

The Department of Chemistry and Biochemistry
Assessment Report– PhD Programs- Academic Year 2016/2017

MSU's Mission

Montana State University, the state's land grant institution, educates students, creates knowledge and art, and serves communities by integrating learning, discovery and engagement.

The Department of Chemistry and Biochemistry Mission

The mission of the Department of Chemistry and Biochemistry is to provide students with educational experiences that empower and guide them to think critically and creatively for long term professional success in their chosen fields.

The following assessment report highlights the Department of Chemistry and Biochemistry's Ph.D. programs in chemistry and biochemistry based on data from Fall of 2015 through Spring of 2017. The report begins with facts about the program in the last ~2 years and then presents information on the Department's and the Graduate School's requirements. Data on Ph.D. learning outcomes are also presented.

Facts about the Program

- 67 graduate students were enrolled in the Fall of 2015.
- 67 graduate students were enrolled in the Fall of 2016.
- 2 Ph.D. students were accepted in the Spring of 2017 (not included in table below)
- 15 new graduate students will be attending MSU in the Fall of 2017 (not included in table below).

Table 1 below provides the number of graduate students in the program based on their entering class year. Of the current total (67) in the Fall of 2016, 4 students were on either a thesis or coursework (CW) Master (MS) track. All other students are pursuing a Ph.D. in chemistry or biochemistry.

Table 1 – Current Students in the Department According to Entering Year

2016	2015	2014	2013	2012	2011	2010	2008
12	11	11	10	10	7	5	1

- Of the last 2 entering classes (2015 and 2016), only one Ph.D. student who entered in 2015, transferred to a different university with a professor who left the department.
- Two other students left in the summer of 2015. One student on the MS track failed to obtain their degree and one PhD student left because she was not in good standing.
- A Ph.D. student who entered in 2010 left the program in the Fall of 2016 without a degree.

The next section of the documents provides information on both department and The Graduate School Requirements.

1. Qualifying Exams

All first year students take qualifying exams (proficiencies) to demonstrate their preparedness for an advanced degree in our program. The exams are a department requirement. Students are required to pass 3 proficiency exams in their first year of graduate school to remain in good standing. The exams are offered 4 times a year and except for the structural and molecular biology exam, all exams are standardized American Chemistry Society (ACS) exams given in 5 different sub-disciplines. The outcome for any exam can be a Full Pass (FP) Master Pass (MP) or a No Pass (NP). As determined by the well-publicized ACS norms, a FP is set at the 55th percentile, the MP is set at ~ 50th percentile and scores below the 50th percentile are considered a NP. The names and results of each student who took proficiencies in the entering classes of 2015, and 2016 appear in Appendix A (data not shown).

Results:

Entering Class of 2015 – Of the 9 students taking the proficiency exams, all student have the met the department requirement of passing 3 exams.

Entering Class of 2016 - Of the 12 students taking the proficiency exams, all of them have passed the proficiency requirement.

2. Comprehensive Exams

The Graduate School requires a comprehensive exam after 2/3 of a student's coursework has been completed. Typically our department has students defend written and oral portions of the exam (at the same time) during the student's second semester of their second year of graduate school. See Appendix B (data not shown) for names of those students who defended the exams in AY 2015/2016, and AY 2016/2017. A summary of the results are below.

Eleven students that were in good standing from the class of 2014 successfully defended their written and oral comprehensive exams in either spring of 2016 or the fall of 2016. One student in the class of 2014 changed from a Ph.D. track to an MS after she defended her comprehensive exam. Of the entering class of 2015, 8 students successfully defended their comprehensive exams in the spring of 2017. One student transferred to a different program and one student switched to an MS coursework option and did not take the comprehensive exam.

3. Department Requirement- 4th year seminar

The Department of Chemistry and Biochemistry requires that all students in their 3rd or 4th year of graduate school give a public research seminar. The students meet with their Ph.D. committees after their seminar to discuss relevant research questions and to obtain feedback from their committee on progress to date and time of expected graduation. It is assumed that the student will graduate with their degree ~ 1-2 years after they give their seminar.

Completed seminar in year 2015

7 students completed this requirement.

Completed seminar in 2016

5 students completed this requirement

Completed Seminar in 2017

4 students completed this requirement

4. Graduation

Table 2 summarizes our graduation statistics for the last 8 years. Figure 1 (conclusion section) depicts a longitudinal overview of degrees awarded since 1999. The names of students who graduated in the 2015, 2016 and currently in 2017 appear in Appendix C (data not shown).

Table 2 Graduation Statistics

Degree	N	Average Credits	Average GPA	Average #yrs to graduate
2009 (Jan-Dec)				
MS	4	42.5	3.51	2.8
PhD	7	76.3	3.7	5.7
2010				
MS	3	38	3.67	3
PhD	8	80.5	3.75	5.4
2011				
MS	7	47.85	3.55	3.7
PhD	4	72.5	3.74	5
2012				
MS	6	39.5	3.46	3.3
PhD	6	78.33	3.7	5.7
2013				
MS	4	45.25	3.66	3.5
PhD	8	85.15	3.72	6.3
2014				
MS	1	47	3.55	4
PhD	13	69.91	3.59	5.8
2015				
MS	3	33.0	3.42	2.5
PhD	14	69.13	3.75	5.7
2016				
MS	6	32.6	3.26	2.58
PhD	12	67.41	3.35	5.27
2017(May-August)				
MS	2	43.5	3.69	3.5
PhD	6	66	3.50	5.83

Program Learning Outcomes

For doctoral students:

1. Demonstrate mastery of subject content knowledge.
2. Demonstrate effective oral and written communication skills.
3. Conduct independent research and analysis in their discipline and contribute original and substantive work in their field.
4. Demonstrate independent scientific thinking and advanced knowledge in their current discipline and in related areas of their discipline.
5. Demonstrate knowledge of basic lab safety and the requirements to assist in establishing a safe lab environment.
6. Understand ethical issues and responsibilities especially in matters related to professionalism, data collection, the laboratory setting and in writing and publishing theses, dissertations and scientific papers.
7. Professionalization into the field of study: publications, presentations, attended conferences, received funded fellowships, and professional association activities.

Program Learning Outcomes 1-4;

We created a rubric to evaluate learning outcomes 1-4. For ease in the assessing, outcomes 1, 3 and 4 were combined to evaluate students at their PhD or MS defenses. We evaluated the student separately on written and oral communication skills.

In the Fall of 2014, we began to distribute the rubric to 3 faculty members on a student's committee at the student's Ph.D. and M.S defenses. The overall scores for each of the outcomes assessed were averaged for each student. For each learning outcome, an average score of 1 was unacceptable; 2 was acceptable and 3 exceptional. Data were collected on 16 Ph.D students (Fall 2015-spring 2017.)

On the outcome "the student has effective oral communication skills", 100% of our students averaged a score of 2 (acceptable) or better. On the outcome "the student has effective written communication skills, all 16 students averaged a 2 (acceptable) or better (tendency for exceptional). On the combined outcomes of 1, 3 and 4 "the student demonstrated mastery of subject content and successfully conducted independent research and analysis contributing original substantive work in their field" all 16 students averaged a 2 (acceptable) or better.

All 16 students (assessed) earned a Ph.D. in either chemistry or biochemistry.

Program Learning Outcomes 5 and 6;

All entering students complete ethics training with either the Graduate School and/or the Department of Chemistry and Biochemistry. For the past 3 years, during orientation for the first year graduate students, Professor Mary Cloninger has presented an ethics in research module

for all incoming graduate students. In addition to this classroom time, students have completed an online training certification through the Collaborative Institutional Training Initiative (CITI) offered through the University of Miami ([https://www.citiprogram.org/.](https://www.citiprogram.org/)) Students had to attend the classroom training session with Professor Mary Cloninger and pass the necessary CITI online training modules and quizzes in order to be a student in good standing in our department. We will continue this training every year for the new incoming graduate students. Last year (Fall 2016) our incoming students also had a training session in research compliance, ethics and legal issues with the Graduate School's orientation session in August.

