

Griffin Chure, PhD (He/Him) | Curriculum Vitae

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Education

PhD Biochemistry & Molecular Biophysics Division of Biology and Biological Engineering Rob Phillips Lab <i>Thesis Topic: The Molecular Biophysics of Evolutionary and Physiological Adaptation</i>	Caltech 2013 – 2020
BSc Biology (Honors) – Cell & Molecular Emphasis BSc Chemistry (Minor Physics) – Biological Emphasis Department of Biology David F. Blair Lab <i>Thesis Topic: The Biochemical Assembly of the Bacterial Flagellar Motor</i>	University of Utah 2009 – 2013

Professional Research Experience

Postdoctoral Scholar Stanford University Stanford CA, USA Department of Biology Jonas Cremer Lab <i>Summary: Leveraging theory and experiment to explore fundamental questions in microbiology and eco-evolutionary dynamics.</i>	Jan. 2021 – Present
Postdoctoral Scholar Caltech Pasadena CA, USA Department of Applied Physics Rob Phillips Lab <i>Summary: Quantitatively explored the breadth and depth of human impacts on Earth's biogeochemistry.</i>	Jun. 2020 – Dec. 2020
PhD Student Caltech Pasadena CA, USA Division of Biology and Biological Engineering Rob Phillips Lab <i>Summary: Used statistical physics to derive and experimentally dissect predictive models of gene regulation in bacteria.</i>	Jun. 2014 – Jun. 2020
Research Assistant University of Utah Salt Lake City UT, USA Department of Biology David F. Blair Lab <i>Summary: Used tools of molecular biology and microscopy to dissect the biochemical assembly of the bacterial flagellar motor.</i>	Jan. 2010 – Aug. 2013

Research Interests & Accomplishments

My work focuses on building a predictive understanding of complex biological phenomena by dissecting the underlying physical principles that govern them. Over the past decade, I've applied this approach to various topics in biology, ranging from immunology to microbial physiology. During my PhD, I used statistical physics to model the thermodynamics of DNA-protein interactions, enabling quantitative predictions of how mutations affect gene expression. As a postdoc, I expanded these models to study the intrinsic coordination of the central dogma, demonstrating that protein synthesis limits bacterial growth and creating a framework for predicting physiological and evolutionary adaptation in microbes. Using a theory-experiment dialogue, future work will explore how gene regulatory network variations drive intra-species physiological diversity and how they constrain ecological competition in dynamic environments.

Academic Honors & Awards

NSF Postdoctoral Research Fellowship in Biology \$230,000 USD	Jan. 2021 – Dec. 2023
NSF Graduate Research Fellowship Honorable Mention	2015
Amgen Research Fellowship Full Stipend	2015
University of Utah "Honors at Entrance" Scholarship Full Tuition	Aug. 2009 – May 2013

