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Isaac Boris Breinyn

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Education and Training

Max Planck Institute for Animal Behavior 2025-Present
Post-doctoral fellow *Adviser: Iain Couzin*

Princeton University 2025
Ph.D. *Adviser: Daniel J. Cohen*

Marine Biological Institute at Woods Hole 2023
Trainee *in 2 month 'Cell Physiology' course*

Princeton University 2022
M.A. *in Quantitative and Computational Biology*

University of California, Santa Barbara 2019
B.Sc. *in Physics & Astrophysics* *GPA: 3.86/4.0 (magna cum laude)*

Awards & Honors

American Physical Society Early Career Prize 2025
Finalist

NSF GRFP 2022-2025
'Towards an electric band-aid for wound healing'

Best Poster 2023
Biophysics of Organoids, Princeton Center for Theoretical Science

Orange & Black Award for Best Poster & Video Presentation 2023
Princeton Research Day

Princeton McGraw Center Graduate Teaching Fellowship 2022-2023
Student-Athletes, Problem Solving, and Science Communication

UCSB Physics High Honors 2019
GPA: 3.86/4.0 (magna cum laude)

Best Undergraduate Talk 2019
KITP Undergraduate Symposium

Publications

* denotes equal-contribution authorship
co-authors have agreed to flexible ordering on respective CV's

Pre-Prints and In Submission

1. **Cellular cruise control: energy dissipation as a regulator of collective migration in epithelia.** **Breinyn, I.B.***, Martina-Perez, S.*, Baker, R., Cohen, D.J. *bioRxiv*

2. **Spatial heterogeneity in collective electrotaxis: continuum modeling and applications to optimal control.** Martina-Perez, S., **Breinyn, I.B.**, Cohen, D.J., Baker, R. *arXiv* (2024)

Peer-reviewed

3. **Optimal control of collective electrotaxis in epithelial monolayers.** Martina-Perez, S., **Breinyn, I.B.**, Cohen, D.J., Baker, R. *Bulletin of Mathematical Biology* (2024)
4. **Bioelectric stimulation controls tissue shape and size. Breinyn, I.B.***, Shim, G.*, Martínez-Calvo, A., Sameeksha, Cohen, D.J. *Nature Communications* (2024)
5. **E-cadherin biomaterials reprogram collective cell migration and cell cycling by forcing homeostatic conditions.** Suh, K.*, Cho, Y.*, **Breinyn, I.B.**, Cohen, D.J. *Cell Reports* (2024)
6. **A hybrid, deep-learning pipeline for social network analysis in bumblebee colonies.** Ruttenberg, D.M.*, Wolf, S.W.*, Knapp, D., Webb, A.E., Kane, A., Gee, T., **Breinyn, I.B.**, LeChance, J., Cohen, D.J., Kocher, S.D. *Integrative and Comparative Biology* (2023)
7. **Short-term bioelectric stimulation of collective cell migration in tissues reprograms long-term supracellular dynamics.** Wolf, A.E., **Breinyn, I.B.***, Heinrich, M.A.*, Zajdel, T.J., Cohen, D.J. *PNAS Nexus* (2022) https://doi.org/10.1093/pnasnexus/pgac002

Contributed Talks

excludes talks given at home universities (full list available upon reasonable request)

Visiting Talks

1. *Multicellular Collective Behaviors: Driven migration and active fluid pumping*. 2024
   University of Konstanz (MPI Animal Behavior)

American Physical Society, March Meeting

1. *Macroscopic patterns of force production and cell division in epithelia*. CA, 2025
2. *Electric stimulation induces morphogenetic elongation in a 3D embryo model*. MN, 2024
3. *Cellular Cruise Control: Energy dissipation regulates collective migration in epithelia*. NV, 2023
4. *Electrical cues regulate swelling in cysts and organoids*. IL, 2022

EMBO Physics of Cells Ein Gedi, Israel

5. *Pump it up: Bioelectrical control of inflation in lumenized structures*. 2022

UMass Amherst School on Soft Solids and Complex Fluids Amherst, MA

6. *Electrically induced swelling in cysts and organoids*. 2022

LBNL NSF REU Poster Session Berkeley, CA

7. *Minimizing Inductance in a MEMS Compact Linear Accelerator*. 2017

Teaching

Student Mentees

Amina Anowara | *Senior Thesis Student* 2024
Current: University of Pennsylvania, Ph.D.

Liam T. Davis | *BE-SURE Summer Student* 2024
Current: Oxford University, Ph.D.

Jack E. Schenkman | *Junior & Senior Thesis Student* 2024
Current: Stanford, Ph.D.

Scientific Teaching

MPI-AB VTK Course 2025 | *Lecturer* 2025
Flow in Collective Systems

MBL Cell Physiology Course | *Teaching Assistant* 2025
Project ideation, experimental guidance, student mentoring

Princeton, MAE 223: Modern Solid Mechanics | *Teaching Assistant* 2023
Grading, teaching precepts, and test proctoring

Princeton Center for Physics of Biological Function Summer School | *Guest presenter* 2022
Periodicity in Collective Systems: Fourier Transforms and Tissue Dynamics

UCSB, INT 94VW: Physics Career Development | *Lecturer* 2019
Co-created curriculum, taught lectures

UCSB, Phys 103: Intro to Classical Mechanics | *Learning Assistant* 2019
Teaching precepts

UCSB, Phys 104: Advanced Classical Mechanics | *Learning Assistant* 2018
Teaching precepts

Non-Scientific Teaching

Yeh College Music Production Open Table | *Educator & Facilitator* 2023-2025
Created an environment for teaching and collaboration in computer-aided music production

Princeton McGraw Center for Teaching & Learning | *Teaching Fellow* 2022-2023
Student-Athletes, Problem Solving, and Science Communication

Outreach

Scientific Outreach

Molecular Biology Outreach Program: Sol Feinstone Science Fair | *Guest Judge* 2024
Adjudicated elementary and middle school science projects

Odd Salon Presents: Lab Tales Workshop on Storytelling | *Guest Presenter & Assistant* 2021 – 2025
Presented on and facilitated activities geared towards science communication

Physics Tutoring | *Independent & University Tutor* 2021 – 2025
Topics ranging from High School to Graduate Physics

Skype a Scientist | *Scientist* 2022
Presented graduate-level biophysics concepts to elementary school classrooms

Non-Scientific Outreach

Resident Graduate Student | *Yeh College, Princeton University* 2023-2025
Advise undergraduates on all topics, plan collegiate events

Mercer Lake Rowing Association | *Assistant Coach* 2023-2025
Assist in planning and leading group workouts

Deadbeats & Hustlers Improv Troupe | *Rehearsal leader* 2022-2023
Planned and led rehearsals for local improv troupe