Christopher Mathy, PhD - Postdoctoral Scholar

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Fields of research: bioengineering; systems and synthetic biology; protein biophysics and biochemistry; functional genomics; computational biology and machine learning. ***Model systems***: mitochondria, CAR-T cells, small GTPases, *S. cerevisiae*.

EDUCATION AND TRAINING

Postdoctoral Scholar, Dept. of Genetics — Stanford University — 2022 - Present
Engineering synthetic mitochondrial genomes in human cells.
Functional genomic screens and protein language models of CAR-T mutational variants to engineer cell state.
advised by Lars Steinmetz, PhD

PhD in Bioengineering — UCSF and UC Berkeley — 2016 - 2022
Systems biology of allosteric GTPase mutations
advised by Tanja Kortemme, PhD

BS in Bioengineering, with honors — Stanford University — 2012 - 2016
Engineering the NK1 Fragment of the Human Hepatocyte Growth Factor for Dual Use as a Potent Agonist and a Gene Therapy Delivery Vehicle
advised by Jennifer Cochran, PhD

PUBLICATIONS

Peer-reviewed:

1. Mathy CJP, Kortemme T. (2023). Emerging maps of allosteric regulation in cellular networks.
   Current Opinion in Structural Biology, 80, 102602. link
2. Mathy CJP, Mishra P, Flynn JM, Perica T, Mavor D, Bolon DNA, Kortemme T. (2023). A complete allosteric map of a GTPase switch in its native network.
   Cell Systems, 14(3), 237-246. link
3. Perica T*, Mathy CJP*, Xu J, Jang GM, Zhang Y, Kaake R, Ollikainen N, Braberg H, Swaney DL, Lambright DG, Kelly MJS, Krogan NJ, & Kortemme T. (2021). Systems-level effects of allosteric perturbations to a model molecular switch.
   Nature, 599, 152–157. link *equal contribution.
4. Baker JJ, Mathy CJP, Schaletzky J. (2021) A proposed workflow for proactive virus surveillance and prediction of variants for vaccine design.
   PLoS Computational Biology, 17(12), e1009624. link
5. Bouhaddou M, Memon D, Meyer B ... Mathy CJP ... Krogan NJ (2020). The Global Phosphorylation Landscape of SARS-CoV-2 Infection.
   Cell, 182(3), 685–712.e19. link
6. Gordon DE, Jang GM, Bouhaddou M ... Mathy CJP ... Krogan NJ (2020). A SARS-CoV-2 protein interaction map reveals targets for drug repurposing.
   Nature, 583(7816), 459–468. link

AWARDS

2024 - 2025 **Dean's Postdoctoral Fellowship**, Stanford School of Medicine

2024 **Finalist**, A.P. Giannini Foundation's Postdoctoral Research Fellowship & Leadership Award

2022 **Bioengineering Service and DEIB Award** for service to the graduate program and contributions to diversity, equity, inclusion, and belonging, UCSF - UC Berkeley Bioengineering

2018 - 2021 **Byers Family Discovery Fellowship**, UCSF

INVITED TALKS

As Postdoctoral scholar:

2023-06-08 Integration over insulation: rethinking pathway-level engineering in human cells using mitochondrial genomes. **Stanford Synthetic Biology Synthesis Talk.**

2023-03-06 Mapping allosteric perturbations from structure to cellular networks in a central GTPase switch. *Synthetic Biology and Cell Engineering Meeting*. UCSF.

As PhD student:

2021-11-11 Integrating biophysics and high-throughput systems biology to uncover new models of GTPase switch function. *Special Guest Speaker, Pathology Advanced Translational Research Unit (PATRU)*. Emory University School of Medicine Department of Pathology and Laboratory Medicine.

2021-08-09 Conformational switching constrains the mutational tolerance of novel allosteric sites in the GTPase Gsp1. *Annual RosettaCon Protein Design Conference*. RosettaCommons, virtual conference.