Publications

* Equal contribution. † Corresponding Author

- Hplc-py: A Python Utility for Rapid Quantification of Complex Chemical Chromatograms** 2024
Griffin Chure[†] and Jonas Cremer | *Journal of Open Source Software* 9(94) | DOI: 10.21105/joss.06270
- Quantifying the Daily Harvest of Fermentation Products From the Human Gut Microbiota** 2024
Markus Arnoldini[†], Richa Sharma*, Claudia Moresi*, Griffin Chure, Julien Chabbey, Emma Slack and Jonas Cremer[†]
bioRxiv (in revision at Cell) | DOI: 10.1101/2024.01.05.573977
- Stringent Control Over Cytoplasmic and Membrane Densities Defines Cell Geometry In *E. coli*** 2023
Griffin Chure, Roshali T. de Silva, Richa Sharma, Michael C. Lanz and Jonas Cremer[†]
bioRxiv (in revision at Nature Communications) | DOI: 10.1101/2023.10.28.564462
- An Optimal Regulation of Fluxes Dictates Microbial Growth In and Out of Steady-State** 2023
Griffin Chure[†] and Jonas Cremer[†] | *eLife* | DOI: 10.7554/eLife.84878
Featured Spotlight: Avi I. Flamholz and Akshit Goyal (2023). "Matching metabolic supply to demand optimizes microbial growth." *Trends in Microbiology*. DOI: 10.1016/j.tim.2023.06.003
- Be Prospective, Not Retrospective: A Philosophy for Reproducibility in Modern Biological Research** 2022
Griffin Chure[†] | *arXiv* | DOI: 10.48550/arXiv.2210.02593
- Anthroponumbers.org: A Quantitative Database of Human Impacts on Planet Earth** 2022
Griffin Chure^{*†}, Rachel A. Banks*, Avi I. Flamholz, Nicholas S. Sarai, Mason Kamb, Ignacio Lopez-Gomez, Yinon M. Bar-On, Ron Milo and Rob Phillips[†] | *Patterns* 3 | DOI: 10.1016/j.patter.2022.100552
Feature: Selected as cover article for September 2022 issue.
News Coverage: Featured in articles by [EurekAlert.org](#), [Caltech](#), and [Wired Magazine](#).
- Fundamental Limits on the Rate of Bacterial Growth and Their Influence on Proteomic Composition** 2021
Nathan M. Belliveau*, Griffin Chure*, Christina L. Hueschen, Hernan G. Garcia, Jane Kondev, Daniel S. Fisher, Julie A. Theriot[†] and Rob Phillips[†] | *Cell Systems* 12 | DOI: 10.1016/j.cels.2021.06.002
Feature: Selected as cover article for September 2021 issue.
- The Anthropocene by the Numbers: A Quantitative Snapshot of Humanity's Influence on the Planet** 2020
Griffin Chure, Rachel A. Banks, Avi I. Flamholz, Nicholas S. Sarai, Mason Kamb, Ignacio Lopez-Gomez, Yinon M. Bar-On, Ron Milo and Rob Phillips[†] | *arXiv* | DOI: 10.48550/arXiv.2101.09620
- First-Principles Prediction of the Information Processing Capacity of a Simple Genetic Circuit** 2020
Manuel Razo-Mejia, Sarah S. Marzen, Griffin Chure, Muir J. Morrison, Rachel Taubman and Rob Phillips[†]
Physical Review E 102, 022404 | DOI: 10.1103/PhysRevE.102.022404
Feature: Selected as an "Editor's Suggested Article" for August 2020 issue
- Sequence-Dependent Dynamics of Synthetic and Endogenous RSSs in V(D)J Recombination** 2020
Soichi Hirokawa, Griffin Chure, Nathan M. Belliveau, Geoffery A. Lovely, Michael Anaya, David G. Schatz, David Baltimore and Rob Phillips[†] | *Nucleic Acids Research* 48(12) | DOI: 10.1093/nar/gkaa418
- Theoretical Investigation of a Genetic Switch for Metabolic Adaptation** 2020
Kathrin S. Laxhuber, Muir J. Morrison, Griffin Chure, Nathan M. Belliveau, Charlotte Strandkvist, Kyle L. Naughton and Rob Phillips[†] | *PLoS ONE* 15(5) | DOI: 10.1371/journal.pone.0226453
- Physiological Adaptability and Parametric Versatility in a Simple Genetic Circuit** 2019
Griffin Chure, Zofia A. Kaczmarek and Rob Phillips[†] | *bioRxiv* | DOI: 10.1101/2019.12.19.878462
- Predictive Shifts in Free Energy Couple Mutations to Their Phenotypic Consequences** 2019
Griffin Chure, Manuel Razo-Mejia, Nathan M. Belliveau, Tal Einav, Stephanie L. Barnes, Mitchell Lewis and Rob Phillips[†] | *PNAS* 116(35) | DOI: 10.1073/pnas.1907869116

- Figure 1 Theory Meets Figure 2 Experiments in the Study of Gene Expression** 2019
 Rob Phillips[†], Nathan M. Belliveau, Griffin Chure, Manuel Razo-Mejia, Clarissa Scholes and Hernan G. Garcia
Annual Reviews of Biophysics 48 | DOI: 10.1146/annurev-biophys-052118-115525
- Connecting the Dots Between Osmotic Shock, Mechanosensitive Channel Abundance, and Survival at Single-Cell Resolution | Griffin Chure***, Heun J. Lee*, Akiko Rasmussen and Rob Phillips[†] 2018
Journal of Bacteriology 200(23) | DOI: 10.1128/JB.00460-18
Feature: Selected as an "article of significant interest" for December 2018 issue.
- Tuning Transcriptional Regulation Through Signaling: A Predictive Theory of Allosteric Induction** 2018
 Manuel Razo-Mejia*, Stephanie L. Barnes*, Nathan M. Belliveau*, Griffin Chure*, Tal Einav*, Mitchell Lewis and Rob Phillips[†] | *Cell Systems* 6 | DOI: 10.1016/j.cels.2018.02.004
Featured Spotlight: Quincey Justman (2018). "Splitting the World with Absolute Measurements: A Call for Collaborations in Physical Biology." Cell Systems (6). DOI: 10.1016/j.cels.2018.04.006
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Selected Invited Talks

