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Alex J. Hughes, Ph.D.

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Citizenship

U.S. and New Zealand

Education

2013 Ph.D. Bioengineering, University of California, Berkeley
2008 B.E.(Honors 1st class), Chemical & Materials Engineering
2008 B.Sc., Pharmacology, University of Auckland, New Zealand

Academic Positions

2018-	Assistant Professor, Penn Bioengineering
2018-	Secondary Faculty, Penn Cell & Developmental Biology
2013-2017	Postdoctoral Researcher, University of California, San Francisco
2008-2013	Graduate Student, University of California, Berkeley

Honors/Distinctions

2021-2026	NSF CAREER Award
2021	Penn Nemirovsky Engineering and Medicine Opportunity (NEMO) Prize
2015-2018	Jane Coffin Childs Medical Research Postdoctoral Fellowship
2015	American Cancer Society Postdoctoral Fellowship (Declined)
2015	NIH F32 Postdoctoral Fellowship (Declined)
2014	Society of General Physiologists Scholar, MBL, Woods Hole
2012-2013	Siebel Scholarship
2009-2012	National Defense Science & Eng. Graduate (NDSEG) Fellowship

Publications

19. Viola, J.M., Porter, C.M., Gupta, A., Alibekova-Long, M., Prahl, L.S., Hughes, A.J. High-throughput assembly of compositionally controlled 3D cell communities for developmental engineering. *In press*. In: Methods in Molecular Biology, 2022.

18. Beck, L.E., Lee, J., Coté, C., Dunagin, M.C., Lukonin, I., Salla, N., Chang, M.K., Hughes, A.J., Mornin, J.D., Gartner, Z.J., Liberali, P., Raj, A. Systematically quantifying morphological features reveals constraints on organoid phenotypes. Cell Systems, 13: 1-14, 2022.

17. Viola, J.M., Liu, J., Prahl, L.S., Huang, A., Chan, T.J., Hayward-Lara, G., Porter, C.M., Hughes, A.J. Tubule jamming in the developing kidney creates cyclical mechanical stresses instructive to nephron formation. *Submitted*, *bioRxiv*. 2022.

16. Prahl, L.S., Viola, J.M., Liu, J., Hughes, A.J. The developing kidney actively negotiates geometric packing conflicts to avoid defects. *In review*, Developmental Cell, 2022.

15. Gupta, A., Lutolf, M.P., Hughes, A.J., Sonnen, K.F. Bioengineering *In Vitro* Models of Embryonic Development. Stem Cell Reports. 16: 1104-1116, 2021.

14. Daly*, A.C., Prendergast*, M.E., Hughes, A.J., Burdick, J.A. Bioprinting for the Biologist. Cell, 184: 18-32, 2021. *Equal contribution.

13. Viola*, J.M., Porter*, C.M., Gupta, A., Alibekova, M., Prahl, L.S., Hughes, A.J. Guiding Cell Network Assembly Using Shape-Morphing Hydrogels. Advanced Materials, 2002195: 1-9, 2020. *Equal contribution.

12. Gartner, Z.J., Hughes, A.J. (News & Views) Getting the Measure of Living Biomaterials. Nature, 572: 38-39, 2019.

11. Hughes, A.J., Mornin, J.D., Biswas, S.K., Bauer, D.P., Bianco, S., Gartner, Z.J. Quanti.us: A Tool for Rapid, Flexible, Crowd-Based Annotation of Images. Nature Methods, 15: 587-590, 2018.

10. Hughes, A.J., Coyle, M., Zhang, J., Miyazaki, H., Laurie, M., Chu, D., Vavrusova, Z., Schneider, R.A., Klein, O.D., Gartner, Z.J. Engineered Tissue Folding Driven by Mechanical Compaction of the Mesenchyme. Developmental Cell, 44: 165-178, 2018.

9. Todhunter, M.E., Jee, N.Y., Hughes, A.J., Coyle, M.C., Cerchiari, A., Farlow, J., Garbe, J.C., LaBarge, M.A., Desai, T.A., Gartner, Z.J. Programmed Synthesis of 3D Tissues. Nature Methods, 12: 975–981, 2015.

8. Hughes, A.J., Spelke, D.P., Xu, Z., Kang, C.-C., Schaffer, D.V., Herr, A.E. Single-Cell Western Blotting. Nature Methods, 11: 749–755, 2014.

