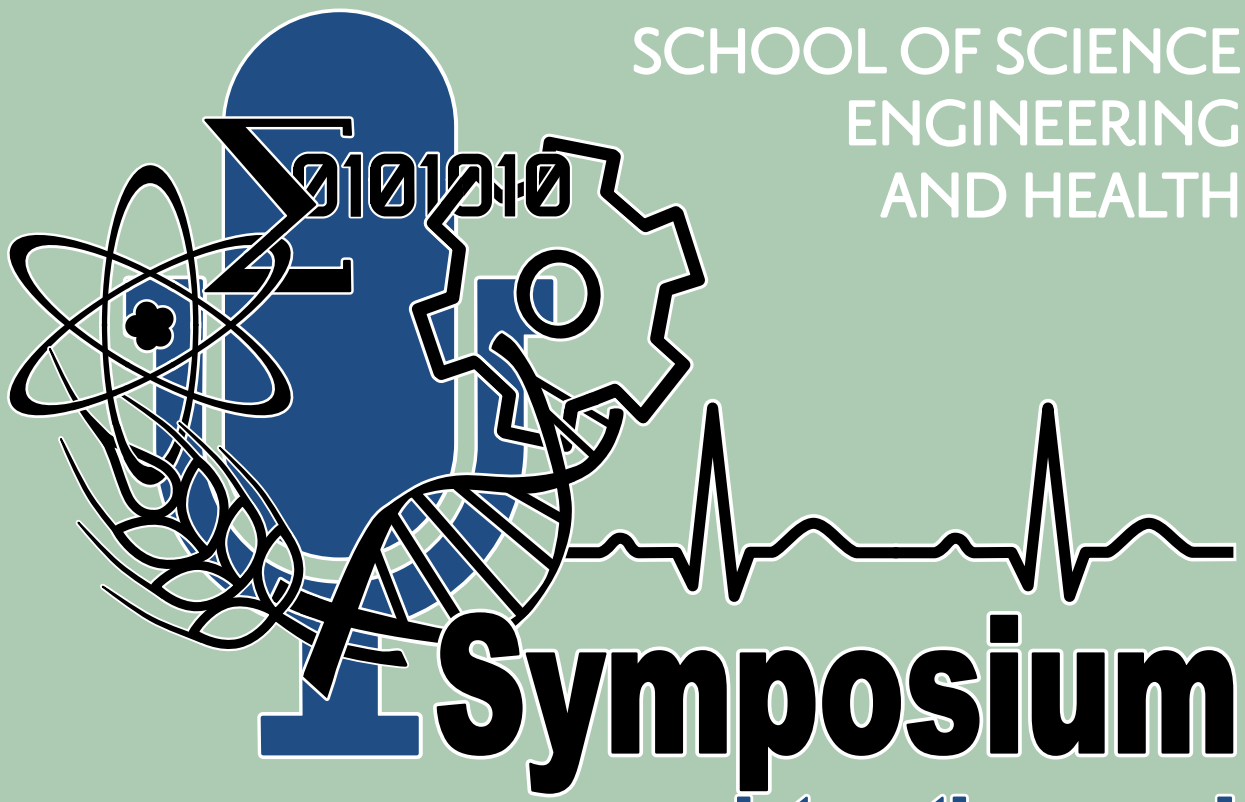
FRIDAY, MAY 3, 2019

MESSIAH COLLEGE

SCHOOL OF SCIENCE
ENGINEERING
AND HEALTH



Symposium

sixteenth annual

PROMOTING THE COMMON GOOD

PROGRAM & ABSTRACTS

A Word from the Dean

In this 16th Annual Symposium of the School of Science, Engineering, and Health, our faculty, staff and students continue the strong tradition of showcasing student and faculty innovation, creativity, and productivity in our academic departments.

Basic and applied research in science and health fields stem from curiosity, acquired skill, and a desire to test and improve processes from foundational principles. The outcomes of scientific research expand intellectual understanding and have tremendous impact on quality of life, environmental health, and human flourishing.

Angela C. Hare, Ph.D.
Dean of the School of Science, Engineering and Health

Special Session
Hostetter Chapel
1:20-2:40

A select series of shorter talks highlighting the diversity of contributions of our student scholars.

Special Thanks

Thank you to Holly Myers, Administrative Assistant to the Dean of the School of Science, Engineering and Health, for coordinating room reservations, catering, and setup of the Symposium venues. Special thanks also to Dr. Scott Weaver, D.P.S., Department Chair of Computer and Information Science, for development and maintenance of the Symposium Project Registration and Management system (SymPRM) used to collect and organize the information contained in this booklet.

Matthew Farrar, Ph.D., Special Session Coordinator
John Harms, Ph.D., Symposium Coordinator
Larry Mylin, Ph.D., Symposium Coordinator
Tim Van Dyke, Ph.D., Engineering Coordinator

Welcome to the **16th Annual Symposium**
of the School of Science, Engineering and Health.

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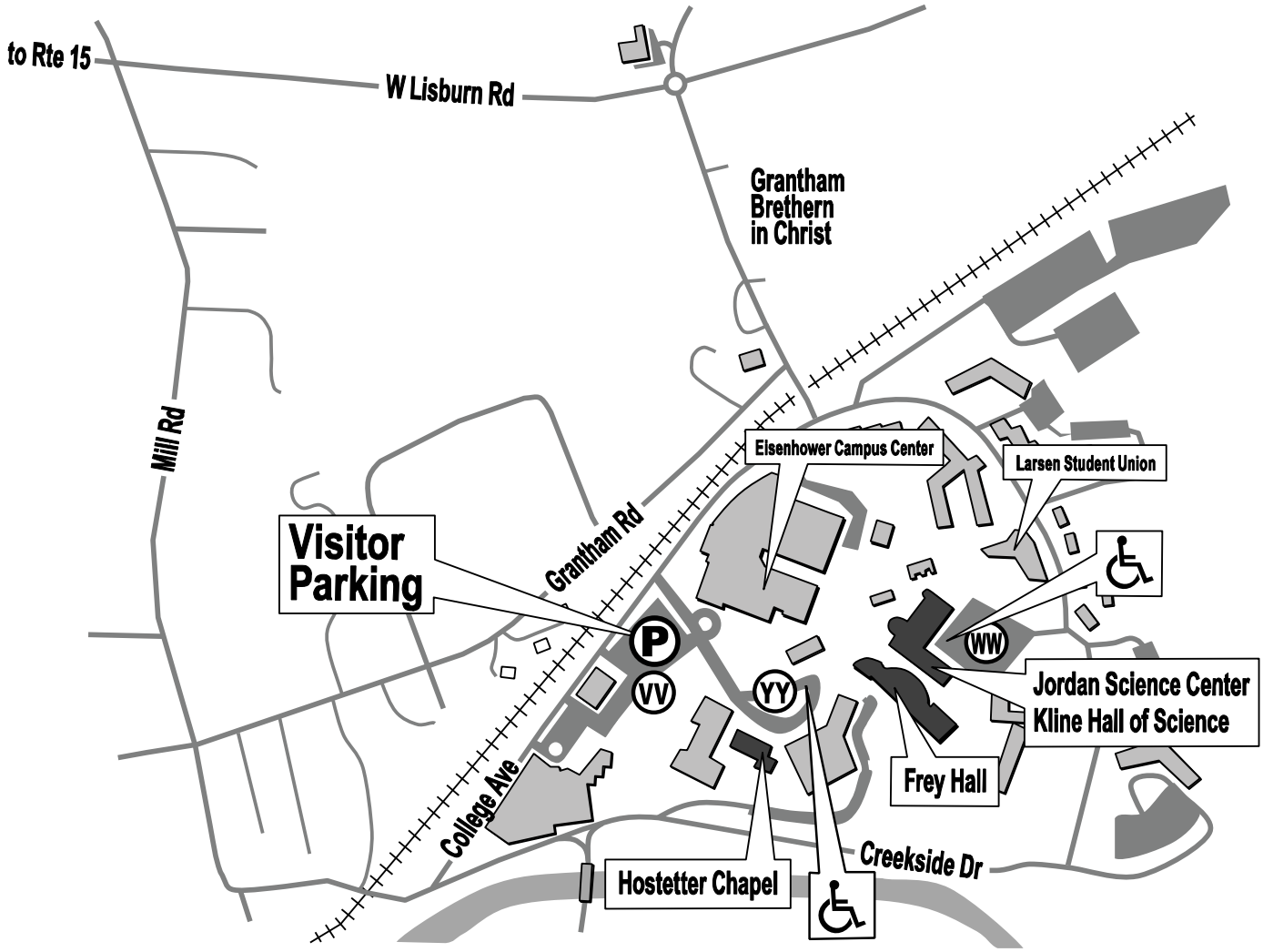
Messiah College



Welcome to Messiah College!

Visitor Parking: Parking is provided in the main Visitor Parking lot (VV) accessed from College Avenue, between Old Main and the Eisenhower Campus Center. Parking tags are not required during the Symposium. While designated handicapped parking is distributed throughout campus, spots closest to Symposium venues are available in the employee parking lots behind the Jordan Science Center (WW) and in the circle at the heart of campus (YY).

Dining facilities: The Lottie Nelson Dining Hall (upper level) and The Falcon (lower level; soup, paninis, salads) are located in the Eisenhower Campus Center. The Union Café (pizza, grill, wraps, salads) is located in the Larsen Student Union.

Using this Booklet

This **Program and Abstract booklet** provides times, locations and titles for all presentations in the Symposium**.** A consolidated "**Schedule at a Glance**" (page 4) summarizes the schedule of all Oral Presentations and Poster Presentations (page 6).

Presentation Number: Each presentation has been assigned a unique Presentation Number based on its order in the schedule. To allow for cross-referencing, this number is used throughout the booklet to identify the presentation and will be displayed with each poster to aid your navigation during the Poster Sessions.

Authorship: All contributing co-authors and mentors are listed in the Program (page 10) and Abstract section (page 36). **Bold font** indicates the names of **presenting authors**. An **Index** at the end of the booklet (page 71) lists the names of all authors alphabetically with the number(s) of each presentation on which each is included.

Program & Symbols: Presentations are organized in discipline-specific sessions. Throughout the Program and "Schedule at a Glance," unique discipline category icons designate the various fields.

Abstracts: Abstracts for each oral and poster presentation in the Symposium are arranged by Presentation Number.

Acknowledgments: All faculty mentors, external mentors and collaborators, and nursing professionals are recognized. Sources of financial and material support are also listed (page 34) with corresponding presentation numbers.

Authorship Legend:

bold Presenting author
† Research or project mentor
‡ Off-campus contributor

Discipline Categories:

- Cellular & Molecular Biology
- Chemistry & Biochemistry
- Computer & Information Science
- Engineering
- Exercise Science
- Mathematics
- Nursing
- Organismal & Ecological Biology
- Physics

Additional Symbols:

- This oral presentation is accompanied by a poster
- This poster is accompanied by an Oral Presentation
- This project was supported by the Steinbrecher Undergraduate Summer Research Program
- This project was supported by the Collaboratory for Strategic Partnerships and Applied Research
- Extended presentation (~30 min)

Schedule at a Glance

	Alexander Auditorium (Frey 110)	Frey 150	Frey 343	Frey 349
	Engineering I	**Computer & Information Science**	**Physics**	**Mathematics**
8:15	Welcome and instructions by Session Chairs			
8:20	1 MacBride, Braunworth, Eshleman	10 Gelok, Butler, Mahan, Varney	15 Weindorf, Kendall	20 Petersen
8:40	2 Zwart, Dietrich, Sum	11 Sloop	16 Luu	21 Wichert
9:00	3 Cressman	12 Collins, Reichert, McClelland, Desola, Douglass	17 Chan	22 Diethrich
9:20	4 Dyrli, Pond, Rider	13 Wood, Baumer, Hoffman	18 Shea	23 Firestone
9:40	5 Ma, Blackhurst, Mewha	14 Derk, Simmons, Braide, Underwood, Mwankenja	19 Sredenschek	24 Essig
10:00	6 Prelog, Gillisse	**Engineering II**		25 Low
10:20	7 Carter			26 Sredenschek
10:40	8 Bornman, Gaudreau	28 Robinson, Blest, Smith		27 Althoff, Diethrich, Wichert
11:00	9 Brewster, Denlinger, Harris, Trimble	29 Film, Bender, Defrance, Reyer		
11:20				

Engineering Poster Session — **11:30-12:00 Frey 070**

	Engineering III	**Engineering IV**
1:00	30 Chambers	35 Franken, King
1:20	31 Siepelinga, Sidell	36 Hardman, Gittens, Platteel
1:40	32 Feczko, Haseltine, Mantsevich	37 Hiduk
2:00	33 Reedy, Morral	38 Charney
2:20	34 Carpenter, Binford	39 Wambach, Luu, Martin

Engineering Poster Session — **2:40-4:00 Frey 070**

	Engineering V
4:00	56 Good, Cunningham, Weaver
4:20	57 Witters, Barley, Moore
4:40	58 Schott, Dyche, Noble
5:00	59 Bane, Eshelman, Underhill

Oral Presentations

Hostetter Chapel

Special Session:
Promoting the Common Good

1:20 Welcome
1:25 Ma
1:37 Jones
1:49 Lohr
2:01 Stock, Kidwell
2:13 McCarver
2:25 Good

PROMOTING THE COMMON GOOD

Schedule at a Glance

	Kline 120	Jordan 159	Jordan 161	Oakes Museum
	Exercise Science	**Chemistry**	**Cellular Immunology**	**Organismal Biology**
1:20	40 Romberger	44 Martin	48 Orner	52 Manfredo
1:40	41 Kreiger	45 Nisly	49 Sweitzer	53 Lawell
2:00	42 Parry	46 O'Boyle	50 Leib	54 Fliehler
2:20	43 Leaman	47 Rhodes	51 Hevenor	55 Robbins

Poster Session 2:40-4:00 Hollinger Atrium & Lounge

	Biochemistry	Cancer Biology	Health & Infectious Disease	Genetics & Neuroscience
4:00	60 Crawford	64 Darok	68 Lohr	71 Perez
4:20	61 Sommerville	65 Jones	69 Stewart	72 Sawicki
4:40	62 Martin	66 Le	70 Scialanca	
5:00	63 McCarver	67 LaRow		

Poster Presentations

Engineering

Frey 070 Project Space; 11:30 – 12:00, 2:40 – 4:00

73 Benner, Kripas, Sampson, Witmer

74 Boettger, Tavani

75 Brenneman, Gobeille, Myers

76 Brubaker, Issis

77 Burlew, Cornelius

78 D'Amico, Adair, Fino, Oon

79 Decker, Chan, Meier, Taylor

80 Dixon, Danielsen, Landis, Lauer

81 Feldgus, Holsinger, Schmidt, Weaver

82 Bashore, Forshey, Lilienthal, Lo, Mellott, Southall

83 Fonda, Hacker, Shreiner

84 Henry, Harnish, Martin

85 Albrite, Holderman

86 Hoppe, Marra

87 Jenkins, Paulus, Vega

88 Criddle, Khamis

89 Barber, Casey, Kueakomoldej, Kurian

90 McGarry, Rose

91 Aldrich, Higley, Sobek

92 Dickey, Greaser, Kantner, Southwick

93 Vogan, Curry

94 Hurst, Vollert

95 Wiley, Bunch, Derstine, Higgs, Kerlen, Workman

96 Ports, Quintilian, Whittle, Yoder

Evidence-Based Nursing Care

Hollinger Lounge; 2:40 – 4:00

97 Rechenberg, Miller, Nguyen, Carman

98 Kidwell, Stock, Smith

99 McGowan, Lorson, Smith, Morin

100 Olson, Kelpen, Landes, Smith

101 Eichorn, Kirsch, Cunningham

102 Cummings, Cornman, Toburen

103 Muchmore, Starr, Stouffer

104 Adel, Silvera, Moyer

105 Bornman, Haught, Dinger

106 Karper, Harmon, Faught, Ramey

107 Sechrist, Barrows, Carbaugh, Crowley, Nieman

Natural Sciences

Hollinger Atrium & Hollinger Lounge; 2:40 – 4:00

19 Sredenschek

43 Leaman

45 Nisly

46 O'Boyle

47 Rhodes

48 Orner

49 Sweitzer

51 Hevenor

52 Manfredo

53 Lawell

61 Sommerville

64 Darok

65 Jones

66 Le

67 LaRow

68 Lohr

69 Stewart

72 Sawicki

108 Herr

109 Tritt

110 Sponsler

111 Smith

112 Steckbeck

113 Blanchfield, Wagner, Norton, Beckner

114 Hartman, Aytes, Sergent, Marley, Wurtz

115 Mayo

116 Walter

117 Monko

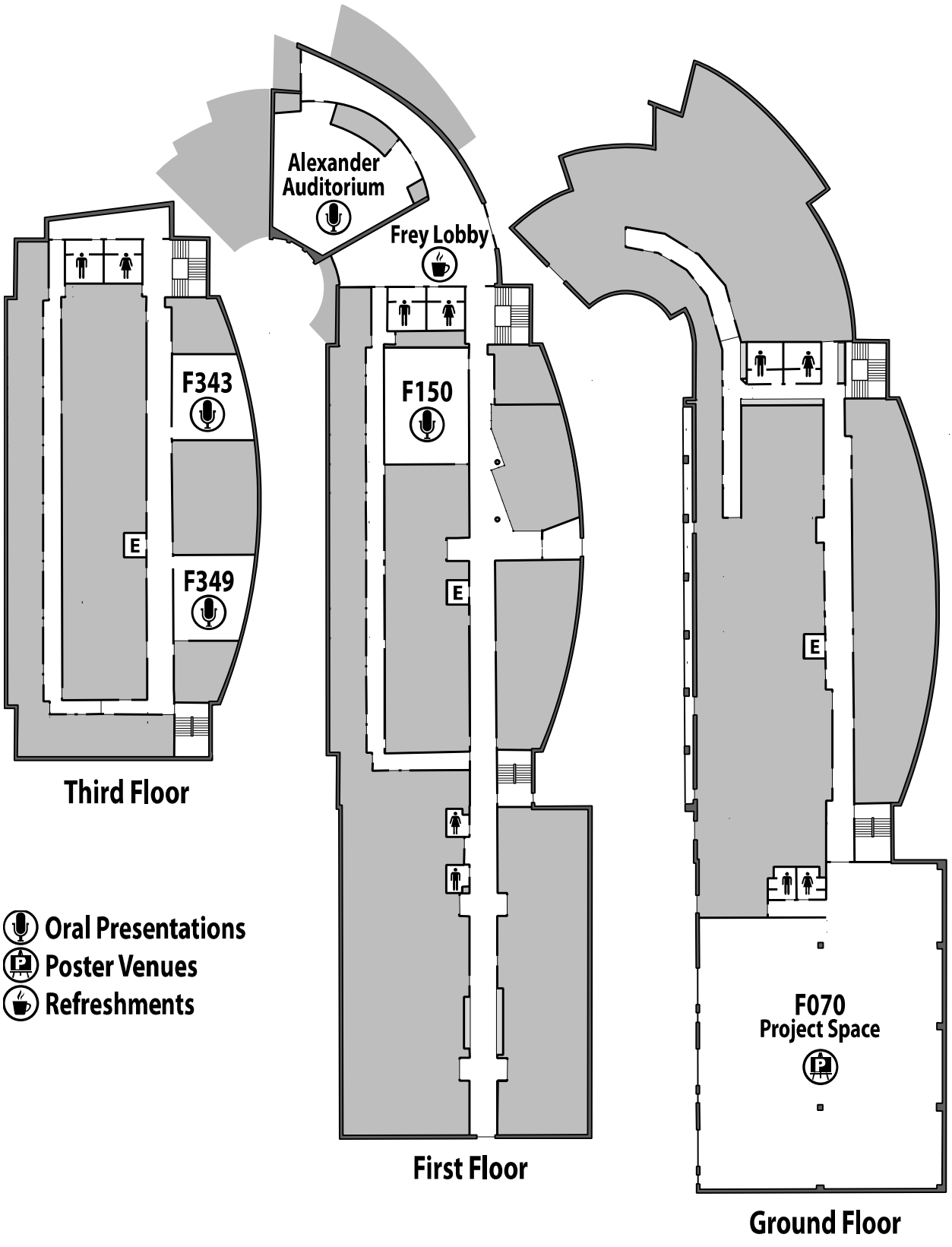
118 Armstrong

119 Taylor

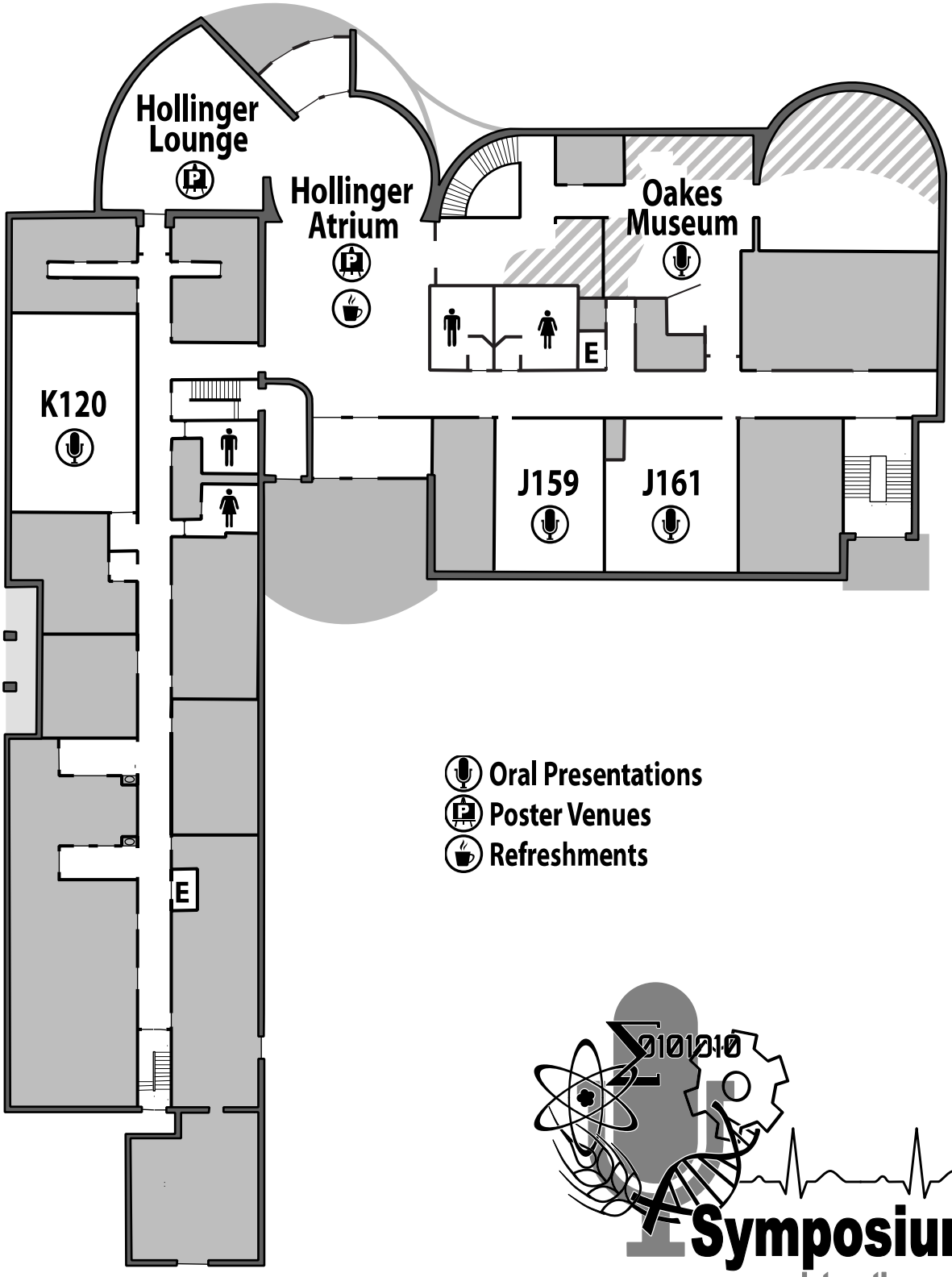
120 Cortez

121 Kerkeslager

Frey Hall


Alexander Auditorium
Frey Lobby
F343
F349
F150
E
Third Floor
First Floor
Ground Floor
F070
Project Space
Oral Presentations
Poster Venues
Refreshments

