, and fragment analysis was performed on DNA samples collected periodically to determine the relative densities of each strain in culture. NF54HT-GFP-luc (NF54) was competed against each of two parasite clones (NHP<sup>#</sup> and NHP\*) that were recently isolated from patients on the Thailand-Myanmar border and showed delayed parasite clearance following treatment with artemisinin. NHP<sup>#</sup> has the most common mutation in the K13 propeller domain (C580Y), while NHP\* has no mutation in the kelch propeller region. The competition between NF54 and NHP<sup>#</sup> initially favors NF54; however, after 17 cycles (35 days) an increase in the proportion of NHP<sup>#</sup> to NF54 is observed and this trend continues until NHP<sup>#</sup> outgrows NF54. In another experiment we found that NHP\* outcompeted NF54 within 21 days. In a competition between the two field isolates, NHP\* outcompeted NHP<sup>#</sup> within 23 days. These results provide insights into the potential fitness costs and advantages of mutations in the K13 propeller domain. Future experiments involving competitions with a non-transfected NF54 strain will shed light on the potential fitness advantages of these isolates. Further examination of competitive growth will provide a deeper understanding of how parasite interactions within mixed infections can influence the spread of resistant parasites.

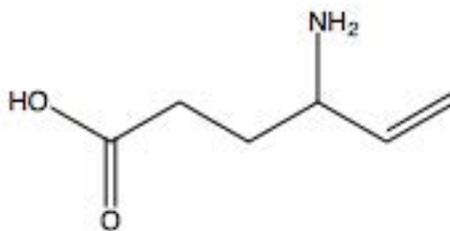
## Poster Presentation

### *Synthesis of Vigabatrin for Breast Cancer Brain Metastasis Chemotherapeutic Trials*

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Biochemistry  
Kaitlyn Eckert  
College of Science  
Chemistry

Advisor: Brandon Ashfeld, Dept. of Chemistry and Biochemistry

Penetration of the blood brain barrier (BBB) is customarily a large obstacle to brain cancer treatment design, as most molecules are not small, lipophilic, or nonpolar enough to cross this barrier. 4-Amino-5-hexanoic acid, more commonly known as vigabatrin, exhibits high BBB penetration and is known to inhibit the breakdown of the neurotransmitter GABA. While it is most commonly used to treat epilepsy under the brand name Sabril, recent studies have shown that it has an anti-proliferative effect. This, along with its ability to penetrate the BBB, provides positive evidence supporting its use as a new breast cancer brain metastasis treatment. While this drug is routinely synthesized industrially through the utilization of vinyl Grignards, it is very expensive to purchase commercially. Additionally, vinyl Grignards are notoriously difficult to produce and handle because of their instability and air sensitivity. Alternatively, this compound can be synthesized by selectively reducing glutamic acid and then performing a Wittig reaction. This alternate synthetic pathway utilizes more temperate reactions that can be easily conducted in a lab setting and scaled up to provide gram quantities for clinical trials.



vigabatrin molecular structure

## Poster Presentation

### *Fish Feed: Identifying which commercial laboratory diet is best for zebrafish*

Rebecca Turcios  
College of Science  
Science Preprofessional Studies  
Advisor: Kay Stewart, Dept. of Biological Sciences

For decades, zebrafish have been used as biomedical research models to study anything from aquatic toxicology to developmental biology. Despite their extensive use and innumerable contributions to science, very little is known about their husbandry and their specific nutritional requirements. This is problematic because laboratories want these fish to grow as fast as possible in order to obtain research data at a faster rate. Many laboratories presently feed a diet made exclusively of live prey like rotifers and Artemia for they are more visually and chemically appealing, easily digested, and presumed to be nutritionally balanced. However, the cost required to maintain a constant supply of live prey is exceedingly high; artificial supplements might be able to alleviate the cost of caring for cultured fish while increasing the growth rate. This study aims to determine whether or not this is possible. For this study, Hatchfry Encapsulon, Gemma, and Ziegler artificial zebrafish diets were fed to tanks of approximately twenty individuals. Each week they were measured until their growth rates diminished and their average length remained constant. Zebrafish typically reach their full size between three to four months of age, which is precisely how long it took for the zebrafish in this project to reach adulthood. Ideally, the results of this experiment will help other laboratories to optimize the productivity of their zebrafish. In addition it could also improve our understanding of zebrafish nutritional requirements.