2021-04-07 Integrating biophysics and systems biology to uncover new models of GTPase switch function. *19th Annual National Graduate Student Symposium*. St. Jude Children's Research Hospital, Memphis, TN.

2020-01-28 Integrating biophysics and systems biology to understand mutations of the GTPase Ran/Gsp1. *Signaling Across Scales Symposium*. Quantitative Biosciences Institute, UCSF.

2018-10-27 Mapping molecular properties of Gsp1 point mutants to cellular phenotype. *Bioengineering Retreat.* UC Berkeley - UC San Francisco Graduate Group in Bioengineering.

POSTER PRESENTATIONS

As Postdoctoral scholar:

2023-09-20 Mathy CJP*, Bertolini M*, Van Kooten M*, Lore S, Wilming J, Steinmetz LM. Engineering synthetic mitochondrial genomes in human cells. Stanford Genetics Annual Retreat.

2023-06-23 Mathy CJP, Van Kooten M, Bertolini M, Lore S, Steinmetz LM. Custom synthetic mitochondrial genomes and high-throughput library screens for engineering allotopic expression of OXPHOS genes. 2023 International Mammalian Synthetic Biology Workshop (mSBW).

As PhD student:

2022-07-07 Mathy CJP, Mishra P, Flynn JM, Perica T, Mavor D, Bolon DN, Kortemme T. Complete mutational mapping of a GTPase switch in vivo reveals novel allosteric regulation. 36th Annual Symposium of the Protein Society.

Awarded Best Poster

2021-10-14 Mathy CJP, Mavor D, Flynn JM, Perica T, Mishra P, Kelly MJS, Kortemme T, Bolon DN. Conformational switching constrains the mutational tolerance of novel allosteric sites in the GTPase Gsp1. UC Berkeley – UC San Francisco Bioengineering Retreat.

2019-10-05 Mathy CJP, Perica T, Xu J, Zhang Y, Ollikainen N, Jang G, Kaake R, Swaney D, Kelly MJS, Krogan NJ, Kortemme T. Allosteric coupling between interfaces and the nucleotide binding site of the small GTPase Gsp1 influences cellular processes. Quantitative Biosciences Consortium, UCSF.

Awarded Best Poster

2019-06-02 Mathy CJP, Perica T, Zhang Y, Ollikainen N, Xu J, Jang G, Kaake R, Swaney D, Kelly MJS, Krogan NJ, Kortemme T. Targeted mutational perturbations of the small GTPase Ran reveal how pleiotropy is encoded in a model molecular switch. Annual Protein Society Meeting.

2018-08-09 Mathy CJP, Perica T, Zhang Y, & Kortemme T. Biophysical analysis to map molecular properties of Gsp1 point mutations to their cellular scale phenotypes. Annual RosettaCon Protein Design Conference.

2018-02-21 Mathy CJP, Perica T, & Kortemme T. Mapping of molecular-level perturbations to systems-level phenotypes in Gsp1/Ran, a highly conserved protein switch. Biophysical Society Annual Meeting.

2017-10-07 Mathy CJP, Perica T, & Kortemme T. Mathematical modeling of Gsp1, a protein switch, to map mutations to phenotypic perturbations. UC Berkeley – UC San Francisco Bioengineering Retreat.

As undergraduate:

2016-05-24 Mathy CJP, Engineering the NK1 Fragment of the Human Hepatocyte Growth Factor for Dual-Use as a

Potent Agonist and a Gene Therapy Delivery Vehicle. Stanford Bioengineering Honors Poster Fair.

2016-04-07 Baisiwala S, Mathy CJP, Moahi K, & Malavé C. Gel-Aid, Redefining Wound Packing: An Absorbent Removable Hydrogel. Stanford Tau Beta Pi + IEEE Engineering Showcase.

