Hannah K. Wayment-Steele

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Education

Ph.D. Candidate in Chemistry, Stanford University — Anticipated 2021
Concentration in Chemical Physics
Supervisors: Rhiju Das
Vijay Pande (now at Andreessen-Horowitz)

M.Phil. in Chemistry, University of Cambridge — September 2016
Supervisor: Daan Frenkel
Funded by the Churchill Scholarship
Thesis: Investigating the Role of Boundary Bricks in DNA Brick Assembly via Monte Carlo Simulation

B.A., Pomona College, Claremont, CA — May 2015
Chemistry and Applied Mathematics (Double Major), Minor in Music
GPA: 3.93, Magna cum Laude
Chemistry Thesis: Investigating the Effect of Al^{3+} on Lipid Bilayers: Experimental and Simulation Studies
Mathematics Thesis: A Stochastic Differential Equations Model for Microtubule Dynamics in Early *C. Elegans* Development

Scholarships & Awards

NSF Graduate Research Fellowship	April 2016
Churchill Scholarship, Sir Winston Churchill Foundation of the USA	January 2015
Beckman Scholar	April 2014
Goldwater Scholar	March 2014
ACS Colloid & Surface Chemistry Division Poster Award	March 2014
National Merit Scholar	March 2011
Siemens Award for Advanced Placement	February 2011

Pomona College Awards

John Stauffer Prize for Academic Merit in the Sciences — May 2015
– *Awarded to one senior annually in the natural sciences who exhibits the highest academic promise.*
Philip Goldberg Memorial Prize — May 2015
– *Awarded to one student annually for outstanding musical performance.*
Brackett Prize in Chemistry — May 2015
Tileston Physics Prize — August 2014
Llewellyn Bixby Prize in Mathematics — May 2013

Preprints / Manuscripts under Review

Andreasson, J. O., Gotrik, M. R., Wu, M. J., Wayment-Steele, H. K., Kladwang, W., Portela, F., ... Das, R., Greenleaf, W. J. (2019). Crowdsourced RNA design discovers diverse, reversible, efficient, self-contained molecular sensors. bioRxiv, 877183.

Wayment-Steele, H. K., Hernandez, C. X., Pande, V. S. (2018). Modelling Intrinsically Disordered Protein Dynamics as Networks of Transient Secondary Structure. bioRxiv, 377564.

Peer Reviewed Publications

Wayment-Steele, H. K., Wu, M., Gotrik, M., Das, R. (2019). Evaluating riboswitch optimality. *Methods in Enzymology*, 623, 417-450.

Kostrz, D., Wayment-Steele, H. K., Wang, J. L., Follenfant, M., Pande, V. S., Strick, T. R., Gosse, C. (2019). A modular DNA scaffold to study protein–protein interactions at single-molecule resolution. *Nature Nanotechnology*, 1-6.

Wayment-Steele, H. K., Pande, V. S. (2018). Variational encoding of protein dynamics benefits from maximizing latent autocorrelation. *The Journal of Chemical Physics*, 149(21), 216101.

C. X. Hernàndez*, H. K. Wayment-Steele*, M. M. Sultan*, B. E. Husic, V. S. Pande (2018). Variational Encoding of Complex Dynamics. *Physical Review E*, 97(6), 062412 *Equal contributions.

M. M. Sultan, H. K. Wayment-Steele, V. S. Pande (2018). Transferable neural networks for enhanced sampling of protein dynamics. *Journal of Chemical Theory and Computation*, 14(4), 1887-1894.

B. E. Husic, K. A. McKiernan, H. K. Wayment-Steele, M. M. Sultan, V. S. Pande, (2018). A minimum variance clustering approach produces robust and interpretable coarse-grained models. *Journal of Chemical Theory and Computation*, 14(2), 1071-1082.

H. K. Wayment-Steele, D. Frenkel, A. Reinhardt. (2017) "Investigating the role of boundary bricks in DNA brick self-assembly." *Soft Matter* (2017) 13, 1670-1680.