## Oral Presentation

### *Senescence and Plant Quality During the Growing Season of Wild Blue Lupine, *Lupinus perennis**

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College of Science

Biological Sciences, Chemistry, and English

Lainey Bristow, Dept. of Biological Sciences

Advisor: Jessica Hellmann, Dept. of Ecology, Evolution & Behavior, University of Minnesota

Senescence of a plant is a natural indicator of an end to its growing season. Understanding and tracking the senescence of a plant such as the Wild Blue Lupine, *Lupinus perennis*, can lead to a deeper understanding of the species and its surrounding ecosystem. The purpose of the study is to identify trends in lupine senescence and quality during its growing season. We predicted that as the growing season progresses, the plant quality will deteriorate and as senescence occurs the carbon/nitrogen ratios will decrease. We also predicted that future climate change conditions will negatively affect the species. Wild Blue Lupine serves as the only larval food source and host plant for the endangered Karner Blue butterfly, *Lycaeides melissa samuelis*, therefore a declination of lupine may further threaten the Karner's endangerment. Lupine leaflet samples were collected every 1 to 2 weeks during the growing season from the Indiana Dunes at predetermined geographical locations. The leaflets were processed by measuring water weight, pulverizing dry samples, and analyzing carbon and nitrogen composition using an Elemental Analyzer. We conducted an experiment in a controlled setting where lupine was exposed to increasing intervals of climate change conditions based on data from the 2014 Intergovernmental Panel on Climate Change. The lupine exposed to these conditions experienced rapid growth then rapid deterioration and senescence. The lupine collected from the Indiana Dunes contributes to an ongoing project that will provide data on the 2015 growing season. Future experiments should be conducted on the micro-climates within the dunes by analyzing temperature, precipitation, elevation and plant data to grasp a more intricate understanding of the species and its future. Lupine senescence and quality are important to study due to lupine's delicate relationship with Karner, especially if the plant quality deteriorates and senesces more rapidly than previous seasons.

## Poster Presentation

### *A Motivation for Higher Categories: Topological Quantum Field Theory*

Jonathan Vandenburg  
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Mathematics

Advisor: Mark Behrens, Dept. of Mathematics

Two major advancements in recent mathematics have been the invention of category theory in the 1940s and the theoretical developments in higher category theory in the 21st century. These advancements have been widely influential in mathematics, physics, computer science, and philosophy. In this poster, I will describe category theory and higher category theory pictorially, focusing on examples taken from quantum physics. I will define categories and the basic language of category theory, explaining the concepts through simple diagrams. I will then discuss topological quantum field theory (TQFT), describing what higher categories are and explaining why they are useful for TQFT. Ultimately, I seek to convey why mathematicians care about categories and higher categories, how these concepts are useful in a variety of settings, and how their pictorial descriptions are so simple that the physicist Bob Coecke claims they can be used to teach quantum mechanics to kindergarteners.

## Oral Presentation

### *Climate Change's Effect on Montana's Bunchgrass Prairie*

Zoe Volenec

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Economics and Environmental Sciences

Advisor: Gary Belovsky, Dept. of Biological Sciences

Plants form the foundation for all terrestrial food webs, thus shifts in their phenology and productivity have the potential to alter ecosystem function and drive bottom-up community effects. One driver of these shifts is climate change. Over the past 35 years at the National Bison Range, temperature has increased by 0.6°C, while annual precipitation has decreased by 26%, but increased in the plants' May-June growing season. The objective of this project was to predict the various effects that elements of climate change, such as increased temperature and changes in precipitation levels and seasonality, will have on bunchgrass prairie production and species composition at Montana's National Bison Range. Here I show that an increased precipitation treatment increased annual net primary productivity (ANPP), and that the precipitation/minimum temperature ratio acted as a significant predictor of ANPP. This precipitation/minimum temperature ratio captures the soil moisture available for plant growth by accounting for the evapotranspiration rate. Available soil moisture may be the predominant driver of plant responses in the bunchgrass prairie due to its unique ecosystem characteristics, which fall between a cold desert and grassland. For example, increased precipitation significantly increased plant species richness, but the competing effect of increased temperature significantly decreased richness. Elevated temperatures also exacerbated already reduced water availability in the late growing season, significantly increasing the rate of plant senescence and subsequent litter production. Management at the National Bison Range must thus take into consideration not only the role water availability will play in plant biomass production, key to sustaining herbivore populations, but also how warming may alter late growing season water availability and increase the risk of fire. Further climate change research should focus on the interplay between multiple drivers of ecosystem responses, as single factor experiments alone do not capture the interaction between climate variables.