In the Fall of 2015, the department head implemented a mandatory fire safety training for all graduate students and TAs affiliated with the department. All graduate students in the department of chemistry and biochemistry completed a 90 min fire safety training with Skip Hougland from MSU's Safety and Risk Management. In addition to mandatory fire safety training, all entering students for the past three years (n=35) participated in a 3-day teaching training orientation with Professor Chris Bahn. This training included a 45 minutes session on laboratory safety. All first year students in the department have to complete an online laboratory safety course through Safety and Risk Management in order to be in good standing with the department. This training will continue forward with every new entering graduate class.

Learning Outcome 7

For the learning outcome of "professionalization into the field of study: publications, presentations, attended conferences, received funded fellowships, and professional association activities, we initially thought that we would collect CVs from the students who obtained a Ph.D. from our department. While some students did email the graduate program director the information, multiple emails to students did not achieve the desired results. We eliminated this form of data collection and relied on the "thesis points" document. The thesis points document is a requirement for our PhD students to complete before their scheduled defense. The thesis point of one of our students can be found in Appendix E (data not shown).

We report below, a list of compiled awards, conferences attended and publications of 16 PhD students that have graduated between Dec. 2015- May-2017.

Dr. Jacob Artz Graduated in December of 2016

Current Position: post-doctoral fellow at Washington State University, Institute of Biological Chemistry Pullman, Wa.

MSU Achievements

Awards

2016	Best Poster, 11 th International Hydrogenase Conference
2015	First Prize, MSU Graduate Student Research Summit
2015	MSU Graduate Student Competitive Research Competition
2012	Presidential Graduate Scholarship

Poster Presentations

- July, 2016 11th International Hydrogenase Conference, "Structural determinants of catalytic bias in [FeFe]-hydrogenases as revealed by potentiometric EPR spectral deconvolution"
- June, 2016 Northwest Crystallography Conference, "Structural determinants of catalytic bias in [FeFe]-hydrogenases as revealed by potentiometric EPR spectral deconvolution"
- October, 2015 Montana State University Graduate Student Research Summit, "[FeFe]-Hydrogenases as a Model System for the Study of Catalytic Bias"
- March, 2015 22nd West Coast Protein Crystallography Workshop, "Structural and Biochemical Characterization of a Highly Thermostable Mercuric Reductase from *Metallosphaera sedula*"

PUBLICATIONS

- Artz JH, White SN, Zadvornyy OA, Fugate CJ, Hicks D, Gauss GH, Posewitz MC, Boyd ES, Peters JW. (2015) Biochemical and Structural Properties of a Thermostable Mercuric Ion Reductase from *Metallosphaera sedula*. *Front Bioeng Biotechnol*. Jul 13;3:97. doi: 10.3389/fbioe.2015.00097. eCollection 2015. PubMed PMID: 26217660; PubMed Central PMCID: PMC4500099.
- Swanson KD, Ratzloff MW, Mulder DW, Artz JH, Ghose S, Hoffman A, White S, Zadvornyy OA, Broderick JB, Bothner B, King PW, Peters JW. (2015) [FeFe]-hydrogenase oxygen inactivation is initiated at the H cluster 2Fe subcluster. *J Am Chem Soc*. Feb 11;137(5):1809-16. doi: 10.1021/ja510169s. Epub 2015 Jan 29. PubMed PMID: 25579778

Dr. Ashley Beckstead

Defended May 2017 (Will Graduate Summer 2017)

No current position but looking for a postdoctoral position

MSU Achievements

Awards

- 2014-2017 NSF AGEP-National Science Foundation "Alliances for Graduate Education and Professoriate" Graduate Research Supplement
- 2016 NSF Division of Chemistry (CHE) Supplement for Professional Development
- 2012 Meritorious Graduate Fellowship, Montana State University

PUBLICATIONS

- Beckstead, A. A.; Zhang, Y.; Smith, H.; Bermel, E.; Skowron, D.; de La Harpe, K.; Oliver, T. A. A.; Foreman, C.; Kohler, B. "Excited-State Deactivation of the Bacterial Pigment Violacein", *in preparation*.
- Beckstead, A. A.; Zhang, Y.; Li, X. -B.; Spata, V. A.; Matsika, S.; Burrows, C. J.; Kohler, B. "Excited-State Dynamics of C5-Hydroxyl Substituted Cytidine and Uridine as Nucleosides and as Dinucleotides with Adenine", *in preparation*.
- Zhang, Y.; Beckstead, A. A.; Hu, Y.; Piao, X.; Bong, D.; Kohler, B. "Excited-State Dynamics of Melamine and Its Lysine Derivative Investigated by Femtosecond Transient Absorption Spectroscopy", *Molecules*, **2016**, *21*, 1645.
- Skowron, D.; Zhang, Y.; Beckstead, A. A.; Remington, J. M.; Strawn, M.; Kohler, B. "Subnanosecond Emission Dynamics of AT DNA Oligonucleotides", *Chem. Phys. Chem.*, **2016**, *17*, 3558-3569.
- Beckstead, A. A.; Zhang, Y.; de Vries, M.; Kohler, B. "Life in the Light: Nucleic Acid Photoproperties as a Legacy of Chemical Evolution", *Phys. Chem. Chem. Phys.*, **2016**, *18*, 24228-24238.

- Martinez-Fernandez, L.; Zhang, Y.; de La Harpe, K.; Beckstead, A. A.; Kohler, B.; Improta, "Photoinduced Long-Lived Charge Transfer States in AT-DNA Strands", *Phys. Chem. Chem. Phys.*, **2016**, *18*, 21241-21245.
- Zhang, Y.; Li, X. -B.; Fleming, A. M.; Dood, J.; Beckstead, A. A.; Orendt, A. M.; Burrows, C. J.; Kohler, B. "UV-Induced Proton-Coupled Electron Transfer in Cyclic DNA Miniduplexes", *J. Am. Chem. Soc.*, **2016**, *138*, 7395-7401.
- Zhang, Y.; de La Harpe, K.; Beckstead, A. A.; Martinez-Fernandez, L.; Improta, R.; Kohler, B. "Excited-State Dynamics of DNA Duplexes with Different H-Bonding Motifs", *J. Phys. Chem. Lett.*, **2016**, *7*, 950-954.
- Zhang, Y.; de La Harpe, K.; Beckstead, A. A.; Improta, R.; Kohler, B. "UV-Induced Proton Transfer Between DNA Strands", *J. Am. Chem. Soc.*, **2015**, *137*, 7059-7062.
- Lu, Z.; Beckstead, A. A.; Kohler, B.; Matsika, S. "Excited State Relaxation of Neutral and Basic 8-Oxoguanine", *J. Phys. Chem. B*, **2015**, *119*, 8293-8301.
- Zhang, Y.; Dood, J.; Beckstead, A. A.; Li, X. -B.; Nguyen, K. V.; Burrows, C. J.; Improta, R.; Kohler, B. "Photoinduced Electron Transfer in DNA: Charge Shift Dynamics Between 8-Oxo-Guanine Anion and Adenine", *J. Phys. Chem. B*, **2015**, *119*, 7491-7502.
- Zhang, Y.; Dood, J.; Beckstead, A. A.; Li, X. -B.; Nguyen, K. V.; Burrows, C. J.; Improta, R.; Kohler, B. "Efficient UV-Induced Charge Separation and Recombination in an 8-Oxoguanine Containing Dinucleotide", *Proc. Natl. Acad. Sci. USA*, **2014**, *111*, 11612-11617.
- Zhang, Y.; Dood, J.; Beckstead, A. A.; Chen, J.; Li, X. -B.; Burrows, C. J.; Lu, Z.; Matsika, S.; Kohler, B. "Ultrafast Excited-State Dynamics and Vibrational Cooling of 8-oxo-7,8-dihydro-2'-deoxyguanosine in D₂O", *J. Phys. Chem. A*, **2013**, *117*, 12851-12857.

