
Spring 4-28-2017

14th Annual Symposium of the School of Science, Engineering and Health

Messiah College

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Recommended Citation

Messiah College, "14th Annual Symposium of the School of Science, Engineering and Health" (2017).
School of Science, Engineering & Health (SEH) Symposium. 2.
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Sharpening Intellect | Deepening Christian Faith | Inspiring Action

Messiah University is a Christian university of the liberal and applied arts and sciences. Our mission is to educate men and women toward maturity of intellect, character and Christian faith in preparation for lives of service, leadership and reconciliation in church and society.

SCHOOL OF SCIENCE, ENGINEERING AND HEALTH



PROGRAM & ABSTRACTS

Frey Hall - Jordan Science Center - Kline Hall of Science
Friday, April 28, 2017



Special thanks to D. Scott Weaver (Department of Computer and Information Science) for development of the new Symposium Project Registration and Management system (SymPRM) used to collect and organize the information contained in this booklet. Special thanks also to Lori Zimmerman, Administrative Assistant to the Dean of the School of Science, Engineering and Health, for coordinating room reservations, catering and setup of the Symposium venues.

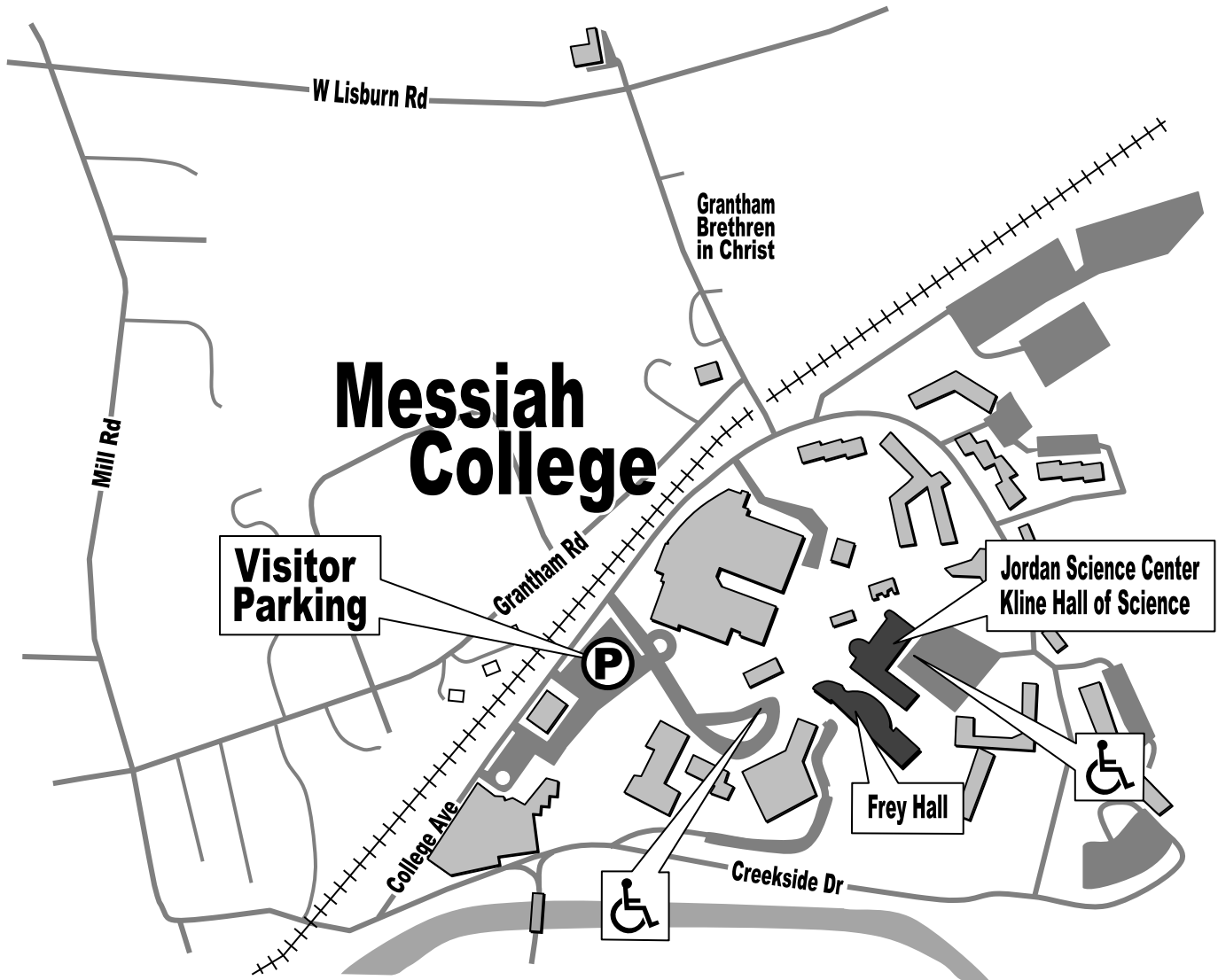
– John Harms & Tim Van Dyke, Symposium Coordinators

Welcome to the 14th Annual Symposium of the School of Science, Engineering and Health! This event continues a strong tradition showcasing student and faculty innovation, creativity and productivity in academic departments largely from within 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 Session.

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 69) lists the names of all authors alphabetically with the number(s) of each presentation on which each is included.

Authorship Legend:

bold indicates a presenting author
+ indicates a research or project mentor
‡ indicates an off-campus contributor





Discipline Categories:

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

Program & Symbols: Presentations in Engineering, Computer & Information Science, Mathematics, and Physics are organized in discipline-specific sessions. Presentations in the Biological Sciences, Chemistry & Biochemistry, Exercise Science, and Biopsychology are organized in integrated sessions to encourage cross-disciplinary exposure with the Natural Sciences. Posters in Evidence-Based Nursing Care will be highlighted in dedicated poster venue (page 25). Throughout the Program and “Schedule at a Glance” unique symbols designate the various disciplines.

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

Additional Symbols:

-  This oral presentation is accompanied by a poster presented in the mid-afternoon Poster Session
-  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*

Acknowledgments: All faculty mentors, external mentors and collaborators, and nursing professionals are recognized. Sources of financial and material support are also listed (page 33) with corresponding presentation numbers.

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 Bohn, Coshun, Hahn

10 Martin, Piette, Miller, Park, Chung

8:40 2 Nguyen, Rice, Torres

11 Fernandez, Piette, Sun, Underwood

9:00 3 Collier, Eckman, Gehman

12 Bernhardt, Pinkham, Budd

21 Barner, Grove, Mohler, Roth

25 Σ Mullin

9:20 4 Keepports, Padovano, Weaver

13 Seyni, Nguyen, Martin

21 Barner, Grove, Mohler, Roth

26 Σ Melson

9:40 5 Goodwin, Harro

14 Greenawalt, Hum, Budd, Daub

22 Murray

27 Σ Kragt

10:00 6 Bordner, Brubaker

15 Cameron, Choate, Isaac, Millary, Snader

23 McManiman

28 Σ Wasser

10:20 7 Esch, Heindel, Petersheim, Smith

16 Park, Talbert, Houck, Spencer, Reichert

24 Sredenschek

29 Σ Conrady

10:40 8 Cochran, Garber, Serrano

10:40

30 Σ Weaver

11:00 9 Barrett, King, Laub, Tomasetti, Vivolo

11:00

31 Σ Schwiker



Engineering Poster Session
11:20-12:00 Frey 070



Computer Gaming
10:00-12:00 Hollinger Lounge

11:20

32 Σ Scala

11:40

33 Σ Smetak



Engineering II

Engineering III

1:00 34 Gover, Raboci

40 Ernst, Sharkey

1:20 35 Lim, Lord, Yoder

41 Birdsall, Younger

1:40 36 Chambers, Shaubach, Yeisley

42 Grossnickle, McGovern, Schandel, Troyer

2:00 37 Barner, Roth

43 Artuso, Burt, Quatralo

2:20 38 Charleston, Curtis, Redcay

44 Goss, Warden

2:40 39 Kerstetter, Peck

45 Chang, Ma



Engineering Poster Session

3:00-4:00 Frey 070



Engineering IV

Engineering V

4:00 63 Tajiri, Talamo, Zigarelli

68 Bright, Lowman, Peris

4:20 64 Martin, Moussa, Pardoe

69 Hsu

4:40 65 Clemente, Ehrenzeller, Sloop

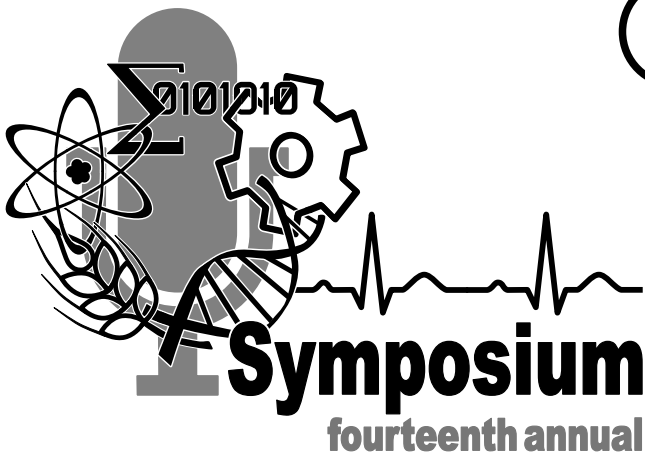
70 Jacoby, Kauffman, Mast, Musser

5:00 66 Engle, Reinert, Yeoman

71 Criddle, Loefstedt, Pardoe

5:20 67 Breisch, Holderman

72 Mast, Moore, Pasti



Oral Presentations

Kline 120

Hollinger Lounge







Jordan 159














Natural Sciences I

Natural Sciences II

Natural Sciences III

- 1:00 46  Yoon
- 1:20 47  Weaver
- 1:40 48  Tomes
- 2:00 49  Nguyen
- 2:20 50  Robbins
- 2:40 51  Reale

- 52  Hoover
- 53  McKiernan
- 54  Christensen
- 55  Arnold
- 56  Mitcheltree
- 57  Sargent

- 58  Bogetti
- 59  Keaton
- 60  Steves
- 61  Striker
- 62  Merrill




Poster Session 3:00-4:00




Natural Sciences: Hollinger Atrium & Hallway
Evidence-Based Nursing Care: K108 & K113



Natural Sciences IV

Natural Sciences V

- 4:00 73  Wieder
- 4:20 74  Frank
- 4:40 75  Rossomme

- 76  Shenk
- 77  Nevin
- 78  Haas, Roper

Schedule at a Glance



Poster Presentations & Demonstrations



Computer Gaming Demonstrations

Hollinger Lounge; 10:00 – 12:00

- 17 Spencer, Port
- 18 Butler, Port, Romero
- 19 Byrd, Henry
- 20 Talbert



Engineering

Frey 070 Project Space; 11:20 – 12:00, 3:00 – 4:00

- 79 Barner, Roth
- 80 Frawley, Sisson, Sponsler
- 81 Forshey, Ho, Stoltzfus
- 82 Kobzowicz, Lim
- 83 Gaudreau, Haas, Reimer, Roper
- 84 Conrady, Musselman
- 85 Peterson, Thomas
- 86 Burch, Chambers, Hah Chien Vern, Kuhns
- 87 Davenport, Kunkle, Taylor
- 88 Gallagher, Moyer, O'Connell, Ortiz, Ramirez
- 89 Gray
- 90 Bornman, Carpenter, Kline, Moretz, Patterson
- 91 Kratz, Nicolais, Ressler
- 92 Braunworth, Reedy, Rogers
- 93 Brenneman, Kelley
- 94 Janney, Morrone, Shirk
- 95 McCormick
- 96 Simpkins
- 97 Doll, Kuhn, Ladeau
- 98 Issis, Stevens
- 99 Aukamp
- 100 Tan
- 101 McCullum, Nichols, Snozzi Solther
- 102 Dunmire, Hannon, Henry, Hiduk, Mavros, Mishler, Shirk
- 103 Katcher, Patawaran
- 104 Ma, Sindabizera Ntwari



Evidence-Based Nursing Care

Kline 108 & Kline 113; 3:00 – 4:00

- 116 Benner, Burton, Leary, Sullivan
- 117 Biener, Weaver, Walker
- 118 Catalano, Lenox, Mozol, Simpson
- 119 Albrecht, Bee, Eldridge, Slinkerd, Wagner
- 120 Barker, Douglas, Frye, Kroon
- 121 Kriner, Pappas
- 122 Beam, Bechard, Dolan, Outland
- 123 Orehowsky, Belyea, Kimmel, Gallo
- 124 Bennicoff, Dench, Percherke

Schedule at a Glance



Natural Sciences

Hollinger Atrium & Jordan Hallway; 3:00 – 4:00

46 Yoon

47 Weaver

49 Nguyen

50 Robbins

52 Hoover

54 Christensen

55 Arnold

57 Sargent

58 Bogetti

60 Steves

62 Merrill

73 Wieder

74 Frank

75 Rossomme

76 Shenk

77 Nevin

105 Carroll, Walter, Brocht

106 Wandel

107 Ohlhausen

108 Donohue, Schmidt, Sadorf

109 Linde, Schmidt

110 Harkins

111 Bellows, Bjorkman, Kreiger, Williams

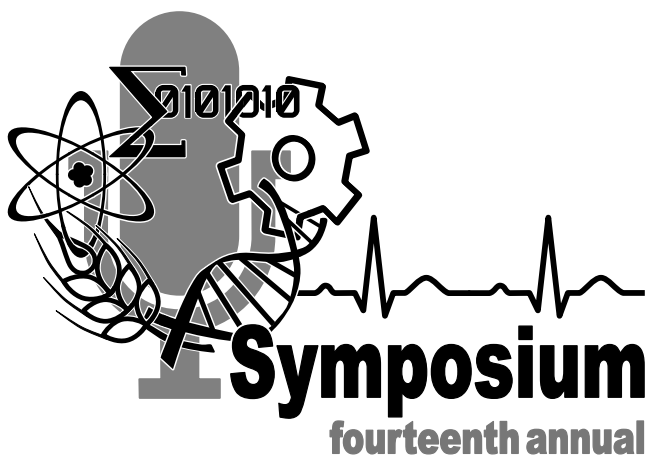
112 McPheeters

113 Zigarelli

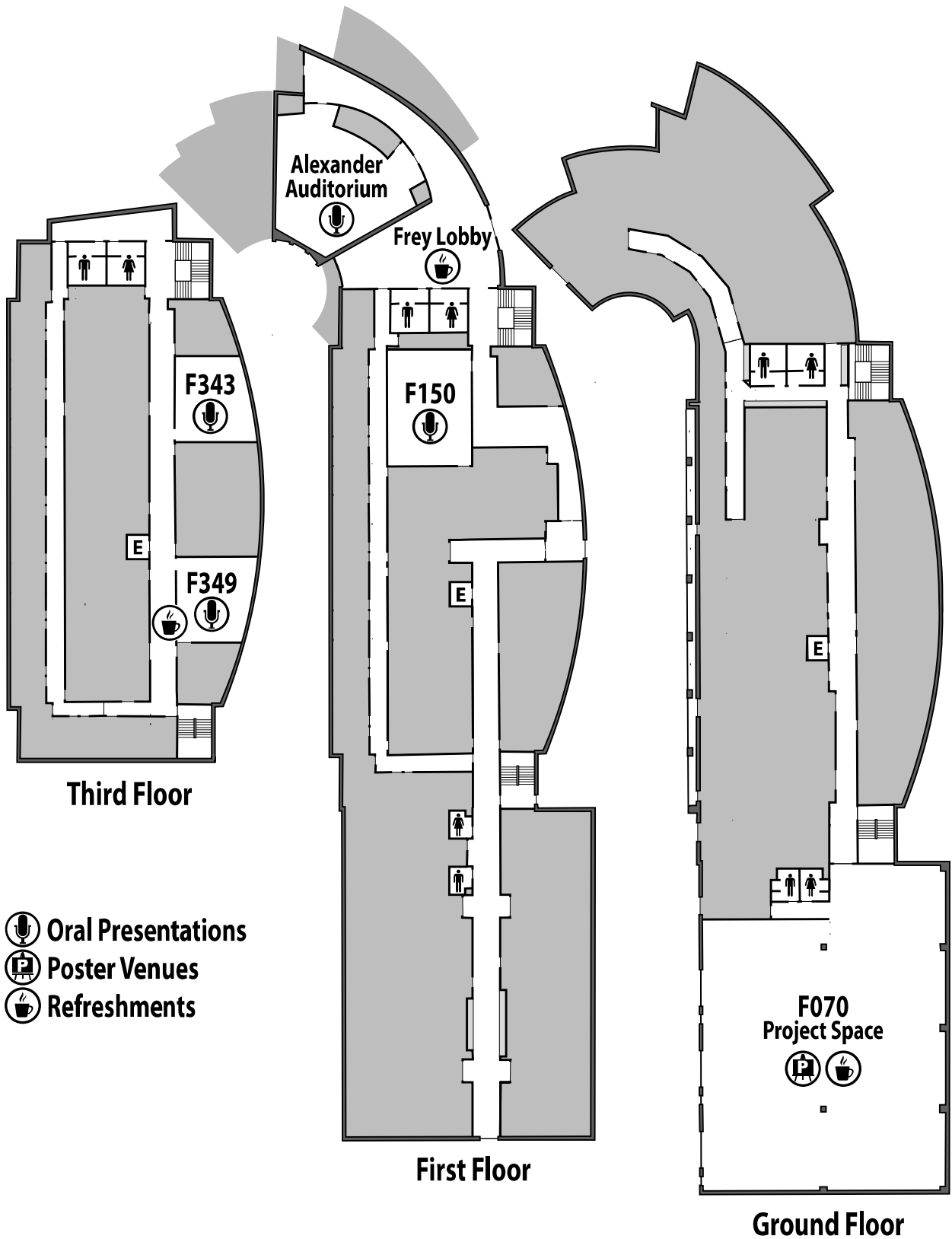
114 Hasse

115 Gotwals

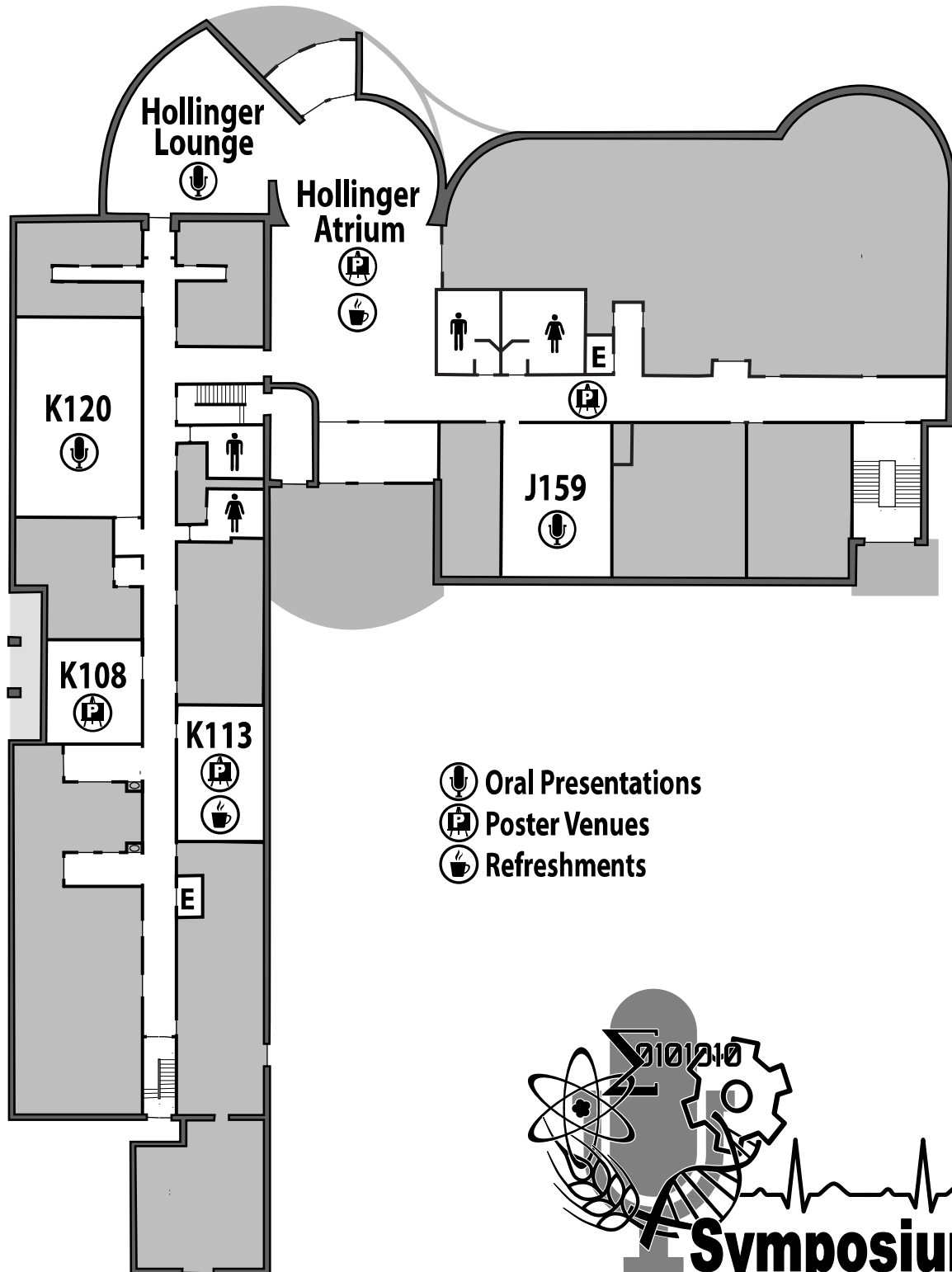
Schedule at a Glance



Frey Hall

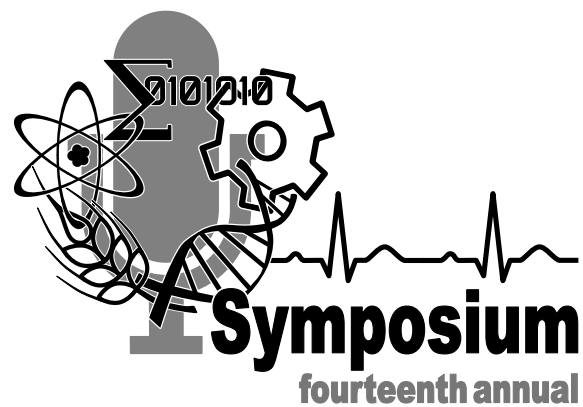


Jordan Science Center - Kline Hall of Science



-  Oral Presentations
-  Poster Venues
-  Refreshments

Maps




Oral Presentations (Morning)