Jordan Science Center • Kline Hall of Science



Symposium
sixteenth annual

Oral Presentations (Morning)

Engineering I

Alexander Auditorium (Frey 110); 8:15 – 11:30

1 **8:20** *PumpMinder*
Robert MacBride, **Shane Braunworth**, **Matthew Eshleman**, Randall Fish†

2 **8:40** *Remote Monitoring of Hand Pumps in West Africa*
Paul Zwart, **Roque Dietrich**, **Nicholas Sum**, Daniel Labrie, Randall Fish†
76

3 **9:00** *Muscle-Activated Prosthetic Hand for 11 Year Old Client*
Erin Cressman, Emily Farrar†, Dereck Plante†
96

4 **9:20** *Safety Testing of 3D Printed Prosthetic Sockets*
Erik Dyrli, **Thomas Pond**, **Jared Rider**, Andy Erikson†, Emily Farrar†
93

5 **9:40** *Village Water Ozonation Systems: The Challenges of International Water Projects*
Daniel Ma, **Brandon Blackhurst**, **Daniel Mewha**, Michelle Lockwood†
88

6 **10:00** *Cunningham Clubfoot Brace*
Katherine Prelog, **Dylan Gillisse**, Tim Howell†
82

7 **10:20** *Flight Following System Redesign*
Jonathan Carter, Harold Underwood†
86

8 **10:40** *Developing a Low-Cost Optical HIV Viral Load Detection System*
Caleb Bornman, **Lily Gaudreau**, Matthew Farrar†
79

9 **11:00** *Panama Bridge Project*
Seth Brewster, **Eric Denlinger**, **Troy Harris, Jr.**, **Calvin Trimble**, Brent Basom‡†, Steve Deller‡†, Jeff McIlhenny‡†, Mark Raup‡†, Doug Stumpp‡†, Brian Swartz†, Russell Woleslagle‡†
75

Computer & Information Science

Frey 150; 8:15 – 10:00

10 **8:20** *Sherlock*
James Gelok, **Jared Butler**, **Sam Mahan**, **Donovan Varney**, Joel Worrall†, Trevor Bunch†

11 **8:40** *Just-Eat-It*
Nik Sloop, Joel Worrall†, Trevor Bunch†

12 **9:00** *Serve Central*
Tyler Collins, **Garrett Reichert**, **Rebekah McClelland**, **Nicholas Desola**, **Andrew Douglass**, Joel Worrall†, Trevor Bunch†

13 **9:20** *Wildereef Kombucha*
Thomas Wood, **Brandon Baumer**, **Andrew Hoffman**, Trevor Bunch†, Joel Worrall†

14 **9:40** *Board Game Fact Checker*
Wyatt Derk, Trevor Bunch†, Joel Worrall†, **Joshua Simmons**, **Ibi Braide**, **Benjamin Underwood**, **Eliezer Mwankenja**

Physics

Frey 343; 8:15 – 10:00

15 **8:20** *Development of Prototype Cerenkov Detector for High Energy Cosmic Rays*
Brandon Weindorf, **Aeowyn Kendall**, Abaz Kryemadhi†, Harry Hawbecker, Trieu Luu

16 **8:40** *Development of a Compact Cosmic Ray Muon Detector*
Trieu Luu, Abaz Kryemadhi†

17 **9:00** *Characterization of New Crystal Detectors for Gamma Ray Studies in Space*
Nathan Chan, Abaz Kryemadhi†

18 **9:20** *Fluorescence-Rayleigh Correlated Burst Analysis Spectroscopy for Quantification of Ultra-low Concentration Species*
Kyler Shea, Matthew Farrar†

19 **9:40** *Growth of titanium boride thin films by magnetron co-sputtering*
Alexander Sredenschek, Niklas Hellgren†

Mathematics

Frey 349; 8:15 – 11:00

20 **8:20** Σ *Sudoku Puzzles and Graph Coloring*
Amanda Petersen

21 **8:40** Σ *Solutions to the Wave Equation*
Emily Wichert

22 **9:00** Σ *The Shannon Switching Game*
Daniel Diethrich

23 **9:20** Σ *Properties of Adjacency and Incidence Matrices*
Brooke Firestone

24 **9:40** Σ *Partial Differential Equations and Fourier Series*
Olivia Essig

25 **10:00** Σ *Tweet the Bridge of Polarization? Two-Way ANOVA Test on the U.S. Political Partisanship*
Xin-dee Low

26 **10:20** Σ *Calculus of Variations*
Alexander Sredenschek

27 **10:40** Σ *Statistics on Type-B Permutation Tableaux*
Ryan Althoff, **Daniel Diethrich**, **Emily Wichert**, Xin-dee Low, Amanda Lohss†

Engineering II

Frey 150; 10:40 – 11:30

28 **10:40** ⚙ *Living Love Ministries - Kenya Land Development*
Jonathan Robinson, **Justin Blest**, **Cheylee Smith**, Madalyn Heckman, J Scott Heisey†

29 **11:00** ⚙ *Fire Protection for Developing Communities*
Jacob Film, **Lake Bender**, **Victor Defrance**, **Conner Reyer**, Samuel Burgess, Caleb Danehower, Robert Donley, Donald Waardenburg†

Oral Presentations (Afternoon)

Special Session: Promoting the Common Good

Hostetter Chapel; 1:20 – 2:40

1:20 *Welcome*

1:25 *Safe, affordable drinking water in Oaxaca, Mexico*
Daniel Ma

The Village Water Ozonation Systems project team applies engineering and interdisciplinary skills to help communities access safe, affordable drinking water. By collaborating with NGOs and local leaders, the team aims to deliver sustainable solutions to make lasting impacts in communities. Our team has previously installed an ozone disinfection system at a children's ministry site in Oaxaca, Mexico and is working towards implementing another system at a nearby church.

1:37 *Understanding the aggressiveness of pancreatic cancer*
Rebekah Jones

The dismal survival rate of pancreatic cancer drives our endeavors to understand the contribution of a hormone-signaling pathway to the aggressiveness of this cancer. In particular, we explore a possible correlation between a small genetic change, presence of an abnormal hormone receptor, and increased risk of pancreatic cancer. In this study, genetic analysis of patient samples lends support to the correlation. However, these and other data from our lab suggest a complicated multiple-factor phenomenon is likely at work, and our recent detection of the abnormal receptor in allegedly normal tissue samples spurs new questions in our efforts to battle this disease.

1:49 *MTSS risk-factor determination for collegiate volleyball athletes*
Jackson Lohr

Medial Tibial Stress Syndrome (MTSS), often referred to as shin splints, is a commonly occurring chronic musculoskeletal condition in the active population. This study was conducted to determine the presence of known risk factors for MTSS in a population of collegiate volleyball athletes. Risk factors evaluated included ankle and hip range of motion, body mass index, and arch structure within the foot. Recognition of potential injury-causing risk factors allows clinicians to implement preventive and corrective strategies that may ultimately reduce time lost to injury and healthcare expenses.

2:01 *Improving opioid withdrawal by use of standardized protocols*

Blake Stock and Kylee Kidwell

Opioid abuse is an epidemic in the US. When hospitalized patients who are addicted to opioids begin to withdraw, recognition of the root cause of their symptoms is imperative to successful treatment. This presentation will describe an evidence-based clinical opioid withdrawal scale, as well as the pharmacological treatment for hospitalized patients experiencing opioid withdrawal.

2:13 *Protein engineering of biochemical catalysts*

Beau McCarver

Our ability to engineer proteins with desirable binding interactions or catalytic activities have led to advances in medicine and chemical processing technologies. Recently, heme proteins with the central iron substituted for other metals have been engineered to display a broad potential for chemical catalysis, but their production is too inefficient and expensive for use in the chemical or pharmaceutical industry. This work focuses on the efficient production of a cobalt-substituted heme protein for renewable fuel catalysis applications using engineered heme protein biosynthesis enzymes.

2:25 *Flood water management for area non-profit ministry*

Brenden Good

Paxton Ministries is a non-profit organization and currently has temporary flooding problems that occur following appreciable rainfall events from a storm drainage pipe discharging onto their property. Based upon review of initial preliminary designs, Paxton Ministries directed the team to develop a design for a long-term solution, identified as the Spring Creek Discharge Design. The team has prepared design drawings to construct the project and has submitted the drawing package to Paxton Ministries to allow for final design and permitting to be completed by a professional engineering firm, as well as refine the construction cost estimate to explore sources of funding for the project.

Engineering III

Alexander Auditorium (Frey 110); 1:00 – 2:40

30 **1:00** *The Prosthetic Knee Project* — 74
Vaughn Chambers, Miranda Chiang, Nyles Rife, Jamie Williams†

31 **1:20** *Destruction of Landmines with the Hybrid Thermal Lance* — 89
Rachel Siepelinga, **Daniel Sidell**, Donald Pratt†

32 **1:40** *Sustainable Mobility for Persons Living with Disability in West Africa* — 95
William Feczko, **Brit Haseltine**, **Alexander Mantsevich**, John Meyer†, David Vader†

33 **2:00** *Pico Hydro Design for the Developing World* — 92
Andrew Reedy, **Ben Morral**, Dan Elliott‡†, Robert Hentz‡†, Wil Kirchner‡†, David Vader†

34 **2:20** *Design of a Solar Powered Water Pumping System for Living Love Ministries in Ol Kalou, Kenya* — 73
Steven Carpenter, **Collin Binford**, David Vader†

Engineering IV

Frey 150; 1:00 – 2:40

35 **1:00** *Sawyer Point One Water Filter Test System*
Joseph Franken, **Nathan King**, Thomas Soerens†

36 **1:20** *Design of a Gravity Fed Water System to Deliver Safe Drinking Water to Villages in Vanuatu* — 91
Nathan Hardman, **Jamar Gittens**, **Kurtis Platteel**, Thomas Soerens†

37 **1:40** *Mechanized Percussion Well Drilling* — 84
Cole Hiduk, Philip Tan†

38 **2:00** *Nicaragua Manual Block Press* — 90
Joshua Charney, Philip Tan†

39 **2:20** *Energy Monitoring and Management System* — 81
Joseph Wambach, **Trieu Luu**, **Justin Martin**, Thomas Austin‡†

Exercise Science

Kline 120; 1:20 – 2:40

40 **1:20** *HIITing it on the head: High intensity interval training and the brain*
Nate Romberger, Doug Miller†

41 **1:40** *THE APHS Senior Seminar Personal Training Project- does it work?*
Dani Kreiger, Doug Miller†

42 **2:00** *Perceived benefits from a 6-week synchronized swimming fitness class*
Erin Parry, Melinda Smith†

43 **2:20** *The influence of caffeine on task performance*
Kara Leaman, H. Scott Kieffer†, Jesse Torbic, Alyssa Cunningham, Emily Davis, Carissa Weaver, Jessica Eby

Chemistry

Jordan 159; 1:20 – 2:40

44 **1:20** *Assessing aggregation of quinazoline inhibitors of Protein Tyrosine Phosphatase 1B through a Nuclear Magnetic Resonance assay*
Ashley Martin, Jesse Kleingardner†, Matthew Farrar†, Anne Reeve†

45 **1:40** *Synthesis and Characterization of Carbon Nitride Electrodes for Efficient Oxygen Reduction*
Josiah Nisly, Richard Schaeffer†, Niklas Hellgren†

46 **2:00** *XPS characterization of alkanethiolate self-assembled monolayers on zinc selenide thin films*
Sarah O'Boyle, Niklas Hellgren†, Alison Noble†

47 **2:20** *AFM characterization of variable-head / variable-etch self-assembled monolayers on ZnSe*
Bailey Rhodes, Alison Noble†, Niklas Hellgren†

Cellular Immunology

Jordan 161; 1:20 – 2:40

48 **1:20** *Immunotherapy targeting an insertion sequence in an altered tumor-associated growth receptor associated with aggressive pancreatic cancers*
Amber Orner, Justin Sweitzer, John Harms†, Lawrence Mylin†

49 **1:40** *In Search of Improved Strategies to Induce T Cell Immunity Targeting a Receptor Expressed by Aggressive Pancreatic Cancer Cells*
Justin Sweitzer, Lawrence Mylin†

50 **2:00** *Insertion of a target for immunotherapy of pancreatic cancer into an oncoprotein to produce a tumor cell-based vaccine*
Ashlee Leib, Lawrence Mylin†

51 **2:20** *Understanding the Role of CD4+ T Cells in Regulating Cellular Immune Responses to Tumors*
Laura Hevenor, Justin Sweitzer, Lawrence Mylin†

Organismal Biology

Oakes Museum; 1:20 – 2:40

52 **1:20** *Identifying sexual dimorphism in the skin patterning and pigmentation of the Panamanian golden frog, Atelopus zeteki*
Nicole Manfredo, Erik Lindquist†

53 **1:40** *Using Hotspotter Recognition Software as Means of Noninvasive Identification of Strawberry Poison Frogs (Oophaga pumilio)*
Emma Lawell, Erik Lindquist†

54 **2:00** *Quantifying differences in gray squirrel (Sciurus carolinensis) response to sympatric avian alarm calls*
Daniel Fliehler, Jeff Erikson†

55 **2:20** *Vegetative Propagation of Cocoa in an Aquaponics System*
Cooper Robbins, David Foster†

Engineering V

Alexander Auditorium (Frey 110); 4:00 – 5:20

56 **4:00** *Paxton Ministries Site Drainage*
Brenden Good, **Kimberly Cunningham**, **Eric Weaver**, Crosby Harro, J Scott Heisey[†]

57 **4:20** *Oakwood Hills Pedestrian Access*
Justin Witters, **Adam Barley**, **Treavor Moore**, Ben Holderman[‡†], L. Bryan Hoover[‡†]
77

58 **4:40** *Sight and Sound Remote Latching System*
Ben Schott, **Brandin Dyche**, **George Noble**, Timothy Van Dyke[†]
94

59 **5:00** *Sustainable Agriculture*
Lexi Bane, **Daria Eshelman**, **Isaac Underhill**, Michelle Lockwood[†]
83

Biochemistry

Kline 120; 4:00 – 5:20

60 **4:00** *Conversion of Heme b to Heme c in Mycobacterium tuberculosis catalase peroxidase*
Priscila Crawford, Jesse Kleingardner[†]

61 **4:20** *Template-based engineering of stacked c-type hemes*
Chelsea Sommerville, Jesse Kleingardner[†]

62 **4:40** *Changing the metal specificity of the calcium-binding protein Twitch-2B*
Hannah Martin, Jesse Kleingardner[†]

63 **5:00** *Direct Expression of Cobalt-Substituted Cytochrome c using Variants of Holo-Cytochrome c Synthase*
Beau McCarver, Jesse Kleingardner[†]

Cancer Biology

Jordan 159; 4:00 – 5:20

64 **4:00** *Evidence for the role of gastrin signaling in the uniquely fibrotic pancreatic tumor microenvironment*
Matthew Darok, John Harms†

65 **4:20** *Prevalence of a variant gastrin receptor RNA and correlating genomic polymorphism in human pancreatic cancer*
Rebekah Jones, John Harms†

66 **4:40** *Cloning a fluorescent fusion protein for detection and localization of the gastrin receptor*
Vinh Le, John Harms†

67 **5:00** *Clarifying the connection between oncogenic K-ras and gastrin/CCK2R signaling in pancreatic tumorigenesis*
Andrew LaRow, John Harms†

Health and Infectious Disease

Jordan 161; 4:00 – 5:00

68 **4:00** *Prevalence of Common Risk Factors of Medial Tibial Stress Syndrome in Collegiate Volleyball Players*
Jackson Lohr, Matthew Lewis†

69 **4:20** *Towards generating a neutralizing antibody against bacteriophage T4: working out a small-scale screening assay*
Dominique Stewart, Lawrence Mylin†

70 **4:40** *Collection and cryopreservation of human blood for in vitro cultivation of Plasmodium falciparum: a shelf life study*
Madison Scialanca, Annalise Armstrong, Lawrence Mylin†

Genetics and Neuroscience

Oakes Museum; 4:00 – 4:40

71 **4:00** *Heavy Metal Ion Toxicity and its Effect on Arabidopsis thaliana mutants rack1b, rack1c, and mtp1*
Christina Perez, Michael Shin†

72 **4:20** *Role of Lck in Oligodendrocyte Progenitor Migration*
Abigail Sawicki, Jennifer Ness-Myers†

Poster Presentations

Engineering

Frey 070 Project Space; 11:30 – 12:00, 2:40 – 4:00

73 *Design of a Solar Powered Water Pumping System for Living Love Ministries in Ol Kalou, Kenya* — 34
Christopher Benner, **Joshua Kripas**, **Meghan Sampson**, **Trey Witmer**, Cade Bender, Matt Laven, David Vader[†]

74 *The Prosthetic Knee Project* — 30
Bryson Boettger, **Matthew Tavani**, Miranda Chiang, Nyles Rife, Jamie Williams[†]

75 *Panama Bridge Project* — 9
Erin Brenneman, **Samuel Gobeille**, **Nathan Myers**, Brent Basom[‡†], Steve Deller[‡†], Jeff McIlhenny[‡†], Mark Raup[‡†], Doug Stumpp[‡†], Brian Swartz[†], Russell Woleslagle[‡†]

76 *Remote Hand Pump Monitoring in West Africa* — 2
Cory Brubaker, **Amanda Issis**, Daniel Labrie, Randall Fish[†]

77 *Oakwood Hills Pedestrian Access* — 57
Matthew Burlew, **Christian Cornelius**, Ben Holderman[‡†], L. Bryan Hoover[‡†]

78 *All-terrain, Customizable Wheelchair for Wheels for the World*
Emily D'Amico, **Carlie Adair**, **Sam Fino**, **Ivan Chun Hao Oon**, Timothy Van Dyke[†]

79 *Developing a Low-Cost Optical HIV Viral Load Detection System* — 8
Alicia Decker, **Nathan Chan**, **Brant Meier**, **Morris Taylor**, Jordan Sponsler, Matthew Farrar[†], Jesse Kleingardner[†]

80 *Optimization of the Design of a Solar Oven for Refugees Use in the Kiziba Camp, Rwanda*
Miriam Dixon, **Justus Danielsen**, **Jason Landis**, **Mitchell Lauer**, Tim Howell[†]

81 *Energy Monitoring and Management System* — 39
Nathen Feldgus, **Zachery Holsinger**, **Zachary Schmidt**, **Ben Weaver**, Thomas Austin[‡†]

82 *Cunningham Clubfoot Brace* — 6
Aaron Bashore, **Rebekah Forshey**, **Liam Lilienthal**, **Michelle Lo**, **Benjamin Mellott**, **Leigha Southall**, Kay Laura Sindabizera, Tim Howell[†]

83 *Sustainable Agriculture: Soil Free Farming*
Jared Fonda, **Landon Hacker**, **Noah Shreiner**, Michelle Lockwood†

84 *Mechanized Percussion Well Drilling*
Nathan Henry, **Nate Harnish**, **Chris Martin**, Philip Tan†

85 *Living Love Ministries - Kenya Land Development*
Isaac Albrite, **Jacob Holderman**, Madalyn Heckman, J Scott Heisey†

86 *Flight Following System Redesign*
Matt Hoppe, **Eric Marra**, Harold Underwood†

87 *Fluency Assistive Device (FAD)*
Michael Jenkins, **Jessica Paulus**, **Larry Vega**, Harold Underwood†

88 *Village Water Ozonation System*
Jordan Criddle, **John Khamis**, Michelle Lockwood†

89 *Disarming Improvised Explosive Devices (IEDs)*
Justin Barber, **Hunter Casey**, **Nuttapat Kueakomoldej**, **Andrew Kurian**, Donald Pratt†

90 *Nicaragua Manual Block Press*
John McGarry, **Kathryn Rose**, Philip Tan†

91 *Design of a Gravity Fed Water System to Deliver Safe Drinking Water to Villages in Vanuatu*
Sarah Aldrich, **Jordan Higley**, **Ella Sobek**, Thomas Soerens†

92 *Pico Hydro Design for the Developing World*
Robert Dickey, **Johnny Greaser**, **Cameron Kantner**, **Caleb Southwick**, Dan Elliott‡†, Robert Hentz‡†, Wil Kirchner‡†

93 *Design of 3D Printed Orthotics and Bacterial Testing on Silicone Liners for CURE Kenya*
Emma Vogan, **Shane Curry**, Andy Erikson†, Emily Farrar†

94 *Sight and Sound Remote Latching System*
Cory Hurst, **Alexander Vollert**, Timothy Van Dyke†

95 *Sustainable Mobility for Persons Living with Disability in West Africa*
Helen Wiley, **Katie Bunch**, **Dylan Derstine**, **Matthew Higgs**, **Faith Kerlen**, **Emma Workman**, John Meyer†, David Vader†

96 *Design of Muscle Activated Prosthesis*
Nicholas Ports, **TJ Quintilian**, **Samuel Whittle**, **Ryan Yoder**, Emily Farrar†, Dereck Plante†

Evidence-Based Nursing Care

Hollinger Atrium & Hollinger Lounge; 2:40 – 4:00

97 *The Impact of Music Intervention on Pain and Anxiety in Laboring Women*
Carly Rechenberg, **Sarah Miller**, **Angela Nguyen**, **Andrea Carman**

98 *The Benefits of Using a Standardized Symptom-Triggered Opioid Withdrawal Protocol to Reduce Length of Detox and Hospital Stay and Increase Patient and Staff Satisfaction*
Kylee Kidwell, **Blake Stock**, **Kierra Smith**

99 *Smoking Cessation and the Cardiovascular Patient*
Danielle McGowan, **Olivia Lorson**, **Emily Smith**, **Molly Morin**

100 *The Importance of Education in Patients Experiencing Psychogenic Nonepileptic Seizures*
Imogen Olson, **Elizabeth Kelpen**, **Shelby Landes**, **Madeleine Smith**

101 *Order Sets for End-of-life: Improving the Patient Experience*
Lydia Eichorn, **Sierra Kirsch**, **Aja Cunningham**

102 *Reporting Workplace Violence*
Alexandria Cummings, **Megan Cornman**, **Natalie Toburen**

103 *Evidence-Based Recommendations to Shorten Pre-Procedural Fasting Times of Procedures Using Anesthesia or Conscious Sedation*
Elizabeth Muchmore, **Isaac Starr**, **Shelby Stouffer**

104 *Safe Administration of Outpatient Parenteral Antibiotic Therapy (OPAT) Through a PICC Line in Patients with a History of Intravenous (IV) Drug Use*
Tabitha Adel, **Ella Silvera**, **Katie Moyer**

105 *Evidence-Based Interventions to Increase Laboring Women's Satisfaction*
Gabrielle Bornman, **Katie Haught**, **Madison Dinger**

106 *The Use of Fish Oil to Prevent Atrial Fibrillation in Post-operative Cardiac Patients*
Hayley Karper, **Jenna Harmon**, **Eric Faught**, **Hannah Ramey**

107 *Effective Interventions on Maintaining Skin Integrity Among Preterm Infants in the NICU*
Katie Sechrist, **Rebecca Barrows**, **Maggie Carbaugh**, **Brooke Crowley**, **Blair Nieman**

Posters

Natural Sciences

Hollinger Atrium & Hollinger Lounge; 2:40 – 4:00

19 *Growth of titanium boride thin films by magnetron co-sputtering*
Alexander Sredenschek, Niklas Hellgren†

43 *The influence of caffeine on task performance*
Kara Leaman, H. Scott Kieffer†, Jesse Torbic, Alyssa Cunningham, Emily Davis, Carissa Weaver, Jessica Eby

45 *Synthesis and Characterization of Carbon Nitride Electrodes for Efficient Oxygen Reduction*
Josiah Nisly, Richard Schaeffer†, Niklas Hellgren†

46 *XPS characterization of alkanethiolate self-assembled monolayers on zinc selenide thin films*
Sarah O'Boyle, Niklas Hellgren†, Alison Noble†