PRESENTATIONS

- Beckstead, A. A.; Li, X. -B.; Zhang, Y.; Burrows, C. J.; Kohler, B. "Charge Transfer Dynamics of 5-Hydroxycytidine and 5-Hydroxyuridine Investigated by Time-Resolved IR Spectroscopy", The 63rd Pacific Conference on Spectroscopy and Dynamics, Pacific Grove, CA, 2016 (contributed talk)
- Beckstead, A. A.; Li, X. -B.; Zhang, Y.; Burrows, C. J.; Kohler, B. "Charge Transfer Dynamics of 5-Hydroxycytidine and 5-Hydroxyuridine Investigated by Time-Resolved IR Spectroscopy", MSU Graduate Student Summit, Bozeman, MT, 2015 (poster)
- Beckstead, A. A.; Zhang, Y.; Dood, J.; Li, X. -B.; Burrows, C. J.; Improta, R.; Kohler, B. "Monitoring the Photoinduced Electron Transfer Capability of 8-Oxo-7,8-dihydro-2'-deoxyguanosine Using Ultrafast Time-Resolved IR Spectroscopy", The 69th Northwest Regional Meeting of the ACS, Missoula, MT, 2014 (contributed talk)
- Beckstead, A. A.; Zhang, Y.; de La Harpe, K.; Hariharan, M.; Kohler, B. "Excited-State Dynamics of Adenine DNA Systems in Non-Aqueous Deep Eutectic Solvents Revealed by Femtosecond Transient Absorption Spectroscopy" OpTeC Optical Science and Engineering Conference, Bozeman, MT, 2014 (poster)
- Beckstead, A. A.; Dood, J.; Zhang, Y.; Li, X. -B.; Burrows, C. J.; Improta, R.; Kohler, B. "Excited-State Dynamics of a Modified Monomer Nucleobase as Revealed by Femtosecond Pump-Probe Spectroscopy" OpTeC Optical Science and Engineering Conference, Bozeman, MT, 2013 (poster)

Dr. Rebecca Danforth

(Defended in April-2017) Will Graduate in Summer of 2017

Current position: Instructor of general chemistry- Montana State University

MSU Achievements

Awards

2017 Ph.D. Dissertation Completion Award-The Graduate School Montana State University

2016 E.W. Mares Award –The Department of Chemistry and Biochemistry, Montana State University

PUBLICATIONS

Danforth, R. A.; Kohler, B. "Ultrafast Photochemical Dynamics of the Hexaaquairon(III) Ion", Chem. Phys. Lett. 2017, <http://dx.doi.org/10.1016/j.cplett.2017.02.048>

PRESENTATIONS

"Ultrafast Photochemical Dynamics of the Hexaaquairon(III) Ion" Pacific Conference on Spectroscopy and Dynamics Asilomar, CA.

"Ultrafast Decay Kinetics of Hydrolyzed Iron(III) in Aqueous Solutions Upon Photoexcitation"

4th Year Seminar for the Department of Chemistry and Biochemistry, Montana State University, Bozeman, MT

"Excited State Dynamics of Aqua-Iron(III) Complexes at Low pH Utilizing Ultrafast Transient Absorption Spectroscopy" Poster presented at the annual Optec Conference, Bozeman, MT

Dr. Ethan Edwards

Graduated in Summer of 2016

Current position: post-doctoral fellow Matrivax R&D Corporation, Boston, MA

Dr. Carl Fahlstrom

Graduated in Spring of 2016

Current position: Web Development Instructor Big Sky Code Academy

Dr. Christine Gobrogge

Graduated in Spring of 2017

Offered a Postdoctoral position at CU- Boulder

MSU Achievements

Awards

2017 Montana State University Graduate School PhD Completion Award

2016 E.W Mares Teaching Award, Department of Chemistry and Biochemistry, Montana State University

2015 Montana State University Graduate Student Competitive Research Grant

2014 Montana State University Chemistry Department Nomination: Outstanding Graduate Teaching Award

2012 Mildred Livingston Presidential Award

PUBLICATIONS

C.A. Gobrogge, V.A. Kong, R.A. Walker "Unusual Temperature Dependent Solvation and Partitioning in Phospholipid Membranes" *Journal of Physical Chemistry B* 120 (8), 1805-1812 (2016).

C.A. Gobrogge, H.S. Blanchard, R.A. Walker "Temperature Dependent Partitioning of C152 in Phosphatidylcholine Lipid Bilayers" *Journal of Physical Chemistry B* (2017), *in press*.

C.A. Gobrogge, R.A. Walker "Quantifying C152 and C461 Partitioning in Phosphatidylcholine Lipid Bilayers" *Analytical Chemistry* (2017), *under review*.

ORAL PRESENTATIONS

- 2015 *Unusual Temperature Dependent Partitioning and Solvation in Phospholipid Membranes*, Fourth-year graduate student seminar, Bozeman, MT
- 2015 *Solute Partitioning in Lipid Membranes: Using Time Resolved Spectroscopy to Understand Accumulation*, American Chemical Society Northwest Regional Meeting, Pocatello, ID
- 2014 *Reversible Partitioning in Model Membrane Systems*, American Chemical Society Northwest Regional Meeting, Missoula, MT
- 2010 *Lasers, Fluorimetry, and FRET*, Student Seminar Series, Holland, MI

POSTER PRESENTATIONS

- 2016 *Temperature Dependent Partitioning of Coumarin 152 in Phosphocholine/Phosphoethanolamine Lipid Bilayers*, Materials Science Under the Big Sky Symposium, Bozeman, MT
- 2015 *Unusual Temperature Dependent Partitioning and Solvation in Phospholipid Membranes*, Optical Technology Center annual meeting, Bozeman, MT
- 2014 *Using TCSPC and DSC to Investigate Partitioning in Mixed-Lipid Model Membranes*, Optical Technology Center annual meeting, Bozeman, MT
- 2013 *Using TCSPC to Investigate Coumarin Partitioning in Model Membrane Solutions*, Optical Technology Center annual meeting, Bozeman, MT

Dr. Eric Gobrogge

Graduated in December of 2015

Current Position: postdoctoral fellow at U.S Army Research Laboratory, Rockville Maryland

MSU Achievements

Awards

- 2010- Mildred Livingston Grant, Montana State University
- 2011-2013 Letters and Science Travel Grant, Montana State University
- 2014 Gordon Pagenkopf Award for outstanding graduate achievement
- 2015 Recommended for NRC fellowship

PUBLICATIONS

- Gobrogge, E.A.; Woods, B.L.; Walker, R.A. Liquid organization and solvation properties at polar solid/liquid interfaces. *Faraday Discussions* 2013, *167*, 309-327.
- Gobrogge, E.A.; Walker, R.A. Binary solvent organization at silica/liquid interfaces: Preferential ordering in acetonitrile-methanol mixtures. *Journal of Physical Chemistry Letters*. 2014, *5*, 2688-2693.
- Ennist, J.H.; Gobrogge, E.A.; Schlick, K.H.; Walker, R.A.; Cloninger, M.J. Cyclodextrin-functionalized chromatographic materials tailored for reversible adsorption. *ACS Applied Materials & Interfaces* 2014, *6*, 18087-18097.
- J. Karnes, E. A. Gobrogge¹, R. A. Walker and I. Benjamin "Unusual structure and dynamics at silica/methanol and and silica/ethanol interfaces – A molecular dynamics and nonlinear optical study" *J. Phys. Chem. B.* **120** (8) 1569-1578 (2016).
- Karnes, J.; Gobrogge, E.A.; Walker, R.A.; Benjamin, I. Unusual Structure and Dynamics at Silica/Methanol and Silica/Ethanol Interfaces – A Molecular Dynamics and Nonlinear Optical Study. *Journal of Physical Chemistry B*. Submitted.
- Burrows, S.M.; Gobrogge, E.A.; Link, K.A.; Fu, L.; Elliott, S.M.; Rasch, P.J.; Wang, H.F.; Walker, R.A. OCEANFILMS-2: Representing Co-Adsorption of Marine Surfactants and Soluble Polysaccharides Improves Simulation of Marine Aerosol Chemistry. *Geophysical Research Letters*. In Preparation.