Engineering I

Alexander Auditorium (Frey 110); 8:15 – 11:20

- | | | | | |
|---|-------|---|--|--|
| 1 | 8:20 |  | <i>Remote Coaching Solution (WERCware) - Sensor and System Integration</i> |  
5 |
| | | | Matthew Bohn, Joseph Coshun, Ryan Hahn, Derrick Peterson, Josh Thomas, Harold Underwood[†] | |
| 2 | 8:40 |  | <i>Flight Tracking and Messaging System (FTMS): Aircraft Control Unit Redesign</i> |  |
| | | | Hoang Nguyen, Samuel Rice, Michael Torres, Harold Underwood[†] | |
| 3 | 9:00 |  | <i>Mechanized Percussion Well Drilling</i> |  
102 |
| | | | Tyler Collier, Dan Eckman, Damaris Gehman, Joseph Longenecker^{††}, Andrew Parkhurst^{††}, Thomas Soerens[†] | |
| 4 | 9:20 |  | <i>Basic Utility Vehicle: Firetruck, BUV:F</i> |  |
| | | | John Keeports, Michael Padovano, Jeffrey Weaver, Donald Pratt[†] | |
| 5 | 9:40 |  | <i>Intelligent Water Project: Remote Sensing of Pump Health for Promotion of Clean Water Access In Developing Countries</i> |  
101 |
| | | | Lydia Goodwin, John Harro, Owen McCullum, Kelsey Nichols, Sandra Snozzi Solther, Randall Fish[†] | |
| 6 | 10:00 |  | <i>Pump Minder: A Water Meter to Promote Sustainable Access to Clean Water in Developing Countries</i> |  |
| | | | Shawn Bordner, Chad Brubaker, Randall Fish[†], Jon Naugle^{††} | |
| 7 | 10:20 |  | <i>Breath of Life: Pressure Swing Adsorption Oxygen Concentration for Hospitals in the Developing World</i> |  
80 |
| | | | Devin Esch, Katie Heindel, Spencer Petersheim, Michael Smith, Kristen Frawley, Caleb Sisson, Jordan Sponsler, Robert Reed^{††}, David Vader[†] | |
| 8 | 10:40 |  | <i>Landmine Detection</i> |  |
| | | | Will Cochran, Grant Garber, Raul Serrano, Donald Pratt[†] | |

- 9 11:00  *Sustainable Mobility: Taking an Assistive Mobility Technology from Prototype to Production*
Daniel Barrett, Cordell King, Anders Laub, Matthew Tomasetti, Daniel Vivolo, Jakob Davenport, Joshua Kunkle, Morris Taylor, John Meyer[†], David Vader[†]



Computer & Information Science





Frey 150; 8:15 – 10:40

- 10 8:20  *Northstar: A Mobile App for Refugee Service Discovery*
Thomas Martin, Katherine Piette, Braden Miller, Sarah Park, Z-Ean Chung
- 11 8:40  *SymPRM*
Kira Fernandez, Katherine Piette, TK Sun, Ben Underwood, D. Scott Weaver[†]
- 12 9:00  *ConLangApp: A Web-based Toolkit for Constructed Languages*
Samuel Bernhardt, Elizabeth Pinkham, Emily Budd, Gene Rohrbaugh[†]
- 13 9:20  *Matching Natural Language Lexicostatistics in Randomly Generated Texts*
Yacoub Seyni, Hoang Nguyen, Thomas Martin, Gene Rohrbaugh[†]
- 14 9:40  *AeroCar: Aeroponics Forecast Scheduling with Calendar*
Ryan Greenawalt, Huey Hum, Emily Budd, Jeffrey Daub
- 15 10:00  *AeroBox: Aeroponics Financials with Profit/Loss Statement*
Andrew Cameron, Joshua Choate, Jonathan Isaac, Nathan Millary, Michael Snader
- 16 10:20  *Fungi Web Application*
Chanbin Park, Kyle Talbert, Samuel Houck, Jonathan Spencer, Garrett Reichert, D. Scott Weaver[†]



Computer Gaming Demonstrations






Hollinger Lounge; 10:00 – 12:00

- 17  *Maze Tron*
Jonathan Spencer, Chalmers Port, Bryce Simmons, Robert Kilmer[†]
- 18  *Live Wire*
Jared Butler, Chalmers Port, David Michael, John Romero, Robert Kilmer[†]
- 19  *Think Fast!*
Charlie Byrd, William Henry, Emmanuel Gundran, Richie Varona, Robert Kilmer[†]
- 20  *Render: Venture*
Kyle Talbert, Robert Kilmer[†]



Physics

Frey 343; 9:00 – 10:40

- 21 9:00  *High Energy Compact Particle Detectors for Space*
Lindsey Barner, Andrew Grove, Jacob Mohler, Alexander Roth, Abaz Kryemadhi[†]
- 21 9:20  *High Energy Compact Particle Detectors for Space II*
Lindsey Barner, Andrew Grove, Jacob Mohler, Alexander Roth, Abaz Kryemadhi[†]
- 22 9:40  *Assessing Student Learning by Gain in their Confidence*
Noel Murray, Niklas Hellgren[†]
- 23 10:00  *Design of a Rutherford Scattering Apparatus*
Tyler McManiman, Niklas Hellgren[†], Harry Hawbecker
- 24 10:20  *Growth of ZnSe Thin Films*
Alexander Sredenschek, Sarah O'Boyle, Niklas Hellgren[†]



Mathematics

Frey 349; 9:00 – 12:00

- 25 9:00 Σ *Pitcher Predictability: Applying Game Theory to Baseball*
Jonathan Mullin

- 26 9:20 Σ *Notes and Letters: Using Music as a Cipher*
Sara Melson

- 27 9:40 Σ *To Infinity and Beyond?*
Benjamin Kragt

- 28 10:00 Σ *Modeling Infectious Disease: The SIR Model*
Morgan Wasser

- 29 10:20 Σ *The Lebesgue Integral*
Joshua Conrady

- 30 10:40 Σ *Color Wars*
Nicholas Weaver

- 31 11:00 Σ *Applying Graph Theory to NCAA Basketball Tournaments*
Kelly Schwiker

- 32 11:20 Σ *Tournaments on Tournaments: Using Graph Theory to Analyze
Tennis Tournaments*
Meagan Scala





- 33 11:40 Σ *Analyzing and Forecasting Zimbabwe's Trade Exports*
Emily Smetak



Oral Presentations (Afternoon)




Engineering II

Alexander Auditorium (Frey 110); 1:00 – 3:00


- | | | | |
|----|------|--|--|
| 34 | 1:00 |  <i>3D-printed Prosthetic Hands for Kids</i>
Timothy Gover, Jessica Raboci, Emily Farrar[†] |  |
| 35 | 1:20 |  <i>Design of a Muscle-Activated Prosthetic Hand</i>
Keith Wei Luen Lim, Jonathan Lord, Jason Yoder, Erin Cressman, Alaric Kobzowicz, Michael Robinson[†] |   82 |
| 36 | 1:40 |  <i>Rapid Orthotics for CURE Kenya</i>
Nathan Chambers, Lyndsy Shaubach, Daniel Yeisley, Emily Farrar[†], Paul Myers[†] |  |
| 37 | 2:00 |  <i>A Low-Cost Dynamic Light Scattering System for Detection of Viral Aggregates</i>
Lindsey Barner, Alexander Roth, Matthew Farrar[†] |   79 |
| 38 | 2:20 |  <i>Cunningham Clubfoot</i>
Noah Charleston, Micah Curtis, Luke Redcay, Rebekah Forshey, Vy Ho, Paul Stoltzfus, Emily Farrar[†], Tim Howell[†] |   81 |
| 39 | 2:40 |  <i>Design of a Solar Power System for Ekuphileni Bible Institute</i>
Scott Kerstetter, Josiah Peck, Caleb Bornman, Steven Carpenter, Jessica Kline, David Moretz, Joshua Patterson, Mark Brill^{††}, Nathan Charles^{††}, Michael Robinson[†] |   90 |












Engineering III



Frey 150; 1:00 – 3:00

- | | | | |
|----|------|--|--|
| 40 | 1:00 |  <i>Aeroponics</i>
Georgia Ernst, Erin Sharkey, Matthew Brenneman, Erin Kelley, Michelle Lockwood[†] |   93 |
|----|------|--|--|

- | | | | |
|----|------|--|---|
| 41 | 1:20 |  <i>Africa WASH Disability Studies Project</i>
Jordan Birdsall, Jacob Younger , Lamarr Widmer [†] , Tesfayohanes Yacob [†] |  |
| 42 | 1:40 |  <i>Affordable Solutions to Pit Latrine Collapse</i>
Kenton Grossnickle, Connor McGovern, Sydney Schandel, Duane Troyer , Rachel Aukamp, Adam Barley, Lorena Reinert, Cheylee Smith, Isaac Underhill, Tesfayohanes Yacob [†] |   99 |
| 43 | 2:00 |  <i>Cumberland Pointe Futsal (Soccer) Project</i>
Jacob Artuso, Peter Burt, Emily Quatrale , Troy Harris, Jr., Sean McCormick, J Scott Heisey [†] , Joshua Weidler ^{††} |   95 |
| 44 | 2:20 |  <i>Gravity Fed Water System</i>
Nolan Goss, Frederic Warden , Shung Yen Tan, Thomas Soerens [†] |   100 |
| 45 | 2:40 |  <i>Village Water Ozonation Systems</i>
Elisabeth Chang, Daniel Ma , Ted Sindabizera Ntwari, Ray Knepper ^{††} , Michelle Lockwood [†] |   104 |

 **Natural Sciences I**
Kline 120; 1:00 – 3:00

- | | | | |
|----|------|--|---|
| 46 | 1:00 |  <i>A Single Nucleotide Polymorphism Does Not Promote Expression of a CCK2R Splice Variant Associated with Pancreatic Cancer</i>
Sung Bo Yoon , John Harms [†] |   |
| 47 | 1:20 |  <i>Method Optimization for High-throughput Screening of FRET Biosensors</i>
Danielle Weaver , Jesse Kleingardner [†] |  |
| 48 | 1:40 |  <i>Effect of Body Armor Application on Functional Movement Capability in Healthy Adults</i>
Colin Tomes , Matthew Lewis [†] | |
| 49 | 2:00 |  <i>Elevated Pharmaceuticals in Golden Seal Using Aquaponics</i>
Van Nguyen , David Foster [†] |   |
| 50 | 2:20 |  <i>Can Pancreatic Cancer be Controlled by Cellular Immunity?</i>
Kirby Robbins , John Harms [†] , Lawrence Mylin [†] |  |

- 51 2:40  *Engineering Metalloproteins for Fuel Catalysis using SLiCE and CHIP Template* 
Emily Reale, Jesse Kleingardner[†]



Natural Sciences II







Hollinger Lounge; 1:00 – 3:00

- 52 1:00  *Synthesis and Characterization of Transition Metal Hydroxyl Sulfate Mineral Phases* 
Travis Hoover, Richard Schaeffer[†]
- 53 1:20  *Resources for Continued Physical Activity Beyond the WELL Courses*
Katelyn McKiernan, Melinda Smith[†]
- 54 1:40  *Allometric Effects on Clutch Size and Quality in the Panamanian Golden Frog, *Atelopus zeteki**  
Micah Christensen, Erik Lindquist[†]
- 55 2:00  *Furthering the Progress of Synthesis of Aspernigrin A* 
Ravenia Arnold, Anne Reeve[†]
- 56 2:20  *The Effects of a 6-week Pilates Program on Postural Stability and Balance in College-aged Athletes*
Tyler Mitcheltree, Melinda Smith[†], H. Scott Kieffer[†], Doug Miller[†]
- 57 2:40  *Non-Invasive Individual Identification of the Panamanian Golden Frog (*Atelopus zeteki*)* 
Alyssa Sargent, Erik Lindquist[†]

Natural Sciences III















Jordan 159; 1:00 – 3:00

- 58 1:00  *Biocatalytic Reduction of Ketones and Imines Using *Daucus carota* Root* 
Anthony Bogetti, Roseann Sachs[†]

- | | | | |
|----|------|--|---|
| 59 | 1:20 |  <i>Microplastic Prevalence in Corbicula fluminea Found in the Yellow Breeches Creek</i>
Madilyn Keaton | |
| 60 | 1:40 |  <i>Characterization of Surface Oxidation on Zinc Selenide</i>
Megan Steves, Niklas Hellgren, Alison Noble[†] |  |
| 61 | 2:00 |  <i>Stress Enhanced Fear Learning</i>
Kelly Striker, Jennifer Thomson[†] | |
| 62 | 2:20 |  <i>Synthesis of Biofunctionalized Self-assembled Monolayers on Zinc Selenide</i>
Autumnn Merrill, Anne Reeve[†], Alison Noble[†] |  |

Engineering IV








Alexander Auditorium (Frey 110); 4:00 – 5:40

- | | | | |
|----|------|---|--|
| 63 | 4:00 |  <i>Moving Towards a Modular Design for the Energy Monitoring and Management System</i>
Paul Tajiri, Greg Talamo, Michael Zigarelli, Austin Kratz, Thomas Martin, Karine Moussa, David Nicolais, Nathaniel Pardoe, Nathan Ressler, Thomas Austin^{††}, Randall Fish[†] |   91 |
| 64 | 4:20 |  <i>Preparing for Future Expansion of the Energy Monitoring and Management System</i>
Thomas Martin, Karine Moussa, Nathaniel Pardoe, Austin Kratz, David Nicolais, Nathan Ressler, Paul Tajiri, Greg Talamo, Michael Zigarelli, Thomas Austin^{††}, Randall Fish[†] |   91 |
| 65 | 4:40 |  <i>Woodcrest Bridge Project</i>
Dylan Clemente, Dexter Ehrenzeller, Bradley Sloop, Brenden Good, Kurtis Platteel, Mark Simpkins, J Scott Heisey[†], Tyler Miller^{††} |   96 |
| 66 | 5:00 |  <i>Pedestrian Bridge for Mexican Ministry Center</i>
Zachary Engle, Benjamin Reinert, Nathaniel Yeoman, Brian Swartz[†], Russell Wolesslagle^{††}, Tim Zimmerman^{††} |  |
| 67 | 5:20 |  <i>Oakwood Hills Pedestrian Access</i>
Kevin Breisch, Benjamin Holderman, Alex Issis, Caleb Stevens, L. Bryan Hoover^{††}, Brian Swartz[†] |   98 |



Engineering V







Frey 150; 4:00 – 5:40

- | | | | |
|--|------|--|--|
| 68 | 4:00 |  <i>Cycle Advancements for Rugged Terrain (CART)</i> |  |
| Jonathan Bright, Spencer Lowman, Adam Peris, Timothy Van Dyke ⁺ | | | |
| 69 | 4:20 |  <i>Block Press: Providing Access to Sustainable Housing Solutions</i> |   94 |
| Samuel Hsu, Adam Janney, Addison Morrone, Brandon Shirk, Kerry Goforth ⁺⁺ , Thomas Soerens ⁺ | | | |
| 70 | 4:40 |  <i>Combined Cooling, Heating and Power Demonstration Model</i> |  |
| Ethan Jacoby, Mitchell Kauffman, Timothy Mast, Nathan Musser, Brian Seip ⁺⁺ , David Vader ⁺ | | | |
| 71 | 5:00 |  <i>Pico Hydro: Powering Developing Communities with Run-of-Stream Hydroelectricity</i> |   92 |
| Tyler Criddle, Daniel Loefstedt, Joshua Pardoe, Shane Braunworth, Andrew Reedy, Jonathan Rogers, Casey Bechard ⁺⁺ , Andrew Breighner ⁺⁺ , Dan Elliot ⁺⁺ , Dereck Plante ⁺ | | | |
| 72 | 5:20 |  <i>Design of Instructional Kits for STEAM Education</i> |   89 |
| Timothy Mast, Mayim Moore, Michael Pasti, Nathen Feldgus, Michael Gray, Jeremy Wakeley, Michael Robinson ⁺ | | | |



Natural Sciences IV







Kline 120; 4:00 – 5:00

- | | | | |
|---|------|--|---|
| 73 | 4:00 |  <i>Sexual Dimorphism of the Panamanian Golden Frog (<i>Atelopus zeteki</i>)</i> |  |
| Katelyn Wieder, Erik Lindquist ⁺ | | | |
| 74 | 4:20 |  <i>Determination of Water Soluble Arsenic Species with a Quartz Crystal Microbalance Functionalized with Iron(III) Oxide</i> |  |
| Jordan Frank, Richard Schaeffer ⁺ | | | |
| 75 | 4:40 |  <i>Electrooptical Dynamics of 4-cyano-4'-pentylbiphenyl Supported on ZnSe Functionalized with Alkanethiolate Self-assembled Monolayers</i> |  |
| Elliot Rossomme, Alison Noble ⁺ | | | |



Natural Sciences V

Hollinger Lounge; 4:00 – 5:00

- 76 4:00  *Designed Heme c Binding Proteins*
Trevor Shenk, Jesse Kleingardner[†] 
- 77 4:20  *The Irrelevance of K-ras: Elucidating the Role of Gastrin as a Driver of Pancreatic Adenocarcinoma*
Andrew Nevin, John Harms[†] 
- 78 4:40  *Fluorescent Tagging and Aggregation of HIV-1 Using a Novel Recombinant Protein*
Daniel Haas, **Brianne Roper**, Matthew Farrar[†], Jesse Kleingardner[†] 



Afternoon
Presentations





























Poster Presentations

Engineering



















Frey 070 Project Space; 11:20 – 12:00, 3:00 – 4:00

- 79  *A Low-Cost Dynamic Light Scattering System for Detection of Viral Aggregates*   37
Lindsey Barner, Alexander Roth, Matthew Farrar[†]
- 80  *Breath of Life: Pressure Swing Adsorption Oxygen Concentration for Hospitals in the Developing World*   7
Kristen Frawley, Caleb Sisson, Jordan Sponsler, Devin Esch, Katie Heindel, Spencer Petersheim, Michael Smith, Robert Reed^{††}, David Vader[†]
- 81  *Cunningham Clubfoot*   38
Rebekah Forshey, Vy Ho, Paul Stoltzfus, Noah Charleston, Micah Curtis, Luke Redcay, Emily Farrar[†], Tim Howell[†]
- 82  *Design of a Muscle-Activated Prosthetic Hand*   35
Alaric Kobzowicz, Keith Wei Luen Lim, Erin Cressman, Jonathan Lord, Jason Yoder, Michael Robinson[†]
- 83  *Viral Load Determination for HIV-1 for the Macha Research Hospital Using a Novel Recombinant Protein and Heparin-Affinity Protocol*   
Lily Gaudreau, Daniel Haas, Danielle Reimer, Brianne Roper, Matthew Farrar[†], Jesse Kleingardner[†]
- 84  *Facilitating Organizational Networking (Henosis): Mobile & Web App Development* 
Joshua Conrady, Mark Musselman, Harold Underwood[†]
- 85  *WERCware: Stress Detection Via EEG*   1
Derrick Peterson, Josh Thomas, Matthew Bohn, Joseph Coshun, Ryan Hahn, Harold Underwood[†]
- 86  *Prosthetic Knee for Burkina Faso* 
Kaleb Burch, Vaughn Chambers, Ashley Hah Chien Vern, Marissa Kuhns, Jamie Williams[†]



- 87  *Sustainable Mobility: Taking an Assistive Mobility Technology from Prototype to Production*   9
Jakob Davenport, Joshua Kunkle, Morris Taylor, Daniel Barrett, Cordell King, Anders Laub, Matthew Tomasetti, Daniel Vivolo, John Meyer[†], David Vader[†]
- 88  *Wheels for the World*  
Daniel Gallagher, Ryan Moyer, Joseph O'Connell, Antonio Ortiz, Wesley Ramirez, Timothy Van Dyke[†]
- 89  *Design of Instructional Kits for STEAM Education*   72
Michael Gray, Nathen Feldgus, Timothy Mast, Mayim Moore, Michael Pasti, Jeremy Wakeley, Michael Robinson[†]
- 90  *Design of a Solar Power System for Ekuphileni Bible Institute*   39
Caleb Bornman, Steven Carpenter, Jessica Kline, David Moretz, Joshua Patterson, Scott Kerstetter, Josiah Peck, Mark Brill^{††}, Nathan Charles^{††}, Michael Robinson[†]
- 91  *Energy Monitoring and Management*   63  64
Austin Kratz, David Nicolais, Nathan Ressler, Thomas Martin, Karine Moussa, Nathaniel Pardoe, Paul Tajiri, Greg Talamo, Michael Zigarelli, Thomas Austin^{††}, Randall Fish[†]
- 92  *Pico Hydro: Powering Developing Communities with Run-of-Stream Hydroelectricity*   71
Shane Braunworth, Andrew Reedy, Jonathan Rogers, Tyler Criddle, Daniel Loefstedt, Joshua Pardoe, Casey Bechard^{††}, Andrew Breighner^{††}, Dan Elliot^{††}, Dereck Plante[†]
- 93  *Aeroponics*   40
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- 94  *Block Press: Providing Access to Sustainable Housing Solutions*   69
Adam Janney, Addison Morrone, Brandon Shirk, Samuel Hsu, Kerry Goforth^{††}, Thomas Soerens[†]
- 95  *Cumberland Pointe Futsal (Soccer) Project*   43
Sean McCormick, Jacob Artuso, Peter Burt, Troy Harris, Jr., Emily Quatrale, J Scott Heisey[†], Joshua Weidler^{††}



- 96  *Woodcrest Bridge Project*   65
Mark Simpkins, Dylan Clemente, Dexter Ehrenzeller, Brenden Good,
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- 97  *Straight Vegetable Oil Research* 
Kyle Doll, Ryan Kuhn, Aaron Ladeau, Andy Erikson[†]
- 98  *Oakwood Hills Pedestrian Access*   67
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- 99  *Affordable Solutions to Pit Latrine Collapse*   42
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- 100  *Gravity Fed Water System*   44
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- 101  *Intelligent Water Project: Remote Sensing of Pump Health for Promotion
of Clean Water Access In Developing Countries*   5
Owen McCullum, Kelsey Nichols, Sandra Snozzi Solther, Lydia Goodwin,
 John Harro, Randall Fish[†]
- 102  *Mechanized Percussion Well Drilling*   3
**Andrew Dunmire, John Hannon, Nathan Henry, Cole Hiduk, Althea
Mavros, Aaron Mishler, Greg Shirk**, Joseph Longenecker^{††}, Andrew
 Parkhurst^{††}, Thomas Soerens[†]
- 103  *Million Gallon Challenge* 
Perri Katcher, David Patawaran, Andrew Nevin, Thomas Soerens[†]
- 104  *Village Water Ozonation Systems*   45
Daniel Ma, Ted Sindabizera Ntwari, Elisabeth Chang, Ray Knepper^{††},
 Michelle Lockwood[†]







