

Lucas C. Wheeler, PhD

POSTDOCTORAL ASSOCIATE · DEPARTMENT OF ECOLOGY AND EVOLUTIONARY BIOLOGY · CU BOULDER

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Education

Ph.D. in Biochemistry

UNIVERSITY OF OREGON

Eugene, OR

Sep. 2012 - Dec. 2017

- Department: Chemistry and Biochemistry
- Advisor: Michael Harms
- Dissertation: Evolution of Metal and Peptide Binding in the S100 Protein Family.

B.S. in Biochemistry

MONTANA STATE UNIVERSITY

Bozeman, MT

Sep. 2009 - June 2012

- Department: Chemistry and Biochemistry
- Advisor: Trevor Douglas

Research Experience

Postdoctoral Associate

UNIVERSITY OF COLORADO

Jan 2018 – present

Boulder, CO

- Coordination of field trips in Brazil and Argentina to collect samples from the Petunieae clade of Solanaceae. Phylogenetics to reconstruct species relationships. Transcriptomics, biochemical analyses, and bioinformatics to study the evolution of floral traits. Handling large sequencing datasets and corresponding collection metadata.
- Development of computational approaches to 1) simulate the evolution of metabolic pathways and 2) perform segregant analyses of back-cross transcriptomic data to identify genes responsible for flower color transitions.
- Acquisition of funding for the development of computational tools, management of data storage and organization for large-scale international collaborative projects.
- Volunteer efforts: Field work at Niwot Ridge Long-term Ecological Research Program collecting soil moisture and plant community composition data, and in the desert Southwest collecting samples of *Physalis* to study self-incompatibility and *Larrea* to study polyploidization.

Graduate Research Fellow

UNIVERSITY OF OREGON

Sep 2012 – Dec 2017

Eugene, OR

- Development of high-throughput binding experiments and implementation of statistical approaches to quantitatively measure the evolution of protein-peptide interaction specificity in the S100 protein family.
- Phylogenetics and biochemical analyses to characterize the evolution of metal binding affinity, specificity, and structural effects in the S100 protein family.
- Managed laboratory tasks, supply ordering, sample storage information. As first student, helped to build the lab infrastructure and foundational projects.

Undergraduate research assistant

MONTANA STATE UNIVERSITY

Sep 2009 – June 2012

Bozeman, MT

- Engineering of virus-like particles as templates for biomedical applications, including analgesics and anti-fungal agents.
- Fluorescent labeling of biomimetic nano-materials for *in vivo* experiments in mice and fungi.

Publications

*Corresponding author †Undergraduate co-author ‡Co-first author

Wheeler LC^{*†}, Walker JF, Ng J, Deanna R, Dunbar-Wallis A, Backes A, Pezzi PH, Virginia Palchetti M, Roberston HM, Monaghan A, Brandão de Freitas L, Barboza GE, Moyroud E, Smith SD. **Transcription factors evolve faster than their structural gene targets in the flavonoid pigment pathway.** *EcoEvoRxiv* (Molecular Biology and Evolution)

Huffine CA, **Wheeler LC**, Wing BA, Cameron JC (2021). **Computational Modeling and Evolutionary Implications of Biochemical Reactions in Bacterial Microcompartments.** *Current Opinion in Microbiology*

Sinnott-Armstrong M, Deanna R, Pretz C, Liu S, Harris J Dunbar-Wallis A, Smith SD, **Wheeler LC^{*}** (2021). **How to approach the study of syndromes in macroevolution and ecology.** *Ecology and Evolution* (accepted)

Wheeler LC, Harms MJ (2021). **Were ancestral proteins less specific?** *Molecular Biology and Evolution*

Wheeler LC^{*}, Wing BA, Smith SD (2020). **Structure and contingency determine mutational hotspots for flower color evolution.** *Evolution Letters*

Wheeler LC[‡], Perkins A, Wong CE[†], Harms MJ (2020). **Learning Peptide Recognition Rules for a Low-Specificity Protein.** *Protein Science*