PRESENTATIONS

- Nonlinear Optical Studies of Cooperative and Competitive Adsorption at Aqueous/Vapor and Solid/Liquid Interfaces. ACS Northwest Regional Meeting. Pocatello, ID. 2015 (Oral)
- Spectroscopic Studies of Noncovalent Interactions at Interfaces and Their Effects on Interfacial Structure, Organization, and Association, Army Research Laboratory, Adelphi, MD. 2015 (Invited Talk)
- Spectroscopic Studies of Noncovalent Interactions at Interfaces and Their Effects on Interfacial Structure, Organization, and Association, Argonne National Laboratory, Argonne, IL. 2015 (Invited Talk)
- Nonlinear Optical Studies of Adsorption and Organization at Silica Interfaces, Departmental Seminar, Department of Chemistry, Montana State University. 2014 (Oral)
- Binary Solvent Organization at Silica/Liquid Interfaces: Preferential Ordering in Acetonitrile-Methanol Mixtures, ACS Northwest Regional Meeting, Missoula, MT. 2014 (Oral)
- Nonlinear Optical Studies of Adsorption and Organization at Solid/Liquid Interfaces, Pacific Conference on Spectroscopy and Dynamics, Pacific Grove, CA. 2014 (Poster)
- Spectroscopic Studies of Reversible Adsorption to Functionalized Solid/Liquid Surfaces, ACS National Meeting, New Orleans, LA. 2013 (Poster)
- Spectroscopic Studies of Reversible Adsorption to Functionalized Solid/Liquid Surfaces, Gordon Research Conference on Vibrational Spectroscopy, Biddeford, ME. 2012 (Poster)
- Catch and Release Chemistry: Optical studies of reversible adsorption at dendrimer functionalized *surfaces*, Optical Technology Center annual meeting, Bozeman, MT. 2011 (Poster)

Dr. Tim Hamerly

Graduated in Spring of 2016

Current Position: post-doctoral researcher in the Emerging Pathogens Institute, Department of Infectious Diseases and Immunology University of Florida, Gainesville

MSU Achievements

Awards

- | | |
|------------|--|
| 2013, 2014 | Letters of College and Science Travel Grant, MSU |
| 2013 | Kopriva Graduate Student Fellowship |
| 2013 | ASMS Asilomar Conference Travel Grant |
| 2014 | ASMS Student Travel Stipend |

PUBLICATIONS

- Hamerly T, Bothner B, "Adding analytical metrics to the production aging of whiskey using a protein sensor assay," Submitted February 2016
- Zignego DL, Mailhiot SE, Hamerly T, Schmidt EE, June RK, "Change in Joint Metabolomics Following Surgical Destabilization and Exercise in Novel Cartilage Reporter Mouse Model," Submitted August 2015
- Hamerly T, Tripet B, Wurch L, Hettich RL, Podar M, Bothner B, Copie V, "Characterization of fatty acids in Crenarchaeota by GC-MS and NMR," *Archaea*, 2015
- Hamerly T, Bothner B, "Investigations into the use of a protein sensor assay for metabolite analysis," *Applied Biochemistry and Biotechnology*, Published online 2015 Sep 22, 1-13

Hamerly T, Butler MH, Fisher ST, Hilmer JK, James GA, Bothner B, "Mass spectrometry imaging of chlorhexidine and bacteria in a model wound," *AIMS Medical Science*, 2015 Aug 6; 2(3): 150-161

Hamerly T, Tripet BP, Tigges M, Giannone RJ, Wurch L, Hettich RL, Podar M, Copie V, Bothner B, "Untargeted metabolomics studies employing NMR and LC-MS reveal metabolic coupling between *Nanoarchaeum equitans* and its archaeal host *Ignicoccus hospitalis*," *Metabolomics*, 2014 Nov 5; 11: 895-907

Hamerly T, Heinemann J, Tokmina-Lukaszewska M, Luszczek ER, Mulier KE, Beilman GJ, Bothner B, "Bovine serum albumin as a molecular sensor for the discrimination of complex metabolite samples from urine and wine," *Analytica Chimica Acta*, 2014 Feb 8; 61-66

Jutila AA, Zignego DL, Hwang BK, Hilmer JK, Hamerly T, Minor CA, Walk ST, June RK, "Candidate mediators of chondrocyte mechanotransduction via targeted and untargeted metabolomics measurements," *Archives of Biochemistry and Biophysics*, 2014 Jan 16; 545: 116-123

Heinemann J, Hamerly T, Maaty WS, Movahed N, Steffens JD, Reeves BD, Hilmer JK, Therien J, Grieco PA, Peters JW, Bothner B, "Expanding the paradigm of thiol redox in the thermophilic root of life," *Biochimica et Biophysica Acta*, 2013 Aug 17; 1840: 80-85

PATENTS

Bothner B, Hamerly T, 2015, "Serum Albumin for Marker Discovery and Complexity Reduction of Samples," US Patent Application #14/686,440, filed April 14th, 2015, Patent pending

PRESENTATIONS

Hamerly T, "Letting Biology Do the Heavy Lifting," Kopriva Seminar Series (Invited Speaker), January 16th, 2015

Hamerly T, Heinemann J, Tokmina-Lukaszewska M, Luszczek ER, Mulier KE, Beilman GJ, Bothner B, "Bovine serum albumin as a molecular sensor for the discrimination of complex metabolite samples from urine and wine," 29th Asilomar Conference on Mass Spectrometry, October 18th – October 22nd, 2013

POSTERS

Butler MH, Hamerly T, Fisher ST, Hilmer JK, James GA, Bothner B, "MALSI-MSI Imaging of Chlorhexidine and Bacteria on an in-vitro Human Skin Model," Montana Biofilm Meeting, July 15th – July 17th, 2014

Hamerly T, Tigges M, Tripet BP, Giannone RJ, Wurch L, Hettich RL, Podar M, Copie V, Bothner B, "Integrated omics analysis of the interaction between *Ignicoccus hospitalis* and *Nanoarchaeum equitans*," 62nd American Society of Mass Spectrometry Conference, June 16th, 2014

Hamerly T, Heinemann J, Tokmina-Lukaszewska M, Luszczek ER, Mulier KE, Beilman GJ, Bothner B, "Bovine serum albumin as a molecular sensor for the discrimination of complex metabolite samples from urine and wine," 29th Asilomar Conference on Mass Spectrometry, October 18th – October 22nd, 2013

Heinemann J, Maaty W, Hamerly T, Reeves BD, Peters JW, Podar M, Copie V, Bothner B, "Metabolomic and proteomic analysis of *Sulfolobus* expands the paradigm of intracellular thiol redox potential," GRC: Archaea: Ecology, Metabolism & Molecular Biology, July 28th – August 2nd, 2013

Lifen Guo, Walid Maaty, Tim Hamerly, and Brian Bothner, "Analysis of Intact Lipids from Arsenic and Buthionine Sulfoximine Stress on *Sulfolobus solfataricus*," Montana State University Summer REU Poster Session, August 7th, 2013

Tigges M, Hamerly T, Tripet B, Hettich RL, Podar M, Copie V, Bothner B, "Metabolomic characterization of the relationship between *Ignicoccus hospitalis* and *Nanoarchaeum equitans*," 9th International Conference of the Metabolomics Society, July 1st-4th, 2013

Hamerly T, Heinemann J, Tokmina-Lukaszewska M, Luszczek ER, Mulier KE, Beilman GJ, Bothner B, "Protein sensor for discrimination of complex metabolite samples," 61st American Society of Mass Spectrometry Conference, June 11th, 2013

Dr. Paul Jordan

Graduated in Spring of 2016

Current position: post-doctoral fellow at Alios BioPharma, part of the Janssen Pharmaceutical Companies of Johnson & Johnson San Francisco CA

Publications

Amy Servid, Paul Jordan, Alison O'Neil, Peter Prevelige, Trevor Douglas, "Location of the Bacteriophage P22 Coat Protein C-terminus Provides Opportunities for the Design of Capsid Based Materials."

Biomacromolecules. 2013 Sep 9; 14(9).

Jordan PC^{1,2}, Patterson DP³, Saboda KN², Edwards EJ^{1,2}, Miettinen HM⁴, Basu G⁵, Thielges MC¹, Douglas T¹. Self-assembling biomolecular catalysts for hydrogen production. *Nat Chem*. 2016 Feb;8(2):179-85. doi: 10.1038/nchem.2416. Epub 2015 Dec 21.

Dr. Ravi Kant

Graduated in Summer of 2016

Current position: Assistant Professor in the Department of University School of Chemical Technology (USCT) at Guru Gobind Singh Indraprastha University, Delhi, India.