## Poster Presentation

### *The Prevalence of Lyme disease in Northern Indiana*

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Chemistry

Advisor: Holly Goodson, Dept. of Chemistry and Biochemistry

Lyme disease has become the most common vector-borne disease in the United States. While it produces flu-like symptoms in the early stages of the disease, nerve problems and arthritis may present itself in the more advance stages. Lyme disease is most often transmitted through the bite of a deer tick, *Ixodes scapularis*, infected with the bacteria *Borrelia burgdorferi*. A large population of this species can be found in the Northeastern region of the country, however there has recently been a large increase of *I. scapularis* found in the Midwest. To investigate the presence of *B. burgdorferi* infected ticks in Northern Indiana, total DNA was extracted from ticks collected at a site in St. Joseph County. The extracted DNA was used in a set of two PCR reactions designed to probe for the presence of (1) tick genomic DNA (this was a control to confirm that the extraction worked) and (2) to the *B. burgdorferi* bacteria that causes Lyme disease. Agrose gel analysis of the resulting PCR products was used to determine the presence of *B. burgdorferi* in the samples. Following the analysis of 4 ticks, *B. burgdorferi* infected ticks have not been found. By obtaining information about the prevalence of *B. burgdorferi* infected ticks in Northern Indiana, adequate precautionary measures can be taken to decrease the spread of Lyme disease.

## Poster Presentation

### *The Effect of Estrogen on Green Bean Plant Growth*

Grace Weaver  
Saint Pius X School, Granger, IN

Introduction- The purpose of my experiment is to demonstrate the effect of estrogen on plant growth. Background research on plants has shown the addition of estrogen to plants impacts growth both negatively and positively. Specific research shows this may be dose specific. I used a fixed dose of estrogen to evaluate the effect on common green bean plant growth. My project is comprised of a control group (n= 7, water), Treatment group 1 (n=5, 2.5 mg conjugated estrogen/1000 ml water), and Treatment group 2 (n=8, 5 mg conjugated estrogen/1000 ml water). Each group was exposed to similar growing conditions. Plant growth was assessed with a basic height measurement. My hypothesis was plants exposed to estrogen would have a higher overall growth. Comparisons were made at weeks 1-5 and recorded. Week 1 growth control=3.5 cm, Treatment 1=3.1 cm, Treatment 2=2.8 cm. Week 2 growth control=8.6 cm, Treatment 1=9.4 cm, Treatment 2=6.3 cm. Week 3 control=8.8 cm, Treatment 1=10.1 cm, Treatment 2=7.7 cm. Week 4=10.3 cm, Treatment 1=12.3 cm, Treatment 2=8.1 cm. Week 5 control=11.1 cm, Treatment 1=15.6 cm, Treatment 2=9.4 cm. In conclusion, green bean plants exposed to the lower concentration of estrogen demonstrated the highest growth. The highest dose of estrogen demonstrated the lowest growth.