Wheeler LC*, Smith SD (2019). Computational modeling of anthocyanin pathway evolution: Biases, hotspots, and trade-offs. Integrative and Comparative Biology

Hiranmayi Duvvuri[†], **Wheeler LC**, Harms MJ (2018). pytc: open source python software for global analyses of isothermal titration calorimetry data. Biochemistry

Wheeler LC, Anderson JA, Morrison AJ, Wong CE[†], Harms MJ (2017) Conservation of specificity in two low-specificity proteins. Biochemistry

Wheeler LC, Harms MJ (2017). S100A5 binds Ca²⁺ and Cu²⁺ independently. BMC Biophysics

Wheeler LC, Donor MT, Prell JS, Harms MJ (2016). Multiple Evolutionary Origins of Ubiquitous Cu²⁺ and Zn²⁺ Binding in the S100 protein Family. PLoS ONE

Wheeler LC[‡], An-Lim S, Marqusee S, Harms MJ (2016). The thermostability and specificity of ancient proteins. Current Opinions in Structural Biology

Funding

2019	Research Innovation Office Seed Grant , \$50,000	CU Boulder
2015	Mechanisms of Protein Evolution III: Student Travel Award , \$600	SMBE
2013-2016	Molecular Biology and Biophysics Training Grant (UO-IMB) , \$75,000	NIH
2011-2012	Montana INBRE Research Award , \$1500	MT INBRE
2011	Swager Summer Research Award , \$600	MSU
2011	Geer-Howald-Callis Summer Research Award , \$1200	MSU

Workshops, trainings, & courses

2021	Learn C++ course , Codecademy	Online
2021	Learn SQL course , Codecademy	Online
2021	Diversity, Equity, and Inclusion Workshop , CU	Boulder, CO
2020	ALTEC Spanish Advanced Conversation , CU	Boulder, CO
2018	Navigating the NSF Review Process as a Beginning PI , CU	Boulder, CO
2017	Individual Development Plan (IDP) workshop , UO	Eugene, OR
2016	Illumina Metagenomics Workshop , UO	Eugene, OR

Teaching Experience

Guest lecturer HERPETOLOGY Invited to give lecture and lead discussion on rattlesnake venom evolution	University of Colorado (Boulder) 2022
Guest lecturer COMPARATIVE GENOMICS Invited to give lecture and lead discussion of the role of structural variants in adaptation and speciation	University of Colorado (Boulder) 2021
Guest lecturer PHYLOGENETICS AND COMPARATIVE BIOLOGY Invited to give lecture and lead discussion of forensic phylogenetics for tracing the origin of viral infections	University of Colorado (Boulder) 2021
Co-instructor PLANTS AND SOCIETY Assembled remote lectures and assignments on topics ranging from genetic engineering to ethnobotany	University of Colorado (Boulder) 2020
Guest lecturer CONVERGENCE AND CONSTRAINT: LESSONS FROM THE EVOLUTION OF FLOWER COLOR Invited to give a remote guest lecture on pleiotropy and genetic constraints for upper level evolution class	University of Hawai'i at Mānoa 2020
Guest Instructor BIOCHEMISTRY OF FLOWER COLOR Developed and taught a lecture and lab exercise for visiting high-school students with CU Upward Bound	University of Colorado (Boulder) 2018
Instructor BIOCHEMISTRY RECITATION: METABOLISM Led article discussions and group activities for this course to supplement the primary lecture course	University of Oregon (Eugene) 2013
Teaching assistant BIOCHEMISTRY LABORATORY Helped to plan, organize, and lead the laboratory that accompanied the upper-level biochemistry course	University of Oregon (Eugene) 2013
Teaching assistant GENERAL CHEMISTRY LABORATORY Helped to test activities and lead the laboratory that accompanied the introductory chemistry course	University of Oregon (Eugene) 2012
Volunteer Instructor ADVANCED 5TH GRADE MATH Designed and taught a pre-algebra course for a group of advanced 5th grade students	Juniper Elementary (Bend, OR) 2007

