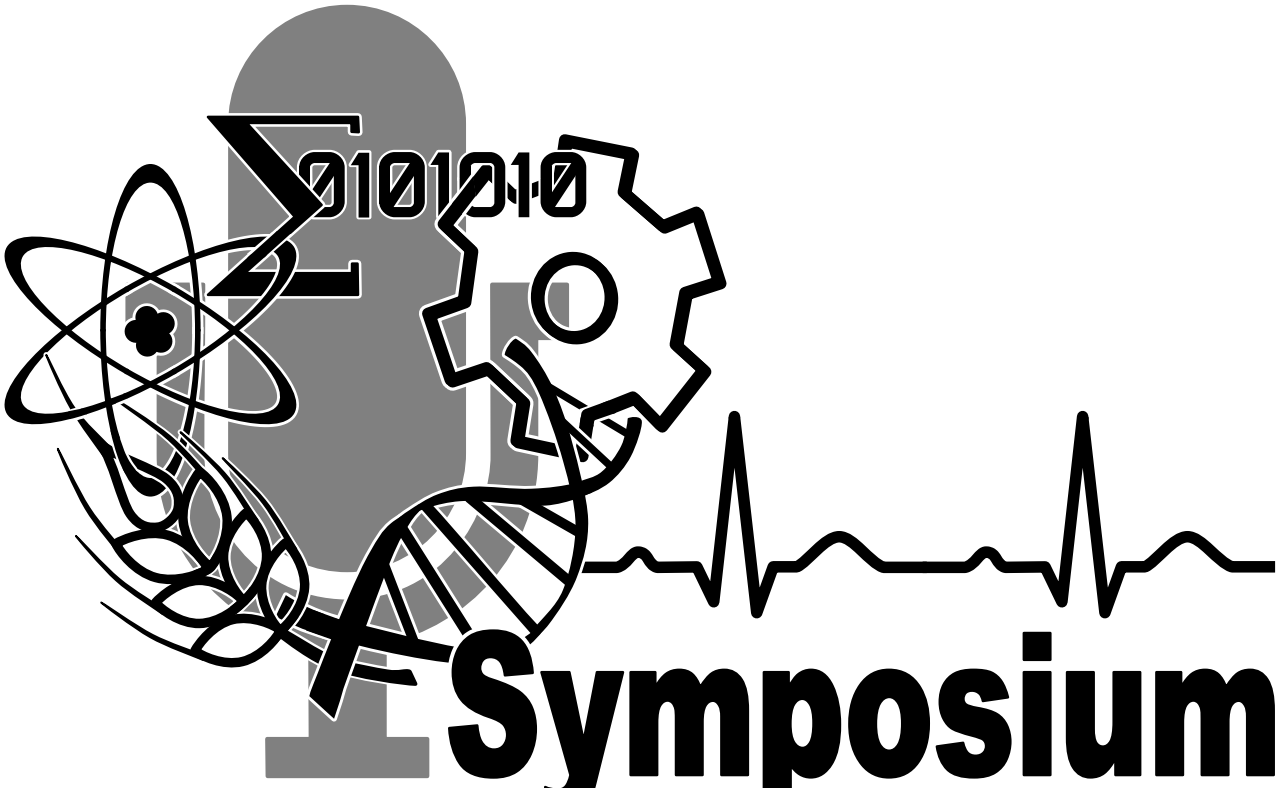
Spring 5-1-2015

12th Annual Symposium of the School of Science, Engineering and Health

Messiah College

SCHOOL OF SCIENCE, ENGINEERING AND HEALTH



twelfth annual

PROGRAM & ABSTRACTS

Frey Hall - Jordan Science Center - Kline Hall of Science
Friday, May 1, 2015

MESSIAH COLLEGE™

the Collaboratory for strategic partnerships and applied research

Special thanks to D. Scott Weaver (Department of Computer and Information Science) for his continued maintenance and development of the online 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 mailings, room reservations, catering and setup of the Symposium venues.

– John Harms & Tim Van Dyke, Symposium Coordinators

Welcome to the **12th 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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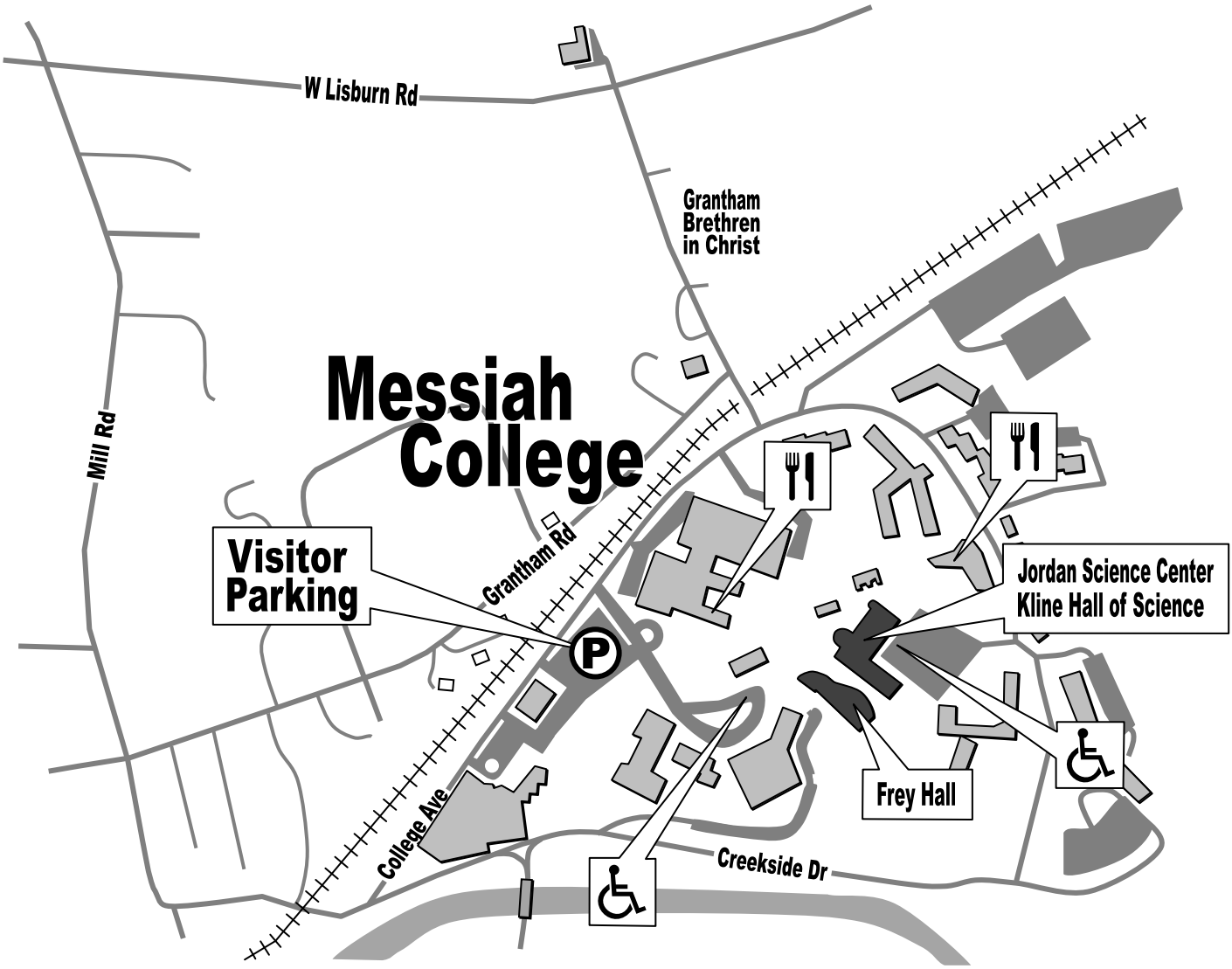
Messiah College



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 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 9) and Abstract section (page 32). **Bold font** indicates the names of **presenting authors**. An **Index** at the end of the booklet (page 75) 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


Nutrition & Dietetics


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, Nutrition & Dietetics, 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 22). Throughout the Program and "Schedule at a Glance" unique symbols designate the various disciplines.

Abstracts: An abstract was provided for each oral and poster presentation in the Symposium. The abstracts are arranged (page 32) in alphabetic order by the last name of the first author.

Acknowledgments: All faculty mentors, external mentors and collaborators, and nursing professionals are recognized. Sources of financial and material support are also listed (page 30) with corresponding presentation numbers.

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*

Schedule at a Glance

F110 — Engineering I

9:00		Welcome and instructions by Session Chairs
9:05	*1*	Bechard, Good
9:25	*2*	Edgin, Gates
9:45	*3*	Carson, Martin, Nesbitt
10:05	*4*	Howell, Penwell
10:25	*5*	Detweiler, Henry
10:45	*6*	Eberly, Long
11:05	*7*	Galaska, Kreider
11:25	*8*	Barton, Brunk, Duke
11:55		
12:05		

F150 — Computer & Information Science

9		Smith, Jones
10		Martin, Richardson, Levengood, Stetson
11		Shuck
12		Chaney
13		*Demonstration of Computer Games:* **- Hollinger Lounge -** Bordner, Chua, Goodwin, Knott, Mailloux, Nicolais, Park, Patawaran, Richardson, Schrock, Schwiker, Serafini, Shipman, Talbert

F349 — Mathematics & Physics

14		Schrom
15		Wingate
16		Cohen
17		Moyer
18		Bressler, Schrock
19		Mayer
20		Bressler
21		Pagenkopf
22		Crawley
23		Van Ness

F110 — Engineering II

12:55		Welcome and instructions by Session Chairs
1:00	*24*	Albert, Daub, Stauffer
1:20	*25*	Albert, Kadar-Kallen, King
1:40	*26*	Baker, Chaney, Evans, Gettemy, Sorrell
2:00	*27*	Senum, Zeigler
2:20	*28*	Dufrenne, Myers, Schmuck
2:40	*29*	Myer, VanSickle

F150 — Engineering III

30		Loar, Oland
31		Hepner, Houck, Ports
32		Listor, Scheib, Schutz
33		Deseno, Wenger
34		Scholl, Yost
35		Angione, Kelley, Stiffler

K120 — Natural Sciences I

36		Cartisano
37		Love
38		Ritenour
39		Chrisfield
40		Rodgers
41		Stephan

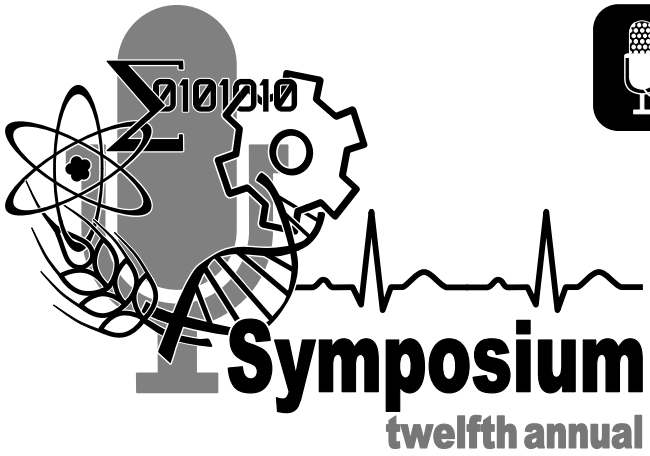
F110 — Engineering IV

4:00	*54*	Kulp
4:20	*55*	Castilow, Stobie
4:40	*56*	Woleslagle
5:00	*57*	Angowski, Chilcote, Kok
5:20	*58*	Wilson
5:40	*59*	Film, Upton

Poster Session:
Engineering
3:00 – 4:00 Frey 070

K120 — Natural Sciences IV

60		Lauver
61		Ingalls
62		Love
63		Wilson
64		Doll



Oral Presentations

	Hollinger Lounge	J161
	Natural Sciences II	**Natural Sciences III**
12:55	Welcome and instructions by Session Chairs	
1:00	*42* White	*48* Branigan
1:20	*43* Mason	*49* Roshong
1:40	*44* Dao	*50* Stern
2:00	*45* Peterson	*51* Martin
2:20	*46* Grando	*52* Faus
2:40	*47* Coleman, Leiphart	*53* Brenneman

	Natural Sciences V
4:20	*65* Baldwin, Adidala
4:40	*66* Ross
5:00	*67* Swartz, Stuart
5:20	*68* Clune
5:40	*69* Roth

Poster Session: 3:00 – 4:20

Hollinger Atrium, J159, K108, K113

- **Evidence-Based Nursing Care**
- **Exercise Science**
- **Nutrition & Dietetics**
- **Biopsychology**
- **Physics**
- **Biological Sciences**
- **Chemistry & Biochemistry**

Poster Presentations

Engineering

Frey 070 Project Space; 3:00 – 4:00

70 Bashore, Foley, Price
71 Rogerson
72 Barrett
73 Joy
74 Pozun, Stobie
75 Mazurek
76 Ashton, Wilkinson
77 Floro, Kerstetter, Kline, Peck
78 Nelson
79 Arnold, Ngui, Sibi Mark
80 Betteridge
81 Aroniss, Margosian, Olson
82 Sargent, Young
83 Luger, Moyer
84 Smeiles, Wright
85 Sollenberger
86 Coshun, Hahn
87 Chang, Clapper, Mea

Natural Sciences

Hollinger Atrium, Jordan 159 & Hallway; 3:00 – 4:20

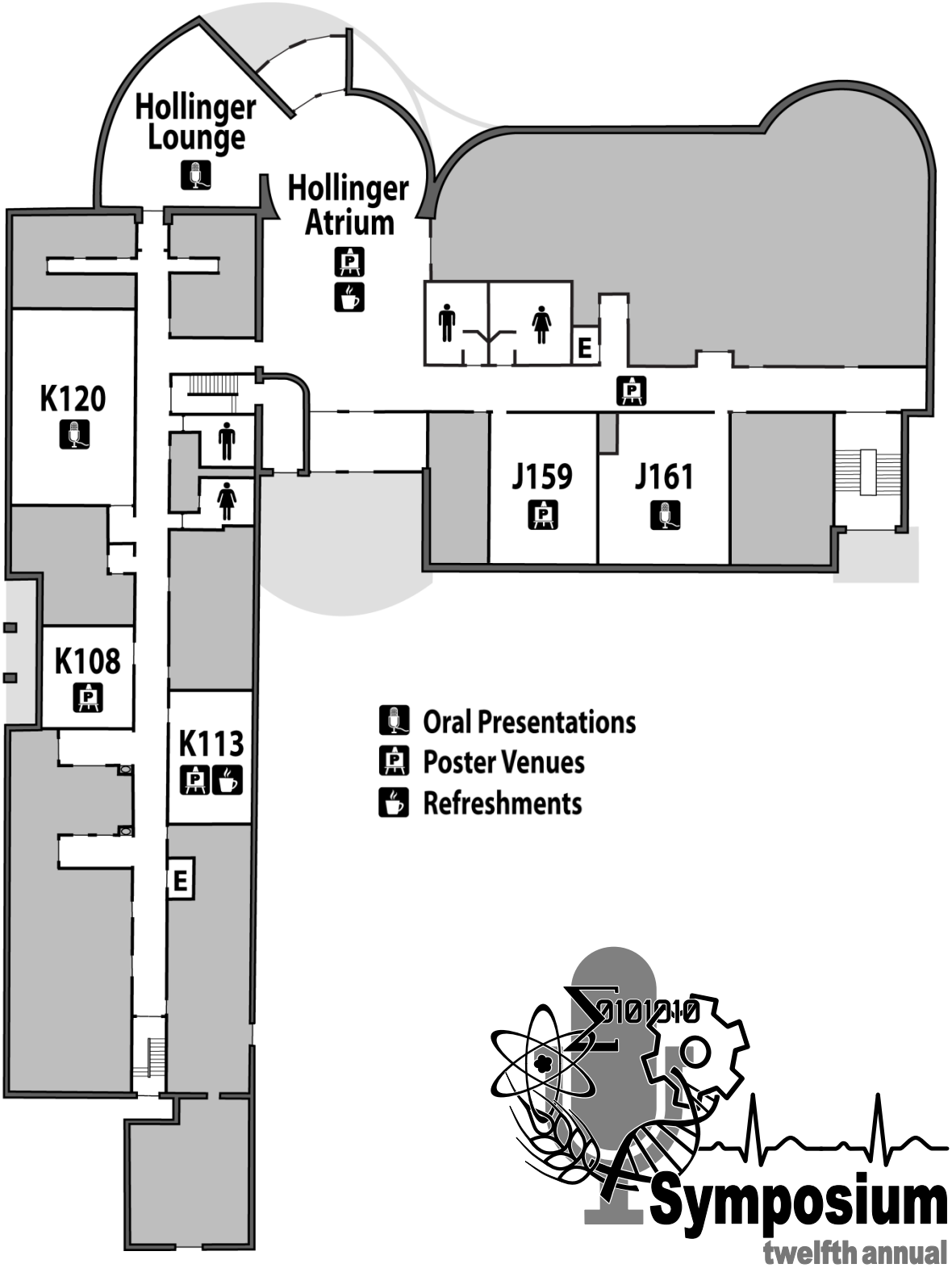
36 Cartisano
38 Ritenour
39 Chrisfield
40 Rodgers
43 Mason
44 Dao
45 Peterson
46 Grando
47 Coleman, Leiphart
48 Branigan
49 Roshong
50 Stern
51 Martin
53 Brenneman
60 Lauver
61 Ingalls
62 Love
63 Wilson
64 Doll
65 Baldwin, Adidala
66 Ross
67 Swartz, Stuart
69 Roth
88 Anderson
89 Christensen
90 Tomlin
91 Zwart
92 Bley
93 Bindel
94 Faus
95 Badgerow
96 Wilson
97 Stump, Poirier, Seipt, Schatz
98 Querfeld, Wisse, Murren, Murren

Evidence-Based Nursing Care

Kline 108, Kline 113; 3:00 – 4:20

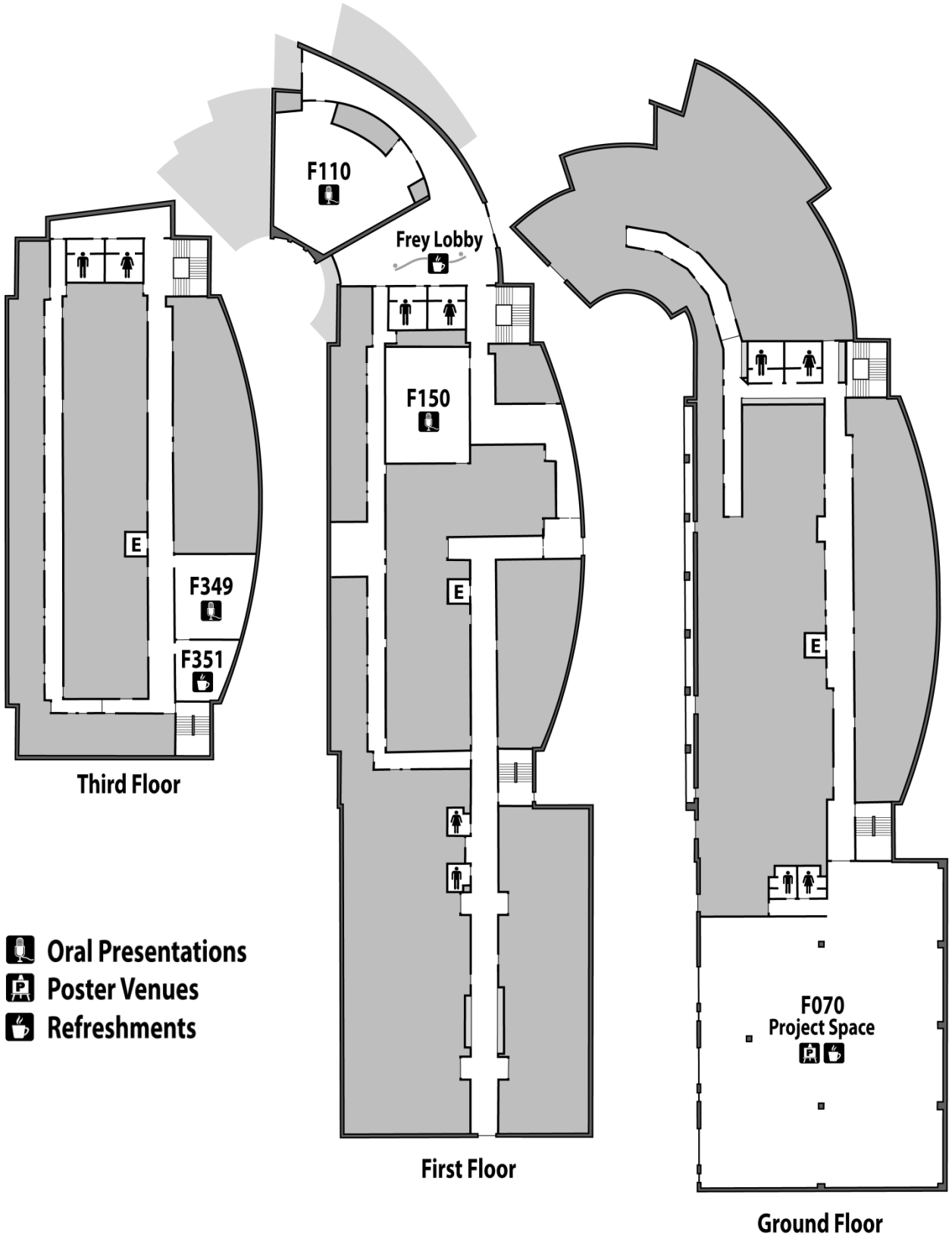
99 Koach, Wolf, Vogt, Grimm
100 Bove, Hagar, Krueger, Corell
101 Hoover, Smullen, Peashey, Wall
102 Flagle, Heisey, Sisson, Wenger
103 Bailey, Deares, Newswanger
104 Frederick, Seigendall, Berkheiser, Jude
105 Alm, Martin, Mellon, Rosenberger
106 Watson, Weaver, Kellner, Shervinskie
107 Cohrs, Deares, Desrosiers
108 Nichols, Mayhew, Lewis, Kellner
109 Steyer, Carbonetto, Locke, Argot
110 Pratt, Silver, Duncan, Eisenberg
111 Dukelow, Espenshade, Heath, Hajek