## Poster Presentation

### *Ecological Effects of Non-native Pacific Salmon and Brown Trout on Native Brook Trout in Great Lakes Tributaries*

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Biological Sciences  
Lillian McGill  
College of Science

Environmental Sciences

Brandon Gerig and Gary Lamberti, Dept. of Biological Sciences

Advisor: Dominic Chaloner, Dept. of Biological Sciences

Pacific Salmon (*Oncorhynchus* spp.) and Brown Trout (*Salmo trutta*) are non-native species actively stocked in the Great Lakes. Since introduction of these species, abundance of native Brook Trout (*Salvelinus fontinalis*) has declined in tributaries for unknown reasons. Potamodromous species, like salmon, accumulate nutrients and energy while maturing in lakes, and transfer this material to lake tributaries where they spawn and die. Within the native range of salmon, this provision of resources can increase growth and change the isotopic composition of resident salmonids. However, the influence of salmon-derived material on resident fish outside their native range is unclear. We addressed whether salmon tissue has differential effects on growth and isotopic composition of co-occurring Brook and Brown Trout. Hatchery age-0 Brook and Brown Trout were reared for 7 weeks in flow-through mesocosms with regular rations of salmon tissue augmented by bloodworms. Fish mass and length were measured weekly, while isotope ratios were determined at conclusion of the experiment. Growth rate of Brook Trout was not altered by presence of salmon tissue or Brown Trout ( $p > 0.05$ ). Brook and Brown Trout were both significantly  $^{15}\text{N}$ -enriched and  $^{13}\text{C}$ -depleted in salmon tissue presence ( $p < 0.001$ ), but isotopic signatures did not differ between species. Strong differentiation in isotopes but not growth between treatments suggests salmon tissue was readily incorporated into bodies of both species, but did not provide a differential resource subsidy for either species. Thus, observed growth responses of resident fish in salmon native range are likely not a result of direct consumption of salmon tissue. Rather, the biochemical makeup of salmon material may influence growth responses (e.g., lipid-rich eggs versus protein-rich tissue). Overall, our results have implications for the influence of introduced salmon on stream-resident fish, the role of the environment in modifying those effects, and interactions between non-native and native fish in Great Lakes tributaries.

## Oral Presentation

### *JNK Signaling Modulates Expression of Genes Responsible For Morphological Change in a Drosophila Photoreceptor Model of Axonal Regeneration*

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College of Science  
Neuroscience and Behavior  
Stephanie Bradburn  
College of Science  
Biological Sciences

Kirk Mecklenburg, Dept. of Biology, Indiana University, South Bend  
Advisor: Joseph O'Tousa, Dept. of Biological Sciences

Neurons respond to axonal insult and neurodegenerative disease through a highly conserved process called Wallerian degeneration, which results in degradation of the injured axon. The c-Jun N-terminal kinase (JNK) pathway is a major player in facilitating cell death or new axonal growth following Wallerian degeneration. However, the molecular mechanism by which JNK signaling coordinates these opposing phenotypes remains unknown. I therefore used the *Drosophila* photoreceptor, a light-sensitive neuron, as a model for the effects of JNK activation on neuronal morphology and cell signaling. To specifically activate the JNK pathway in the photoreceptors, the JNKKK Wallenda (WND) was overexpressed under control of Rh1 rhodopsin promoter. Western blots and coexpression of fluorescently tagged proteins in the photoreceptor showed that WND overexpression caused a dramatic, light-accelerated reduction of the photoreceptor-specific proteins rhodopsin, NINAC, and TRP. Fluorescent and electron microscopy revealed that the loss of these proteins was accompanied by sprouting at axon termini and degradation of the rhabdomere, the membranous cellular location of the lost proteins. Knockdown of JNK components downstream of WND demonstrated that the canonical JNK kinases HEP and BSK and the transcription factor KAY are all required for WND-induced changes in the photoreceptor. To probe transcriptional targets of KAY, transcript profiling was conducted on RNA from the heads of wild type and WND-overexpressing flies. Pathway analysis of significantly changed transcripts revealed that WND expression dramatically reduced the number of phototransduction gene RNA transcripts. Transcriptionally upregulated pathways included ERBB signaling proteins, the ESCRT III Complex responsible for membrane recycling, and the ARP 2/3 Complex involved in cytoskeletal remodeling. These results suggest that the JNK pathway induces both the loss of rhabdomere proteins and novel axonal growth by transcriptional reprogramming of the photoreceptor to a state of membrane and cytoskeletal dynamism.

