

# Arvind S. Pillai

University of Washington, Institute of Protein Design

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Washington Research Foundation Postdoctoral Fellow

## EDUCATION:

2014 BSc. in Molecular Biology from University of Texas, at Austin GPA: 3.94

2021 Ph.D., in Ecology and Evolution from University of Chicago

## PROFESSIONAL APPOINTMENTS

2013-2014 Undergraduate Research Assistant in the Zakon lab and Mehdy lab at the University of Texas at Austin

2016-2021 Graduate Research Assistant in the Thornton lab at the University of Chicago

2021-2022 Postdoctoral Researcher in the Baker lab, Institute of Protein Design, University of Washington

2023-2024 Washington Research Foundation Postdoctoral Fellow in the Baker lab at the Institute of Protein Design, University of Washington.

## AWARDS AND FUNDING

2013 University of Texas Undergraduate Research Fellowship grant

2015 International Graduate Student Fellowship, University of Chicago

2021 Best Dissertation Award in the Biological Sciences Division, University of Chicago

2023 Washington Research Foundation Postdoctoral Fellowship

## PUBLICATIONS

1) **Pillai, Arvind S.**, Shane A. Chandler, Yang Liu, Anthony V. Signore, Carlos R. Cortez-Romero, Justin LP Benesch, Arthur Laganowsky, Jay F. Storz, Georg KA Hochberg, and Joseph W. Thornton. "Origin of complexity in haemoglobin evolution." *Nature* 581 (2020): 480-485.

2) **Pillai, Arvind**, Abbas Idris, Annika Philomin, Connor Weidle, Rebecca Skotheim, Philip JY Leung, Adam Broerman et al. "De novo design of allosterically switchable protein assemblies." *Nature* 632 (2024): 1-10.

3) **Pillai, Arvind S.**, Georg KA Hochberg, and Joseph W. Thornton. "Simple mechanisms for the evolution of protein complexity." *Protein Science* 31, no. 11 (2022): e4449.

4) Praetorius, Florian, Philip JY Leung, Maxx H. Tessmer, Adam Broerman, Cullen Demakis, Acacia F. Dishman, **Arvind Pillai** et al. "Design of stimulus-responsive two-state hinge proteins." *Science* 381,754-760 (2023).

5) Crabtree, Michael D., Jack Holland, **Arvind S. Pillai**, Purnima S. Kompella, Leon Babl, Noah N. Turner, James T. Eaton et al. "Ion binding with charge inversion combined with screening modulates DEAD box helicase phase transitions." *Cell Reports* 42, no. 11 (2023)

6) Sendker, Franziska L., Tabea Schlotthauer, Christopher-Nils Mais, Yat Kei Lo, Mathias Girbig, Stefan Bohn, Thomas Heimer, Daniel Schindler, Arielle Weinstein, Brain P. Metzger, Joeseoph W. Thornton, **Arvind Pillai**, Gert Bange, Jan M. Schuller, Georg K.A. Hochberg. "Frequent evolutionary transitions in homo-oligomeric assembly across the phylogeny of bacterial citrate synthases." (In press, *Nature Communications*. Preprint available on biorXiv:, 2024)

7) Romero, Carlos R., Jixing Liu, **Arvind S. Pillai**, Arthur C. Laganowsky, Joseph W. Thornton. "Evolution of specificity in Hemoglobin subunit assembly." (In revision, *Proceedings of the National Academy of Sciences*. Preprint available on biorXiv: , 2024)

8) An, Linna, Meerit Said, Long Tran, Sagardip Majumder, Inna Goreshnik, Gyu Rie Lee, David Juergens, Justas Daupara, Ivan Anishchenko, Brian Coventry, Asim K. Bera, Alex Kang, Paul M. Levine, Valentina Alvarez, **Arvind Pillai**, Christoffer Norn, David Feldman, Dmitri Zorine, Derrick R. Hicks, Xinting Li, Mariana Garcia Sanchez, Dionne K. Vafeados, Patrick J. Salveson, Anastassia A. Vorobeiva, David Baker. "Binding and sensing diverse small molecules using shape-complementary pseudocycles." *Science* 385, no. 6706 (2024): 276-282.

