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Isaac Vock

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Education

PhD in Molecular Biophysics and Biochemistry

August 2019 - Present

Yale University, New Haven, CT

Bachelor of Science in Physics; Minor in Mathematics

August 2015 – May 2019

Centre College, Danville KY

Summa Cum Laude (4.0 GPA)

Publications

Vock, I. W., Mabin J., Zhang A., Machyna M., Hogg R.J., Simon M.D. Expanding and improving analyses of all nucleotide recoding RNA-seq experiments with the EZbakR-suite. *bioRxiv*. **2024**.

Scharfen, L., **Vock I. W.**, Simon M. D., Neguebauer K. M. Regulation of immediate RNA base pairing upon exit from eukaryotic RNA polymerases. *Submitted to Nat Struct Mol Bio*.

Moon, M. H., **Vock I. W.**, Streit A. D., Connor L. J., Senkina J., Ellman J. A., Simon M. D. Disulfide tethering to map small molecule binding sites transcriptome-wide *ACS Chem Bio*. **2024**.

Lu-Culligan, W. J., Connor L. J., Xie Y., Ekundayo B. E., Rose, B. T., Machyna, M., Zimmer, J. T., **Vock, I. W.**, Bhanu, N. V., King, M. C., Garcia, B. A., Bleichert, F., Simon, M. D. Acetyl-methyllysine marks histone H4 in regulated chromatin. *Nature*. **2023**.

Zimmer, J. T., **Vock, I. W.**, Schofield, J. A., Kiefer, L., Moon, M. H., Simon, M. D. Improving the study of RNA dynamics through advances in RNA-seq with metabolic labeling and nucleotide-recoding chemistry. *bioRxiv*. **2023**.

Vock, I. W., Simon, M. D. bakR: Uncovering differential RNA synthesis and degradation kinetics transcriptome-wide with Bayesian hierarchical modeling. *RNA*. **2023**.

Sullivan, M. C., Niederer, R. O., **Vock, I. W.**, Kiefer, L., Gilbert, W. V., Simon, M. D. An internally normalized approach to comparing RNA levels between samples using nucleoside recoding chemistry. *NAR*, **2022**.

Joy, S. T., Henley, M. J., De Salle, S. N., Beyersdorf, M. S., **Vock, I. W.**, Huldin, A. J. L., Mapp, A. K. A Dual-Site Inhibitor of CBP/p300 KIX is a Selective and Effective Modulator of Myb. *JACS*. **2021**.

Research Experience

PhD Candidate

March 2020 – Present

Yale University

Advisor: Matthew Simon, PhD

- Developed computational tools to process and analyze nucleotide recoding RNA-seq (NR-seq; e.g., SLAM-seq, TimeLapse-seq, TUC-seq, etc.) data. Culminated in the EZbakR suite, an R package (EZbakR) and Snakemake pipeline (fastq2EZbakR).
- Developed statistical methods for performing well powered comparative analyses of kinetic parameters estimated from NR-seq data, fitting linear dynamical systems models to subcellular fractionation NR-seq data, etc.

Research Internship

Summer 2019

Xavier University

Advisor: Justin Link, PhD

- Gained experience using and studied the underlying theory of circular dichroism spectropolarimetry, optical tweezers, and atomic force microscopy.
- Aided in Dr. Link's NSF funded research of cryptochromes in plants.

NSF REU

Summer 2017

University of Michigan

Advisor: Anna Mapp, PhD

Mentors: Omari Baruti, PhD and Stephen Joy, PhD

- Designed and synthesized peptides with the goal of achieving differential binding affinities for two structurally similar proteins, p300 and CREB Binding Protein (CBP).
- Expressed and purified a domain of p300 (KIX domain) used for binding affinity analysis.
- Determined peptide binding affinity with a fluorescent polarization (FP) assay.

Undergraduate Research Assistant

May 2016 – August 2016 and January 2017

Centre College

Advisor: Bruce Rodenborn, PhD

- Constructed two systems of stepper motors and aluminum structures to macroscopically model bacteria that locomote with a rotating helical flagellum.
- Used Matlab scripts to control several stepper motors as well as the DC motor of the robotic bacterial analog.
- Characterized flagellar propulsion with torque sensors and Fourier analysis.