47 *AFM characterization of variable-head / variable-etch self-assembled monolayers on ZnSe*
Bailey Rhodes, Alison Noble†, Niklas Hellgren†

48 *Immunotherapy targeting an insertion sequence in an altered tumor-associated growth receptor associated with aggressive pancreatic cancers*
Amber Orner, Justin Sweitzer, John Harms†, Lawrence Mylin†

49 *In Search of Improved Strategies to Induce T Cell Immunity Targeting a Receptor Expressed by Aggressive Pancreatic Cancer Cells*
Justin Sweitzer, Lawrence Mylin†

51 *Understanding the Role of CD4+ T Cells in Regulating Cellular Immune Responses to Tumors*
Laura Hevenor, Justin Sweitzer, Lawrence Mylin†

52 *Identifying sexual dimorphism in the skin patterning and pigmentation of the Panamanian golden frog, Atelopus zeteki*
Nicole Manfredo, Erik Lindquist†

53 *Using Hotspotter Recognition Software as Means of Noninvasive Identification of Strawberry Poison Frogs (Oophaga pumilio)*
Emma Lawell, Erik Lindquist†

61 *Template-based engineering of stacked c-type hemes*
Chelsea Sommerville, Jesse Kleingardner†

64 *Evidence for the role of gastrin signaling in the uniquely fibrotic pancreatic tumor microenvironment*
Matthew Darok, John Harms†

65 *Prevalence of a variant gastrin receptor RNA and correlating genomic polymorphism in human pancreatic cancer*
Rebekah Jones, John Harms†

66 *Cloning a fluorescent fusion protein for detection and localization of the gastrin receptor*
Vinh Le, John Harms†

67 *Clarifying the connection between oncogenic K-ras and gastrin/CCK2R signaling in pancreatic tumorigenesis*
Andrew LaRow, John Harms†

68 *Prevalence of Common Risk Factors of Medial Tibial Stress Syndrome in Collegiate Volleyball Players*
Jackson Lohr, Matthew Lewis†

69 *Towards generating a neutralizing antibody against bacteriophage T4: working out a small-scale screening assay*
Dominique Stewart, Lawrence Mylin†

72 *Role of Lck in Oligodendrocyte Progenitor Migration*
Abigail Sawicki, Jennifer Ness-Myers†

108 *Inhibition of PTP1B in Drug Development*
Courtney Herr, Anne Reeve†

109 *Mitochondrial apo-cytochrome c vector construction and purification*
Jarred Tritt, Jesse Kleingardner†

110 *Fluorescent Tagging of HIV-1 Using A Novel Recombinant Protein*
Jordan Sponsler, Jesse Kleingardner†, Matthew Farrar†

111 *The effect of the CYP1A2 Polymorphism and caffeine consumption on Anaerobic Exercise Performance*
Caleb Smith

112 *The Effect of Caffeine Ingestion and the ADORA2 Polymorphism on Long Anaerobic Exercise Performance*
Rachel Steckbeck, Kristen Hasse, Caleb Smith, Madison Wright, H. Scott Kieffer†, Michael Shin†

113 *The correlation between core strength and postural stability*
Nate Romberger, **Andrew Blanchfield**, **Roman Wagner**, **Kelsey Norton**, **Madison Beckner**, Joshua Beiler

114 *The effects of acute meditative breathing on heart rate variability*
Sarah Roise Hartman, **Caleb Aytes**, **Madison Sergent**, **Emma Marley**, **Brendan Wurtz**

115 *The cardiometabolic effects of caffeine during submaximal exercise*
Rachel Caldwell, Abigail Beveridge, **Anna Mayo**, Garrett Showalter, Saw Picky, Josette Weaver

116 *The effects of static and dynamic stretching in dancers*
Emily Walter, Laura Sollenberger, Abigail Gibson, Elizabeth Vlieg, Sydney De Poto, Grace Brewster, Emily Lanahan

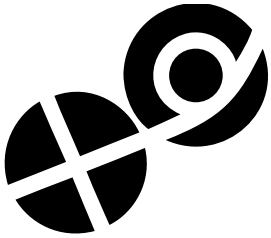
117 *The Influence of Video Distraction on Exercise Performance*
Abby Monko, Shannon Brady, Kristen Cofer, Remington Paul, Meghan Steager, H. Scott Kieffer†, Doug Miller†

118 *Shelf life study of human blood cryopreserved for in vitro cultivation of Plasmodium falciparum*
Annalise Armstrong, Madison Scialanca, Lawrence Mylin†

119 *Optimization of hematoxylin and eosin staining and immunohistochemistry procedures for assessment of vascularity in control samples*
Hannah Taylor, John Harms†

120 *Developmental Expression of Lck and Lyn in the CNS*
Tomas Cortez, Jennifer Ness-Myers†

121 *Aquaponic Rice Cultivation*
Ben Kerkeslager, David Foster†



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The **Collaboratory** is a center for applied research and project-based learning in the School of Science, Engineering and Health at Messiah College. We add value to classroom learning by enabling participants to apply academic knowledge and live out their Christian faith through imaginative, hands-on problem solving that meets needs brought to us by Christian mission, relief and development organizations and businesses. The two-fold mission of the Collaboratory is:

- To foster justice, empower the poor, promote peace, and care for the earth through applications of our academic and professional disciplines.
- To increase the academic and professional abilities of participants, their vocational vision for lifelong servant-leadership, and their courage to act on convictions.

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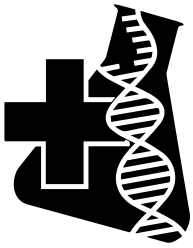

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The Steinbrecher Endowment for Research in the Health and Life Sciences was established at Messiah College in 2003 by Dr. Leroy and Mrs. Eunice Steinbrecher to support collaborative experimental research between students and faculty. Dr. Steinbrecher (Class of 1955) was a physician and longtime supporter of Messiah College. Eunice (Class of 1958) has served on the Board of Trustees at Messiah College continuously since 1987 and as chairperson of the board for 10 years (2000 – 2010).

The Steinbrecher Undergraduate Summer Research Program provides "heads-on, hands-on" research experiences essential to our School's efforts to offer premier undergraduate health and science programs. The research must be experimental and collaborative in nature. Awarded on a competitive basis, the Steinbrecher fellowships provide a stipend supporting full-time research employment for between five and ten weeks of the summer.

Collaboratory Educators, Collaborators & Partners

We gratefully acknowledge the oversight and training provided by Messiah College faculty and external collaborators.

Project Partners

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See Collaboratory Project Managers (p. 28) for faculty from the **Department of Engineering**.

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United Way of Capital Region	*

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Abstracts

Ordered by Presentation Number.

1 ***PumpMinder***

Robert MacBride, **Shane Braunworth**, **Matthew Eshleman**, Randall Fish†

Many NGOs install equipment to provide access to clean water and wish to have the ability to continue to provide clean water for many years to come. Therefore, our project aims to continue the sustainability of the installed hand pumps in rural Ghana, while our client, Water4, hopes to lay the foundation for sustained access to clean water for the community. We hope that by charging fees for water usage to help maintain the pump, we will provide not only the clean water needed for each community, but also a dependable source of work for community members. PumpMinder's goal is to enable Water4 to meter hand pump use in order to collect maintenance fees and ensure the long-term presence of water assets. The PumpMinder team has designed a device necessary to monitor the fees charged by the local pump minder. As the project continues, we have been working to refine and increase the functionality of its units and accelerate the growth of the project by defining a more consistent manufacturing process.

2 ***Remote Monitoring of Hand Pumps in West Africa***

Paul Zwart, **Roque Dietrich**, **Nicholas Sum**, Daniel Labrie, Randall Fish†

Although millions of households in sub-Saharan West Africa rely on hand pumps installed by various non-government organizations, 30 to 50 percent of these pumps are currently inoperative. Under the sponsorship of AlignedWorks, the Intelligent Water Project (IWP) is continuing to develop remote monitoring devices that track the usage and health of hand pumps. These devices allow organizations to catch pump failure early so that these water pumps can remain operational, continually providing fresh water. After installing thirteen of these devices in the summer of 2017, the IWP has been working to correct problems that were discovered from these field tests, while also improving system accuracy and robustness, and preparing for mass manufacturing.

3 ***Muscle-Activated Prosthetic Hand for 11 Year Old Client***

Erin Cressman, Emily Farrar†, Dereck Plante†

Due to the rapid growth of children, and the complexity of myoelectric technology, children are not given the same opportunities to use myoelectric prosthetics as adults. The Muscle Activated Prosthesis (MAP) team is working to create an affordable, trans-radial myoelectric prosthesis for an eleven-year-old girl. The basic mechanism by which this device operates is as follows: a muscle contraction emits an electrical signal that will be detected and used to control the hand in various set patterns of grip. Comprised in this device will be an EMG sensor, electrodes, a development board, motors and tendons to emulate finger motion, feedback, and a battery. We have created a prototype "bionic hand" prosthesis that will be tested by our client in summer 2019.

4 ***Safety Testing of 3D Printed Prosthetic Sockets***

Erik Dyrli, **Thomas Pond**, **Jared Rider**, Andy Erikson†, Emily Farrar†

The ROCK (Rapid Orthotics for CURE Kenya) team is partnered with CURE International's Orthopedic workshop in Kijabe, Kenya to create a system that rapid-prototypes customized prosthetic and orthotic devices using a 3D scanner, several 3D manipulation programs, and a 3D printer. We specialize in transtibial sockets (below the knee) and ankle-foot orthotics (AFOs). The orthopedic technicians are trained in producing 3D printed sockets and have successfully created a transtibial socket from start to finish using our system as of September 2018! Since prosthetics replace a missing appendage, they have a higher priority of verifying patient safety in its use because they need to be able to withstand the weight of the patient, unlike orthotic devices. For this reason, we are running our prosthetic sockets through different mechanical tests to ensure it aligns with international safety standards. Once our sockets meet or exceed these standards, we will be confident in recommending our 3D printing system's product for everyday use by patients around the world.

5 ***Village Water Ozonation Systems: The Challenges of International Water Projects***

Daniel Ma, **Brandon Blackhurst**, **Daniel Mewha**, Michelle Lockwood†

Safe drinking water is a basic human necessity. People around the world face issues like water scarcity, severe contamination, and limited access on a daily basis. Alleviating global water-related illnesses and deaths remains a prevailing challenge to overcome. Therefore, the Village Water Ozonation Systems (VWOS) team contributes to the worldwide effort to increase access to safe drinking water. For the past two years VWOS had the privilege of walking alongside our partner communities in Mexico, Pakistan, and Nicaragua to develop sustainable drinking water solutions. Through collaborations with several Christian organizations such as Forward Edge International in Mexico, Full Gospel Assemblies of Pakistan and, more recently, Friends in Action International in Nicaragua, the team has acquired an increased awareness of drinking water needs and issues across the world. Each individual partnership presents unique challenges with regards to culture, economics, and local environment that require a complete understanding of our partners' needs, the proper application of water treatment knowledge, and the prioritization of health in all aspects of the design process. In order to address the unique challenges facing each of our partners, the team relies on past experience as well as new research to develop the most appropriate solution, evaluating the feasibility of a project from technical, financial, and cultural perspectives.

6 ***Cunningham Clubfoot Brace***

Katherine Prelog, **Dylan Gillisse**, Tim Howell†

Clubfoot is a musculoskeletal birth defect that describes several foot abnormalities characterized by an inward-rotated foot. The current method for correction involves several casts and a boots-and-bar maintenance brace. This method requires 5 years of bracing and has issues with compliance, comfort, and social stigma. The Cunningham brace reduces treatment time to 2-3 years. It can be concealed, reducing the social stigma, and improves the child's mobility while encouraging muscle growth and development throughout treatment. The Collaboratory Cunningham Clubfoot Brace project seeks to increase accessibility to the brace and test the effectiveness of the design. The project has shown that the brace can be 3D printed using a reinforced nylon polymer. The 3D models developed by the team have allowed our client and brace designer, Mr. Jerald Cunningham, to move forward with injection molding of the three parts of the brace. Currently, we are working on validating the Cunningham Brace by measuring the biomechanical forces created and applied by the brace. This will happen through a series of pressure sensors that are attached to the brace and then placed on a child's foot. Along with a clinical study that was started in Kijabe, Kenya and the patient data analysis being conducted by Dr. Emily Farrar, this data will hopefully provide the needed evidence that the Cunningham Brace works so that it will be more widely accepted and used for treatment around the world.

7 ***Flight Following System Redesign***

Jonathan Carter, Harold Underwood†

Outside radar range, small planes flying in remote locations must be tracked by other means. Emergency relief, humanitarian development, and missionary organizations need to follow such flights, for safety and management. The Automatic Flight Following System (AFFS) owned by JAARS has been safety tested and used extensively for this purpose but has been replaced in many cases by new options. Thus, the Flight Tracking and Messaging Systems (FTMS) team has been working with stakeholder Cary Cupka to redesign AFFS 1.0 with updated and more advanced technology modes to increase its value in the field. For proof of concept testing, this includes replacing internal components of the existing AFFS Aircraft Control Unit (ACU) with a new single board computer (SBC A62), upgraded custom display board, and new HF transceiver (LimeSDR). In addition, the ground monitoring unit will have a matched LimeSDR HF transciever, and UDOO QUAD computer with display. Currently the team is developing code for the aircraft (FLIGHTsoft), for the ground unit (GROUNDsoft), and configuring the HF communications link.

8 ***Developing a Low-Cost Optical HIV Viral Load Detection System***

Caleb Bornman, **Lily Gaudreau**, Matthew Farrar†

The DVD project is partnering with the Macha Mission Hospital in rural Zambia to create a point-of-care (POC) device to quantitatively detect the presence of HIV from a human blood sample. The device aims to provide results in under an hour using fluorescence correlation spectroscopy (FCS) as the mode of quantification. Essential to this process is the use of a fluorescently-tagged protein probe which attaches to the virus and is measured by single-photon sensitive

detectors. Traditional detectors are expensive and have power requirements not suitable to a POC device. As such, we have developed a novel silicon photomultiplier sensor for capturing the photons and registering their arrival by a digital pulse. To test the efficacy and limits of our device in a pre-clinical setting, we developed a nanoparticle simulating Human Immunodeficiency Virus (HIV) and preliminary tests have been performed. Ongoing research aims to integrate each step of the methodology into a finalized POC device.

9 ***Panama Bridge Project***

Seth Brewster, **Eric Denlinger**, **Troy Harris, Jr.**, **Calvin Trimble**, Brent Basom[‡†], Steve Deller[‡†], Jeff McIlhenny[‡†], Mark Raup[‡†], Doug Stumpp[‡†], Brian Swartz[†], Russell Woleslagle[‡†]

The Panama Bridge project has partnered with Rio Missions Panama to design a bridge for the village of Peñas Blancas, Panama. The mountain community of Peñas Blancas experiences heavy rainfall during the rainy seasons. A stream runs along the community, with mountainside homes to the north, and the main village to the south. While passable during dry seasons, the stream floods and becomes impassable after heavy rains. The mountain residents are effectively cut off from the village during this time.
To accommodate this need, the Panama Bridge Team has spent the 2018-2019 school year designing an aluminum truss bridge, spanning 80 feet. The design includes a unique construction strategy to deal with challenging site constraints.

10 ***Sherlock***

James Gelok, **Jared Butler**, **Sam Mahan**, **Donovan Varney**, Joel Worrall[†], Trevor Bunch[†]

We built an application that can store and serve testable multi-sided flashcard decks of reliable information to maximize user memory and performance. Human memory is transient and fallible. German psychologist Hermann Ebbinghaus discovered just how transient memory is. His (and repeated studies) concluded that humans tend to halve their memory of newly learned knowledge in a matter of days or weeks unless they consciously review the learned material. This is illustrated by what is known in neuroscience as the forgetting curve. Our application utilizes a method called Spaced Repetition to serve users in increasing intervals the cards they should review based on how many times in a row they got the flashcard correct in order to maximize storage persistence in long term memory.

11 ***Just-Eat-It***

Nik Sloop, Joel Worrall[†], Trevor Bunch[†]

Just Eat It is a mobile application that aims to solve the problem of being unable to decide where a group of people want to go out to eat. We have all faced the problem of having conflicting wants while trying to figure out where we want to eat. Just Eat It aims to solve this problem through a mobile application that will allow users to each input information about where they want to go out to eat, like type of food, cost, distance and special accommodations. We will utilize an algorithm that will take into account each persons preferences and be able to return a handful of restaurants that would best fit the wants of the group. Our application will make this problem less stressful and allow you to more quickly get to a common consensus on where to eat.

12 ***Serve Central***

Tyler Collins, **Garrett Reichert**, **Rebekah McClelland**, **Nicholas Desola**, **Andrew Douglass**, Joel Worrall[†], Trevor Bunch[†]

ServeCentral is a mobile application that aims to incentivize community engagement by empowering organizations and users to host and find service opportunities near them. The application functions by displaying an interactive map on its main page showing nearby service opportunities. When users participate in service events, the app records their service hours for the event and then adds it to their service portfolio. This allows the user to display a record of their service on resumes, compete on in-app leaderboards, and earn badges to represent their service background. Our app's core business model consists of working with companies that host service events, and providing them with a way to increase their participation, receive hard data on the event, and pass off the entire registration process to our app. We hope to impact communities by allowing for a platform that easily creates engagement between organizations and volunteers, making it easier for organizations to advertise their service event and simpler for volunteers to sign up for these same events. Our app, too, will serve as a reminder to our user base to not just serve once, but to keep serving and to stay engaged in the wellbeing of their own community. Overall, we feel that our app will impact communities around the country, enabling volunteers and volunteering organizations to get out there and serve those who are in need.

13 ***Wildereef Kombucha***

Thomas Wood, **Brandon Baumer**, **Andrew Hoffman**, Trevor Bunch†, Joel Worrall†

Wildereef is a startup Kombucha company by Messiah's own Derek Siewert. A website was needed to help establish the brand of Wildereef, giving consumers the ability to experience that brand. The website contains information about the kombucha and the different flavors being brewed, information about the company, a weekly blog containing stories and recipes, and a store containing Wildereef's clothing brand.

14 ***Board Game Fact Checker***

Wyatt Derk, Trevor Bunch†, Joel Worrall†, **Joshua Simmons**, **Ibi Braide**, **Benjamin Underwood**, **Eliezer Mwankenja**

The Board Game Fact Checker is a web application that is designed for tabletop game enthusiasts. Often, these games can lead to debates over how to play a certain game. This app is intended to solve those problems by providing users with ability to look up the rules and details for each game. Games are divided up and listed by the category of board or card game. In addition, games are able to be linked to expansion packs and their rules, should a game support one. The app provides users with access to both the rules as well information such as age, player count, and manufacturer. With a functioning registration and login system, the application is intended to have user generated questions on each game as well as creation of personal libraries for ease of access to each games. With time, this site could become a reliable source of information for any future game night.

15 ***Development of Prototype Cerenkov Detector for High Energy Cosmic Rays***

Brandon Weindorf, **Aeowyn Kendall**, Abaz Kryemadhi†, Harry Hawbecker, Trieu Luu

This project focuses on the terrestrial detection of high energy particles produced from astrophysical objects such as supernovas and black-holes. Traditional methods of detection of these particles consist of large tanks of water and large expensive phototubes. In order to reduce the cost and address the shortage of vendors of vacuum phototubes, we have explored a novel technique of detection which uses water, wavelength shifting fibers, and silicon photomultipliers. As the high energy particles pass through water Cerenkov radiation in the form of blue light is emitted. This light is then captured by the fibers which then route it to the silicon photomultipliers. We report on the feasibility of this technique for high energy particle detectors.

16 ***Development of a Compact Cosmic Ray Muon Detector***

Trieu Luu, Abaz Kryemadhi†

Cosmic ray muons are produced when high energy particles from astrophysical sources interact with the Earth's atmosphere. The detection of these particles at ground level is done via the use of scintillators and photomultipliers along with appropriate electronics. To study the characteristics of muon particles, we have designed a compact, portable, and low-noise muon detector based on different simulation results. On the research end we need compact and low power detectors to study cosmic and gamma ray particles. On the education end we could use these portable detectors to study Einstein's theory of relativity.

17 ***Characterization of New Crystal Detectors for Gamma Ray Studies in Space***

Nathan Chan, Abaz Kryemadhi†

Space based high energy range gamma rays have been largely unexplored due to the difficulty associated with the measurements; however they address a broad range of astrophysical questions, including indirect searches for dark matter. To address these challenges and yet have compact instruments, the next generation experiments would need detectors with high efficiency, excellent energy resolution, and excellent time resolution. Fast and bright crystal scintillators coupled to compact photo-detectors are an ideal option. In this work we have investigated various crystal scintillators, comparing them to each other. We have used the silicon photomultiplier arrays as photo-detectors because of their small size, simple readout, low voltage operation, and immunity to magnetic fields.

18 ***Fluorescence-Rayleigh Correlated Burst Analysis Spectroscopy for Quantification of Ultra-low Concentration Species***

Kyler Shea, Matthew Farrar†

Quantification of dilute nanoparticles in aqueous solution is of great importance for ultrasensitive sensors, including medical diagnostics. Fluorescence correlation spectroscopy (FCS) is a powerful technique that can distinguish particle size and concentration, yet is limited to the picomolar range of concentrations due to diffusive timescales. Our technique involves measuring both Rayleigh-scattered laser light and fluorescent light coming from a fluorescent sample.

Fluorescence has a high signal-to-noise ratio and can be used to label items of interest with high specificity. However, fluorescence alone provides no information on particle size. In contrast, Rayleigh scattering is non-specific, but the scattered intensity scales as the sixth power of the radius, making it extremely sensitive to particle size. By cross referencing the fluorescence and scattering burst intensities, we can build a probability distribution of scattering and fluorescent intensities and use this distribution to probabilistically determine the size of individual molecules diffusing though the focus volume. We can then find the number of different species of different sizes in a mixture at ultralow concentrations.

19 ***Growth of titanium boride thin films by magnetron co-sputtering***

Alexander Sredenschek, Niklas Hellgren†

Titanium diboride (TiB_2) is a ceramic material that has attracted considerable interest due to its distinctive set of properties, such as high melting point and hardness, good thermal and electrical conductivity, as well as excellent corrosion resistance. In some applications, thin coatings of TiB_2 may be desired, and one way to obtain such coatings is through the growth of thin films. Thin films may retain the properties of their bulk counterparts while being on the order of micro/nanometer thickness, but further investigation can reveal novel material properties. One common growth technique is magnetron sputtering. However, when films are grown by magnetron-sputtering from a single TiB_2 target, differences in preferred ejection angles and gas-phase scattering yield B-rich TiB_x films with x typically ranging from 2.5 to 3.5. In this research, we seek to investigate a potential solution to this problem by co-sputtering TiB_x films from Ti and TiB_2 targets. By varying the Ti target power from 0 to 100 W while keeping the TiB_2 power constant at 250 W, the Ti concentration could be independently controlled from x = 1.5 to 3.0. X-ray diffraction shows films show (100) and (101) TiB_2 crystalline structure, and atomic force microscopy analysis shows smooth film growth (rms roughness between 0.96 nm and 2.0 nm).

20 ***Sudoku Puzzles and Graph Coloring***

Amanda Petersen

Sudoku's are a fun and challenging number-placement logic puzzle where a player must fill a 9x9 puzzle with the numbers 1-9. Each row, column and 3x3 grid can only have the numbers 1-9 appear once. Players of Sudoku have their own individualized approach to solving these puzzles. Some focus on going through the puzzle one number at a time and others may begin with specific rows, columns or 3x3 grids. Despite the varied approaches that can be used to solve the puzzle, the solution to the puzzle is unique. While these puzzles are number-based, one can view a Sudoku puzzle through the lens of the field of graph theory. With this lens, using the concepts of vertex coloring and the greedy coloring algorithm, we will explore how to represent a Sudoku puzzle as a colored graph.

21 ***Solutions to the Wave Equation***

Emily Wichert

Waves are seen in many different applications, such as sound waves, electromagnetic waves, and ocean waves. They are typically modeled mathematically by sine and cosine functions. However, they are also modeled through partial differential equations, exhibiting aspects of position and time. This presentation will be an exploration of solutions to one of these partial differential equations, called the wave equation, and will use various methods to solve boundary value problems. The Fourier method will be introduced and applied to the wave equation as well as Fourier series. These methods and applications will provide a better understanding of waves and the wave equation.