- The Form of Growth and Growth of Form: Understanding Cell Growth and Size Homeostasis From First Principles**
 Colorado School of Mines | Golden CO, USA | Quantitative Biosciences and Engineering Seminar Series Feb. 2024
 Upcoming: The Ohio State University | Columbus OH, USA | Department of Microbiology Seminar Series Nov. 2024
- How To Live Forever: Recipes for Reproducible Biological Research in the Digital Age**
 UC Berkeley | Berkeley CA, USA | Reproducibility in the Life Sciences Workshop Jul. 2023
 Caltech | Pasadena CA, USA | Guest Lecture for BE/Bi 103: Data Analysis in the Life Sciences Nov. 2022 & 2023
 New Science Foundation | Boston MA, USA | Guest Lecture for 2022 Fellows Jul. 2022
- On Fundamental Limits, Degenerate Dimensions, and Serendipitous Consequence in Rapid Cellular Growth**
 Chan-Zuckerberg Biohub | San Francisco CA, USA | Invited Seminar by Dr. Ranen Avenir Mar. 2023
- The Anthroponumbers: Building Quantitative Literacy for a Human Dominated Planet**
 Stanford University | Stanford CA, USA | Invited Lecture ILAC 105: Climate Change and Latin America May 2023
 Carnegie Institution for Science | Palo Alto CA, USA | Department of Global Ecology Lunch Seminar Series Sep. 2021
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Selected Conference Presentations

- An Optimal Regulation of Fluxes Dictates Microbial Growth In and Out of Steady-State** Apr. 2023
 Oral Presentation | Northern California Geobiology Symposium | Stanford CA, USA
- Tight Control Over Cytoplasmic and Membrane Densities Defines Regulation of Cell Geometry in *E. coli*** Mar. 2023
 Oral Presentation | American Physical Society March Meeting | Minneapolis MN, USA
- Hail to the Flux: or the Optimal Regulation of Cellular Resources Beyond Steady State** Jan. 2023
 Oral Presentation | Chan-Zuckerberg Biohub Physics of Life Conference | San Francisco CA, USA
- Analytical Descriptions of Fundamental Constraints in Protein Synthesis and Microbial Growth** Mar. 2022
 Oral Presentation | American Physical Society March Meeting | Chicago IL, USA
- The Molecular Biophysics of Adaptation** Dec. 2019
 Poster Presentation | Biophysical Society Annual Meeting | San Diego CA, USA
- The Energetics of Molecular Adaptation** Jul. 2019
 Oral Presentation | NORDITA Summer Course on Predictability and Control in Evolution | Stockholm, Sweden
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Teaching Experience

California Institute of Technology, Pasadena CA, USA

The Great Human Experiment by the Numbers 2020

Caltech APh 150 | Teaching Assistant with Prof. Rob Phillips | Undergraduate & Graduate Student Enrollment

Summary: A quantitative survey of the breadth and depth of humanity's impact on Earth. Responsibilities included course development, direct instruction, and mentorship for research projects.

Evolution 2020

Caltech Bi/Ge/ESE 105 | Teaching Assistant with Profs. Rob Phillips & Victoria Orphan | Undergraduate Enrollment

Summary: A broad and quantitative dive into central concepts of evolutionary theory, including deep time, population genetics, island biogeography, and phylogenetics. Responsibilities included course development, direct instruction, and grading.

Physical Biology of the Cell 2018

Caltech BE/APh 161 | Teaching Assistant with Prof. Justin Bois | Undergraduate & Graduate Student Enrollment

Summary: Derivation and application of physical models and principles to biological phenomena ranging from thermodynamics of molecular binding to viscoelasticity. Responsibilities included direct instruction and grading.

Physical Biology Bootcamp 2017 – 2019

Caltech BE 262 | Optics Teaching Assistant with Prof. Rob Phillips | Incoming Graduate Student Enrollment

Summary: A week-long bootcamp required of all incoming quantitative bioscience graduate students. My duties included teaching daily groups of 3–4 students how to build epifluorescence microscopes, optical tweezers, and line-scan confocal microscopes from scratch using table-top optical elements.