Presentations

Oral Presentations:

- “Extending and improving the study of transcript isoform dynamics with EZbakR”. Chemical Biology RIP talk, Yale University. October 2024.
- “The joy of bioinformatics”. YBDIC computational biology lecture series, Yale University. November 2023.
- “Extending and improving the study of transcript isoform dynamics”. C-Wing Hall Seminar, Yale University. October 2023.
- “Dissecting gene expression regulation mechanisms with bakR”. RNA Club, Yale University. July 2023; Steitz lab joint lab meeting, Yale University. October 2023.
- “Enhanced exploration of chemical probing RNA-seq data with HDProbe”. C-Wing Hall Seminar, Yale University. September 2022
- “Improved Statistical Modeling for Differential RNA Kinetics Analysis”. IBDD RIP talk, Yale University. December 2021; C-Wing Hall Seminar, Yale University. December 2021
- “Modeling Bacterial Swimming”. Kentucky Academy of Science (KAS) Undergraduate Research Presentation, University of Louisville. November 2016

Poster Presentations:

- “Uncovering transcript isoform regulatory dynamics with metabolic labeling and EZbakR”. CSHL Systems Biology: Global Regulation of Gene Expression. March 2024.
- “bakR: uncovering differential RNA synthesis and degradation kinetics transcriptome-wide”. Cold Spring Harbor Laboratory Biological Data Science Conference, CSHL. November 2022; RNA Society Annual Meeting, Suntec Center, Singapore. June 2023
- “Uncovering Differential RNA Metabolic Kinetics with Improved Statistical Modeling”. MB&B departmental retreat. March 2022
- “Differential Binding of c-Myb Mutants to CBP and p300-KIX”. Undergraduate Research Symposium in the Chemical and Biological Sciences, University of Maryland Baltimore County. October 2017

Teaching Experience

Statistical Intuition for Modern RNA Biologists (MB&B 374/574) *January 2025 – May 2025*

Yale University

Role: Instructor on Record

- Course that Matt Simon and I developed and are co-teaching in the Spring of 2025.
- Introduces Yale undergraduates and first year graduate students to core concepts in statistics and how they can be applied to the analyses of modern high throughput biochemical datasets.
- Selected to run as a part of Yale’s [Associates in Teaching](#) program.

Introduction to Physics in Living Systems I (MB&B 121L) *January 2024 – March 2024*

Yale University

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Role: Teaching Fellow

- Half-semester course introducing biophysics majors at Yale to basic concepts in experimental physics.
- Ran discussion sections, helped students design and execute experiments in class, and answered questions about Jupyter notebooks, which students used to record results.

Advanced Eukaryotic Molecular Biology (MB&B 443b/743b)

January 2021 – May 2022

Yale University

Role: Teaching Fellow

- Course on eukaryotic gene expression regulation for junior/senior undergraduates and 1st year graduate students.
- Ran discussion sections (weekly; discussed assigned paper) and graded assignments.

Physics Tutor

September 2016 – May 2019

Centre College

- Provided homework help and explained difficult concepts to those in introductory physics classes.
- Helped students develop useful problem-solving techniques and skills.

Programming Languages

Github profile: [isaacvock](#)

Daily use:

- R (Example project: [EZbakR](#))
- Snakemake (Example project: [fastq2EZbakR](#))
- Bash

Intermediate use:

- Python (Example project: fastq2EZbakR scripts)
- LaTeX
- Stan (Example project: [bakR](#))

Occasional use:

- C ([Example repo](#))
- Pytorch ([Example repo](#))

Other Experience

PEB Discussion Group Coordinator and Moderator

September 2021 – May 2022

- Invited speakers (mainly graduate students and postdoctoral associates; all at Yale) to present at monthly RIP talks associated with Yale's Integrated Graduate Program in Physical and Engineering Biology.
- Organized, advertised, and moderated the talks.

New Haven Science Fair (NHSF) Mentor

March 2020 – May 2021

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- Developed online science content for a second-grade class at Conte West Hills Magnet School, a local public elementary school.
- Worked with a 5th/6th grade enrichment class at FAME, a local multilingual elementary school, to develop and conduct a science fair project presented at the NHSF.

Physics Program Student Representative

August 2017 – May 2019

- Attended meetings to discuss the Centre College physics program and offer student perspective about curriculum, budget, social events, etc.
- Answered questions from prospective physics majors about the program.

Honors and Awards

Yale Associates in Teaching	2024
Yale RNA Center Travel Award	2023
MB&B's Excellence in Teaching Award	2022
NIH Chemical Biology Training Grant	2020-2022
Centre College Class of 2019 Valedictorian Prize	2019
T. Hunton Rogers Memorial Scholarship Prize for a Junior Excelling in the Physical Sciences	2018
Marshall Wilt Physics Prize for an Outstanding Physics Major	2018
Induction into Phi Beta Kappa General Honor Society	2018
Induction into Sigma Pi Sigma Physics Honor Society	2017
Max P. Canves Award for Highest GPA Freshman Year	2017
1 st prize Physics and Astronomy Oral Presentation KAS	2016