Mentorship & Service

RESEARCH MENTORSHIP

Eduardo Alejandro Lozano-Garcia

UNDERGRADUATE STUDENT

Co-mentoring development of improved tools for evolutionary simulations of metabolic pathways

Remote

2021-present

Clair Huffine

PHD STUDENT

Co-mentoring a project to model the evolution of the cyanobacterial carboxysome

Boulder, CO

2021-present

Mikayah Oxendine

UNDERGRADUATE (SUMMER STUDENT)

Oversaw mentorship (by graduate student Sukuan Liu) of project on carnivorous plants in Southeastern North America

Remote

2020

Chandra Jacobs

UNDERGRADUATE (SUMMER STUDENT)

Oversaw mentorship (by graduate student Jesse Harris) of project on phylogenetic relationships between medicinal plants

Remote

2020

Chantelle Yazzi

UNDERGRADUATE (SUMMER STUDENT)

Oversaw mentorship (by graduate student Chelsea Pretz) of project on analysis of flavonols in Navajo Tea (*Thelesperma*)

Remote

2020

Luis Allende

MASTERS STUDENT

Advised on statistical analyses of protein sequence data and the application of phylogenetic comparative methods

Boulder, CO

2019-2020

Ashley Hamilton

UNDERGRADUATE (SUMMER REU STUDENT)

Guided a project in the bioinformatic analysis of transcriptomic data from the genus *Lochroma*

Boulder, CO

2019

Alice Backes

VISITING MASTERS STUDENT

Guided a project in the bioinformatic analysis of transcriptomic and genomic data in online databases

Boulder, CO

2018

Jocelyn Hernandez

UNDERGRADUATE (SUMMER PROGRAM FOR UNDERGRADUATE RESEARCH)

Helped student to develop tools to study epistasis in protein evolution

Eugene, OR

2017

Amber Rolland

PHD ROTATION STUDENT

Helped to guide a project studying metal binding in the S100A8/A9 heterodimer complex

Eugene, OR

2016

Erik Burlingame

MASTERS STUDENT

Guided a group project to develop an analysis pipeline for high-throughput phage display sequencing data

Eugene, OR

2016

Samantha Sivagnanam

MASTERS STUDENT

Guided a group project to develop an analysis pipeline for high-throughput phage display sequencing data

Eugene, OR

2016

Wendy Su

MASTERS STUDENT

Guided a group project to develop an analysis pipeline for high-throughput phage display sequencing data

Eugene, OR

2016

Caitlyn Wong

UNDERGRADUATE (HONORS THESIS)

Guided a project characterizing the structural response of S100 proteins to binding of metals and peptides

Eugene, OR

2015 - 2017

Hiranmayi Duvvuri

UNDERGRADUATE STUDENT

Helped student to learn techniques and carry out isothermal titration calorimetry experiments

Eugene, OR

2015-2016

Sarina Pollat

UNDERGRADUATE (SUMMER PROGRAM FOR UNDERGRADUATE RESEARCH)

Guided a project measuring the thermodynamics of metal and peptide binding in S100 proteins

Eugene, OR

2015

Abigail Tami

UNDERGRADUATE (SUMMER PROGRAM FOR UNDERGRADUATE RESEARCH)

Guided a project measuring the thermodynamics of metal and peptide binding in S100 proteins

Eugene, OR

2014

Sunny Ketchum

GRADUATE ROTATION STUDENT

Guided a project developing the molecular tools to study the S100A8/A9 protein complex

Eugene, OR

2014

Kevin McKnaught

GRADUATE ROTATION STUDENT

Helped student to develop a method for expression and purification of certain S100 proteins

Eugene, OR

2014

Kendall Saboda

UNDERGRADUATE STUDENT

Helped student with the engineering and molecular cloning of custom virus-like particles