B. Agnarsson, H. K. Wayment-Steele, F. Höök, A. Kunze. (2016) "Monitoring of single and double lipid membrane formation with high spatiotemporal resolution using evanescent light scattering microscopy." *Nanoscale* 8, 19219-19223.

H. K. Wayment-Steele, Y. Jing, M. J. Swann, L. E. Johnson, B. Agnarsson, M. S. Johal, A. Kunze. (2016) "Effects of Al^{3+} on phosphocholine and phosphoglycerol containing solid supported lipid bilayers." *Langmuir* 32:7, 1771–1781.

H. K. Wayment-Steele, L. E. Johnson, F. Tian, M. C. Dixon, L. Benz and M. S. Johal. (2014) "Monitoring N3 Dye Adsorption and Desorption on TiO_2 Surfaces: A Combined QCM-D and XPS Study." *ACS Applied Materials & Interfaces* 6, 9093-9099.

F. Tian, A. M. Cerro, A. M. Mosier, H. K. Wayment-Steele, R. S. Shine, A. Park, E. R. Webster, L. E. Johnson, M. S. Johal and L. Benz. (2014) "Surface and Stability Characterization of a Nanoporous ZIF-8 Thin Film." *The Journal of Physical Chemistry C* 118, 14449-14456.

Mentorship, Outreach, and Communication experience

Mentor for PhD rotation students January 2019 - present

Das Lab, Stanford Biochemistry Department

- Mentored two rotation students to date in projects related to modelling RNA thermodynamics.

Trainer for Teaching Assistants May 2017-June 2018

Stanford Chemistry Department

- Met regularly with 4 graduate teaching assistants per quarter (12 in total) to discuss teaching strategies and help guide goal-setting for teaching. Each quarter, ran classroom observation sessions, coordinated teaching evaluations, and summarized and discussed feedback with each mentee.
- Helped plan, coordinate and run weeklong Chemistry department TA training orientation at start of fall quarter. Specifically, developed and ran training sessions on effective teaching

strategies and grading.

Lab Senator for Pande Group, Student-Hosted Colloquium Committee August 2016 - June 2018
Stanford Chemistry Department

- Contributed to regular speaker selection and colloquium organization for the Student-Hosted Colloquium series.
- Upon selection of my nominee, MIT theoretical chemist Troy Van Voorhis, coordinated his visit and served as his host.

Member of organization commitee June 2017
Protein Folding Consortium Workshop, Berkeley, CA

- One of 6 graduate students to coordinate and run a 3-day symposium for roughly 100 student and faculty attendees focused on protein folding.
- Specifically, invited and organized speakers for a series of "lightning" talks and organized a panel on careers outside of academia.

Contributing writer October 2015-August 2016
Cambridge University BlueSci Magazine

- Contributed regular science news briefs.
- Featured longform piece: H. K. Wayment-Steele, "The *Wunderkammer*: The Dawn of Curiosity in Europe", Cambridge University BlueSci Magazine (2016) 35, 30-31.

Mentor for undergraduate researchers 2013-2015
Johal Research Group, Pomona College Chemistry Department

- Served as long-term mentor for four undergraduate students, two of whom are from traditionally underrepresented backgrounds, in an interdisciplinary experimental and computational biochemistry research project.
- Helped develop skills related to laboratory work, data/computational science, critical thinking, academic writing, and presentation.
- Students successfully applied for and obtained an NSF computational startup grant, presented their research in poster and oral presentations, and all continued to pursue graduate degrees in STEM.
- In academic years, worked with students one afternoon a week. Mentored full-time during summer 2015, funded by the Beckman research scholarship.

Head Student Liaison August 2013 to June 2015
Pomona College Chemistry Department

- Planned and ran frequent events for chemistry students to connect with other students and professors; make informed academic decisions about course selection and mentoring; and to consider career options in chemistry.
- Helped select, invite and host visiting speakers, assisted in hosting and evaluating faculty candidates.