## Poster Presentation

### *Down the rabbit hole: Computer-based modeling and validation of mandibular performance*

Zach Wiley

College of Science

Science Preprofessional Studies

Glen Niebur, Dept. of Aerospace and Mechanical Engineering

Henry Fu, Dept. of Biological Sciences

Advisor: Matthew Ravosa, Dept. of Biological Sciences

Determination of Young's modulus (YM), an important physical parameter that denotes the elasticity of a structure, is complicated by the non-uniform shape and density of bone. Our objective was to develop a finite-element model of the mammalian lower jaw, with the aim of comparing and validating this *in silico* method *vis-a-vis* macroscale tests of mandibular properties from *ex vivo* specimens. Computer modeling has benefits over mechanical loading because it facilitates non-invasive determination of YM in samples that cannot be subjected to destructive procedures and allows the analysis of bone properties based solely on 3D images. As elasticity is a function of shape as well as material properties, and because bones are anisotropic (heterogeneous depending on direction studied), finite-element models are well suited for characterizing the overall performance of skeletal structures. Mandibles used for the finite-element model and, ultimately, the macroscale tests are from a long-term study of dietary plasticity in growing rabbits. Genetically similar males were raised from weaning (5 weeks old) until mature adult (53 weeks old) on one of two diets (each n=10): control – pellets; and mechanically challenging – hay plus pellets. An Instron Universal tester was used for 3-point bending of the mandible in the transverse or vertical plane. MicroCT images of rabbit jaws were used to generate computer models that simulated *ex vivo* loading patterns. These were created with the software Analyze and ImageJ on the Linux Red Hat operating system. Finite-element models were then tested in the program Adina for displacements in response to simulated loading patterns, from which we were able to extrapolate YM for comparison with the macroscale tests. YM values determined for the mechanically challenging cohort were higher than in the control group, which agrees with expectations based on prior studies of bone formation and biomineralization, both of which positively influence mandibular strength.

## Poster Presentation

### *Using a lineage tracing system to investigate the dynamics of Müller glia and Neuronal Progenitor Cells (NPCs) proliferation in the regenerating retina of zebrafish*

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Biological Sciences  
Ryne Gorsuch  
College of Science  
Biological Sciences

Advisor: David Hyde, Dept. of Biological Sciences

Zebrafish are a vertebrate model for retinal regeneration, which does not occur in humans. During regeneration, Müller glia dedifferentiate and re-enter the cell cycle to give rise to the missing or damaged neuronal cell types in the retina. One basic gap in our knowledge about regeneration is the contribution of individual Müller glia and their progeny to the global retinal regeneration program. To address this question, we are developing a lineage tracing line to map the fate of individual Müller glia in the regenerating retina. This system will use *Tg(ubi:zbow)* transgenic fish that contain the Zebrabow cassette, a genetic construct that, in the presence of Cre-recombinase, recombines to label individual Müller glia with a unique fluorescence that is inherited by their daughter cells in a lineage-dependent manner. This approach will let us identify and track individual cells and their progeny during the regeneration process to address the contribution of individual Müller glia. In order to express Cre-recombinase in only Müller glia and their daughter cells, expression vectors will be transfected into retinas of adult *Tg(ubi:zbow)* zebrafish using the *in vivo*-jetPEI transfection reagent (Polyplus). Once inside the Müller glia, these vectors will express Cre protein under control of the Müller glia-specific *glial fibrillary acidic protein (gfap)* gene promoter, thus stochastically labeling Müller glia. To induce retinal regeneration, we will trigger photoreceptor cell death in the transfected adult zebrafish with the exposure to constant intense light. Eyes will be collected at time intervals associated with important events in retinal regeneration: at the beginning of light treatment, after 31, 52, 68, and 96 hours, and after full recovery of the retina around 28 days. Fluorescent analysis of the labeled Müller glia and their progeny during regeneration will help us understand their behavior, movements, and dynamics as they respond to retinal damage.