Jordan Science Center - Kline Hall of Science



Maps

Frey Hall


F110
Frey Lobby
F150
E
F349
F351
Third Floor
Oral Presentations
Poster Venues
Refreshments
First Floor
F070
Project Space
Ground Floor

Oral Presentations (Morning)

Engineering I: Oral Presentations
(Frey 110; 9:00 – 11:45)

1 **9:05** *Bio-Fuels: Bio-Diesel Production*
Casey Bechard, **Nathan Good**, Timothy Whitmoyer*

2 **9:25** *Biofuels for Burkina Faso*
Aaron Edgin, **Andrew Gates**, Annaleise Peterson, Timothy Whitmoyer*, Douglas Phillippy*

3 **9:45** *Seed Pressing*
Thomas Carson, **Hannah Martin**, **Daniel Nesbitt**, Samuel Hsu, Timothy Whitmoyer*

4 **10:05** *Limited Pass Village Water Ozonation System (VWOS) Design*
Katy Howell, **Laura Penwell**, Elisabeth Chang, Gabrielle Clapper, Hing Jii Mea, David Vader*, Ray Knepper†*
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5 **10:25** *Mobility Tricycle Project: Rear Axle Redesign*
Jared Detweiler, **Justin Henry**, Tim Van Dyke*, John Meyer*

6 **10:45** *Mobility Tricycle Project: Front End Redesign*
Taylor Eberly, **Lauren Long**, Tim Van Dyke*, John Meyer*
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7 **11:05** *Mobility Tricycle Project: Brake/Control Box Redesign*
Austin Galaska, **John Kreider**, Tim Van Dyke*, John Meyer*

8 **11:25** *Mobility Tricycle Project: Drive Shaft Redesign*
Luke Barton, **Madison Brunk**, **Samuel Duke**, Tim Van Dyke*, John Meyer*

Computer & Information Science: Oral Presentations
(Frey 150; 9:00 – 10:25)

9 **9:05** *Developing an Open Source Ministry Module for Cure International*
Rebekah Smith, **Peter Jones**, Brian Nejmeh*

10 **9:25** *Fungi Identification Website*
Thomas Martin, **Benjamin Richardson**, **Brett Levengood**, **Tom Stetson**, D. Scott Weaver*

11 **9:45** *Intelligent Water Project (IWP): Mobile, Database, and Documentation*
Peter Shuck, Yacoub Seyni, Kafui Dzaka, Steve Nase, Connor Powell, Jeremy Diehl, Andrew Budd, Nathan Chaney, Steven Nicolais, Brian Nejmeh*

12 **10:05** *Intelligent Water Project (IWP): Data Transmission and Web Analytics*
Nathan Chaney, John Snyder, Jeremy Diehl, Connor Powell, Brian Nejmeh*

Computer & Information Science: Demonstrations
(Hollinger Lounge; 10:30 – 11:30)

Play Computer Games Created by Messiah College Students:

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The Journey of the Magic Hat
Sarah Park, **Luke Mailloux**, **Katrina Schrock**

Geo Force
Kyle Talbert, **Isaac Serafini**, **Shawn Bordner**, **Kelly Schwiker**

Broken Stars
Ben Richardson, **David Patawaran**, **Colin Knott**

Block Blockers
Von Bock, **Phoebe Chua**, Jeff Daub

Cave Raider
Steve Nicolais, **Isaiah Shipman**, **Jonny Goodwin**, Dalton Wise

Mathematics & Physics: Oral Presentations
(Frey 349; 9:00 – 12:25)

14 **9:05** ∑ *The Mathematics of Theatre and Performance*
Dylan Schrom

15 **9:25** ∑ *Applications of Monte Carlo Methods*
Michael Wingate

16 **9:45** *'Physics? Gross!': How Physics Education Research Addresses Problems for Undergraduate Physics Students*
Christa Cohen, Abaz Kryemadhi*

17 **10:05** ∑ *To Infinity...and Beyond*
Travis Moyer

18 **10:25** *Development of a neutron veto prototype for Super Cryogenic Dark Matter Search Experiment*
Matthew Bressler, **Katrina Schrock**, Abaz Kryemadhi*

19 **10:45** ∑ *An Exploration of Diophantine Equations and their Applications*
Ryan Mayer

20 **11:05** *Silicon Photomultiplier Studies*
Matthew Bressler, Abaz Kryemadhi*

21 **11:25** ∑ *Geometry of the Universe*
Drew Pagenkopf, Abaz Kryemadhi*

22 **11:45** *Design and Characterization of a Vacuum System*
James Crawley, Niklas Hellgren*

23 **12:05** ∑ *Demographic Analysis of Shark Populations Using Leslie Matrices*
Sarah Van Ness

Oral Presentations (Afternoon)

Engineering II: Oral Presentations
(Frey 110; 1:00 – 3:00)

24 **1:00** *Solar PV for the Theological College of Zimbabwe*
Benjamin Albert, **Steven Daub**, **Jillana Stauffer**, Randall Fish*, Chris Byers†*, Liam Tanis†*
77

25 **1:20** *Low Power Solar PV Systems For the Developing World*
Benjamin Albert, **Josiah Kadar-Kallen**, **Taran King**, Randall Fish*, Chris Byers†*, Liam Tanis†*
78

26 **1:40** *Energy Monitoring and Management System*
Daniel Baker, **Nathan Chaney**, **Ashley Evans**, **Aaron Gettemy**, **Zachary Sorrell**, Randall Fish*, Tom Austin†*
76

27 **2:00** *Kenya Mobile Medical Clinic*
Kariana Senum, **Joel Zeigler**, Donald Pratt*
84

28 **2:20** *Basic Utility Vehicle (BUV) Firetruck*
Richard Dufrenne, **Garrett Myers**, **Robert Schmuck**, Donald Pratt*

29 **2:40** *Solar Commuter Vehicle Electrical System and Variable Gap*
Bryant Myer, **Glenn VanSickle**, Donald Pratt*

Engineering III: Oral Presentations
(Frey 150; 1:00 – 3:00)

30 **1:00** *Cycle Advancements - Universal Hitch*
Wesley Loar, **Nicholas Oland**, Donald Pratt*
85

31 **1:20** *Hollow Fiber Membrane Filter Testing*
Jonathan Hepner, **David Houck**, **Rebecca Ports**, Melanie Aroniss, Kyle Margosian, Braden Olson, Tony Beers*, Thomas Soerens*
81

32 **1:40** *Macha Oxygen Concentrator Project*
Erik Listor, **Chris Scheib**, **Jilean Schutz**, Timothy Whitmoyer*

33 **2:00** *Flight Tracking and Messaging Systems (FTMS)*
John Deseno, **Brianna Wenger**, Harold Underwood*, Carman Frith†*, Cary Cupka†*

34 **2:20** *Thermo-Electric Generator Ventilation Hood*
Joshua Scholl, **Brenton Yost**, Brooks Arnold, Joel Ngui, Joel Sibi Mark, Randall Fish*

35 **2:40** *Better Briquettes*
Giuliana Angione, **Josiah Kelley**, **Samuel Stiffler**, Timothy Whitmoyer*

Afternoon Presentations

Natural Sciences I: Oral Presentations
(Kline 120; 1:00 – 3:00)

36 1:00 *Opioid Growth Factor Affects Presentation of Conditioned Fear Response in Rats*
Emma Cartisano, Jennifer Thomson*

37 1:20 *Self-Assembled Monolayers on Zinc Selenide for Use in In vitro Cellular Studies*
Anna Love, Alison Noble*

38 1:40 *Investigating Immunofluorescent Staining Patterns Produced by Monoclonal Antibodies against CCK2R*
Laura Ritenour, Evan Shirey, John Harms*

39 2:00 *The Effect of Combined Beta-alanine and Creatine Monohydrate Supplementation on Cycling Power Output in College-Age Athletes*
Benjamin Chrisfield, H. Scott Kieffer*, Amy Porto*

40 2:20 *Sign-Tracking vs. Goal-Tracking with Cocaine Self-Administration*
Bridgette Rodgers, Danielle Alexander†*, Patricia Grigson†*

41 2:40 *Barcoding a highly variable 24bp segment of the Plasmodium falciparum gene in Macha, Zambia*
Michael Stephan

Natural Sciences II: Oral Presentations
(Hollinger Lounge; 1:00 – 3:00)

42 **1:00** *Case Report: Labral Tear and Full Thickness Rotator Cuff Muscle Tear in a Collegiate Wrestler*
Kelsey White, Matthew Lewis*

43 **1:20** *Targeting Pancreatic Cancer with Cellular Immunity*
Caitlin Mason, Matthew Lauver, John Harms*, Lawrence Mylin*

44 **1:40** *Reduction Reaction of Ketones and Imines Using Biocatalysts*
Hanh Dao, Roseann Sachs*

45 **2:00** *Slimy Sculpin Gape Size in Relation to Prey Preferences*
Annaleise Peterson, Jeff Erikson*

46 **2:20** *Transfection of Primary Kidney Cells with Mutated SV40 T ag DNA Containing a CCKCR Intron Sequence*
Kaitlyn Grando, Courtney Burkett, Lawrence Mylin*

47 **2:40** *Quantitative Mineral and Nutrient Analysis of Moringa oleifera Leaves*
Lindsay Coleman, **Paul Leiphart**, Richard Schaeffer*

Natural Sciences III: Oral Presentations
(Jordan 161; 1:00 – 3:00)

48 **1:00** *The Effects of Cadmium on Arabidopsis thaliana*
Kimberly Branigan, Richard Schaeffer*, Michael Shin*

49 **1:20** *Effect of Caffeine on Salivary Cortisol Levels during 10K Cycling Time Trials*
Anne Roshong, Lauren Clune, H. Scott Kieffer, Jodie Haak*

50 **1:40** *Tissue Culture in Mertensia virginica (L.) Pers. ex Link*
Adam Stern, David Foster*

51 **2:00** *Synthesis of Aspernigrin A Analogs*
Lauren Martin, Anne Reeve*

52 **2:20** *Lessons from Rwanda: Educational Challenges and Why*
Alex Faus

53 **2:40** *Columbia Arabidopsis thaliana Zinc Tolerance Through the Use of MTP1 as a Vacuolar Zinc Transporter*
Cody Brenneman, Michael Shin*

Engineering IV: Oral Presentations
(Frey 110; 4:00 – 6:00)

54 **4:00** *Wireless Enabled Remote Co-presence (WERC)*
Kelly Kulp, Harold Underwood*
86

55 **4:20** *Affordable Sanitation*
Laura Castilow, **Gavin Stobie**, Brian Swartz*, L. Bryan Hoover †*
74

56 **4:40** *Pedestrian Bridge in Panama*
Russell Woleslagle, Andrew Joy, Brian Swartz*, Tim Zimmerman†*
73

57 **5:00** *Intelligent Water Project*
Stephen Angowski, **Adam Chilcote**, **Ken Kok**, Tony Beers*, Thomas Soerens*
82

58 **5:20** *Manual Percussive Well Drilling*
David Wilson, Tony Beers*, Joseph Longenecker†*, Thomas Soerens*
83

59 **5:40** *Garden Water Access Project*
Aaron Film, **Marcus Upton**, Luke Betteridge, Andrew Dunmire, Damaris Gehman, Althea Mavros, Tony Beers*, Joseph Longenecker†*, Thomas Soerens*
80

Natural Sciences IV: Oral Presentations
(Kline 120; 4:20 – 6:00)

60 **4:20** *Investigating Cellular Immunity Using the Simian Virus 40 Large Tumor Antigen*
Matthew Lauver, Caitlin Mason, Stephanie Schell†, Lawrence Mylin*

61 **4:40** *Establishing a Mini-Scale Hydroponic Protocol in Arabidopsis thaliana*
Matthew Ingalls, Michael Shin*

62 **5:00** *Effects of Sphingosine 1-Phosphate at the Blood-Brain Barrier*
Anna Love, Simona Spampinato†*, Bunny Cotleur†, Richard Ransohoff†*

63 **5:20** *Capacity Building: Establishing Laboratory Culture of Plasmodium falciparum Laboratory Strain NF54 and Patient Isolates at the Macha Research Trust / Malaria Institute at Macha, Choma, Zambia*
Lauren Wilson, Lawrence Mylin*, Ben Katowa†, Saidon Mbambara†, Natasha Laban†, Mwiche Siame†, Jennifer Stevenson†, Philip Thuma†

64 **5:40** *Altering Photosynthate Allocation in Lettuce with Supplemental LED Lighting*
Alyssa Doll, David Foster*

Natural Sciences V: Oral Presentations
(Hollinger Lounge; 4:20 – 6:00)

65 **4:20** *Examining the Efficacy of Opioid Growth Factor in Preventing Post-Traumatic Stress Disorder-Like Symptoms in Sprague-Dawley Rats*
Kelsey Baldwin, **Vetzrel Adidala**, Jennifer Thomson*

66 **4:40** *Increasing Stability and Expression of Green Fluorescent Protein in Pancreatic Cancer Cells*
Holly Ross, John Harms*

67 **5:00** *Evaluation of a Rapid Assessment Model for the Conservation of Woodland Vernal Pools*
Timothy Swartz, **Ellie Stuart**, Erik Lindquist*, David Foster*

68 **5:20** *Effects of Intermittent Caffeine Ingestion on Aerobic Power During a 16.1K Cycling Time Trial*
Lauren Clune, Brett Warner, H. Scott Kieffer*

69 **5:40** *Synthesis and Purification of Aspernigrin A Analogs*
Philip Roth, Anne Reeve*

Poster Presentations

Engineering
(Frey 070 Project Space; 3:00 – 4:00)

70 *Africa WASH and Disability Studies*
Elizabeth Bashore, **Andrew Foley**, **Kaitlin Price**, Tim Van Dyke*, Tony Beers*, Nate Kamban†*

71 *Combined Heat and Power*
Christian Rogerson, Ethan Jacoby, Mitchell Kauffman, Nathan Musser, Brian Swartz*, Brian Seip†*

72 *Library Acoustics*
Katie Barrett, Brian Swartz*, Bill Frantz†*

73 *Pedestrian Bridge in Panama*
Andrew Joy, Brian Swartz*
56

74 *Affordable Sanitation*
Adam Pozun, **Gavin Stobie**, Laura Castilow, Brian Swartz*, L. Bryan Hoover†*
55

75 *Mobility Tricycle Project: Front End Redesign*
Rachel Mazurek, Taylor Eberly, Lauren Long, Tim Van Dyke*, John Meyer*
6

76 *Energy Monitoring and Management System*
Wesley Ashton, **Matthew Wilkinson**, Randall Fish*, Tom Austin†*
26

77 *Solar PV for the Theological College of Zimbabwe*
Andrew Floro, **Scott Kerstetter**, **Jessica Kline**, **Josiah Peck**, Randall Fish*, Chris Byers†*, Liam Tanis†*
24

78 *Low Power Solar PV Systems*
Elkan Nelson, Randall Fish*, Chris Byers†*, Liam Tanis†*
25

79 *Thermo-Electric Generator Ventilation Hood*
Brooks Arnold, **Joel Ngui**, **Joel Sibi Mark**, Randall Fish*
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80 *Garden Water Access Project*
Luke Betteridge, Tony Beers*, Thomas Soerens*

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Jacob Sargent, **Jacqui Young**, Adam Chilcote, Tony Beers*, Thomas Soerens*

83 *Mechanized Percussion Well Drilling*
Amanda Luger, **Kathryn Moyer**, Tony Beers*, Joseph Longenecker†*, Thomas Soerens*

84 *Kenya Mobile Medical Clinic*
Stephen Smeiles, **Jason Wright**, Donald Pratt*

85 *Cycle Advancements - Universal Hitch*
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86 *Wireless Enabled Remote Co-presence (WERC)*
Joe Coshun, **Ryan Hahn**, Harold Underwood*

87 *Limited Pass Village Water Ozonation System (VWOS) Design*
Elisabeth Chang, **Gabrielle Clapper**, **Hing Jii Mea**, Katy Howell, Laura Penwell, David Vader*, Ray Knepper†*

Posters

Natural Sciences
(Hollinger Atrium, Jordan 159 & Hallway; 3:00 – 4:20)

36 *Opioid Growth Factor Affects Presentation of Conditioned Fear Response in Rats*
Emma Cartisano, Jennifer Thomson*

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61 *Establishing a Mini-Scale Hydroponic Protocol in Arabidopsis thaliana*
Matthew Ingalls, Michael Shin*

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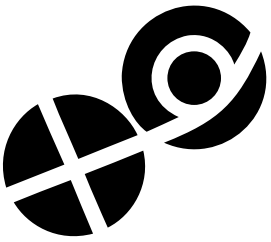

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The Steinbrecher Endowment for Research in the Health and Life Sciences was established at Messiah College in 2003 by Dr. Leroy and Mrs. Eunice Steinbrecher to support collaborative experimental research between students and faculty. Dr. Steinbrecher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

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

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Nursing Professionals of Pinnacle Health

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Bunny Cotleur, M.Sc. *Principal Associate Scientist, Biogen*	62
Patricia Grigson, Ph.D. *Professor, Penn State College of Medicine*	40
Ben Katowa *Lab Scientist, Malaria Research Trust*	63
Natasha Laban *Lab Scientist, Malaria Research Trust*	63
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Mwiche Siame, MS *Senior Lab Scientist, Malaria Research Trust*	63
Simona Spampinato, MD, Ph.D. *Post Doctoral fellow, Cleveland Clinic*	62
Jennifer Stevenson, Ph.D. *Scientific Director, Malaria Research Trust*	63
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Benjamin Albert, **Steven Daub**, **Jillana Stauffer**, Randall Fish*, Chris Byers†*, Liam Tanis†*