Co-President, Food Science Club May 2014 to June 2015
Pomona College

Teaching Experience

Teaching Assistant: Physical Chemistry I Spring 2017
Bianxiao Cui, Department of Chemistry, Stanford University

- 60 students, single TA
- Assisted instructor in developing a new computational lab section for the class. Helped develop lab handouts, code bases and exercises. Assisted in running and delivering lectures for three

weekly lab sections. Developed homework and exam material, held office hours, assisted in grading.
- In non-mandatory course review (13 respondents), 54% said my instruction was "extremely effective", 31% said "very effective". 46% said they learned "a great deal" from my teaching, 31% said they learned "a lot".

Teaching Assistant: Physical Chemistry III Winter 2017
Tom Markland, Department of Chemistry, Stanford University
- 60 students, one of two TAs
- Prepared and delivered weekly hour-long discussion sections to help clarify concepts in statistical mechanics. Developed corresponding activities for discussion sections. Developed homework and exam material, held office hours, assisted in grading.

Teaching Assistant: Accelerated Chemical Principles Fall 2016
W.E. Moerner, Charles Cox, Department of Chemistry, Stanford University
- 150 students, one of 6 TAs
- Directed two weekly experimental lab sections of 15 students each. Assisted in writing and developing homeworks, quizzes, exam materials, held regular office hours, graded all materials for sections.

Practical Supervisor Fall 2015
NanoDTC, Cavendish Laboratory, Cambridge

Met weekly with first-year PhD students to supervise a practical in Monte Carlo simulation of DNA brick self-assembly. Developed course handouts and code for data analysis.

Undergraduate Teaching Assistant 2014-2015
Pomona College Chemistry & Mathematics Departments
- Physical Chemistry: Thermodynamics, Spring 2015
- Physical Chemistry for Molecular Biology, Spring 2015
- Physical Chemistry: Quantum Mechanics, Fall 2014
- Differential Equations, Spring 2014

Research Experience

Das Group August 2018 to present
Department of Biochemistry, Stanford University
- Developed metrics, criteria and benchmark datasets to evaluate all commonly-used physics-based RNA secondary structure prediction algorithms on likelihood prediction of chemical mapping data, accuracy of predicting riboswitch fold changes. Also developed updated benchmark datasets for single-structure accuracy prediction.
- Developed a statistical inference model to train on novel forms of structural data and demonstrated that accuracy on these novel measures was improved.
- Reviewed all synthetic riboswitches and evaluated their performance based on a measure for optimality developed by colleagues.
- Analyzed high-throughput riboswitch experiments using unsupervised learning methods, visualized results from large datasets, and communicated results for publications and to citizen scientist collaborators.

Pande Group September 2016 to August 2018
Department of Chemistry, Stanford University
- Developed an unsupervised learning framework (the Variational Dynamics Encoder, VDE) to encode time-series data with the purpose of extracting protein dynamic motions from all-atom molecular dynamics simulation data and applying via transfer learning to related systems.

- Performed structural modeling and enhanced sampling simulations of protein-protein and ligand-protein interactions in collaboration with Terence Strick and Charlie Gosse (INSERM, PSL University) to develop a novel single-molecule scaffold for measuring affinity.
- Developed a featurization method to more interpretably represent intrinsically disordered proteins (IDPs) in terms of their transient secondary structure to build Markov State Models (MSMs) of IDPs.
- Helped develop a more robust microstate clustering technique to create more interpretable MSMs.

Frenkel Group September 2015 to September 2016
Department of Chemistry, University of Cambridge

- Performed Monte Carlo simulations of self-assembling DNA strands with the intent of understanding kinetic traps and nucleation pathways in addressable self-assembly.
- Implemented simulations in other thermodynamic ensembles for the above system.

Johal Group January 2012 to present
Pomona College Chemistry Department

- Designed and performed experiments to characterize dye adsorption to semiconductors for applications in Dye-Sensitized Solar Cells.
- Conducted Molecular Dynamics simulations of metal ions and lipid membranes.
- Collaborated in experiments to characterize the physical properties of immobilized ZIF-8 nanoparticles.
- Mentored undergraduate researchers on surface chemistry projects including studying the effects of metal ions on lipid membranes, adsorption of organic dyes for photovoltaics, and effects of anti-microbial peptides on lipid membranes.