The Great Ideas of Biology 2017

Caltech Bi 1 | Head Teaching Assistant with Prof. Rob Phillips | Freshman Undergraduate Students

Summary: A required course quantitatively exploring the great ideas of biology (e.g. the central dogma, evolution, liquid-liquid phase separation) for non-biology major freshmen. Responsibilities included development of course material, direct instruction, logistical coordination of a large 10+ person TA team, and reporting of final grades.

Data Analysis in the Biological Sciences 2015–2016

Caltech BE/Bi 103 | Teaching Assistant with Prof. Justin Bois | Undergrad, Graduate Student, & Postdoc Enrollment

Summary: A course dedicated to teaching principles of data analysis in the life sciences including image processing, exploratory data analysis, simulation-based statistical analysis, and applied Bayesian statistical inference using Python + Stan. Responsibilities included course development, grading of complex research assignments, and direct instruction.

Introduction to Programming for the Biological Sciences Bootcamp 2016

Caltech BE/Bi/NB 203 | Teaching Assistant with Prof. Justin Bois | Graduate Student & Postdoc Enrollment

Summary: An intense week-long course teaching introductory computer programming with Python. Responsibilities included course development, direct instruction, and on-the-fly debugging.

The Great Experimental Ideas of Biology 2014–2015

Caltech Bi 1X | Head Teaching Assistant with Prof. Justin Bois | Undergraduate Student Enrollment

Summary: A lab-based course presenting the great experimental ideas of biology using classical and modern experimental methods. Responsibilities included development of course material, organization and preparation of laboratory experiments, direct instruction, grading, and maintenance of research grade microscopy resources.

University of Utah, Salt Lake City UT, USA

Advanced Biochemistry Laboratory 2013

Lab Section Teaching Assistant with Prof. David Goldenberg | Undergraduate Student Enrollment

Summary: A junior and senior level course teaching principles of biochemical experimentation, including enzyme kinetics and protein purification. Responsibilities included direct instruction, grading lab reports, and preparation of experimental materials.

Principles of Genetics

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Teaching Assistant with Prof. John S. Parkinson | Undergraduate & Graduate Student Enrollment

Summary: A survey course exploring principles of prokaryotic and eukaryotic genetics through the lens of classical experiments. Responsibilities included direct instruction, exam proctoring, and grading.

Molecular Biology Research Bootcamp

2010

Teaching Assistant with Prof. Rosemary Gray | Undergraduate Student Enrollment

Summary: A two-week long lab course teaching undergraduate students the basics of wet-lab experiments and molecular biology. Responsibilities included direct instruction, preparation of laboratory stock materials, and coaching on presentations.

Introduction to Biology

2010

Teaching Assistant with Prof. Tanya Vickers | Undergraduate Student Enrollment

Summary: An introductory course on cell and molecular biology. Responsibilities included direct instruction and grading.

International

CSHL Physical Biology of the Cell

2015 & 2023

Computational Instructor | Cold Spring Harbor Laboratory, NY USA | Graduate Student Enrollment

Summary: A week-long course teaching principles of physical biology to all CSHL graduate students. Responsibilities included direct instruction, development of computational tutorials (Python + MATLAB), course administration, and on-the-fly debugging.

IBDM Cell Biology by the Numbers

2018

Computational Instructor | Turing Centre for Development, Marseille FR | Graduate Student & Postdoc Enrollment

Summary: A week-long course teaching principles of physical biology and biological numeracy to interested students and postdocs. Responsibilities included direct instruction, development of computational tutorials, course administration, and on-the-fly debugging.

MBL Physical Biology of the Cell

2018

Optics Faculty Member | Marine Biological Laboratory, MA USA | Graduate Student, Postdoc, & Faculty Enrollment

Summary: An intense research course teaching principles of biophysics. My duties included teaching daily groups of 3–4 students how to build epifluorescence microscopes, optical tweezers, and line-scan confocal microscopes from scratch using table-top optical elements.

MBL Physiology: Modern Cell Biology Using Microscopic, Biochemical, and Computational Approaches

2015–2018

Research Faculty Member | Marine Biological Laboratory, MA USA | Graduate Student, Postdoc, & Faculty Enrollment

Summary: An intense research course where novel, loosely-defined hypotheses are transformed to rigorous research projects on a two-week timescale. Responsibilities included development of hypotheses, direct instruction of computational, theoretical, and experimental techniques, and mentoring on project presentation.