Solar PV for the Theological College of Zimbabwe

Electrical power in Zimbabwe is extremely unreliable and is frequently unavailable. Many of these incidents last for a few minutes but they can extend for several days. Students at TCZ have trouble completing their studies without consistent power. They find it particularly difficult to do school work when the library and computer labs do not have power. We have developed a proposal and chosen the major system components for a Solar PV system which would provide power for the Library and Computer lab. Most of the funding for this system has been provided by local churches and the organization Friends of TCZ is continuing the fundraising efforts. We have built a small scale system at Messiah College to practice the installation. The Solar PV, TCZ site team will travel to Bulawayo Zimbabwe in May 2015. After our visit in May, the system will be fully installed and operational. This will result in the computer labs and library being re-wired separate from the rest of the buildings/rooms. This new network will have sufficient power to function at all times, using power from solar panels, battery back-up from the panels, and the power grid. **(24)**

Benjamin Albert, **Josiah Kadar-Kallen**, **Taran King**, Randall Fish*, Chris Byers†*, Liam Tanis†*

Low Power Solar PV Systems For the Developing World

In many parts of the world the best solution to energy needs is solar power. These systems range from large scale systems which power an entire clinic to small systems charging a battery for a single light bulb. Our project has developed inexpensive low power prototype designs capable of solving two wide-spread application needs. The first system is capable of powering a single well water pump and the second can provide the power needed by a small cluster of computers. This talk will describe these prototype systems and introduce the application of the pump design to the Village Water Ozonization System (VWOS) Project. **(25)**

Jamie Alm, **Stacie Martin**, **Shannon Mellon**, **Sallie Rosenberger**, Marianne Allen†*, Anila Bhatti†*, Tina Daniels†*, Nancy Frank†*

Breast or Bottle: The Effect of Feeding Method on NAS Outcomes

Background: The rate of opioid-dependence is increasing and infants born to dependent women are at high risk for developing neonatal abstinence syndrome (NAS). There are many benefits of breastfeeding, but the safety is not known for this population, and therefore breastfeeding is often not considered. Purpose: To determine the best practice in relation to

feeding method on NAS symptoms and need for pharmacological interventions in infants with NAS. Methods: PubMed and CINAHL were used, and four research articles were selected. Findings: Breastfeeding as compared to formula feeding was found to be correlated with decreased NAS symptoms and need for pharmacological intervention. Recommendations: Evidence suggests a practice change. Opioid dependent mothers should be encouraged to breastfeed. Further education and collaboration between the mothers and providers is needed. **(105)**

Elyse Anderson, Lauren Wilson, Lawrence Mylin*

Cryopreservation of Human Erythrocytes for Laboratory Culture of Plasmodium falciparum (Malaria)

Malaria affects millions of people worldwide and is caused by a resilient and destructive group of parasites from the genus *Plasmodium*. Malaria continues to cause approximately 500,000 deaths annually, primarily among children less than five years of age and in sub-Saharan Africa. Understanding why *Plasmodium falciparum* causes mortality in children and how to best combat the parasite and mosquito vector continue to be topics of active research. The ability to culture *P. falciparum* in the laboratory is essential for many studies. Laboratory culture of *P. falciparum* requires "fresh" human erythrocytes; *P. falciparum* propagates best in laboratory media when provided with erythrocytes that are used within two weeks of collection. However, suitable donors (unmedicated, uninfected and of suitable blood types) may not be readily available for research conducted in rural sub-Saharan Africa. We have chosen to investigate whether frozen blood can be used to propagate *P. falciparum*: in the routine laboratory culture of asexual parasite forms for which thawed erythrocytes must remain intact up to four days, or in the generation of infectious gametocytes for which thawed erythrocytes must remain intact for up to two weeks. Human blood can be preserved for subsequent infusion by freezing in salt solutions that contain glycerol, and viable *P. falciparum* ring-form parasite stages can be frozen as suspensions of infected erythrocytes using the same solution. However, the large volume of preserving solution relative to the volume of erythrocytes frozen, and the failure of thawed erythrocytes to remain intact for two weeks after thawing limit the usefulness of this approach for our purposes. Rapid freezing has been reported to limit cellular destruction by intracellular ice crystal formation; rapid thawing in the presence of polymers that limit re-growth of extracellular ice crystals by dynamic ice reshaping may enhance viable cell recovery. The goal of this study was to determine whether combinations of solutions containing the polymers hydroxyethyl starch and polyvinyl alcohol can be used to cryopreserve and revive human erythrocytes for use in routine cultivation of asexual forms or generation of infectious gametocyte forms of *P. falciparum*. **(88)**

Giuliana Angione, **Josiah Kelley**, **Samuel Stiffler**, Timothy Whitmoyer*

Better Briquettes

Malawi's forest resources are being harvested at alarming and unsustainable rates. Much of this deforestation is caused by the country's demand for charcoal and wood to meet its daily energy requirements. The goal of the Better Briquettes project is to significantly reduce charcoal and wood consumption in Malawi through the introduction of profitable briquettes franchises which will produce and sell fuel briquettes made from abundant agricultural waste

products. Building off of other briquettes initiatives in Malawi, we are working to develop recipes and processes that allow the fuel to become an economically competitive alternative to charcoal and wood in Malawi. This past year, we have developed a proof of concept and have begun to produce briquettes here on Messiah campus. We have also developed testing procedures which allow us to qualitatively compare briquette recipes. This semester, we took significant steps towards replicating processes which are used to make briquettes in Malawi so that we can begin to make improvements on them to improve the efficiency during our next semester of work. **(35)**

Stephen Angowski, **Adam Chilcote**, **Ken Kok**, Tony Beers*, Thomas Soerens*

Intelligent Water Project

Millions of Africans use handpumps such as the Afridev and India MKII to meet the daily water requirements of their households. Unfortunately in many countries hand pump failure rates exceed 30%. This problem is exacerbated by the sparse distribution of pumps and often poor road infrastructure in rural areas. Often NGOs and GOs are unaware of a pump malfunction until several days or weeks have passed hindering their ability to execute a timely response. At the same time cellphones have become ubiquitous in Africa with GSM coverage now exceeding water service delivery. The Intelligent Water Project (IWP) seeks to take advantage of Africa's existing GSM network by deploying cellular enabled, autonomous sensor units in rural handpumps that report pump health statistics to WASH professionals. This allows breakdowns to be detected in 24 hours, and early failure modes to be detected prior to the need for a costly repair. This longitudinal repair and pump health information is accessible by field maintenance technicians to improve efficiency and speed of repair, as well as WASH professionals and NGOs to monitor community health, as well as longitudinal pump usage statistics. **(57)**

Brooks Arnold, **Joel Ngui**, **Joel Sibi Mark**, Randall Fish*

Thermo-Electric Generator Ventilation Hood

In a recent study, it was found that nearly 2 billion people worldwide use open cook fires for common purposes such as making food and boiling water. Women often cook using open fires every day to provide the family with food, but what they don't realize is that the harmful products of burning biomass that settles within the household due to a lack of proper ventilation has been linked to various diseases including pneumonia in children, Chronic Obstructive Pulmonary Disease, asthma and other lung and heart diseases. While fan ventilation would solve this problem, people without electricity cannot use this simple solution. We are developing a ventilation system which uses the heat of the cookstove and a peltier device to generate the electricity needed to power a ventilation fan. **(79)**

Melanie Aroniss, **Kyle Margosian**, **Braden Olson**, Thomas Soerens*

Hollow Fiber Membrane Filter Testing

The HFM (Hollow Fiber Membrane) Filtration Team designs and implements filtration systems that use Sawyer filters. Currently, the HFM Filtration Team is designing a testing system to complete a filter life study for Sawyer bucket filters in order to verify their given life expectancy of lasting several years and one million gallons (approximately 2.5 years of testing). The project proposed to meet the standards of Sawyer filters by re-circulating stream or spiked water

through 24 filters in parallel through the use of a manifold and pump system. Flow and pressure through the system would be monitored to verify the functionality of the filter during forward flow and backwashing procedures. The life cycle test would be measured through the use of periodic biological tests in order to determine the amount of bacteria left in the filters after strenuous use. Data will be provided to Sawyer to verify or deny their proposed life expectancy for the filters. **(81)**

Wesley Ashton, **Matthew Wilkinson**, Randall Fish*, Tom Austin†*

Energy Monitoring and Management System

Solar power systems produce a limited amount of energy. People using these systems need a way to educate themselves about power usage, help them share the available power equitably, and prevent damage to the system that may result from overuse. We are designing a home energy meter that will measure power usage, give educational feedback to the user, and limit the consumption of individual buildings or circuits. **(76)**

Andrew Badgerow, Justin Eby, Matt Kyne, Michael Mattern, H. Scott Kieffer*

The Acute Effects of Static and Dynamic Stretching on Power

Static stretching is a common practice in the health and rehabilitative sciences; however, recent research has indicated that static stretching may lead to a decrease in force generating capacity. Likewise, dynamic stretching has shown to increase force generating capacity. The literature surrounding the issue of stretching encompasses a variety of stretching techniques and modes of testing. The purpose of this study was to determine the effects of static and dynamic stretching on muscular power of the quadriceps and hamstrings following a common static and dynamic stretching protocol. Ten male NCAA Division III lacrosse players free from injury in the lower extremity participated in the study. The participants reported to the lab on four separate occasions. A familiarization time was followed by 3 sessions in which a no stretch, dynamic, and static stretching protocol were randomly performed. The subjects completed 3 sets of 2 stretches for each muscle group. Each stretch was performed for 15 seconds followed by a 15 second rest period between sets. The static and dynamic protocols were matched for muscle group and movement pattern. Muscular work for the quadriceps and hamstrings were measured using the Biodex set at 60 and 180 degrees/sec. The subjects completed 10 repetitions at each speed with a 20 second rest period between exercises. Data were analyzed using a one-way ANOVA with repeated measures for Peak torque, time to peak torque, torque 30˚, total work, work fatigue, average power, and area under the curve. The data will be presented at the Symposium. **(95)**

Arianna Bailey, **Taylor Deares**, **Dana Newswanger**, Kayla Sandstrom, Sarah Harne-Britner†, Sue Tyson†, Ruthanne Hepkins†, Alex Keller†, Talisha Sneeringer†

Changing Staff Beliefs on Family Presence during Resuscitation with a Standardized Protocol

Background: Nurses are taught to incorporate family-centered care into practice. However, this holistic model can be forgotten during emergency situations. Few hospitals in the United States have a written protocol involving the presence of family during CPR. Many studies have shown that family-witnessed resuscitation is positive, but the lack of specific protocol still clouds the practice with controversy. Problem: The lack of a protocol can cause conflict between heath

care professionals that support family-witnessed resuscitation (FWR) and those that have doubts about allowing family into the room. If a protocol is in effect, it can reduce the amount of tension the health care team faces. The protocol can provide staff with an organized way of incorporating family. Purpose: The purpose of this EBP project was to explore the effect of a specific FWR protocol on nurses' attitudes and beliefs towards FWR. Methods: Literature was collected from PubMed, Medline, and CINAHL databases. The following search terms were used: nurse satisfaction, attitudes, family witnessed resuscitation, protocol, emergency department. Results: Nurses in hospitals with a well-established FWR protocol felt much more comfortable interacting with families. Other studies show the benefit of FWR educational programs. These programs were effective in changing nurses' views towards FWR. Those that participated in education were more likely to welcome family during CPR. Implication for Practice: There is a need for FWR education in emergency departments. There are more positive staff attitudes towards FWR after these programs. This education can lead to protocol development that makes FWR a common practice. Areas for Future Research: FWR protocol is still a relatively new idea. Future studies should consider cultural and spiritual barriers towards FWR. Beliefs seem to vary based on profession (i.e. LPN, RN, MD) but the reasons for this occurrence should be explored further. Key Words: protocol; family witnessed resuscitation; nurse attitudes. **(103)**

Daniel Baker, **Nathan Chaney**, **Ashley Evans**, **Aaron Gettemy**, **Zachary Sorrell**, Randall Fish*, Tom Austin[†]*

Energy Monitoring and Management System

Isolated communities in developing countries often experience issues pertaining to insufficient power availability. People in these communities need a way to educate themselves about power usage, help them share the available power equitably, and prevent damage to the system that may result from overuse. Our solution to this problem is a home energy meter that is capable of measuring and regulating power usage to individual buildings, while displaying educational feedback to the user. **(26)**

Kelsey Baldwin, **Vetzrel Adidala**, Jennifer Thomson*

Examining the Efficacy of Opioid Growth Factor in Preventing Post-Traumatic Stress Disorder-Like Symptoms in Sprague-Dawley Rats

Post-traumatic stress disorder (PTSD) is a highly prevalent and debilitating disorder related to the stress response that may manifest in individuals who have experienced significant traumatic episodes. Sufferers of PTSD include military personnel, victims of abuse, and accident and natural disaster survivors. Since pharmacologic and counseling-based treatments have shown to inconsistently reduce symptoms of PTSD, this pilot study sought to evaluate opioid growth factor (OGF), an endogenous opioid, as a possible preventative. Opioid growth factor was selected as a less addictive remedy to morphine. Within a conditioning chamber distinct from their home environment, 10 female Sprague-Dawley rats were conditioned using a traditional fear-conditioning model where each received three mild shocks within a three-minute timespan. Rats received chronic injections of either OGF (10mg/kg) or saline at 0, 24, and 48 hours after administration of the shocks. Fear expression was quantified as the percentage of time spent freezing on days 1, 2, 7 and 14 after administration of OGF. The

results of this study may lead to further research supporting the use of OGF in effectively preventing expressions of PTSD in diverse populations. **(65)**

Katie Barrett, Brian Swartz*, Bill Frantz†*
Library Acoustics
The Library Acoustics Management project is working to foster a more productive study and work environment by reducing the amount of sound pollution in the library. Two years ago, the library underwent renovations to create a modern, open floor plan and a centrally located cafe. The open layout has led to a noisier environment than was historically the case for the library. The project team is partnering with library staff to seek solutions for noise mitigation without compromising the improvements made in the recent renovations. **(72)**

Luke Barton, **Madison Brunk**, **Samuel Duke**, Tim Van Dyke*, John Meyer*
Mobility Tricycle Project: Drive Shaft Redesign
The Mobility Tricycle Project exists to provide transportation solutions to people with disabilities in developing countries. We have partnered with The Center for the Advancement of the Handicapped in Mahadaga, Burkina Faso to design a tricycle that can be fabricated with components readily available in the locations they will be used, thus establishing a sustainable solution for the problem of effective transportation. However, the shaft of the motor in the electric tricycle rotates at a much higher speed than the wheels do and a planetary gear is used to reduce the motor speed to the desired wheel speed. The motor rotates a shaft that mates with the socket of a planetary gear through a series of splines. Currently, contact occurring between the shaft and socket wears and eventually strips the splines of the socket, disabling the tricycle. Wear occurs rapidly because both the shaft and socket are made out of relatively soft materials. Previously we attempted to reduce the wear by using a planetary gear with a harder socket. However, this did not decrease the wear because the shaft was relatively soft compared to the socket. Currently, we are attempted to solve this problem by increasing the hardness of the shaft through a process known as heat treatment. This process allows us to create a shaft that is significantly harder than the existing design, closely matches the hardness of the socket, and is expected to significantly decrease the wear, allowing more miles to be driven on the tricycle without failure. **(8)**

Elizabeth Bashore, **Andrew Foley**, **Kaitlin Price**, Tim Van Dyke*, Tony Beers*, Nate Kamban†*
Africa WASH and Disability Studies
The AWDS seeks to improve the access to and use of water, sanitation, and hygiene (WASH) facilities for persons with disabilities through the development of simple, low-cost WASH technologies and modifications. Partnering with World Vision in the countries of Mali, Niger, and Ghana, project members are currently working to address difficulties associated with the access and transportation of water. Two initiatives are being pursued to mitigate these challenges. First, a water transportation device has been fabricated that couples with a jerry can tipper developed during a previous phase of the project. This allows users to more easily transport a jerry can to and from water access points and offers assistance when managing water in the home. Second, a pump handle extension has been designed that attaches to the end of an India Mark II pump handle. A standard handle consists of a long, thin rod and users

are expected to grasp the rounded end of the bar. This attachment allows individuals to situate themselves in an ergonomic position while still utilizing the full mechanical advantage of the lever system. **(70)**

Casey Bechard, **Nathan Good**, Timothy Whitmoyer*

Bio-Fuels: Bio-Diesel Production

Bio-Diesel is a form of diesel fuel manufactured from vegetable or other oils. It can be run in any vehicle that uses diesel fuel with little modification. It is safe, biodegradable, and produces less air pollutants than petroleum-based diesel. Oil to produce the Bio-Diesel is obtained from the campus dining halls. Over the past semester, the Bio-Diesel Production Project has been in a transition phase. With the new Frey Hall expansion the Bio-Diesel Production Project has changed locations. With this, the group has had to rebuild some of the processor equipment used to make Bio-Diesel. Several safety concerns have also come to our attention during our planning. Halfway through this semester, we have also had a change in the team's goals moving forward. This presentation will give an overview of the team's progress and where we are headed next. **(1)**

Luke Betteridge, Tony Beers*, Thomas Soerens*

Garden Water Access Project

In order to meet the need for irrigation water during the dry season of Western Africa, the Garden Water Access Project has designed a hand-powered well drilling system and simple handpump. In conjunction with SIM and Open Door Development in Mahadaga, Burkina Faso, these systems are already providing water for dozens of families. In the final phase of the project, the drill bits were systematically tested and acceleration data analyzed in order to ensure their effectiveness. **(80)**

Marybeth Bindel, Jarrod Mattias, Matthew Lewis*

Functional Movement Screen Normative Values In A Population of Collegiate Baseball Pitchers

Objective: Use of the functional movement screen (FMS) as a preventative tool is becoming more common in the athletic training setting. However, normative values and mean component scores for specific athletic populations are not widely available. Our objective was to compile and present normative data for a group of collegiate baseball pitchers including both mean component and composite scores. **Design and Settings**: Each subject completed all seven components of the FMS. Video data was recorded for each subject. All videos were scored by a single novice evaluator who compiled and calculated FMS scores using previously established scoring criteria. **Subjects:** The subject population included 20 healthy, male collegiate baseball pitchers between the ages of 18 and 24. **Measurements:** Individual subject data was combined to compile a composite score. Additionally group mean component and composite scores were calculated. **Results:** The mean composite score from this population was 15.75. The mean component scores included: deep squat 1.95, hurdle step 2.15, inline lunge 2.45, shoulder mobility 2.45, active straight leg raise 2.4, push up 2.55, and rotary stability 1.55. **Conclusions**: The mean composite score of 15.75 indicates a low risk of injury, according to Schneiders et al[1]. However, assessing FMS composite scores may not be sensitive

enough to identify specific compensatory movements[2]. Therefore, we suggest evaluation of individual and group mean component scores. Assessing FMS data in this manner may improve the overall sensitivity and allow for identification of specific dysfunctional movement patterns.

1. Schneiders, A., Davidsson, A., Horman, E., & Sullivan, J. (2011). Functional Movement Screen Normative Values in a Young, Active Population. *The International Journal of Sports Physical Therapy, 6*(2), 75-82.
2. Beardsley, C., & Contreras, B. (2014). The Functional Movement Screen: A Review. *Strength and Conditioning Journal, 36*(5), 72-80.

