

Ashlee M. Plummer-Medeiros, Ph.D.

Work Experience

2022-Current

Bryn Mawr College

Assistant Professor

Chemistry Department (Bryn Mawr, PA)

2021-2022

Gettysburg College

Visiting Assistant Professor

Chemistry Department (Gettysburg, PA)

2021

Emmanuel College

Adjunct Instructor

Biology Department (Boston, MA)

2017-2021

Harvard Medical School

Post-Doctoral Fellow

Laboratory of Dr. Maofu Liao (Boston, MA)

Education

2012-2017

Johns Hopkins University

Ph.D., Molecular Biophysics

Laboratory of Dr. Karen Fleming (Baltimore, MD)

2008-2012

North Carolina State University

B.S., Chemistry

Laboratory of Dr. Stefan Franzen (Raleigh, NC)

Publications

Plummer-Medeiros, A. M., Culbertson, A. T., Morales-Perez, C. L., Liao, M., (2023) Activity and Structural Dynamics of Human ABCA1 in a Lipid Membrane, *J Mol Bio*, 435, 168038.

Devlin, T., Marx, D., Roskopf, M., Bubb, Q., **Plummer, A. M.**, Fleming, K.G., (2023), FkpA Enhances Membrane Protein Folding using an Extensive Interaction Surface, *Protein Sci*, 32, e4592.

Plummer, A. M.*, Culbertson, A. T.*, Liao, M., (2021) The ABCs of Sterol Transport, *Annu. Rev. Physiol.*, 83, 153-181. (*Equally Contributing Authors)

Marx, D. C., **Plummer, A. M.**, Faustino, A. M., Roskopf, M. A., Leblanc, M. J., Devlin, T., Lessen, H. J. Majumdar, A., Amann, B. T., Fleming, P. J., Krueger, S., Fried, S. D., Fleming, K. G., (2020) SurA is a cryptically grooved chaperone that expands unfolded outer membrane proteins, *PNAS*, 117(45), 28026-28035.

Marx, D. C., Leblanc, M., **Plummer, A. M.**, Krueger, S., Fleming, K. G., (2020) Domain Interactions Determine the Conformational Ensemble of SurA, *Protein Science*, 29(10), 2043-2053.

Peterson, J. H., **Plummer, A. M.**, Fleming, K. G., Bernstein, H. D., (2017) Selective pressure for rapid membrane integration constrains the sequence of bacterial outer membrane proteins, *Molecular Microbiology*, 106(5), 777-792.

Mo, G. C. H., Ross, B., Hertel, F., Manna, P., Yang, X., Greenwald, E., Booth, C., **Plummer, A. M.**, Tenner, B., Chen Z., Wang, Y., Kennedy, E. J., Cole, P. A., Fleming, K. G., Palmer, A., Jimenez, R., Xiao, J., Dedecker, P., Zhang, J., (2017) Genetically-Encoded Biosensors for Visualizing Live-cell Biochemical Activity at Superresolution, *Nature Methods*, 14, 427-434.

Plummer, A. M., Fleming, K. G., (2016) From Chaperones to the Membrane with a BAM!, *Trends in Biochemical Sciences*, 41(10), 872-882.

Costello, S. M., **Plummer, A. M.,** Fleming, P. J., Fleming, K. G., (2016) Dynamic periplasmic chaperone reservoir facilitates biogenesis of outer membrane proteins, *PNAS*, 113(33), E4794-E4800.

Plummer, A. M., Fleming, K. G., (2015) BamA Alone Accelerates Outer Membrane Protein Folding In Vitro through a Catalytic Mechanism, *Biochemistry*, 54(39), 6009-11.

Plummer, A. M.*, Gessmann, D.*, Fleming, K. G., (2015) The role of a destabilized membrane for OMP insertion, *Methods in Molecular Biology*, 1329, 57-65. (*Equally Contributing Authors)

Gessmann, D., Chung, Y. H., Danoff, E. J., **Plummer, A. M.,** Sandlin, C. W., Zaccai, N. R., Fleming, K. G., (2014) Outer membrane β -barrel protein folding is physically controlled by periplasmic lipid head groups and BamA, *PNAS*, 111, 5878-5883.

Plummer, A. M., Thompson, M. K., Franzen, S. (2013) Role of Polarity of the Distal Pocket in the Control of Inhibitor Binding in Dehaloperoxidase-Hemoglobin, *Biochemistry*, 52, 2218–2227.

Research Experience

2022-Current

Bryn Mawr College

Principle Investigator (Department of Chemistry)

My lab concentrates on the functional, computational, and structural characterization of bacterial membrane proteins which play a role in the widespread virulence of bacteria. Cell membranes are amazingly complex mixtures of phospholipids and membrane proteins – these membranes surround cells and create a protective barrier against outside threats. The proteins that reside within membranes work in many critically important processes and the dysfunction of these proteins is linked to innumerable diseases, including atherosclerosis, cancer, and neurodegenerative disorders. Our work combines several different experimental techniques, including in vitro biochemical assays, structural biology-based studies, cell-based assays, and computational simulations to understand 1) how these proteins work and 2) how they interact with the surrounding lipid bilayer.