9) Edin Muratspahić, Isaac Sappington, Max D. Overath, Esperanza Rivera-de-Torre, Jann Ledergerber, Andreas H. Laustsen, Kim Boddum, Asim K. Bera, Alex Kang, Evans Brackenbrough, Iara A. Cardoso, Edouard P. Crittenden, Rebecca J. Edge, Justin Decarreau, Robert J. Ragotte, **Arvind S. Pillai**, Mohamad Abedi, Hannah L. Han, Stacey R. Gerben, Analisa Murray, Rebecca Skotheim, Lynda Stuart, Lance Stewart, Thomas J. A. Fryer, Timothy P. Jenkins, and David Baker. "De novo designed proteins neutralize lethal snake venom toxins." (In Revision, *Nature*, Preprint available on *Research Square*. 2024)

10) **Pillai, Arvind S.**, Alex Shida, Cullen W. Demakis, Samuel Pellock, Anna Lauko, David Baker. "Deep-learning based design of conformational change in de-novo enzymes." (in Preparation).

## PRESS

**Nature News and Views**, “Extinct proteins resurrected to reconstruct the evolution of vertebrate haemoglobin”; <https://doi.org/10.1038/d41586-020-01287-8>, by Michael Berenbrink.

**Nature News and Views**, “How to design a protein that can be switched on and off (nature.com)”; <https://doi.org/10.1038/d41586-024-02242-7>, by A. Joshua Wand.

**Phys.org**, “Researchers reveal origins of complex hemoglobin by resurrecting ancient proteins”; <https://phys.org/news/2020-05-reveal-complex-hemoglobin-resurrecting-ancient.html>.

**Chemical and Engineering News**, “Reconstructing hemoglobin’s ancestors to trace development of structural complexity”. <https://cen.acs.org/biological-chemistry/Reconstructing-hemoglobins-ancestors-trace-development/98/i20>; by *Celia Henry Arnaud*

**Genetic Engineering and Biotechnology News**, “AI Designed Proteins Morph on Demand for Steerable Functionality”. AI Designed Proteins Morph on Demand for Steerable Functionality ([genengnews.com](http://genengnews.com)), by Fay Lin.

## CONFERENCE PRESENTATIONS

- 1) Oral presentation, Darwinian Cluster Retreat, 2016, **Pillai, Arvind S.**, Yang Liu, Arthur Laganowsky, Georg KA Hochberg, and Joseph W. Thornton. “Birth of Hemoglobin”, won best talk, 2016 September
- 2) Oral presentation, Society for Molecular Biology and Evolution 2018, Deer Valley Utah, **Pillai, Arvind S.**, Shane A. Chandler, Yang Liu, Anthony V. Signore, Carlos R. Cortez-Romero, Justin LP Benesch, Arthur Laganowsky, Jay F. Storz, Georg KA Hochberg, and Joseph W. Thornton. “Origin of multimerization in Hemoglobin”
- 3) Oral presentation, Midwest Population Genetics conference 2019, Chicago, Illinois, **Pillai, Arvind S.**, Shane A. Chandler, Yang Liu, Anthony V. Signore, Carlos R. Cortez-Romero, Justin LP Benesch, Arthur Laganowsky, Jay F. Storz, Georg KA Hochberg, and Joseph W. Thornton. “Origin of multimerization in Hemoglobin”
- 4) Oral presentation, Symposium on the genomics of evolutionary adaptation, 2019, **Pillai, Arvind S.**, Shane A. Chandler, Yang Liu, Anthony V. Signore, Carlos R. Cortez-Romero, Justin LP Benesch, Arthur Laganowsky, Jay F. Storz, Georg KA Hochberg, and Joseph W. Thornton. “Origin of multimerization in Hemoglobin”
- 5) Poster presentation, Population, Evolutionary, Quantitative Genetics conference, 2018,

**Pillai, Arvind S.**, Shane A. Chandler, Yang Liu, Anthony V. Signore, Carlos R. Cortez-Romero, Justin LP Benesch, Arthur Laganowsky, Jay F. Storz, Georg KA Hochberg, and Joseph W. Thornton. "Origin of multimerization in Hemoglobin"