(93)

Ed Bley, Anne Reeve*

Aspernigirin A: Progress toward Allylic Bromination

Aspernigrin A is a compound isolated from the Mediterranean sea sponge *Axinella damicornus* and the fungus *Aspergillus niger*. This secondary metabolite has been shown to be cytotoxic against human cancer cell lines and represents a possible oncological drug candidate. Several synthesis plans have been outlined for both aspernigrin A as well as its analogs. One scheme for the synthesis of the parent compound involves the synthesis of 3-(dimethylaminomethylene)-4-oxo-6-methyl-2-pyrone from the commercially available pyrone. The second step uses the molecule from the first step to form 6-methyl-1,4-dihydro-4-oxopyridine-3-carboxylic acid. Both of these steps were previously done and were replicated with moderate yields and with good purity. The next step proposed was the bromination of the previous molecule at the allylic position. Bromination at the allylic position would provide a good leaving group for attaching the phenyl via a cross coupling reaction. A number of bromine reactions and reagents have been tried in an effort to successfully brominate at the allylic. These reagents include hydrobromic acid, N-Bromosuccinimide and molecular bromine in a variety of reaction conditions. These have all proven unsuccessful for allylic bromination. **(92)**

Jennifer Bove, **Morgan Hagar**, **Aubery Krueger**, **Emily Corell**

Cardiac Prescreening in Young Adult Athletes Decreases Risk for Sudden Cardiac Events

Research Question: Among athletes between the ages of 12-24 years, what is the effectiveness of preventing cardiac events and death with cardiac prescreening? Significance and Background: Current prescreening in the United States fails to monitor the risk for sudden cardiac death (SCD), the leading cause of death in athletes. It is estimated that 1:50,000 college athletes and 1:50-80,000 high school athletes die of SCD (Harmon, 2014). Due to these alarming statistics, it is essential that echocardiogram (ECG) monitoring be implemented in initial prescreenings. Methods: Literature searches were performed using CINAHL, PubMed, and Cochrane databases. Resources used are dated between 2010 through 2014. Of the 33 resources found, 9 were utilized within this project with levels of evidence ranging from II to V with B quality. Findings: Evidence supported cardiac prescreening including ECG (Grazioli, 2013; Asif, 2012). Research showed that inclusion of ECG within athletic prescreening increased the likelihood of being able to detect cardiovascular abnormalities; however, there is a concern related to the false-positive rate (Asif, 2012; O'Connor, 2010). According to Corrado et. al (2011), the threshold to consider a health intervention cost effective is $50,000. The estimated cost for adding ECG screenings to history and physical examination is $42,000 per life saved

(Morse, 2010). Conclusions: Further ECG interpretation education necessary for physicians to help decrease the incidence of false-positive results. Increased evidence is needed as to why certain groups are at higher risk. Studies need to be conducted with reliable resources instead of reliance on media for statistics. Prescreenings that include ECG, past medical history, and physical exam are cost-effective and should be considered as the national guideline. **(100)**

Kimberly Branigan, Richard Schaeffer*, Michael Shin*

The Effects of Cadmium on Arabidopsis thaliana

Even in small amounts heavy metals can prove toxic to plant growth. The plant model organism, *Arabidopsis thaliana*, was used in these experiments to observe the effects of cadmium ($CdCl_2$) on plant growth. Studies were conducted to determine the amount of $CdCl_2$ that *Arabidopsis* could grow on and remain healthy. First, plants were grown on a broad range of 0.0 µM- 1000 µM $CdCl_2$ treated plates with 100 µM increments, then plants were grown on a more narrow range of 0.0 µM- 100 µM $CdCl_2$ treated plates with 10 µM increments. The results from the broad range tolerance assay show that even at a concentration of 100 µM concentration *Arabidopsis* was unable to grow. Therefore a second tolerance assay testing $CdCl_2$ concentrations less than 100 µM was carried out in which all plates showed at least minimal plant growth with the lower concentrations showing more substantial growth. A separate experiment was also conducted to determine the amount of $CdCl_2$ accumulated by *Arabidopsis* when healthy plants were grown on untreated plates then transferred and grown on a range of concentrations of $CdCl_2$ plates for a week. The amount of $CdCl_2$ accumulated inside plants was analyzed using atomic absorption analysis. These experiments present preliminary data showing cadmium's toxic effects on *Arabidopsis* and also the ability of *Arabidopsis* to accumulate Cd. **(48)**

Cody Brenneman, Michael Shin*

Columbia Arabidopsis thaliana Zinc Tolerance Through the Use of MTP1 as a Vacuolar Zinc Transporter

MTP1 plays a significant role in zinc transport into the vacuole and is thought to increase zinc tolerance and uptake. Two MTP1 mutant Columbia *Arabidopsis thaliana* strains, SAIL_305_A09 and MTP1-1, have been obtained for testing. This research will reveal the phenotypic effects of the mutations in the two strains, providing a broad characterization of the MTP1 transporter. Seed samples of MTP1-1 were plated with kanamycin as a selectable marker to determine the zygosity of each parent plant. Homozygous parent plants were plated on increasing zinc concentrations and root lengths were analyzed after 1 and 2 weeks of growth. A second goal was to determine the kinetics of wild type *A. thaliana* zinc uptake when grown on saturating levels of zinc. The plants were grown for two weeks on media excluding zinc and then transferred to media containing 1000 µM $ZnCl_2$ for varying time periods. They were placed in vials to dry, digested and analyzed through atomic absorption spectroscopy. Time course results of the wild type strain will provide baseline results used for comparisons in future assays utilizing the mutant strains. Any compromised zinc uptake and increases in the rate of saturation will be attributed to the lack of MTP1 function in SAIL_305_A09 and MTP1-1. **(53)**

Matthew Bressler, Abaz Kryemadhi*

Silicon Photomultiplier Studies

The goal of this project was to test various silicon photomultipliers (photon detection devices) at a range of temperatures. We know that temperature should affect the devices' performance, but the extent to which different brands, such as AdvanSiD and Hamamatsu, respond to temperature is as of yet unknown. After building a dark box with a cooling system, the silicon photomultipliers were to be placed inside and cooled to temperatures as low as possible so that we could study the gain, dark noise, and efficiency at cooler temperatures. **(20)**

Matthew Bressler, **Katrina Schrock**, Abaz Kryemadhi*

Development of a neutron veto prototype for Super Cryogenic Dark Matter Search Experiment

We assisted in assembling and testing a neutron veto prototype for the SNOLAB phase of the Cryogenic Dark Matter Search (CDMS). As a part of this, we had to analyze various aspects of the construction, including different glues and scintillator compositions using a spectrophotometer and a fluorimeter. Additionally, we were able to characterize our silicon photomultipliers (SIPMs) at temperatures nearing -25°C, allowing us to view the effect of temperature on dark noise. We also were able to begin testing the efficiency of neutron capture in our scintillator using radioactive sources. **(18)**

Thomas Carson, **Hannah Martin**, **Daniel Nesbitt**, Samuel Hsu, Timothy Whitmoyer*

Seed Pressing

Up until the present year, the Bio-Fuels Seed Pressing facility was used primarily as an occasional testing and research facility for the work done by the Bio-Fuels Burkina Faso Pressing & Production Team. This Team directed use of this facility concerning the production of sunflower oil for the bio-diesel process. In an effort to increase the usefulness of the Seed Pressing facility, the Team implored Messiah Dining Services concerning the possibility of producing sunflower oil to be used in the fryers at all the various dining locations around campus. This insightful invention would serve as a local and sustainable alternative to the frying oil they currently use. The goal of this new phase of the project is to receive sunflower seeds from the silo, feed them through the seed press and filter, and direct the product into containers that are ready to deliver to Lottie Nelson Dining Hall. This presentation will cover the intensive work that has been completed this year in order to design and successfully implement this process. **(3)**

Emma Cartisano, Jennifer Thomson*

Opioid Growth Factor Affects Presentation of Conditioned Fear Response in Rats

Post-traumatic stress disorder (PTSD) is a disorder of the stress response that may develop in some individuals following exposure to certain traumatic events including combat, crime, or natural disaster. Clinical studies have found a negative correlation between morphine administration and PTSD expression. The present study investigated the use of opioid growth factor (OGF) as a treatment to prevent the expression of conditioned fear in an animal model of PTSD. OGF, like morphine, acts on the opioid system within the central nervous system. Unlike morphine, OGF is a naturally produced peptide that demonstrates limited addiction potential. A traditional fear-conditioning model was used, in which rats were exposed to a series of three

foot shocks in a conditioning chamber distinct from the home environment. In Experiment 1, animals received an injection of either OGF (10 mg/kg) or saline at 48 hours post-stressor. In Experiment 2, animals received chronic injections of either OGF (10 mg/kg) or saline at 0, 24 and 48 hours after the traumatic experience. Fear expression was quantified as the percentage of time spent freezing on days 1, 2, 7 and 14 after administration of OGF. Rats that received a single dose of OGF showed a decreased conditioned fear response across test days as compared to animals receiving saline control injections. This study is the first to show a potential effect of OGF on learned fear responses in an animal model of PTSD. Future studies will investigate the use of OGF in other animal models of PTSD. **(36)**

Laura Castilow, **Gavin Stobie**, Brian Swartz*, L. Bryan Hoover†*

Affordable Sanitation

The World Health Organization (WHO) currently estimates that only 45 percent of rural Africans have access to basic sanitation services. Therefore, the majority of the population in rural communities continues to rely on open defecation and is therefore subject to the transmission of fecal-oral diseases. In many cases, the prohibitive costs associated with the construction of pit latrines restrict access to effective sanitation. In response to this challenge, students and faculty at the Collaboratory at Messiah College are working on the Affordable Sanitation Project. It is the objective of this project to identify design solutions to reinforce the structural integrity and increase the lifespan of pit latrines, with careful attention to the life cycle cost of the solution. This project will seek design solutions that are both more functional and more affordable than the current designs. **(55)**

Nathan Chaney, John Snyder, Jeremy Diehl, Connor Powell, Brian Nejmeh*

Intelligent Water Project (IWP): Data Transmission and Web Analytics

At the core of the Intelligent Water Project is a reliable data transmission system and website. Data is sent from handpumps to a server via SMS and a SMS receiver service, and it is processed by the server and put into a database. The server uses the data to determine the status of each pump, and the web application has many features to help users understand the data and determine how to respond to problems as they arise. **(12)**

Elisabeth Chang, **Gabrielle Clapper**, **Hing Jii Mea**, Katy Howell, Laura Penwell, David Vader*, Ray Knepper†*

Limited Pass Village Water Ozonation System (VWOS) Design

The Village Water Ozonation System (VWOS) team has designed a new limited pass embodiment of their ozone-based water treatment technology that reduces tank size and cost while increasing portability. Previous designs purified water in large-tank batches. The new design allows clients to purify water as it is needed. This change also aims to widen the clientele for the system by enabling one mobile system to treat water for multiple customers, resulting in more customers each bearing a smaller portion of the capital cost of the VWOS system. The VWOS team will share their design modifications and performance testing work, and progress toward the goal of maintaining a constant inflow of raw water and an equal outflow of water that has been filtered and ozonated to an oxidation reduction potential of 750 mV. **(87)**

Benjamin Chrisfield, H. Scott Kieffer*, Amy Porto*

The Effect of Combined Beta-alanine and Creatine Monohydrate Supplementation on Cycling Power Output in College-Age Athletes

β-alanine (BA) and creatine monohydrate (CrM) supplementation have been shown to augment athletic performance during high intensity activity. Research studying the effects of the combined supplementation of BA+CrM is limited. The purpose of this study was to evaluate the ergogenic effects of the combined supplementation of BA and CrM compared to the ergogenic effects of BA and CrM alone. Eleven males and three females voluntarily participated in a 4-week, double-blind, experimental study. Subjects Each subject was randomly assigned to receive either BA+CrM (4g BA+10g CrM daily followed by 4g BA+5g CrM daily), BA (4 g BA+10g maltodextrin placebo (PLA) daily followed by 4g BA+5g PLA daily), or CrM (4g PLA+10g of CrM daily followed by 4g PLA+5g CrM daily). Subjects consumed a loading phase dose for the first 2 weeks and then the maintenance dose for the following 2 weeks. Prior to and immediately following supplementation subjects completed a 30-second and 90-second Wingate (WAnT) test on a cycling ergometer. The data collected were the maximum power output in Watts and the fatigue index for each WAnT. The average change in fatigue for the 30-second WAnT from pre to post-supplementation was -2.8±0.5% ($\bar{x}$ ± SD) for BA+CrM, 1.9±0.2% for BA, and -1.8±0.5% for CrM. The average change in fatigue for the 90-second WAnT from pre to post-supplementation was for 0.8±5.0% BA+CrM, -2.3±6.4% for BA, and 5.3±7.6% for CrM. Eleven of fourteen subjects had completed testing at the time that this abstract was completed. Full results will be presented at the Symposium. **(39)**

Daniel Christensen, Richard Schaeffer*, Michael Shin*

Abiotic Stress on Arabidopsis thaliana Due to Zinc Toxicity

Plants depend on very specific concentrations of various micronutrients, including metal ions, for proper development. When these metal ions such as nickel, cadmium, and zinc appear in excessive amounts, as seen in areas with contaminated soil, plants may be damaged or unable to develop. For this reason, the study of plants that can resist, or remediate these toxicities is of great importance. *Arabidopsis thaliana*, an ideal plant model system, was used to test the accumulation of Zn^{2+}. An uptake and accumulation response curve of wild type *Arabidopsis* to zinc has already been determined at a lower resolution, in 250 µM increments from 0-2.0 mM $ZnCl_2$, and it was shown that zinc accumulation levels off at approximately 750 µM $ZnCl_2$. As an extension of this previous research, this study involved the determination at a finer resolution of the uptake and accumulation of exogenous zinc, in 50 µM increments from 0-750 µM $ZnCl_2$. Plants were grown over a two-week time period and subsequently allowed to accumulate in varying concentrations of zinc for one week. Once harvested, dried, and digested with nitric acid, the remaining metal was analyzed with atomic absorption spectroscopy. **(89)**

Lauren Clune, Brett Warner, H. Scott Kieffer*

Effects of Intermittent Caffeine Ingestion on Aerobic Power During a 16.1K Cycling Time Trial

PURPOSE: This study compared the efficacy of two different modes of caffeine administration on cycling performance during a 16.1 kilometer time trial (TT). METHODS: A randomized, placebo-controlled (PL) double-blind study was used to compare a caffeine bolus administered in a single dose via capsule to an intermittent bolus administered via caffeinated gum. Eight

trained cyclists, 6 male, 2 female (Mean+SD: 27.8±11.8 years, 76.7±13.9 kg, 176.1±8.2 cm, VO_2peak = 47.9±6.4 ml•kg^{-1}•min^{-1}) completed one familiarization and three experimental trials. During the first session, the cyclists completed a graded cycling protocol to determine VO_2peak and an orientation to the Velotron cycle ergometer. During the experimental trials, the subjects received a dual $pill_p$-gum_g bolus containing either a placebo (PL) or caffeine (CAF) dose equal to 5 mg•kg^{-1} of body mass. The pill-gum combination included PL_p-PL_g, PL_p-CAF_g and CAF_p-PL_g. The pill was given 60 minutes prior to the TT and the gum was given in equal doses at 5 minutes prior to the TT and at 8K. Subjects performed the 16.1K TT on a 2% ramped incline with VO_2, RER, HR, Watts, and RPM measured continuously. Data was analyzed using a two-way ANOVA (condition x time). RESULTS: There was no statistical difference in finish time for any condition, PL_p-PL_g = 2387.4±237.0, PL_p-CAF_g = 2393.5±194.5 and CAF_p-PL_g = 2410.8±228.7 s. There were no statistical differences for the main effects of condition for any variable, PL_p-PL_g, PL_p-CAF_g and CAF_p-PL_g for VO_2 (Mean±SD: 36.6±8.0; 36.5±7.0; 36.6±8.6 ml•kg^{-1}•min^{-1}, respectively), Watts (204.9±33.1; 202.34±32.9; 200.2±33.4 W, respectively), or HR (163.4±20.8; 168.4±21.7; 163.1±24.0 bpm, respectively). In addition, there were no significant differences for VO_2, Watts, or HR across the TT; however, significant decreases were found in RER and RPM (Mean RER = -7.1% (P = 0.001); Mean RPM = -4.4% (P = 0.34)). No interaction effects were found. CONCLUSION: The present findings indicate 5 mg•kg^{-1} of caffeine does not improve overall 16.1K TT performance, metabolic response, or cycling efficiency with no statistical difference between a single bolus dose in capsular form or intermittent doses in gum form. RER decreases over distance as the body may increase fat utilization, and RPM decreases over distance as subjects succumb to fatigue. **(68)**

Christa Cohen, Abaz Kryemadhi*

'Physics? Gross!': How Physics Education Research Addresses Problems for Undergraduate Physics Students

Physics Education Research, a relatively new field of study, seeks to identify, address, and resolve problems faced by physics students in a variety of courses. In this project, I investigated the generalized problems identified by researchers, their possible causes, and several proposed and researched modifications to physics teaching methods. **(16)**

Alyssa Cohrs, **Tori Deares**, **Kimberly Desrosiers**, Teresa Biagio†*, Dawn Hippensteel†*, Deb Heisey†*, Tiffany Boyd†*, Sue Ann Bruce†*

Culturally Competent Knowledge Impacts Transgender Patient Satisfaction

Background: Nurses at Pinnacle Health System have seen a recent increase in the number of transgender patients they care for, and some specific incidents have triggered a need for deeper study in this area. Included in this evidence based practice project are a number of findings from literature reviews as well as from studies aimed at measuring the overall satisfaction of transgender patients. These studies and reports were conducted in both clinical and community settings, and utilized both written survey and interview formats. Aims: The purpose of this project is to determine what factors affect overall transgender patient satisfaction in the healthcare setting. Methods: Relevant information was obtained from National Guidelines Clearinghouse, CINHAL, and PubMed databases using the following key search terms: transgender nursing care, transgender care, transgender health care, LGBT

health care, transgender patient satisfaction. Results: Nurses play a key role in transgender patient satisfaction in healthcare settings. Discrimination against transgender patients is a common problem. Transgender patients are at risk for poor quality of healthcare. More research needs to be done in this area. Recommendations: Practice changes are essential to improve transgender patient care. Provide continuing education classes to current nurses to improve competency. Incorporate transgender care into curriculum for nursing students. Enhance the overall healthcare environment to make it more welcoming and unbiased. Conduct additional studies to focus on more specific issues within the transgender population. **(107)**

Lindsay Coleman, **Paul Leiphart**, Richard Schaeffer*

Quantitative Mineral and Nutrient Analysis of Moringa oleifera Leaves

Moringa oleifera leaves recently have been getting a lot of attention in the nutritional world for their alleged nutritional benefits. Gram for gram, *Moringa* leaves are said to have nine times more protein than yogurt, twenty-five times more iron than spinach, fifteen times more potassium than bananas, seventeen times more calcium than milk, ten times more vitamin A than carrots, and as much vitamin C as oranges. The scientific literature on the nutritional content of the leaves shows that the mineral composition is highly varied (some with relative standard deviations as high as 82%). The high standard deviations of mineral composition could be a result of poor sampling, or the high variance could be due to the nature of the plant and its environment – the soil, the atmosphere, and the age of the plant[1]. For the majority of analyses, the plants were digested with aqueous solutions of HNO_3 and H_2O_2. Only Na and Cu fell within the 95th percent confidence interval when analyzed in a certified NIST standard, but the other metals tested can guide future analysis. In the sample of *Moringa* analyzed, the concentrations of the following nutrients were measured in mg per kg of dry leaf: Ca, 13,490 (± 35.8); K, 11,660 (± 41.5); Mg, 4905 (± 9.2); Na, 123 (± 0.87); Zn, 34.26 (± 8.2×10^{-2}); Cu, 7.18 (± 9.5×10^{-3}); and Pb, 1.4 (±16×10^{-2}).

