Hannah K. Wayment-Steele, Ph.D.

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Education

Ph.D., Chemistry (Chemical Physics concentration), Stanford University	2016 – 2021
M.Phil., Chemistry, Churchill College, Cambridge University	2015 – 2016
B.A. *magna cum laude*, Chemistry and Mathematics double major, Pomona College	2011 – 2015

Research Experience

Postdoctoral Fellow, Wyss Institute, Dana-Farber Cancer Institute   2021 – present
- Designed frameworks for ultra-sensitive protein and RNA detection using DNA nanotechnology.

Graduate research with Rhiju Das and Vijay Pande, Stanford University   2016 – 2021
- Created biophysical models for RNA degradation, applied methods to design experimentally-validated model RNA therapeutics with improved shelf lives.
- Developed improved algorithms and novel experimental frameworks for RNA thermodynamic prediction using statistical mechanics to link high-throughput experiment and machine learning.
- Developed theoretical links between dynamical systems theory and unsupervised machine learning frameworks to create improved analysis tools for protein dynamics.

Graduate research with Daan Frenkel, Cambridge University   2015 – 2016
- Contributed to improved understanding of DNA nanomaterial nucleation and assembly via molecular modelling.

Visiting researcher, Chalmers University of Technology   2013 – 2015
- Designed experimental methods to characterize adsorption kinetics for varied applications in surface chemistry / lipid membrane biophysics.

Select Honors and Awards

Award for Outstanding Graduate Research, ACS PHYS division, Journal Chemical Physics	2021
Chemical Computing Group Excellence Award, ACS COMP division	2021
Joseph R. McMicking Award, Stanford Chemistry Department	2021
NSF Graduate Research Fellowship	2016
Churchill Scholarship, Sir Winston Churchill Foundation of the USA	2015
John Stauffer Prize for Academic Merit in the Sciences (Pomona College)	2015
Awarded to one graduate annually in the natural sciences who exhibits the highest academic promise.	
Beckman Scholar	2014
Goldwater Scholar	2014

Manuscripts under Review

Wayment-Steele, H. K.*, Kladwang, W.*, Watkins, A. M.*, Kim, D. S.*, Tunguz, B.*, … Das, R. (2021) Predictive models of RNA degradation via dual crowdsourcing. Arxiv, 3977815. *Equal contributions.

Leppek, K.*, Byeon, G.W.*, Kladwang, W.*, **Wayment-Steele, H. K.*,** Kerr, C. H.*, … Barna, M., Das, R. (2021) Combinatorial optimization of mRNA structure, stability, and translation for RNA-based therapeutics. bioRxiv, 437587. *Equal contributions.

> **Highlighted in:**
> Chavez, M. Bannon, S. "Screening for Enhanced RNA Vaccines with Kathrin Leppek, Gun Woo Byeon, and Hannah Wayment-Steele." Fifty Years podcast, October 14, 2021.
> Wei-Haas, M. "Future COVID-19 vaccines might not have to be kept so cold", National Geographic, April 13, 2021.

Koodli, R.V., Rudolfs, B., **Wayment-Steele, H.K.,** Das, R. (2021). Redesigning the Eterna100 for the Vienna 2 folding engine. bioRxiv, 457839.

Wayment-Steele, H.K., Kladwang, W., A. I. Strom, Eterna Participants, Treuille, A., Das, R. (2020). RNA secondary structure packages ranked and improved by high-throughput experiments. bioRxiv, 124511.

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

Select Peer-Reviewed Publications

Wayment-Steele, H.K., Kim, D.S., Choe, C.A., Nicol, J.J., Wellington-Oguri, R., Sperberg, R.A.P., Huang, P., Eterna Participants, Das, R. (2021). Theoretical basis for stabilizing messenger RNA through secondary structure design. *Nucleic Acids Research*, 48(18), 10604-10617.

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*, 14(10), 988-993.

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.

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

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

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

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

Full publication list at https://scholar.google.com/citations?user=MHNfkuUAAAAJ

Patent Applications

H. K. Wayment-Steele, E. Sharma, R. Das, W. Greenleaf. 63/245,744, "Systems and Methods to Determine Nucleic Acid Thermodynamics and Uses thereof", Sep. 17, 2021.

R. Das, **H. K. Wayment-Steele**. PCT/US2021/040026, "Systems and Methods to Enhance RNA Stability and Translation and Uses Thereof", July 1, 2021.

R. Das, C. A. Choe, **H. K. Wayment-Steele**, W. Kladwang, 17/364,890, "Systems and Methods to Enhance RNA Stability and Translation and Uses Thereof", June 30, 2021.

Software Repositories (Lead Developer)

"Superfolder COVID mRNA vaccines" https://github.com/DasLab/superfolder-covid-mrna-vaccines
- Public repository of designed stabilized sequences for S-2P mRNA COVID vaccines and variant strains. 57 stars since Jan. 2021 launch.

"Arnie" https://github.com/DasLab/arnie
- General tool for comparing RNA structure algorithms. Used by over 1600 teams to augment datasets in machine learning competition on Kaggle. 47 stars since Sep. 2019 launch.

Select Presentations

"Designing stabilized vaccines with community science." TEDx Washington High, Fremont, CA. May 1 2021.

"Inferring RNA ensembles via high-throughput data." Center for HIV-1 Studies Annual Workshop. April 5 2021.

"Improving the stability of RNA therapeutics through biophysics, machine learning, and crowdsourcing" IEEE Silicon Valley Chapter, Information Theory Society, Invited Talk, March 24 2021.

"Improving RNA structure prediction with high-throughput crowdsourced data". International Conference on Intelligent Systems for Molecular Biology (ISMB), Virtual. 13 July 2020.

Select Teaching, Mentorship, Outreach Experience

2021	Program mentor, Center for Genetically Encoded Materials REU, UC Berkeley
2020	Co-instructor, BIOL 4013, Topics in Genomics, Prairie View A & M University
2020	Program mentor, Stanford Summer Research Program
2019 – 2021	Outreach lead, Eterna Project
2017 – 2018	Teaching assistant mentor, Department of Chemistry, Stanford University
2016 – 2017	Teaching assistant, Department of Chemistry, Stanford University
2015	Supervisor, Nanotechnology Doctoral Training Center, Cavendish lab, Cambridge University