Bozeman, MT

2012

Kristen Hyberg

UNDERGRADUATE STUDENT

Helped student with the molecular cloning, expression, and purification of custom virus-like particles

Bozeman, MT

2011-2012

SERVICE ACTIVITIES

Solanaceae seminars

CO-ORGANIZER

Helping to organize the SOL Seminar Online international seminar series

Colorado
2021-present

CDA Noxious Weed Advisory Committee

COMMITTEE MEMBER

At-large member, helping to advise CO department of agriculture on strategies for noxious weed management

Colorado
2021-present

CCL Colorado Virtual Seminars

CO-ORGANIZER

Helping to organize interdisciplinary seminar and discussion group on climate policy

Colorado
2020-present

Smith lab Summer internship for Native American undergraduates

VOLUNTEER

Helped to coordinate a Summer research experience for former students from the CU Upward Bound program

Remote/in-person
2020-2021

Bridge Program Choose Research Panel

VOLUNTEER

Sat on a panel discussion for community college transfer students interested in undergraduate research

Remote
2020

McKenzie school district outreach

VOLUNTEER

Science discussions for 2nd grade classroom in the McKenzie school district in Oregon

Remote
2019-present

CU Upward Bound

INSTRUCTOR

Leading virtual and in-person outreach activities for high school students

Colorado
2018-present

Pinhead Institute

INSTRUCTOR

Leading "Punk Science" outreach activities for K-12 students

Telluride, CO
2019

2019 Mayors' Climate Panel

CO-ORGANIZER

Helped to organize the 2019 Mayors' Climate Panel. Managed online registration and speaker invitations

Denver, CO
2019

Citizens' Climate Lobby

VOLUNTEER

Helped to organize tabling events, educational presentations, and lobby meetings with US representatives

Golden, CO
2018 - present

Quantitative Problem Solving & Research Communication Consortium

CO-CHAIR & CO-FOUNDER

Helped to organize presentations & brainstorming sessions for graduate students and postdocs

Eugene, OR
2016 - 2017

UO SafeRide Program

VOLUNTEER

Helped to provide free, safe rides at night for members of the university community

Eugene, OR
2016 - 2017

Mad Duck Science Fridays

VOLUNTEER

Helped to organize and run engaging science learning activities for middle school students

Eugene, OR
2013 - 2017

Associated Students of MSU

STUDENT SENATOR

Served on several committees and acted as liaison to several student groups

Bozeman, MT
2010 - 2011

Undergraduate Chemistry Society

SECRETARY & VICE-PRESIDENT

Helped to organize fundraisers and to provide educational activities for local and rural Montana schools

Bozeman, MT
2009 - 2012

Sacajawea Middle School

VOLUNTEER MENTOR

Mentored a gifted student in advanced math; oversaw development of a project on fractals

Bozeman, MT
2009-2010

Juniper Elementary School

VOLUNTEER MENTOR

Provided tailored educational activities to students with special needs

Bend, OR
2005 - 2008

Presentations and Seminars

Sol International Conference

"PHYLOTRANSCRIPTOMIC ANALYSIS OF FLOWER COLOR EVOLUTION IN PETUNIEAE"

- Submitted poster

Online
November 2020

Solanaceae Seminar Series

"AN INTEGRATIVE APPROACH TO STUDYING THE EVOLUTION OF FLORAL PIGMENTATION"

- Invited talk

Online
September 2020

Botany virtual meeting

"PHYLOTRANSCRIPTOMICS OF THE PETUNIEAE CLADE OF SOLANACEAE"

- Submitted talk

Online
July 2020

Evolution meeting

"PREFERENTIAL FIXATION OF STRUCTURAL OR REGULATORY MUTATIONS DEPENDS ON PATHWAY POSITION"

- Submitted talk

Providence, RI
June 2019

Society for Integrative and Comparative Biology

“COMPUTATIONAL MODELING OF ANTHOCYANIN PATHWAY EVOLUTION”