1. Witt, Kathryn. The Nutrient Content of *Moringa oleifera* Leaves. Echo Community. Accessed March 2014

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Joe Coshun, **Ryan Hahn**, Harold Underwood*

Wireless Enabled Remote Co-presence (WERC)

The Wireless Enabled Remote Co-presence (WERC) team is working on a system to allow people with social and cognitive disorders to live and work more on their own. People (participants) with disorders such as PTSD and Asperger's Syndrome often have to rely on an assistant (e.g., social coach or attendant) to perform daily tasks. However, the assistant/participant relationship can lead to dependence and/or stretch the resources of the social agency. WERCware 3.0 envisions a solution that allows a life-coach to remotely attend numerous participants with various disabilities via a Skype call on an Android phone. Calls may be voluntarily or auto-triggered. This year, the WERC team has been analyzing ways to measure stress, as a threshold trigger for an automatic call from a participant to the coach. Prior work has shown that Galvanic Skin Response (GSR) can serve as such a stress indicator, but tends to conflate positive versus negative stress. Subsequent experiments have tested voice analysis using an Artificial Neural Network (ANN). The human voice typically has frequency

characteristics that change due to stress. By passing multiple audio samples into its inputs, an ANN can be trained to accurately make "yes" or "no" decisions about stress, with a relatively high success rate. Future work for this project includes further testing and implementation of the ANN and other research involving electroencephalography (EEG) to determine its potential to measure stress via characteristics of a person's brain waves. **(86)**

James Crawley, Niklas Hellgren*

Design and Characterization of a Vacuum System

Vacuum systems are commonly used in research applications where it is important that the material of interest does not interact with, or is being contaminated by the exposure to atmosphere. In this project, we have constructed a vacuum system with an ultimate pressure of ~10^{-7} Torr, designed for thin film vapor deposition. The vacuum performance was characterized in terms of pump down speed, pressure vs. gas flow, and power consumption. We will also report on initial attempts to deposit thin films. **(22)**

John Deseno, **Brianna Wenger**, Harold Underwood*, Carman Frith†*, Cary Cupka†*

Flight Tracking and Messaging Systems (FTMS)

Outside radar range, small planes flying in remote locations must be tracked by alternative means. Organizations aimed at emergency relief, humanitarian development and missionary support follow such flights, to insure safety. The Automatic Flight Following System (AFFS) has been extensively tested by JAARS for this purpose, but its central microcontroller -- a small single board computer (SBC) has become obsolete. The FTMS team had been upgrading AFFS to version 2.0 by replacing the SBC with a newer one on the market and integrating newer technology to add additional features to the system. However, this past year, the team has been researching, recording, and communicating with outside sources in order to come up with a more complete, practical and modernized solution to modifying the system. This includes the use of newer smartphone technology. Also after much research, the team chose to use the "Arduino Mega Android ADK" as a central processor in order to configure the display unit on the ACU, process all GPS data, and monitor all controlled systems. Vision for future work includes research on establishing a communication link between the aircraft/ground station, and also developing a prototype to be tested. **(33)**

Jared Detweiler, **Justin Henry**, Tim Van Dyke*, John Meyer*

Mobility Tricycle Project: Rear Axle Redesign

The Mobility Tricycle Project designs electric and hand-powered tricycles for persons with disabilities in Burkina Faso, West Africa. In 2009, the tricycle frame was redesigned to improve manufacturability, strength and ergonomics. This new, simplified frame design relied on the ability of the rear wheel axle to be supported on one side, similar to how traditional wheelchairs wheels are supported. Prior to this, the frame designs supported the axles on both sides. Field data collected in Burkina Faso and extensive testing conducted at Messiah College revealed that axles used on the new frame design failed prematurely in the electric version of the tricycle. After evaluating several variations of the single-sided axle support, it was ultimately decided to return to a more traditional double-sided axle support configuration. The goal of the current project is to integrate this double sided wheel support structure into the

current frame design in order to increase the life of the axles while utilizing materials and manufacturing processes available to fabricators in Burkina Faso. While the original double-sided design had already been developed, it was decided to create a new double-sided design in order to make it less difficult to manufacture, eliminate dangerous protruding corners, and reduce the overall width of the trike. This new design was developed using computer design and simulation software that enabled us to validate the strength of our new frame design. A prototype of the new frame was created and final adjustments are being made before the first model is produced. **(5)**

Alyssa Doll, David Foster*

Altering Photosynthate Allocation in Lettuce with Supplemental LED Lighting

Aquaponics is a food production system that combines conventional aquaculture, such as raising tilapia in tanks, with hydroponics, a method of cultivating plants in water. Food production through aquaponics provides a sustainable method to grow crops year round because of its minimal water use, energy efficient lighting, and circle of nutrient exchange. The goal of this study was to use programmable LED lighting to manipulate the daily light integral (DLI), a measure of the amount of light received in a single day for a specific area combined with the spectral composition of LED emitted light energy, in order to maximize plant growth per unit time in an aquaponics system using Thai basil (*Ocimum basilicum,* Siam Queen). DLI effects were compared between a 16- and 24-hour photoperiod, assessed by measuring plant biomass production in total biomass, root and leaf compartments, as well as comparing CO_2 uptake at various light levels with fluorescence measurements of maximal chloroplast activity and chlorophyll concentration. Overall, this study concluded that there was not a significant difference in CO_2 uptake between the two groups. However, significantly more roots were produced at the longer photoperiod. In conclusion, a 16-hour photoperiod is the better route for growing Thai basil in aquaponics because it is more energy efficient, cost effective, and produces the same amount of edible biomass as a 24-hour photoperiod. **(64)**

Richard Dufrenne, **Garrett Myers**, **Robert Schmuck**, Donald Pratt*

Basic Utility Vehicle (BUV) Firetruck

This year, the Basic Utility Vehicle team took on a new direction for the project. The end goal is to create a BUV that will serve as a fire truck to fight small structural fires in remote areas. In many developing countries, there is a lack of equipment and infrastructure in place to combat fires, especially in rural areas. This project hopes to meet that need by providing an inexpensive and rugged vehicle that will make effective use of limited resources. For example, the team has been investigating the use of a compressed air foam system (CAFS) to improve the fire-fighting capacity of the water, a potentially limited resource. The most immediate goals for the group were to develop a design that would meet desired specifications and to begin obtaining components that will be used in that design. Our team has created an initial design for the chassis and acquired power train components and a centrifugal pump. We have begun the testing of components and the construction of the frame. The team's next main goals include completing the chassis, suspension, and steering. **(28)**

Melissa Dukelow, **Bethany Espenshade**, **Alyssa Heath**, **Storm Hajek**

Early Implementation of Palliative Care to Better Patient Outcomes in Congestive Heart Failure Patients

Research Question: What are the effects of early implementation of palliative care on patient outcomes in patients with congestive heart failure? Significance and Background: Palliative care is a specialized type of care that focuses on symptom relief and improving quality of life. Palliative care has been shown to improve patient outcomes with cancer patients (Adler, 2009); but there is little research about the benefits of early implementation of palliative care in patients with congestive heart failure (CHF). Delayed implementation of palliative care results in poorer patient outcomes and decreased benefits. Benefits include symptom relief, improved patient satisfaction, and decreased care costs. Methods: A review of literature was conducted utilizing PubMed, CINAHL, Center to Advance Palliative Care, American Journal of Hospice and Palliative Medicine, and Cochrane Database from 2008-2014. A total of 88 articles were identified; 5 articles were utilized that addressed the problem and were the focus of the review. The majority of the articles were a level IV with an A quality. Findings: Evidence supports early implementation of palliative care in a CHF diagnosis. Clinical guidelines call for the implementation at the time of diagnosis (National Consensus Project for Quality Palliative Care, 2009). Early implementation of palliative care had a positive impact on communication ($p < 0.001$) and emotional support of patients ($p < 0.001$) (Casarett, 2008) as well as being associated with fewer days until discharge, decreased inpatient deaths ($p < 0.01$), and higher hospice admissions among the frail inpatient deaths ($p < 0.003$) (Reyes-Ortiz, 2014). Conclusion: Research provides consistent proof of concept and indicates pilot changes in practice. Palliative care consultation should be initiated at diagnosis. In addition, a dissemination of research findings is needed based on minimal published findings. **(111)**

Taylor Eberly, **Lauren Long**, Tim Van Dyke*, John Meyer*

Mobility Tricycle Project: Front End Redesign

The Mobility Tricycle Project designs electric and hand-powered tricycles for people living with physical disabilities in Burkina Faso, West Africa. Most of the tricycle design has been carefully reviewed and optimized; however, one area in particular, the front-end of the tricycle, can still benefit from a systematic redesign. With the current tricycle design, the rider must constantly exert a force on the steering handle in order to maintain a straight path and, as the tricycle reaches higher speeds, the steering begins to wobble left and right. These handling characteristics are undesirable and troublesome for many of our clients who have limited upper body strength. We identified four factors that could contribute to poor handling performance in the current tricycle design: front-to-back weight distribution, one-sided drive system, brake design, and the geometry of the front end. We developed and completed multiple tests to determine how each of these factors influenced tricycle handling and steering performance. Testing results indicated that the tricycle's tendency to steer to the right increased as weight shifted to the front of the tricycle, but this also increased the front wheel's traction on loose surfaces. Further, our testing revealed that the front end geometry has a very large effect on the tricycle's tendency to steer to the right, while the drive and brake have little effect. In particular, we discovered that the bicycle fork used in the front end of the tricycle was not symmetric. This asymmetry was created as the fork was manually spread during manufacturing

of the tricycle in order to accommodate larger wheels. To correct this issue, we designed, built and tested a tool which can be used to spread the fork in a more controlled and uniform way. Our goal is to provide this tool to our manufacturers in Burkina Faso to be used during new front fork installations. Use of this tool should ensure uniform spreading of front forks and improve the tricycle's steering performance. **(6)**

Aaron Edgin, **Andrew Gates**, Annaleise Peterson, Timothy Whitmoyer*, Douglas Phillippy*
Biofuels for Burkina Faso
The Bio-Fuels: Burkina Faso Pressing and Production project works to implement seed pressing and bio-diesel production in the developing sector. Currently, all of the fuel in Burkina Faso is imported, leading to fairly high gas and diesel prices. Our team is seeking cheaper, alternative fuel sources. We are working with Matt Walsh and SIM, Serving in Mission, to install a complete pressing and production setup in Mahadaga, Burkina Faso to provide an alternative source of diesel fuel. Last January, we sent a team to Mahadaga to work on installing the seed press. With the seed press now running, we have turned our focus to the production of bio-diesel. Sourcing the chemicals necessary for producing bio-diesel has proved challenging and time consuming. As we continue to work with various suppliers, we have turned our attentions to alternative uses of the oil produced from the press. In the village of Mahadaga, many people have small diesel engines used for de-husking rice and milling grain. The current work of the team is focused on finding ways in which those smaller, stationary, diesel engines can be run off of straight vegetable oil. This will cut out the need for the chemicals and provide some more immediate solutions to our client while we continue to work towards the greater goal of bio-diesel production. **(2)**

Alex Faus
Lessons from Rwanda: Educational Challenges and Why
This presentation will focus on lessons learned while teaching physical education and civil engineering classes in Rwanda. There are currently significant challenges facing the educational system in Rwanda, including language barriers, financial constraints, oversimplification of content, and a lack of emphasis on critical thinking skills. The lessons learned from this semester abroad are applicable to any vocation, but this presentation will highlight implications for those entering health professions. **(52)**

Alex Faus, Will Franken, Hunter Harris, Jodie Haak*, H. Scott Kieffer*
Comparison of Energy Expenditure During Walking, Jogging, and Running One Mile
Walking and running are common exercise modalities used in exercise prescription programs to improve fitness and body composition levels. The American College of Sports Medicine indicates the exercise prescription intensity levels for healthy adults should range between 50 and 80% of maximal VO_2R. Each of these intensities will have an impact on the total energy expenditure of the exercise bout. Therefore, the purpose of this study is to determine the difference in caloric expenditure between walking, jogging, and running during one mile. Three recreationally active females completed a one mile treadmill test at speeds equivalent to 50, 65 and 80% maximal VO_2R. The exercise intensities for each subject were obtained using a submaximal treadmill test, by which the speed of the treadmill was predicted using a regression

equation specific to each individual's response to the graded exercise test. Oxygen consumption was measured with the Moxus oxygen analyzer using breath-by-breath analysis. Caloric expenditure was calculated using the non-protein conversion factor from the RER obtained during the analysis. The results will be presented at the Symposium. **(94)**

Aaron Film, **Marcus Upton**, Luke Betteridge, Andrew Dunmire, Damaris Gehman, Althea Mavros, Tony Beers*, Joseph Longenecker†*, Thomas Soerens*

Garden Water Access Project

In order to meet the need for irrigation water during the dry season of Western Africa, the Garden Water Access Project has designed a hand-powered well drilling system and simple handpump. In conjunction with SIM and Open Door Development in Mahadaga, Burkina Faso, these systems are already providing water for dozens of families. In the final phase of the project, the drill bits were systematically tested and acceleration data analyzed in order to ensure their effectiveness. **(59)**

Stephanie Flagle, **Valerie Heisey**, **Jillian Sisson**, **Sally Wenger**, Melanie Duffy†*, Karen Good†*, Ashley Arnold†*, Kathy Chester†*, Jennifer Albert†*

Family Involvement in Sensory Stimulation of Adult Patients with Neurological Insult

Background: Previous research studies have shown the benefits of family involvement in sensory stimulation on the recovery process of adult patients with neurological insult. However, nurses' experiences have shown that family members often inappropriately stimulate the patient. Since involvement in care increases family satisfaction, families could benefit from basic information about appropriate sensory stimulation. Purpose: To determine if sensory stimulation education has a positive effect on family satisfaction. Methods: A systemic review was conducted using CINAHL, Cochrane, and PubMed databases. Four articles were chosen for evaluation. Findings: Sensory stimulation education enhances family involvement in care and increases family satisfaction. Recommendations: Implement a practice change by developing an educational tool. **(102)**

Andrew Floro, **Scott Kerstetter**, **Jessica Kline**, **Josiah Peck**, Randall Fish*, Chris Byers†*, Liam Tanis†*

Solar PV for the Theological College of Zimbabwe

Electrical power in Zimbabwe is extremely unreliable and is frequently unavailable. Many of these incidents last for a few minutes but they can extend for several days. Students at TCZ have trouble completing their studies without consistent power. They find it particularly difficult to do school work when the library and computer labs do not have power. We have developed a proposal and chosen the major system components for a Solar PV system which would provide power for the Library and Computer lab. Most of the funding for this system has been provided by local churches and the organization Friends of TCZ is continuing the fundraising efforts. We have built a small scale system at Messiah College to practice the installation. The Solar PV, TCZ site team with travel to Bulawayo Zimbabwe in May 2015. After our visit in May, the system will be fully installed and operational. This will result in the computer labs and library being re-wired separate from the rest of the buildings/rooms. This

new network will have sufficient power to function at all times, using power from solar panels, battery back-up from the panels, and the power grid. **(77)**

Juliana Frederick, **Elizabeth Seigendall**, **Katelyn Berkheiser**, **Pratima Jude**, Morgan Petrie†, Kathryn Shradley†*, Kimberly Fowler†*

The Nurse's Role in Pain Control for Chest Tube Removal

Background- Chest tubes are commonly found on cardiothoracic post-operative units and their removal is perceived by patients as anxiety inducing and painful. From the nurse perspective, pain control is not adequate and creates unnecessary anxiety and stress for patients. Because nurses have gained rapport with patients, and are aware of medication regimens and schedules, a possible solution to this clinical problem is for nurses to remove the chest tubes. Purpose- The purpose of this evidence-based practice project was to explore the effects of bedside nurses removing chest tubes on pain and anxiety in cardiothoracic post-operative patients. Methods- Literature was obtained via CINHAL and PubMed databases. Limited evidence was found to support this evidence-based practice problem, but additional research evidence was collected to emphasize the importance of the topic. Results- Nurse-led chest tube removal should not be implemented because of a lack of evidence, but it should not be dismissed as a possibility. Upon analysis of the literature, it has become clear that a protocol, including time-sensitive pharmacological and non-pharmacological interventions is necessary to control pain for chest tube removal. Conclusions- A limitation of this evidence-based practice problem includes the limited current research on nurses removing chest tubes. Additionally, there was limited research evidence on the topic of pain and anxiety during chest tube removal in general. Recommendations- Because of a nurse's unique position in patient care, it is crucial that they play a role in the management of chest tubes, and especially their removal. More research is necessary in order to determine the significance of nurses removing chest tubes, but it is clear that collaboration with other practitioners is essential in order to provide adequate pain control for patients undergoing chest tube removal. **(104)**

Austin Galaska, **John Kreider**, Tim Van Dyke*, John Meyer*

Mobility Tricycle Project: Brake/Control Box Redesign

The Disability Resources - Mobility Tricycle Project exists to provide transportation for those with physical disabilities in Burkina Faso. As the Brake/Control Box Redesign team, our goal is to finalize and improve the brake redesign from last year which had minor issues which needed to be changed. These issues led to accelerated wear due to lack of tolerances in manufactured parts or failure of parts due to stress. In addition to improving the brake design, the control box was redesigned in order to simplify fabrication of parts and manufacture of the control box assembly. The new design uses gears with set screws to hold gears onto a shaft instead of gears which had to be held in place by pins put through holes drilled in the shaft and gear. Various part dimensions were changed to minimize cost. A shaft collar was utilized to replace the need for a drilled hole and cotter pin. With these changes, we were able to simplify the design of the brake/control box in a way which decreases manufacture time and minimizes cost. All of these changes are reflected in the updated assembly document so our clients are provided with a consistently manufactured product. **(7)**

Kaitlyn Grando, Courtney Burkett, Lawrence Mylin*

Transfection of Primary Kidney Cells with Mutated SV40 T ag DNA Containing a CCKCR Intron Sequence

Cholecystokinin-C receptor (CCKCR) is an alternatively spliced version of cholecystokinin-B receptor (CCKBR) found in pancreatic cells. CCKCR is uniquely expressed by cancer cells, making it an important target for immune therapy. Simian Virus 40 Large Tumor Antigen (SV40 T ag) has proven to be a powerful model in the study of cell-mediated immune responses to tumors. Our goal was to construct cells which express a derivative of SV40 T ag that incorporates the retained intron sequence from CCKCR to use as a tool in the study of cell-mediated immunity targeting this unique sequence. Two variations of plasmids containing mutated T ag DNA with a 20 codon replacement (20mer) from CCKCR intron 4 were prepared: containing either an F408A substitution in epitope IV (pCBKG/F408A) or wild-type (WT) epitope IV (pCBKG/WT). Sequencing confirmed the presence of the 20mer in place of epitope I through II/III, confirmed the appropriate sequence in epitope IV (F408A or WT), and revealed a previously undetected silent mutation within the 20mer. These DNA preparations were purified and used to transfect primary kidney cells harvested from naïve mice. Transfection was performed in four parallel batches: pCBKG/F408A, pCBKG/WT, pSelectESV (WT Tag), and a no DNA control. After several weeks, dense foci of growth were isolated and expanded. Those transfected with WT T ag showed greater numbers of foci and growth rate of isolated cell lines than those transfected with either 20mer replacement mutant. Immunofluorescence revealed successful transfection of the WT, but was inconclusive for pCBKG/WT and negative for pCBKG/F408A. **(46)**

Hanh Dao, Roseann Sachs*

Reduction Reaction of Ketones and Imines Using Biocatalysts

Green chemistry is a relatively new branch of chemistry that desires to perform chemical reactions using more environmental friendly reactants and processes in order to reduce or eliminate the generation of hazardous substances. Many different approaches to green chemistry have been studied. Among them, biotransformation, the use of biological materials such as cells, organs, or enzymes to perform chemical reactions, is one of the most popular approaches. This research focused on the reduction reaction of ketones and imines in aqueous media, at room temperature. The biocatalyst mostly used throughout this research was *Daucus carota* (carrots). The first attempted reaction was the reduction of 2-benzofuranylmethylketone to 1S-1-(2-benzofuranyl)-ethanol, which was well studied. Thin layer chromatography and gas chromatography - mass spectrometry both confirmed that the product formed after 2 hours of reaction and the reaction went to completion between 6 to 8 hours. This research also focused on imine reduction. Two imines, 3-dimethyl-1,3-dihydro-2H-indol-2-imine hydrochloride and 3-phenyl-2H-1-benzopyran-2-imine hydrochloride, with similar structure to 2-benzofuranylmethylketone were studied with limited success. Reductions with materials and reagents reported in the literature could not be reproduced in our laboratory. For example, nitrobenzene was reported to successfully reduce to aniline with 52% yield after 8 days of reaction, using *Beta vulgaris* (beet). However, after 8 days of reaction with either *Beta vulgaris* or *Daucus carota*, no product was detected. The reported reduction of benzophenone to benzohydrol was also further explored. **(44)**

Jonathan Hepner, **David Houck**, **Rebecca Ports**, Melanie Aroniss, Kyle Margosian, Braden Olson, Tony Beers*, Thomas Soerens*

Hollow Fiber Membrane Filter Testing

The HFM (Hollow Fiber Membrane) Filtration Team designs and implements filtration systems that use Sawyer filters. This includes a system that was installed in Panama in January 2015. Currently, the HFM Filtration Team is designing a testing system to complete a filter life study for Sawyer bucket filters in order to verify their given life expectancy of lasting several years and one million gallons (approximately 2.5 years of testing). The project proposed to meet the standards of Sawyer filters by re-circulating stream or spiked water through 24 filters in parallel through the use of a manifold and pump system. Flow and pressure through the system would be monitored to verify the functionality of the filter during forward flow and backwashing procedures. The life cycle test would be measured through the use of periodic biological tests in order to determine the amount of bacteria left in the filters after strenuous use. Data will be provided to Sawyer to verify or deny their proposed life expectancy for the filters. **(31)**