Natural Sciences

Hollinger Atrium & Jordan Hallway; 3:00 – 4:00

- 46  *A Single Nucleotide Polymorphism Does Not Promote Expression of a CCK2R Splice Variant Associated with Pancreatic Cancer* 
Sung Bo Yoon, John Harms[†]
- 47  *Method Optimization for High-throughput Screening of FRET Biosensors* 
Danielle Weaver, Jesse Kleingardner[†]
- 49  *Elevated Pharmaceuticals in Golden Seal Using Aquaponics* 
Van Nguyen, David Foster[†]
- 50  *Can Pancreatic Cancer be Controlled by Cellular Immunity?* 
Kirby Robbins, John Harms[†], Lawrence Mylin[†]
- 52  *Synthesis and Characterization of Transition Metal Hydroxyl Sulfate Mineral Phases* 
Travis Hoover, Richard Schaeffer[†]
- 54  *Allometric Effects on Clutch Size and Quality in the Panamanian Golden Frog, *Atelopus zeteki** 
Micah Christensen, Erik Lindquist[†]
- 55  *Furthering the Progress of Synthesis of Aspernigrin A* 
Ravenia Arnold, Anne Reeve[†]
- 57  *Non-Invasive Individual Identification of the Panamanian Golden Frog (*Atelopus zeteki*)* 
Alyssa Sargent, Erik Lindquist[†]
- 58  *Biocatalytic Reduction of Ketones and Imines Using *Daucus carota* Root* 
Anthony Bogetti, Roseann Sachs[†]
- 60  *Characterization of Surface Oxidation on Zinc Selenide* 
Megan Steves, Niklas Hellgren, Alison Noble[†]
- 62  *Synthesis of Biofunctionalized Self-assembled Monolayers on Zinc Selenide* 
Autumn Merrill, Anne Reeve[†], Alison Noble[†]
- 73  *Sexual Dimorphism of the Panamanian Golden Frog (*Atelopus zeteki*)* 
Katelyn Wieder, Erik Lindquist[†]


Posters






- 74  *Determination of Water Soluble Arsenic Species with a Quartz Crystal Microbalance Functionalized with Iron(III) Oxide* 
Jordan Frank, Richard Schaeffer[†]
- 75  *Electrooptical Dynamics of 4-cyano-4'-pentylbiphenyl Supported on ZnSe Functionalized with Alkanethiolate Self-assembled Monolayers* 
Elliot Rossomme, Alison Noble[†]
- 76  *Designed Heme c Binding Proteins* 
Trevor Shenk, Jesse Kleingardner[†]
- 77  *The Irrelevance of K-ras: Elucidating the Role of Gastrin as a Driver of Pancreatic Adenocarcinoma* 
Andrew Nevin, John Harms[†]
- 105  *Test-retest Reliability and Learning Effect of the Modified CTSIB Balance Protocol*
Ashley Carroll, **Emily Walter**, **Emily Brocht**, Paula Johnson[†], H. Scott Kieffer[†]
- 106  *Pre-Participation Jump-landing Assessment in a Population of Female Collegiate Volleyball Athletes*
Erika Wandel, Matthew Lewis[†]
- 107  *Electrophilic Additions to Alkenes in Ionic Liquids*
Micah Ohlhausen, Roseann Sachs[†]
- 108  *The Effects of Virtual Reality Training on Static and Dynamic Balance in Female Athletes*
Kristin Donohue, **Karalyn Schmidt**, **Alyssa Sadorf**, Wendy Cheesman[†], H. Scott Kieffer[†]
- 109  *Implicit Antifat Bias Differences Between First-year and Senior Applied Health Science Majors*
Rebekah Linde, **Karalyn Schmidt**, Doug Miller[†], H. Scott Kieffer[†]
- 110  *Buprenorphine's Impact on Stress-Enhanced Fear Learning*
Elias Harkins, Nicholas Balten, Jacinta Davis, Hannah Roland, Kelly Striker, Jennifer Thomson[†]

- 111  *The Effects of Static and Dynamic Stretching on Muscular Strength and Power*
Hunter Bellows, Kyle Bjorkman, Dani Kreiger, Meghan Williams, H. Scott Kieffer[†]
- 112  *Differential Plant Nutrient Uptake in Dry vs. Saturated Wetland Soils*
Devyn McPheeters
- 113  *The Influence of Green Tea on Fat Oxidation at Rest and During Exercise*
Sarah Zigarelli, Zach Bair, Jeremiah Brown-Suarez, Glenn Petraitis, Kendra Herbenar, H. Scott Kieffer[†]
- 114  *Study Update: The Effect of Caffeine Ingestion and the CYP1A2 Polymorphism on Long Anaerobic Exercise Performance*
Kristen Hasse, Laura Sollenberger, Julia Rodgers, Rachel Steckbeck, Brian Shenk, Michael Shin[†], Eric Rawson[†], H. Scott Kieffer[†]
- 115  *Searching for *Cryptotis parva*: A Small Mammal Survey of South-Central Pennsylvania with a Special Focus on the Least Shrew*
Summer Gotwals, Randy Cassell[†]






Evidence-Based Nursing Care

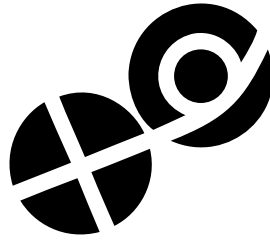
Kline 108 & Kline 113; 3:00 – 4:00

- 116  *Aroma Therapy for Agitation in Adults with Dementia*
Joanna Benner, Allison Burton, Shannon Leary, Megan Sullivan
- 117  *Patient Outcomes of Nurse-Led Central Venous Catheter Insertions*
Melissa Biener, Marisa Weaver, Amy Walker
- 118  *The Impact of Postpartum Maternal Fatigue on Infant Falls*
Darby Catalano, Victoria Lenox, Olga Mozol, Julia Simpson
- 119  *Intra-Hospital Nursing Handoff in the Emergency Department*
Christina Albrecht, Victoria Bee, Hannah Eldridge, Courtney Slinkerd, Nicole Wagner
- 120  *The Use of Pivot Nursing and Immediate Bedding in the Emergency Department*
Eileen Barker, Kristen Douglas, Brielle Frye, Jonathan Kroon



- 121**  *Effectiveness of Managing a Multi-Modal Approach to Workplace Violence*
Rebecca Kriner, KateLynne Pappas, Michaela Miller, Rebecca Nichols
- 122**  *The Effect of TENS and Accupuncture on Postoperative Opioid Use*
Elizabeth Beam, Ellen Bechard, Sarah Dolan, Stephen Outland
- 123**  *Lost in Translation*
Lauren Orehowsky, Mackenzie Belyea, Olivia Kimmel, Darby Gallo
- 124**  *Brassiere Use to Reduce Post-Sternotomy Pain*
Rachel Bennicoff, Samantha Dench, Melissa Percherke





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We graciously acknowledge the oversight and training provided by Messiah College faculty and external collaborators!



Collaboratory Educators, Collaborators & Partners

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 Andrew Breighner
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 Michael Robinson
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 Harold Underwood
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 Open Door Development
 Rider Musser Development
 Rio Missions
 Sawyer Products
 Serving in Missions (SIM)
 The Ekuphileni Bible Institute
 Water4
 Wheels for the World
 Woodcrest Retreat
 World Vision

Acknowledgments

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Chuck Arnold	Bryan Hoover	Darlene Perez-Brown
Tom Austin	Richard Houck	Doug Phillippy
Katie Barrett	Bruce Hulshizer	Tim Przybylowski
Chris Bauer	Randy Jackson	Bob Reed
Casey Bechard	Tim Johnston	Scott Reichenbach
Tony Beers	Andrew Jones	Quentin Rissler
Ross Billings	Andrew Joy	Jake Sargent
Jim Boyer	Josh Joyce	Brian Seip
Andy Breighner	Jesse Kleingardner	Adam Shamenek
Mark Brill	Ray Knepper	Jonathan Shenk
Alex Brubaker	Mike Kuhns	Eric Shoemaker
Bruce Brubaker	Dentin Lehr	Brian Snader
Carol Buckley	Matthew Lewis	Ron Spacht
Nathan Chaney	Kaitlin Logan	Gavin Stobie
Nathan Charles	Joseph Longenecker	Doug Stumpp
Gene Chase	Joel Love	Rachel Swank
Wayne Chen	Amanda Luger	Liam Tanis
Adam Chilcote	Brian Mast	Danny Thompson
Chad Clemens	Scott McConnell	Leif Uptegrove
Stephen Crooks	Rob Miller	Ariela Vader
Jerald Cunningham	Seth Miller	Scott Weaver
Brendon Earl	Steven Miller	Erik Weenick
Dan Elliot	Tyler Miller	Josh Weidler
Murray Fisher	Katie Moyer	Duane Weiss
Kerry Goforth	Lawrence Mylin	Lamarr Widmer
Eric Gogola	Jon Naugle	Jon Winger
Kevin Hartnett	Nick Noss	Russ Woleslagle
Bob Hentz	David Owens	Jacqui Young
Sam Hepner	Andrew Parkhurst	Tim Zimmerman
Phil Hess	Nancy Patrick	Jean Zipagan

We graciously acknowledge oversight and training provided by full time and adjunct Messiah College faculty of...



The School of Science, Engineering and Health
and
The School of Business, Education and Social Sciences[‡]

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***We gratefully acknowledge the oversight and
training provided by the following
Nursing Professionals***

Holy Spirit Hospital

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Katie Shradley MS, RN, CVRN-BC

We gratefully acknowledge the following
Financial and Material Support

	<i>Presentation</i>
Access Development LLC	6
Anthony & Carolyn Hahn	1, 85
AROMA of Messiah College	43, 95
Benjamin & Erin Bergen	9, 87
Carroll & Donnamae Lindman	5, 6, 44, 45, 100, 101, 103, 104
Charles Lady	72, 89
Clayton & Elizabeth Swartz	66, 67, 96, 98
Conrad N. Hilton Foundation	41
CS Davidson Inc	66, 67, 96, 98
CURE International	36
David Miller Associates Inc	44, 100
Dawood Engineering Inc.	66, 67, 96, 98
Department of Energy	21
Dillsburg Brethren in Christ Church	9, 87
Edward Campbell	66, 67, 96, 98
Engineering Ministries International	71, 92
Eric Shoemaker, CPO, Ability Prosthetics & Orthotics	34, 36
Fermi National Accelerator Laboratory	21
Horst Construction	65, 96
Impact Venture Challenge 2015	63, 64, 91
Intel Corporation	24
Jacob L. Hitz Machine Shop	69
James & Margaret Scroggin	7, 80

We gratefully acknowledge the following
Financial and Material Support

	<i>Presentation</i>
Jerald Cunningham, Cunningham Prosthetic Care, Wells, ME	38, 81
John & Maude Yacapsin	66, 67, 96, 98
John & Nancy Howell	35, 36, 38, 81, 82
Justin & Jessica Eberhart	66, 67, 96, 98
Kate Elizabeth Johnstone	9, 87
Kenneth & Polly Ann Brown	5, 6, 44, 45, 100, 101, 103, 104
Larson Design Group	65, 96
Leif & Carol Uptegrove	37, 39, 79, 90
Matthew & Jennifer Ransil	37, 79
McMahon Associates Inc.	66, 67, 96, 98
Merck Company Foundation	5, 6, 44, 45, 100, 101, 103, 104
Messiah College Impact Venture Challenge	63, 64, 84, 91
NASA PA Space Grant Consortium	21
Nathaniel & Jennifer Nichols	39, 63, 64, 70, 71, 90, 92
NTM Engineering Inc.	66, 67, 96, 98
Olympic Steel	66
Pamela R. Kirkpatrick	72, 89
Patrick J. Kelly	66, 67, 96, 98
Penn State Center for Nanoscale Science NSF-MRSEC (DMR-0820404)	24, 60, 62, 75
Penn State Hershey Department of Health Physics	50
Pennsylvania Society for Professional Engineers	66
Ray H. Crist Student Research Scholarship	46, 54

We gratefully acknowledge the following
Financial and Material Support

	<i>Presentation</i>
Rider Musser Development, LLC	67, 98
Rodney & Lynn Niner	66, 67, 96, 98
Russell A. Woleslagle	66, 67, 96, 98
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The Ray Deiner Fund	45, 104
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Water4	6
World Vision	5, 41, 42, 99, 101

Acknowledgments

Abstracts

Ordered by Presentation Number.

1 Remote Coaching Solution (WERCware) - Sensor and System Integration

Matthew Bohn, Joseph Coshun, Ryan Hahn, Derrick Peterson, Josh Thomas, Harold Underwood[†]

Individuals in society with various developmental disabilities currently rely on habilitation assistants to help them learn or relearn daily tasks. Such in-person social coaching may foster dependency in the long term, and may not represent the most efficient business model. WERCware seeks to revolutionize this service industry, ultimately offering the ability for one coach to provide services to multiple participants from a remote location, while creating the potential for more independence among those being taught and supervised. The WERCware systems consists of an Android-based smartphone interfaced with various stress-detecting bio-sensors. When the system identifies stress in the user, a video conferencing call will be initiated from the smartphone to the coach that allows the coach to help manage the user's stress. If the user enters a private area, video and audio transmission will be temporarily halted when the system is in close proximity to Bluetooth beacons deployed in these areas. Recent progress includes the implementation of artificial intelligence for real-time detection of stress in the human voice, as well as development of a custom Android application (app) to facilitate component interaction and video conferencing.

2 Flight Tracking and Messaging System (FTMS): Aircraft Control Unit Redesign

Hoang Nguyen, Samuel Rice, Michael Torres, Harold Underwood[†]

Once outside radar range, small planes flying in remote locations must be tracked by alternative means. Organizations focused on emergency relief, humanitarian development and missionary support need to follow such flights, for safety and management. The Automatic Flight Following System (AFFS) owned by JAARS has been extensively employed for such flight tracking, but is no longer in use due to emerging alternatives. Thus, the Flight Tracking and Messaging Systems (FTMS) team is now

working with stakeholder Cary Cupka to redesign AFFS to include more advanced technology modes. This includes replacing the existing Single Board Computer (SBC) in AFFS 1.0 with a new microcontroller capable of similar functions and open to further expansion. The UDOO QUAD prototyping board and Qseven 928 industrial module have now been selected as the SBC for this redesign. Careful study of the existing Aircraft Control Unit (ACU) display board has enabled the redesigned layout and implementation of an upgraded version, to save space. RS - 232 serial communication has been established between the SBC and AFFSWin (Automatic Flight Following System for Windows) to simulate sending messages from the ACU to the ground station during ongoing development.

3 Mechanized Percussion Well Drilling

Tyler Collier, Dan Eckman, Damaris Gehman, Joseph Longenecker^{††}, Andrew Parkhurst^{††}, Thomas Soerens[†]

The Mechanized Percussion Well Drilling Project seeks to design a simple mechanized well drilling system to be used by our client for drilling shallow water wells in Burkina Faso, Africa. Currently our client has trouble drilling through hard rock layers, and often has to 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. As of April 2017, a prototype of the mechanized rig has been built and tested on campus, and a safety training video for the rig has been created. In addition, a steel mast superstructure has been designed and manufactured that will replace the conventional tripod. This will allow for more space around the well site and give the operator more control over drilling operations. Other supporting equipment that was designed and manufactured includes: a drilling jar, casing hammer, and casing pulling system. The project is preparing to travel to Burkina Faso in the Summer of 2017 to meet with the client and assess client need.

4 Basic Utility Vehicle: Firetruck, BUV:F

John Keeports, Michael Padovano, Jeffrey Weaver, Donald Pratt[†]

The Basic Utility Vehicle: Firetruck, or BUV: F project works to meet the emergency response needs of people in poor rural areas in Africa. The BUV: F project partners with the Institute for Affordable Transportation to explore options to easily and effectively convert existing utility vehicles into mobile fire-fighting platforms, complete with versatile operating ranges and powerful delivery systems. Lessons learned from the first prototype's construction will help the BUV: F project meet its final criteria—a 25 mph firefighting vehicle capable of transporting and deploying over 200 gallons to even the most remote blaze.

5 Intelligent Water Project: Remote Sensing of Pump Health for Promotion of Clean Water Access in Developing Countries

Lydia Goodwin, John Harro, Owen McCullum, Kelsey Nichols, Sandra Snozzi Solther, Randall Fish[†]

Millions of communities in developing countries rely on hand pumps installed by various non-governmental organizations (NGOs). Studies have shown that these pumps are often broken with significant delays before maintenance people arrive. The Intelligent Water Project (IWP) has developed a remote sensor to report failure of one of these hand pumps and provide data necessary for implementation of a proactive maintenance policy. Currently, there are 12 IWP systems installed in Ghana, Africa. This past year, the IWP team analyzed data gathered from these field units and implemented design changes to ensure functionality, increase serviceability, and prepare for mass production of the IWP unit.

6 Pump Minder: A Water Meter to Promote Sustainable Access to Clean Water in Developing Countries

Shawn Bordner, Chad Brubaker, Randall Fish[†], Jon Naugle^{††}

The Pump Minder project is a component in an overall plan to increase clean water access in areas where safe water is scarce. Our clients, Water4 and Access Development, are developing sustainable models for hand pumps in Ghana, West Africa, allowing water access for much longer than the typical lifespan of a pump. In order for this sustainable model to be achieved, a small fee must be charged for the delivery of water. This money

funds upgrades and maintenance projects as well as the salary for a person to manage the usage of the pump. This worker, called the pump minder, is the inspiration for the name of the project. Our project is directly involved in the transaction between the pump minder and the local community by developing water sensors measuring the amount of water pumped out of the nozzle. This provides accountability for the pump minder so the price of water stays at a reasonable cost. If this accountability was not in place, people could revert to finding water from the same contaminated sources before the hand pump was installed. In this presentation, the discussion will focus on the third revision of this water sensor. This redesign is highlighted by cost savings, increase in battery life, ease of manufacturability, and the retrieval of data using a laptop computer.

7 Breath of Life: Pressure Swing Adsorption Oxygen Concentration for Hospitals in the Developing World

Devin Esch, Katie Heindel, Spencer Petersheim, Michael Smith, Kristen Frawley, Caleb Sisson, Jordan Sponsler, Robert Reed^{††}, David Vader[†]

The Breath of Life project team has partnered with Macha Mission Hospital in Zambia to meet the need for medical oxygen at developing world hospitals situated in tropical climates. High humidity levels damage the zeolite particle beds in pressure swing adsorption oxygen concentrators, which in turn causes premature failure of the devices. This drives up the cost of healthcare in these areas. In a developing world context, the lack of ready access to parts and maintenance means that the failure of oxygen concentrators can leave patients in respiratory distress without the oxygen they need to survive. Our team is designing a dehumidifier using electrostatic precipitation that is attachable to the air intake of oxygen concentrators to remove moisture from the ambient air before it enters the machine. Our current prototype uses a high voltage potential to charge and collect water particles out of the air. A long-term solution that is currently being developed is a hospital-wide oxygen system that is primarily driven by compressed air to create concentrated oxygen when the power is out. The system will use compression and rapid expansion to dry the ambient air before it enters modular oxygen concentrators and travels throughout the hospital.

8 *Landmine Detection*

Will Cochran, Grant Garber, Raul Serrano, Donald Pratt[†]

The Landmine Detection project seeks to offer a viable option for the detection of landmines to address a crucial need of the citizens in Banteay Meanchey Province, Cambodia. This project is currently in the process of exploring multiple, efficient methods of detecting various types of landmines and other unexploded ordnance (UXO). Possible methods include infrared technology or ground penetrating radar. An advanced deployment vehicle for the transportation of the detection technology is being explored with possibilities such as drones and blimps. Through experimentation and development, the project aims to explore the application of state of the art technology to detect landmines. The Landmine Detection project seeks to improve the safety of the citizens of Banteay Meanchey Province, Cambodia in regards to active landmine interaction.

9 *Sustainable Mobility: Taking an Assistive Mobility Technology from Prototype to Production*

Daniel Barrett, Cordell King, Anders Laub, Matthew Tomasetti, Daniel Vivolo, Jakob Davenport, Joshua Kunkle, Morris Taylor, John Meyer[†], David Vader[†]

The mission of the Sustainable Mobility Project is to equip our partner, the Centers for the Advancement of the Handicapped in Burkina Faso, West Africa, with an appropriate and sustainable method for locally building and distributing our mobility tricycle design to those in need. In rural West Africa, this personal mobility technology brings freedom and empowerment to some of the most marginalized persons in the world. Within the past year, we have shifted our focus to the development of tools and processes to facilitate scaling the manufacture of Collaboratory electric tricycles from single to multiple units. Ultimately, we aim to provide our partner with the ability to effectively meet the mobility needs in their community. Specifically, this year the Sustainable Mobility Project has focused on the manufacturing development of the structural frame, the drive train assembly, the motor cast housing, and the electrical control system. In each of these areas, we evaluated former manufacturing techniques and improved these techniques to be more successful in future production of mobility tricycles in multiple international locations. In January 2017, for the first time ever, the team built five electric tricycles with our Burkinabé partners in Fada, Burkina Faso.

Moving forward, the team will further develop and test tricycle manufacturing to generate a complete design and manufacturing handbook for our current and future partners.

10 *Northstar: A Mobile App for Refugee Service Discovery*

Thomas Martin, Katherine Piette, Braden Miller, Sarah Park, Z-Ean Chung

Northstar is a browser-based mobile application created for refugees who have moved to the USA and provides easy access to the services available to them based on their personal demographics. Our app provides a form for a refugee, or a neighbor or service worker to fill out for a refugee, with their demographics (date of birth, country of origin, gender, date of arrival in the US, etc.) and returns them a list of the services available to them in their surrounding area. The need for this application was brought to our attention from the Lancaster County Refugee Coalition who wanted an app that would make it easier to know what kinds of services were available to which people to get them help faster. Throughout this project, we have had a lot of ability to learn new kinds of technologies and use the skills and talents God has given us to provide a product that will potentially help lots of people. Our hope for this project is that it can continue after this semester and potentially be used by refugees and different nonprofit companies across the country to make personalized access to services easier.

11 *SymPRM*

Kira Fernandez, Katherine Piette, TK Sun, Ben Underwood, D. Scott Weaver[†]

SymPRM is the internal management software that Messiah College uses to manage the annual SEH Symposium. More than 120 projects are presented by the School of Science, Engineering & Health every year, and this application helps streamline the organization of the annual event. This year, our team primarily focused on developing system administration features and finalizing the new application layout. Over the course of this project, we have learned more about database interactions and database queries, PHP and Javascript development, and the design and process of developing a full scale web application. By the end of the semester we intend to have the administration features fully developed and to pass along a strong codebase to the next group of students who are responsible for this application.

12 *ConLangApp: A Web-based Toolkit for Constructed Languages*

Samuel Bernhardt, Elizabeth Pinkham, Emily Budd, Gene Rohrbaugh[†]

Throughout the years, linguists and authors such as J.R.R. Tolkien have created languages used in a variety of ways. Our team developed a web application for creating such constructed languages. The application, Language Constructor, allows users to specify the characteristics of their language or randomly assign them. We chose Ruby on Rails as our development platform as it is well suited to rapid prototyping. We developed a user interface and data models for storing and processing language data.