6) Poster presentation, Gordon Research Conference on the molecular mechanisms of evolution, 2019, **Pillai, Arvind S.**, Shane A. Chandler, Yang Liu, Anthony V. Signore, Carlos R. Cortez-Romero, Justin LP Benesch, Arthur Laganowsky, Jay F. Storz, Georg KA Hochberg, and Joseph W. Thornton. "Origin of multimerization in Hemoglobin"

7) Poster presentation, Population, Evolutionary, Quantitative Genetics conference, 2018, **Pillai, Arvind S.**, Shane A. Chandler, Yang Liu, Anthony V. Signore, Carlos R. Cortez-Romero, Justin LP Benesch, Arthur Laganowsky, Jay F. Storz, Georg KA Hochberg, and Joseph W. Thornton. "Origin of multimerization in Hemoglobin"

8) Poster Presentation, Gordon Research Conference on Molecular Mechanisms in Evolution 2023, **Arvind S. Pillai**, Abbas Idris, Annika Philomin, Connor Weidle, Rebecca Skotheim, Philip J. Y. Leung, Adam Broerman, Cullen Demakis, Andrew J. Borst, Florian Praetorius, David Baker. "De novo design of allosterically switchable protein assemblies"

9) Poster Presentation, RosettaCON, 2023, **Arvind S. Pillai**, Abbas Idris, Annika Philomin, Connor Weidle, Rebecca Skotheim, Philip J. Y. Leung, Adam Broerman, Cullen Demakis, Andrew J. Borst, Florian Praetorius, David Baker. "De novo design of allosterically switchable protein assemblies"

10) Oral Presentation, Summer RosettaCON, 2023, **Arvind S. Pillai**, Abbas Idris, Annika Philomin, Connor Weidle, Rebecca Skotheim, Philip J. Y. Leung, Adam Broerman, Cullen Demakis, Andrew J. Borst, Florian Praetorius, David Baker. "De novo design of allosterically switchable protein assemblies"

11) Poster Presentation, Summer RosettaCON, 2024, **Arvind S. Pillai**, Alex Shida, Cullen W. Demakis, Samuel Pellock, Anna Lauko, David Baker. "Designing novel allosteric enzymes."

## **TEACHING EXPERIENCE**

2019 Teaching Assistant and Guest Lecturer for Evolutionary and Genomic Medicine, University of Chicago

2018 Teaching Assistant for Evolution of Biological Molecules, University of Chicago

## **RESEARCH MENTORSHIP**

2019-2021 Arielle Weinstein, Undergraduate Researcher at the University of Chicago, admitted into MIT Biology Ph.D. program, co-author on Citrate Synthase Phylogeny paper.

2019-2021 Carlos R. Cortez-Romero, Graduate Student Researcher at the University of

Chicago, co-author on Pillai et al. 2020 and sole first author on Hemoglobin evolution paper currently in revision. Joining the Fordyce lab, Stanford as a Postdoctoral Researcher.

2022-2023 Annika Philomin, Undergraduate Researcher at University of Washington, co-author on switchable assembly paper (Pillai et. al. 2024). Admitted into UW Molecular Engineering Ph.D. program.

2022-2024 Abbas Idris, Graduate Student in UW Molecular Engineering, co-first author on switchable assembly paper (Pillai et. al. 2024).

2024-now Alex Shida, M.D. Ph.D. student, UW Molecular Engineering, co-first author on enzyme design publication currently in prep.

## **OUTREACH**

**Author of Fins to Feet ([ww.finstofoet.com](http://www.finstofoet.com))**, an online history of vertebrate life on earth over the last 500 million years geared towards a general audience. Wrote detailed natural history articles (dealing with comparative anatomy, paleontology and phylogenetics among other things) on various animal groups, from jawless fish to bats to sauropod dinosaurs.

**Illustrator and Animator:** I have produced many educational materials – including animations, illustrations and comics, on subjects spanning physics, history, archaeology, evolution, archived at [www.scribblopedia.com](http://www.scribblopedia.com).