Rachel Hoover, **Elizabeth Smullen**, **Alexa Peashey**, **Sarah Wall**

Evidence-Based Distraction Techniques to Decrease Chronic Pain in Pediatric Patients

Research Question: In pediatric patients, what is the impact of distraction techniques on chronic pain? Significance and Background: Distraction techniques are important because pain is an undesired adverse effect that impacts school performance and psychosocial development. Pediatric patients are a vulnerable population who require health care tailored to their developmental needs. Chronic pain among children is a challenge to manage. Distraction is effective in chronic pain management (Kollar, 2012). Methods: A literature review from 2008-2014 was conducted using the following databases: Medline, PubMed, CINAHL, Cochrane Database, and National Guideline Clearinghouse. Seventeen articles had application to the research question and a majority were Level 1 with B Quality. Findings: The few studies that related to chronic pediatric pain had significant p-values to support distraction techniques to reduce acute pediatric pain (Miller, 2010; Wohlheiter, 2012; Koller, 2012; Singh, 2012; Downey, 2012). The few studies that dealt with chronic pain reported distraction techniques were beneficial in reducing perception of pain in both adults and children (Grob, 2012; Wiederhold, 2014). Additional findings included decreased anxiety, stress, and improved quality of life (Potasz, 2013; Koller, 2012; Grob, 2012). Conclusion: Researchers have noted that distraction techniques in clinical practice improve pain levels in children with acute pain. Many distraction techniques have been identified in aiding acute pain management. These techniques may be tried in patients with chronic pain to obtain relief. Due to the complexity of chronic pain, not much research has been done on this significant issue of chronic pain in children. More research needs to be done to test generalizability of acute pain distraction techniques for chronic pain. Implementation of these techniques may decrease chronic pain levels in pediatric patients. **(101)**

Katy Howell, **Laura Penwell**, Elisabeth Chang, Gabrielle Clapper, Hing Jii Mea, David Vader*, Ray Knepper†*

Limited Pass Village Water Ozonation System (VWOS) Design

The Village Water Ozonation System (VWOS) team has designed a new limited pass embodiment of their ozone-based water treatment technology that reduces tank size and cost while increasing portability. Previous designs purified water in large-tank batches. The new design allows clients to purify water as it is needed. This change also aims to widen the clientele for the system by enabling one mobile system to treat water for multiple customers, resulting in more customers each bearing a smaller portion of the capital cost of the VWOS system. The VWOS team will report on their design modifications and performance testing work, and progress toward the goal of maintaining a constant inflow of raw water and an equal outflow of water that has been filtered and ozonated to an oxidation reduction potential of 750 mV. **(4)**

Matthew Ingalls, Michael Shin*

Establishing a Mini-Scale Hydroponic Protocol in Arabidopsis thaliana

Heavy metal accumulation poses a great threat to the environment and human health. Phytoremediation is a method which has potential to remove these heavy metals from the environment. In order to employ phytoremediation to remove heavy metals it is important to understand the mechanisms behind their uptake in plants. We worked toward the establishment of a protocol for mini-scale hydroponic cultivation which will eventually be used in a staining procedure to localize nickel in *Arabidopsis thaliana*. This study varied conditions of germination, solid phase media, liquid phase media, and growth chambers. It was discovered that the method of germination does not greatly affect the overall growth of plants. We also found that it is advantageous to use media lacking sucrose and cover growth chambers to avoid contamination. Additionally, the introduction of aeration aids in the prevention of the anthocyanic trait as well as improves overall plant health. Lastly, we explored solid phase media composition and found that it plays a large role in longitudinal root growth. This data can be used in the future to further establish a protocol for use in staining procedures. **(61)**

Andrew Joy, Brian Swartz*

Pedestrian Bridge in Panama

In the Bridge Project, we believe that everyone deserves the right to have safe and reliable access to essential life resources. With our partner, Rio Missions, we have identified communities in Panama with restricted access due to seasonal flooding, and are working to improve access to life-sustaining resources by designing and constructing pedestrian bridges. Last summer, we completed our first bridge in a community called Arraijan. This bridge now connects two halves of a community, and provides safe and reliable year-round access to the road where kids can travel to the local school. After the successful completion of the first bridge, we identified a new community called La Gigi. This community is cut-off from their local school and medical center by a seasonally flooding river, comparable to the Yellow Breaches. We are working with a service-oriented bridge building organization called Bridges-to-Prosperity and have recently finished designs for this 215ft cable suspended pedestrian bridge. We are planning a six week construction trip for this Summer starting in mid-May and finishing at the end of June. **(73)**

Lindsay Koach, **Benjamin Wolf**, **Rachel Vogt**, **Cooper Grimm**, Maryalyce McCormick†*, Stefanie Miller†*, Yana Dillman†*, Becca Fox†*, Wanda Hoyer†*

Reducing Agitation in Dementia with Aromatherapy

In older persons with dementia, agitation is a common and disruptive symptom. It places stress and unnecessary suffering on individuals, their family, and their caretakers. The purpose of this EBP project was to study the effects of aromatherapy on agitation in older persons with dementia. Multiple databases were used including CINAHL, PUBMED, and the Cochrane Library. Eight studies were selected, but only four were ultimately used. It was found that lavender is a statistically significantly treatment option for agitated patients as an adjunctive therapy with pharmacological agents without the negative side effects of pharmacological agents. Lavender was found to be a safe and effective alternative therapy. **(99)**

Kelly Kulp, Harold Underwood*

Wireless Enabled Remote Co-presence (WERC)

The Wireless Enabled Remote Co-presence (WERC) team has worked with SymBionyx to develop a system that dispenses coaching services via a remote link. People with cognitive disabilities or traumatic brain injuries often need an assistant to help them learn or re-learn daily tasks. However, direct ongoing assistance by a life-coach or attendant-care provider can foster dependency, and limit the ability of social agencies to meet other needs. WERCware aims to revolutionize this strategy, by enabling one attendant to serve multiple participants from a remote location, while fostering more independent development by the participant. WERCware 3.0 initiates and maintains contact between attendant and participant via Skype over an Android smartphone worn by the participant via a pendant-style adjustable holster. This presentation reports on the automatic cut-off solution, a backup feature of the WERCware system that turns off any video and sound feed for privacy in identified confidential areas, if not already done so voluntarily by the participant. The cut-off sensor should recognize when the participant has entered a confidential area and issue a signal that tells the smart phone to turn off the video and sound feed. An ultrasonic emitter-detector pair has been tested, with receiver circuitry intended to interface with the Arduino microcontroller, and integrated with the smartphone. The Arduino and the smartphone will be connected either by USB or bluetooth connection, the choice of which has been an issue of investigation. Other ongoing work by the "human stress analysis" team includes development of biometric sensors (e.g., GSR, voice, EEG, etc.) interfaced with the Arduino to monitor emotional health of the participant, so as to supplement the automatic cut-off feature with automatic call-triggering to the remote coach, for an overall more robust solution. **(54)**

Matthew Lauver, Caitlin Mason, Stephanie Schell†, Lawrence Mylin*

Investigating Cellular Immunity Using the Simian Virus 40 Large Tumor Antigen

The Simian virus 40 large tumor antigen (SV40 T ag) is a viral oncoprotein that generates a strong cellular immune response in H-2^b (C57BL/6) mice directed against multiple immunodominant (I, II/III, IV) and immunorecessive (V) CD8+ T lymphocyte epitopes. Because of its ability to induce tumors and serve as the target for anti-tumor T cell responses, the SV40 T ag has been studied extensively as a model to better understand immune targeted control of solid tumors. Our laboratory has recently identified three CD4+ epitopes within the T ag and is

conducting studies to characterize their role(s) in regulating cellular immunity to the T ag, including the generation of CD8+ T lymphocyte memory. Towards this goal, we have generated a cell line (C2a) that expresses a derivative of the T ag in which the three newly discovered CD4+ epitopes have been inactivated by substitution or deletion. The induction of SV40 T ag epitope I- and IV-specific CD8+ T cells has been compared by MHCI Tetramer staining and Intracellular Cytokine Staining (ICS; IFN-γ) following primary and secondary immunization using B6/WT-19 cells which express the intact SV40 T ag and/or the C2a cells. Experiments were conducted to investigate the role and importance of negative regulation by enumerating SV40 T ag-specific IL-10-secreting CD4+ under similar conditions and by searching for additional determinants in the T ag that stimulate IL-10 secreting T cells by ELISPOT using a 175 member peptide library corresponding to the SV40 T ag. The identity of the IL-10-secreting cells was also investigated by ICS for IL-10. Our findings suggest that the CD4+ epitopes may play a role in the negative regulation of cellular immune responses to the SV40 T ag. **(60)**

Erik Listor, **Chris Scheib**, **Jilean Schutz**, Timothy Whitmoyer*

Macha Oxygen Concentrator Project

The Macha Oxygen Concentrator Project team (MOXY) works in conjunction with the Macha Mission Hospital in Zambia, Africa, to provide engineering support for respiratory devices. The project members have been engaged in troubleshooting early failures experienced by the hospital's oxygen concentrators, which are machines that separate oxygen from other gases in the ambient air via a material called zeolite. Research has found that this material becomes contaminated when exposed to high amounts of humidity and dust, both of which are prevalent in the environment at Macha. The team's work at the beginning of the year was focused on designing an alternate concentrator inlet filter, using a water-permeable Nafion membrane, which would adequately reduce the zeolite's exposure to humidity. The project leader was sent to Macha in January 2015 in order to evaluate the current state of the concentrators and test the filter prototype. It was found that the use of a pre-filter for humidity removal does not meet the hospital's current needs, given that the zeolite of many of the machines has already been contaminated and there is no solution for contamination other than replacement. **(32)**

Wesley Loar, **Nicholas Oland**, Donald Pratt*

Cycle Advancements - Universal Hitch

100 - 125 cc motorcycles are more affordable than larger vehicles that are specifically designed for towing and power take-off, such as Basic Utility Vehicles. However, small displacement vehicles are not designed to move equipment, crops, etc. Despite obvious size and performance limitations, small motorcycles are becoming increasingly popular in many developing regions around the world, including West Africa, South America, and Southeast Asia. The market in these areas is currently flooded with off-brand motorcycles that are mass-manufactured quickly and efficiently, leading to products that are cheap and low quality. The CART project team's goal is to design attachments for these motorcycles to increase utility in a wide variety of applications, as well as improve their longevity. Many of these bikes undergo loads much greater than intended by manufacturers; thus, high factors of safety must be incorporated into our designs. Additionally, a focus of the CART project is to create attachments that can be

recreated or repaired with the tools and resources available to those in our target area. Therefore, we must be mindful of our machining and assembly processes so that they are simple and cost effective. Ultimately, the purpose of this project is to improve the quality of life for those whose livelihood depends on the use of these small displacement motorcycles. **(30)**

Anna Love, Alison Noble*

Self-Assembled Monolayers on Zinc Selenide for Use in In vitro Cellular Studies

One interaction of applicable value in the field of neurochemistry is the interaction between prostheses in the central nervous system (CNS) and the cellular components of the brain itself. Biocompatibility of prosthesis placed into the CNS is extremely important to avoid immune response and the accompanying neurodegeneration. In order to study these interactions, chemical modification of material surfaces with immobilized peptides created for the selective binding of cellular components of the CNS (*eg* astrocytes, fibroblasts etc.) can be assembled and modulated to find the most effective product. Self-assembled monolayers on ZnSe provide a unique platform for optical characterization of these kinds of interactions. Specifically, after binding a certain peptide sequence to a SAM, it can then be utilized to bind a cell or biomolecule for further manipulation or examination. One possible application of peptide-terminated self-assembled monolayers is as a novel *in vitro* assay for studying biochemical interactions of components of the CNS. Understanding of these biochemical interactions, which are mediated through a complex system of protein receptors and signaling pathways, is necessary for the engineering and implementation of a variety of preventative treatments for neurological degeneration. **(37)**

Anna Love, Simona Spampinato[†]*, Bunny Cotleur[†], Richard Ransohoff[†]*

Effects of Sphingosine 1-Phosphate at the Blood-Brain Barrier

Sphingosine 1-phosphate (S1P) is a biomolecule present in the body that has diverse cellular effects, including trafficking of lymphocytes, upregulation of gene expression, and cell proliferation. These effects are mediated through binding of S1P to specific G-protein coupled receptors, which are expressed on both endothelial cells (EC) and astrocytes (AC), two important components of the blood brain barrier (BBB). The BBB is a highly selective cellular structure that monitors the homeostasis of the brain through regulation of exchange between the CNS and the periphery. However, when the AC and EC are unable to perform their key functions, the integrity of the BBB is compromised. Since S1P signaling plays a role in the egress of lymphocytes from the lymph nodes during an immune response, we questioned if modulating the S1P receptors expressed on the AC and the EC would be beneficial for the integrity of the BBB. We examined the effects of S1P by using an *in vitro* model for the BBB, a transmigration assay. We also ran experiments testing the effects of S1P on cell permeability and viability. Our results show that astrocytes release factors which improve structure and viability of endothelial cells. In addition, it appears S1P is an important factor in the signaling and transmigration of lymphocytes, and may be a potential drug candidate for decreased lymphocyte trafficking across the BBB. **(62)**

Amanda Luger, **Kathryn Moyer**, Tony Beers*, Joseph Longenecker†*, Thomas Soerens*
Mechanized Percussion Well Drilling
The goal of this project is to develop an engine-powered percussive well drilling system. This system will be used by our client in Burkina Faso, West Africa to produce shallow bore holes for water access. The machine reduces the labor required to manually drill wells, and interfaces with the drill bits that were designed previously by the Garden Water Access Project. This year we have focused on designing a wooden prototype of the mechanized drilling rig to test the concept, and discover any unforeseen problems. After the first prototype was built and tested, we used the conclusions from testing to guide the design of a steel frame for the mechanized system. In addition to this, we have also been working on designing a new steel tripod that will be beneficial for our team as we continue testing the mechanized system. **(83)**

Lauren Martin, Anne Reeve*
Synthesis of Aspernigrin A Analogs
Aspernigrin A is a natural product first isolated in 2004 from an *Aspergillus niger* strain harbored in the Mediterranean sea sponge *Axinella damicornis*. It was isolated again in 2005 from the endophyte *Cladosporidium herbarum* obtained from *Cynodon dactylon*. Aspernigrin A was found to be cytotoxic towards multiple strains of colon cancer, which promotes interest in synthesizing both the compound itself and its analogs. Progress has been made on the synthesis of multiple 6-aryl structural analogs. The TMS enol ether of 4'-methylacetopheone is converted to 4-hydroxy-6-(4-methylphenyl)-2-pyrone in good yield upon treatment with malonyl dichloride at low temperature. The pyrone is converted to the corresponding 6-subsituted 3-carboxy-4-pyridone in a two-step synthesis using dimethylformamide dimethyl acetal followed by methanolic ammonia. Optimization of these reactions have afforded all intermediates in good yield, which several analogs completed and significant progress on related asperngrin A analogs. **(51)**

Thomas Martin, **Benjamin Richardson**, **Brett Levengood**, **Tom Stetson**, D. Scott Weaver*
Fungi Identification Website
Dr. Emberger, a biology professor at Messiah College with a special interest in mycology (the study of fungi), set out to create an online source for the identification of fungi growing on wood in 2003. The idea was to modernize the identification process, making a key available as some of the currently printed books were no longer in print. With the idea of keeping this key up to date, we set out to fully utilize the capabilities of technology to make the fungi identification key easier to use, update, and maintain. **(10)**

Caitlin Mason, Matthew Lauver, John Harms*, Lawrence Mylin*
Targeting Pancreatic Cancer with Cellular Immunity
The goal of this study was to investigate the potential for using T cell responses targeting intron-encoded amino acid sequences of the CCKC pancreatic-cancer-associated form of the cholecystokinin receptor (CCKR) to control tumor growth in mice. A splice variant of the CCKB receptor, known as CCKC (cancer-associated CCK receptor) contains a unique insertion of 69 amino acids encoded by an intron that is usually removed from the normal CCKB receptor mRNA. Preliminary experiments have demonstrated by an IFN-g ELISPOT that T cell responses

could be generated in mice by intradermal immunization with a synthetic 20mer peptide representing a portion of the 69 amino acid intron-encoded sequence. Subsequent experiments utilized Intracellular Cytokine Staining for IFN-g-expressing T cells to determine whether the responsive cells were of the CD8+ or CD4+ subset(s). While overall responses to the repeat intradermal immunizations were weak, several mice did show evidence of intron peptide-specific CD8+. TriVax is a more recent intravenous peptide immunization method in which synthetic peptide is injected in combination with poly IC and an anti-CD40 antibody and is reputed to generate robust T cell responses. The TriVax method was used to compare responses to a CD4+ SV40 T ag 525-543 peptide and the CCK intron peptide by ELISPOT and ICS. While the T ag peptide induced robust numbers of IFN-g-secreting cells that were of the CD4+ T subset, the CCK intron peptide failed to induce IFN-g-secreting cells that could be detected by either method. Immunization with irradiated murine pancreatic cancer cell lines engineered to express the CCKB receptor splice variant failed to induce intron-specific T cell responses that could be detected by ELISPOT or ICS. The interpretation of the results of these experiments may require closer analysis of the quality of the intron-peptide stock following extended storage at -20°C. **(43)**

Ryan Mayer

An Exploration of Diophantine Equations and their Applications

This presentation will explore the various applications of diophantine equations. A diophantine equation is a polynomial equation that is limited to having only integer solutions. The research presented involves attempting solutions to some of the equations and additionally, learning the theory behind their use in other areas of mathematics. This project is an extension of the abstract algebra course offered at Messiah and also number theory. **(19)**

Rachel Mazurek, Taylor Eberly, Lauren Long, Tim Van Dyke*, John Meyer*

Mobility Tricycle Project: Front End Redesign

The Mobility Tricycle Project is working to improve and fine tune the current hand powered and electric tricycle models for people with limited mobility living in Burkina Faso, West Africa. Our goal is to produce a more comfortable and efficient tricycle while maintaining or lowering the cost of manufacture, maintenance, and operation. The front end redesign team focuses on the front portion of the tricycle structure, including the steering handle, head tube, fork, and front wheel, which impact tricycle handling and steering characteristics. As a result of different handling and straightening tests conducted during the past year, the front end redesign team detected an imbalance in the handling of the electric tricycle, which caused the tricycle to pull to the left. Further analysis revealed that this imbalance was due to an assembly defect that caused the fork to be permanently bent such that it was no longer symmetrical. This nonsymmetry occurs during the trike assembly process when the two blades of the fork are pulled apart, by hand, to accommodate different front wheel widths. Since both blades are not of equal strength, the weaker one will bend out while the other remains mostly in place. The front end redesign team has recently produced a tool that aids in the manufacture of the front end of the tricycle and prevents any non-symmetrical bending of the fork. **(75)**

Travis Moyer

To Infinity...and Beyond

Infinity is defined as a number greater than any assignable quantity or countable number. Though infinity is not countable, there are varying levels. In other words, one infinity can be greater than another. This idea was studied and eventually proven by Georg Cantor using the infinite set of natural numbers and the infinite set of real numbers. Cantor found that he could prove his theorem by assuming the two sets to be one-to-one and then finding a contradiction of that assumption. By contradiction, Cantor was able to prove that the set of real numbers between 0 and 1 represent a larger infinity than the set of natural numbers. Ultimately, many forms of infinity will differ in size based on the foundation with which they are produced. **(17)**