The goal of this project is to provide a framework for constructing realistic languages, with the same patterns found in existing natural languages. In order to do this, we broke language down into its smallest units, and used random weighted generation to assemble a text. We explored several methods for random generation with the goal of producing syllables, words, and sentence structures with patterns analogous to those found in natural languages. In the end we selected weighted random selection.

13 *Matching Natural Language Lexicostatistics in Randomly Generated Texts*

Yacoub Seyni, Hoang Nguyen, Thomas Martin, Gene Rohrbaugh[†]

Language is a fundamental tool for humanity. For many years, a lot of research has been carried out to study characteristics that hold true across natural languages. Along with Dr. Rohrbaugh, we sought to study some of their characteristics. We focused on finding phonotactic patterns and word distribution patterns in natural language texts. Using the collected research, we were able to run analysis on generated artificial languages to determine how well they fit the characteristics of natural language.

14 *AeroCar: Aeroponics Forecast Scheduling with Calendar*

Ryan Greenawalt, Huey Hum, Emily Budd, Jeffrey Daub

Boxcar Central is a software company located in Summerville, South Carolina which recently acquired a shipping container aeroponic farm to use for research and development. They are developing an application to allow farmers to grow plants more efficiently. Our team developed an extension to the Boxcar Central application to generate grow and

financial forecasts. Our application, LilBoxcar, allows the user to input their information about their Aeroponic farm to generate their own plans. We used the Boxcar's tech stack which consists of, Tomcat, MySQL, Java, and Html/Css. Our goal is to provide an easy to use forecast creation and management add-on to the existing Boxcar application. In order to do this, we broke forecast creation down into small intuitive segments for the farmer to enter information. This allows each piece of the forecast to be stored before generating a full grow plan and a profit and loss projection. The farmer will use these tools to predict and manage expenses as well as plan future crops.

15 *AeroBox: Aeroponics Financials with Profit/Loss Statement*

Andrew Cameron, Joshua Choate, Jonathan Isaac, Nathan Millary, Michael Snader

Boxcar Central is a software company located in Summerville, South Carolina which recently acquired a shipping container aeroponic farm to use for research and development. They are developing an application to allow farmers to grow plants more efficiently. Our team developed an extension to the Boxcar Central application to generate grow and financial forecasts. Our application, LilBoxcar, allows the user to input their information about their Aeroponic farm to generate their own plans. We used the Boxcar's tech stack which consists of, Tomcat, MySQL, Java, and Html/Css. Our goal is to provide an easy to use forecast creation and management add-on to the existing Boxcar application. In order to do this, we broke forecast creation down into small intuitive segments for the farmer to enter information. This allows each piece of the forecast to be stored before generating a full grow plan and a profit and loss projection. The farmer will use these tools to predict and manage expenses as well as plan future crops.

16 *Fungi Web Application*

Chanbin Park, Kyle Talbert, Samuel Houck, Jonathan Spencer, Garrett Reichert, D. Scott Weaver[†]

The Fungi Web Application is a tool for people who study Mycology. The primary function of this website is to act as a key to identify various species of fungi based on shape, substrate and other physical attributes. The website allows the user to browse existing fungi species and is updated as new fungi are discovered.

Over the course of this project, we have learned more about database interactions and database queries, PHP and Javascript development, complex HTML and CSS design elements and the process behind developing a full scale web application. We continued the development from the previous team and improved upon the foundation for the teams that will follow after.

17 *Maze Tron*

Jonathan Spencer, Chalmers Port, Bryce Simmons, Robert Kilmer[†]

Maze Tron is a videogame designed using a compiler called Processing. The premise of this game was inspired by Tron the American science fiction action-adventure film. In our game the player is subject to split second decision making and complex mazes requiring memory of what the level looks like. This project has a lot of elements to it and took a lot of time and effort for our team to put together. We really enjoyed this project and hope others will too.

18 *Live Wire*

Jared Butler, Chalmers Port, David Michael, John Romero, Robert Kilmer[†]

At times, your average Physics or Circuits class can get a bit boring. Sure the labs are fun, but when it's time to study for the big test, your motivation may be a bit underwhelming. This underwhelming motivation is what motivated our project: Live Wire. We created Live Wire as a gamified educational experience to allow students to review their circuits knowledge in a fun and interactive way. Please, stop by, relax, and enjoy the games we made.

19 *Think Fast!*

Charlie Byrd, William Henry, Emmanuel Gundran, Richie Varona, Robert Kilmer[†]

This presentation will cover the game Think Fast! and the games that are in it. The several games that are included are, long jump, skeet shooting, tennis, and water polo. each game teaches a specific genre such as math, state abbreviation, language, typing skills and Spanish to English translation. Each game is designed to help students learn about a specific subject. In long jump the player is to type the English translation of the Spanish word five times to gain points. In skeet shooting the player is to type words that appear on the disks to hit them, in tennis the player types the solution to a math addition problem when the player hits the ball. In water polo, the player is to type the state that the abbreviation is

displayed. Each of these games is to help the player learn about the specific subject.

20 *Render: Venture*

Kyle Talbert, Robert Kilmer[†]

Render: Venture is a computer game designed as a narrative that plays with the concepts of both digital media and "rendering". The main character Ren, along with his trusty sidekick Synx, explore levels of a crashed spaceship. Ren appears to be the only survivor of the crash, and Synx (a maintenance "holobot") guides him through the wreckage, helping him defeat a pesky infestation of "Glitches". As they progress, the depths of the gameplay and the style of the graphics expand as Ren gets closer and closer to the game's finale. Each level represents a different era of interactive gaming and technology. The Prologue plays homage to text-based adventures, then soon transitioning to include image graphics. The first level enters a more familiar realm of early platform gaming, with blocky graphics and 8-bit sounds. The second and third levels expand into more modernized graphics, with vector-based shapes, more fluid movement, and a more dynamic soundboard.

21 *High Energy Compact Particle Detectors for Space*

Lindsey Barner, Andrew Grove, Jacob Mohler, Alexander Roth, Abaz Kryemadhi[†]

Although dark matter is believed to compose most of the mass in our universe, it remains completely undetected. Detectors with very good energy precision are needed to search for dark matter in space; however current technologies for such space-based detectors are very bulky. We have explored using LYSO crystals and silicon photomultipliers to develop compact and precise detectors for future dark matter searches in space. We have investigated our detector's performance with both low energy gamma rays and high energy anti-particles (positrons) produced at the Fermi National Accelerator Laboratory and will report our findings.

22 *Assessing Student Learning by Gain in their Confidence*

Noel Murray, Niklas Hellgren[†]

Standardized multiple-choice pre- and post tests are popular with education professionals because they give a quick and easy assessment of how much students learn in a course. However, a commonly raised objection to this test format lies in the potential for guessing. While it is statistically

apparent that guessing on a large number of problems does not yield good results for the test taker, from the perspective of the test administrator, guessing on multiple choice tests does remove some level of reliability from the test. By administering a test on which students could indicate their level of confidence on each question, we look to establish a connection between confidence and correctness in a second semester general physics class. For instance, and correct answer associated with a high confidence indicate good understanding, while a correct answer and low confidence is likely a lucky guess. We will look at some special cases and discuss how this method can be used to draw better conclusions from the assessment tests.

23 Design of a Rutherford Scattering Apparatus

Tyler McManiman, Niklas Hellgren[†], Harry Hawbecker

The Rutherford Scattering experiment was one that had immense impacts on our understanding of science as we know it today, specifically in the realm of the atom. If students could experience this experiment first hand, they will not only be able to relive this historic moment, but also gain a better understanding and appreciation of the knowledge we now have because of Rutherford. I have reviewed the designs of both commercial and homebuilt apparatuses, and based on this research, I propose a design for a Rutherford Scattering apparatus suitable for the needs of the Messiah physics department. There are apparatuses available commercially, but many are expensive or not conducive for Messiah College's needs. The history of the experiment, as well as its real world applications, will be discussed, as well as a comparison of my design with commercially available apparatuses.

24 Growth of ZnSe Thin Films

Alexander Sredenschek, Sarah O'Boyle, Niklas Hellgren[†]

Zinc Selenide (ZnSe) is a commonly used substrate for self-assembled monolayers. However, commercially-available bulk ZnSe tends to be very rough, making detailed analysis of surface chemistry difficult. An alternative is to use ZnSe thin films. In this research, ZnSe thin films were grown on Silicon substrates using radio-frequency magnetron sputtering. The roughness of the films was characterized by atomic force microscopy as a function of chamber pressure, applied target power, bias power, and substrate temperature. Additionally,

the surface chemistry was analyzed using x-ray photoelectron spectroscopy, and crystalline structure of the films was analyzed using x-ray diffraction.

25 Pitcher Predictability: Applying Game Theory to Baseball

Jonathan Mullin

Baseball is as mental as it is physical. It is a game in which the pitcher is trying to outsmart the batter while the batter is trying to be prepared for the pitch that he is about to see. Using data collected from the Messiah College baseball team versus the Alvernia University baseball team, I will analyze the tendencies of pitchers throughout the 2015 and 2016 seasons by the percent that a certain pitch is thrown in a specific count in a game. I will then apply game theory to try and develop a method in which the batter can best guess when a particular pitch is coming in order to give himself the greatest chance of being successful. I will evaluate a pure strategy for an entire game, a pure strategy for each count, a mixed strategy for an entire game, and a mixed strategy for each count. I will then compare this data to data of the Messiah versus Alvernia series this year and analyze how successful it would be.

26 Notes and Letters: Using Music as a Cipher

Sara Melson

Throughout history, people have had a need for encoding messages. People have used different languages and unique symbols to attempt to keep their secrets safe. To keep a message private a cipher can be used. One type of cipher is the polyalphabetic cipher, which uses multiple substitution alphabets. Using the basic elements of music, one can encode a message in several different ways to keep the contents confidential. Examining the frequency of letter distribution is a method to explain the complexity of the cipher and the ease of cracking the code.

27 To Infinity and Beyond?

Benjamin Kragt

Since Cantor, we have known there are different degrees of infinity, but what does that mean? My research examines the concept of infinity and explores several relevant perspectives on how such an abstract concept might be understood and used. I will explore some paradoxes that infinity helps to resolve and also paradoxes that infinity might seem to cause. In particular, I will explain some of the reasons why infinity is often confused for a number,

and suggest a perspective that avoids the issue. Finally, I will examine some of the mathematical work that has been done studying the countable and uncountable cardinalities of infinite sets.

28 *Modeling Infectious Disease: The SIR Model*

Morgan Wasser

Throughout history, the world has been plagued by the spread of infectious diseases taking millions of lives. The spread of these diseases can be modeled mathematically to determine the severity and help with prevention. For years, mathematicians have worked alongside epidemiologists to develop models to predict the spread of rampant diseases. One model in particular used in the field of epidemiology is the SIR model. The traditional SIR model is comprised of a system of three differential equations. A study of this model along with an overview of systems of differential equations will be presented in this project. The culminating idea will be an extension of the SIR model to represent the virtual spread of small pox through the state of Pennsylvania.

29 *The Lebesgue Integral*

Joshua Conrady

Although the Riemann Integral is most commonly taught in college-level calculus, more rigorous forms of integration exist, particularly the Lebesgue Integral. Through a foray into the history of calculus, this presentation seeks to enlighten the audience as to what the Lebesgue integral is, where it came from, and what its practical applications are. Using real analysis, the functionality of the Lebesgue integral will be explained and subsequently compared to the Riemann integral, which is assumed to be more familiar to the audience.

30 *Color Wars*

Nicholas Weaver

Game theory is a relatively new branch of research with applications in many fields, including graph theory. In this talk I will discuss various graph coloring games, which consist of two players coloring the vertices of a given graph. Winning strategies (if they exist) will be proven and I will show how existing theorems in graph theory can be used to reach such conclusions. I will then introduce a new twist on these standard rules and discuss possible strategies for both players and attempt to find a stable winning strategy.

31 *Applying Graph Theory to NCAA Basketball Tournaments*

Kelly Schwiker

Determining the hierarchy of good basketball teams and bad basketball teams is no simple task. One way of analyzing a team's quality in comparison to another team is to analyze their head-to-head competition throughout the season. Using a weighted and directed multigraph allows for the comparison of multiple teams simultaneously. Applying a centrality measure to the established graph provides a means of establishing rankings for all of the teams included in the graph. In turn, assigning rank to each of the teams can help to predict outcomes in tournament competitions.

32 *Tournaments on Tournaments: Using Graph Theory to Analyze Tennis Tournaments*

Meagan Scala

In an elimination tournament for any given sporting event, it is easy to determine the winner since it is simply the last player (or team) standing. In other cases, however, the results are not always so obvious. With round robin tournaments, for example, there is the possibility of a tie between two or more players based on the players' number of wins. A tiebreaking process must then be implemented to determine the winner and/or the ranks of the competing players. Through the use of a tournament digraph, the results of a tennis tournament can be visually represented and analyzed. Different graph theory techniques can be applied to a tournament digraph to determine the outcome of the tennis tournament. Through this project, the best technique will be determined and compared to practices that are currently in use for professional tennis tournaments.

33 *Analyzing and Forecasting Zimbabwe's Trade Exports*

Emily Smetak

A country's economic success hinges upon trade, and statistical time series is a powerful tool to analyze and forecast such performance. In this presentation, I will be analyzing export data from Zimbabwe to discuss how time series techniques can be used to manipulate economic data, construct models and predict upcoming trade trends. I will be particularly describing the implications of using the Dickey-Fuller method to evaluate non-stationary/stationary behavior, as well as how AR and MA techniques can model our data. This project dovetails perfectly with

current work in international development and jumpstarts the conversation as to the role statistics can play in fields such as public policy, political science and economic development.

34 3D-printed Prosthetic Hands for Kids

Timothy Gover, Jessica Raboci, Emily Farrar[†]

Every year, approximately 1,500 babies are born in the US with an upper limb deformity. These children often have to go without assistive prosthetic devices because of cost. Prosthetic hands can cost \$20,000 or more and children need a new device every year due to growth. Our project, affectionately named “Raptor Hand” due to the whimsical dinosaur-ish design of our device, aims to provide a low cost prosthetic hand to children. Emily Hoffman, a six year old girl from the Philadelphia area, has been the first child to receive one of our hands. Our team created a custom 3-D printed prosthetic hand for Emily using designs from E-Nable and the Flexy Hand 2. Our newest prototype, delivered to Emily in Spring 2017, has extensive design features including thumb opposition, compliant grip, and a personalized palm socket.

35 Design of a Muscle-Activated Prosthetic Hand

Keith Wei Luen Lim, Jonathan Lord, Jason Yoder, Erin Cressman, Alaric Kobzowicz, Michael Robinson[†]

Due to the financial burden in purchasing a myoelectric prosthesis, which can cost upwards of \$75,000, this project aims to design a low-cost alternative. Such devices are sought after because of their ability to closely mimic the anatomy and motion of the human hand through a combination of functionality, versatility, and natural appearance. This prosthesis is controlled via electrical signals generated by muscle contractions in the residual limb, which are read by a Myoware muscle sensor and accompanying electrodes. An A/D converter, Arduino, and motor driver then work in conjunction to interpret the intensity and pattern of the signal in order to output a certain set of commands to 3 motors, which accordingly move the prosthetic fingers to fixed grip patterns. Worm and spur gear couplings and pinned mechanical linkages achieve the latter. The current design designates one motor to the movement of the thumb, one to control both the first and second digits, and one to control both the third and fourth digits. To further alleviate costs, the structure of the prosthesis is to primarily be 3-D printed using available resources at Messiah College. This device is planned for a patient with a transradial

(below the elbow) amputation and will be custom fitted and sized on a client-to-client basis. As a standard of measure, the overall cost is intended to remain below \$1,000.

36 Rapid Orthotics for CURE Kenya

Nathan Chambers, Lyndsy Shaubach, Daniel Yeisley, Emily Farrar[†], Paul Myers[†]

The goal of the Rapid Orthotics for CURE Kenya (ROCK) team is to help hospitals in the developing world be able to 3-D print prosthetic devices. Our first client in this endeavor is CURE International, whose hospital in Kijabe, Kenya is a leading center of prosthetics in East Africa. 3-D printing will help increase the number of patients who can receive a prosthetic from CURE Kenya by decreasing the time and cost of manufacturing. This is critically important, as lower limb amputations are most prevalent in the developing world, which is also where there is the lowest incidence of orthopedic surgeons and technicians. The system we have designed for the CURE Kenya includes a 3-D scanner, software for prosthetic design, and a 3-D printer. We will deploy the system at the CURE hospital in Kenya in May 2017. We will also provide two weeks of training on the system, a training manual, and continued support and troubleshooting throughout the 2017-2018 school year. We hope to continue to partner with them in their use of the 3-D prosthetics system in order to expand their abilities and collaborate towards increasingly impactful prosthetics solutions for the developing world.

37 A Low-Cost Dynamic Light Scattering System for Detection of Viral Aggregates

Lindsey Barner, Alexander Roth, Matthew Farrar[†]

Access to HIV diagnostics and viral load monitoring in developing nations with endemic HIV-1 infections, such as many sub-Saharan African countries is limited. Current methods are either high-cost diagnostics that quantify viral load, typically in central facilities, after weeks of processing, or else fast but non-quantitative methods unable to measure viral load. Because treatment must be adjusted depending on viral load, a low-cost diagnostic that can quantitatively identify how many viral copies a patient carries would improve treatment outcome. Partnered with the Macha Research Center in Zambia, Diagnostics for Viral Diseases aims to design such a diagnostic device by combining recombinant protein engineering with an optics-based particle-sizing technique, dynamic light

scattering (DLS). We have explored designing a low-cost DLS apparatus and have assessed its capabilities and limitations. Among our innovations is the use of silicon photomultiplier detectors with custom signal processing circuitry and field-programmable gate array (FPGA) technology. This system could potentially serve as DVD's capability to size and thus diagnose viral aggregates.

38 *Cunningham Clubfoot*

Noah Charleston, Micah Curtis, Luke Redcay, Rebekah Forshey, Vy Ho, Paul Stoltzfus, Emily Farrar[†], Tim Howell[†]

The Cunningham Clubfoot project is focused on aiding children in Kijabe, Kenya that are born with clubfoot. If clubfoot is left uncorrected it can affect one's ability to walk on their own which can inhibit one's ability to be independent and provide for themselves and/or their family later in life. Our goal is to provide a more comfortable, convenient, and effective clubfoot brace than what is currently utilized. One of our partners, Mr. Jerald Cunningham, a board-certified prosthetist and orthotist, invented and developed the Cunningham Clubfoot Brace and currently manufactures them at Cunningham Prosthetic Care. Our Collaboratory team is in the process of replicating Cunningham's design so that it may be 3D printed and used in Kijabe, Kenya with the assistance of our other partner, CURE International. Our presentation will focus on clearly defining clubfoot, force analysis of the Cunningham Clubfoot Maintenance Brace, 3D printing results to date, and initial investigation into hygiene concerns with 3D printed products.

39 *Design of a Solar Power System for Ekuphileni Bible Institute*

Scott Kerstetter, Josiah Peck, Caleb Bornman, Steven Carpenter, Jessica Kline, David Moretz, Joshua Patterson, Mark Brill^{††}, Nathan Charles^{††}, Michael Robinson[†]

The solar team of the Collaboratory at Messiah College in Mechanicsburg, Pennsylvania has partnered with the Ekuphileni Bible Institute (EBI) of Zimbabwe to design and install a solar photovoltaic system, providing reliable and sustainable electricity for the students and faculty. The need for sustainable electricity arose since power production in Zimbabwe is not sufficient to meet the consumer demand; thus, load shedding is used to reduce the demand. Due to load shedding, the grid inadequately supports EBI as it leaves them without

power several times a week. The design work began with a preliminary site-survey in May 2015, and detailed design has continued into Spring 2016. An upcoming site-team installation is planned for May into June 2017.

40 *Aeroponics*

Georgia Ernst, Erin Sharkey, Matthew Brenneman, Erin Kelley, Michelle Lockwood[†]

The Aeroponics Project aims to turn the western concept of aeroponics into something that can be made and used in developing contexts, such as those of our client, Open Door Development (ODD) in Mahadaga, Burkina Faso. While soil and available space are not the limiting factors, reducing the amount of water needed for agriculture leaves more available for the community to drink and use. ODD is not the only possible client, either; communities experience drought and limited water supplies all over the world, all the time. Our hope is that aeroponics systems can improve access to fresh food via a sustainable approach to agriculture.

41 *Africa WASH Disability Studies Project*

Jordan Birdsall, Jacob Younger, Lamarr Widmer[†], Tesfayohanes Yacob[†]

Persons with disabilities (PWDs) living in some developing communities face extreme challenge in getting access to WASH services. The African WASH Disability Studies Project (AWDS) project works with World Vision to strengthen WASH services through low cost hardware improvements and educational outreach. During the current academic year, the project designed an inclusive handwashing station (Tippy Tap), created a technology handbook for dissemination of the assistive technologies previously developed by AWDS, and designed an assistive crawling device. These were accomplished through focused work on empowering those who are disabled, and bringing inclusive WASH to selected western African communities. The team tested three designs of the Tippy Tap to determine what additions could be made to allow for easier use by persons with disability. These additions include a wider foot pedal, a change in the ropes used to pull the container that holds the water, and additional supports for the frame. A technology handbook design was drafted with technical drawing and text and was outsourced to a Messiah College art and design class for a more professional creation. The handbook includes three of the assistive technologies developed by AWDS: the latrine chair, bucket tipper,

and the water cart. The handbook design is focused on presenting these technologies in an easy to read manner for use by World Vision in countries they work in.

42 Affordable Solutions to Pit Latrine Collapse

Kenton Grossnickle, Connor McGovern, Sydney Schandel, Duane Troyer, Rachel Aukamp, Adam Barley, Lorena Reinert, Cheylee Smith, Isaac Underhill, Tesfayohanes Yacob[†]

The Affordable Sanitation Project is trying to address the issue of pit latrine collapse in Ghana, specifically Northern Ghana. Pit latrines are holes dug in the ground that provide a means for people to safely relieve themselves. They are used to prevent open defecation which leads to the spread of disease. However, most latrines are not lined and as such have a tendency to collapse. In Ghana there is a dry season and a rainy season. During the rainy season it rains nearly every day which completely saturates the typical sandy soil. This exacerbates the instability of the latrine walls and can lead to their collapse. Collapsing latrines leads to fears in using them which can cause a reversion to open defecation. To prevent this reversion, World Vision has tasked the Affordable Sanitation project of the Collaboratory with designing a latrine liner that will stabilize the hole while remaining affordable to communities in Northern Ghana. Over the past year the team has visited the affected areas in Northern Ghana and gained valuable feedback. Since then four possible solutions have surfaced. These are the Plastic tub, Sand bag, Ferro-cement, and Rebar-reinforced fabric liners. Through testing and research the plastic tub liner was rejected as a solution whereas the Sand bag, Ferro-cement, and Rebar-reinforced liners were retained. The rebar-reinforced liner was constructed and tested in Ghana last summer and was reported to have stabilized the hole. The team is now focused on optimizing the design of these three possible solutions.