22 ***The Shannon Switching Game***

Daniel Diethrich

The Shannon Switching Game is a two-player game played on a mathematical graph. In this game, two vertices on the graph are specified, and the two players alternate turns by choosing edges. The "positive" player tries to create a path between the two specified vertices by claiming edges, and the "negative" player destroys edges in an attempt to block the pursuit of the positive player. While the Shannon Switching Game requires no mathematical knowledge or ability to play, it has many interesting mathematical properties. With minimal foundational concepts and definitions of graph theory, one can prove a theorem about graphs that have winning strategies for the positive player. Furthermore, from this theorem one can construct an algorithm that details this winning strategy.

23 ***Properties of Adjacency and Incidence Matrices***
Brooke Firestone

Graph theory is a branch of mathematics that examines binary relationships between nodes or vertices, using edges connecting nodes to represent a relationship. Surprisingly, it is another branch of mathematics, linear algebra, and the mathematical object of a matrix, that can reveal the relationships in a mathematical graph. There is intricacy and beauty in the synergy between these two mathematical fields. Adjacency and incidence matrices illuminate the mathematical properties of a graph more clearly than a pure graph theory approach.

24 ***Partial Differential Equations and Fourier Series***
Olivia Essig

Analogous to the relationship between Calculus III and Calculus I, partial differential equations is an expansion of ordinary differential equations by means of utilizing more than one independent variable. There are numerous methods of solving partial differential equations, including representing functions as an infinite series of trigonometric functions called a Fourier series. Partial differential equations and Fourier series are useful for modeling situations in the physical sciences. The general concepts of linear homogeneous partial differential equations and Fourier series will be discussed, as well as one specific application of heat conduction in the field of chemistry.

25 ***Tweet the Bridge of Polarization? Two-Way ANOVA Test on the U.S. Political Partisanship***
Xin-dee Low

Platforms such as Twitter gave rise to the process of microblogging, where everyone is allowed to share their opinions anytime and anywhere through their smart phones. This democratic process encompasses most countries around the world, creating virtual crowds that transcend geographical boundaries. Initial optimism that social media would expose individuals to diverse viewpoints and interactions has been tempered by concern that social media tools, such as filter bubbles, promote a dangerous confirmation bias that can give rise to extremism. This research investigates how social media within the political sphere heightens political partisanship and can increase conflict among citizens. The research uses data analytics and statistical analysis to enrich digital political study.

26 ***Calculus of Variations***
Alexander Sredenschek

Optimization problems are of particular interest to scientists, engineers, and mathematicians, and calculus offers a robust set of tools to obtain solutions. One particular class of problems is concerned with minimizing or maximizing quantities such as distance, surface area, time, etc. The calculus of variations offers an elegant formalism to obtain solutions to these problems. The foundational concepts of the calculus of variations (Euler-Lagrange equation, second variation) and some of its applications to geodesics, physics, and topology will be discussed.

27 ***Statistics on Type-B Permutation Tableaux***
Ryan Althoff, **Daniel Diethrich**, **Emily Wichert**, Xin-dee Low, Amanda Lohss[†]

Type-B permutation tableaux are combinatorial objects consisting of rows and columns of cells that are filled according to certain rules, much like a Sudoku puzzle. These objects, introduced by Lam and Williams, have interesting applications in particle physics and biochemistry. In this talk, we will present multiple statistics on type-B tableaux, which highlight the distinctive properties of these objects. We will make connections between our results on type-B tableaux and those previously determined for regular permutation tableaux and will conclude with a brief discussion of the aforementioned applications.

28 ***Living Love Ministries - Kenya Land Development***
Jonathan Robinson, **Justin Blest**, **Cheylee Smith**, Madalyn Heckman, J Scott Heisey[†]

The Land Development in Kenya team has partnered with Living Love Ministries (LLM), an organization that operates a children's home in Ol Kalou, Kenya, to design an irrigation system to help grow year-round produce and crops to increase self-sufficiency at their facility. The LLM community experiences a significant hot and dry season that affects their ability to grow crops during this time, and they have requested that the Land Development team initially design a system to irrigate two acres of cultivated fields at the children's home. The irrigation system will tie into LLM's elevated water tower currently used to supply water for daily operations. Water will overflow from this tower to an auxiliary storage tank to provide additional water capacity for the irrigation system. A booster pump will be used to pressurize a main trunk line of a drip irrigation system that will feed a series of emitters which control irrigation specific to plant types and row configurations over a nominal 2-acre

area. The team has planned a site trip to Kenya in late May 2019 to install the main components of this initial system, and hopes to modularize the system so that LLM will be able to expand their irrigation in a simple and effective manner.

29 ***Fire Protection for Developing Communities***

Jacob Film, **Lake Bender**, **Victor Defrance**, **Conner Reyer**, Samuel Burgess, Caleb Danehower, Robert Donley, Donald Waardenburg†

The Institute for Affordable Transportation (IAT) is a non-profit public charity "devoted to improving the lives of the world's poor by providing simple, low-cost vehicles in order to facilitate community transformation." The centerpiece of their work is the Basic Utility Vehicle, known as the "BUV", which they distribute to developing rural communities in several countries around the world. Upon recognizing the need in these communities for proper firefighting resources, the IAT partnered with the Collaboratory to develop a way to equip the BUV with firefighting capabilities. The proposed solution is a "firefighting insert" which can be easily placed into the bed of the BUV. The insert design process has proceeded with an emphasis placed on simplicity, durability, versatility, and cost efficiency in order to provide its users with straightforward yet flexible operation and to minimize initial investment and maintenance requirements. The current design utilizes a wooden frame (called the skid) which supports water storage tanks, houses the necessary plumbing, and holds a small pump, engine, output manifold, and hoses. The components selected enable versatile operation which is not limited to firefighting applications, making the insert valuable for everyday usage in addition to fire protection. At the end of the Spring 2019 semester, the fully constructed design will be turned over to the IAT along with manuals for its construction and proper operation.

30 ***The Prosthetic Knee Project***

Vaughn Chambers, Miranda Chiang, Nyles Rife, Jamie Williams†

The Prosthetic Knee Project addresses the need of the Centre for the Advancement of the Handicapped in Mahadaga, Burkina Faso. The Centre can construct an entire prosthetic leg except for the knee locally. While the Centre used to receive prosthetic knees through donations, these donations were exhausted over five years ago halting the production of full prosthetic legs. The Centre was in need of a design for a low-cost, locally manufacturable prosthetic knee that is compatible with the rest of the prosthetic leg that can be made there. In previous semesters, we successfully designed a working $20 prosthetic knee made almost entirely out of local materials. Along with this knee, we have designed low-cost adapters to replace the expensive pyramidal adapter connection pieces that the Centre used to buy. We have also designed a flexion-offset plate to allow less-flexible amputees to better accept a prosthetic leg. With the help of applied health science majors, we have also been working on a rehabilitation protocol that will put amputees through an exercise program to keep them in shape after leg amputation before receiving their prosthetic leg. Since we have a working, low-cost product, we have decided to add Cure Kenya as a second client. We will be traveling there this summer to find out how we need to alter our design for them. This past semester, we focused on fatigue testing our design, finalizing the adapter design, finalizing the rehabilitation protocol, and preparing for our trip to Kenya this summer.

31 ***Destruction of Landmines with the Hybrid Thermal Lance***

Rachel Siepelinga, **Daniel Sidell**, Donald Pratt†

The Landmine Neutralization Project undertaken by the Messiah College Collaboratory serves to create a safer way to destroy landmines, IEDs, and other unexploded ordnance (UXO). Currently, the most common method of destroying UXO is to use a small explosive charge to detonate the mines in place. However, due to the risks associated with this method the team has been asked to develop an alternative. To accomplish this, the project team partnered with the HALO Trust, the world's largest demining NGO, to develop the hybrid-thermal lance (HTL). The HTL is based upon the principles of hybrid rocketry with slight modifications to provide a precise flame and heat to pierce through the outer casings of several types of UXO and burn the explosives within. This process rendered the UXO inert without causing detonation. This year the team has advanced their project through several parametric studies to better understand the characteristics and capabilities of the HTL as well as the development of an automated control circuit to allow the process to be run remotely.

32 ***Sustainable Mobility for Persons Living with Disability in West Africa***

William Feczko, **Brit Haseltine**, **Alexander Mantsevich**, John Meyer†, David Vader†

The Sustainable Mobility Project empowers people living with a disability in the developing world to fully

participate in family and community life and makes possible the pursuit of educational and work opportunities. The Collaboratory 3-wheeled off-road wheelchair design is well-regarded among mobility practitioners. Our design has already transformed the lives of dozens of clients through a partnership with the Center of Hope in Fada, Burkina Faso. Now to reach more people in new locations with more partners, the Sustainable Mobility team is reducing manufacturing time and cost, developing supply chains to bring parts and materials to build sites, and developing a turn-key business model that puts local fabricators to work building tricycles wherever they are needed. With our client, SIM Burkina Faso, we are establishing a mobility manufacturing center in Fada, Burkina Faso. Finally, we will work to facilitate the formation of a new independent entity to manage supply chains and to facilitate the formation of additional small businesses that will produce our design in the developing world.

33 ***Pico Hydro Design for the Developing World***
Andrew Reedy, **Ben Morral**, Dan Elliott[‡†], Robert Hentz[‡†], Wil Kirchner[‡†], David Vader[†]

Access to renewable and sustainable energy plays a vital role in eliminating poverty and enabling economic opportunities. The Pico-Hydro team has the unique opportunity to design a product that gives a point of access to renewable and sustainable energy via small scale hydro power. This presentation outlines the team's progress toward a general hydro prototype which will be deployable in streams worldwide fitting certain stream parameters, as well as a site-specific hydro design opportunity in Panama.

34 ***Design of a Solar Powered Water Pumping System for Living Love Ministries in Ol Kalou, Kenya***
Steven Carpenter, **Collin Binford**, David Vader[†]

The Solar Photovoltaics team is working with Living Love Ministries (LLM) in Ol Kalou, Kenya to help meet water needs for domestic use and irrigation with a solar powered water pumping system. LLM currently relies on a diesel generator to power their well pump. Solar power will be both more reliable and more financially practical in the long-term. Stanley Earth has partnered with the Solar PV team and LLM to donate a motor, pump, and pump controller system as well as a second backup system. Some important design questions considered this year were solar array sizing, wire sizing, panel mounting location, and the effect of mounting orientation. The Solar team is traveling to LLM this May to install the well pump and a 26 panel, 6.9kW solar array on Pamoja Hall at LLM to power the pump.

35 ***Sawyer Point One Water Filter Test System***
Joseph Franken, **Nathan King**, Thomas Soerens[†]

The purpose of the Sawyer Point One Water Filter Test system is to test the structural integrity of the hollow fiber membrane as each filter passes 100,000 gallons at a pressure of 10 psi. Structural integrity of the filter is directly related to the filters ability to remove bacteria. Governmental regulation mandates log 6 removal of bacteria for safe drinking water. The Sawyer Point One Water Filter Test System is a project dedicated to designing a system that tests the longevity of these Sawyer Point One Hollow Fiber Membrane Filter and their ability to perform bacterial removal at a standard of log 6.

36 ***Design of a Gravity Fed Water System to Deliver Safe Drinking Water to Villages in Vanuatu***
Nathan Hardman, **Jamar Gittens**, **Kurtis Platteel**, Thomas Soerens[†]

In the Big Bay region of Espiritu Santo island, Vanuatu, approximately 1350 people living in 30 rural villages lack direct access to safe and potable water. This deficiency can have significant negative effects on the health and livelihood of these communities and may limit their ability to grow both socially and economically. Therefore, the Gravity Fed Water - Vanuatu project, in partnership with Friends in Action International, has designed a gravity fed water system to be implemented to provide easy access to clean, safe, and drinkable water. The system consists of an intake structure at the water source and continues with about 16 miles of pipe to deliver water from the source to storage tanks in the villages along the route; the system requires no external energy to run. Friends in Action International plans to begin construction of the system in the summer of 2020. The team hopes that implementing the gravity fed water system will help to improve the health and livelihood of the villagers and to provide more opportunities for social and economic growth.

37 ***Mechanized Percussion Well Drilling***
Cole Hiduk, Philip Tan[†]

The Mechanized Percussion Well Drilling Project seeks to design a simple mechanized well drilling system to be used for drilling shallow water wells in Burkina Faso, Africa. These systems will be operated by local drilling teams, allowing them to earn an income for themselves and their families. Currently, our client,

Open Door Development, has trouble drilling through hard rock layers and often must abandon holes due to inadequate equipment. The goal of this project is to enable our client to efficiently drill through these rock layers with a mechanized percussion rig and supporting drilling equipment. One of the areas the project has focused on this year was increasing the life of the cathead, a critical piece of the drilling rig which severely wore during in-country testing in the summer of 2017. The team determined that the aluminum cathead was not able to resist the wear of the rope, which had particles of dirt and rock embedded in it. The team tested catheads made of steel, wood, and different plastics, and steel was found to be the most viable solution. In order to verify the life of the cathead, the team designed and manufactured an automated testing rig. This rig will allow the team to test the cathead continuously and determine if a steel cathead will last for at least 50 hours of drilling.

38 ***Nicaragua Manual Block Press***

Joshua Charney, Philip Tan[†]

The Block Press project is developing a manual block press to produce compressed earth blocks used to construct various buildings on the east coast of Nicaragua. Friends In Action International tasked the project to design an easily mobile, lightweight (2-3 people can carry), simple manual press for the Rama community requiring only 1-2 people to operate. The press needs to make an interlocking 12”x6”x4.25” clay-sand-cement brick efficiently (~200 a day) to be used for the new buildings. A SolidWorks model was designed, analyzed and used to fabricate the first block press that was tested in Nicaragua in June 2017. The first press was brought back to Messiah College and modifications were made. A second press made of stainless steel to combat the rusting problem in the first press was fabricated by E&E Metal Fab. Inc., based on the modifications done to the first press. The second press’ viability as well as five block mixtures are currently being tested by the 2018-2019 Block Press team. This testing allowed for an improved design for a third press. The 2018-2019 team has sent the part files and engineering drawings to E&E Metal Fab. Inc. for fabrication. Once tested and assured of the third press’s viability, it will be given to Tim Johnston and Friends In Action International. Two to three more presses will be fabricated for Friends In Action International from this third press design if the testing goes well.

39 ***Energy Monitoring and Management System***

Joseph Wambach, **Trieu Luu**, **Justin Martin**, Thomas Austin[‡†]

The Energy Monitoring and Management System facilitates access to electric power in regions with limited energy by increasing energy conservation and education. The solution consists of a meter which allocates a configurable daily energy limit per facility, and a display that provides practical information to the user including reporting how much energy they have used and how much they have left before their power is automatically cut off until the next day.

The current version of the system has successfully been installed in multiple facilities in Burkina Faso and Zimbabwe. Currently, the team has completed the redesign of the system's power sense module to increase performance to meet client specifications. In addition, we have increased the manufacturability of our enclosure through redesigning our baseplate. Finally, we developed a full manufacturing process for our meter as we are traveling to Zimbabwe this May and needed to manufacture 35 meters. This presentation will detail the steps made to redesign the power sense module as well as baseplate redesign and manufacturing process leading up to our Zimbabwe site team trip.

40 ***HIITing it on the head: High intensity interval training and the brain***

Nate Romberger, Doug Miller[†]

High-intensity interval training (HIIT) was originally developed by coaches to improve athletic performance. However, its usage for the general population has grown as research continues to demonstrate its effectiveness. In the ACSM Worldwide Survey of Fitness Trends, HIIT has been in the top five fitness trends every year since 2014. Research has consistently demonstrated that HIIT is a superior and time-efficient method to train the cardiovascular system. However, research is currently limited regarding the neurological and psychological adaptations resulting from HIIT. Current research demonstrates that even a single bout of HIIT has positive effects on motor learning, executive function, long-term memory, and learning. When performed regularly, HIIT has been shown to improve emotional regulation, learning, memory, executive function, and inhibitory control. This likely occurs through a variety of mechanisms involving proteins, such as BDNF and Dopamine, as well as alterations in blood flow through the brain. Additionally, research demonstrates that HIIT can be effective, safe, and enjoyable for

sedentary populations, overweight individuals, and patients with chronic disease. Finally, reported levels of enjoyment and positive affect have been comparable between HIIT and moderate intensity continuous exercise. Research involving HIIT and the brain should continue to further clarify its effects on the brain and mechanisms by which it affects the brain.

41 ***THE APHS Senior Seminar Personal Training Project- does it work?***

Dani Kreiger, Doug Miller†

Applied Health Science students at Messiah College are required to participate in an experiential learning activity for their Senior Seminar class that helps them develop interpersonal skills, provides them with an opportunity to apply their health and exercise science knowledge and skills, and meets an identified need in the community. Prior to the beginning of the semester, Messiah College employees volunteer to participate in the program and are assigned to a student. The program requires students to interview their clients, assess their fitness levels pre- and post-semester, assist with goal setting, write an individualized exercise program, and meet face-to-face with their client each week. Workouts are primarily focused on cardiovascular fitness, are progressive throughout the semester, include Challenge Days, and are mostly unsupervised. An analysis of program outcomes over the past four semesters (n=57), found significant post-semester decreases in resting heart rate, submaximal exercise heart rate, and mile run/walk time ($p \leq 0.001$). Subjective written feedback from clients at the end of the experience revealed that 98% agreed or strongly agreed that the experience was worthwhile, and 81% agreed or strongly agreed that most of their fitness goals were met. In conclusion, a 12-week individualized, semi-supervised exercise program can effectively improve fitness and health parameters of employees without offering monetary incentives typical of many worksite wellness programs.

42 ***Perceived benefits from a 6-week synchronized swimming fitness class***

Erin Parry, Melinda Smith†

Synchronized swimming is a form of group exercise that challenges cardiovascular fitness, muscular strength and endurance, core stability and flexibility of participants. However, many college students do not have prior experience with this mode of exercise. The purpose of this research was to investigate perceived participant benefits from a 6-week synchronized swimming fitness class. The researcher, who has competitive experience in synchronized swimming, designed and implemented the class for students at Messiah College. This class included fundamental skills of synchronized swimming paired with more familiar fitness components. The class met once each week for 60 minutes. After the final session, the researcher conducted a semi-formal interview with a focus group to evaluate the participants' overall experience with the class. Participants discussed perceived benefits of synchronized swimming, recommended adjustments to the class, post-class exercise outlook and future exercise interests. Participant feedback suggested a positive overall class experience due to the opportunities for social interaction within an exercise setting and new skill acquisition. The perceived benefits of the class included diversifying from familiar and sometimes monotonous forms of exercise, as well as noticeable improvements in aquatic capabilities. All students who took part in the focus group expressed interest in pursuing various forms of aquatic exercise in the future. This research suggests that group aquatics classes, such as synchronized swimming, may be beneficial for students at Messiah College.

43 ***The influence of caffeine on task performance***

Kara Leaman, H. Scott Kieffer†, Jesse Torbic, Alyssa Cunningham, Emily Davis, Carissa Weaver, Jessica Eby

Dopamine and adenosine are powerful neuromodulators that antagonize each other to influence movement. **PURPOSE:** The purpose of this study is to see how caffeine interacts with that pathway to impact specifically fine motor skills. **METHODS:** Fine motor abilities were assessed using the Purdue Pegboard Test and the Minnesota Dexterity Test. The Purdue Pegboard Test had participants place pegs into a pegboard, and the Minnesota Dexterity Test had participants manipulate small discs. In addition, buccal cells were obtained by saline mouthrisnse and DNA was isolated using the Qiagen DNA MiniPrep kit. Endpoint PCR reaction was run to genotype DRD2 and qPCR analysis was conducted to determine the genotype for ADORA2. **RESULTS and DISCUSSION**: The results and discussion of our preliminary data will be presented at the SEH symposium.

44 ***Assessing aggregation of quinazoline inhibitors of Protein Tyrosine Phosphatase 1B through a Nuclear Magnetic Resonance assay***

Ashley Martin, Jesse Kleingardner[†], Matthew Farrar[†], Anne Reeve[†]

Protein Tyrosine Phosphatase 1B is a negative regulator of insulin and leptin signaling. Inhibition of this protein has been shown to be a viable treatment for obesity and type 2 diabetes. As part of a screening of small molecule leads generated computationally a quinazoline derivative was found to be a low μM inhibitor. However, loss of inhibition upon the addition of non-ionic detergent Triton led to the hypothesis that the compound is an aggregator, which inhibit enzymes nonspecifically. To test for aggregation, a nuclear magnetic resonance (NMR) assay was developed. Upon dilution, a nonaggregating control showed merely a decrease in intensity of 1H NMR signal in comparison to an internal standard. In contrast, serial dilution of an aggregating compound showed changes in chemical shift and/or in resonance patterns. Furthermore, addition of detergent showed changes in chemical shift and resonance patterns in the 1H NMR spectrum for aggregators while it had no effect on the 1H NMR signal of nonaggregating controls. Analysis of 1H NMR spectra indicated that the quinazoline inhibitors of PTP1B are aggregators.

45 ***Synthesis and Characterization of Carbon Nitride Electrodes for Efficient Oxygen Reduction***

Josiah Nisly, Richard Schaeffer[†], Niklas Hellgren[†]

The oxygen reduction reaction is particularly relevant in its application in hydrogen fuel cells. As of now, platinum is the most effective catalyst for this reaction, but it is rare and expensive. If a less expensive material could be found with comparable efficiency to platinum in this respect, hydrogen fuel cells would become more accessible as a commercial technology. Recently, nitrogen-doped graphene (or graphitic carbon nitride) has been explored as a more affordable substitute for platinum in hydrogen fuel cells. In this project we explore films of carbon nitride to determine the extent of their electrochemical activity. Carbon nitride films were deposited on commercially-available screen-printed graphite electrodes by DC magnetron sputtering, a physical vapor deposition method. The samples produced by these methods were analyzed for oxygen reduction by cyclic voltammetry (CV) in an aqueous KOH solution saturated with O_2, and physically characterized by x-ray photoelectron spectroscopy (XPS) and atomic force microscopy (AFM).

46 ***XPS characterization of alkanethiolate self-assembled monolayers on zinc selenide thin films***

Sarah O'Boyle, Niklas Hellgren[†], Alison Noble[†]

Alkanethiolate self-assembled monolayers (SAMs) have been formed on zinc selenide (ZnSe) through adsorption from solution. Zinc selenide as a SAM-supporting substrate is of particular interest due to its transparency in the infrared region of the electromagnetic spectrum, enabling interfacial interactions at the substrate surface to be studied through transmission IR spectroscopy. In the past, mechanically polished, optical quality ZnSe surfaces have been used to support SAM formation. This surface, however, typically has a rms roughness around 40 nm, meaning it cannot support highly-ordered SAMs. In order to characterize the system, a more ordered system is required. A significantly smoother ZnSe surface has be produced through physical vapor deposition (PVD) onto silicon substrates. The PVD-generated zinc selenide exhibits the same IR transparency as the mechanically polished substrate, but with a rms roughness in the range of 2.7 ± 0.9 nm, which is over an order of magnitude improvement in surface roughness. The ZnSe-SAM system was characterized through Fourier Transform Infrared (FTIR) spectroscopy, contact angle goniometry and x-ray photoelectron spectroscopy (XPS). In the XPS spectrum, the shifts and relative intensities of Zn 2p, Se 3d, S 2p, and C 1s peaks when SAMs are applied show whether the SAM is physiosorbed or chemisorbed. A significant shift in the S 2s peak for a ZnSe film with SAMs compared to free thiol literature values, suggesting that the SAMs are chemisorbed to the ZnSe.