Bryant Myer, **Glenn VanSickle**, Donald Pratt*

Solar Commuter Vehicle Electrical System and Variable Gap

In early February, the Solar Commuter Vehicle (SCV) team experienced the loss of the vehicle's primary battery pack to some kind of slow drain. The team was diverted from final road testing of the vehicle to search for another battery source. The result of the search was the discovery of a set of battery packs from a recent Messiah College Genesis project solar race car that would suit our purposes. These battery packs were already wired with charge balancing circuitry that will simplify charging. The SCV employs a brushless DC (in hub) electric drive motor with variable gap capabilities. The distance between magnetic plates can be adjusted via a screw with an external gear. The motor's operational characteristics can be tailored toward high operating efficiency or toward high instantaneous torque by altering the motor gap. The system invented this semester provides the operator with control over this gap. Contrary to the operation of a combustion powered motorcycle, a brushless electric motor can be "shifted" while under power with no need to modify throttle input. Due to its effect on available motor torque and motor operating power consumption, it is desirable to allow the vehicle operator to tailor the motor's operational characteristics toward the instantaneous performance requirement. The result of this semester's work is a design for a mechanical system using a bidirectional ratchet and pawl mechanism. **(29)**

Elkan Nelson, Randall Fish*, Chris Byers†*, Liam Tanis†*

Low Power Solar PV Systems

In many parts of the world the best solution to energy needs is Solar power. These systems range from large scale systems which power an entire clinic to small systems charging a battery for a single light bulb. Our project has developed inexpensive low power prototype designs capable of solving two wide-spread application needs. The first system is capable of powering a single well water pump and the second can provide the power needed by a small cluster of computers. **(78)**

Hannah Nichols, **Megan Mayhew**, **Carolyn Lewis**, **Jessica Kellner**

Exercise Interventions to Improve Outcomes in Heart Failure Patients

Research Question: Among adult heart failure patients what effect does exercise have on patient outcomes and readmission rates? Significance and Background: About 5.1 million people in the United States are diagnosed with heart failure (HF), with a 50% mortality rate

within five years of diagnosis (CDC, 2014). HF is a condition that affects physical function, is expensive, and contributes to hospital readmission rates (Davidson, 2010). Exercise has the potential to improve outcomes in HF patients by lowering readmission rates, increasing quality of life (QOL). Methods: A review of the literature from 2009-2014 was conducted utilizing PubMed, MedLine, CINAHL, and Cochrane databases. Six articles addressed the problem and were used in the review. The majority of the articles were level 1 and C quality. Findings: Reiter (2014) reports that exercise does not improve functional capacity but does improve QOL. Brubaker (2009) fails to produce consistent results regarding benefits of exercise. Albert (2014) suggests further research on exercise perceptions and HF education benefits. Courtney (2009) and Davidson (2010) show that HF patients who exercise have fewer readmissions and improved QOL. Belardinelli (2012) shows improved outcomes over a ten-year period including QOL ($p<0.05$), ejection fraction ($p< 0.01$), cardiac mortality ($p<0.001$), readmission rates ($p<0.001$) and functional capacity. Conclusions: Although results contain supporting evidence that exercise improves function among HF patients, more compelling evidence is necessary. Recommendations for practice include: conducting further research regarding patient perception of exercise benefits, consistent application of the operational definition of 'physical activity', conducting research in settings in diverse settings, and broadening the sample size to include nonwhite patients. Throughout review of the literature, common themes demonstrated the importance of nurse-coordinated, supervised exercise that included a follow-up intervention. **(108)**

Drew Pagenkopf, Abaz Kryemadhi*

Geometry of the Universe

Albert Einstein's general theory of relativity in 1915 gave us an amazing description of gravitation in the physics of this world, and through these theorems, we can conceptualize the geometry of the universe. With the general relativity equation, we can study the origin and the development of our universe. By applying the cosmological principle and Friedmann's equations, we can study the geometry of the observable universe and analyze different possibilities of it. Also, using Friedmann's equations, we will ask the question "what could it be?" and study the impact of an added gravitational system into our observable universe. **(21)**

Annaleise Peterson, Jeff Erikson*

Slimy Sculpin Gape Size in Relation to Prey Preferences

Slimy sculpins, *Cottus cognatus*, are a benthic freshwater fish that feed on macroinvertebrates. They are sensitive to water pollution and are important stream health indicators. This study assessed the relationship between gape size and prey selection. Trout Run was tested at two different sites. Each stream site was divided into 3, 10 meter segments for testing. A minimum of ten slimy sculpins were collected from each 10 meter section, in addition a macroinvertebrate sample was collected within each section. The gape size, length of each sculpin, stomach volume, and size and identity of prey items were assessed. The mean length of the sculpins was 46.87 cm with a standard deviation of 7.38. The average gape size was 6.625 mm, but the average size of a food item was 5.829 mm, only 0.796 mm smaller than the gape size. This indicates that there is a trend between gape size and prey size preference. Sculpins consumed a few large or numerous small prey items. Slimy sculpins are gape limited feeders

and will seek prey items that will provide them with the highest energy with reduced handling time. **(45)**

Adam Pozun, **Gavin Stobie**, Laura Castilow, Brian Swartz*, L. Bryan Hoover†*
Affordable Sanitation
The World Health Organization (WHO) currently estimates that only 45 percent of rural Africans have access to basic sanitation services. Therefore, the majority of the population in rural communities continues to rely on open defecation and is therefore subject to the transmission of fecal-oral diseases. In many cases, the prohibitive costs associated with the construction of pit latrines restrict access to effective sanitation. In response to this challenge, students and faculty at the Collaboratory at Messiah College are working on the Affordable Sanitation Project. It is the objective of this project to identify design solutions to reinforce the structural integrity and increase the lifespan of pit latrines, with careful attention to the life cycle cost of the solution. This project will seek design solutions that are both more functional and more affordable than the current designs. **(74)**

Sarah Pratt, **Allison Silver**, **Christina Duncan**, **Faith Eisenberg**
Are We Doing Enough? Effects of Education on Nursing Attitudes Towards Chronic Pain.
Research Question: What is the effect of education on nursing attitudes towards pain management in patients with chronic pain? Significance and Background: Nurses may display poor attitudes towards the administration of opiates and may treat their patients like they are "drug seekers" (Vallerand & Nowak, 2012). This negative attitude toward pain management can be due to the fact that no pain management education is required among registered nurses in the US (Clarke, 1996 & Long, 2013). Methods: A review of literature was conducted using CINHAL, PubMed, Cochrane, and National Guideline Clearinghouse resulting in 35 articles of interest. Eight articles were chosen as the focus of review. The majority of articles were published within the last 5 years and were level II evidence with B quality. Findings: A variety of pain management programs were implemented, including modules, lectures, activities, and committees. Several researchers utilizing the Nurses' Knowledge and Attitudes Survey Regarding Pain found significant differences in scores before and after a pain management program ($p=0.028$, Gustafsson, 2013; $p=0.007$, Machira, 2013). Researchers using other, similar tools also found statistically significant differences in pre- and post-test scores ($p<0.0001$, Cui, 2013; $p=0.02$, Long, 2013; $p=0.002$, Klassen, 2009). Conclusions: Based on the good quality level of evidence found in the review of literature, a pilot study with adequate sample size and reliable and valid tools is recommended. Adequate pain information given in hospital orientation programs, training pain resource nurses, establishing a pain committee, and creating a pain information bulletin board were found to be helpful; but more research is required to determine the best means for chronic pain education. **(110)**

Rebecca Querfeld, **Sienna Wisse**, **Neil Murren**, **Silas Murren**, H. Scott Kieffer*, Matthew Lewis*
Effects of ACL Reconstruction Surgery on LESS (Landing Error Scoring System) Test Scores in Female Athletes.
An evaluation used to determine jumping and landing mechanics in athletes is the landing error scoring system (LESS). The LESS test is a multiple component procedure in which each athlete is

given a score to determine risk of knee injury or re-injury. Many different functional tests can be used to determine risk of knee injury; however, the LESS test is a much quicker procedure to evaluate mechanics. Therefore, the purpose of the study is to compare female athletes who have had ACL reconstruction surgery and female athletes who have not on LESS test scores. Ten female athletes (5 with ACL reconstruction surgery and 5 healthy) completed familiarization and two testing trials including jumping off a 30 cm box, landing a distance of half their height out from the box then jumping as high as possible straight up and landing in the same position. Each subject was given scores based on the LESS. Each trial was videotaped and analyzed by researchers to assign scores based on jumping and landing mechanics. Unpaired t-test will then be calculated and used to determine the significance of the results. Results will be presented at the symposium. **(98)**

Laura Ritenour, Evan Shirey, John Harms*

Investigating Immunofluorescent Staining Patterns Produced by Monoclonal Antibodies Against CCK2R

Pancreatic cancer is one of the most aggressive cancers with a five-year survival rate of only 6%, largely due to the lack of early detection and effective treatment options. A better understanding of the mechanism of tumor growth and metastasis is necessary to improve patient outcomes. Two gastrointestinal hormones, gastrin and cholecystokinin (CCK), have been associated with increased tumor aggression. The CCK2 receptor (CCK2R) binds both of these hormones and is expressed at abnormally high levels in tumor cells. In order to facilitate studies of these hormones and their receptor, two monoclonal antibodies against the receptor have been developed: one (anti-CCK2R) binds all forms of the receptor, while a second (anti-$CCK2_{i4sv}R$) binds an epitope unique to a constitutively-active splice variant of the receptor ($CCK2_{i4sv}R$). In preliminary immunofluorescence studies, the two antibodies appeared to produce different staining patterns when both were bound to cells expressing $CCK2_{i4sv}R$. This was thought to potentially indicate binding to distinct receptor sub-populations, although there was no clear model to explain the difference in cellular compartmentalization. In this follow-up double-labeling experiment, it was observed that each antibody colocalized with a commercial anti-CCK2R polyclonal antibody and produced only membranous staining patterns. The previously observed difference in staining may have been due to discrepancies in antibody concentration, as only recently was a high-titer stock of the anti-CCK2R monoclonal antibody produced. Nevertheless, even when concentrations were adjusted to attain similar levels of background fluorescence, anti-$CCK2_{i4sv}R$ achieved brighter, clearer staining than anti-CCK2R and therefore may have higher affinity for the receptor. **(38)**

Bridgette Rodgers, Danielle Alexander[†]*, Patricia Grigson[†]*

Sign-Tracking vs. Goal-Tracking with Cocaine Self-Administration

Drug addiction is a recurring, detrimental brain disease that can cause emotional and behavioral distress in affected individuals and others involved. By observing behavioral differences, propensity of addiction may be measured and foreseen. Published data suggests that individuals who are attracted to reward-related cues may be especially vulnerable to develop compulsive behaviors with drugs. Twenty-four male Sprague-Dawley rats were tested in a Pavlovian conditioned response paradigm and sorted into three groups: sign-trackers (ST),

goal-trackers (GT), and the intermediate group (IG). ST are attracted to the cue that signals the delivery of reward; GT are attracted toward the goal (i.e., the location of reward delivery), and behavior of the IG falls in between. Thereafter, rats were given five-minute access to a 0.15% saccharin cue immediately followed by two-hours to intravenously (iv) self-administer cocaine (0.33 mg/infusion) for fourteen daily trials. The rat's willingness to work for drug was then tested using Progressive Ratio (PR) in which the response required to receive each infusion increased exponentially, cocaine-seeking was tested during extinction (i.e., when no drug was available) and during cocaine-induced reinstatement. Results revealed clear ST and GT groups. GT were more goal-directed when self-administering cocaine, although ST and GT took equal amounts of drug during self-administration, were equally motivated for drug during PR, and had similar reinstatement patterns. These data suggest that approach behavior towards signals (cues) vs. goals does not predict the propensity for addictive behavior in our animal model. One possible confounding factor may be the inclusion of a sweet cue. **(40)**

Christian Rogerson, Ethan Jacoby, Mitchell Kauffman, Nathan Musser, Brian Swartz*, Brian Seip†*

Combined Heat and Power

The Messiah College campus is embarking on an initiative to bring natural gas to campus, and to implement a combined heat and power (CHP) system in order to control energy costs. A student demonstration model is planned in parallel with the full-scale campus project in order to help College leadership communicate this technology to its various stakeholders. Combined heat and power technology harnesses thermal energy in the exhaust gases from electrical generation processes. The waste heat can be used to meet heating - and cooling - needs with no additional energy cost, using energy that would otherwise be wasted. This project aims to design and build a functional model of a combined heat and power system that includes electric generation and harnessing the exhaust energy for the purposes of both heating and cooling in a demonstration interface. **(71)**

Anne Roshong, Lauren Clune, H. Scott Kieffer, Jodie Haak*

Effect of Caffeine on Salivary Cortisol Levels during 10K Cycling Time Trials

Cortisol is a steroid hormone that is produced in the body as a response to stressors, including acute bouts of exercise. One of the roles of cortisol related to exercise involves the enhanced metabolism of fat, carbohydrates, and proteins. Caffeine is the most commonly-used ergogenic aide and has been suggested to improve performance in high-intensity and endurance exercise. However, it is unclear whether the mode used to deliver the caffeine has an effect on performance or whether that effect would be related to the release of cortisol from the adrenal glands. The goal of this double-blind study was to test the differences in performance and cortisol levels between caffeine gum and caffeine pills. Due to the non-invasive nature of saliva collection, and because cortisol is known to accumulate in the saliva in a predictable pattern, this study measured salivary cortisol. Trained cyclists were completed three separate 10K time-trials, and each time they were given either caffeine gum/placebo pill, caffeine pill/placebo gum, or placebo of both. These three conditions were done in a random order. Saliva was collected using passive drool five minutes before and immediately following each time trial. Saliva samples were stored at -80°C until they were assayed for cortisol. Samples were analyzed

using an ELISA test and a high-sensitivity salivary cortisol kit from Salimetrics, Inc. (State College, PA). Data will be presented at the symposium upon completion of analysis. **(49)**

Holly Ross, John Harms*

Increasing Stability and Expression of Green Fluorescent Protein in Pancreatic Cancer Cells

Pancreatic cancer is the fourth leading cause of cancer death in the United States, with only 11% of patients diagnosed with metastatic disease surviving the first year. Even so, few studies exist to characterize the mechanism of metastasis in this highly aggressive form of cancer. Consequently, it is imperative that techniques, such as tagging cells with green fluorescent protein (GFP), are developed to track cancerous cells over the course of their spread. Unfortunately, the existing GFP vector contains a cytomegalovirus promotor, which is readily silenced by cells and decreases the vector's usefulness for long-term studies *in vivo*. It was hypothesized that the insertion of the enhanced GFP gene downstream from a beta-actin promotor would increase expression and long-term stability of GFP in pancreatic cancer cells. Using restriction digests with EcoRI and NotI, the enhanced GFP gene was removed from the pEGFP-N1 vector and then ligated into pCAGEN.puro. The product of this reaction was transformed into *E. coli* for selection and amplification of the plasmid. Successful construction of pCAGEN.puro-EGFP was confirmed with a diagnostic digest with XmaI. The plasmid was then transfected into the murine pancreatic cancer cell line PANC02, and fluorescence was detected after 24 hours. The quantification of fluorescence and the cloning of these transfected cells are ongoing. In the fall, this study will continue with an assessment of the long-term stability of GFP via flow cytometry. **(66)**

Philip Roth, Anne Reeve*

Synthesis and Purification of Aspernigrin A Analogs

Aspernigrin A is a natural product first isolated in 2004 from an *Aspergillus niger* strain harbored in the Mediterranean sea sponge *Axinella damicornis*. It was isolated again in 2005 from the endophyte *Cladosporidium herbarum* obtained from *Cynodon dactylon*. Aspernigrin A was found to be cytotoxic towards multiple strains of colon cancer, which promotes interest in synthesizing both the compound itself and its analogs. Progress has been made on the synthesis of multiple 6-aryl structural analogs. The pyrone is converted to the corresponding 6-substituted 3-carboxy-4-pyridone in a two-step process using dimethylformamide dimethyl acetal followed by methanolic ammonia. Optimization of these reactions have afforded all intermediates in good yield, with several analogs completed and significant progress on related aspernigrin A analogs. **(69)**

Jacob Sargent, **Jacqui Young**, Adam Chilcote, Tony Beers*, Thomas Soerens*

Intelligent Water Project

Did you know that 36% of hand pumps in Sub-Saharan Africa do not deliver water to their communities? To combat this, the Intelligent Water Project is developing an automated, hand pump monitoring system that allows organizations to monitor the functionality of all of their pumps in the field. The information generated by IWP can be used to determine how much specific pumps are being used and to generate warnings of any pumps that are failing or have

failed and are in need of repair. The information is collected via SMS in a database that can be accessed by authorized technicians online, anywhere in the world.
http://www.IntelligentWater.net **(82)**

Joshua Scholl, **Brenton Yost**, Brooks Arnold, Joel Ngui, Joel Sibi Mark, Randall Fish*
Thermo-Electric Generator Ventilation Hood
In a recent study, it was found that nearly 2 billion people worldwide use open cook fires for common purposes such as making food and boiling water. Women often cook using open fires every day to provide the family with food, but what they don't realize is that the harmful products of burning biomass that settles within the household due to a lack of proper ventilation has been linked to various diseases including pneumonia in children, Chronic Obstructive Pulmonary Disease, asthma and other lung and heart diseases. While fan ventilation would solve this problem, people without electricity cannot use this simple solution. We are developing a ventilation system which uses the heat of the cookstove and a peltier device to generate the electricity needed to power a ventilation fan. **(34)**

Dylan Schrom
The Mathematics of Theatre and Performance
Mathematics is a discipline that has aided in the development of diverse subjects. In his speech, Dylan reveals the theatrical practices performed today and in history to analyze the mathematics of theatre and performance. Dylan will explain different ways in which math has both aided in the development of the subject and its hidden mathematics. Topics will include the mathematics of comedic delivery, the Actor's formula for practice and the Alexandrian approach to theatre. **(14)**

Kariana Senum, **Joel Zeigler**, Donald Pratt*
Kenya Mobile Medical Clinic
The Kenya Mobile Medical Clinic (MMC) project seeks to outfit a small trailer as a mobile clinic primarily detecting and treating cervical cancer in the region of central Kenya. Our client is Dala development, a Christian-based healthcare organization located in Meru, Kenya. In East Africa, cancer is the third most common cause of death and cervical cancer is a leading form. When it is detected at an early stage, cervical cancer is preventable and treatable. Dala Development came to the Collaboratory requesting a trailer that could make screenings and treatment more available to people in rural communities far from Meru. The project was started in the Fall semester of 2013 with the acquisition of a used trailer from another Collaboratory project. The Mobile Medical Clinic is set to be finished in May 2016 at which point it will be loaded into a shipping container and sent to Meru, Kenya. **(27)**

Peter Shuck, Yacoub Seyni, Kafui Dzaka, Steve Nase, Connor Powell, Jeremy Diehl, Andrew Budd, Nathan Chaney, Steven Nicolais, Brian Nejmeh*
Intelligent Water Project (IWP): Mobile, Database, and Documentation
A crucial component of the Intelligent Water Project is the ability for pump technicians to have access to the IWP database on the go. The IWP mobile application is being developed to support the initialization of pumps, creation of various pump reports, and an alert system. In

conjunction with the other IWP groups, a team has focused on maintaining the database so that it is compatible with new development in the Intelligent Water Project. Another team has been focusing on documenting the functionality and current state of the IWP application as well as creating an online user manual for the system. **(11)**

Stephen Smeiles, **Jason Wright**, Donald Pratt*
Kenya Mobile Medical Clinic
The Kenya Mobile Medical Clinic (MMC) project seeks to outfit a small trailer as a mobile clinic primarily detecting and treating cervical cancer in the region of central Kenya. Our client is Dala development, a Christian-based healthcare organization located in Meru, Kenya. In East Africa, cancer is the third most common cause of death and Cervical cancer is a leading form. When it is detected at an early stage, cervical cancer is preventable and treatable. Dala Development came to the Collaboratory requesting a trailer which could make screenings and treatment more available to people in rural communities far from Meru. The project was started in the Fall semester of 2013 with the acquisition of a used trailer from another Collaboratory project. The Mobile Medical Clinic is set to be finished in May 2016 at which point it will be loaded into a shipping container and sent to Meru, Kenya. **(84)**

Rebekah Smith, **Peter Jones**, Brian Nejmeh*
Developing an Open Source Ministry Module for Cure International
HospitalRun is an open source Hospital Information System (HIS) created by CURE International for use in their hospitals around the world. The choices for non-profit hospitals for software like this are limited, so the goal behind HospitalRun is to create a HIS with a focus on the user experience. This semester, our task was to design and implement a module of HospitalRun to allow the Hospital Ministry Directors to create and store reports about the ministry events each hospital reports on monthly. The goal was to take all of their current reporting methods and turn them into an easy-to-use, functional reporting system integrated with HospitalRun. **(9)**

Benjamin Sollenberger, Donald Pratt*
Cycle Advancements - Universal Hitch
Utility transportation is becoming more popular in developing countries. Vehicles specifically designed for towing and power take off, such as Basic Utility Vehicles, are not as affordable as 100 - 125 cc motorcycles. Nonetheless in rural areas, a quick, reliable mode of transportation is necessary. However, small displacement vehicles are not designed to move equipment, crops, etc. Even so, small motorcycles are becoming increasingly popular in many developing regions around the world, including West Africa, South America, and Southeast Asia. Currently, the market is flooded with off-brand motorcycles that are manufactured quickly and efficiently in bulk, leading to products that are cheap and low quality. The CART project team's goal is to design attachments for these motorcycles to increase utility in a wide variety of applications, as well as improve their longevity. Many of these bikes undergo loads much greater than intended by manufacturers; thus, high factors of safety must be incorporated into our designs. Additionally, a focus of the CART project is to create attachments that can be reproduced or repaired with the tools and resources available to those in our target area. Therefore, we must be mindful of our machining and assembly processes so that they are simple and cost effective.