MSU Achievements

PUBLICATIONS

Rayaprolu, V.; Kruse, S.; Kant, R.; Venkatakrishnan, B.; Movahed, N.; Brooke, D.; Lins, B.; Bennett, A.; Potter, T.; McKenna, R.; Agbandje-McKenna, M.; Bothner, B. "Comparative Analysis of Adeno-Associated Virus Capsid Stability and Dynamics", *J. Virol*. 2013, 87 (24), 13150-13160.

Rayaprolu, V.; Kruse, S.; Kant, R.; Movahed, N.; Brooke, D.; Bothner, B. "Fluorometric Estimation of Viral Thermal Stability". *Bio-Protocol*. 4(15).

Celis, A.I.; Streit, B.R.; Moraski, G.C.; Kant, R.; Lash, T.D.; Lukat-Rodgers, G.S.; Rodgers, K.R.; DuBois, J.L. "Unusual Peroxide-Dependent, Heme-Transforming Reaction Catalyzed by HemQ". *Biochemistry*. 2015, 7; 54(26):4022-32.

Selzer, L.; Kant, R.; Wang, J.C.; Bothner B.; Zlotnick A. "Hepatitis B Virus Core Protein Phosphorylation Sites Affect Capsid Stability and Transient Exposure of the C-terminal Domain *J Biol Chem*. 2015, 20;290(47):28584-93

Streit, B.R.; Kant, R.; Tokmina-Lukaszewska, M.; Celis, A.I.; Machovina, M.M.; Skaar, E.P.; Bothner, B.; DuBois, J.L. "Time-resolved studies of IsdG identify molecular signposts along the non-canonical heme oxygenase pathway". *J Biol Chem*. 2016, 8; 291(2):862-71

PRESENTATIONS

Kant, R.; Rayaprolu, V.; Qazi S.; Douglas T.; Bothner B. "Changes in stability and dynamics of P22 bacteriophage during maturation", Northwest Regional Meeting, 2014.

Kant, R.; Rayaprolu, V.; Qazi S.; Douglas T.; Bothner B. "Changes in stability and dynamics of P22 bacteriophage during maturation", Northwest Regional Meeting, University of Montana, Missoula, Jun 22-25, 2014.

Posters

- Movahed, N.; Rayaprolu, V.; Ruzicka, J.; Kant, R.; Brooke, D.; Nguyen, A.; Domitrovic, T.; Keles, E.; Johnson, J.E.; Bothner, B. "Aging Gracefully; Maturation of a Tetravirus", FASEB, 2012.
- Ankney, P.; Fang, X.; Kant, R.; Bothner, B. "Understanding lipid membrane structure, dynamics, and rigidity using a quartz crystal microbalance and lipolysis", REU, Montana State University, 2014.
- Kant, R.; Rayaprolu, V.; Qazi S.; Douglas T.; Bothner B. "Understanding the stability and dynamics of P22 bacteriophage during maturation", Gordon Research Conference, Ventura, Jan. 25-30, 2015.
- Celis, A; Kant, R, Bothner, B; and DuBois, J. L. Heme: substrate, product, or cofactor? Understanding the mechanism of IsdG: the non- canonical heme oxygenase", Gordon Research Conference, 2014.
- Kant, R.; Rayaprolu, V.; Qazi S.; Douglas T.; Bothner B. "Understanding the stability and dynamics of P22 bacteriophage during maturation", Gordon Research Conference, Ventura, Jan. 25-30, 2015.
- Kant, R.; Rayaprolu, V.; Qazi S.; Douglas T.; Bothner B. "Understanding the stability and dynamics of P22 bacteriophage during maturation", Gordon Research Conference, Ventura, Jan. 25-30, 2015.
- Kant, R.; Movahed N.; Brooke D.; Rayaprolu, V.; Lins B.; McKenna M.; Bothner B. "What can phylogenetic, lipase activity, and capsid stability tell us about AAV entry?" Gordon Research Conference, Ventura, Jan. 25-30, 2015

Dr. Stephen Keable **Graduated in Spring of 2017**

Current Position: post-doctoral research fellow, Department of Chemistry and Biochemistry, Montana State University

MSU Achievements

Awards

2015 Department of Energy, Office of Science Graduate Student Research (SCGSR) Fellowship

PUBLICATIONS

- Sarma, R., Barney, B.M., Keable, S., Dean, D.R., Seefeldt, L.C., and J.W. Peters. (2010) Insights into substrate binding at FeMo-cofactor in nitrogenase from the structure of an alpha-70(Ile) MoFe protein variant. *J. Inorg. Biochem.* 104(4) 385-389
- Guo, Y., Brecht, E., Aznavour, K., Nix, J.C., Xiao, Y., Wang, H., George, S.J., Bau, R., Keable, S., Peters, J.W., Adams, M.W., Jenney, F., Sturhahn, W., Alp, E.E., Zhao, J., Yoda, Y., and S.P. Cramer. (2013) Nuclear resonance vibrational spectroscopy (NRVS) of rubredoxin and MoFe protein crystals. *Hyperfine Interact.* 222 77-90
- Mitra, D., George, S.J., Guo, Y., Kamali, S., Keable, S., Peters, J.W., Pelmeshnikov, V., Case, D.A., and S.P. Cramer. (2013) Characterization of [4Fe-4S] cluster vibrations and structures in nitrogenase Fe protein at three oxidation levels via combined NRVS, EXAFS, and DFT analyses. *J Am Chem Soc.* 135(7) 2530-2543.
- Cohen, A.E., Soltis, S.M., González, A., Aguila, L., Alonso-Mori, R., Barnes, C.O., Baxter, E.L., Brehmer, W., Brewster, A.S., Brunger, A.T., Calero, G., Chang, J.F., Chollet, M., Ehrensberger, P., Eriksson, T.L., Feng, Y., Hattne, J., Hedmean, B., Hollenbeck, M., Holton, J.M., Keable, S., Kobilka, B.K., Kovaleva, E.G., Kruse, A.C., Lemke, H.T., Lin, G., Lyubimov, A.Y., Manglik, A., Mathews I.I., McPhillips, S.E., Nelson, S., Peters, J.W., Sauter, N.K., Smith, C.A., Song, J., Stevenson, H.P., Tsai, Y., Uervirojnangkoorn, M., Vinetsky, S., Weis, W.I., Zadvornyy, O.A., Zeldin, O.B., Zhu, D., and K.O. Hodgson. (2014) Goniometer-based femtosecond crystallography with X-ray free electron lasers. *Proc. Natl. Acad. Sci.* 111(48) 17122-17127

Danyal, K., Rasmussen, A.J., Keable, S.M., Inglet, B.S., Shaw, S., Zadvornyy, O.A., Duval, S., Dean, D.R., Raugei, S., Peters, J.W., and L.C. Seefeldt. (2015) Fe protein independent substrate reduction by nitrogenase MoFe protein variants. *Biochemistry* 54(15) 2456-2462

Keable, S.M., Rasmussen, A.J., Danyal, K., Eilers, B.J., Prussia, G.A., Levine, A.X., Seefeldt, L.C., and J.W.Peters. (2016) Three structural states of the nitrogenase P-cluster revealed in MoFe protein structures at poised potentials. (In preparation)

Keable S.M., Vertemara, J., Karamatullah D., Rasmussen A.J., Eilers, B.J., Zadvornyy, O.A., De Gioia, L., Zampella, G., Seefeldt, L.C., and J.W. Peters. (2016) Acetylene interaction with the nitrogenase FeMo-cofactor investigated by structural and computational analysis. (In preparation)

Brown K.A., Harris, D.F., Wilker, M.B., Rasmussen, A.J., Hamby, H., Keable, S., Dukovic, G., Peters, J.W., Seefeldt, L.C., and P.W. King. (2016) Light-driven dinitrogen reduction by a CdS:nitrogenase MoFe protein biohybrid. *Science*. 352(6284) 448-450

PRESENTATIONS

Keable, S.M., Karamatullah, D., Zadvornyy, O.A., Shaw, S., Inglet, B.S., Duval, S., Dean, D.R., Hoffman, B.M., Seefeldt, L.C., and J.W. Peters. (2012) Structural insights into a variant MoFe protein capable of substrate reduction in the absence of Fe protein and ATP, Northwest Crystallography Workshop, Bozeman, MT (poster)

Keable, S.M., Karamatullah D., Zadvornyy, O.A., Shaw, S., Inglet, B.S., Duval, S., Dean, D.R., Hoffman, B.M., Seefeldt, L.C., and J.W. Peters. (2014) Structural insights into a variant MoFe protein capable of substrate reduction in the absence of Fe protein and ATP, Gordon Research Conference on Iron-Sulfur Enzymes, Stonehill College, Easton, MA (poster)

Keable, S.M., Rasmussen, A.J., Danyal, K., Eilers, B.J., Prussia, G.A., Levine, A.X., Seefeldt, L.C., and J.W.Peters. (2015) Three distinct structural states of the nitrogenase P-cluster revealed by X-ray structures of the MoFe protein at defined redox potentials, Northwest Crystallography Workshop, Pullman, WA (oral)

Dr. Ryan Latterman

Graduated in Spring of 2016

Current Position: post-doctoral fellow at the University of Montana in the Department of Chemistry. He will be starting as an assistant professor at Wisconsin Lutheran College, August, '17.