47 ***AFM characterization of variable-head / variable-etch self-assembled monolayers on ZnSe***

Bailey Rhodes, Alison Noble[†], Niklas Hellgren[†]

Zinc selenide (ZnSe) is a substrate of interest due to its infrared transparency, which allows self-assembled monolayers (SAMs) to be characterized using Fourier Transform Infrared Spectroscopy (FTIR), and for future applications in optoelectronics. Alkanethiolate SAMs have successfully been formed and characterized on the surface of ZnSe substrates. However, it has been shown that varying the SAM head groups and chemical surface preparation may be advantageous in the optimization of SAMs adsorbed to ZnSe. In this study ZnSe SAMs were formed using combinations of carboxylate (PA) and thiolate head groups (HDT), as well as surface preparation using no etch (none), an ethanol etch (EtOH), or an ammonium

hydroxide etch (NH_4OH) prior to SAM assembly on the surface. Samples were analyzed directly post-etch and after SAM formation using contact angles (CA), Fourier-transform infrared spectroscopy (FTIR), and atomic force microscopy (AFM). Contact angle analysis confirmed increasing organic character after adsorption of the monolayers and FTIR analysis indicated successful formation of SAMs on HDT-EtOH and PA-NH_4OH samples with an absorbance intensity ~0.002, while the remaining 4 samples showed higher absorbance intensities indicative of less-successful SAM formation. AFM analysis confirmed these results, yielding an rms roughness of 20.8 nm and 29.7 nm for HDT-EtOH and PA-NH_4OH, respectively, and roughness values in excess of 70 nm for the remaining samples. Results indicate that of these methods, both the HDT-EtOH and PA-NH_4OH syntheses are viable procedures for the synthesis of SAMs on ZnSe substrates.

48 ***Immunotherapy targeting an insertion sequence in an altered tumor-associated growth receptor associated with aggressive pancreatic cancers***

Amber Orner, Justin Sweitzer, John Harms†, Lawrence Mylin†

With a five-year survival rate of 7%, pancreatic cancer is one of the most lethal forms of cancer. Recent studies have found that a mis-spliced variant of the cholecystokinin (CCK) receptor that retains a 69 amino acid intron-encoded segment is associated with aggressive pancreatic cancers. While normal CCK receptors bind gastrin and signal for increased production of digestive enzymes, the lengthened $CCK2_{i4sv}R$ receptor variant appears to promote increased cell proliferation through autocrine stimulation. The intron-encoded segment represents a potential target for T cell-mediated immunotherapy. We have found that immunization of C57Bl/6 mice with a synthetic peptide corresponding to 20 amino acids of the variant receptor intron-encoded sequence stimulates the induction of T cells. In the present study, we sought to determine whether intron-peptide-specific T cells could control the formation of tumors by PANC02 murine pancreatic tumor cells engineered to co-express the $CCK2_{i4sv}R$ variant human receptor. Groups of mice were immunized with emulsions containing the intron peptide or a control peptide mixture. Peptide-specific T cell responses were confirmed in a subset of each group, and PANC02-$CCK2_{i4sv}R$ cells were transplanted into both flanks of each of the remaining immune mice. Tumor progression was monitored over four weeks after which tumors were excised and preserved for histological analysis, and splenic frequencies of peptide-specific T cell frequencies were measured by ELISPOT. Both intron-peptide-specific and control-peptide-specific T cells were detected in varying frequencies in tumor-bearing individuals from each group. The presence of the intron-peptide-specific T cells appeared to correlate with reduced rate of tumor growth.

49 ***In Search of Improved Strategies to Induce T Cell Immunity Targeting a Receptor Expressed by Aggressive Pancreatic Cancer Cells***

Justin Sweitzer, Lawrence Mylin†

Pancreatic cancer is difficult to detect, at diagnosis is often in advanced stages, and has usually metastasized making surgical resection or chemotherapy ineffective. We propose immunotherapy as a strategy to treat pancreatic cancer. We seek to determine if appropriate immunization can stimulate production of T cells that can destroy pancreatic cancer cells based on recognition of portions of a unique protein sequence inserted into the cytoplasmic face of a form of the cholecystokinin receptor ($CCK2_{i4sv}R$) associated with aggressive tumors. Previous studies by our group have demonstrated that a synthetic peptide corresponding to a portion of the insertion sequence can stimulate the production of T cells in C57Bl/6 mice. Syngeneic pancreatic cancer cells (PANC02) engineered to express the human $CCK2_{i4sv}R$ provide a model system with which the efficacy of T cell-based immunity targeting the altered receptor can be tested. The goal of this study was to determine whether immunization strategies designed to enhance the activation of professional antigen presenting cells would lead to induction of higher frequencies of $CCK2_{i4sv}R$ insert-sequence-specific T cells. Two “improved” immunization strategies were compared to vaccination with simple peptide emulsions: a) vaccination using peptide-pulsed, in vitro-activated dendritic cells, and b) TriVax immunization in which a mixture of anti-CD40 monoclonal antibody and polyIC were injected intravenously with the synthetic peptide. Neither of the alternate strategies generated robust T cell responses to the pancreatic cancer peptide or to another MHC class II-restricted control peptide, but did induce immunity to a control MHC class I-restricted epitope peptide. These results imply that an epitope within the pancreatic cancer-associated insert-sequence peptide is recognized by CD4+ T cells.

50 ***Insertion of a target for immunotherapy of pancreatic cancer into an oncoprotein to produce a tumor cell-based vaccine***

Ashlee Leib, Lawrence Mylin†

Pancreatic cancer is aggressive and difficult to detect within its early stages. As a result, only 6% of individuals diagnosed survive beyond 5 years. Previous research has associated an altered form of the cholecystokinin receptor, $CCK2_{i4sv}R$ which contains 69 amino acids encoded by the non-spliced intron IV, with aggressive pancreatic cancers. Our goal is to induce T cell-mediated immunity directed against the intron-encoded sequences by vaccination. The SV40 large tumor antigen is a highly immunogenic viral oncoprotein that has been used in the past as a carrier for heterologous T cell epitopes. Our approach is to insert a 20 codon sequence corresponding to the intron-encoded portion of $CCK2_{i4sv}R$ at one of two locations within the SV40 T ag by site-directed mutagenesis. Synthetic oligonucleotides were designed to insert 20 codons corresponding to residues 281-300 of $CCK2_{i4sv}R$: 1) replacing SV40 T ag CD8+ epitope I (10 codons) and 10 amino-terminal flanking codons; 2) between SV40 T ag amino acid codons 350 and 351. The altered SV40 T ag genes will be used to generate immortal C57BL/6 kidney cell lines which will be used to immunize C57BL/6 mice to assess the immunological potency of the inserted epitopes by ELISPOT. The syngeneic cell vaccine(s) will ultimately be used in tumor control studies utilizing murine pancreatic cancer cell lines engineered to express the human $CCK2_{i4sv}R$. If, as expected, tumor cell-based immunization induces T cells of higher avidity than immunization with synthetic peptides, this may represent an effective strategy for cell-based immunization against pancreatic cancer.

51 ***Understanding the Role of CD4+ T Cells in Regulating Cellular Immune Responses to Tumors***

Laura Hevenor, Justin Sweitzer, Lawrence Mylin†

Immunotherapy is a strategy that seeks to use the body's own immune system to fight cancer and other diseases. $CD4^+$ T cells (helper T cells) and $CD8^+$ T cells (cytotoxic or killer T cells) are two important subsets of T lymphocytes that collaborate to control viral infections or cancers. The goal of this research is to better understand regulatory relationships between these subsets. Robust $CD4^+$ T cell responses are thought to promote robust $CD8^+$ T cell responses; this research sought to determine whether robust CD8+ T responses may instead modify the accompanying CD4+ T response. The SV40 T antigen oncoprotein provides a powerful model to study both tumor induction and control by T cell-mediated immunity. Mice were injected with two types of SV40 T antigen-expressing tumor cells: one line (B6/K-0) that produced the intact, highly immunogenic SV40 T ag; and a second (B6/K-1,4,5) that expressed a mutated form of the SV40 T ag lacking the major targets for CD8+ T cells. Both SV40 T ags retained multiple $CD4^+$ T cell target sequences. Results of a dose response study will be discussed. Mice were injected with different numbers of tumor cells. After 10 days, splenic leukocytes were prepared and ELISPOT technology was used to quantify the numbers of SV40 T antigen-specific ($CD4^+$ T) cells present, and to determine how many of the responding CD4+ T cells were pro-inflammatory (secrete IFN-gamma) vs. anti-inflammatory (secrete IL-10). Previous results suggested that stronger SV40 T antigen-specific CD8+ responses favored an anti-inflammatory CD4+ response.

52 ***Identifying sexual dimorphism in the skin patterning and pigmentation of the Panamanian golden frog, Atelopus zeteki***

Nicole Manfredo, Erik Lindquist†

The Panamanian golden frog, *Atelopus zeteki*, is a critically endangered toad endemic to Panama and holds immense cultural significance as a prominent national symbol, analogous to that of the Bald Eagle in the United States. Wild populations of this frog have been decimated by the chytrid fungus and are generally assumed to be extinct in the wild. However, captive populations are currently being kept at accredited facilities throughout North and Central America to aid conservation efforts that will potentially allow for the reintroduction of this species to native habitats. Noninvasive field methods of accurately and consistently identifying the sex of *A. zeteki* individuals are critical to the long-term success of future reintroductions and monitoring programs. The present study attempts to develop such a method by investigating both the skin patterning and pigmentation of this species as possible modes of sexual dimorphism by dividing dorsal photographs of both males and females into 12 separate segments. The ratio of black to yellow coloration in each segment was determined via pixel measurements using Adobe Photoshop and examined for the presence of sexual dimorphism.

53 ***Using Hotspotter Recognition Software as Means of Noninvasive Identification of Strawberry Poison Frogs (Oophaga pumilio)***

Emma Lawell, Erik Lindquist†

The ability to identify individuals in the wild is an essential part of monitoring the population dynamics of animals. As amphibian populations around the globe are rapidly declining it is important to monitor these particularly sensitive species. Strawberry Dart Frogs (*Oophaga pumilio*), a species endemic to central America, are among these populations susceptible to decline due to human activity. Former methods of monitoring populations have been invasive (toe-clipping, tattooing, tagging, etc.) Photo recognition offers a noninvasive, cost-effective way to replace invasive mark and recapture practices that could alter the health or behavior of individuals. HotSpotter is a software used for individual animal recognition. It uses regions of interest (ROI's) on a specimen to match a query with a corresponding individual in the HotSpotter database. Photographs of Strawberry Dart frogs from previous mark-and-recapture studies were imported to the HotSpotter database in a blind study in order to compare the accuracy of both noninvasive methods. HotSpotter found over 100 matches from 2007 through 2017, the majority of which were ranked as the 1st match. This software also caught several errors in incorrectly recording color morphology and sex as well as catching individuals that were mistakenly recorded twice. These results indicate that using visual identification and photo recognition can serve as a noninvasive, but accurate and time efficient way to perform mark-and-recapture studies.

54 ***Quantifying Differences in Gray Squirrel (Sciurus carolinensis) Response to Symaptric Avian Alarm Calls***

Daniel Fliehler, Jeff Erikson†

This study seeks to build on our understanding of sciurid eavesdropping by investigating whether gray squirrels, *Sciurus carolinensis*, respond differently to the alarm calls of different sympatric avian species. Squirrels exhibited the largest increase in vigilant behavior in response to American Robin, *Turdus migratorious*, and Blue Jay, *Cyanocitta cristata*, alarm calls, respectively, although Robin alarm was the only alarm call that elicited a significantly greater response than its species' respective control call. American Robins were most common in the study area, and this vulgarity may explain the strength of squirrel response to Robin alarm calls. This leads to the hypothesis that eavesdropping species' response to the alarms signals of sympatric species is positively correlated with the alarm signaling species' density in the area of range overlap. In addition, antagonistic interactions between the eavesdropping and signaling species may influence the eavesdropper's response to the signaler.

55 ***Vegetative Propagation of Cocoa in an Aquaponics System***

Cooper Robbins, David Foster†

Products produced from the fruit of the cocoa tree (*Theobroma cacao*) makeup multi-billion-dollar industries worldwide; this makes the cocoa tree a vital crop to the world's population. The reproduction of cocoa trees is a time and resource-costly endeavor that, if optimized, would increase cocoa tree product production. However, research conducted on the vegetative propagation of the cocoa tree is very limited and none include the pairing of vegetative propagation with an aquaponics system. The aim of this study is to test the success of certain vegetative propagation techniques that have no prior research recorded in the Intag patented media beds of an aquaponics system. The first technique involved air layering vertical growing branches on parent trees, the second involved trench layering whole trees, and the third involved trench layering of only the upright portion (chupons). Aquaponics utilizes a mutualistic relationship in which waste of Nile tilapia (*Oreochromis niloticus*) is used as nutrients for plants. Water is recirculated through a closed-loop system which includes Intag patented media beds and a fish rearing tank. If successful, these techniques could be further researched to determine their significance on a larger scale population of cocoa trees. Results will be reported when they become available.

56 ***Paxton Ministries Site Drainage***

Brenden Good, **Kimberly Cunningham**, **Eric Weaver**, Crosby Harro, J Scott Heisey†

Paxton Ministries, located in Harrisburg, PA, is a Christ-centered, nonprofit organization providing affordable housing and support services to adults in need, many of whom are challenged with poverty, mental illness, or intellectual disabilities. Currently, there are drainage and temporary flooding problems that occur following appreciable rainfall events from a storm drainage pipe discharging onto their property. The flooding submerges the tennis court area on the property, and the stormwater drains to a sinkhole location on the site.

The Collaboratory partnered with Paxton Ministries to investigate solutions for their site drainage problems. The project consisted of three phases: defining the problem, developing feasible alternatives, and designing a stormwater management solution. Defining the problem and developing feasible alternatives was completed during the 2017-2018 academic year. In the fall of 2018, two preliminary designs were generated to help Paxton Ministries understand their options to manage the stormwater, along with order of magnitude costs for construction. Upon review of the preliminary designs, Paxton Ministries directed the team to develop a more detailed design for a long-term solution, identified as the Spring Creek Discharge Design. The design treats the stormwater for pollutants using Best Management Practices that include a sediment forebay and rain garden. Once treated, the stormwater is conveyed off-site by a 1,600-foot pipe and channel network that discharges nearby into Spring Creek. The team has prepared design drawings to construct the project and has submitted the drawing package to Paxton Ministries to allow for final design and permitting to be completed by a professional engineering firm, as well as refine the construction cost estimate to explore sources of funding for the project.

57 ***Oakwood Hills Pedestrian Access***

Justin Witters, **Adam Barley**, **Treavor Moore**, Ben Holderman[‡†], L. Bryan Hoover[‡†]

This year, the Oakwood Hills Pedestrian Access Team has been working with Rider Musser Development, LLC to expand their trail network with the creation of a pedestrian crossing of the on-site stream. The team has worked to determine possible options and assess them to find solutions that would satisfy the crossing criteria. In determining the most suitable option, the team has created a decision matrix, stream survey and conceptual Type, Size, and Location report to deliver our findings to Rider Musser.

58 ***Sight and Sound Remote Latching System***

Ben Schott, **Brandin Dyche**, **George Noble**, Timothy Van Dyke[†]

The Sight and Sound Latch team is partnering with Sight and Sound Theatres in Lancaster, Pennsylvania to develop a remote-operated latching system for the theater to use in its shows. Sight and Sound Theatres produces Biblical-based musical performances, uses massive set pieces for visual displays and stages for actors to perform on. Sometimes these need to be connected together to complete the display. Currently, Sight and Sound uses hand operated latches to do so. Occasionally these latches are in hard-to-reach places or need to be operated at inopportune times. The goal of our team is to develop a remote latching mechanism which will eliminate the need for these hand-operated latches. Our team began by looking at various latching mechanisms and ultimately decided to base our design on a common cabinet latch. The basic design involves having a pneumatic cylinder on one set piece which extends towards a latching mechanism on the other set piece which, connects to the cylinder rod and allows the pneumatic cylinder to pull the two set pieces together. For this use, we had to scale up the original design of the latch mechanism from a common cabinet latch and modify the design significantly. Using a computer modeling program, we were able to model the mechanism parts and, using 3D printers, we were able to produce plastic prototypes of our latching mechanism. After revisions were made based on these models, a prototype in steel was created. This metal prototype was tested in different configurations and for reliability, wear, and strength. This led to more design changes and retesting. The final design was attached to real set pieces and it was confirmed that the latch functioned as desired.

59 ***Sustainable Agriculture***

Lexi Bane, **Daria Eshelman**, **Isaac Underhill**, Michelle Lockwood[†]

The Sustainable Agriculture team is working with Sheltering Wings (SW), in Yako, Burkina Faso to troubleshoot and fix the currently installed aquaponics system. The team will deliver an operational procedure on how to build, run, and maintain an aquaponics system to Sheltering Wings, for use in their agricultural school. In order to fully understand how an aquaponics system works to make suggestions to the current design, the team has developed a system prototype. The aquaponics system process starts with fish that produce waste, which contains high levels of ammonia. Using nitrifying bacteria that grow in the system, the ammonia is converted to nitrite, then to nitrate. This water containing the nutrients cycles from the fish tank, through a clarifier, into media beds where the plants are growing. The plants absorb the nitrates before the water is cycled back to the fish tank. The prototype design implements the use of two media beds with pea gravel arranged in a parallel configuration. The entire flow of the system runs by

gravity until the water is pumped back up into the fish tank to cycle through again. The team plans to use and develop this prototype into a best practice aquaponics system. The team will then reproduce this system in Burkina Faso with the available materials and make modifications as necessary. In collaboration with SW, members of the community will be trained on how to build, run, and maintain an aquaponics system.

60 ***Conversion of Heme b to Heme c in Mycobacterium tuberculosis catalase peroxidase***

Priscila Crawford, Jesse Kleingardner†

Metalloprotein engineering involves incorporating a metal into a protein or modifying existing metal-containing proteins to achieve desired properties or structures. Engineering proteins can give insight into the relationship between protein structure and function which allows us to understand our world better. The engineered proteins can also possess properties that can be used in biotechnological and chemical applications. Conversion of the heme of an enzyme from a heme b, which is non-covalently bound to a protein, to a covalently bound heme c can possibly increase the enzyme's thermal stability and its redox or enzymatic properties. Mycobacterium tuberculosis catalase peroxidase (KatG), a metalloenzyme with a heme b that oxidizes the tuberculosis pro-drug, Isoniazid, into its active form, is a great candidate to test the effects of the conversion of the heme b to a heme c. We hypothesize that the conversion of KatG from a b-type heme to a c-type heme will enhance its thermal stability while having a small but positive impact on the rate of its catalase and peroxidase activities, thus speeding up the reaction of oxidizing Inh into its active form. Via site-directed mutagenesis and protein expression, the KatG gene was engineered to contain a heme c. Gel Electrophoresis results established we had DNA that was viable for transformation. Colonies from the transformation confirmed a probable successful conversion of KatG from a b-type heme to a c-type heme. Expression, purification, and kinetic analysis will be conducted to test the effects of this heme conversion on the protein properties.

61 ***Template-based engineering of stacked c-type hemes***

Chelsea Sommerville, Jesse Kleingardner†

Metalloprotein engineering is used to study structure-function relationships, enhance the properties of a metalloprotein, or design functions beyond those observed in naturally-occurring metalloproteins. Of particular interest are metalloproteins with metal clusters, which are known to catalyze multi-electron redox reactions - the four-electron oxidation of water to O_2 or the reverse reduction. For example, synthetic stacked cobalt porphyrins have been shown to catalyze the O_2 reduction reaction almost exclusively to water, a crucial reaction to most fuel cells. Based on protein structure analysis and modeling, heme *c* insertion into the protein CHIP is hypothesized to generate a dimer with a stacked heme structure, not yet seen in naturally-occurring proteins. To test the hypothesis, two expression vectors were created using seamless ligation cloning extract (SLiCE): one for wild-type CHIP and one where a heme *c*-binding CXXCH motif has been introduced into the sequence (CHIP-heme). Holo-CHIP-heme was only expressed inconsistently in auto-inducing media. Based on SDS-PAGE analysis comparing osmotic shock periplasmic extraction to complete cell lysis, it is hypothesized that CHIP-heme expression is not robust due to poor periplasmic secretion, which is signaled using the N-terminal pelB signal peptide. The secretion is necessary for heme attachment via the cytochrome *c* maturation system. Three new CHIP-heme vectors are currently being constructed with new signaling sequences: OmpA, Nfra, and a modified pelB signal. Each gene will be expressed and the protein product tested for successful heme attachment.

62 ***Changing the metal specificity of the calcium-binding protein Twitch-2B***

Hannah Martin, Jesse Kleingardner†

The calcium sensing protein, Twitch-2B, is a fusion protein composed of a piece of Troponin C, in between two fluorescent proteins, YFP (yellow fluorescent protein) and CFP (cyan fluorescent protein). Energy between these two fluorescent proteins can be exchanged through a process known as Forster Resonance Energy Transfer (FRET). When calcium binding occurs, it causes a conformational change in Twitch-2B and allows for the two fluorescent proteins to come in close enough proximity to transfer energy. This causes a detectable change in fluorescence that we can then measure. The hypothesis was that by changing the amino acids coded for in the calcium binding region, other metal binding affinity could be achieved. The first step in the project was PCR-based mutagenesis of the Troponin-C gene fragment, the calcium binding region of Twitch-2B. This was done by using degenerated primers to produce genetic diversity of Twitch-2B then testing for efficacy to determine whether the

mutagenesis was beneficial for binding capability or not. The next step was insertion of the library of mutated troponin C gene fragments into a protein expression vector using SLiCE technique. Seamless Ligation Cloning Extract (SLiCE), is a cloning method that can be used to assemble fragmented DNA for DNA recombination by utilizing DNA repair mechanisms found in extracts of dead *E.coli* cells. The final step was the use of fluorescent screening to determine metal binding. The gene sequences were determined for the variants which displayed a change in fluorescence when a metal was added.

63 ***Direct Expression of Cobalt-Substituted Cytochrome c using Variants of Holo-Cytochrome c Synthase***
Beau McCarver, Jesse Kleingardner[†]

Cytochrome *c* is a 104-mer protein located in the electron transport chain of the mitochondria used to shuttle electrons from complex III to IV. Naturally, cytochrome *c* contains a heme cofactor (protoporphyrin ring with a central iron atom), however, cobalt protoporphyrin cofactors have been shown to catalyze key reactions such as the reduction of pH-neutral water to hydrogen gas. Unfortunately, previous synthesis attempts have been either unsuccessful or achieved low yields that required too many input costs to remain energetically favorable. The synthesis of cytochrome *c* is highly regulated by holo-cytochrome *c* synthase (HCCS) and if any errors are detected by the enzyme (such as cobalt-substitution), the protein is marked for degradation before it is ever released from the final step of synthesis. With this in mind, an E138A mutant HCCS that is less selective and regulative was generated and used in a growth attempt to determine if it was still capable of synthesizing cytochrome *c*. The evidence of slightly pink cells suggest that the mutated enzyme does not work at the same efficiency as the wild-type enzyme, but is still able of generating cytochrome *c*. Additionally, wild-type HCCS was shown to express cytochrome *c* in an inconsistent manner, suggesting that the synthesis is challenging to accomplish in auto-inducing minimal media. After several modifications to the generic media recipe, expression became more consistent. To date, growth trials with increased cobalt concentrations have been inconsistent and lead to confounding results.

64 ***Evidence for the role of gastrin signaling in the uniquely fibrotic pancreatic tumor microenvironment***
Matthew Darok, John Harms[†]

Pancreatic cancer is currently the third most common cause of cancer-related death in the United States. This lethality is due, in part, to the fact that traditional treatment options are largely unsuccessful. It is hypothesized the highly and uniquely fibrotic nature of the pancreatic tumor microenvironment (TME) constricts blood flow and thereby inhibits chemotherapeutic delivery. The hormone gastrin is produced by pancreatic cancer cells and contributes to their proliferation; previous studies have also suggested it has a role in TME fibrosis. In two independent trials utilizing an orthotopic pancreatic cancer model, we determined that mice treated with a gastrin antagonist (proglumide) demonstrated a statistically significant inhibition of fibrosis in the TME. Studies to detect whether this inhibition increases efficacy of gemcitabine treatments have shown that combination therapy exhibits a slight improvement in mean tumor diameter, with histological analysis of tumor samples still ongoing. To further elucidate the cellular mechanism driving the elevated tumor fibrosis, we utilized an *in vitro* model to examine gastrin signaling in both human pancreatic cancer cells (PANC-1) and pancreatic stellate cells (PSC's; cells population potentially responsible for abundant collagen in the TME). Treatment with exogenous gastrin did not result in the elevation of collagen expression in either cell type; and similarly, gastrin antagonists (proglumide; YM 022) failed to suppress collagen expression. However, analysis revealed PANC-1 cancer cells produce significantly more collagen than the stellate cells, suggesting they may contribute more to the generation of fibrotic tissue in the pancreatic TME than previously believed.