Biological Physics Department Summer 2013 and Summer 2014
Chalmers Institute of Technology, Gothenburg, Sweden

- Designed and performed experiments to investigate the effects of both biologically-relevant and neurotoxic metal ions on physical properties of model lipid membranes using surface chemistry techniques including Quartz Crystal Microbalance with Dissipation Monitoring (QCM-D), Dual Polarization Interferometry (DPI), and Fluorescence Recovery after Photobleaching (FRAP).
- Travel sponsored by Pomona College Summer Undergraduate Research Program.

Selected Oral Presentations

H. K. Wayment-Steele. "Evaluating and Improving RNA Secondary Structure Models with Multitask Learning". Stanford Biochemistry Annual Retreat, Santa Cruz, CA, 16 Oct 2019.

H. K. Wayment-Steele. "An Interpretable Model for the p53-CTD Disordered Landscape." Biophysical Society Annual Meeting, San Francisco, CA, 21 Feb. 2018.

H. K. Wayment-Steele. "Investigating Effects of Al^{3+} on Structure and Fluidity of Lipid Membranes: FRAP and Molecular Dynamics." American Chemical Society National Conference, Denver, CO, 3/22/2015.

H. K. Wayment-Steele, L. E. Johnson, M. C. Dixon, M. S. Johal. "Characterization of N3 Dye Adsorption on TiO_2 using QCM-D," SPIE Solar Energy & Technology, San Diego, CA, 8/25/2013.

Invited Workshops

Gordon Research Conference: "Proteins" June 2017
Holderness, NH

D. E. Shaw Research Graduate and Postdoc Women's Forum — June 2017
New York City, NY

MolSim: Course on advanced molecular simulation techniques — January 2016
Amsterdam, Netherlands

Telluride School of Theoretical Chemistry — July 2015
Telluride, CO

Conference Proceedings

H. K. Wayment-Steele, S. Svedhem, L. E. Johnson, M. S. Johal, B. Agnarsson, and A. Kunze (presenting). "Al^{3+} binding effects on lipid membrane structure" German Physical Society Annual Meeting, Berlin, Germany, 3/18/2015.

M. C. Dixon (presenting), H. K. Wayment-Steele, L. E. Johnson, F. Tian, L. Benz, and M. S. Johal. "Fundamental Dye Self-assembly and Removal Studies". Smart Coatings Conference, Orlando, FL, 2/25/2015.

B. Agnarsson, H. K. Wayment-Steele, S. Svedhem, F. Höök, B. Kasemo, and A. Kunze (presenting). "Ion-mediated formation of a double lipid membrane." German Biophysical Society Annual Meeting, Lübeck, Germany, 9/14/2014.

H. K. Wayment-Steele, L. E. Johnson, M. C. Dixon, M. S. Johal. (2013, September 13). "Characterization of N3 Dye Adsorption on TiO_2 using Quartz-Crystal Microbalance with Dissipation Monitoring." In L. Eldada, M. Heben (Eds.) *SPIE Proceedings Vol. 8823*. Paper Presented at SPIE Optics & Photonics: Thin Film Solar Technology V, San Diego, 25-29 August.

Memberships

Phi Beta Kappa — April 2015
Mortar Board — April 2014
Sigma Xi Scientific Research Society — August 2013

Other activities: International & National Recognition in Rowing

Selected to represent the U.S.A. at the World Rowing Coastal Championships, Hong Kong, China.
– Placed 7th overall of 32 entries in the women's coastal double (CW2x).
– Placed 9th overall of 24 entries in the women's coastal solo (CW1x). — November 2019
Awarded Fastest Overall Single at the 47th annual Bridge-to-Bridge Race,
first woman in the history of the race to achieve, San Francisco, CA. — October 2019
Invited to compete with Riverside High Performance Group, Cambridge, MA. — Summer 2019
Qualified for and competed in US National Team selection camp, Oakland, CA. — February 2019