- Submitted talk

Geobiology Supergroup Seminar

“COMPUTATIONAL MODELING OF FLOWER COLOR EVOLUTION”

- Invited talk

Quantitative Think Tank

“DEVELOPING A COMPUTATIONAL MODEL OF THE ANTHOCYANIN PATHWAY”

- Submitted talk

Society for Molecular Biology and Evolution

“PHAGE DISPLAY AND DEEP SEQUENCING TO STUDY THE EVOLUTION OF BINDING SPECIFICITY”

- Submitted poster

Institute of Molecular Biology Seminar Series

“EVOLUTION OF METAL AND PEPTIDE BINDING IN THE S100 PROTEIN FAMILY”

- Annual seminar

Third International Symposium on Protein Folding and Dynamics

“TRACING THE EVOLUTION OF PEPTIDE BINDING SPECIFICITY IN THE S100 PROTEIN FAMILY USING PHAGE DISPLAY AND DEEP SEQUENCING”

- Submitted talk

Gibbs Conference on Biological Thermodynamics

“PREFERENTIAL FIXATION OF STRUCTURAL OR REGULATORY MUTATIONS DEPENDS ON PATHWAY POSITION”

- Submitted talk

Life at the Nanoscale mini-symposium

“TRACING THE EVOLUTION OF PEPTIDE BINDING SPECIFICITY IN THE S100 PROTEIN FAMILY USING PHAGE DISPLAY AND DEEP SEQUENCING”

- Submitted poster

Institute of Molecular Biology Seminar Series

“TRACING THE EVOLUTIONARY HISTORY OF TRANSITION-METAL BINDING AND PEPTIDE BINDING SPECIFICITY IN THE S100 PROTEIN FAMILY”

- Annual seminar

Mechanisms of Protein Evolution III: Origins

“TRACING THE EVOLUTIONARY FLUCTUATIONS OF PEPTIDE BINDING SPECIFICITY IN THE S100 PROTEIN FAMILY”

- Submitted talk

Gibbs Conference on Biological Thermodynamics

“TRACING THE EVOLUTIONARY FLUCTUATIONS OF PEPTIDE BINDING SPECIFICITY IN THE S100 PROTEIN FAMILY”

- Submitted poster

Protein Folding Consortium Workshop

“PROBING THE EVOLUTIONARY HISTORY OF PEPTIDE BINDING SPECIFICITY IN THE S100 PROTEIN FAMILY”

- Submitted talk

Institute of Molecular Biology Seminar Series

“PROBING THE EVOLUTION OF PEPTIDE-BINDING SPECIFICITY IN THE S100 PROTEIN FAMILY”

- Annual seminar

Gibbs Conference on Biological Thermodynamics

“EVOLUTIONARY BIOPHYSICAL STUDIES OF PEPTIDE SPECIFICITY IN THE S100S”

- Submitted poster

Grad Talk Series

“EVOLUTION AS A MOLECULAR MATCH MAKER: HOW DO BIOLOGICAL MOLECULES EVOLVE TO RECOGNIZE EACH OTHER?”

- Invited talk

Protein Folding Consortium Workshop

“EVOLUTIONARY BIOPHYSICAL STUDIES OF PROTEIN FUNCTION IN THE S100 FAMILY”

- Submitted poster

Tampa, FL

Jan. 2019

Boulder, CO

Nov. 2018

Boulder, CO

Oct. 2018

Austin, TX

July 2017

Eugene, OR

May. 2017

Bangalore, India

Nov. 2016

Carbondale, IL

Sep. 2016

Eugene, OR

Jun. 2016

Eugene, OR

Apr. 2016

Denver, CO

Nov. 2015

Carbondale, IL

Sep. 2015

Berkeley, CA

May. 2015

Eugene, OR

May. 2015

Carbondale, IL

Sep. 2014

Eugene, OR

Nov. 2014

Ann Arbor, MI

May. 2014