65 ***Prevalence of a variant gastrin receptor RNA and correlating genomic polymorphism in human pancreatic cancer***
Rebekah Jones, John Harms[†]

The five-year survival rate of pancreatic adenocarcinoma (PDAC) is an abysmal 5%. The gastrointestinal hormone, gastrin, has been implicated as a driver of cell proliferation and pancreatic tumor growth via its receptor (CCK2R). Our lab has focused on the etiology of $CCK2_{i4sv}R$, a hyperactive splice variant of the gastrin receptor which has been associated with increased pancreatic tumor aggressiveness. While previous studies have

correlated a single nucleotide polymorphism (SNP; C>A) in the receptor with decreased survival and potential expression of the variant receptor, we have previously reported the A-allele, alone, is not causative of missplicing. To determine if the SNP is part of a multifactor phenomenon resulting in $CCK2_{i4sv}R$, we undertook an analysis of normal and cancerous human pancreatic specimens. Tissue samples were genotyped, and CCK2R and $CCK2_{i4sv}R$ mRNA were quantified by Real Time RT-PCR. An elevated incidence of the A-allele in PDAC samples (48%) compared to the normal population (14%) may support a correlation between the SNP and pancreatic cancer. Surprisingly, low levels of the splice variant receptor were detected with high frequency in normal pancreatic tissue, though it should be acknowledged that normal specimens derived from pancreatic resections may not be truly normal. Efforts to bolster sample size and test truly normal samples are ongoing.

66 ***Cloning a fluorescent fusion protein for detection and localization of the gastrin receptor***

Vinh Le, John Harms†

Pancreatic ductal adenocarcinoma (PDAC) is the fourth leading cause of cancer-related death worldwide. It is promoted by multiple cellular signaling events. Gastrin, a hormone that regulates several aspects of gastrointestinal physiology and maintenance of the gastrointestinal mucosa, is abnormally expressed in pancreatic cancer cells and promotes PDAC growth. Its effects are chiefly mediated through CCK2R, a seven membrane-spanning G protein-coupled receptor. Upregulation of CCK2R and the cancer-associated splice variant, $CCK2_{i4sv}R$, have been shown to contribute to tumorigenicity, with the latter promoting increased tumor aggressiveness. Our lab has previously reported the development of monoclonal antibodies specific to CCK2R and $CCK2_{i4sv}R$. However, immunofluorescence and Western blotting detection were achieved in cells transiently-transfected with these receptors, and detection at physiological levels and in stable transfections has proven difficult. As such, sensitivity of these monoclonal antibodies has not been determined. To fully characterize these antibodies and develop accurate receptor quantification, we report development of a plasmid encoding a fusion of enhanced green fluorescent protein (EGFP) to the C-terminus of CCK2R/$CCK2_{i4sv}R$ under the constitutive control of a beta-actin promoter with CMV-enhancers (pCAGEN.neo). Transient transfection of the assembled plasmid into human pancreatic cells confirmed intact fluorescence of the $CCK2_{i4sv}R$-EGFP fusion protein. This positive-control fusion protein will enable determination of antibody sensitivity and selectivity and additionally permit *in vitro* tracking of receptor subcellular localization.

67 ***Clarifying the connection between oncogenic K-ras and gastrin/CCK2R signaling in pancreatic tumorigenesis***

Andrew LaRow, John Harms†

Pancreatic ductal adenocarcinoma (PDAC) is an extremely deadly cancer: the overall five-year survival rate is 8%. This is mainly due to the difficulty of diagnosing PDAC in its early stage: only 9% of patients are diagnosed with localized cancer. Cancer cells display rapid growth and cell division, due in part to oncogene activation and stimulation of mitogenic pathways. In PDAC, mutant K-ras, an oncogene and intracellular signaling protein, is present in 90% of all cases. Because of this high correlation and the role of mutant K-ras in PDAC, it has been repeatedly targeted for cancer therapy, but with little success. Interestingly, K-ras has been shown to increase gastrin expression in colon cancer. Gastrin is a peptide hormone also aberrantly expressed in PDAC cells. It plays a role in PDAC progression because it stimulates tumor cell proliferation in an autocrine manner, mediated through the gastrin receptor, CCK2R. It was hypothesized that K-ras increases gastrin expression in PDAC. Preliminary data showed the receptor, CCK2R, rather than gastrin, is upregulated by mutant K-ras. Further studies were undertaken using aggressive human pancreatic cancer cells as well as normal pancreatic ductal cells. No consistent pattern of altered CCK2R expression was observed, suggesting the preliminary data were not accurate. However, gene expression levels and protein levels do not necessarily correlate. Western Blotting is currently being undertaken to determine if a correlation between K-ras activation and CCK2R exists at the protein level.

68 ***Prevalence of Common Risk Factors of Medial Tibial Stress Syndrome in Collegiate Volleyball Players***

Jackson Lohr, Matthew Lewis†

Objective: Medial Tibial Stress Syndrome (MTSS) is a common chronic musculoskeletal injury and well researched in runners and military recruits. However, little data has been reported related to the presence of previously established risk factors and the

prevalence of this diagnosis in collegiate volleyball athletes. Our purpose was to conduct a pilot study on the prevalence of common risk factors for MTSS in collegiate volleyball players. **Risk Factors:** Navicular drop (ND), plantar flexion (PF) range of motion (ROM), and body mass index (BMI). **Subjects:** 16 collegiate volleyball athletes 18-24 years of age. Exclusion criteria included any athletes below age 18 and those currently dealing with any lower extremity injury preventing them from full participation in sport. **Measurements:** Height and weight were recorded via standard tape measure and balance scale. Plantarflexion range of motion was assessed using a goniometer. The Navicular Drop Test was used to assess positional change in the Navicular between a seated, non-weight-bearing posture and standing, weight-bearing posture. Body mass index was calculated using standardized calculations. **Results:** Navicular Drop (5.7 ± 2.39), BMI (22.35 ± 5.33), Plantarflexion (60.68 ± 17.07) **Conclusions:** Data compiled from this study will be compared to mean data reported in previous studies to determine whether or not volleyball athletes present with the same risk factors as the more commonly studied running and military recruit populations. Injury data will continue to be collected and analyzed in order to determine the relationship between these risk factors and MTSS occurrence in this population.

69 ***Towards generating a neutralizing antibody against bacteriophage T4: working out a small-scale screening assay***

Dominique Stewart, Lawrence Mylin†

Adaptive immunity utilizes neutralizing antibodies to combat viral infections. While a response often produces a mixture of antibodies that bind to multiple distinct sites on the virus particle, only a subset known as neutralizing antibodies actually interfere with the ability of the virus to bind to and/or enter host cells. Neutralizing antibodies may block key cell-interaction surfaces of the virion, or pre-release proteins required at the time of cell penetration. Microbiology students at Messiah College were able to conduct a laboratory exercise in which polyclonal neutralizing antisera were used to prevent infection of *Escherichia coli* strain B by bacteriophage T4. Students compared simulated patient sera for efficacy in reducing plaque formation and thereby determined which patient exhibited the best protection. Unfortunately, the original anti-T4 serum is no longer available, and no suitable substitute has been found. We plan to use hybridoma technology to generate a mouse monoclonal antibody that will neutralize phage T4. It will be essential to have a small-scale assay to rapidly screen supernatants from multiple hybridoma clone candidates for the presence of T4 neutralizing antibodies. The goal of the first part of this study was to gain an understanding of how to control T4 infection of *E. coli* B cells in liquid culture and to scale down infection screening mixtures to a 96 well plate format to allow for analysis using a microtiter plate reader. This presentation will describe progress in establishing the small-scale screening assay

70 ***Collection and cryopreservation of human blood for in vitro cultivation of Plasmodium falciparum: a shelf life study***

Madison Scialanca, Annalise Armstrong, Lawrence Mylin†

Malaria, caused by the parasite *Plasmodium falciparum*, is considered one of the "Big Three" pathogens, along with HIV and tuberculosis, for its persistence among impoverished populations in the developing world. Despite being both treatable and preventable, half of the world's population live in areas continually at risk of malaria, with 500,000 deaths each year consisting of mostly children under the age of five. To support ongoing needs for *Plasmodium* culture by the Malaria Research Trust in Zambia, this study is intended to investigate the shelf-life of uninfected human red blood cells. Work this semester primarily focused on collecting blood from A+, O+, AB+ donors in Grantham, Pennsylvania, and freezing it in the presence of ice recrystalization inhibitors for culture experiments scheduled to begin in fall of 2019. Most of the blood will be stored at -80ºC for several months, but some will be transferred to liquid nitrogen for two weeks to simulate international shipment. This shelf life study will use established culture methods to perform side by side comparisons of fresh vs. frozen blood in the propagation of asexual and sexual stages of *P. falciparum*. Being able to collect, freeze and store store human blood for a year will enhance the ability to conduct culture experiments in regions of the globe (like Zambia) where blood is not readily available from uninfected donors.

71 ***Heavy Metal Ion Toxicity and its Effect on Arabidopsis thaliana mutants rack1b, rack1c, and mtp1***

Christina Perez, Michael Shin†

Arabidopsis thaliana was used as a model system to study how plants respond to and process heavy metal

ions. This experiment studied three genes that were potentially involved in plant responses to heavy metal ion stress: *rack1b* and *rack1c*, which encode for scaffolding proteins involved in stress responses to abiotic stressors, and *mtp1* which encodes for a vacuole cation transporter. These mutants were studied using a tolerance assay to view their response in various concentrations of $Cd^{2+,}$ Ni^{2+}, and Zn^{2+}. An accumulation assay using Ni^{2+} was also run for the *rack1c* and *rack1b* mutants. The *rack1c* mutants were more tolerant of Cd^{2+} at 60 µM. They behaved like the wild type on the other metals; however, they absorbed less nickel than the wild type in the accumulation assay. The *rack1b* mutant showed no growth or tolerance differences from the wild type. It could not be determined whether the *mtp1* had differences in tolerance compared to the wild type at all concentrations on Cd^{2+} and Ni^{2+}. On Zn^{2+} the *mtp1* mutants had overall shorter root lengths compared to the wild type, however, these mutants also demonstrated a greater number of secondary roots. Previous research on *mtp1* mutants under abiotic stress discussed how this could represent a protective mechanism adopted by the plants[1], although for the purposes of this experiment this cannot be determined until an accumulation assay is run. It also had decreased symptoms of chlorosis as compared to the wild type.

[1]Desbrosses-Fonrouge A-G, Voigt K, Schröder A, Arrivault S, Thomine S, Krämer U. Arabidopsis thaliana MTP1 is a Zn transporter in the vacuolar membrane which mediates Zn detoxification and drives leaf Zn accumulation. FEBS Letters. 2005;579(19):4165-4174. doi:10.1016/j.febslet.2005.06.046.

72 ***Role of Lck in Oligodendrocyte Progenitor Migration***

Abigail Sawicki, Jennifer Ness-Myers†

The myelin sheath is a significant structure on neurons because it supports rapid electrical signaling to produce efficient communication in the nervous system. Two types of cells produce myelin in the nervous system: Schwann cells and oligodendrocytes. With diseases like multiple sclerosis that are caused by damaged myelin, it is important to study the mechanism of myelination to generate treatments that could promote remyelination of neurons. The signaling pathways that regulate myelination in oligodendrocytes are not fully understood. The Src-family kinases are a group of cell signaling proteins that are known to influence myelination in the nervous system. The Src-family kinase Lck has been researched in Schwann cells and found to influence migration, but its function in oligodendrocytes is unknown. We hypothesized that Lck will function in oligodendrocytes similar to Schwann cells and will affect migration in oligodendrocytes. To test this, oligodendrocyte precursor cells were isolated from neonatal rat brains and cultured for further analysis. The expression and function of Lck was explored through migration assays and RNA analysis. Results and conclusions will be presented at the symposium.

73 ***Design of a Solar Powered Water Pumping System for Living Love Ministries in Ol Kalou, Kenya***

Christopher Benner, **Joshua Kripas**, **Meghan Sampson**, **Trey Witmer**, Cade Bender, Matt Laven, David Vader†

The Solar Photovoltaics team is working with Living Love Ministries (LLM) in Ol Kalou, Kenya to help meet water needs for domestic use and irrigation with a solar powered water pumping system. LLM currently relies on a diesel generator to power their well pump. Solar power will be both more reliable and more financially practical in the long-term. Stanley Earth has partnered with the Solar PV team and LLM to donate a motor, pump, and pump controller system as well as a second backup system. Some important design questions considered this year were solar array sizing, wire sizing, panel mounting location, and the effect of mounting orientation. The Solar team is traveling to LLM this May to install the well pump and a 26 panel, 6.9kW solar array on Pamoja Hall at LLM to power the pump.

74 ***The Prosthetic Knee Project***

Bryson Boettger, **Matthew Tavani**, Miranda Chiang, Nyles Rife, Jamie Williams†

Our project, The Prosthetic Knee Project, is partnered with the Centre for the Advancement of the Handicapped in Mahadaga, Burkina Faso, Africa and now with Cure Kenya. Due to a large number of trans-femoral (above the knee) amputees in these locations, our project aims to provide a low-cost prosthetic knee design (~$20) that can be easily manufactured using the tools and machinery readily available in both of these partner locations, and that can be compatible with the rest of the leg that our partners are able to provide. Throughout past semesters we have successfully researched, designed, and tested our knee and alternative device (pyramidal adapter) connecting the knee to the femoral and shank components of the leg. This poster will recap our knee design and testing with a local amputee and discuss further on our recent project work. Specifically, we will focus on our work on finalizing the alternative pyramidal adapter design. We will also discuss the

fatigue and strength testing that our project has been able to perform and how that data impacts our knee design. With the help of Applied Health Science majors, we have also been working at creating a rehabilitation protocol for the amputees to use after their amputation. Finally, we will talk about our partnership with CURE Kenya, our upcoming trip to Kenya in May this summer, and how this will impact our project moving forward.

75 ***Panama Bridge Project***

Erin Brenneman, **Samuel Gobeille**, **Nathan Myers**, Brent Basom[‡†], Steve Deller[‡†], Jeff McIlhenny[‡†], Mark Raup[‡†], Doug Stumpp[‡†], Brian Swartz[†], Russell Woleslagle[‡†]

The Panama Bridge project has partnered with Rio Missions Panama to design a bridge for the village of Peñas Blancas, Panama. The mountain community of Peñas Blancas experiences heavy rainfall during the rainy seasons. A stream runs along the community, with mountainside homes to the north, and the main village to the south. While passable during dry seasons, the stream floods and becomes impassable after heavy rains. The mountain residents are effectively cut off from the village during this time. To accommodate this need, the Panama Bridge Team has spent the 2018-2019 school year designing an aluminum truss bridge, spanning 80 feet. The design includes a unique construction strategy to deal with challenging site constraints.

76 ***Remote Hand Pump Monitoring in West Africa***

Cory Brubaker, **Amanda Issis**, Daniel Labrie, Randall Fish[†]

Although millions of households in sub-Saharan West Africa rely on hand pumps installed by various non-government organizations, 30 to 50 percent of these pumps are currently inoperative. Under the sponsorship of AlignedWorks, the Intelligent Water Project (IWP) is continuing to develop remote monitoring devices that track the usage and health of hand pumps. These devices allow organizations to catch pump failure early so that these water pumps can remain operational, continually providing fresh water. After installing thirteen of these devices in the summer of 2017, the IWP has been working to correct problems that were discovered from these field tests, while also improving system accuracy and robustness, and preparing for mass manufacturing.

77 ***Oakwood Hills Pedestrian Access***

Matthew Burlew, **Christian Cornelius**, Ben Holderman[‡†], L. Bryan Hoover[‡†]

This year, the Oakwood Hills Pedestrian Access Team has been working with Rider Musser Development, LLC to expand their trail network with the creation of a pedestrian crossing of the on site stream. The team has worked to determine possible options and assess them to find solutions that would satisfy the crossing criteria. In determining the greatest option, the team has created a decision matrix, stream survey and conceptual Type, Size, and Location report to deliver our findings to Rider Musser.

78 ***All-terrain, Customizable Wheelchair for Wheels for the World***

Emily D'Amico, **Carlie Adair**, **Sam Fino**, **Ivan Chun Hao Oon**, Timothy Van Dyke[†]

The Wheels for the World Team strives to create a practical mobility option for individuals in developing nations who are unable to move on their own. The device will allow the same mobility as a wheelchair while remaining affordable and practical. This project is working with Wheels for the World (an outreach of Joni and Friends) to create a design which will be capable of being mass-produced at a low cost in the United States, shipped anywhere in the world in a box, and then assembled in the country of use. A major requirement for the design is that it should be fully customizable to fit different users and be fully collapsible for easy storage and transportation. The team has developed a design for this device which is similar to a tricycle; however, in this design the third wheel is in the back. This design uses plates and bolts to hold together telescoping square tubing, which acts as the backbone of the design with the seat, wheels, and a footrest attached to this tubing. A shock absorber system was also included to reduce impacts from road variations. A manufacturing manual and assembly manual, which are to be provided with the design, have been completed. The team is currently in the process of redesigning the wheelchair, making several adjustments recommended by our client and physical therapists from Messiah's Doctor of Physical Therapy program. A new prototype will be built in order to evaluate the redesigned wheelchair. The team will finish documentation of all redesigned parts and update the manufacturing and assembly manuals accordingly.

79 ***Developing a Low-Cost Optical HIV Viral Load Detection System***

Alicia Decker, **Nathan Chan**, **Brant Meier**, **Morris Taylor**, Jordan Sponsler, Matthew Farrar[†], Jesse Kleingardner[†]

Our client, the Macha Mission Hospital in Zambia, has asked our team to create a low-cost point of care device for measuring HIV viral load in infected patients. Our team plans to detect HIV using a fluorescent recombinant protein that binds to HIV specifically. Fluorescence Correlation Spectroscopy (FCS), a laser-based technique, is then used to quantify the viral load. Currently, we have developed a tentative method for viral isolation from a blood sample, produced and validated a fluorescent protein probe, designed a prototype printed circuit board for detecting single-photon fluorescence, and implemented hardware to process the signal and display results to the end user.

80 ***Optimization of the Design of a Solar Oven for Refugees Use in the Kiziba Camp, Rwanda***

Miriam Dixon, **Justus Danielsen**, **Jason Landis**, **Mitchell Lauer**, Tim Howell[†]

The project team is working with our client Dr. Michael Pucci, Director of GO-ED. The team's goal is to create a solar oven for the community in the Kiziba Refugee Camp, Rwanda. The camp was founded for Congolese refugees with Rwandan cultural roots who had fled to Rwanda to escape the genocide wracking the Congo. It is still dangerous for the people to return there, and they are not likely to be resettled elsewhere, so they are left trying to integrate into the local community. Recent changes to the distribution and amount of UN resources has further strained their already tenuous financial position. The team hopes to design an affordable solar oven that can heat up to 300°F to be able to render tallow and be made of locally sourced materials with a cost of less than 10000 RWF ($12 USD). This, in turn, will then provide the refugees with a marketable product and a sustainable and profitable business model. GO-ED would like to use this to create a "business in a box" where they would standardize the oven's use in a franchise model that would include training, equipment, contracts, and licenses. This in turn could be shared with other NGOs.

81 ***Energy Monitoring and Management System***

Nathen Feldgus, **Zachery Holsinger**, **Zachary Schmidt**, **Ben Weaver**, Thomas Austin[‡†]

The Energy Monitoring and Management System facilitates access to electric power in regions with limited energy by increasing energy conservation and education. The solution consists of a meter which allocates a configurable daily energy limit per facility, and a display that provides practical information to the user including reporting how much energy they have used and how much they have left before their power is automatically cut off until the next day. The current version of the system has successfully been installed in multiple facilities in Burkina Faso and Zimbabwe. Currently, the team has completed the redesign of the system's power sense module to increase performance to meet client specifications. In addition, we have increased the manufacturability of our enclosure through redesigning our baseplate. Finally, we developed a full manufacturing process for our meter, as we are traveling to Zimbabwe this May and need to manufacture 30 meters. This presentation will detail the steps made to redesign the power sense module as well as baseplate redesign and manufacturing process leading up to our Zimbabwe site team trip.

82 ***Cunningham Clubfoot Brace***

Aaron Bashore, **Rebekah Forshey**, **Liam Lilienthal**, **Michelle Lo**, **Benjamin Mellott**, **Leigha Southall**, Kay Laura Sindabizera, Tim Howell[†]

Clubfoot is a musculoskeletal birth defect that describes several foot abnormalities characterized by an inward-rotated foot. The current method for correction involves several casts and a boots-and-bar maintenance brace. This method requires 5 years of bracing and has issues with compliance, comfort, and social stigma. The Cunningham brace reduces treatment time to 2-3 years. It can be concealed, reducing the social stigma, and improves the child's mobility while encouraging muscle growth and development throughout treatment. The Collaboratory Cunningham Clubfoot Brace project seeks to increase accessibility to the brace and test the effectiveness of the design. The project has shown that the brace can be 3D printed using a reinforced nylon polymer. The 3D models developed by the team have allowed our client and brace designer, Mr. Jerald Cunningham, to move forward with injection molding of the three parts of the brace. Currently, we are working on validating the Cunningham Brace by measuring the biomechanical forces created and

applied by the brace. This will happen through a series of pressure sensors that are attached to the brace and then placed on a child's foot. Along with a clinical study that was started in Kijabe, Kenya and the patient data analysis being conducted by Dr. Emily Farrar, this data will hopefully provide the needed evidence that the Cunningham Brace works so that it will be more widely accepted and used for treatment around the world.

83 ***Sustainable Agriculture: Soil Free Farming***
Jared Fonda, **Landon Hacker**, **Noah Shreiner**, Michelle Lockwood†

The sustainable agriculture team is dedicated to developing alternative and sustainable agricultural solutions to alleviate poverty. The team is currently working with Sheltering Wings in Yako, Burkina Faso. Sheltering Wings is a women's shelter and orphanage that has a nonfunctional aquaponics system. The goal of this project is to troubleshoot and fix the aquaponics system through developing cost-efficient modifications and supplying a working procedure on the operation and maintenance of the aquaponics system. In order to achieve this goal, the sustainable agriculture team needs to be able to understand how an aquaponics system works in the areas of biology, irrigation, structural design, and vegetation. Following research and testing, the team designed and built a system prototype, along with a greenhouse. The team will move forward with testing the system prototype in the semesters to come.

84 ***Mechanized Percussion Well Drilling***
Nathan Henry, **Nate Harnish**, **Chris Martin**, Philip Tan†

The Mechanized Percussion Well Drilling Project seeks to design a simple mechanized well drilling system to be used for drilling shallow water wells in Burkina Faso, Africa. These systems will be operated by local drilling teams, allowing them to earn an income for themselves and their families. Currently, our client, Open Door Development, has trouble drilling through hard rock layers and often must abandon holes due to inadequate equipment. The goal of this project is to enable our client to efficiently drill through these rock layers with a mechanized percussion rig and supporting drilling equipment.

One of the areas the project has focused on this year was increasing the life of the cathead, a critical piece of the drilling rig which severely wore during in-country testing in the summer of 2017. The team determined that the aluminum cathead was not able to resist the wear of the rope, which had particles of dirt and rock embedded in it. The team tested catheads made of steel, wood, and different plastics, and steel was found to be the most viable solution. In order to verify the life of the cathead, the team designed and manufactured an automated testing rig. This rig will allow the team to test the cathead continuously and determine if a steel cathead will last for at least 50 hours of drilling.