7. Tentori, A.M., Hughes, A.J., Herr, A.E. Microchamber Integration Unifies Distinct Separation Modes for Two-Dimensional Electrophoresis. Analytical Chemistry, 85: 4538–4545, 2013.

6. Hughes, A.J., Herr, A.E. Microfluidic Western Blotting. PNAS, 109: 21450– 21455, 2012.

5. Hughes, A.J., Lin, R.K., Peehl, D.M., Herr, A.E. Microfluidic Integration for Automated Targeted Proteomic Assays. PNAS, 109: 5972–5977, 2012.

4. Hughes, A.J., Tentori, A.M., Herr, A.E. Bistable Isoelectric Point Photoswitching in Green Fluorescent Proteins Observed by Dynamic Immunoprobed Isoelectric Focusing. JACS, 134: 17582–17591, 2012.

3. Chen, X., Kapil, M.A., Hughes, A.J., Herr, A.E. Single-Microchannel, Multistep Assay Reports Protein Size and Immunoaffinity. Analytical Chemistry, 83: 6573–6579, 2011.

2. Hughes, A.J., Herr, A.E. Quantitative Enzyme Activity Determination with Zeptomole Sensitivity by Microfluidic Gradient-Gel Zymography. Analytical Chemistry, 82: 3803–3811, 2010.

1. Hughes, A.J., Titchener, M.R., Taylor, M.P. and Chen, J.J.J. Pseudoresistance Entropy as an Approach to Diagnostics and Control in Aluminium Production. Asia Pac. J. Chem. Eng., 2: 355–361, 2007.

Current Research Grants

"Engineering induction and assembly of human kidney tissue"
Source of Support: NIH R01
Total Award Amount: $1,790,528
Total Award Period Covered: 04/01/2022-03/31/2026

"NEMO Prize: scProteome-seq: Single-cell proteomic fingerprinting of patient biopsies"
Source of Support: Nemirovsky Engineering and Medicine Opportunity (NEMO) Prize
Total Award Amount: $80,000
Total Award Period Covered: 9/30/2021 – 10/1/2022

"CAREER: Synthetic 'remote control' of kidney tissue formation towards large-scale models of congenital disease"
Source of Support: NSF CAREER
Total Award Amount: $529,904
Total Award Period Covered: 3/1/2021 – 2/28/2026

"A developmental engineering toolbox for large-scale tissue engineering"
Source of Support: NIH Maximizing Investigators' Research Award (MIRA) (R35)
Total Award Amount: $1,779,737
Total Award Period Covered: 08/01/2019-07/31/2024

Laboratory startup fund
Source of Support: University of Pennsylvania
Total Award Amount: $1,600,000
Total Award Period Covered: 01/01/2018-01/01/2023

Pending Research Grants

"Balancing fluid-like and solid-like cell behaviors: Biomechanical and biochemical integration in branching morphogenesis"
Source of Support: NIH R21
Total Award Amount: $446,688.00
Total Award Period Covered: 06/01/2021-05/31/2025

Invited Seminars/Lectures/Presentations

30. Center for Cell Plasticity and Organ Design (CPOD) Seminar Series, University of Michigan, Oct 2022.
29. Interpreting geometric rules of early kidney formation for synthetic morphogenesis. BMES, Oct 2022.