43 Cumberland Pointe Futsal (Soccer) Project

Jacob Artuso, Peter Burt, Emily Quatrala, Troy Harris, Jr., Sean McCormick, J Scott Heisey[†], Joshua Weidler^{††}

The CP Futsal team is working with AROMA Missions to provide a playing area to teach futsal (soccer) to the kids living in the Cumberland Pointe Apartment Complex in Mechanicsburg, Pennsylvania. The team has developed conceptual plans, a permit application, and construction drawings for AROMA to

use for fundraising purposes as well as construction of the playing facility.

44 Gravity Fed Water System

Nolan Goss, Frederic Warden, Shung Yen Tan, Thomas Soerens[†]

The Gravity Fed Water Systems project aims to build a sustainable clean water filtration system with zero energy footprint for a village in rural Lombok Island, Indonesia in cooperation with Access Life International. ALI Lombok serves the poor in hilly rural areas by building clean water systems and has been doing so since 2013. The students on this project performed hydraulic design and analysis of the system, design of biosand filtration, and made suggestions on system layout, pipe sizes, and other technical design to connect the spring capture to the ferrocement tank in the village allowing for clean, drinkable water on demand.

45 Village Water Ozonation Systems

Elisabeth Chang, Daniel Ma, Ted Sindabizera Ntwari, Ray Knepper^{††}, Michelle Lockwood[†]

According to the World Health Organization, over 600 million people do not have access to clean water. Without clean water, waterborne illnesses are common and can decrease the average lifespan of a community. The Village Water Ozonation Team strives after the ideal that every community should have access to the cleanest water they can sustainably afford. This year has focused on the development of two lower cost options for water sanitation, biosands filtration and ultraviolet (UV) purification. The UV system passes water through a pump, filters, and a UV lamp that operates in the UV-C spectrum. The filters remove particles larger than 5 microns that would impede the ability of UV light to contact pathogens. It effectively deactivates the DNA of pathogens making them incapable of reproduction. The focus of working with this system has been to optimize the system for developing communities, and to develop reliable ways to test for the system's efficacy. The biosands filtration system is being designed to treat 60 gallons of water daily, for a school of 120 children in Honduras. It is composed of fine sand, separating gravel, and drainage gravel layers. The sand media size and the developed biolayer play key roles in the removal of pathogens. The water passes through the biolayer and sand layers to remove particulates and pathogens. The focus of the work on this system has been sizing the layers to optimize flow rate and

efficacy. The system's water treatment performance will be of interest in the Fall Semester.

46 A Single Nucleotide Polymorphism Does Not Promote Expression of a CCK2R Splice Variant Associated with Pancreatic Cancer

Sung Bo Yoon, John Harms[†]

Pancreatic cancer is an aggressive cancer with low life expectancy and poor five-year survival. The gastrin receptor, CCK2R, has previously been implicated in pancreatic tumor growth. Additionally, a receptor splice variant, CCK2_{i4sv}R, results from the abnormal retention of the fourth intron and exhibits greater tumor growth. Two recent studies have associated a C>A single nucleotide polymorphism (SNP) in CCK2R with lower survival and expression of CCK2_{i4sv}R. Thus, we hypothesized that the A-allele favors intron retention and subsequent translation of CCK2_{i4sv}R. To test this, we developed novel mini-gene constructs to accurately model CCK2_{i4sv}R splicing. Human and murine pancreatic cancer cells, BxPC-3 and PANC02, respectively, were each transfected with the mini-gene constructs and total RNA was isolated from clonal lines. To accurately quantify the relative abundance of each splice variant, a novel SYBR Green-based Real-Time RT-PCR assay was developed that precludes amplification of unspliced RNA or gDNA while independently quantifying each splice variant. In BxPC-3 transfectants, CCK2_{i4sv}R was detected in 6 of 8 A-allele clones and 5 of 7 C-allele clones. Fully-spliced CCK2R was the predominant splice variant in both A-allele and C-allele clones, accounting for 99.3% of total receptor. CCK2_{i4sv}R represented only 0.51% of total receptor in A-allele clones compared to 0.78% in C-allele clones. Similarly, in PANC02 cells, fully-spliced CCK2R was predominant in both alleles and no correlation between the SNP and intron 4 retention was observed. Together, these data do not support a causative association between the C>A polymorphism alone and intron 4 retention in CCK2_{i4sv}R in pancreatic cancer.

47 Method Optimization for High-throughput Screening of FRET Biosensors

Danielle Weaver, Jesse Kleingardner[†]

Forster resonance energy transfer (FRET) is becoming an increasingly widespread technique used to measure metal ion concentrations. Previous research shows that calcium ion concentrations can be measured using protein probes that express FRET activity, also known as FRET biosensors. Following

the model established for calcium, the goal of this project is to generate iron and copper biosensors that can be used to measure these ion concentrations in cells. An essential step in producing functional biosensors and the focus of this experiment was to develop a method for high-throughput screening that could be used to screen a library of variants for their ability to detect specific metal ions. A plate reader and a fluorescence microscope were considered for the screening procedure. The effectiveness of each instrument in accurately detecting FRET induced by metal-binding is in the process of being evaluated. Along with instrumentation, cell culture conditions and fluorescence detection parameters were optimized for the FRET sensor and a control plasmid. Auto-inducing media ZYM-5052 (Studier 2005) was used to prepare cell cultures in 96-well plates. The auto-inducing media generated cell cultures with maximum cell densities between 4 and 5 after 14-18 hours of incubation at 37°C with shaking at 370 rpm. It was also determined that background noise in fluorometry results was greatly reduced when cells were resuspended in tris buffer pH 7. Additional experimentation is being considered to further develop this potential screening procedure.

48 Effect of Body Armor Application on Functional Movement Capability in Healthy Adults

Colin Tomes, Matthew Lewis[†]

Introduction: Do current body armor vests impart a functional movement deficit upon the wearer? Tactical athletes are more frequently utilizing ballistic protection. The Functional Movement Screen (FMS) was selected for its field expediency and ability to detect functional movement impairments. **Methods:** Subjects were randomized by coin flip. If selected for the loaded condition, the vest was fitted by the primary investigator. Subjects were provided instructions for each FMS component and indicated their perceived effort for each component on a Visual Analog Scale (VAS). A minimum of 24 hours was required prior to repeating test in the opposite load condition. **Data Analysis:** Sign Test was used for comparison of FMS score data. A Paired T-Test was used for the comparison of VAS data. **Results:** The level of significance was set at p=0.05. A Significant VAS score difference was identified between load conditions for the following movements: squat, dominant shoulder mobility and Non-dominant houlder mobility. A significant VAS score difference was identified between the dominant and non-

dominant sides for the following movements: loaded shoulder mobility and unloaded shoulder mobility. A significant FMS score difference was identified between load conditions in the following movements: dominant side in-line lunge, non-dominant side in-line lunge, dominant shoulder mobility, non-dominant shoulder mobility, and non-dominant rotary stability. **Discussion:** Functional movement deficits and increased perception of effort were present in the loaded condition. Based on these findings, there is a need for further research on vest ergonomics and tactical athlete mobility training.

49 *Elevated Pharmaceuticals in Golden Seal Using Aquaponics*

Van Nguyen, David Foster[†]

Hydrastis canadensis (goldenseal) is a herbaceous perennial plant that contains various medicinal properties. It has become rare due to over-harvesting and increased market demand. Due to the inadequacy of current cultivation methods, this study aimed to optimize the growth conditions of goldenseal by maximize the yield of bioactive alkaloids-berberine and hydrastine- in a recirculating aquaponics system versus a typical soil condition. Two lighting conditions were compared: 38 $\mu\text{mol/s}$ blue light versus 331 $\mu\text{mol/s}$ red supplemental lighting (for a 16-hour light interval. In addition, a light response curve was established for goldenseal samples, suggesting that the plant may thrive in either 50% or 100% sunlight. During the summer of 2016, three growth trials were conducted from May to September 2016 with 94 $\mu\text{mol/s}$ blue lighting supplement versus no supplemental lighting. Due to constant exposure to heat, plants (n=23) grown in aquaponics system under both lighting conditions suffered from 80-90% mortality rate. Plants (n=15) grown under natural shading in a typical soil condition exhibited a much lower mortality rate of 33%. In the Spring of 2017, two new trials were conducted using the modified aquaponics gravel beds (n=24 and n=18) with a much lower mortality rate (5-17%). The results highlight the importance of cool temperature in growing goldenseal. Levels of berberine and hydrastine cannot be assessed at the present phase of the project.

50 *Can Pancreatic Cancer be Controlled by Cellular Immunity?*

Kirby Robbins, John Harms[†], Lawrence Mylin[†]

Pancreatic cancer is aggressive and poorly understood with a five-year survival rate of only 5%

because most cases are diagnosed at a late stage. Currently, there are no effective treatments, so further research is required to develop methods to detect and combat this disease. An altered form of the gastrin/cholecystokinin receptor (CCK2R) may be associated with aggressive pancreatic cancers. Altered splicing of the CCK2R mRNA encodes a variant receptor, CCK2_{i45V}R, which contains a 69 amino acid insertion to the third intracellular loop. Because this variant has only been detected in cancer cells, our goal has been to target this domain with T cell immunity. Our group has shown that a synthetic peptide corresponding to twenty amino acids internal to the loop elicits a T cell response in mice. The goal of this research was to determine whether murine cells expressing the intron-containing CCK2_{i45V}R variant could elicit similar T cell responses. To achieve particularly high levels of receptor, CCK2_{i45V}R was transiently transfected into murine pancreatic cancer cells already expressing a basal amount of the human, variant receptor. To optimize transfection efficiency, preliminary experiments tested two commercial transfection reagents. Lipofectamine 2000 achieved transfection of more than 60% of cultured cells with a GFP-encoding plasmid. Using this optimized protocol, cells were transfected with the receptor and, 48 hours later, were irradiated and used to immunize C57Bl/6 mice. Intron-specific T cell responses were monitored by ELISPOT. Optimization of the transfection procedure and the results of the ELISPOT will be discussed.

51 *Engineering Metalloproteins for Fuel Catalysis Using SLICE and CHIP Template*

Emily Reale, Jesse Kleingardner[†]

To support the rapid expansion of global energy needs, new catalysts are required for more efficient conversion between electrical energy from renewable sources and chemical energy in the form of fuels. Structures incorporating cobalt porphyrins have shown promise in catalyzing O₂ reduction, an important fuel cell reaction. The goal of this study is to engineer a novel di-heme protein with a stacked heme arrangement and explore its catalytic potential for O₂ reduction upon substitution of the heme iron for cobalt. Carboxyl-terminus of Hsp70 interacting protein (CHIP) is a naturally occurring protein that has been chosen as a template by computer-based structural modeling. The structure of CHIP has recently been determined, revealing a pocket where two c-type hemes are predicted to stack upon protein dimerization. The CHIP template has been

modified by the introduction of a Cys-X-X-Cys-His motif for heme *c* binding and by the deletion of a steric clashing amino residue. An N-terminal histidine tag has been replaced by a PelB signal sequence for proper heme attachment. The modified CHIP gene was cloned into a pRSETB-based expression vector using a the SLiCE (seamless ligation cloning extract) method. SLiCE utilizes extract from a RecA– strain of *E. coli* to perform in vitro recombination, eliminating the need for restriction enzymes or ligases. Expression and purification protocols are currently being developed, and the resulting samples will be tested for dimerization and for the presence of stacked hemes within the modified CHIP protein.

52 Synthesis and Characterization of Transition Metal Hydroxyl Sulfate Mineral Phases

Travis Hoover, Richard Schaeffer[†]

Hydroxyl sulfate minerals of first-row transition metals are useful in electrochemistry, nanochemistry, and other areas, but these systems are not well-characterized. In the present study, crystalline mineral products of precipitation reactions were analyzed for phase composition and stoichiometry. The syntheses generally involved reacting a transition metal oxide with a sulfate of either the same or a different transition metal. Using this method, we were able to synthesize novel mixed salts of the form $A_aB_b(SO_4)_x(OH)_y \cdot zH_2O$, where A and B are transition metals. Our results suggest that the original oxide acts as an undissolved template for crystal formation. Furthermore, it was found that zinc provides the most reactive oxides in this setting, which is likely due to its relative basicity. This new data sheds light on the behavior of transition metals in an aqueous environment, which may be valuable in further studies involving mineral synthesis.

53 Resources for Continued Physical Activity Beyond the WELL Courses

Katelyn McKiernan, Melinda Smith[†]

Effective promotion and maintenance of physical activity behavior change occurs when there is an emphasis on a combination of education, behavior skills, and psychological variables (Lockwood & Wohl, 2012). These areas are addressed throughout the semester-long QuEST WELL courses at Messiah College, where students are engaged in physical activity three times during the week. To enhance

continued physical activity participation after the conclusion of the semester, we identified a need for available and relevant resources for students. The purpose of this project was to create simple physical activity programs for students who are interested in accessing these resources once their QuEST WELL courses conclude. The resources were designed after receiving student feedback, including desired modes and frequency for physical activity. In addition, wellness tips, relevant online physical activity and health sites, and off-campus fitness opportunities were included in the handout designs to emphasize a holistic approach to wellness and fitness.

54 Allometric Effects on Clutch Size and Quality in the Panamanian Golden Frog, *Atelopus zeteki*

Micah Christensen, Erik Lindquist[†]

Amphibians are important for ecosystem stability making their presence or absence useful for ecological health assessments, especially when considered in combination with other unrelated indicator species. In addition, many amphibians secrete chemicals through their skin with the potential to provide tangible products through the discovery and development of pharmaceutical drugs. Unfortunately, at least 32% of amphibian species are in danger of extinction due to multiple causes worldwide. The Panamanian Golden frog (*Atelopus zeteki*) is one such amphibian that was thrust into critical endangerment due to disease, habitat destruction, and over-collection. *A. zeteki* may now be extinct in the wild as none have been seen since 2009. Captive populations are currently kept in a number of zoos and aquariums, such as the Maryland Zoo in Baltimore (MZiB), in the hopes of eventually releasing individuals into the wild. Mathematical models are being refined to guide future reestablishment planning. Unfortunately, *A. zeteki* was not extensively studied in the wild leaving gaps in reestablishment models. Average egg clutch size was not studied until wild populations were already drastically declined and the clutches of the well-fed captive frogs were expected to be larger with a higher percentage of eggs fertilized. The effect of parental allometrics (lengths and weights) was studied in frogs at the Maryland Zoo in Baltimore with the hope of extrapolating to wild populations using field data collected by Erik Lindquist, Roberto Ibáñez, and Edgardo Griffith to potentially improve reestablishment models.

55 *Furthering the Progress of Synthesis of Aspernigrin A*

Ravenia Arnold, Anne Reeve[†]

Aspernigrin A is a natural product that is found in the fungus *Aspergillus niger* harbored in the Mediterranean sea sponge *Axinella damicornis*.³ It also occurs in an endophytic fungi found in crabgrass⁷. This natural product has shown evidence of cytotoxicity in multiple leukemia and carcinoma cell lines. Since the natural product can not be obtained from the fungus in the quantity necessary to further the work, synthesis of the compound is in progress in the lab. This semester's work was focused on reestablishing that the work done previously on a new pathway was successful. This pathway involved adding a benzyl protecting group as opposed to the original idea of using methyl group¹. This was seen to be successful and that success was reiterated when this semester the same product was obtained using benzyl bromide, triethylamine and dichloromethane. The following step in this research was also done by oxidizing of the carbonyl to the aldehyde. This step was successful in finding the product which is not found previously in literature. The pathway from the 4-hydroxy-6-methyl-2-pyrone to the benzyl pyrone has been successful and should continue to be pursued as a method of synthesizing aspernigrin A.

56 *The Effects of a 6-week Pilates Program on Postural Stability and Balance in College-aged Athletes*

Tyler Mitcheltree, Melinda Smith[†], H. Scott Kieffer[†], Doug Miller[†]

From college athletes to older adults, Pilates has become one of the most popular and beneficial exercise trends during the past decade. Pilates training uses various exercises to improve muscular strength and endurance, flexibility, balance, and posture, in addition to enhancing mental awareness. The present study looked at the effects of a short-term Pilates training program on postural stability, balance and core strength in off-season NCAA DIII and club sport athletes at Messiah College. The experimental group included seventeen off-season female athletes who participated in a supervised Pilates training program which took place two times a week for six weeks. [MS1] The Pilates program consisted of body weight training that progressed to the incorporation of four and five pound dumbbells. Pre and post-test measurements were taken in four functional tests (Force Plate Tandem Balance, Limits of Postural Stability, Biering-Sorensen Back Extension, and Biodex Isometric Trunk

Flexion/Extension). In addition, a control group that was not involved in Pilates training was used for pre-test and post-test comparison. We hypothesized that we would see an increase in postural stability, core and back muscle endurance, and tandem foot balance in our experimental group who participated in the six-week program.

57 *Non-Invasive Individual Identification of the Panamanian Golden Frog (*Atelopus zeteki*)*

Alyssa Sargent, Erik Lindquist[†]

The Panamanian golden frog (*Atelopus zeteki*), has been the focus of many conservative efforts for 20 years. As a way of monitoring captive and wild populations, this study assesses the potential for using dorsal and ventral photography, and subsequent computer-assisted identification, as a noninvasive means of identifying and re-identifying individuals. 50 individuals at the Maryland Zoo in Baltimore were tracked over a period of ten months, grouped into 10 subgroups, or tanks, of 5. It has been determined that manual identification based on variable dorsal patterning is an effective means of differentiation between individuals, despite ontogenetic pattern changes. Based on the photography, these changes do appear to slow Computer-assisted identification has been less reliable, though this may be due to a number of factors, particularly the broad patterning on individuals.

58 *Biocatalytic Reduction of Ketones and Imines Using *Daucus carota* Root*

Anthony Bogetti, Roseann Sachs[†]

Whole vegetables are currently sought as an alternative to traditional reducing reagents in organic, chemical reactions because of their effectiveness in aqueous solvents, very low environmental impact, worldwide availability and their impressive stereoselectivity. Furthermore, the reduction of imines, a nitrogen containing analog of ketones, while biologically important, are not well described in the literature. The present study uses the root of the carrot (*Daucus carota*) in water as a biocatalytic reducing agent for the transformation of ketones to alcohols and imines to amines. Method optimization showed that untreated, peeled carrots reduced ketones, particularly a benzofuran containing compound, many times more efficiently than grated or juiced carrots given reported reaction times and yields in the literature. The revised procedure was then applied to the reduction of 3,4-

dihydro- β -carbolines, structural analogues of the benzofuran functional group. However, the test compounds had to first be synthesized. The synthetic pathway to these compounds, adapted from literature precedents, incorporated green chemical methods by using the coupling reagents COMU and DCC instead of HOBt and EDC. 3,4-dihydro-1-methyl- β -carboline was synthesized in 31% yield from tryptamine and acetic acid and its structure was confirmed by proton NMR and GC-MS analysis.

59 *Microplastic Orevaleance in Corbicula fluminea Found in the Yellow Breeches Creek*

Madilyn Keaton

Microplastic (< 5 mm) is perhaps the world's most common pollutant that has the capability to bring down entire ecosystems. They have been found in even the most pristine corners of the earth and have been known to collect in the digestive tracts of many organisms. In this experiment, microplastic fiber pollution was measured in order to gauge the levels of its presence within the local environment. Thirty clams (*Corbicula fluminea*) were collected from the Yellow Breeches Creek in upstream and downstream sites near a sewage treatment plant. The bodies were dissolved in nitric acid and poured over glass filter paper. Presence of microplastic fibers was found in most clams, ranging from 1 fiber to 18 fibers in an individual clam.

60 *Characterization of Surface Oxidation on Zinc Selenide*

Megan Steves, Niklas Hellgren, Alison Noble[†]

The surface chemistry of polished zinc selenide and etched zinc selenide substrates was studied and compared towards supporting the formation of thiolate and carboxylate self-assembled monolayers (SAMs). Analysis of SAMs formed on the etched substrates shows that the etch promotes adsorption of the carboxylate SAMs, but inhibits the adsorption of thiolate SAMs. X-Ray photoelectron spectroscopy (XPS) demonstrated that the etch solution removed the native oxide layer from the ZnSe surface. The etched surface is also passivated, with the regeneration of the native oxide layer considerably slowed as compared to an unetched fracture surface. To study the rate of the reformation of the native oxide, XPS measurements were performed at time intervals after the substrate was etched and the eventual reformation of the native oxide layer was observed. Characterization of the surface using SIMS

is ongoing to further characterize the species present on the surface. Of particular interest is the O1s peak, which remains present in the XPS spectrum, despite the removal of the zinc and selenium oxides by the etch. Studies of carboxylate SAMs formed on etched ZnSe which was then aged showed that the reformation of the oxide layer upon exposure to air inhibits the formation of well-ordered monolayers.

61 *Stress Enhanced Fear Learning*

Kelly Striker, Jennifer Thomson[†]

Traumatic events or instances with potential harm may cause the development of a stress-response disorder known as post-traumatic stress disorder (PTSD). Notable symptoms of PTSD include intrusive thoughts, flashbacks, nightmares, negative changes in mood and cognition and hyperarousal. PTSD is commonly associated with military personnel and the traumatic events they experience during service, however PTSD can affect any survivors of trauma. This includes victims of sexual assault, natural disasters, illness, accidents and other crimes. In fact, 6.8% of adults and 4% of adolescents will experience PTSD in their lifetime. Because these symptoms are unhealthy coping mechanisms, research to treat or prevent PTSD symptoms would greatly advance mental healthcare. In this pilot experiment, twelve female rats underwent stress-enhanced fear learning. In the primary environment, six rats received 15 mild foot shocks, while the others did not. All rats were placed in the secondary environment, receiving one mild shock. Finally, all rats were placed in the secondary environment, without receiving shocks. Rats were given buprenorphine or saline injections immediately after, 24 and 48 hours after the initial shocks. Stress-enhanced fear learning in rats mimics traumas and triggers experienced by humans. The research group hypothesized immediate and prolonged use of buprenorphine would lessen or prevent freezing time, the fear responses of rats. Percent freezing time and other statistical models were used for data analysis. If treatment is effective, buprenorphine may potentially treat symptoms of PTSD in trauma survivors.