GIST Physical Biology of the Cell

2016–2017

Computational Instructor | Gwangju Institute of Science and Technology, Gwangju PRK | Graduate Student Enrollment

Summary: A week-long course teaching principles of physical biology to undergraduate students. Responsibilities included direct instruction, development of computational tutorials, course administration, and on-the-fly debugging.

KITP Evolutionary Cell Biology

2015

Research Instructor | Kavli Institute for Theoretical Physics, CA USA | Graduate Student, Postdoc, & Faculty Enrollment

Summary: An intense research course where novel, loosely-defined hypotheses are transformed to rigorous research projects on a two-week timescale. Responsibilities included development of hypotheses, direct instruction of computational, theoretical, and experimental techniques, and mentoring on project presentation.

Mentorship

Direct Mentorship of Graduate Students

Stanford University | Stanford CA, USA | Three Biology and Biophysics Graduate Students

2021–Present

Caltech | Pasadena CA, USA | Seven Biology, Physics, & Bioengineering Graduate Students

2015 – 2020

Summary: I directly mentored students on projects covering cell physiology, experimental biochemistry, and statistical physics.

Direct Mentorship of University Undergraduate Students

Caltech | Pasadena CA, USA | Three Biology and Applied Physics Undergraduates 2015 – 2020

University of Utah | Salt Lake City UT, USA | Two Chemistry Undergraduates 2011 – 2013

Summary: I directly mentored undergraduate students on a mix of honor's thesis projects, varying from experimental biochemistry to computational biology.

Direct Mentorship of Community College Undergraduate Students

Stanford University | Stanford CA, USA | Research Mentor | Three Physics & Mech. Eng. Undergraduates 2023

Summary: I directly mentored SF Bay Area community college students through the Stanford Small Science Group (SSG) program on 10-week research projects covering climate science and theoretical physics.

Direct Mentorship of Junior High School Students

Caltech | Pasadena CA, USA | Caltech RISE Physics, Biology, and Math Tutor | Three Jr. High Students 2015 – 2016

Summary: I tutored Pasadena, CA local junior high school students from underrepresented and disadvantaged backgrounds through the Caltech RISE Program. Topics included basic physics, cell biology, algebra, and geometry.

Service & Leadership

Scientific Committee Member for the Biohub “Physics of Life” Conference

Chan-Zuckerberg Biohub | San Francisco CA, USA

Jan. & Oct. 2023, Sep. 2024

Summary: A biophysics conference for researchers in the SF bay area. Responsibilities included organizing the conference schedule, reading and scoring abstracts, introducing speakers, and mediating Q&A.

Session Chair and Organizer for “Quantitative Cell Physiology” Focus Session at APS

American Physical Society Global Physics Summit | Anaheim CA, USA

Mar. 2025

American Physical Society March Meeting | Minneapolis, MN, USA

Mar. 2024

American Physical Society March Meeting | Las Vegas NV, USA

Mar. 2023

Summary: An internationally attended annual physics conference with a large biological physics community. Responsibilities included organizing a field-specific focus session, reading and scoring abstracts, introducing speakers, and mediating Q&A.

ENVISION International Research Proposal Competition Judge

ENVISION by WiSTEM | International

2021 – 2023

Summary: I served as a research proposal judge for an international research competition for high-school aged women and genderqueer students. Responsibilities included reading and scoring 5–6 page research proposals on feasibility, creativity, rigor, and scholarship. Topics included biomedical engineering and microbiology.

Graduate Student Council Program Co-Chair

Caltech Biochemistry & Molecular Biophysics Graduate Program | Pasadena CA, USA

2015 – 2018

Summary: I served as the co-chair of the graduate student council for my PhD program. Responsibilities included planning and organizing recruitment events, planning and organizing annual program retreats, design and administration of a program-wide student wellness survey, and conflict mediation between graduate students and their adviser.

Personal References

Contact information available upon request.

Dr. Jonas Cremer | Stanford University | Assistant Professor | Department of Biology

Dr. Rob Phillips | Caltech | Fred & Nancy Morris Professor of Biophysics and Biology | Division of Biology & Biological Engineering and Department of Physics

Dr. Hernan G. Garcia | UC Berkeley | Associate Professor | Departments of Cell & Molecular Biology and Physics

Dr. Justin Bois | Caltech | Teaching Professor | Division of Biology & Biological Engineering

Dr. Madhav Mani | Northwestern | Associate Professor | Department of Engineering Sciences & Applied Mathematics