PUBLICATION

R. E. Latterman¹, S. Birrell, P. A. Sullivan, and R. A. Walker "Improved pulsed laser operation with engineered nanomaterials" *ACS Applied Materials and Interfaces* **8** (30) 19724-19731 (2016).

Dr. Amanda Mattson

Graduated in Spring of 2017

Current position: Instructor, Department of Chemistry and Biochemistry REU program

MSU Achievements

Awards

2008 MSU Presidential Scholarship

2011 Gold Award- 7th International Dendrimer Symposium (07/11)

Highest award for graduate work presented in both the forms of a poster and oral presentation

PUBLICATIONS

Mattson, A. L.; Michel, A. K.; Cloninger, M. J., Using In(III) as a promoter for glycosylation. *Carbohydrate Research* **2012**, *347* (1), 142-146

PRESENTATIONS

Mattson, A.L., Cloninger, M.J. "In(III) as a glycosylation promoter using acetyl or acetonide protected mannose", Montana ACS Conference, Butte, MT Feb. 20, 2010 (oral).

Mattson, A.L., Cloninger, M.J. "Characterization of Dendrimer Endgroup Functionalization Via Electron Paramagnetic Resonance", 7th International Dendrimer Symposium, Washington, DC. Jun. 26–July 1, 2011 (oral and poster).

Mattson, A.L., Cloninger, M.J. "Characterization of Dendrimer Endgroup Functionalization Via Electron Paramagnetic Resonance", 2nd International SFB-765 Symposium, Berlin, Germany. October 18-19, 2012 (poster).

Dr. Melissa McIntyre

Graduated in Fall of 2016

Current Position- research scientist at ZAF Energy Systems (Columbia Falls, MT)

MSU Achievements

PUBLICATIONS

McIntyre, M. D.; Neuburger, D. M.; Walker, R. A. *In Operando* Raman Spectroscopy Studies of Temperature Dependent Carbon Accumulation on SOFCs Operating with Syngas. Submitted to the *Journal of Electrochemical Society*.

McIntyre, M. D.; Driscoll, D. R.; Welander, M. M.; Sofie, S. W.; Walker, R. A. *In Situ* Formation of Multifunctional Ceramics: Mixed Ion-Electron Conducting Properties of Zirconium Titanium Oxides. Submitted to the *Journal of Materials Chemistry A*.

M. L. Traulsen, M. D. McIntyre¹, K. Norrman, S. Sanna, M. Mogensen, and R. A. Walker "Reversible Decomposition of Secondary Phases in BaO Infiltrated LSM Electrodes – Polarization Effects" *Advanced Materials-Interfaces* **3** (24) Art. No. 1600750 (2016).

Driscoll, D. R.; McIntyre, M. D.; Welander, M. M.; Sofie, S. W.; Walker, R. A. Enhancement of High Temperature Metallic Catalysts: Aluminum Titanate Nickel-Zirconia System. *Applied Catalysis A: General*, 2016, *527*, 36-44.

McIntyre, M. D.; Neuburger, D. M.; Walker, R. A. In Situ Optical Studies of Carbon Accumulation with Different Molecular Weight Alkanes on SOFC Ni Anodes. *Electrochemical Society Transactions*, 2015, *66*(32), 11-19.

McIntyre, M. D.; Traulsen, M. L.; Norrman, K.; Sanna, S.; Walker, R. A. Polarization Induced Changes in LSM Thin Film Electrode Composition by In Operando Raman Spectroscopy and TOF-SIMS. *Electrochemical Society Transactions*, 2015, *66*(2), 47-59.

McIntyre, M. D.; Kirtley, J. D.; Singh, A.; Islam, S.; Hill, J. M.; Walker, R. A. Comparing In Situ Carbon Tolerances of Sn-Infiltrated and BaO-infiltrated Ni-YSZ Cermet Anodes in Solid Oxide Fuel Cells Exposed to Methane. *Journal of Physical Chemistry C*, 2015, *119*(14), 7637-7647.

Reeping, K. W.; Halat, D. M.; Kirtley, J. D.; McIntyre, M. D.; Walker, R. A. In Situ Optical and Electrochemical Studies of SOFC Carbon Tolerance. *Electrochemical Society Transactions*, 2014, *61*(1), 57-63.

McIntyre, M. D.; Kirtley, J. D.; Halat, D. M.; Reeping, K. W.; Walker, R. A. In Situ Spectroscopic Studies of Carbon Formation in SOFCs Operating with Syngas. *Electrochemical Society Transactions*, 2013, 57(1), 1267-1275.

Kirtley, J. D.; McIntyre, M. D.; Halat, D. M.; Walker, R. A. Insights into SOFC Ni/YSZ Anode Degradation Using In-Situ Spectrochronopotentiometry. *Electrochemical Society Transactions*, 2013, 50(44), 3-15.

Kirtley, J. D.; Halat, D. M.; McIntyre, M. D.; Eigenbrodt, B. C.; Walker, R. A. High-Temperature "Spectrochronopotentiometry": Correlating Electrochemical Performance with In Situ Raman Spectroscopy in Solid Oxide Fuel Cells. *Analytical Chemistry*, 2012, 84(22), 9745-9753.

Chu, X.; McIntyre M. Comparison of the strong-field ionization of N₂ and F₂: A time-dependent density-functional-theory study. *Phys. Rev. A*, 2011, 83(1).

Dr. David Skowron

Graduated in Summer of 2017

Currently looking for a postdoctoral position

MSU Achievements

PUBLICATIONS

Skowron, D. J.; Zhang, Y.; Beckstead, A. A.; Remington, J. M.; Strawn, M.; Kohler, B. "Subnanosecond Emission Dynamics of AT DNA Oligonucleotides." *Chemphyschem* 2016, 17, 355

PRESENTATIONS

David Skowron, Yuyuan Zhang, Ashley Beckstead, Jacob M. Remington, and Bern Kohler, "Time-resolved Fluorescence of Model DNA Oligonucleotides," oral presentation at the Optical Technology Center 2016 Annual Conference, Bozeman, MT. Oct. 4, 2016

David Skowron, Yuyuan Zhang, Ashley Beckstead, and Bern Kohler, "Sub-nanosecond Emission from AT DNA Oligonucleotides Compared with Time Resolved Absorption," poster presentation at the 63rd Pacific Conference on Spectroscopy and Dynamics, Pacific Grove, CA. Jan. 28 – 31, 2016

David Skowron and Bern Kohler, "Time Dependent Fluorescence of Model DNA Oligomers," poster presentation at the Optical Technology Center 2015 Annual Conference, Bozeman, MT. Sep. 15, 2015.

Dr. Charles Stark

Graduated in Fall of 2016

Current Position: post-doctoral position at the Keemilise ja Bioloogilise Füüsika Instituut (National Institute of Chemical Physics and Biophysics) in Tallinn, Estonia.

Dr. Alan Weaver

Graduated in Fall of 2016

Current position: postdoctoral fellow at U.S Institute of Surgical Research (San Antonio, Texas).