2022-Current

Molecular Education and Research Consortium in Undergraduate Computational Chemistry (MERCURY)

My lab is a current member of the MERCURY consortium which strives to facilitate research collaborations in computational Chemistry at Primarily Undergraduate Institutions (PUIs) across the country.

2017-2021

Harvard Medical School

Post-Doctoral Fellow (Department of Cell Biology, Laboratory of Dr. Maofu Liao)

My post-doctoral research investigated how cholesterol is exported by the eukaryotic ATP-Binding Cassette (ABC) transmembrane protein ABCA1 – dysfunction of ABCA1 is related to increased risk of cardiovascular disease and various cancers. I utilized cryo-electron microscopy (EM) to interrogate the mechanism of ABCA1-cholesterol extraction and understand how the conformations of ABCA1 correspond to its ATP-hydrolysis cycle. I complemented these studies with both *in vitro* and *in vivo* transport assays and molecular dynamics simulations to better understand the details of binding interactions between ABCA1 and cholesterol.

2012-2017

Johns Hopkins University

Dissertation Work (Department of Molecular Biophysics, Laboratory of Dr. Karen Fleming)

My Ph.D. research aimed to understand how *E. coli* Outer Membrane Proteins (OMPs) interact with two protein folding factors: the periplasmic chaperone SurA and the OMP-folding catalyst BamA. The bacterial outer membrane is the first barrier that antibiotics must cross to gain entrance into the cell, therefore understanding OMP biogenesis is prerequisite to the design of effective, novel antibiotics. During my dissertation work, I utilized SDS-PAGE based folding assay to monitor OMP folding; biochemical crosslinking to construct a structural model for this complex by integrating analytical ultracentrifugation, circular dichroism and fluorescence spectroscopy, and small-angle neutron scattering experimental data; and I mentored an undergraduate student in the development of a holistic MATLAB model for OMP biogenesis; I conceptualized this project and actively worked towards its completion and subsequent

publication (*Costello, et al., PNAS 2016*). Themes throughout my dissertation work involve aiming to understand membrane protein folding and quality control, while also using collaborations and holistic modeling to piece together the details of the OMP folding pathway into the larger cellular puzzle.

2010-2012

North Carolina State University
Zhejiang University (Hangzhou, China)

Undergraduate Research (Department of Chemistry, Laboratory of Dr. Stefan Franzen)

My introduction to protein structure-function studies came in my undergraduate work on the bioremedial enzyme Dehaloperoxidase which converts environmentally toxic trihalogenated phenols into dihalogenated quinones. I designed and studied mutants utilizing UV-Vis and Resonance Raman spectroscopy, molecular dynamics, and X-ray crystallography experiments. I conducted X-ray crystallography experiments at Argonne National Laboratory. During my summer study abroad in Hangzhou, China (2010), I collaborated with local students to build and run molecular dynamics simulations of protein variants.

Teaching Experience

In-Classroom Teaching and Training

2022-2023

Chemistry Department, Bryn Mawr College

Fall, 2022: Chem-103: General Chemistry 1 & Chem-251: Research Methodology Laboratory

Spring, 2023: Bio-354: Topics and Concepts of Biochemistry & Chem-377: Biochemistry 2 – Metabolism

2022

ACS-New Faculty Workshop

American Chemical Society (Baton Rouge, LA)

2022

Teaching and Learning Institute: Students as Learners & Teachers Program

Bryn Mawr College

2021

Chemistry Department, Gettysburg College

Fall, 2021: General Chemistry 1 & Biochemistry I Laboratory

Spring, 2022: Biochemistry 2 – Metabolism Lecture & Laboratory sections

2021

Biology Department, Emmanuel College

Spring, 2021: Organism and Evolutionary Biology Laboratory

2020

New England Future Faculty Workshop

Northeastern University

2019

Teaching Institute: Theory, Practice, & Navigating STEM Education Workshop

Harvard Medical School

2016-2017

Preparing Future Faculty Certification Program

Johns Hopkins University

2016 Co-instructor for Advanced Seminar in Membrane Protein Structure, Function, & Pharmacology

JHU

2013

TA for Physical Chemistry of Biology Macromolecules

JHU

2010-2012

Peer Supervisor/Academic Coach

University Tutorial Center, North Carolina State University

2010-2012

Supplemental Instruction Leader

University Tutorial Center, NCSU

In-Laboratory Mentoring

2022-2023

Chemistry Department, Bryn Mawr College

My group at Bryn Mawr College has six current undergraduate students. Individual projects were conceptualized for each student. Three full-time students were accommodated through the Summer Science Research (SSR) program in 2023.

2019

Harvard Medical School Cell Biology Research Scholars Program

For this project, I designed and oversaw the completion of experimental protocols by a visiting undergraduate student. I also provided constructive criticism for written and oral presentations.