85 ***Living Love Ministries - Kenya Land Development***
Isaac Albrite, **Jacob Holderman**, Madalyn Heckman, J Scott Heisey†

The Land Development in Kenya team has partnered with Living Love Ministries (LLM), an organization that operates a children's home in Ol Kalou, Kenya, to design an irrigation system to help grow year-round produce and crops to increase self-sufficiency at their facility. The LLM community experiences a significant hot and dry season that affects their ability to grow crops during this time, and they have requested that the Land Development team initially design a system to irrigate two acres of cultivated fields at the children's home. The irrigation system will tie into LLM's elevated water tower currently used to supply water for daily operations. Water will overflow from this tower to an auxiliary storage tank to provide additional water capacity for the irrigation system. A booster pump will be used to pressurize a main trunk line of a drip irrigation system that will feed a series of emitters which control irrigation specific to plant types and row configurations over a nominal 2-acre area. The team has planned a site trip to Kenya in late May 2019 to install the main components of this initial system, and hopes to modularize the system so that LLM will be able to expand their irrigation in a simple and effective manner.

86 ***Flight Following System Redesign***
Matt Hoppe, **Eric Marra**, Harold Underwood†

Outside radar range, small planes flying in remote locations must be tracked by other means. Emergency relief, humanitarian development, and missionary organizations need to follow such flights, for safety and management. The Automatic Flight Following System (AFFS) owned by JAARS has been safety tested and used extensively for this purpose but has been replaced in many cases by new options. Thus, the Flight Tracking and Messaging Systems (FTMS) team has been working with stakeholder Cary Cupka to redesign AFFS 1.0 with updated and more advanced technology modes to increase its value in the field. For proof of concept testing, this includes replacing

internal components of the existing AFFS Aircraft Control Unit (ACU) with a new single board computer (SBC A62), upgraded custom display board, and new HF transceiver (LimeSDR). In addition, the ground monitoring unit will have a matched LimeSDR HF transciever, and UDOO QUAD computer with display. Currently the team is developing code for the aircraft (FLIGHTsoft), for the ground unit (GROUNDsoft), and configuring the HF communications link.

87 ***Fluency Assistive Device (FAD)***

Michael Jenkins, **Jessica Paulus**, **Larry Vega**, Harold Underwood†

Currently, in the world, about 1% of the population (70 million people) have a stutter. Approximately 5% of children stutter for about 6 months and 1% have a long term stutter. This device, originally known as the Edinburg Masker, was created to assist people who have a stutter, but have not been helped by therapy. A stutter has been defined by the American Speech–Language–Hearing Association (ASHA) as a fluency disorder. Few fluency assistive devices exist for this population, and the ones available are highly expensive or unreliable. The Fluency Assistive Device (FAD) team strives to address this deficiency. Our client, Dave Germeyer, serves a niche community of people who rely on a masker. Improvements are needed to update the components and apply new methods recommended by our client. The FAD team will conduct research and testing to develop an upgraded prototype solution. In the future, we will move towards a new design to serve this community more effectively.

88 ***Village Water Ozonation System***

Jordan Criddle, **John Khamis**, Michelle Lockwood†

Safe drinking water is a basic human necessity. People around the world face issues like water scarcity, severe contamination, and limited access on a daily basis. Alleviating global water-related illnesses and deaths remains a prevailing challenge to overcome. Therefore, the Village Water Ozonation Systems (VWOS) team contributes to the worldwide effort to increase access to safe drinking water. For the past two years VWOS had the privilege of walking alongside our partner communities in Mexico, Pakistan, and Nicaragua to develop sustainable drinking water solutions. Through collaborations with several Christian organizations such as Forward Edge International in Mexico, Full Gospel Assemblies of Pakistan and, more recently, Friends in Action International in Nicaragua, the team has acquired an increased awareness of drinking water needs and issues across the world. Each individual partnership presents unique challenges with regards to culture, economics, and local environment that require a complete understanding of our partners' needs, the proper application of water treatment knowledge, and the prioritization of health in all aspects of the design process. In order to address the unique challenges facing each of our partners, the team relies on past experience as well as new research to develop the most appropriate solution, evaluating the feasibility of a project from technical, financial, and cultural perspectives.

89 ***Disarming Improvised Explosive Devices (IEDs)***

Justin Barber, **Hunter Casey**, **Nuttapat Kueakomoldej**, **Andrew Kurian**, Donald Pratt†

Our client, the HALO Trust is an NGO that works with many governments around the world to remove landmines and defuse explosive devices. We are tasked by our client to build a remotely activated wire cutter that will be used to defuse improvised explosive devices (I.E.D). While there are readily available commercial alternatives, these are either too expensive, use explosive components that are restricted in many places where HALO is working, or lack the cutting precision they would like to have. For this device, they want a cutter that is waterproof, sand proof, mud proof and shockproof, which will make it suitable for the harsh conditions in which they often have to work. We came up with 3 designs for our prototypes, a ceramic blade shear cutter, a steel blade shear cutter, and an anvil cutter. All of the prototypes are powered by a waterproof linear actuator. The actuator gives enough power to cut the required thickness of wires the de-miners will face in the field.

90 ***Nicaragua Manual Block Press***

John McGarry, **Kathryn Rose**, Philip Tan†

The Block Press project is developing a manual block press to produce compressed earth blocks used to construct various buildings on the east coast of Nicaragua. Friends In Action International tasked the project to design an easily mobile, lightweight (2-3 people can carry), simple manual press for the Rama community requiring only 1-2 people to operate. The press needs to make an interlocking 12"x6"x4.25" clay-sand-cement brick efficiently (~200 a day) to be used for the new buildings. A SolidWorks model was designed, analyzed and used to fabricate the first block press that was tested in Nicaragua in June 2017. The first press was brought back to Messiah College

and modifications were made. A second press made of stainless steel to combat the rusting problem in the first press was fabricated by E&E Metal Fab. Inc., based on the modifications done to the first press. The second press' viability as well as five block mixtures are currently being tested by the 2018-2019 Block Press team. This testing allowed for an improved design for a third press. The 2018-2019 team has sent the 3D model and engineering drawings to E&E Metal Fab. Inc. for fabrication. Once tested and assured of the third press's viability, it will be given to Tim Johnston and Friends In Action International. Two to three more presses will be fabricated for Friends In Action International from this third press design if the testing goes well.

91 ***Design of a Gravity Fed Water System to Deliver Safe Drinking Water to Villages in Vanuatu***

Sarah Aldrich, **Jordan Higley**, **Ella Sobek**, Thomas Soerens[†]

In the Big Bay region of Espiritu Santo island, Vanuatu, approximately 1350 people living in 30 rural villages lack direct access to safe and potable water. This deficiency can have significant negative effects on the health and livelihood of these communities and may limit their ability to grow both socially and economically. Therefore, the Gravity Fed Water - Vanuatu project, in partnership with Friends in Action International, has designed a gravity fed water system to be implemented to provide easy access to clean, safe, and drinkable water. The system consists of an intake structure at the water source and continues with about 16 miles of pipe to deliver water from the source to storage tanks in the villages along the route; the system requires no external energy to run. Friends in Action International plans to begin construction of the system in the summer of 2020. The team hopes that implementing the gravity fed water system will help to improve the health and livelihood of the villagers and to provide more opportunities for social and economic growth.

92 ***Pico Hydro Design for the Developing World***

Robert Dickey, **Johnny Greaser**, **Cameron Kantner**, **Caleb Southwick**, Dan Elliott[‡†], Robert Hentz[‡†], Wil Kirchner[‡†]

Access to renewable and sustainable energy plays a vital role in eliminating poverty and enabling economic opportunities. The Pico-Hydro team has the unique opportunity to design a product that gives a point of access to renewable and sustainable energy via small scale hydro power. This poster outlines the team's progress toward a general hydro prototype which will be deployable in streams worldwide fitting certain stream parameters, as well as a site-specific hydro design opportunity in Panama.

93 ***Design of 3D Printed Orthotics and Bacterial Testing on Silicone Liners for CURE Kenya***

Emma Vogan, **Shane Curry**, Andy Erikson[†], Emily Farrar[†]

Our project, Rapid Orthotics for CURE Kenya, partners with CURE International's charitable hospital in Kijabe, Kenya, in order to implement a 3D printing system into their orthopedics department to rapidly produce orthopedic and prosthetic devices. CURE is a Christian nonprofit organization that provides medical care to children who suffer from orthopedic and neurological conditions. They asked us to design a 3D printing system that helps them shorten the time it takes them to make prosthetics and orthotics while also lowering the cost. One of the requests from the client during our site team trip in 2018 was a way of producing their dynamic ankle-foot orthotics using their current 3D printing system. As of now, we are in the process of finishing a training manual with instructions for making the newly designed 3D printed dynamic ankle-foot orthotics to deliver during our site team trip in May 2019. Additionally, our client asked us to analyze the feasibility of replacing their current Ethylene Vinyl Acetate prosthetic liners with silicone prosthetic liners. One major concern with this is that the tight fit produced by silicone liners may be dangerous in low-resource settings and humid environments due to harmful levels of bacterial growth. This has led to the designing and testing of a procedure to analyze bacterial growth on silicone liners. From this we want to be able to inform them of the feasibility of using these liners by May 2020.

94 ***Sight and Sound Remote Latching System***

Cory Hurst, **Alexander Vollert**, Timothy Van Dyke[†]

The Sight and Sound Remote Latching System team is partnering with Sight and Sound Theater in Lancaster, Pennsylvania to develop a remote-operated latching system for the theater to use in its shows. Sight and Sound Theatre, a theater company which produces Biblical-based musical performances, uses massive set pieces for visual displays and stages for actors to perform on. Some of these set pieces must be connected together and are joined using hand-operated latches. Occasionally these latches are in hard-to-reach places or need to be operated at inopportune times, which increases stress on

performers and stagehands. The goal of our team is to develop a latching mechanism which will eliminate the need for these hand-operated latches. Our team began by looking at various latching mechanisms and ultimately decided to base our design on a common cabinet latch. The basic design consists of two parts each attached to a different set piece: a pneumatic cylinder on one set piece, and the latching mechanism on the other. The piston extends a bolt head towards the latch which clamps onto the head of the piston. This allows the pneumatic cylinder to pull the two set pieces together and securely hold them until the end of the scene. For this use, we had to scale up this design of the latch mechanism from a common cabinet latch and modify the design significantly. We created virtual models of the mechanism parts in a solid modeling software and produced plastic prototypes of our latching mechanism using 3D printers. After revisions were made based on these models, we fabricated a steel prototype for physical analysis. This metal prototype was tested in different configurations and for reliability, wear, and strength. This led to more design changes and retesting. The final design was attached to real set pieces belonging to the client. After months of testing the latch prototype, we have confirmed that the design functions as intended.

95 ***Sustainable Mobility for Persons Living with Disability in West Africa***

Helen Wiley, **Katie Bunch**, **Dylan Derstine**, **Matthew Higgs**, **Faith Kerlen**, **Emma Workman**, John Meyer†, David Vader†

The Sustainable Mobility Project empowers people living with a disability in the developing world to fully participate in family and community life and makes possible the pursuit of educational and work opportunities. The Collaboratory 3-wheeled off-road wheelchair design is well-regarded among mobility practitioners. Our design has already transformed the lives of dozens of clients through a partnership with the Center of Hope in Fada, Burkina Faso. Now to reach more people in new locations with more partners, the Sustainable Mobility team is reducing manufacturing time and cost, developing supply chains to bring parts and materials to build sites, and developing a turn-key business model that puts local fabricators to work building tricycles wherever they are needed. With our client, SIM Burkina Faso, we are establishing a mobility manufacturing center in Fada, Burkina Faso. Finally, we will work to facilitate the formation of a new independent entity to manage supply chains and to facilitate the formation of additional small businesses that will produce our design in the developing world.

96 ***Design of Muscle Activated Prosthesis***

Nicholas Ports, **TJ Quintilian**, **Samuel Whittle**, **Ryan Yoder**, Emily Farrar†, Dereck Plante†

Children are among the primary patients needing a prosthetic device as over 2,250 children per year are born with a residual limb. However, many children do not have access to the health insurance benefits that would allow them to afford an appropriate device before the age of 14 since a realistic-looking, functioning myoelectric prosthesis costs more than $20,000. Our local partner, Eric Shoemaker of Ability Prosthetics and Orthotics, has an 11-year-old patient who would particularly benefit from a myoelectric prosthetic device, an externally powered artificial limb that is controlled by the electrical signals generated by one's own muscles to give the user more freedom and movement than a mechanical prosthesis. Our team will use biomedical, electrical, and mechanical engineering principles to design a low-cost (estimated $1000) muscle-activated prosthesis utilizing 3-D printing technology to print the hand, forearm and socket customized for the anatomy of our patient. After reading electrical signals from the muscles, sensors relay various patterns and intensities of muscle contractions to a microprocessor that then converts the data into commands for electric motors to move finger joints to open and close the prosthetic hand. We hope through this project to make the best possible treatment available to our client and other patients in need of a prosthetic device.

97 ***The Impact of Music Intervention on Pain and Anxiety in Laboring Women***

Carly Rechenberg, **Sarah Miller**, **Angela Nguyen**, **Andrea Carman**

Background: Women experience increasing pain and anxiety during childbirth as labor progresses which can negatively affect the mother and neonate. Pain and anxiety management during labor is a major concern for clinicians and patients. A non-pharmacological music intervention provides an opportunity for nurses to implement a pain and anxiety management technique without a physician order. **Problem:** Pain and anxiety are very common during the labor process increasing as labor progresses. Pharmacological interventions are used during labor, however, non-pharmacological interventions are often overlooked. Music as an

intervention is under utilized, despite its benefits to the laboring woman. Patient education is needed to encourage the use of music intervention. **Purpose:** The purpose of this evidence-based practice project was to determine if music intervention during labor decreases pain and anxiety. **Methods:** Literature was obtained via PubMed, CINAHL, MedLine, and COCHRANE databases, searching the key terms *music intervention, music during labor, effects of music on pain, labor pain interventions.* **Results:** Mothers in the music therapy group reported lower levels of pain and anxiety compared with those in the control group. Listening to music during labor has a positive impact on labor pain and anxiety. **Implication for Practice:** There is a need for increased education on nonpharmacological pain interventions during labor, specifically music intervention. Audio analgesia is an intervention that is simple to implement and can give patients another option for pain management. **Areas for Future Research:** Future research should consider more studies in the United States and allow the laboring women to choose the preferred type of music. Additional studies exploring different types of music for different stages of the labor is a potential area for further research.

98 ***The Benefits of Using a Standardized Symptom-Triggered Opioid Withdrawal Protocol to Reduce Length of Detox and Hospital Stay and Increase Patient and Staff Satisfaction***

Kylee Kidwell, **Blake Stock**, **Kierra Smith**

Background: From 2015 to 2016, the rate of overdose due to opioid use has increased by over 20% (CDC, 2017). Patients suffering from opioid withdrawal may experience symptoms such as vomiting, hyper-agitation, hypotension, tachycardia, and even death. The most common opioids include fentanyl, morphine, oxycodone, hydrocodone, and heroin. **Problem**: Symptom-triggered opioid withdrawal protocols are varied and inconsistently utilized. **Purpose**: The purpose of this evidence-based practice project was to identify a standardized symptom-triggered protocol that could be initiated to control the severity of acute opioid withdrawal symptoms. **Methods**: A review of literature was conducted by searching CINAHL, PubMed, and the Cochrane Database of Systemic Reviews using the key words: *COWS, Clinical Opioid Withdrawal Scale, opioid withdrawal, buprenorphine, opioid withdrawal protocols*. **Results**: Research has shown that during the acute phase of withdrawal, the combination of utilizing the Clinical Opioid Withdrawal Scale (COWS) and administering buprenorphine, an opioid partial agonist/antagonist, reduced the length of detox in patients. The interventions used during the acute withdrawal phase from opioids helps in the promotion of recovery and the prevention of relapse. Patient and staff satisfaction is promoted due to the decreased detox period, reduced percentages of relapse, and reduced cost of care to the patient and to the hospitals. **Implications for Practice**: The COWS scale is a valid and reliable tool to assess the severity of opioid withdrawal symptoms. Ease of withdrawal benefits patient, staff, and institution. **Areas for Future Research**: Future research studies should include studies comparing buprenorphine use in inpatient treatment versus outpatient treatment versus as a take home medication in the retention of sobriety.

99 ***Smoking Cessation and the Cardiovascular Patient***

Danielle McGowan, **Olivia Lorson**, **Emily Smith**, **Molly Morin**

Background: Smoking is one of the leading causes of preventable mortality and morbidity. Cardiovascular patients are at an increased risk for smoking related-complications due to the vascular impacts that smoking has on the body. Heart disease remains the leading cause of death among smokers. Poor long-term smoking abstinence rates are a continuing problem for the cardiac patient. While education modalities vary among healthcare settings, standard cessation education care currently includes bedside education from the nurse and an informational pamphlet given to the patient regarding smoking morbidities and the benefits of quitting. **Purpose:** The purpose of this evidenced-based practice project is to analyze current smoking cessation interventions and to assess if these interventions are still considered best practice. **Methods:** Literature was collected via CINAHL, PubMed, and MEDLINE databases. *Keywords used included: smoking cessation, cardiac patients, combination therapy, pharmacotherapy and behavioral therapy.* The evidence included literature reviews, quantitative studies, and a mixed methods approach. **Results:** Recent evidence suggests that a combination treatment therapy provides a higher rate of efficacy among cardiac patients. Medication therapies along with follow-up counseling proves to be more effective than the standard care currently implemented. In addition to extended cessation treatments, combining medications has shown to be significantly more effective in helping patients quit for longer periods of time. Telephone follow up was

found to be more cost effective, convenient and efficient for the patient. **Areas for Future Research:** Future research should consider socioeconomic status regarding treatments, cost-effective outcomes, and the implementation of telephone counseling before and after cardiac surgeries in reference to smoking cessation education.

100 ***The Importance of Education in Patients Experiencing Psychogenic Nonepileptic Seizures***

Imogen Olson, **Elizabeth Kelpen**, **Shelby Landes**, **Madeleine Smith**

Purpose: Through conversations with professional nurses as well as review of research articles, it was discovered that there is a need for a better understanding of psychogenic nonepileptic seizures both by patients and healthcare professionals. The specific interest was to determine if structured patient education has an effect on patients with psychogenic nonepileptic seizures. **Methods**: A search of evidence using CINAHL and PubMed databases was conducted using key words: *nonepileptic seizures, nonepileptic seizure education, psychogenic seizures, implications, and nursing*. A randomized controlled study (RCT), an RCT pilot, and literature reviews were analyzed. **Results**: The review of articles found that structured patient education has a positive impact on patient outcomes through the decrease in readmission rates and symptomology. Patients tend to accept their diagnosis of nonepileptic seizures in a more positive fashion with a greater understanding of their pathophysiology. Reframing the diagnosis of pseudo-seizures as psychogenic non-epileptic seizures or attacks, also positively affects patient outcome. **Implications for Practice:** Patients with psychogenic nonepileptic seizures tend to have high readmission rates, which results in negative stigma surrounding these patients by health care professionals and a waste of monetary resources. If a patient with psychogenic nonepileptic seizures has proper education of their diagnosis, these issues are less likely to occur. **Conclusions:** While a need for additional research exists, an increase in education for patients and reframing the diagnosis has been found to be beneficial for the patient to decrease the likelihood of a recurrence of a nonepileptic seizure.

101 ***Order Sets for End-of-life: Improving the Patient Experience***

Lydia Eichorn, **Sierra Kirsch**, **Aja Cunningham**

Background: Care for the dying patient is becoming a relevant topic in hospitals around the nation. End-of-life (EOL) order sets provide physicians and nurses with well-defined medication orders and nursing interventions to be implemented. Nursing assessment helps guide the intervention process. EOL care is necessary to increase family satisfaction, patient comfort, and to improve symptomology. Providing structure through existing order sets will minimize delay of care, provide more adequate symptom management, and is useful in improving patient outcomes. **Purpose:** The purpose of this evidence-based practice project was to evaluate end-of life care order sets to determine if appropriate interventions were implemented to increase outcomes in patients nearing death. **Methods:** CINHAL, PubMed, and MEDLINE databases were used to find relevant literature using the following key search terms: *end-of-life care, order sets, nurses, palliative care, patient satisfaction.* **Results:** Order sets increased the availability of medications and improve patient comfort in patients receiving EOL protocol. Patients receiving comfort measure order sets were deemed more comfortable at time of death than patients not receiving the protocol. Additionally, patients receiving order sets had more family meetings and code status changes. Demographics such as age, insurance status, and level of consciousness, are correlated with lower implementation of EOL protocols. **Implications for Practice:** Order sets help identify areas of missed care and opportunities for quality improvement. It can be concluded from the research that having EOL order sets were beneficial but was not fully sufficient. **Conclusions:** Future research is needed to evaluate the effectiveness of symptom management and patient comfort in a way that eliminates barriers such as incomplete documentation, delay of treatment, and demographic disparities.

102 ***Reporting Workplace Violence***

Alexandria Cummings, **Megan Cornman**, **Natalie Toburen**

Background*:* Workplace violence (WPV) is an increasing problem in the healthcare field. A review of literature showed a significant decrease in self-reporting of WPV due to lack of education on what constituted WPV, belief WPV is expected in the healthcare field, and lack of support from administration. WPV was consistently defined in the literature as any physical or verbal threat or act directed toward a healthcare professional. *Aims:* The purpose of this evidence-based practice project is to identify strategies that promote WPV reporting among healthcare staff. **Methods***:* CINAHL,

EBSCOhost, MedLine, and PubMed databases were used to search for relevant evidence using the keywords: *workplace violence, reporting, verbal abuse, physical abuse, reporting tool.* Four quality improvement projects were critiqued. **Results:** In each project, a reporting tool other than the traditional Incident Reporting System (IRS) was used to examine if an alternate tool would increase staff reporting of WPV. Staff were first educated on what encompasses WPV and then encouraged to use the alternate reporting tool. Follow-up assessment was conducted to determine if these interventions increased staff reporting. There was an overall increase in WPV reporting after staff education. **Conclusions***:* The evidence demonstrated that most quality improvement project interventions using an alternate reporting tool, displayed an increase in both WPV reporting, staff awareness, and knowledge on workplace aggression. However, due to the Quality Improvement format, generalizability of the project is not possible. Future research studies are needed to determine which evidence-based tools are appropriate for reporting of WPV.

103 ***Evidence-Based Recommendations to Shorten Pre-Procedural Fasting Times of Procedures Using Anesthesia or Conscious Sedation***
Elizabeth Muchmore, **Isaac Starr**, **Shelby Stouffer**

Background: Common protocol prior to anesthesia or conscious sedation includes nothing by mouth (NPO) after midnight the evening before the procedure (Kulshrestha, Matthews, Kapadia, & Sanwatsarker, 2013). This leads to extended NPO status; therefore, it is important to determine a minimum pre-procedure fasting time to improve patient satisfaction and hydration status. **PICO Question:** What is the effect of clear liquids 2 hours pre-procedure versus current practice of nothing by mouth (NPO) after midnight among patients undergoing procedures using anesthesia or conscious sedation? **Methods of Literature Search:** The majority of the literature was reviewed using PubMed and CINAHL. The article dates ranged from 2003-2018. A total of 1,868 articles were found and 8 articles were used that addressed the PICO question. Using the John's Hopkins Model, the majority of articles ranged from Level III and Level V with an A or B quality with one Level I Systematic Review found. **Findings:** Evidence supports that patients undergoing scheduled procedures using anesthesia or conscious sedation can consume clear liquids up to two hours prior to their procedure (Apfelbaum et al., 2017). Patients who consumed clear liquids until two hours pre-procedure had no negative affects compared to patient who were NPO after midnight the evening prior (Hamid et al., 2014; Brady, Kinn, Stuart, & Ness 2003; Shah, Maharjan, & Gurung, 2018). Patients who fasted for 12 or more hours reported higher anxiety and had imbalanced electrolyte and those fasting for less than 12 hours had statistically significant less hunger, thirst, nausea and pain ($p = 0.03$) (Tosun, Yava, & Acikel, 2015). **Recommendations:** Based on the reviewed literature, patients who are scheduled for procedures should be able to consume clear liquids up to two hours prior to their procedure. These protocols should be implemented in institutions following proper staff education of the current evidence.