2015-10-24 Mathy CJP, Lim S, & Cochran JR. Internalization Study of the NK1 Fragment of the Human Hepatocyte Growth Factor. Symposium of Undergraduate Research and Public Service at Stanford University.

2013-08-29 Mathy CJP, Lim S, & Cochran JR. Development of Reporter Cell Assay for Engineering Human Hepatocyte *Growth Factor. Summer Research Experience for Undergraduates Poster Fair at Stanford University*

TEACHING

2021 Teaching Assistant, UCSF Biophysics 219: Computational Protein Design. Prepared exercises on computational protein modeling in Rosetta. Led a project group which successfully predicted the binding affinities of mutations in the SARS-CoV-2 Spike protein with the ACE2 receptor using ΔΔG calculations in Rosetta. Prepared lectures for first year UCSF graduate students, including the topic of protein design for therapeutic applications.

2018 Certificate, Science Teaching Effectiveness Program for Upcoming Professors (STEP-UP) workshop, UC San Francisco. 16-hour program on evidence-based teaching strategies that support student-centered learning in the college classroom, with an emphasis on supporting diverse learners.

2016 Teaching assistant, Stanford BIOE 131: Ethics in Bioengineering

2014 - 2016 Personal tutor for middle- and high-school aged students in the San Francisco Bay Area.

SERVICE & OUTREACH

2024 Volunteer, Stanford@TheTech - Stanford Genetics Dept. Outreach at The Tech Interactive museum in San Jose, CA.

2021 - 2022 Co-President, UC Berkeley - UCSF Graduate Group in Bioengineering Association of Students. Non-voting member of the graduate program Executive Committee, advocating for student issues.

2020 - 2022 Admissions Committee, UC Berkeley - UCSF Graduate Group in Bioengineering Association of Students. Performed holistic admissions review for 70 applicants to the graduate program alongside faculty and 9 other PhD students.

2020 - 2021 Specialist, Rapid Reviews COVID-19 (MIT Press). Screened and pitched preprints for review and publication at Rapid Reviews COVID-19, an open-access overlay journal based at UC Berkeley.

2018 - 2019 Volunteer Educator, UCSF Science & Health Education Partnership. Taught scientific lessons in collaboration with teachers at local area elementary schools.

2017 - 2019 Retreat Committee, UC Berkeley - UCSF Graduate Group in Bioengineering Association of Students. Organized two annual scientific meetings with over 150 attendees.

2017 - 2019 Recruitment Committee, UC Berkeley - UCSF Graduate Group in Bioengineering Association of Students. Organized two annual visits for over 50 PhD program applicants.

2018 UCSF Center for Community Engagement Research Committee. Strategic planning and grant application review for partnerships between UCSF and community organizations.

2017 Volunteer Educator, Bay Area Scientists in Schools. Taught scientific lessons in collaboration with teachers at local area elementary schools.

MENTORSHIP

2024 Lorenzo Magni, Stanford Bioengineering PhD Student. Mentored in yeast genetics and molecular biology.

2023 - 2024 Shirley Bi, Stanford Genetics research technician. Mentored in molecular biology, functional genomics, computational biology, and machine learning.

2022 - 2023 Sierra Lore, Stanford Bioengineering undergraduate. Mentored in mitochondria biochemistry, isolation, and transplantation into mammalian cells.

2022 Jon Zhang, UCSF Biophysics PhD Student. Mentored in GTPase protein production and biochemistry.

2019 Wilson Nieves Vasquez, UCSF Biophysics PhD student. Supervised for rotation project using hydrogen-deuterium exchange to study the differences in GTPase conformations.

2019 Maru Jaime Garza, UCSF Biophysics PhD student. Supervised for rotation project using 1-D ^{31}P-NMR to study the effect of partner binding on GTPase conformations.

2019 Christina Stephens, UCSF Biophysics PhD student. Supervised for rotation project using computational protein modeling to examine how mutations impact GTPase conformational dynamics.