2014-2016

Johns Hopkins Undergraduate Research Fellows

I mentored two research fellows on two projects during my dissertation work: one project involved the development of a holistic MATLAB model for OMP biogenesis, while a second project centered on the investigation of the solution

properties of a chaperone protein. I worked actively with both students to ensure the success of their research. To this end, I designed computational and experimental projects for respective students. I had numerous one-on-one meetings with undergraduates to keep projects on track. I actively collaborated in the writing and editing of a publication on the OMP biogenesis computation model (*Costello, et al., PNAS 2016*).

2013-2014

Biophysics Research for Baltimore Teens, Johns Hopkins University

I served as a mentor for two summers for visiting local high school students. I designed cloning projects for each student, oversaw their weekly progress, and assisted them with preparation of oral presentations.

Grants, Resources, and Fellowships

2023

National Science Foundation, XSEDE/ACCESS Start-Up Allocation

Title: Investigation of the Bacterial Membrane Protein Dynamics and Lipid Interactions

2022

Tri-Co Mellon Brainstorming Grant

Title: Tri-Co Biochemistry Consortium Meeting, Spring 2023; funding awarded to host an interest group for Biochemistry faculty from Swarthmore, Haverford, and Bryn Mawr Colleges

2021

NSF, XSEDE Research Allocation

Title: Molecular Dynamics Simulations of Membrane-Embedded ABC Transporters

2020-2021

NSF, XSEDE Start-Up Allocation

Title: Investigation of the Role of Drug Binding and Lipid Interactions on the Conformational Landscape of a Multidrug Exporter

2018-2020

American Heart Association Post-Doctoral Fellowship

Title: Elucidation of the mechanism for cholesterol and phospholipid transport by ABCA1

2014-2017

National Science Foundation Graduate Research Fellowship

Title: The role of the periplasmic chaperone SurA in outer membrane protein biogenesis

2012

George Owen Fellowship, Johns Hopkins University

2011

Undergraduate Research Grant, North Carolina State University

Selection of Invited Talks/Conferences as a PI

2023

Joint Membrane Protein Biophysics Group Meeting

Swarthmore College, PA

2023

Annual MERCURY Symposium

Furman College, SC

Student poster title: Molecular Dynamics Simulations of Bacterial Lipid Trafficking Proteins

2023

Invited Guest Lecturer, Dept of Biophysics

Johns Hopkins University

2022

Invited Career Panel Member, Annual Biophysics Retreat

Johns Hopkins University

2022

BioSphere Biology Student Club Evening Series

Gettysburg College

2022

Student Invited Speaker, Sceptical Chymists Student Club

Gettysburg College

Selection of Conference Presentations and Attendance as a trainee

2021	Moderator, HMS Cryo-EM super-group symposium (Boston, MA)
2020	Guest blogger, Biophysical Society Conference (San Diego, CA)
2018	Attendee, Center on Membrane Protein Production and Analysis Symposium (New York, NY)
2017	Poster, Gordon Conference on Membrane Protein Folding (Easton, MA)
2017	Poster, Biophysical Society Conference (New Orleans, LA)
2016	Invited Speaker, Johns Hopkins University Annual Biophysics Retreat (Baltimore, MD)
2016	Invited Speaker, Gibbs Society of Biothermodynamics Conference (Carbondale, IL)
2015, 2016	Invited Speaker, Johns Hopkins University Student Evening Series (Baltimore, MD)
2016	Departmental Recruiter, Annual Biomedical Research Conference for Minority Students (Tampa, FL)
2016	Attendee, International Physics of Living Systems Conference (Boston, MA)
2015	Student Organizer, Johns Hopkins University Annual Biophysics Retreat (Baltimore, MD)
2014	Poster, Gibbs Society of Biothermodynamics Conference (Carbondale, IL)
2013	Poster, Biophysical Society Conference (Philadelphia, PA)
2011	Invited Speaker, Local American Chemical Society Meeting (Raleigh NC)

Service to Bryn Mawr College

2022-2023	Director of the Graduate Program of Chemistry
2022-2023	Graduate Council Committee
2022	Panel member on CV Preparation Bryn Mawr College, Graduate Group of Science & Math

Peer Review Experience

2019-2021	Early Career Reviewer	Journal of Biological Chemistry
2019	Peer Reviewer of Post-Doctoral Fellowship Applications	American Heart Association

Community Outreach

2021	Teaching Assistant	Harvard Medical School Cell Biology Research Scholars Program
2021	Science Fair Judge	Boston Public Science Fair
2020-2021	Member of the Committee for Diversity and Equity	Cell Biology Department, Harvard Medical School
2016	White House Visit for STEM Policy Discussions with JHU students	Washington, DC
2014, 2016	U.S. Science and Engineering Festival Volunteer	Washington, DC
2013-2014	Biophysics Research for Baltimore Teens Volunteer Mentor	Johns Hopkins University