62 *Synthesis of Biofunctionalized Self-assembled Monolayers on Zinc Selenide*

Autumn Merrill, Anne Reeve[†], Alison Noble[†]

Thiolate self-assembled monolayers (SAMs) formed on zinc selenide (ZnSe) were functionalized with oligonucleotides using a method called click

chemistry. In order to form the compounds needed for the functionalization of the SAM, a multiple step synthesis was run to replace the carboxylic acid terminal group of 16-mercaptohexadecanoic acid (MHDA) with an azide group. The structure of the formed molecule was confirmed with infrared (IR) spectroscopy and carbon and proton NMR. An oligonucleotide modified with a 5' alkyne was used to react with the azide of the synthesized compound in the presence of copper to form a triazole group between the oligonucleotide and the synthesized compound. A fluorescently tagged complementary oligonucleotide was then hybridized with the bound oligonucleotide and the modified compound was used to form a SAM on ZnSe, which was visualized using fluorescence microscopy. Microcontact printing was also used to confirm the functionalization of the SAM, by differentiating the areas of clean/bare ZnSe from those coated with the functionalized SAM. These self-assembled monolayers functionalized with biologically active molecules can be used towards future work of creating a biosensor.

63 *Moving Towards a Modular Design for the Energy Monitoring and Management System*

Paul Tajiri, Greg Talamo, Michael Zigarelli, Austin Kratz, Thomas Martin, Karine Moussa, David Nicolais, Nathaniel Pardoe, Nathan Ressler, Thomas Austin^{††}, Randall Fish[†]

The Energy Monitoring and Management System facilitates access to electric power in regions with limited energy by increasing energy conservation and education. Our solution consists of a meter which allocates a configurable daily energy limit per facility, and a display that provides practical information to the user reporting how much energy they have used or have left before power is automatically cut off until the next day. The current version of our system has successfully been installed in multiple facilities in Burkina Faso and Zimbabwe. The current version of our meter fulfills the base requirements of allocating a configurable daily energy limit per facility but is not conducive to easy feature upgrades. This year we began the redesign of the system to move to a more modular design. Subdividing functionality into plug in modules makes it possible to add or upgrade features without replacing the entire meter. The first step towards modularity has been developing SPI communications between the circuit boards, and the creation of the meter's first 'module'. Now that the modular nature of the meter has been realized, we are in a position to add improvements such as a 'pay-

as-you-go' version of the meter as well as remote administration by a small business energy provider.

64 *Preparing for Future Expansion of the Energy Monitoring and Management System*

Thomas Martin, Karine Moussa, Nathaniel Pardoe, Austin Kratz, David Nicolais, Nathan Ressler, Paul Tajiri, Greg Talamo, Michael Zigarelli, Thomas Austin^{††}, Randall Fish[†]

The Energy Monitoring and Management System is an energy allocation device which is being used to conserve energy in regions with a limited amount of power. The meter allows an administrator to assign a daily power allotment to ensure that each individual user cannot expend the community's total shared supply of power. The system includes an interactive display which provides practical information to the user, reporting how much energy they have used or have left before they use their daily allotment. EMMS currently has 5 meters installed in Burkina Faso for a SIM mission organization, and 14 meters installed in The Theological College of Zimbabwe; these meters have been successful in conserving energy and reducing financial energy expenditure by 50%.

Our project is working toward long-term goals of achieving modularity - the ability to add more functions to the original product - and designing a robust testing procedure. Modularity is an important attribute for clients who would like to add certain features, such as a pay-as-you go feature or wifi. An official testing procedure is needed to ensure that meters are properly evaluated and modified before they are installed for long-term operation. This presentation will detail some of the changes made to the meter to accommodate expected future modules, as well as the development of test procedures used to evaluate the accuracy and operation of our meter.

65 *Woodcrest Bridge Project*

Dylan Clemente, Dexter Ehrenzeller, Bradley Sloop, Brenden Good, Kurtis Platteel, Mark Simpkins, J Scott Heisey[†], Tyler Miller^{††}

The purpose of this project is to design and build a bridge to connect a hiking trail at Woodcrest Retreat, a Christian camping facility in Ephrata, PA. We have designed a suspended bridge to cross over a drainage swale that currently separates the trail. The bridge is also located near the entrance road to the camp, and it is intended to provide a site landmark feature of the retreat. Our goal is to use our talents to design the bridge in such a way that honors God.

66 Pedestrian Bridge for Mexican Ministry Center

Zachary Engle, Benjamin Reinert, Nathaniel Yeoman, Brian Swartz[†], Russell Woleslagle^{††}, Tim Zimmerman^{††}

The Mexico Bridge Project is a continuation of a previous partnership between The Collaboratory, Forward Edge International, and a local community center Trigo y Miel. This partnership has empowered the community center with clean water to support their various tutoring, lunch, and ministry programs. The Mexico Bridge Project aims to continue to empower the center by addressing problems with pedestrian access to the facility. Currently, a seasonally flooding drainage ditch interrupts southern access to the community center, causing a half-mile detour across muddy roads. The Mexico Bridge Project aims to identify an appropriate structure type, and complete all design and construction work in order to prepare a group of students to partner with locals in building the selected structure.

67 Oakwood Hills Pedestrian Access

Kevin Breisch, Benjamin Holderman, Alex Issis, Caleb Stevens, L. Bryan Hoover^{††}, Brian Swartz[†]

The Oakwood Hills Pedestrian Access project seeks to provide an efficient and safe way to provide pedestrian access from Messiah College to future commercial development locations. This project serves the commercial developer, Rider Musser Development Corporation, and their land architect, H. Edward Black & Associates. This project allows students to design, develop, and construct solutions to this transportation problem that faces Messiah College students wishing to have pedestrian access to this new development area.

68 Cycle Advancements for Rugged Terrain (CART)

Jonathan Bright, Spencer Lowman, Adam Peris, Timothy Van Dyke[†]

The goal of the CART project is to create new uses for the small motorcycles that are used in developing countries. By adding a universal hitch and various vehicular attachments, these motorcycles will become a useful tool. After careful research, two different hitch designs were created. A prototype of one of these designs was fabricated and attached to the motorcycle. It was found that the prototype offered a large range of motion and had no adverse effects on the handling, even when the trailer was loaded to 350 lbs.

In order to look at durability of the hitch design, strain gages were attached to the hitch at three locations. Impact loading and field testing that simulated various real-world operating conditions were conducted using this strain-gaged hitch. The collected strain data was used in a SolidWorks finite element model to determine the point of maximum stress on the hitch. This maximum stress was used to calculate how long the hitch could be expected to last before failure. This was found to be more than sufficient, indicating that the hitch design will hold up to repeated real-world use.

Looking forward, the CART team is looking to distribute drawings of the hitch to developing countries so more hitches can be built and feedback can be received and used for improvement. The team is also looking to design a trailer that is optimized for the hitch and offers greater safety and usability than the homemade trailers that are often used in developing countries.

69 Block Press: Providing Access to Sustainable Housing Solutions

Samuel Hsu, Adam Janney, Addison Morrone, Brandon Shirk, Kerry Goforth^{††}, Thomas Soerens[†]

The Block Press project develops and tests mechanical presses to produce structural building blocks used for residential housing. Currently the project is serving a community off the east coast of Nicaragua. The indigenous people known as the Rama are migrating from the island Rama Cay to the mainland. The Rama are making this transition through the help of Friends In Action International. The press that the Rama had been using is too heavy to move in small boats and takes 3-4 people to operate. The project is designing a simple manual press that will only require 1-2 people to operate. The presentation will focus on the prototype developed for the site team trip in early June 2017.

70 Combined Cooling, Heating and Power Demonstration Model

Ethan Jacoby, Mitchell Kauffman, Timothy Mast, Nathan Musser, Brian Seip^{††}, David Vader[†]

Messiah College recently partnered with UGI Performance Solutions to build a 1 MW electric power plant on our campus with Combined Cooling, Heating and Power (CCHP) capability. Half or more of the thermal energy driving most electric power plants is lost to the environment. CCHP locates electric power generation near thermal loads where the waste thermal energy stream may be captured

and put to work. Messiah College requested that the Collaboratory develop a micro-scale demonstration model to highlight the College's commitment to sustainability and to educate visitors and the public about CCHP technology. We approached UGI performance solutions to ask them for sponsorship and mentorship on the project. To demonstrate CCHP technology, we designed a system that captures energy from the exhaust stream of a 1000-Watt generator. The system heats water and air while also refrigerating an enclosure. Hot exhaust gasses run through three heat exchangers in series to perform the heating and cooling functions. Users may interact with heated water, heated air, and the refrigerated enclosure to experience first-hand the benefits of CCHP technology.

71 *Pico Hydro: Powering Developing Communities with Run-of-Stream Hydroelectricity*

Tyler Criddle, Daniel Loefstedt, Joshua Pardoe, Shane Braunworth, Andrew Reedy, Jonathan Rogers, Casey Bechard^{††}, Andrew Breighner^{††}, Dan Elliot^{††}, Dereck Plante[†]

Many rural communities in the developing world lack access to basic utilities, such as electric power generation. The Pico Hydro project team has partnered with Engineering Ministries International (EMI) to develop a run-of-stream hydroelectric generator capable of generating 300 to 800 Watts of electrical power in communities that have access to a stream. The project team has tested three generator prototypes provided by EMI. With the results of those tests, along with research and outside sources, the team is formulating, constructing, and testing their own design for a hydroelectric generator with improved cost and reliability performance.

72 *Design of Instructional Kits for STEAM Education*

Timothy Mast, Mayim Moore, Michael Pasti, Nathen Feldgus, Michael Gray, Jeremy Wakeley, Michael Robinson[†]

The STEAM (Science, Technology, Engineering, Art, Mathematics) Education project aims to develop a kit that, in the spirit of the LEGO EV3 Robotics kit, is reconfigurable and designed with the intent to engage and educate middle-high school students. Unlike the EV3 kit, however, this kit will cost less than \$100 and have individual "modules" that will communicate a specific STEAM concept (i.e. provide a visualization of how the Pythagorean theorem works, facilitate an interactive game that teaches the user to recognize particular musical tones,

demonstrate how changing the variables in the circle equation affects the shape a circle, etc.).

73 *Sexual Dimorphism of the Panamanian Golden Frog (Atelopus zeteki)*

Katelyn Wieder, Erik Lindquist[†]

With the world's amphibians rapidly declining, it is important to understand as much as possible about them in order to conserve their populations. The Panamanian Golden frog was chosen to study because its populations have declined so much that they are considered to be extinct in the wild. These frogs are the national symbol of Panama and it is important that they can one day be reintroduced to their natural habitat. This study focuses on sexual dimorphism in the Panamanian Golden Frog. Skin patterning and coloration were analyzed thoroughly using photographs and collecting data from specific areas of each individual. The proposed hypothesis is that the Panamanian Golden Frog exhibits sexual dimorphism. The data collected shows statistical indications that there are some areas of the body that exhibit sexual dimorphism.

74 *Determination of Water Soluble Arsenic Species with a Quartz Crystal Microbalance Functionalized with Iron(III) Oxide*

Jordan Frank, Richard Schaeffer[†]

Arsenic contamination of freshwater is a crucial issue in some parts of the world. This work investigates developing a chemical sensor for water-soluble arsenic species based on functionalizing a quartz crystal microbalance (QCM). The QCM is an analytical instrument that enables accurate measurement of extremely small masses with detection limits to the sub-nanogram level. QCMs utilize the piezoelectric properties of quartz crystals such that applying an electric potential induces mechanical stress as a relatively constant resonance frequency. The resonance frequency changes as a linear function of the mass of material deposited on the surface of the quartz crystal. However, this response, while sensitive, is not selective to a particular chemical species. To produce a sensor selective for arsenic species, the QCM was functionalized with a coating of hydrated iron(III) oxides via electrochemical deposition. This system was then characterized for its suitability as a sensor to determine the concentration of aqueous arsenic species.

75 Electrooptical Dynamics of 4-cyano-4'-pentylbiphenyl Supported on ZnSe Functionalized with Alkanethiolate Self-assembled Monolayers
Elliot Rossomme, Alison Noble[†]

The electrooptical properties of zinc selenide (ZnSe), a semiconductor transparent in the infrared region of the electromagnetic spectrum, have been exploited in the development of a variety of scientific technologies. Additional studies have demonstrated the facility of this substrate for the adsorption of alkanethiol self-assembled monolayers (SAMs) and the supporting of nematic liquid crystals (LCs), such as 4-cyano-4'-pentylbiphenyl (5CB). We have investigated the influence of the ZnSe morphology on the electrooptical dynamics of ultra-thin 5CB liquid crystalline films supported on both the bare substrate and a surface functionalized with hexadecanethiol (HDT) SAMs. Infrared spectra indicate that the introduction of an HDT monolayer between the ZnSe surface and the liquid crystalline film reorients the bulk director of the liquid crystalline film with respect to a film supported on bare ZnSe. Furthermore, the attenuation of the electronic effects of the ZnSe surface by the SAM led to a notable decrease in the threshold voltage required to induce the Fréedericksz transition in the 5CB film. This feature of SAM functionalized ZnSe suggests the possibility of fine-tuning the dynamics of 5CB, allowing for additional applications of the substrate. In conjunction with this study, we also report a new bi-layer positive resist methodology for the fabrication of a gold interdigitated electrode microarray on ZnSe—a methodology that can be readily generalized for the fabrication of other microscale structures.

76 Designed Heme c Binding Proteins
Trevor Shenk, Jesse Kleingardner[†]

Metalloprotein design seeks to combine the specificity of protein structures and the functionality of metal cofactors to produce novel reaction catalysts. The functional roles of the heme cofactor such as oxygen transport, redox catalysis, and gas sensing demonstrate a remarkable functional diversity which can be harnessed in engineered heme proteins. Heme c is a post-translational modification that is directed towards a CXXCH backbone amino acid sequence. Nuclear lamin structural proteins were chosen as small and simple protein scaffolds for developing a model for how the incorporation of heme influences the backbone structure and dynamics. The Polymerase Chain

Reaction (PCR) was used to amplify the Twitch2B expression vector as well as the wild-type lamin gene. PCR with mutagenic primers was also used to amplify a heme-binding mutant gene (MutLam379). These gene products were separately combined using the Seamless Ligation Cloning Extract (SLICE) reaction for creation of wild-type and mutant protein expression vectors. Transformation into 5 α *E. coli* allowed for cloning of the plasmids for sequence analysis and protein expression. The wild-type Lamin gene has also been transformed into BL21 *E. coli* for expression of the protein. Further characterization of the wild-type and mutant proteins will provide insight into successful strategies for future heme c metalloprotein design.

77 The Irrelevance of K-ras: Elucidating the Role of Gastrin as a Driver of Pancreatic Adenocarcinoma
Andrew Nevin, John Harms[†]

Gastrin is a peptide hormone with important functions in regulating digestion, however, it has also been implicated in pancreatic tumorigenesis. Elimination of gastrin from pancreatic adenocarcinoma (PDAC) has been shown to greatly decrease tumor growth. Kirsten rat sarcoma viral oncogene homolog (K-ras) is an oncogene of singular importance in genetic analyses of human cancer. Mutant or activated K-ras has been associated with multiple cancerous phenotypes, including lung and colon cancer. However, K-ras is most strongly associated with pancreatic adenocarcinoma – a 90% correlation. Previous studies have demonstrated that when a mutant, oncogenic K-ras allele (G12V) was introduced into near-normal, non-tumorigenic, human pancreatic ductal epithelial (HPDE) cells, the cells exhibited 50% tumorigenicity and showed altered expression of 43 different genes – not including gastrin. It has long been hypothesized that K-ras mediates its tumorigenic effects through gastrin, among other effectors. We sought to determine the role of gastrin in initiating PDAC caused by these HPDE cells. Gastrin mRNA was present at very high levels in the HPDE cells irrespective of their K-ras status. The gastrin levels observed in the HPDE cells, regardless of K-ras genotype, indicates there are pathways that can lead to gastrin upregulation outside of the Ras/Raf/MEK/MAPK cascade. This potentially modifies both a current working model of pancreatic tumorigenesis and the role of gastrin in the normal pancreas. Continuing studies will observe the effects of gastrin through artificial (RNAi) manipulation and

further elucidating the role of K-ras signaling in PDAC phenotypes, especially through the gastrin pathway.

78 *Fluorescent Tagging and Aggregation of HIV-1 Using a Novel Recombinant Protein*

Daniel Haas, Brianne Roper, Matthew Farrar[†], Jesse Kleingardner[†]

The HIV virus is endemic to sub-Saharan Africa with recent WHO reports estimating that more than 88% of the world's HIV-positive children reside in the area. For a child diagnosed at the age of 2 and prescribed antiretroviral therapy, effective monitoring of their condition will require upwards of 120 viral load tests over an average life span. At an average of \$30 per test, this comes to a final cost of \$3,600 for viral load tests alone over a lifetime which comprises ~22% of average household expenditures in the developing world compared to the usual 2% spent on health. Because of this, it is necessary to develop a cost-effective technique for measuring HIV load in resource-restricted regions. Therefore, it is the goal of this project to create a recombinant detection protein consisting of an HIV binding domain (mD1.22) dimer that could be used in conjunction with dynamic light scattering to measure viral load. Currently, the mD1.22 protein has been synthesized and its binding affinity for the HIV envelope protein, gp120, is being analyzed using DSS cross-linking and protein gel electrophoresis. A Monte Carlo simulation has also been created to explore particle interaction *in silico* to answer critical questions to inform the diagnostic design, such as what viral load and probe concentrations are required to form aggregates. To date, this "hard spheres model" code has shown that binding occurs only at extremely high virus titers, indicating that HIV concentration will be necessary in our diagnostic design.

79 *A Low-Cost Dynamic Light Scattering System for Detection of Viral Aggregates*

Lindsey Barner, Alexander Roth, Matthew Farrar[†]

Access to HIV diagnostics and viral load monitoring in developing nations with endemic HIV-1 infections, such as many sub-Saharan African countries is limited. Current methods are either high-cost diagnostics that quantify viral load, typically in central facilities, after weeks of processing, or else fast but non-quantitative methods unable to measure viral load. Because treatment must be adjusted depending on viral load, a low-cost diagnostic that can quantitatively identify how many

viral copies a patient carries would improve treatment outcome. Partnered with the Macha Research Center in Zambia, Diagnostics for Viral Diseases aims to design such a diagnostic device by combining recombinant protein engineering with an optics-based particle-sizing technique, dynamic light scattering (DLS). We have explored designing a low-cost DLS apparatus and have assessed its capabilities and limitations. Among our innovations is the use of silicon photomultiplier detectors with custom signal processing circuitry and field-programmable gate array (FPGA) technology. This system could potentially serve as DVD's capability to size and thus diagnose viral aggregates.

80 *Breath of Life: Pressure Swing Adsorption Oxygen Concentration for Hospitals in the Developing World*

Kristen Frawley, Caleb Sisson, Jordan Sponsler, Devin Esch, Katie Heindel, Spencer Petersheim, Michael Smith, Robert Reed^{††}, David Vader[†]

The Breath of Life project team has partnered with Macha Mission Hospital in Zambia to meet the need for medical oxygen at developing world hospitals situated in tropical climates. High humidity levels damage the zeolite particle beds in pressure swing adsorption oxygen concentrators, which in turn causes premature failure of the devices. This drives up the cost of healthcare in these areas. In a developing world context, the lack of ready access to parts and maintenance means that the failure of oxygen concentrators can leave patients in respiratory distress without the oxygen they need to survive. Our team is designing a dehumidifier using electrostatic precipitation that is attachable to the air intake of oxygen concentrators to remove moisture from the ambient air before it enters the machine. Our current prototype uses a high voltage potential to charge and collect water particles out of the air. A long-term solution that is currently being developed is a hospital-wide oxygen system that is primarily driven by compressed air to create concentrated oxygen when the power is out. The system will use compression and rapid expansion to dry the ambient air before it enters modular oxygen concentrators and travels throughout the hospital.

81 *Cunningham Clubfoot*

Rebekah Forshey, Vy Ho, Paul Stoltzfus, Noah Charleston, Micah Curtis, Luke Redcay, Emily Farrar[†], Tim Howell[†]

The Cunningham Clubfoot project is focused on aiding children in Kijabe, Kenya that are born with

clubfoot. If clubfoot is left uncorrected it can affect one's ability to walk on their own which can inhibit one's ability to be independent and provide for themselves and/or their family later in life. Our goal is to provide a more comfortable, convenient, and effective clubfoot brace than what is currently utilized. One of our partners, Mr. Jerald Cunningham, a board-certified prosthetist and orthotist, invented and developed the Cunningham Clubfoot Brace and currently manufactures them at Cunningham Prosthetic Care. Our Collaboratory team is in the process of replicating Cunningham's design so that it may be 3D printed and used in Kijabe, Kenya with the assistance of our other partner, CURE International. Our poster will focus on defining clubfoot, force and finite element analysis of the Cunningham Clubfoot Maintenance Brace, 3D printing results to date, cost analysis of alternative production options, and initial investigation into hygiene concerns with 3D printed products.

82 Design of a Muscle-Activated Prosthetic Hand

Alaric Kobzowicz, Keith Wei Luen Lim, Erin Cressman, Jonathan Lord, Jason Yoder, Michael Robinson[†]

Due to the financial burden in purchasing a myoelectric prosthesis, which can cost upwards of \$75,000, this project aims to design a low-cost alternative. Such devices are sought after because of their ability to closely mimic the anatomy and motion of the human hand through a combination of functionality, versatility, and natural appearance. This prosthesis is controlled via electrical signals generated by muscle contractions in the residual limb, which are read by a Myoware muscle sensor and accompanying electrodes. An A/D converter, Arduino, and motor driver then work in conjunction to interpret the intensity and pattern of the signal in order to output a certain set of commands to 3 motors, which accordingly move the prosthetic fingers to fixed grip patterns. Worm and spur gear couplings and pinned mechanical linkages achieve the latter. The current design designates one motor to the movement of the thumb, one to control both the first and second digits, and one to control both the third and fourth digits. To further alleviate costs, the structure of the prosthesis is to primarily be 3-D printed using available resources at Messiah College. This device is planned for a patient with a transradial (below the elbow) amputation and will be custom fitted and sized on a client-to-client basis. As a

standard of measure, the overall cost is intended to remain below \$1,000.

83 Viral Load Determination for HIV-1 for the Macha Research Hospital Using a Novel Recombinant Protein and Heparin-Affinity Protocol

Lily Gaudreau, Daniel Haas, Danielle Reimer, Brianne Roper, Matthew Farrar[†], Jesse Kleingardner[†]

The HIV virus is endemic in sub-Saharan Africa with recent WHO reports estimating that over 88% of the world's HIV-positive children reside in the area. While viral load monitoring is essential for successful treatment, industry-standard nucleic acid assays are often costly or inaccessible to many regions. Consequently it is necessary to develop a cost-effective technique for measuring viral load. Our approach is to use a recombinant protein consisting of a fluorophore (GFP) and a HIV-binding domain (mD1.22) dimer that could be used to cause viral aggregation. The presence of aggregates can be detected using photon correlation spectroscopy, allowing for the direct quantification of HIV load. To explore aggregation dynamics, we have custom-written a Monte-Carlo simulation, allowing for the exploration in silico of the effects of virus and probe concentrations. To date, our results suggest that concentration of native virus concentrations will play a key role. As a result, we have opted to explore a method using immobilized heparin-agarose microspheres to capture the virus and remove it from the blood sample. We are currently exploring the possibility of detecting viral proteins directly on the agarose microspheres instead of in solution, obviating the need for ultracentrifugation.