MSU Achievements

AWARDS

2014 Chemistry Graduate Association Travel Grant, Montana State University

2014 College of Letters and Science Student Research Travel Grant, Montana State University

2015 Montana Academy of Sciences Student Research Grant

2015 Metabolomics Travel Scholarship, University of Alabama-Birmingham

CONFERENCES & WORKSHOPS

2014 Gordon Research Conference: "New Antibacterial Discovery and Development." Ventura, California.

2015 Montana Biofilm Meeting. Montana State University-Center for Biofilm Engineering. Bozeman, Montana.

2015 3rd Annual Workshop on Metabolomics. University of Alabama, Birmingham, Alabama

2016 Annual Montana Academy of Sciences Meeting. Montana Tech, Butte, Montana.

2016 NMR-Based Metabolomics Workshop. University of Wisconsin-Madison.

2016 Montana Biofilm Meeting. Montana State University-Center for Biofilm Engineering. Bozeman, Montana.

PUBLICATIONS

Wilkinson R., Pincus S., Song K., Shepard J., Weaver A., Labib M., Teintze M. 2013. "Improved guanide compounds which bind the CXCR4 co-receptor and inhibit HIV-1 infection." *Bioorganic & Medicinal Chemistry Letters* 23: 2197-2201.

Weaver AJ, Shepard J., Wilkinson R., Watkins R., Walton S., Radke A., Wright T., Awel M., Cooper C., Erikson E., Labib M., Voyich J., Teintze M. Antibacterial activity of THAM Trisphenylguanide Against Methicillin-Resistant *Staphylococcus aureus*. *PLoS One*. 2014; 9(5):e97742.

Fuchs A.,† Weaver A.,† Tripet B., Teintze M., Ammons M., Copié V. "Allicin Identified as the Principal Antimicrobial Compound in 1,000-Year-Old Bald's Eyesalve." *International Journal of Antimicrobial Agents*, 2016. (*in review*) (†authors contributed equally)

Weaver A., Van Vuren A., Rakesh, Lee R., Copié V., Teintze M. "Exposure of Methicillin-Resistant *Staphylococcus aureus* to Low Levels of the Antibacterial THAM-3ΦG Generates a Small Colony Drug-Resistant Phenotype." *PLoS One*. 2016. (*in review*)

PRESENTATIONS

Weaver, A., Tapsak, M. "Experimental Design of Biodiesel Salt Analysis by Flame Photometry." Department of Chemistry and Biochemistry, Bloomsburg University. 239th American Chemical Society National Meeting: "Chemistry for a Sustainable World." San Francisco, California (2010). (poster)

Weaver, A., Wilkinson R., Shepard, J., Voyich, J., Teintze, M. "Elucidating the Mechanism of Action of a Novel Antibacterial Agent: THAM-3ΦG." Department of Chemistry and Biochemistry, Montana State University. Gordon Research Conference: "New Antibacterial Discovery and Development." Ventura, California (2014). (poster)

Weaver, A., Voyich, J., Copie, C., Teintze, M. "18β-Glycyrrhetic Acid Results in Increased Pigment Production and cnn, Montana State University. Montana Academy of Sciences Conference. Butte, Montana (2016). (oral)

Dr. Daniel Willems – Graduated in Fall of 2016

Current Position: post-doctoral Fellow Montana State University

MSU Achievements

Awards

2015/2016 Kopriva Graduate Student Award

Current Graduate Student Awards and Fellowships (August 2016-May 2017)

2017– NSF Graduate Research Program Fellowship- Casey Kennedy (Erik Grumstrup)
2017-Ford Fellowship – Elizabeth Corbin (Ed Dratz)
2017-A.R. Johansson Teaching Award -Jesse Peach (Brian Bothner)
2017 –PhD Completion Awards-The Graduate School-Rebecca Danforth (Erik Grumstrup) and Christine Gobrogge (Rob Walker)
2017 Harlan Byker Research Award – Elias Pomeroy (Rob Walker)-
2016 Meritorious Award – The Graduate School- Emerald Ellis (Jen DuBois) and Elias Pomeroy (Rob Walker)
2016- Department of Energy Office of Science Graduate Student Research Program –Melodie Machovina (Jen DuBois)
2016/2017- Kopriva Graduate Awards- Arianna Celis-Luna (Jen DuBois), Amanda Byer (Joan Broderick) and Amanda Fuchs (Valérie Copié)
2016/2017 -Department of Chemistry and Biochemistry E.W Mare Award Recipients:
Michelle Aries, Allison Phillips, Christine Gobrogge, Mackenzie Norlin, Katie Link, Colin Miller, Ky Mickelsen, Rebecca Danforth, Devan Watt, Sean Zabawa
2016/2017 PhD Enhancement Award – The Graduate School (Fall) Angela Patterson (Spring) Jesse Peach
2016 Research Rendezvous poster session winner –The Graduate School, Amanda Byer (Joan Broderick)
2016 Graduate Student Association Travel Award – Eric Massaro (Erik Grumstrup), Jessica Ennist (Mary Cloninger)
2016- The Graduate School Travel Award Jacob Artz and Amanda Byer
2016 Harlan Byker Research Award – Casey Kennedy (Erik Grumstrup)
2016 Gordon Pagenkopf Research Award – Amanda Fuchs (Valerie Copie)

Current Graduate Students Poster Presentations and Workshop Attendance

Amanda Fuchs (Copié Lab) attend the Cell Symposia: 100 Years of Phagocytes in Sicily, Italy (Fall of 2016) and presented a poster titled "Deciphering the Biofilm-Macrophage Interactome." She also attend the Mayo Clinic Metabolomics Symposium in Rochester, MN Oct. of 2016 and presented the same poster.

Eric Massaro (Grumstrup Lab) presented a poster at the Material Research Society spring meeting in Phoenix AZ (2017) titled "Spectroscopic Characterization by Super Resolution Transient Absorption Microscopy".

Sarah Partovi (Peters Lab) attended the 2016 Northwest Crystallography Workshop (June 17-19, 2016) in Pullman, Washington and presented (1) "Biosynthesis of Coenzyme M and its involvement in 2-ketopropyl coenzyme M oxidoreductase/carboxylase catalyzed carboxylation." (2) She also attended the 2016 Molecular Basis of Microbial One-Carbon Metabolism Gordon Research Conference and Gordon Research Seminar (Summer of 2016) and presented the poster: A new pathway for coenzyme M biosynthesis in proteobacterium Xanthobacter autotrophicus Py2.

Angela Patterson (Bothner Lab) attended (1) The Gordon Research Seminar on Physical Virology and presented a poster titled "Conformational Dynamics of DNA Binding and Cas3 Recruitment by the CRISPR RNA-guided Cascade Complex."

(2) The Gordon Research Conference on Physical Virology Structure-Function Relations in Viruses and Virus-Like Materials I presented a poster at both the seminar and the conference titled: Conformational Dynamics of DNA Binding and Cas3 Recruitment by the CRISPR RNA-guided Cascade

Complex. "Nanoscale Exploration of Viral Structure and Function for Applications in Medicine and Materials Research" Renaissance Tuscany Il Ciocco Lucca (Barga), Italy.