## Oral Presentation

### *The Role of ZNF77 in Cisplatin Sensitivity and Its Effect on Pharmacogenetics*

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Environmental Sciences and Political Science  
M. Eileen Dolan, Dept. of Medicine, University of Chicago  
Alexis Thornburg  
Marion High School  
Advisor: Amy Stark, Dept. of Biological Sciences

Cisplatin is a platinum-based chemotherapeutic drug commonly prescribed to patients with a variety of different cancers including lung, bladder, cervical and testicular cancers. The biggest obstacles in effective treatment are its severe side effects and resistance to treatment, both intrinsic and acquired. Intrinsic sensitivity to cisplatin varies dramatically across ethnic populations, as Asian patients exhibit a heightened sensitivity to the drug as compared to patients of African or Caucasian ancestry. The gene ZNF77 is a transcription factor of unknown consequence that was selected for evaluation due to its demonstrated differences in cisplatin-induced expression between cisplatin-sensitive and cisplatin-resistant noncancerous lymphoblastoid cells. ZNF77 expression was evaluated after 5  $\mu$ M cisplatin treatment in A549 lung cancer cells and found a decrease in expression, similar to cisplatin-sensitive noncancerous cells, suggesting its importance in mechanisms of cisplatin sensitivity. Further interrogation of ZNF77 for genetic variants predictive of gene expression found rs35699176 ( $p=7.38 \times 10^{-24}$ ), a missense mutation causing a stop codon. The frequency of this genetic variant varies between ethnic populations; it is common in Asian populations present in approximately 50% of people but less common in all other populations present in 4-12% of people. This genetic variant that predicts ZNF77 expression has similar frequency patterns to clinically observed cisplatin sensitivity patterns. This work suggests ZNF77 expression levels may contribute to the ethnically disparate cisplatin response rates and contributes to an understanding of the genetic basis for it. Furthermore, these findings may be used in the future as a prognostic tool for determining the potential effectiveness of cisplatin treatment on an individual patient.

**Poster Presentation**

***Female dominance relationships across populations and species of *Papio* baboons: a review***

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Science Preprofessional Studies

Kaya Moore  
College of Science  
Biological Sciences

Advisor: Robert Habig, Dept. of Biological Sciences

Studying the evolution of group living and sociality in non-human primates is central to our understanding of human behavior. In this review, we conducted a meta-analysis of the relationship between dominance rank and fitness in female *Papio* baboons, and tested which social and abiotic factors affected the strength of this relationship. We conducted a comprehensive literature search of the dynamic nature of dominance relationships in different species and populations of *Papio* baboons with a specific focus on variation in behavior, morphology, and physiology. Our literature search yielded over 75 distinct studies, and our preliminary findings indicate that on average, high-ranking females tend to have greater reproductive success than low-ranking females and that this pattern is mediated by kinship, group size, and possibly habitat type. However, in many studies, we found no rank-related differences for certain proxies of fitness including access to resources and stress hormones, which suggests that all females, not just high-ranking females, benefit from group living despite the pervasiveness of dominance hierarchies in baboons.

## Poster Presentation

### *Polymerase Chain Reaction Pooling for Detection of Plasmodium in Anopheles Mosquitoes*

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Advisor: Neil Lobo, Dept. of Biological Sciences

Malaria is an acute febrile illness caused by parasites that are transmitted to people through the bites of infected female *Anopheles* mosquitoes. There were an estimated 214 million cases and 438,000 deaths attributed to malaria in 2015 (WHO2015). Vector control remains the most effective measure to prevent malaria transmission (WHO 2011). It has been demonstrated effective from larval control in Brazil and Egypt in the 1940s with the discovery of dichloro-diphenyl-trichloroethane (DDT) and from present day long lasting insecticide treated nets (LLINs) and indoor residual spraying campaigns (IRS). Vector control hence remains an integral part of the Global Malaria Control Strategy (GMSC). An ideal vector intervention towards the reduction of disease transmission would be one that was based on the bionomic characteristics of local mosquitoes species i.e. the intervention strategy would take advantage of behaviors towards the reduction of disease such as bed nets take advantage of indoor biting mosquitoes. Recent research (Lobo 2015 & St. Laurent 2016) demonstrate that phenotypical identification of vectors can often be wrong with bionomic characteristics being attributed to the wrong vector species and consequent implications on intervention strategies. It is necessary to adopt molecular approaches that can best identify the vector species with associated bionomic factors. Currently sporozoite and hence vector incrimination relies on Polymerase Chain Reaction (PCR) methods performed on each mosquito sample individually using an assay based on the cytochrome oxidase 1 gene (COX-1) and the standard 18s-rRNA nested PCR. In this study, a pooling strategy was developed for up to 12 samples to be analyzed at the same time. This method enables a higher throughput, faster, simpler, and cheaper sporozoite detection method, which contributes to better vector incrimination and to the larger goal of malaria elimination.