84 Facilitating Organizational Networking (Henosis): Mobile & Web App Development

Joshua Conrady, Mark Musselman, Harold Underwood[†]

Through online tools, Henosis seeks to facilitate collaboration, foster community outreach and enhance member participation among charitable organizations and churches. Current developments will result in a release of our website for the second round of alpha testing in May 2017 and our mobile platform for alpha testing in May 2018. Mobile and web teams are currently working on API connections which map user functions to database values. In other words, we are working on connecting our mobile application to the web platform so that all of the functions of the website are available to a mobile user. Our main goal is to make the communication

between churches and charitable organizations more efficient and transparent, to encourage new participation and outreach in target communities throughout the United States. We plan to have at least twelve churches in three states using our platform on release. Targeted marketing and client interfacing underway has produced interest in our product including churches actively testing it. Two key clients include Eastside Church of Christ in Colorado Springs, CO and Ashburn Presbyterian Church in Ashburn, VA.

85 WERCware: Stress Detection Via EEG

Derrick Peterson, Josh Thomas, Matthew Bohn, Joseph Coshun, Ryan Hahn, Harold Underwood[†]

The WERCware project team has been designing a system to provide wireless remote job coach services to people with developmental and cognitive disabilities. For that purpose, we have investigated electroencephalography (EEG) as a way to monitor human stress. Published studies have shown that by sensing electrical activity in various parts of the brain, EEG can monitor measurable changes in emotional state. For further experimentation, WERCware has acquired an Emotiv Insight (EI) wireless EEG headset. From the EI headset, we have collected and examined data in search of evidence for the human stress pattern. To facilitate this process, we have modified an existing artificial neural network (ANN) to classify EEG data as stressed or not stressed. The modified ANN is based on one previously built by WERCware for audio data, shown to detect human stress with a high rate of accuracy. Currently the EEG ANN code compiles; it creates a neural network, trains the network based on sample data, and processes data from the headset in real time. The EEG ANN has been trained on simulated data; training it on real EEG data remains for future work.

86 Prosthetic Knee for Burkina Faso

Kaleb Burch, Vaughn Chambers, Ashley Hah Chien Vern, Marissa Kuhns, Jamie Williams[†]

In Mahadaga, Burkina Faso, the Centre for the Advancement of the Handicapped was once able to create full prosthetic legs. The Centre accepted prosthetic knees from a donor and made the rest of the leg with their own resources. However, they have exhausted the supply of donated knees and are no longer able to assist leg amputees. Our group aims to design a simpler prosthetic knee that can be manufactured in Mahadaga, and is compatible with

the rest of the leg that the Centre has been using. Through this work, we hope to be better able to serve our client in the future and to share with them the Christian faith.

87 Sustainable Mobility: Taking an Assistive Mobility Technology from Prototype to Production

Jakob Davenport, Joshua Kunkle, Morris Taylor, Daniel Barrett, Cordell King, Anders Laub, Matthew Tomasetti, Daniel Vivolo, John Meyer[†], David Vader[†]

The mission of the Sustainable Mobility Project is to equip our partner, the Centers for the Advancement of the Handicapped in Burkina Faso, West Africa, with an appropriate and sustainable method for locally building and distributing our mobility tricycle design to those in need. In rural West Africa, this personal mobility technology brings freedom and empowerment to some of the most marginalized persons in the world. Within the past year, we have shifted our focus to the development of tools and processes to facilitate scaling the manufacture of Collaboratory electric tricycles from single to multiple units. Ultimately, we aim to provide our partner with the ability to effectively meet the mobility needs in their community. Specifically, this year the Sustainable Mobility Project has focused on the manufacturing development of the structural frame, the drive train assembly, the motor cast housing, and the electrical control system. In each of these areas, we evaluated former manufacturing techniques and improved these techniques to be more successful in future production of mobility tricycles in multiple international locations. In January 2017, for the first time ever, the team built five electric tricycles with our Burkinabé partners in Fada, Burkina Faso. Moving forward, the team will further develop and test tricycle manufacturing to generate a complete design and manufacturing handbook for our current and future partners.

88 Wheels for the World

Daniel Gallagher, Ryan Moyer, Joseph O'Connell, Antonio Ortiz, Wesley Ramirez, Timothy Van Dyke[†]

The Wheels for the World Team strives to create a practical mobility option for individuals unable to move on their own in developing nations. 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 in the United States, shipped anywhere in the world in a box, and then

assembled in the country of use. A design has been completed which is similar to a tricycle with the third wheel in the back. This design uses bolts and plates to hold together telescoping square tubing as the frame of the design. A shock absorber system has been included to reduce the impacts from road variations. The design was developed to be fully adjustable to fit the user and be fully collapsible for easy storage and transportation. A prototype is being constructed. Design refinements will be made based on that prototype and an assembly manual to be distributed with the design will also be drafted and completed. It is hoped that Wheels for the World will then begin distributing the design for field testing and then distributing it to developing nations throughout the world.

89 *Design of Instructional Kits for STEAM Education*

Michael Gray, Nathen Feldgus, Timothy Mast, Mayim Moore, Michael Pasti, Jeremy Wakeley, Michael Robinson⁺

The STEAM (Science, Technology, Engineering, Art, Mathematics) Education project aims to develop a kit that, in the spirit of the LEGO EV3 Robotics kit, is reconfigurable and designed with the intent to engage and educate middle-high school students. Unlike the EV3 kit, however, this kit will cost less than \$100 and have individual "modules" that will communicate a specific STEAM concept (i.e. provide a visualization of how the Pythagorean theorem works, facilitate an interactive game that teaches the user to recognize particular musical tones, demonstrate how changing the variables in the circle equation affects the shape a circle, etc.).

90 *Design of a Solar Power System for Ekuphileni Bible Institute*

Caleb Bornman, Steven Carpenter, Jessica Kline, David Moretz, Joshua Patterson, Scott Kerstetter, Josiah Peck, Mark Brill⁺⁺, Nathan Charles⁺⁺, Michael Robinson⁺

The Solar PV team works in developing countries to design and install solar arrays where the lack of reliable electric power hinders the missions of their clients. For their current client, the Ekuphileni Bible Institute (EBI) located in Mtshabezi, Zimbabwe, the local power grid fails often, preventing the school from providing optimal education to future church leaders. Frequent unexpected shut offs can last anywhere from a few hours to a few days at a time. This inconsistency means that EBI students are not able to use the computer lab, connect to the

internet, use lighting for studying, or store food for fear of spoiling. To provide a sustainable and long lasting solution to EBI's current power issues, the Solar PV team will send five students along with Dr. Randall Fish and Engineering Projects Manager Derek Plante to install a five kilowatt system on the campus to provide power to their library, fridges, and classroom. The team leaves May 19th, 2017.

91 *Energy Monitoring and Management*

Austin Kratz, David Nicolais, Nathan Ressler, Thomas Martin, Karine Moussa, Nathaniel Pardoe, Paul Tajiri, Greg Talamo, Michael Zigarelli, Thomas Austin⁺⁺, Randall Fish⁺

The Energy Monitoring and Management System facilitates access to electric power in regions with limited energy by increasing energy conservation and education. Our solution consists of a meter which allocates a configurable daily energy limit per facility, and a display that provides practical information to the user reporting how much energy they have used or have left before power is automatically cut off until the next day. The current version of our system has successfully been installed in multiple facilities in Burkina Faso and Zimbabwe. We are currently working on troubleshooting and fixing problems that were discovered in the field. We are also working on a complete redesign of the user interface box, which was 3D printed in the past, but is now being adapted to allow use of a manufactured box. This new user interface design and updated software will be installed in Burkina Faso during the summer of 2017.

92 *Pico Hydro: Powering Developing Communities with Run-of-Stream Hydroelectricity*

Shane Braunworth, Andrew Reedy, Jonathan Rogers, Tyler Criddle, Daniel Loefstedt, Joshua Pardoe, Casey Bechard⁺⁺, Andrew Breighner⁺⁺, Dan Elliot⁺⁺, Dereck Plante⁺

Many rural communities in the developing world lack access to basic utilities, such as electric power generation. The Pico Hydro project team has partnered with Engineering Ministries International (EMI) to develop a run-of-stream hydroelectric generator capable of generating 300 to 800 Watts of electrical power in communities that have access to a stream. The project team has tested three generator prototypes provided by EMI. With the results of those tests, along with research and outside sources, the team is formulating, constructing, and testing their own design for a hydroelectric generator with improved cost and reliability performance.

93 *Aeroponics*

Matthew Brenneman, Erin Kelley, Georgia Ernst, Erin Sharkey, Michelle Lockwood[†]

The Aeroponics Project aims to turn the western concept of aeroponics into something that can be made and used in developing contexts, such as those of our client, Open Door Development (ODD) in Mahadaga, Burkina Faso. While soil and available space are not the limiting factors, reducing the amount of water needed for agriculture leaves more available for the community to drink and use. ODD is not the only possible client, either; communities experience drought and limited water supplies all over the world, all the time. Our hope is that aeroponics systems can improve access to fresh food via a sustainable approach to agriculture.

94 *Block Press: Providing Access to Sustainable Housing Solutions*

Adam Janney, Addison Morrone, Brandon Shirk, Samuel Hsu, Kerry Goforth^{††}, Thomas Soerens[†]

The Block Press project develops and tests mechanical presses to produce structural building blocks used for residential housing. Currently the project is serving a community off the east coast of Nicaragua. The indigenous people known as the Rama are migrating from the island Rama Cay to the mainland. The Rama are making this transition through the help of Friends In Action International. The press that the Rama had been using is too heavy to move in small boats and takes 3-4 people to operate. The project is designing a simple manual press that will only require 1-2 people to operate. The presentation will focus on the prototype developed for the site team trip in early June 2017.

95 *Cumberland Pointe Futsal (Soccer) Project*

Sean McCormick, Jacob Artuso, Peter Burt, Troy Harris, Jr., Emily Quatrala, J Scott Heisey[†], Joshua Weidler^{††}

CP Futsal is a project working with AROMA Missions to connect with a local community through sports at the Cumberland Pointe Apartment Complex in Mechanicsburg, Pennsylvania. The goal of this project is to build a facility that will also build relationships with the kids in the community. The CP Futsal team has developed conceptual plans, initiated a permit application, and prepared construction drawings to build a futsal playing area that resembles a sport-court soccer field.

96 *Woodcrest Bridge Project*

Mark Simpkins, Dylan Clemente, Dexter Ehrenzeller, Brenden Good, Kurtis Platteel, Bradley Sloop, J Scott Heisey[†], Tyler Miller^{††}

The Woodcrest Bridge Project team is designing a cable-suspended bridge for Woodcrest Retreat, a Christian campground located in Ephrata, Pennsylvania. The bridge will span approximately 80 feet and will connect two hiking paths at the campground. Beyond its functionality, the bridge will be visible at the entrance to the campground, allowing it to be a site landmark feature of the retreat. Larson Design Group is partnering with the Woodcrest Bridge Team in the design and planning stages to provide professional review of our work. Additionally, Horst Construction is planning to assist with construction management to help build the bridge. The team is now finalizing the design and drawings to submit for building permits to allow for the start of construction later this year.

97 *Straight Vegetable Oil Research*

Kyle Doll, Ryan Kuhn, Aaron Ladeau, Andy Erikson[†]

The BioFuels: Straight Vegetable Oil Research Team was created to provide our client with the research and information necessary to run agricultural equipment off of locally sourced Vegetable Oil or a Vegetable Oil-Diesel Mix to alleviate their dependence on imported Diesel fuel and help to support and empower the local economy. The creation of this project came from a request from our client Matt Walsh and his organization SIM that the Collaboratory continue its research into Bio-diesel fuel sources. The goal of this project is to be able to supply Matt with the information needed to run his diesel engines off a proven blend of vegetable oil and diesel fuel, and later to supply him with a standalone heating system that will heat the oil and allow him to further increase the percentage of vegetable oil that he is mixing into his diesel fuel. Although right now the goal is to supply this system to Matt and serve him as best as possible, in the long term there is potential to produce a modular fuel system that can be used across the world in order to ease the dependence on imported diesel fuel in the third world, and thus make energy more accessible to people everywhere.

98 Oakwood Hills Pedestrian Access

Alex Issis, Caleb Stevens, Kevin Breisch, Benjamin Holderman, L. Bryan Hoover^{††}, Brian Swartz[†]

The Oakwood Hills Pedestrian Access project seeks to provide an efficient and safe way to provide pedestrian access from Messiah College to future commercial development locations. This project serves the commercial developer, Rider Musser Development Corporation, and their land architect, H. Edward Black & Associates. This project allows students to design, develop, and construct solutions to this transportation problem that faces Messiah College students wishing to have pedestrian access to this new development area.

99 Affordable Solutions to Pit Latrine Collapse

Rachel Aukamp, Adam Barley, Kenton Grossnickle, Connor McGovern, Lorena Reinert, Sydney Schandel, Cheylee Smith, Duane Troyer, Isaac Underhill, Tesfayohanes Yacob[†]

The objective of the Affordable Sanitation Team is to address the issue of pit latrine collapse in Northern Ghana. Pit latrines, holes dug into the ground which are used as restrooms, prevent open defecation and the spread of disease when implemented and utilized. Pit latrines should ideally provide a safe means for people to relieve themselves; however, most latrines are not lined and have a tendency to collapse due to soil pressures. Particularly during the rainy season, sandy soil becomes saturated, decreasing the stability of the latrine walls. Due to this issue of collapse, many people have fears of using the latrines that have been constructed in their towns and often revert to open defecation, which poses a significant problem. To prevent this reversion, World Vision has tasked the team with designing a latrine liner that will stabilize the hole while remaining affordable to communities in Northern Ghana. Over the past summer, the team visited the affected areas in Ghana and gained new direction for their work. Since this trip, four possible solutions have been considered: a plastic tub liner, a sand bag liner, a ferro-cement liner, and a rebar-reinforced fabric liner. Through testing and research over the course of the year, the plastic tub liner was rejected as a solution whereas the sand bag, ferro-cement, and rebar-reinforced liners were retained and developed. The team is now focused on optimizing the design of these three possible solutions with the hope of implementing these liners in Ghana next year.

100 Gravity Fed Water System

Shung Yen Tan, Nolan Goss, Frederic Warden, Thomas Soerens[†]

The Gravity Fed Water Systems project aims to build a sustainable clean water filtration system with zero energy footprint for a village in rural Lombok Island, Indonesia in cooperation with Access Life International. ALI Lombok serves the poor in hilly rural areas by building clean water systems and has been doing so since 2013. The students on this project performed hydraulic design and analysis of the system, design of biosand filtration, and made suggestions on system layout, pipe sizes, and other technical design to connect the spring capture to the ferrocement tank in the village allowing for clean, drinkable water on demand.

101 Intelligent Water Project: Remote Sensing of Pump Health for Promotion of Clean Water Access in Developing Countries

Owen McCullum, Kelsey Nichols, Sandra Snozzi Solther, Lydia Goodwin, John Harro, Randall Fish[†]

Millions of communities in developing countries rely on hand pumps installed by various non-governmental organizations (NGOs). Studies have shown that these pumps are often broken with significant delays before maintenance people arrive. The Intelligent Water Project (IWP) has developed an automated sensor to report failure of one of these hand pumps and provide data necessary for implementation of a proactive maintenance policy. Currently, there are 12 IWP systems installed in Ghana, Africa. This past year, the IWP team analyzed data gathered from these field units and implemented design changes to ensure functionality, increase serviceability, and prepare for mass production of the IWP unit.

102 Mechanized Percussion Well Drilling

Andrew Dunmire, John Hannon, Nathan Henry, Cole Hiduk, Althea Mavros, Aaron Mishler, Greg Shirk, Joseph Longenecker^{††}, Andrew Parkhurst^{††}, Thomas Soerens[†]

The goal of this project is to develop and refine an efficient well-drilling system for a well drilling team in Burkina Faso, a small country in Western Africa. Our client is Matt Walsh, an SIM missionary and the founder of Open Door Development in Burkina Faso. With our total of 10 members on the team, we were able to work on a variety of components in the drilling process. This year, we were able to finish the design and manufacture our new superstructure and

casing-pulling system, research new drill bit designs, and test our drilling equipment for a total of 60 hours. This summer, part of our team will travel to Burkina Faso to document conditions that will help perfect the components of our project.

103 *Million Gallon Challenge*

Perri Katcher, David Patawaran, Andrew Nevin, Thomas Soerens[†]

This project is assessing the long term performance of Sawyer PointOne hollow fiber membrane filters for point of use water treatment. The filters are fist-sized units that are used for camping and also as household filters. In the laboratory test, water is run continuously through twenty-four filters with hourly backflushing. The filters are periodically tested for bacteria removal.

104 *Village Water Ozonation Systems*

Daniel Ma, Ted Sindabizera Ntwari, Elisabeth Chang, Ray Knepper^{††}, Michelle Lockwood[†]

According to the World Health Organization, over 600 million people do not have access to clean water. Without clean water, people can contract waterborne illnesses, which can decrease the quality of life in the community. The Village Water Ozonation team pursues the ideal of providing communities with access to the cleanest water they can sustainably afford. Our work this year has focused on the development of two cost effective options for water sanitation: Biosand filtration and ultraviolet (UV) purification. The UV system passes water through a pump, two filters, and a UV lamp that operates in the UV-C spectrum. The filters remove particles as small as 5 microns that can diminish the ability of UV light to contact pathogens. The light deactivates the DNA of pathogens, making them incapable of reproduction. The focus of working with this system has been to optimize the system for developing communities and to develop reliable ways to test for the system's efficacy. The biosand filtration system is being designed to serve a school of 120 children in Honduras. The system will treat 60 gallons on a day. It is composed of fine sand, separating gravel, and drainage gravel layers. The sand media size plays a key role in the removal of pathogens. The focus of the work on this system has been sizing the layers to optimize flow rate and efficacy. The system's performance in terms of water treatment will be a subject of experiment in the Fall of 2017.

105 *Test-retest Reliability and Learning Effect of the Modified CTSIB Balance Protocol*

Ashley Carroll, Emily Walter, Emily Brocht, Paula Johnson[†], H. Scott Kieffer[†]

Purpose: The purpose of this study was to determine the test-retest reliability of the Clinical Test of Sensory Integration and Balance (CTSIB) protocol in healthy college-aged adults. In addition, the study examined the effects of short term balance training on sway and postural control under different sensory conditions. **Methods:** For the test-retest reliability, twenty participants were tested using the modified CTSIB on the Biodex Balance System SD. The test included four 30 second static balance conditions, standing on a firm and foam surface with eyes open and eyes closed. The following day the subjects returned to the lab and completed the CTSIB protocol. In order to assess learning, ten participants were randomly selected to participate in two, 10 minute, training sessions using both firm and unstable (foam) conditions. All participants were reassessed on the CTSIB protocol after six days. Correlational analysis and paired t-tests were used to assess the test-retest reliability and paired t-tests were used to assess the learning effect from training. **Results and Conclusion:** The results and the conclusion will be discussed at the symposium.

106 *Pre-Participation Jump-landing Assessment in a Population of Female Collegiate Volleyball Athletes*

Erika Wandel, Matthew Lewis[†]

Objective: The objective of this study was to evaluate jump-landing mechanics of the women's volleyball team – specifically dynamic stability and neuromuscular control. A secondary objective was to attempt to identify athletes at high risk of suffering lower extremity injury. **Design and Settings:** Height was recorded and each subject completed a five-minute stationary bike warm-up. The Landing Error Scoring System (LESS) Test was conducted first. Each subject completed three trials (one practice and two recorded). Equipment needed for test included a slow-motion video recorder, 30cm step, tape measure and scoring sheet. Next, subjects completed the (Single-Leg Triple Hop Test) SLTHT bilaterally. This included one practice and two test trials. Objects required for test included athletic tape and a tape measure. **Subjects:** Subject population included 17 healthy, female collegiate volleyball players between the ages of 18 and 22 with a mean height of 170.48cm (\pm 8.2cm). Any subjects with current musculoskeletal injury to the lower extremity

required physician clearance prior to participation. **Measurements:** LESS and SLTHT. **Results:** For the LESS test only one subject was above the threshold (5) and categorized as high risk. While for the SLTHT two subjects fell below the risk threshold (<90% limb-symmetry index). **Conclusion:** Three athletes were classified as high risk for lower extremity injury. None of the athletes scored perfectly on both tests. Considering these results, a team-wide jump-training program would be beneficial in order to target unilateral and functional strength as well as neuromuscular control.

107 *Electrophilic Additions to Alkenes in Ionic Liquids*

Micah Ohlhausen, Roseann Sachs[†]

Ionic liquids are increasingly popular green solvents for organic synthesis and are ideal in many ways as they are non-toxic, non-flammable, non-volatile, and recyclable. These compounds have properties whereby they can act both as an organic solvent and an aqueous solvent, which adds diversity to the ability of the compound. Ionic liquids are made entirely out of ions, and the different combinations of cations and anions have different properties. Their unique properties make them useful for stabilizing charged intermediates in reactions, and enable them to act additionally as a catalyst or reagent. This project explores the properties of ionic liquids as both a solvent and a reagent in electrophilic additions to alkenes. A series of reactions will be analyzed to evaluate the impact of the ionic liquid on these reactions.

108 *The Effects of Virtual Reality Training on Static and Dynamic Balance in Female Athletes*

Kristin Donohue, Karalyn Schmidt, Alyssa Sadorf, Wendy Cheesman[†], H. Scott Kieffer[†]

Balance in athletes is an important aspect of performance, requiring an individual to maintain their center of gravity in response to changes in body position. Virtual reality is a new technology that can be used to test and train balance in individuals as they are exposed to an interactive environment. **Purpose:** The purpose of this study is to examine the effects of short-term virtual reality training, using a headset, on the static and dynamic balance in female collegiate athletes. **Methods:** Ten female athletes were recruited for this study who had no history of concussions or lower leg injuries. Prior to the training sessions, subjects completed baseline testing for dynamic and static balance on the AMTI forceplate (static) and the Biodex Balance System (dynamic).

Balance testing on the forceplate consisted of a 30-second static single leg stance with both the eyes open and eyes closed condition. Dynamic balance was assessed using the Limitations of Stability program on the Biodex Balance System SD. For the short-term training, the subjects participated in three 7 minute sessions of virtual reality training that simulated walking and maintaining balance on a tightrope. Post-testing followed the same procedures used in the baseline testing. The data were analyzed by using paired t-test. **Results/Conclusions:** Results and conclusions will be discussed at the Symposium as research is currently in progress.