104 ***Safe Administration of Outpatient Parenteral Antibiotic Therapy (OPAT) Through a PICC Line in Patients with a History of Intravenous (IV) Drug Use***
Tabitha Adel, **Ella Silvera**, **Katie Moyer**

Background: There is currently no treatment protocol for patients with a history of IV drug use requiring long-term parenteral therapy. Clinicians are apprehensive in placing peripherally inserted central catheter (PICC) lines in this patient population resulting in extended hospitalization. This leads to increased cost, risk of leaving against medical advice, and poor patient outcomes. Additionally, negative treatment outcomes and poor patient self-esteem are more likely when biased opinions are held by healthcare providers. **PICO Question:** Is it safe to use OPAT for a PICC line placed in past intravenous drug abusers? **Methods of Literature Search:** A review of the literature was conducted through PubMed, CINAHL, and MEDLine from 2010-2018. Of 96 articles found, 11 were used to address the PICO; five of those were Level III with B quality. **Findings:** Findings which support safe use of OPAT in patients with history of IV drug use incorporate medical treatment of patients in alternative settings with concurrent substance abuse counselling and temporary housing when needed (Ho, 2010; Jafari, 2015; Jewell, 2013). Use of OPAT was found to reduce costs and increase patient satisfaction (Hernandez, 2016; Jafari, 2015; Jewell, 2013). In the study conducted by Ho (2010), patients signed a contract and were monitored carefully by nurses in conjunction with tamper-evident technology (TET). Risk factors associated with OPAT failure included time since last IV drug use ($p = 0.041$) (Buerhle, 2017). **Recommendations:** Consider development of a protocol that incorporates use of an interdisciplinary, substance abuse therapy approach

instead of prolonged hospitalization. Use of OPAT combined with drug counselling and TET can be effective in improving quality of care, reducing hospital costs, and increasing patient satisfaction. Further research is indicated to determine effect of current guidelines on treatment of IV drug users in need of long-term parenteral therapy.

105 ***Evidence-Based Interventions to Increase Laboring Women's Satisfaction***

Gabrielle Bornman, **Katie Haught**, **Madison Dinger**

Background: Laboring pain and the childbirth process are experienced in individual ways for individual women. By equipping women with a variety of pain management options, control of their own pain processes is optimized and satisfaction increased. Pros and cons of two primary interventions were reviewed to better understand their effectiveness. **PICO Question:** What is the effect of using inhaled nitrous oxide for childbirth pain control compared with epidural analgesia on the laboring woman's satisfaction? **Methods of Literature Search:** Literature was reviewed through PubMed, MedLine, CINAHL and the Cochrane Database from 2013-2018. A total of 161 articles were available within the identified search settings; 7 addressed the topic and were the focus of the literature review. The majority of the articles were Level III and V with a B quality. **Findings:** Evidence supports the introduction of nitrous oxide, subsequently followed by epidural analgesia for optimal pain relief and satisfaction (Richardson, Lopez, Baysinger, Shotwell & Chestnut, 2017). Richardson, Chestnut, Raymond, Baysinger, & Kook (2018) found 93% of laboring women reported high pain relief from nitrous oxide. Patients who received epidural analgesia experienced greater pain relief than patients who received inhaled nitrous oxide during labor, but patient satisfaction was not solely influenced by pain relief (Likis et al, 2014). Benefits of the use of nitrous oxide over epidural analgesia during labor include: anxiolytic properties, non-invasive delivery, increased patient mobility, and no adverse effects on uterine contractions (Collins, S., 2018; Collins, M., 2018; Sanders & Lamb, 2014). Additionally, nitrous oxide provided a safe pain relief method for laboring mothers who were opioid dependent (Migliaccio, Lawton, Leeman & Holbrook, 2017). **Recommendations:** Based on the literature review, practice change is not recommended until further research is conducted. More research is recommended to better assess the quality of each intervention using pain scales and patient pain goals.

106 ***The Use of Fish Oil to Prevent Atrial Fibrillation in Post-operative Cardiac Patients***

Hayley Karper, **Jenna Harmon**, **Eric Faught**, **Hannah Ramey**

Background: New onset postoperative Atrial Fibrillation (POAF) is a common complication following cardiac surgery, contributing to increased morbidity, mortality, and hospital expenses. The pathophysiology of POAF is unknown but may be influenced by predisposing factors, perioperative components, and physiological imbalances. It is important to identify measures to decrease the occurrence of POAF. **PICO Question:** In postoperative cardiac surgery patients, is giving fish oil supplements effective in reducing incidents of new onset atrial fibrillation? **Methods of Literature Search:** A review of the literature was conducted using PubMed, MedLine, and CINAHL from 2013-2018. A total of 301 articles were identified; 6 were found to address the problem and were the focus of the review. The majority of the articles reviewed were Level I with a B quality. **Findings:** Evidence is conflicting on the benefits of using fish oils to prevent POAF. Results from one meta-analysis indicated statistical significance in the reduction of POAF using fish oil p=0.03 (Wang, 2018). Langiois (2016) stated lower dosages of fish oil had increased effectiveness in preventing POAF than higher dosages. Other researchers reported fish oil did not significantly reduce the incidence of POAF (Dinesen, 2016; Farahani, 2017; Xin, 2013). A randomized controlled trial was terminated early due to the intervention group having a higher incidence of POAF with the use of fish oils (Lomivorotov, 2014). **Recommendations:** Based on the literature review, a change in practice is not recommended. Further investigation on adequate dosages and routes of fish oil administration is needed.

107 ***Effective Interventions on Maintaining Skin Integrity Among Preterm Infants in the NICU***

Katie Sechrist, **Rebecca Barrows**, **Maggie Carbaugh**, **Brooke Crowley**, **Blair Nieman**

Background and significance: Infants are at an increased risk for the development of pressure ulcers and skin complications (Schindler et al., 2013). Infants in the NICU are at a higher risk related to use of medical devices with thin, immature skin. The longer the stay in the NICU, the more at risk the infant is to develop a skin ulcer (p<.007). If the infant develops a skin ulcer, risk of mortality increases (p=0.02). Given these threats, standardized skin care guidelines are

essential for the NICU population. **PICO Question:** What are effective interventions for maintaining skin integrity among the NICU population? **Methods of Literature Search:** A review of the literature was conducted utilizing PubMed, MedLine, CINAHL, NANN Advances in Neonatal Nursing, and the Cochrane Database from 2010-2017. A total of 18 articles were identified; 11 were found to address the problem and were the focus of the review. The majority of the articles were Level I-II with a B quality. **Findings from EBP project:** Literature reviews suggest infrequent bathing (Allwood, 2011; Johnson, 2016; Schaefer, Naidom, & Neves, 2016; Schindler et al., 2013; Yonezawa, Haruna, Matsuzaki, Shiraishi, & Kojima, 2017). Original research found that topical coconut oil reduces TEWL (p=<0.01), skin teams increase pressure injury detection (0.49 per 1000 patient days to 3.32), and staff education (p=<0.001) promotes skin integrity (Nangia et al., 2015; Nist et al., 2016; Schindler et al., 2013). Evidence for full-term infants may be generalized to the NICU, and suggest bathing with water versus soap are equal, soap leads to improvement, and water versus wipes for diaper changes are equal (Bartels et al., 2010; Lavender et al., 2011; Lavender et al., 2012; Lavender et al., 2013). **Recommendations for practice:** Infrequent bathing of infants and nurse education on prevention and early detection of skin breakdown are both recommended based on the literature

108 ***Inhibition of PTP1B in Drug Development***

Courtney Herr, Anne Reeve†

Communication between cells is essential for nearly every physiological process of the body. The body's catalysts, known as enzymes, regulate the signals that lead to cellular responses such as growth, division, and metabolism. Overexpression of certain enzymes can block proper cell signaling and lead to many severe, pathological conditions. The enzyme of interest in this research is Protein Tyrosine Phosphatase 1B (PTP1B). PTP1B is a protein tyrosine phosphatase located within the cytoplasm of a cell. It is a negative regulator of the signaling cascade responsible for insulin and leptin receptor pathways. PTP1B has enzymatic activity linked to disorders such as Type 2 diabetes, obesity, and autoimmunity. This project focuses on methods of inhibiting this enzyme to potentially develop a drug treatment for these conditions. Some difficulties have arisen in disrupting PTP1B function, for example selectivity, bioavailability, and clumping of the potential inhibiting compounds. However, this research is based on the syntheses of compounds with moderate success in the past, known as 8453 and 9559, to synthesize similar compounds that could inhibit PTP1B without clumping. Successful inhibition of this enzyme may lead to several essential advancements in medicine.

109 ***Mitochondrial apo-cytochrome c vector construction and purification***

Jarred Tritt, Jesse Kleingardner†

Mitochondrial apo-cytochrome *c* is a well characterized heme binding protein. Substitution of the native iron in heme for other metals, such as cobalt, may create desirable changes in the catalytic properties of holo-cytochrome *c*. Here, an apo-cytochrome *c* expression vector was constructed by restriction-digestion of a pET15b plasmid and its recombination with the apo-cytochrome *c* gene for the subsequent transformation and expression by *E. coli*. The pET15b and holo-cytochrome *c* expression vectors were extracted from 5-alpha *E. coli* cells using MiniPrep and quantified with NanoDrop. Forward and reverse primers were designed in SnapGene for the PCR amplification of the apo-cytochrome *c*. After PCR amplification of the cytochrome *c* gene and restriction enzyme digest of the pET15b vector to remove its PKA gene, an agarose gel was performed to confirm the success of these reactions. After cloning with DNA ligase, the resulting expression vector will be sequenced with DNA sequencing.

110 ***Fluorescent Tagging of HIV-1 Using A Novel Recombinant Protein***

Jordan Sponsler, Jesse Kleingardner†, Matthew Farrar†

The goal of the DVD project is to create a highly sensitive and efficient device for the detection of the HIV-1 virus. A crucial aspect of this device is the protein probe that can bind to HIV-1 viruses in solution and fluoresce which can be detected via fluorescence correlation spectroscopy (FCS). A pure protein probe consisting of GFP (green fluorescent protein) and a single mD1.22 protein has already been obtained. The mD1.22 protein will theoretically allow the protein to bind with high affinity to the HIV-1 virus via binding to the GP120 envelope protein while GFP will allow for FCS. However, purification of this probe involves a two-step purification process due to an impurity likely caused by cleavage of our plasmid at the junction of GFP and mD1.22. Thus, our hypothesis was to hinder this cleavage via introducing steric hindrance through a rigid linker sequence. Primers

were designed to insert a Proline-Alanine-Proline (PAP) linker before mD1.22 to potentially evade eventual protease recognition responsible for such cleavage. Single-primer site-directed mutagenesis is being carried out to synthesize this plasmid.

111 ***The effect of the CYP1A2 Polymorphism and caffeine consumption on Anaerobic Exercise Performance***
Caleb Smith

The influence of the cytochrome P450 enzymes, specifically a polymorphism of the CYP1A2 genotype, following caffeine ingestion has been shown to influence aerobic endurance; however, the effect on short-term anaerobic performance is inconclusive. Individuals with the AA variant are responders to caffeine and those with the AC/CC variant are non-responders. **PURPOSE**: To examine the effects of caffeine and specific CYP1A2 genotype on anaerobic performance. **METHODS**: 10 subjects completed two 30 second Wingate Anaerobic Tests (WAnT30) (resistance = 0.075 kg•BW-1) on the Velotron that were separated by 2 to 7 days. Relative peak power (PP) and relative mean power (MP) were computed by the Velotron software. An oral bolus of caffeine (CAF), 5mg•kg-1, or placebo (PLA), maltodextrin, was given in a randomized and counterbalanced design 60 min prior to testing. Buccal epithelial cells were collected via a mouth rinse of 0.9% NaCl. Genomic extraction was obtained using QiAmp Mini spin columns and cell lysing with proteinase k, followed by PCR amplification with Fast Taq. The restriction enzyme (ApaI) was used to cut fragments. Cut and uncut samples underwent electrophoresis in 1% agarose gel and ultraviolet light photography identified genotype. The data was analyzed using a 2 (condition) x 2 (CYP) ANOVA with repeated measures ($p>0.05$). **RESULTS**: 5 people were AA and 5 people were AC/CC. The results revealed that CAF elicited no ergogenic effects. The main effect of condition, PLA versus CAF, showed no significant difference for PP or MP ($p = 0.49$). The main effect of CYP1A2, AA or AC/CC, did not reveal power differences for PP or MP ($p = 0.96$). Follow-up pairwise comparisons between PLA to CAF for PP (W•kg-1) showed non-significant D's of 1.17% in AA (10.3 and 10.42) and -0.38% for AC/CC (10.36 and 10.46, respectively). Likewise, MP resulted in non-significant D's of 3.66% for AA (8.2 and 8.5 W•kg-1, respectively) and 2.24% for AC/CC (8.3 and 8.5, W•kg-1 respectively). **CONCLUSION**: Caffeine did not produce an ergogenic effect for anaerobic exercise, regardless of an individual's CYP1A2 variant. However, the larger percent increases, specifically in MP, suggest that further research should be conducted, such as increasing sample size and identifying confounding variables such as other receptor sites that may interact with caffeine.

112 ***The Effect of Caffeine Ingestion and the ADORA2 Polymorphism on Long Anaerobic Exercise Performance***
Rachel Steckbeck, Kristen Hasse, Caleb Smith, Madison Wright, H. Scott Kieffer†, Michael Shin†

Caffeine is a commonly used stimulant. Research suggests that variants in CYP1A2, AA (responder) and AC/CC (non-responder), as well as variants in ADORA2A, CC (sensitive) and TT (insensitive) may influence caffeine effects on exercise. We hypothesized that AA (CYP1A2)/CC (ADORA2A) subjects would experience greater power increases upon caffeine ingestion compared to CC/TT subjects. To test these hypotheses, subjects completed two 90-second Wingate Anaerobic Tests, with caffeine or placebo boluses given 60 minutes prior. Relative peak power (PP) and relative mean power (MP) were computed. Buccal epithelial cells were collected and genomic DNA extracted. A 920bp fragment of the CYP1A2 gene was amplified using PCR. Genotypes were identified by restriction digestion and gel electrophoresis. qPCR was also run with the genomic DNA with probes to determine ADORA2A genotype. A 2 (condition) x 2 (genotype) x 3 (time) repeated measures ANOVA was used to compare PP and TW. Our results showed that, for the CYP1A2 alleles, caffeine ingestion did not significantly change PP. A non-significant increase in PP was seen for AA compared to AC/CC. A significant decrease in PP was seen in each 30-second segment; however, there were no interaction effects of time for condition or genotype. There was no difference in TW over 90 seconds and no significant difference in total power for genotype. There were no interaction effects with TW for condition or genotype. Overall, the results indicate that neither caffeine nor the CYP1A2 genotype impacted PP or TW during long-anaerobic testing. The ADORA2A polymorphism testing is currently ongoing.

113 ***The correlation between core strength and postural stability***
Nate Romberger, **Andrew Blanchfield**, **Roman Wagner**, **Kelsey Norton**, **Madison Beckner**, Joshua Beiler

Core strength and core stability both affect the amount of postural sway someone will exhibit.

PURPOSE: The purpose of this study was to determine the relationship between core strength and core stability by measuring postural sway with the use of a force plate. **METHODS:** 14 healthy college students came in for testing two times, the methods included measuring mean path length, average x and y deviation, and average velocity by using the force plate and ACCUSWAY program. The digital force gauge was used to measure force exerted anterior flexion, posterior extension, and lateral flexion. All testing was done while standing on the right foot. **RESULTS and DISCUSSION:** The results and discussion of our preliminary data will be presented at the SEH symposium.

114 ***The effects of acute meditative breathing on heart rate variability***

Sarah Roise Hartman, **Caleb Aytes**, **Madison Sergent**, **Emma Marley**, **Brendan Wurtz**

Heart rate variability (HRV) is the balance between the parasympathetic and sympathetic nervous system and how it affects the consistency between the time between RR intervals in milliseconds. HRV can be used as a way to measure a patient's heart health in more detail than the standard heart rate measurement. **PURPOSE**: The purpose of this study is to determine the effect of various breathing techniques using heart rate variability as a result of the parasympathetic and sympathetic nervous system response. **METHODS:** Heart rate variability was assessed through the use of a Polar H10 heart rate monitor. Participants were involved in a 15-minute testing period with 5 minutes of rest, 5 minutes of a guided breathing exercise, and 5 more minutes of rest. After importing the RR values from the Polar H10 monitor, the Kubios HRV Standard application allowed for measurements such as root mean square of the successive differences (RMSSD), low-frequency (LF) percent, LF in normalized units, high-frequency (HF) percent, HF in normalized units, and peak HF/LF ratio. **RESULTS:** Results will be discussed during the symposium.

115 ***The cardiometabolic effects of caffeine during submaximal exercise***

Rachel Caldwell, Abigail Beveridge, **Anna Mayo**, Garrett Showalter, Saw Picky, Josette Weaver

Caffeine is an ergogenic aid that is widely used in both daily life and for athletic performance, and affects the central nervous system and the local muscle level to improve performance and ventilation during exercise. **PURPOSE** The purpose of the study is to observe the ergogenic effects of caffeine supplementation on ventilation and maximal oxygen consumption (VO2 max) during submaximal exercise on a treadmill in collegiate students. **METHODS** 15 healthy college students came in for two testing days and ingested a capsule of either 6 mg*kg^-1 caffeine or a placebo of starch an hour prior to testing. Participants were put on a treadmill at 60% of their max heart rate for 15 minutes and respiratory exchange ratio, heart rate, and oxygen consumption were calculated every minute. **RESULTS** The results and discussion will be presented at the SEH symposium.

116 ***The effects of static and dynamic stretching in dancers***

Emily Walter, Laura Sollenberger, Abigail Gibson, Elizabeth Vlieg, Sydney De Poto, Grace Brewster, Emily Lanahan

Power output and flexibility are two vital disciplines to a dancer's physiology; it is important for them to improve their flexibility while maintaining power output. **PURPOSE** The purpose of the study was to determine the immediate effects of dynamic, static, and no stretching protocols on power output and balance in collegiate dancers. **METHODS** Multiple aspects of power were tested using an isokinetic dynamometer (Biodex), squat jumps and countermovement jumps on an AccuPower force plate. Unilateral balance was assessed by tracing center of gravity with a balance plate, AccuSway. **RESULTS and DISCUSSION**: The results will be discussed at the SEH Symposium.

117 ***The Influence of Video Distraction on Exercise Performance***

Abby Monko, Shannon Brady, Kristen Cofer, Remington Paul, Meghan Steager, H. Scott Kieffer†, Doug Miller†

The advancement of technology may be able to offer a solution to the lack of physical activity adherence. **PURPOSE** The purpose of this study was to determine the effects of watching an adventurous documentary during high-intensity cycling on physiological and psychological responses in healthy college-aged adults and to determine the eligibility of using a mental distraction as a possible tool for physical activity adherence. **METHODS** Ten participants cycled for two ten minute sessions. One session included watching a documentary as a form of distraction and the other session did not include a type of distraction. During both sessions, participants were instructed to cycle hard and cover as much distance as they could. Oxygen consumption, heart rate, rating of perceived

exertion, and overall enjoyment were collected throughout both sessions. **RESULTS AND DISCUSSION** Results and discussion will be presented at the symposium.

118 ***Shelf life study of human blood cryopreserved for in vitro cultivation of Plasmodium falciparum***

Annalise Armstrong, Madison Scialanca, Lawrence Mylin†

Malaria kills 0.5 million people each year and no vaccine is available. The goal of this project is to support malaria research at the Macha Research Trust in Zambia by providing blood collected from healthy, uninfected individuals in the United States to use to culture malaria strains collected from patients in Zambia. Refrigerated blood may be used to cultivate *Plasmodium falciparum* only within two weeks of collection. Therefore, we have investigated methods to allow small, culture-appropriate volumes of blood to be stored for extended periods when frozen in the presence of two ice recrystallization inhibitors, hydroxyethyl starch and polyvinyl alcohol. Initial results indicate that asexual forms and gametocytes of *P. falciparum* develop and propagate well in blood that has been flash frozen in liquid nitrogen and stored at -80°C for less than one month. The purpose of this study is to determine whether blood stored at -80°C for longer periods will continue to work well in culture. Moreover, frozen blood will be shipped to Zambia in liquid nitrogen. Therefore, some of the blood in this study will be transferred from -80°C to liquid nitrogen for two weeks to simulate the temperature cycling involved in transport. Hemolysis of temperature-cycled will be compared to blood consistently maintained at -80°C. Both will be compared to freshly collected blood and blood frozen for less than a month for propagation of asexual forms and development of gametocytes for the *P. falciparum* laboratory strain NF54 following six months to a year of storage at -80°C.

119 ***Optimization of hematoxylin and eosin staining and immunohistochemistry procedures for assessment of vascularity in control samples***

Hannah Taylor, John Harms†

Pancreatic cancer's late detection, aggressive metastasis, and high chemoresistance contribute to a dismal 6% survival rate. Pancreatic tumors have the unique trait of being highly fibrotic, with 90% of the tumor microenvironment composed of dense, fibrotic tissue. This fibrosis causes an increase in intra-tumor pressures, resulting in collapse of vascular structures that are necessary to deliver chemotherapy drugs and provide access to immune surveillance. Our lab has demonstrated that treatment of mice bearing pancreatic ductal adenocarcinoma (PDAC) with the gastrin antagonist, proglumide, results in a 32% decrease in tumor fibrosis. We hypothesize that proglumide treatment will improve vascularity and immune cell infiltration in treated tumors. We currently report the optimization of staining techniques that will subsequently enable analysis of treated and untreated PDAC tumor samples. Due to the distinct vascularity of kidneys and the immune cell composition of spleen tissue, these tissues were chosen as optimal control samples. These control, normal mouse kidney and spleen samples were fixed for paraffin embedding and microtome sectioning. Serial sections from each tissue sample were produced and successfully were stained with Hematoxylin and Eosin (H&E). Ongoing research includes Immunohistochemistry (IHC) procedures, using CD31 endothelial vascular and CD14 pan-macrophage markers, allowing for visualization of these structures for data collection.

120 ***Developmental Expression of Lck and Lyn in the CNS***

Tomas Cortez, Jennifer Ness-Myers†

Oligodendrocytes are essential myelinating cells of the central nervous system. The myelin sheaths created by oligodendrocytes allow rapid conduction of signals down the axons of neurons. However, in neurologic and neurodegenerative diseases like multiple sclerosis, schizophrenia, and bipolar disorder, the myelin sheaths and oligodendrocytes are damaged, or the cells are unable to myelinate correctly during development. To prevent and treat neurodegenerative diseases, it is necessary to understand the process of generating myelin. Prior research has shown that myelination by oligodendrocytes is regulated by Fyn, a Src kinase family member. The purpose of this study is to analyze the gene and protein expression of two other Src family kinase members, lymphoid cell kinase (Lck) and protein-tyrosine kinase (Lyn), in postnatal rats during early development. It is hypothesized that the expression of Lck and Lyn will be increased through the developmental period of myelination. Results and conclusions will be presented at the symposium.

121 ***Aquaponic Rice Cultivation***

Ben Kerkeslager, David Foster†

Aquaponics agriculture is a sustainable way to grow a variety of different plants, while recycling the natural waste of fish into plant nutrients. The overall goal of this research is to create a more efficient and sustainable way to grow rice, which is one of the planet's most important crops. In progress toward this goal, the ideal conditions to grow rice in an aquaponics system must be achieved. Advancing from Tyler McFeaters' research in the spring of 2018 on rice germination and the ideal gravel height for rice in the aquaponics media bed, this research studies the effect of DLI (Daily Light Integral) and photoperiod on rice plants' ability to flower. Using grow lights to adjust the intensity and photoperiod of light that the plants receive, we expect to observe flowering and rice yield in the plants. The hypothesis is that by increasing the DLI to about 43 mol/m^2/day and giving the plants less than 12-hour periods of light, they will flower in the aquaponics system. If rice can be more efficiently grown in an aquaponics system than the traditional field-growing methods, it could revolutionize the way farmers cultivate rice across the world in years to come.

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