Ultimately, the purpose of this project is to improve the quality of life for those whose livelihood depends on the use small displacement motorcycles. **(85)**

Michael Stephan

Barcoding a highly variable 24bp segment of the Plasmodium falciparum gene in Macha, Zambia

In 2012, the World Health Organization estimated 207 million cases of malaria worldwide. 90% of malaria deaths occurred in Sub-Saharan Africa and 77% or 482,000 were children under the age of five. Certain regions across southern Africa have experienced a decrease in the prevalence of malaria while other regions with similar control efforts have not experienced this decrease. A better understanding of malaria transmission and transmission prevention will help bring southern Africa closer to malaria elimination. The epidemiology of malaria in southern Africa can be more fully understood by knowing the prevalence of specific *Plasmodium falciparum* strains. *P. falciparum* is known to have a diverse genetic sequence with many single nucleotide polymorphisms (SNPs). A specific gene sequence 24 base pairs long within the *P. falciparum* genome contains a high frequency of SNPs and is unique for various *P. falciparum* strains. We barcoded this highly variable 24 base pair region in DNA samples from malaria patients positive by a cytochrome B PCR test to determine which *P. falciparum* strain they were infected with. Barcoding was completed using High Resolution Melting (HRM) and *Taqman* approaches. Successful troubleshooting resulted in consistent *Taqman* barcoding data. All 2008 Macha DNA samples positive for a cytochrome B diagnostic test have been barcoded. A high frequency of mixed infections was observed in the 2008 samples, indicative of a time when malaria prevalence was higher in Macha. Future work will include barcoding 2009-2014 Macha DNA samples and barcoding analysis to detect trends in the epidemiology of malaria. **(41)**

Adam Stern, David Foster*

Tissue Culture in Mertensia virginica (L.) Pers. ex Link

This study continues this lab group's callus tissue culture in the species *Mertensia virginica.* Callus tissue samples were obtained from previous cultures produced by Warren and Foster. Primary callus tissue samples were also produced from young leaf petioles following the procedure per Warren and Foster. These callus samples were grown on modified Murashige and Skoog (MS) media as per Fedoreyev et al. (2012). Two distinct media types were used; one containing 1- naphthaleneacetic acid (NAA) and the other containing 2, 4-dichloro-phenoxy-acetic acid (2-4-D) as auxins. Both media types contained N^6 – benzyladenine (6-BA) as a cytokinin. Callus samples were held in an environmental chamber at 25°C. Survival rates for each media type were evaluated. Differences in qualitative observations were also taken for each media type. The NAA media produced callus tissue that was yellow in color and grew in a "smear" formation. The 2-4-D media produced faster growing callus that was white and green in color. The 2-4-D callus tissue also grew in a more cohesive formation. Viable callus samples from each media type were then used to attempt shoot organogenesis *in vitro*. The shoot initiation media contained an elevated cytokinin concentration (5 ppm) while maintaining a low auxin concentration (1 ppm). This test is still in process. **(50)**

Keterly Steyer, **Claire Carbonetto**, **Ashley Locke**, **Rebecca Argot**

Impact of Hourly Rounding on Medical-Surgical Units

Research Question: What are the effects of hourly rounding on Medical-Surgical units? Significance and Background: Hourly rounding is a process that requires a staff member to enter each patient's room hourly and assess patient needs. This is significant because staff commitment to anticipate patient needs and improve patient outcomes is needed. Hourly rounding is difficult to implement because structural change in nursing practice is warranted (Kessler, 2012). Examination of the impact of hourly rounding on Medical-Surgical Units is essential to determine effects on patient-related and nurse-sensitive outcomes. Methods: A review of the literature was conducted utilizing PubMed, MedLine, CINAHL, and the Cochrane Database from 2009-2014. A total of 68 articles were identified; 6 were found to address the problem and were the focus of the review. Articles ranged from Level I, B quality to Level V, C quality. Findings: Units that implemented hourly rounding as part of their policy reported reduced patient falls from 4.67% to 2.19% (Lowe, 2012 & Kessler, 2012), decreased call bell usage by 3.7 times per day (Berg, 2011 & Dearmon 2013), and improved patient satisfaction scores (Meade, 2006 & Kessler, 2012). Additional findings included decreased patient anxiety, decreased stress, and decreased use of inappropriate coping mechanisms (Mitchell, 2014). Nurse-related findings include improved employee satisfaction scores and decreased RN vacancy rate (Kessler, 2012). Conclusion: Most of the evidence demonstrated consistent and significant outcomes. Therefore, implementation of hourly rounding is recommended for Medical-Surgical Units. Research identified several barriers to implementation of hourly rounding. Further research is indicated to explore and overcome these barriers in order to more effectively implement hourly rounding. **(109)**

Regina Stump, **Samantha Poirier**, **Holly Seipt**, **Jared Schatz**, H. Scott Kieffer*

A Regression Equation for VO_2 From the YoYo Test in Female Athletes

The maximum amount of oxygen that an athlete can utilize, known as VO_2 max (ml/kg/min), can be a indicator of aerobic performance. For aerobic sports with intermittent high intensity characteristics, increasing VO_2 max can improve performance .Various intermittent fitness testing has been used to assess female aerobic capability, therefore the purpose of the study is to develop a regression equation to predict VO_2 max from the results of the intermittent Yo-Yo field test. The Yo-Yo Intermittent Recovery Test Level 1 (YY1R1) is a field test used to evaluate players' ability to perform repeated intense exercise according to test performance (Martinez-Lagunas & Hartmass, 2014). The YY1R1 test is a 20 meter intermittent running test whereby subjects run at increasing speeds in accordance with a timed beep. After the completion of each 20 meter running bout, subjects have a 10 second recovery period before the next stage. Subjects who could not keep up with the corresponding beeps indicated test conclusion, and were scored by the last stage completed. In addition, subjects completed a VO_2 max treadmill protocol in which treadmill speed was increased 0.6 mph every minute. Subjects ran until exhaustion, with oxygen consumption being measured via breath-by-breath analysis with Moxus oxygen analyzer**.** By correlating the results of a treadmill protocol to measure VO_2 to the results of the YY1R1, an equation can be formulated to determine VO_2 max. Five female NCAA eligible DIII field hockey or soccer athletes from Messiah College participated in the study. **(97)**

Timothy Swartz, **Ellie Stuart**, Erik Lindquist*, David Foster*

Evaluation of a Rapid Assessment Model for the Conservation of Woodland Vernal Pools

Woodland vernal pools are small-scaled forested wetlands that flood each spring and gradually dry in the heat of summer. While vernal pools offer a vital woodland oasis for the reproduction of many of Pennsylvania's frog and salamander species, these ecosystems are under persistent threat of destruction. Land-use conversion has already turned much of Pennsylvania's wild lands into housing developments and warehouses. The highly seasonal nature of vernal pools impedes straightforward assessment of individual pools by state or nonprofit agencies and evaluation may be costly in terms of human and financial resources. Therefore, conservation would benefit from the development of a reliable tool that is optimized to curtail the expenditure of time and money without sacrificing its power to predict amphibian diversity. The objective of our work has been to evaluate predictive equations, provided by a recently published rapid assessment model, which correlate vegetation, water chemistry and pool area with amphibian abundance, richness, and diversity. In the last year, we have attempted to thoroughly quantify amphibian utilization of thirty pools and compare our results to those predicted by the published model. Our field research has confirmed the importance of a tool for rapidly assessing the conservation value of vernal pools. **(67)**

Jessica Tomlin, David Foster*

Rain Garden Design and Installation

Stormwater runoff and its potentially harmful effects in local waterways are of increasing concern. Rain gardens are a noninvasive, inexpensive way of reducing negative impacts of runoff and are considered a stormwater best management practice by the U.S. Environmental Protection Agency. However, research on this topic is limited. The objective of this ongoing study is to implement a large-scale rain garden to serve as the primary means of stormwater management for runoff generated within a small housing development located on Lot 5 Cottage Brook (CB5). The overall design specifications and vegetative selections for this raingarden were influenced by evaluation of an existing large-scale raingarden. Maintenance for this garden consisted of Preen™ herbicide treatment each spring for five consecutive years. Treatment was not successful for preventing late summer and fall seeding non-native overgrowth. The non-natives were also better suited for the site conditions than the original vegetation. The results of this survey indicated that maintenance and condition-specific vegetation are significant factors in effectiveness and longevity of the raingarden. The conclusions drawn provided insight into modifications of the design proposal for the CB5 raingarden, which was initially established in preliminary phases of this research in collaboration with landscape artist Tashya-Leaman Dalen. These modifications include fall preen and a mulch layer to avoid germination of fall seedings, consistent weeding of woody plant, and light and soil amendments to ensure adequate vegetative conditions. This research is significant in indicating the effectiveness and potential for raingarden use as an environmentally-friendly alternative for stormwater management. **(90)**

Sarah Van Ness

Demographic Analysis of Shark Populations Using Leslie Matrices

The analysis of populations and how they change over time is an essential part of many ecological studies. It is particularly relevant for fishery operations because human actions greatly influence the populations of fish. There are two main approaches to numerically study populations: through life tables or Leslie matrices. Both methods take similar data about a population and yield multiple life history parameters that describe the population growth and composition. However, the eigenvalues and eigenvectors of a Leslie matrix provide population characteristics that can only be approximated using the life table approach. In this talk, the population information that can be derived from a Leslie matrix will be explored and the technique applied to a specific shark population. **(23)**

Chelsey Watson, **Brittany Weaver**, **Lauren Kellner**, **Micaela Shervinskie**, Karen Wagner[†]*, Dana Dolan[†]*, Deb Schafer[†]*, Stacy Chubb[†]*, Erin Anderson[†]*

Sterile Water Injections for Lower Back Pain Relief in Labor

Sterile water injections cause the firing of the a-delta fibers to overwhelm that of the c-fibers, making pain less noticeable, a strategy similar to that of acupuncture. The water causes osmotic irritation and mechanical stimulation of the skin due to increased local tissue pressure, leading to instant pain relief. Intracutaneous sterile water injections also cause endorphin release, diminishing pain perception. This intervention is based on the gate control theory of pain. The purpose of this evidence-based practice project was to explore the effects of sterile water injections on pain level in lower back labor. Current literature was retrieved from CINHAL, PubMed, and Cochrane databases using key terms: labor pain, sterile water injection, analgesia, intradermal saline. Sterile water injections in the lumbosacral region reduced lower back pain level. Women reported pain of injection as short and tolerable, and expressed willingness to have the pain intervention in subsequent births. There is a need for more labor pain management options. Sterile water injections are a safe option with few side effects. This intervention allows for greater mobility during labor, resulting in repositioning of the fetus, ultimately reducing risk for C-section. **(106)**

Kelsey White, Matthew Lewis*

Case Report: Labral Tear and Full Thickness Rotator Cuff Muscle Tear in a Collegiate Wrestler

Background: This case involves a twenty-three year old male, Division III wrestler. During competition the athlete's shoulder was forced into an extreme overhead position. Due to chief complaints of pain and loss of function, the athlete withdrew himself from competition. Upon evaluation by an athletic trainer, visual inspection revealed no discoloration, edema, or deformity. Athlete complained of point tenderness over the posterior aspect of the shoulder and demonstrated greatly reduced strength and range of motion. The decision was made to refer athlete to team physician. **Differential Diagnosis:** Possibilities included labral tear, rotator cuff tear, or possible glenohumeral subluxation. **Treatment:** MRI (arthrogram) results reported a Type IV SLAP tear and a full-thickness supraspinatus tear. The surgical procedure included labral repair, subacromial bursectomy, supraspinatus tendon repair, labral debridement, and posterior glenoid chondroplasty. **Uniqueness:** Full-thickness rotator cuff tears are uncommon in a young, healthy population. The presence of a greater than fifty percent tear of the long head

of the biceps and the resulting tenodesis add to the uniqueness and complexity of this case. **Conclusion:** Differential diagnosis proved to be accurate. A full repair of the labrum, supraspinatus tendon and biceps tendodesis were performed. **Relevant Evidence:** Completion of biceps tenodesismay yield improved surgical outcomes as compared to previously utilized methods.[1] There is a significant (P<.001) improvement in ASES and VAS scores with biceps tenodesis.[1] Due to high success rates, biceps tenodesis is gaining recognition and becoming a more commonplace method for labral repair.

1. Gottschalk M, Karas S, Ghattas T, Burdette R. Subpectoral Biceps Tenodesis for the Treatment of Type II and IV Superior Labral Anterior and Posterior Lesions. American Journal Of Sports Medicine. September 2014;42(9):2128-2135.

(42)

David Wilson, Tony Beers*, Joseph Longenecker†*, Thomas Soerens*

Manual Percussive Well Drilling

The goal of this project has been to create a small, engine-powered, drilling winch to reduce the amount of human power required to use the percussion well drilling system previously designed by the Garden Water Access Project. Our clients in Burkina Faso in West Africa have been using the percussion drilling system, but the process is hard on the well drillers bodies and tiring which reduces effectiveness. Our project has been designing the third prototype and has further refined the system. This presentation will discuss the latest design and decisions that led to its creation. It will also cover in brief the design of components for testing the prototype. **(58)**

Haley Wilson, Katelyn McKiernan, Erin Sollenberger, Becca Simon, Madeline Berger, Wendy Cheesman*, H. Scott Kieffer*

The Effects of Kinesio Tape on Stability in Female Athletes with Chronic Ankle Instability

Kinesio Tape (KT) is a new innovative product used in sports medicine to treat a variety of acute and chronic injuries. Although the use of KT has gained popularity among practitioners, the research regarding the efficacy of KT to help with ankle instability is mixed. Therefore, the purpose of this study was to determine the effects of KT application on postural stability in athletes with a history of chronic ankle instability. Five NCAA Division III female soccer players and one NCAA Division III female lacrosse player with chronic ankle instability underwent 4 consecutive days of postural instability testing to determine if the use of KT helped influence measures of stability. The subjects underwent a familiarization session to minimize the learning effect of the stability protocol on the Biodex Balance System using the Single Leg Athlete Test. Stability was measured prior to the taping technique, immediately after the taping, and subsequent measures were taken at 24, 48 and 72 hours. Data from overall postural sway, anterior-posterior sway and medial-lateral sway were all analyzed using a one-way ANOVA with repeated measures with an alpha level of $p \leq 0.05$. The results of the study will be presented at the symposium. **(96)**

Lauren Wilson, Lawrence Mylin*, Ben Katowa†, Saidon Mbambara†, Natasha Laban†, Mwiche Siame†, Jennifer Stevenson†, Philip Thuma†

Capacity Building: Establishing Laboratory Culture of Plasmodium falciparum Laboratory Strain NF54 and Patient Isolates at the Macha Research Trust / Malaria Institute at Macha, Choma, Zambia

The Macha Research Trust was established in rural southern Zambia adjacent to Macha Hospital in collaboration with Johns Hopkins University in 2005. Infrastructure and capacity for conducting research was built initially for malaria and then for other health conditions, including HIV and tuberculosis. Malaria research programs of MRT currently employ a variety of PCR- and ELISA-based technologies to analyze *Plasmodium sp.* (parasite) genetic diversity and prevalence and *Anopheles sp.* (vector) infectivity, and are supported by fully functional insectary facilities. However, the capacity to conduct routine laboratory cultivation of the malaria parasite *Plasmodium falciparum* remained undeveloped. Addition of several small pieces of equipment, media and reagents, and permission from the Zambian National Health Research Ethics Committee to import *P. falciparum* laboratory strains and human serum allowed existing equipment and facilities to be repurposed to support successful cultivation of the laboratory strain NF54. Related techniques were used to culture and preserve multiple isolates of *P. falciparum* from venous blood drawn from consenting patients presenting with a positive HRPII RDT (rapid diagnostic test for malaria infection) at the Macha Mission Hospital or surrounding Rural Health Clinics. Red blood cells from uninfected human donors are required for laboratory propagation of *P. falciparum*. Our studies reveal that media-washed red blood cells obtained from individuals undergoing malaria prophylaxis with either Doxycycline or Deltaprim support ongoing propagation of asexual forms of the parasite as well as the development of morphologically mature gametocytes. The availability of cultured parasites provides opportunities to prepare standards for ongoing molecular diagnostic analyses as well as for the production of infectious sexual gametocyte forms which can be used for future studies of mosquito infection using artificial membrane feeding system(s). This newly acquired capacity should enhance research opportunities at the Zambian field location of the Johns Hopkins Bloomberg School of Public Health. **(63)**

Michael Wingate

Applications of Monte Carlo Methods

Monte Carlo methods are algorithms that perform computations based off of sampling a large number of random inputs, then aggregating the results. They are useful in cases where many other algorithms fail, especially having to do with modeling. These methods have been shown to be effective in a wide variety of applications, from molecular modeling to artificial intelligence. **(15)**

Russell Woleslagle, Andrew Joy, Brian Swartz*, Tim Zimmerman†*

Pedestrian Bridge in Panama

In the Bridge Project, we believe that everyone deserves the right to have safe and reliable access to essential life resources. With our partner, Rio Missions, we have identified communities in Panama with restricted access due to seasonal flooding, and are working to improve access to life-sustaining resources by designing and constructing pedestrian bridges.

Last summer, we completed our first bridge in a community called Arraijan. This bridge now connects two halves of a community, and provides safe and reliable year-round access to the road where kids can travel to the local school. After the successful completion of the first bridge, we identified a new community called La Gigi. This community is cut-off from their local school and medical center by a seasonally flooding river, comparable to the Yellow Breaches. We are working with a service-oriented bridge building organization called Bridges-to-Prosperity and have recently finished designs for this 215ft cable suspended pedestrian bridge. We are planning a six week construction trip for this Summer starting in mid-May and finishing at the end of June. **(56)**

Sarah Zwart, Emily Mellott, Alison Noble*

Characterization of Self-Assembled Monolayers on Zinc Selenide (ZnSe)

Self-assembled monolayers (SAMs) are organized, single layers of organic molecules which spontaneously form on certain surfaces. SAMs are widely used in the design of surfaces for a wide range of applications, such as biosensors, and directing different orientations of liquid crystals. SAMs are usually studied on gold substrates, but SAMs can be formed on a variety of surfaces, such as silver, copper, and zinc selenide (ZnSe). ZnSe is advantageous to use because it is transparent in the infrared region of the electromagnetic spectrum and is a common element in FTIR spectroscopy. The formation of SAMs on ZnSe has not been fully characterized. In our work, surface energies for several different thiolate SAMs were determined using contact angles and the Owens-Wendt-Rabel-Kaelble (OWRK) method, where Young's equations is rewritten with two components of surface energy, polar and dispersive. Current work is focused on determination of monolayer density and defects using a variety of characterization methods including static contact angles, XPS, and ellipsometry. **(91)**

Index of Authors

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and corresponding presentation number(s).

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