**Poster Presentation**

***The Role of the mirn23a MicroRNA Cluster in Hematopoiesis  
and B-Cell Acute Lymphoblastic Leukemia***

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College of Science

Art History and Science Preprofessional Studies

Jeffrey Kurkewich

College of Science

Biological Sciences

Nathan Klopfenstein, Dept. of Biological Sciences

Advisor: Richard Dahl, Indiana University School of Medicine – South Bend  
and Dept. of Biological Sciences

Previously our laboratory has shown that the miR-23a miRNA cluster (mirn23a) promotes granulocyte/macrophage myeloid development at the expense of B-cells (lymphoid) in overexpression studies. Consistent with this phenotype we have observed that mice lacking the mirn23a gene have increased lymphoid (adaptive immune cells) and decreased myeloid (innate immune cells) progenitors in the bone marrow.

To investigate potential pathways regulated by mirn23a that inhibit B-cell differentiation, we looked at lymphoid gene expression networks in B-cell lines overexpressing mirn23a. Gene expression and western blot analysis showed that mirn23a decreased expression of B-cell specific transcription factors Ebf1 and Pax5. Since these factors are not known to be direct targets of mirn23a, we looked at known mirn23a target Trib3 as a potential mechanism to regulate Ebf1 and Pax5 through Akt and FoxO1 signaling. Overexpression of mirn23a caused decreased Trib3 gene expression and western blot analysis showed FoxO1 protein was also decreased.

In acute lymphoblastic leukemia (ALL), Ebf1 and Pax5 are tumor suppressors and Akt1 is oncogenic. Mirn23a's ability to downregulate Ebf1 and Pax5, as well as increase Akt activity, is suggestive that it plays a role in the development of lymphoid leukemia. Gene expression array analysis shows that mirn23a miRNAs are overexpressed in MLL-AF4+ and Bcr-Abl+ ALL cells. Studies are currently underway using mirn23a<sup>-/-</sup> mice to determine if mirn23 miRNAs contribute to the development of ALL in transplantation models of Bcr-Abl-induced leukemia. Thus, our data supports the conclusion that mirn23a drives hematopoietic differentiation through the Akt/FoxO1 signaling pathway. This has implications for leukemia development as mirn23a has the ability to downregulate critical ALL tumor suppressors and activate the ALL oncogene Akt.

## Poster Presentation

### *Production and biological evaluation of the polyketide naphthocyclinone from the bacteria *Streptomyces arenae**

Emily Zion  
College of Science  
Biochemistry  
Eve Granatosky  
College of Science  
Biochemistry

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Natural products have been valued for their medicinal qualities for thousands of years and have helped to form the basis of modern medicine. The term natural product is used to encompass a wide range of compounds that are derived from natural sources such as bacteria and plants. The polyketide class of natural products includes many diverse secondary metabolites produced by organisms for a survival advantage. Naphthocyclinone, one natural product produced by the bacteria *Streptomyces arenae*, is a type II, aromatic polyketide that possesses antibacterial properties. In particular, naphthocyclinone belongs to the isochromane quinone family of antibiotics, which also includes the natural products granaticin and kalafungin. The full therapeutic potential of naphthocyclinone, however, is not completely understood. In order to delve deeper into this potential drug source, we plan to extract naphthocyclinone from *Streptomyces arenae* and complete a full chemical characterization. Efforts will be placed into increasing the production of the natural product through the engineering of the growth media. This will be done by changing the carbon and nitrogen sources available to the bacteria. Another aspect of this project will focus on identifying analogues of naphthocyclinone produced by *S. arenae* under different growth conditions. This analysis will utilize methods including LCMS and HPLC for identification of the compounds. Further research will go into investigating the therapeutic properties or other medical functions of naphthocyclinone and its analogues. This investigation of naphthocyclinone could lead to potentially beneficial uses for the natural product, and will contribute to the field of research of natural products and specifically the study of polyketides.