Mohammed Refai (Bothner Lab) attended the National Institutes of Health IDeA Program, National Resource for Proteomics Workshop (2017) Little Rock AR

Recent Publications from Current Graduate Students

- Celis, A. I.; Gauss, G.H.; Streit, B. R.; Shisler, K.; Moraski, G. C.; Rodgers, K. R.; Lukat-Rodgers, G. S.; Peters, J. W.; DuBois, J. L. (2017) Structure-based mechanism for decarboxylation reactions mediated by amino acids and heme propionates in coproheme decarboxylase (HemQ). *J. Am. Chem. Soc.*, **139**, 1900-1911.
- Hill, A. H.; Smyser, K. E.; Kennedy, C. L.; Massaro, E. S.; Grumstrup, E. M., Screened Charge Carrier Transport in Methylammonium Lead Iodide Perovskite Thin Films. *J. Phys. Chem. Lett.* **2017**. <http://dx.doi.org/10.1021/acs.jpcclett.7b00046>
- Carolyn E. Lubner, David W. Mulder, Paul W. King, David P. Jennings, Anne K. Jones, Gerrit J. Schut, Diep M. Nguyen, Gina L. Lipscomb, Michael W. W. Adams, Oleg A. Zadvornyy, Monika Tokmina-Lukaszewska, Luke Berry, Brian Bothner, John W. Peters, John P. Hoben, Anne-Frances Miller "Mechanistic insights into energy conservation by Flavin based electron bifurcation." *Nature Chemical Biology* **13**, (2017) 655-659.
- Natasha W. Pettinger,^a Robert E. A. Williams,^b Jinqun Chen^a and Bern Kohler^{*ac} "Crystallization kinetics of cerium oxide nanoparticles formed by spontaneous, room-temperature hydrolysis of cerium(IV) ammonium nitrate in light and heavy water." *Physical Chemistry Chemical Physics* (5) 2017 doi:10.1039/C6CP08227K
- Cousin JM1, Cloninger MJ2. *J Mol Sci.* 2016 Sep 16;17(9). pii: E1566. doi: 10.3390/ijms17091566. "The Role of Galectin-1 in Cancer Progression, and Synthetic Multivalent Systems for the Study of Galectin-1."
- Machovina, M.M., Usselman, R.J., DuBois, J.L. (2016) "Cofactorless Dioxygen Catalysis by an Antibiotic Biosynthesis Monooxygenase: Testing the Flavin Hypothesis." *J. Biol. Chem.* **291**(34):17816-28
- Maria A Tesa-Serrate, Eric J Smoll, Lucia D'Andrea, Simon M Purcell, Matthew L Costen, Duncan W Bruce, John M Slattery, Timothy K Minton, Kenneth G McKendrick, "Hiding the Headgroup? Remarkable Similarity in Alkyl Coverage of the Surfaces of Pyrrolidinium- and Imidazolium-Based Ionic Liquids," *J. Phys. Chem. C*, 2016, **120** (48), pp 27369–27379
- Massaro, E. S.; Hill, A. H.; Kennedy, C. L.; Grumstrup, E. M., Imaging theory of structured pump-probe microscopy. *Opt. Express* **2016**, **24**, 20868.
- Massaro, E. S.; Hill, A. H.; Grumstrup, E. M., Super-Resolution Structured Pump–Probe Microscopy. *ACS Photonics* **2016**, **3**, 501-506
- Min Qian, Vanessa J Murray, Wei Wei, Brooks C Marshall, Timothy K Minton, A "Resistance of POSS Polyimide Blends to Hyperthermal Atomic Oxygen Attack", *CS Appl. Mater. Interfaces*, 2016, **8** (49), pp 33982–33992 DOI: 10.1021/acsami.6b10612
- Prussia, G. A.; Gauss, G. H.; Mus, F.; Conner, L.; DuBois, J. L.; Peters, J. W. (2016) Substitution of a conserved catalytic dyad into 2-KPCC causes loss of carboxylation activity. *FEBS Lett.*, **590**, 2991-2996.
- Streit, B.R., Kant, R., Tokmina-Lukaszewska, M., Celis, A.I., Machovina, M.M., Skaar, E.P., Bothner, B., DuBois, J.L. (2016) "Time-resolved Studies of IsdG Protein Identify Molecular Signposts along the Non-canonical Heme Oxygenase Pathway." *J. Biol. Chem.* **291**: 862-871.
- Sundsahl, B.; Mickelsen, K.; Zabawa, S.; Anderson, B. K.; Livinghouse, T. J. "1,2-Disubstituted Alkenes as Migratory Insertion Participants in Zn(II) Promoted Metalloamination/Cyclizations of *N,N*-Dimethylhydrazinoalkenes." *Org. Chem.* **2016**, **81**, 10.1021/acs.joc.6b01328.

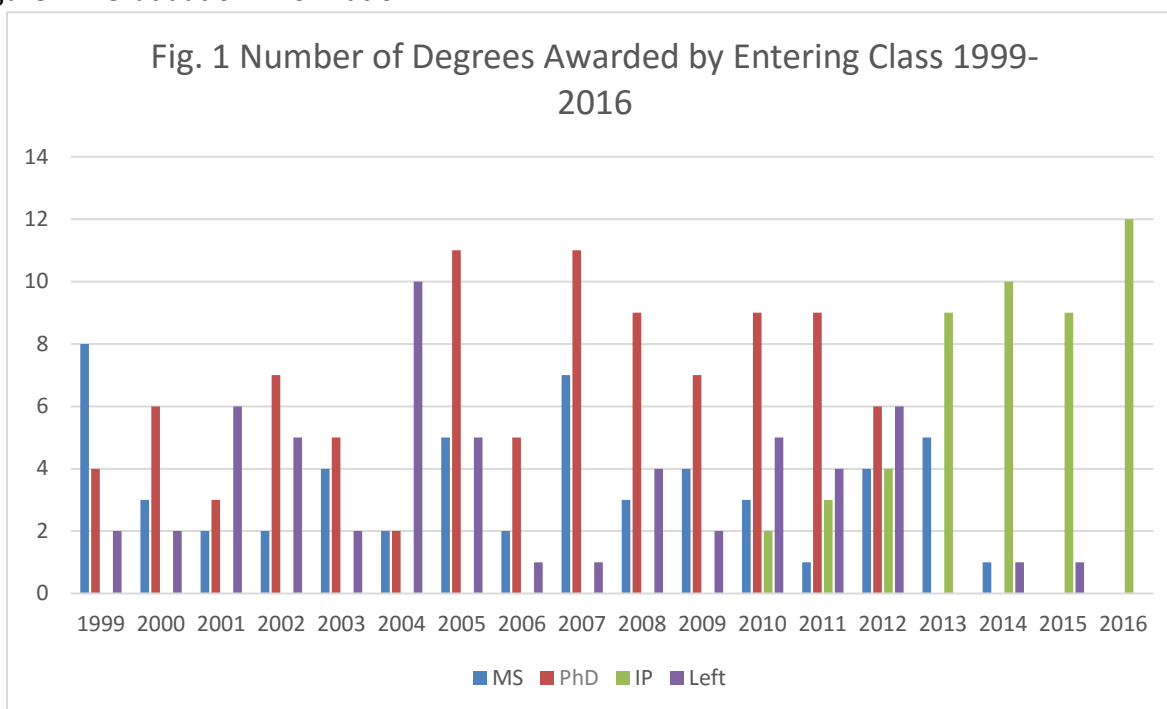
Concluding Remarks

The learning outcomes are being met for the Ph.D. programs in chemistry and biochemistry. Our initial threshold responses as decided in Fall of 2014 were the following:

- At least 80% of students will be ranked at a level 2 or 3 in subject content knowledge, written communication, and oral communication.
- At least 90% of students will pass their defense on their first attempt.
- 100% of students will successfully complete the ethics training and lab safety training.
- At least 95% of students will demonstrate more than one form of professionalization in their field.

We will continue to keep these threshold responses although our current data indicate we are well above the 80% of our students ranked at a level 2 or 3 in subject content knowledge, written communication, and oral communication skills. We had one student that did not pass his Ph.D. on the first try but completed the requirement 6 months later on the second try (PhD awarded in Fall of 2016). 100% of our students have participated in fire safety training in the past year and 100% of our entering graduate student body in the past 3 years have completed ethics training. We can state that 100% of our graduated Ph.D. students have demonstrated more than one form of professionalization in their field.

Figure 1 – Graduation Information



From 1999-2005 the number of students that left the program without a degree was alarming. We now can account for every student leaving the program (after 2005) and provide a reason for their departure. The information gleaned can be useful. We are on average graduating our students in both chemistry and biochemistry PhD programs in less than six years. We ramped up our recruiting efforts in the Fall of 2016 with a newly formed department recruiting committee with the task to increase the number of students entering our graduate programs. Our Fall 2017 entering class is currently at 15 people and we are still receiving late applications.

Finally, the data reveal the department is succeeding in reaching its mission to graduate students with strong educational experiences that guide them for long-term professional success. With the exception of a few graduates in May of 2017 graduating class, all of our PhD graduates have found professional positions at universities or major research laboratories.

We are not making any major changes to our Ph.D. program in chemistry or biochemistry.