109 *Implicit Anti-fat Bias Differences Between First-year and Senior Applied Health Science Majors*

Rebekah Linde, Karalyn Schmidt, Doug Miller[†], H. Scott Kieffer[†]

Obesity has often been popularly portrayed in society with a negative connotation, leading to the presence of anti-fat bias. This bias has previously been reported in health care and fitness professionals as well as undergraduate students majoring in those disciplines. Throughout Messiah College's Applied Health Science (APHS) curriculum, students are exposed to a multifaceted approach to obesity in courses such as Chronic Disease and Exercise, Concepts of Conditioning and Senior Seminar. The purpose of this study was to determine if anti-fat bias differs between first-year Applied Health Science majors and senior Applied Health Science majors. The Implicit Association Test (IAT) uses word groupings such as good vs bad, motivated vs lazy, and smart vs stupid to assess attitudes toward obese individuals. This instrument was administered during a classroom activity to 33 APHS first-year students and 39 APHS seniors three years later. Anti-fat bias was present among both groups of students. However, seniors demonstrated significantly less anti-fat bias than first-year students in all categories (good vs bad, $p < 0.05$, motivated vs lazy, $p < 0.01$, smart vs stupid, $p < 0.01$). These outcomes suggest that the Messiah College experience moves Applied Health Science majors in a positive direction regarding implicit attitudes toward obesity. Required departmental curricula which exposes students to the pathophysiology and genetic influences related to obesity, as well as providing students with practical experiences working with obese individuals may contribute to the decreased anti-fat bias among seniors.

110 *Buprenorphine's Impact on Stress-Enhanced Fear Learning*

Elias Harkins, Nicholas Balten, Jacinta Davis, Hannah Roland, Kelly Striker, Jennifer Thomson[†]

Stress-Enhanced Fear Learning (SEFL) is an inducible process analogous to Post-Traumatic Stress Disorder. Opiates such as morphine have been shown to be effective at preventing development of SEFL (Szczytkowski-Thomson, Lebonville, & Lysle, 2013). The purpose of this experiment was to investigate buprenorphine, an opiate receptor agonist that acts similar to morphine, and its effect on the SEFL process. The hypothesis was that buprenorphine would prevent SEFL development as measured by decreased freezing rates. 12 female Sprague-Dawley rats were organized into three groups of four, with one group receiving SEFL treatment and buprenorphine, one group receiving SEFL treatment and a saline injection, and one control group receiving no SEFL treatment and a saline injection.. The SEFL protocol used included severe and mild stressors. The rat fear response was quantified by recording the animal and noting its time spent frozen. Rats were recorded in a unique sensory environment over the course of approximately two weeks to observe behavior trends over time. The collated results showed the rats that experienced the severe stressor also were more likely to engage in freezing behavior. This is evidence that the SEFL procedure was effective at inducing the fear learning process in the rat population. Results also showed that buprenorphine administration did not decrease time spent freezing. Therefore, the results indicate the hypothesis was not supported.

111 *The Effects of Static and Dynamic Stretching on Muscular Strength and Power*

Hunter Bellows, Kyle Bjorkman, Dani Kreiger, Meghan Williams, H. Scott Kieffer[†]

Purpose: The purpose of this study was to compare the effects of dynamic stretching (DS) and static stretching (SS) on muscular power using a counter-movement jump (CMJ), vertical jump (VJ), and knee flexion/extension on trained male and female college students. **Methods:** Ten trained college-aged students (2 males and 8 females) between the ages of 20 and 21 participated in this study. Following a familiarization session, the subjects underwent three randomized sessions in which a 5-minute warm-up was followed by either a control (no stretch), DS, or SS protocol. The control protocol consisted of subjects sitting for a period of time following the

warm-up, to match their stretching time, prior to performing the power tests. The DS protocol included dynamic range of motion stretches, russian kicks, butt kicks, and tip-toe walking. Each stretch was performed in a controlled manner for 30 seconds for two sets. The SS protocol included unilateral sit and reach, unilateral quad hold, and a standing calf stretch with wall assistance. The stretches were performed at maximum intensity (maximum stretch without discomfort). Following each stretching protocol, three power tests, a VJ, CMJ, and an isokinetic knee extension/flexion protocol at 60° and 180° per/sec on a Biodex isokinetic dynamometer were completed to measure absolute (Watts) and relative (Watts/kg) power. **Results:** The results and discussion will be presented during the Symposium.

112 *Differential Plant Nutrient Uptake in Dry vs. Saturated Wetland Soils*

Devyn McPheeters

In an effort to understand ideal conditions for created wetlands, this study examined the nutrient uptake of two facultative wetland plant species in saturated versus unsaturated wetland soil. Soil samples taken from a wetland on Messiah College property were used to determine nutrient levels for potassium, nitrogen, and phosphorus, as well as pH. Two species of facultative wetland plants were grown, *Monarda didyma* and *Mertensia virginica*, each in both dried out soil and water saturated soil. The four groups were measured for total biomass and nutrient uptake to determine which environment was most favorable for plant growth.

113 *The Influence of Green Tea on Fat Oxidation at Rest and During Exercise*

Sarah Zigarelli, Zach Bair, Jeremiah Brown-Suarez, Glenn Petraitis, Kendra Herbenar, H. Scott Kieffer[†]

Green tea's anti-obesity effects have been marketed as a natural pharmacokinetic agent to help individuals lose weight; however the efficacy of the potential benefits remain elusive. The purpose of this study was to investigate the acute metabolic effects of both caffeinated (CGT) and decaffeinated (DGT) green tea at rest and during exercise. In a double-blind and randomized study, twelve healthy college-aged men and women consumed 8 ounces of freshly brewed CGT or DGT, steeped according to the package directions. Twenty minutes post-consumption, resting VO₂, RER, and HR were recorded with the subjects in the supine, seated, and

standing positions. Subjects then performed a graded treadmill test, increasing intensity in 1 minute intervals. VO₂, RER, and HR were all recorded continuously until the subject reached 85% of their predicted HR_{max}. The results and discussion will be presented at the Symposium.

114 Study Update: The Effect of Caffeine Ingestion and the CYP1A2 Polymorphism on Long Anaerobic Exercise Performance

Kristen Hasse, Laura Sollenberger, Julia Rodgers, Rachel Steckbeck, Brian Shenk, Michael Shin[†], Eric Rawson[†], H. Scott Kieffer[†]

This study recently received IRB approval and is in the initial stages of testing. The authors of this study will be present during the Poster Session to discuss the various protocols implemented in this study. First, the authors will address the installation and implementation of the new Wingate cycle ergometry software for the Velotron to measure anaerobic power. The authors will present examples of data obtained to measure peak power, average power and power decline. Secondly, the authors will describe the procedure for extraction and analysis of the polymorphisms associated with the CYP450 (CYP1A2) enzyme polymorphism associated with variation in drug response among individuals. In conclusion, the authors will discuss future directions and timelines for data collection and presentation at various external venues.

115 Searching for *Cryptotis parva*: A Small Mammal Survey of South-Central Pennsylvania with a Special Focus on the Least Shrew

Summer Gotwals, Randy Cassell[†]

Shrews are small insectivorous mammals that are largely nocturnal and have an extremely elevated metabolic rate. In Pennsylvania, there are seven species of shrews. One species of particular interest is *Cryptotis parva*, or the least shrew, which is locally endangered within the Commonwealth. The least shrew was widespread and common in Pennsylvania prior to the 1960s because of land clearing and deforestation that occurred in the early 1900s. However, because of the regeneration of forests, loss of pastureland and fencerows, and the advent of monocropping these meadows have disappeared along with *Cryptotis parva*. Since 1960 only three specimens of *Cryptotis parva* have been recovered within Pennsylvania; at two locations in York county and one in Adams county. For this study three trapping methods were used concurrently to conduct

a small mammal survey of edge habitat in rural south-central Pennsylvania. The three methods: Victor snap-traps, Sherman live traps, and pitfall arrays were then compared based on the number of species caught and the frequency at which they were caught.

116 Aroma Therapy for Agitation in Adults with Dementia

Joanna Benner, Allison Burton, Shannon Leary, Megan Sullivan

Background and Significance: The number of patients with dementia is rapidly rising. Agitation is one of the most commonly observed symptoms in dementia patients, with nearly half of all dementia patients having symptoms of agitation every month. Many psychotropic medications have been effective for the treatment of agitation in dementia patients. However, there are multiple adverse effects and side effects of these medications. Therefore, it is important to identify and explore alternatives, such as essential oils, to decrease the adverse effects from these medications and increase the quality of life of dementia patients. **PICO Question:** In adult patients with dementia, does the use of essential oils/aromatherapy compared to conventional medicine decrease agitation? **Methods of Literature Search:** A review of literature was conducted utilizing PubMed, CINAHL, the Cochrane Database, and MedLine from 2013-2016. However, one article from 2002 was included due to being a Level I, quality A study. A total of 200 articles were found and, of those, 8 were used to focus our review. The majority were Level I, quality A. **Summary of Findings:** Five randomized controlled trials show statistically significant findings for improvement of agitation in the use of essential oils.^{1, 2, 4, 7} Four randomized controlled trials showed no difference.^{1, 2, 4, 7} There were a variety of oils (lemon balm or lavender) as well as methods of application used in these studies (massage/lotion application, aroma diffuser, acupuncture etc). Aromatherapy significantly decreased agitation (p=.006) and significantly alleviated depressed mood (p<.001) when applying a thirty-minute aroma-massage to the neck, shoulders, and arms. These study results demonstrated that aromatherapy reduces agitation in dementia patients. The most commonly studied products have been lemon balm and lavender oils. Evidence showed that lavender had an overall positive effect on the patients as evidenced by a reduction of agitated behavior and a noticeable decrease in disturbed

sleep patterns. Methods of application included spraying oils into the air, spraying oils onto the body, massaging oils onto palms and arms, and using fan diffusers. Studies reflected that stimulation of the olfactory system in the method of administration reflects positive responses in decreasing agitation in these patients. **Recommendations:** Further research is needed address the gaps in evidence related to essential oils/aromatherapy: compare the effect of different aromatherapy techniques on agitation level; compare the effect of different scents on agitation level; compare the need for psychotropic medications before and after implementation of essential oils/aromatherapy. The recommendation when using essential oils is to combine methods of application of the oils (massage and aromatherapy).

117 *Patient Outcomes of Nurse-Led Central Venous Catheter Insertions*

Melissa Biener, Marisa Weaver, Amy Walker

Background and Significance: Many patients in hospital settings are in need of central venous access for multiple reasons. Central venous catheters (CVCs) are associated with an increase in morbidity, mortality, and health care utilization. Patients receiving central venous catheters often must wait a long time for insertion. These wait times, coupled with patient outcomes of infection, pneumothorax, and other complications are a problem in the healthcare field. The current practice is physicians and physician assistants are allowed to insert central venous catheters. This project compares nurse insertion of central venous catheters to physician and physician assistant insertion and the effect each has on patient outcomes and satisfactions. **PICO Question:** Among patients who need central venous access, what are the effects of nurse insertion compared to physician, physician assistant, or anesthesia staff insertion on patient outcomes? **Methods of Literature Search:** A review of the literature was conducted using PubMed and CINAHL databases from 2009-2014. A total of 14 articles were identified; 4 sufficiently addressed the problem and were chosen for review. All of the articles are Level III with the majority an A quality; one article is a systematic review. **Findings:** Evidence supports nurse-led CVC insertion. With specialized training and experience, nurse-led CVC insertion had lower or similar procedural complication rates compared to physicians, physician assistants, and anesthesiology staff. Nurse-led insertion had lower CLABSIs rates (1.3:1000 catheters; Alexandrou, 2011 and 0.3:1000

catheters; Yacopetti, 2010), suggesting full compliance to aseptic technique. Additionally, nurse-led insertion reduced patient wait times (from 2-5 days to 48 days) and increased the percentage of patients (from 80% to 97%) receiving a CVC the same day as the physician order. **Recommendations:** Based on the literature review, a change in practice is supported. A protocol-based training program can be safely implemented to prepare a vascular access nursing team for central venous catheter insertion. Nurse insertion is a viable option to improve hospital efficiency and patient outcomes. Further research is recommended as the current literature is completed by two specific authors and is limited to the United Kingdom and Australia.

118 *The Impact of Postpartum Maternal Fatigue on Infant Falls*

Darby Catalano, Victoria Lenox, Olga Mozol, Julia Simpson

Background and Significance: After labor and childbirth, postpartum mothers are naturally fatigued. With many hospitals implementing rooming in, a component of the Baby Friendly initiative, maternal fatigue is becoming a bigger concern as it affects infant safety during routine care activities such as breast feeding. Instances of mothers dropping newborns after falling asleep have resulted in various injuries to the newborn. It is important to identify the risks that lead to newborn falls as well as interventions that decrease this risk of impaired safety. **PICO Question:** Among postpartum mothers what is the effect of fatigue on infant safety in the hospital setting? **Methods of Literature Search:** A literature search was conducted using CINAHL, PubMed, MedLine, and Cochrane database from 2010-2016. A total of 13 articles were initially pulled from the databases; 6 addressed the problem and were the focus of review. Most articles were Level V with a B Quality. **Findings: Routine Assessment of Mothers:** Hourly rounds that integrated maternal fatigue assessment resulted in zero infant falls in 11 months, following a 12-month span that yielded 5 newborn falls prior to this implementation (Matteson, 2013) Falls education and safety assessment done by staff on admission, at every shift, and any time the staff enters the mother's room significantly decreased infant falls (Ainsworth, 2016). Newborn falls assessment scale assigned a risk level to the newborn based on the nurse's assessment of the mother's ability to stay awake while feeding the baby. Based on the risk level the

nurse took suggested actions (Ainsworth, 2016). Postpartum fatigue positively correlated with difficulty in baby care activities for Cesarean ($r=0.30$, $p=0.02$) and vaginal births ($r=0.31$, $p=0.018$) (Lai et al., 2015) **Risk Factors Related to Falls:** Sloger (2015) suggests the following as high risk situations: high level of fatigue in the new mother, recent pain medication, night shift hours, prior near miss with the patient, woman >2 days post-partum, and woman with history of narcotic substance use and/or in methadone treatment protocol. Helsley (2010) found that more than 50% of falls occur in the early morning hours

119 *Intra-Hospital Nursing Handoff in the Emergency Department*

Christina Albrecht, Victoria Bee, Hannah Eldridge, Courtney Slinkerd, Nicole Wagner

Background and Significance: There is currently no standardized method of nursing handoff from the Emergency Department (ED) to intra-hospital units. Current practice ranges greatly from verbal to electronic to no handoff. This creates a vast variability in the information nurses share, leading to a possibility of missed information. This missed information could ultimately create a potential danger for patients and can result in decreased satisfaction among the nursing staff. **PICO question:** Among nurses receiving patients from the ED, does using a report-off method of electronic & verbal report result in increased nurse satisfaction? **Methods of Literature Search:** A review of the literature was conducted using Cochrane, CINAHL, and PubMed. Three hundred sixty-four articles published from 2011-2016 were retrieved. Five were reviewed. Three expert opinions were obtained. Most of the evidence was Level III, Quality B. **Findings:** Johnson & Nichols (2011) found that handoff report differs from unit-to-unit and the ED is a high intensity unit that necessitates concise reporting. There is often missed information due to lack of time, multiple handoffs, distractions, and lack of standardization (Ong & Coiera, 2011; Smith et al., 2015; Kowitlawakul et al., 2015). Hilligross & Cohen, (2013) noted that electronic reporting promotes patient safety. Nurses have a consistent desire to have an opportunity to ask questions, advocating for verbal reports (Betrossi, 2016; Stroup, 2016; Thuma-McDermond, 2016). **Recommendations:** Evidence suggests that the use of both electronic and verbal

handoff in the ED may result in better patient outcomes and increased nurse satisfaction. More research must be completed to develop a standardized handoff tool. The implementation of the tool must be evaluated before introduction in the hospital setting.

120 *The Use of Pivot Nursing and Immediate Bedding in the Emergency Department*

Eileen Barker, Kristen Douglas, Brielle Frye, Jonathan Kroon

Background and Significance: Historically, triage in the Emergency Department (ED) has been a standard practice of care to determine the most acute patients in need of treatment, but it can also increase wait times. This wait time along with time-consuming assessments leads to longer length of stay (LOS) and decreased patient satisfaction. It is crucial to address the barriers causing increased LOS in the ED and to identify measures to improve patient satisfaction and decreased door-to-provider time. **PICO question:** In patients presenting to the emergency department, does PIVOT nursing using immediate bedding contribute to decreased door-to-provider time and increased patient satisfaction when compared with the routine triage pathway? **Methods of literature review:** A review of literature was conducted utilizing PubMed, CINAHL, MedLine, and Cochrane Database from 2011 – 2016. Six articles addressed the problem and were used for review. Many articles were Level V and B quality. Two articles were C quality and were not applied to the findings and recommendations. **Findings:** Evidence supports a change in the ED triage process. Implementing a Pivot nurse triage process using immediate bedding allows the nurse to focus on the patient's appearance, vital signs and chief complaints. Christensen (2016), Flood (2015), and Marino (2016) all found a significant decrease in door-to-provider times ($p<0.001$) by modifying the triage process. Using the Press Ganey scale, patient satisfaction scores decreased by 0.61-points for each additional hour waited in the emergency department (Handel, 2014). The Pivot triage process limits over-triaging, which is the leading source of unnecessary time expenditure in the ED (Christensen, 2016). **Recommendations:** Based on the literature review, implementing a Pivot nursing triage process decreases door-to-provider time. Findings were current and relevant, but larger scale studies and implementation need completed to confirm findings.

121 Effectiveness of Managing a Multi-Modal Approach to Workplace Violence

Rebecca Kriner, KatLynne Pappas, Michaela Miller, Rebecca Nichols

Purpose/Objectives: The purpose of this EBP project was to explore the different approaches to preventing workplace violence in emergency departments. **Background/Rationale (Quality or EBP project) or Design (Research):** Workplace violence (WPV) is an escalating problem within U.S. emergency departments (ED). Due to its high prevalence, employees have grown to accept this violence as the environmental norm or part of the job. This is a dangerous problem for ED employees, especially nurses, who are exposed and vulnerable to this violence as the frontline caregivers. WPV has negative outcomes on the overall health of ED employees including physical injuries, acute stress reactions, and even post-traumatic stress symptoms. Additionally, the impact of WPV on ED employees can compromise the ability to provide quality patient care. **Description (Quality or EBP project) or Methods (Research):** Literature was collected through PubMed, CINAHL, and MEDLINE databases. The key search terms used included: workplace violence; violence prevention and control; violence prevention program; emergency department; assaults. Four studies were selected out of nine after critically appraising the evidence. The studies chosen included one systematic review, one literature review, and two quasi-experimental studies. **Findings or Outcomes:** Evidence reveals that workplace violence in emergency departments can be reduced through multi-modal interventions. The studies chosen for the evidence-based practice project revealed that WPV can be best prevented through a combination of strategies such as structural changes, procedural changes, and education and training for staff. Educational and training methods found to be effective in terms of knowledge retention and learning outcomes included the use of both online and classroom settings. However, even though the literature revealed many current strategies to approach WPV, the evidence was very weak in terms of the actual effectiveness of the identified strategies. **Conclusions/Implications for Practice:** Further research is needed in regards to the actual effects of implementing both single and multi-modal interventions in effectively reducing workplace violence in the ED.

122 The Effect of TENS and Accupuncture on Postoperative Opioid Use

Elizabeth Beam, Ellen Bechard, Sarah Dolan, Stephen Outland

Background: Post-operative and post-surgical pain are an issue in acute care settings. Opioid analgesics are commonly used to decrease pain level, but put the patient at risk for drug dependence and other side effects. Alternative methods of analgesia could decrease the need for opioid analgesic use. **Aim:** To determine if the use of transcutaneous electrical nerve stimulation (TENS) or acupuncture therapies decreases opioid usage in postoperative and post-surgical pain control. **Method:** A review of current literature was completed using both Pubmed and CINAHL databases. Three randomized control trials and one systematic review with meta-analysis were selected for appraisal. Key words included TENS, acupuncture, adult, inpatient, opioid, postoperative pain. **Results:** TENS and acupuncture therapies were found to effectively reduce postoperative pain and opioid usage for patients in the acute care setting. These results are significant, but practice change is not recommended at this point. The studies in the reviewed literature, there is a lack of generalizability to acute care settings in the United States. **Conclusion/Recommendations:** The limitations present in the articles as well as the lack of research done in the U.S. warrant further research. Some studies did not use adequate sample sizes, and some lacked a power analysis. Future studies should test the effectiveness of TENS and acupuncture usage to decrease postoperative opioid use in U.S. acute care facilities. These steps would increase generalizability and increase the potential for practice change.

123 Lost in Translation

Lauren Orehowsky, Mackenzie Belyea, Olivia Kimmel, Darby Gallo

Purpose: With a rising population of Low English Proficiency (LEP) individuals, translation devices have rapidly advanced in their use in the health care setting. This Evidence Based Practice project looks at the usage of translation devices in healthcare, specifically the barriers to and satisfaction of using such devices from the perspective of the healthcare team and the patients. **Methods:** Four articles were selected for critical appraisal. Databases used include: CINAHL, PubMed, and Cochrane Database. Key words used included: barriers, translation, low English proficiency, and interpreters. **Findings:** Patients vocalized satisfaction with care with

effective translation device usage. Barriers to usage included time restraints, technical support, and professionalism of the interpreters. **Summary of Findings:** There is an indication for continued education regarding the importance of using translation devices and the LEP patient's perspective of their care. Practice change is recommended to help eliminate current barriers, allowing for frequent and standard use.

124 *Brassiere Use to Reduce Post-Sternotomy Pain*

Rachel Bennicoff, Samantha Dench, Melissa Percherke

Before implementing an evidence based practice project, it was found that the Society for Thoracic Surgery recommends women wear a brassiere after open heart surgery. Although some pre-operative surgery classes recommend women wear a brassiere, there is mixed practice among staff members. Currently, there is no standardized procedure for patients to wear a brassiere following surgery; however, after surveying patients, it is beneficial to most women to wear a brassiere. The purpose of our literature review is to determine if women who undergo sternotomy surgical procedures benefit from the use of a brassiere post-operatively. The aim

is to evaluate pain and comfort levels when patients used a brassiere when compared to patients who do not wear one. The brassiere was evaluated to other interventional methods including sports tape, braces, supportive undergarments, and usual care. One literature review article, one quasi-experimental article, and two randomized controlled trial articles were found from CINAHL and PubMed. After analyzing these four articles relevant to the formulated PICO question, methods, results, strengths, and weaknesses were reviewed. Analyzing research articles led to the determination that fewer women reported pain with a brassiere compared to women experiencing usual care. Review of research articles did not give enough evidence to conclude a complete and statistically significant result. However, female participants consistently expressed a preference to a brassiere compared with any other device to increase comfort levels in the recovery period. This literature review suggests that the use of a brassiere is beneficial to post-sternotomy female patients when decreasing pain and increasing comfort levels. It is evident that further research needs to be conducted for future protocol change.

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