28. Interpreting geometric rules of early kidney formation for synthetic morphogenesis. Gordon Conference on Signal Transduction by Engineered Extracellular Matrices, July 2022.
27. Physical packing constraints restrict the outcomes of kidney tubule morphogenesis and sculpt the mechanical microenvironment of nephron formation. SDB, July 2022.
26. Extracting and building with the engineering principles of kidney development. SB3C, June 2022.
25. Interpreting geometric rules of early kidney formation for synthetic morphogenesis. ISSCR, June 2022.
24. scProteome-seq: Sequencing the Proteomes of Single Cells. Penn Idea to Impact HealthTech Symposium, June 2022.
23. Extracting and building with the engineering principles of kidney development. Keystone conference, Engineering Multi-Cellular Living Systems, Apr 2022.
22. In vivo study and synthetic engineering of mechanical rules for kidney tubule morphogenesis. BMES CMBE conference, Jan 2022.
21. In vivo study and synthetic engineering of mechanical rules for kidney tubule morphogenesis. ASCB Subgroup 4: Cell and Tissue Morphodynamics in Engineered Systems, Dec 2021.
20. How the kidney negotiates a tubule packing conflict during development. Penn Cell & Developmental Biology Faculty Talks, Nov 2021.
19. In vivo study and synthetic engineering of mechanical rules for kidney tubule morphogenesis. Carnegie Mellon Forum on Biomedical Engineering, Sep 2021.
18. Shape-shifting tissue scaffolds for kidney cell assembly. NIH ReBuilding a Kidney Consortium annual meeting, Sep 2021.
17. How the kidney negotiates a tubule packing conflict during development. University of Delaware Center for Computation Biology and Bioinformatics, Sep 2021.
16. How the kidney negotiates a tubule packing conflict during development. Princeton Developmental Colloquium, April 2021.
15. Shape-shifting tissue scaffolds for kidney cell assembly. Signal Transduction by Engineered Extracellular Matrices Gordon Research Conference, July 2020. **Postponed to summer 2022 due to COVID-19 pandemic.*
14. Kidney tissue engineering by developmental mimicry. Penn Dental Medicine Frontiers in Science, April 2020.
13. Kidney tissue engineering by developmental mimicry. Penn Center for Molecular Studies in Digestive and Liver Diseases, Feb 2020.
12. Kidney tissue engineering by developmental mimicry. Penn Institute for Regenerative Medicine International Symposium on Engineering Cell & Tissue Organization, Feb 2020.
11. Building Long-Range Kidney Tissue Organization by Mimicking Developmental Matrix Remodeling in 4D. BMES, Oct 2019.
10. Synthetic morphogenesis by reconstitution of embryonic connective tissue biomechanics. 16th Int. Symp. on Comp. Methods in Biomech. and Biomed. Eng. (CMBBE), Columbia University NY, Aug 2019.
9.Uncovering the developmental rules for kidney duct morphogenesis by programming mesenchymal remodeling in space and time. Developmental Biology Gordon Research Conference, June 2019.
8. Synthetic strategies for developmental engineering. Temple University Bioengineering Seminar Series, Mar 2019.
7. Inferring the Design Rules of Development by Tissue Reconstitution. Penn Institute for Regenerative Medicine, Program in Musculoskeletal Regeneration, Feb 2018.
6. Inferring the Design Rules of Development by Tissue Reconstitution. Penn Center for Pulmonary Biology, Feb 2018.

5. Inferring the Design Rules of Development by Tissue Reconstitution. Penn Center for Engineering Mechanobiology, Feb 2018.

Talks list is partial prior to 2018
4. Inferring the Design Rules of Development by Tissue Reconstitution. UCSF Center for Cellular Construction Quarterly Meeting, May 2017.
3. Panel Speaker, NSF Workshop: Additive Manufacturing for Health, Arlington, VA, March 2016.
2. Coupling Between Spatial Organization and Proliferation in a Mammary Epithelial Occult Tumor Model. UCSF Center for Systems & Synthetic Biology Monthly Meeting, Jan 2015.
1. Microfluidic Western Blotting for Rapid HIV Screening Diagnostics. Point-of-Care Diagnostics (POCDx) Idea Lab, UC Berkeley, April 2012.

Membership/Leadership Positions in Scientific and Professional Societies
2019- Member, American Society of Nephrology (ASN)
2019- Member, Society for Developmental Biology (SDB)
2019- Member, International Society for Stem Cell Research (ISSCR)
2016- Member, American Society for Cell Biology (ASCB)
2014- Member, Biomedical Engineering Society (BMES)
2012- Member, American Chemical Society (ACS)

Teaching Experience
2020- Instructor, BE350 – Introduction to Biotransport Processes.
2019- Instructor, BE565 – Developmental Engineering of Tissues.
2018- Guest Lecturer, CAMB511 – Principles of Development.
2018- Guest Lecturer, CAMB703/BE640 – The ECM, adhesion receptors, and translational biomechanics.

Doctoral Dissertations/Theses Supervised
2026 Aria Huang
2026 Jiageng Liu
2023 Mariia (Masha) Alibekova
2023 John Viola
2023 Catherine Porter

Masters Dissertations/Theses Supervised
2021 Aria Huang
2021 Peter Bertone

Undergraduate Projects Supervised
2022 Priya Shah
2021 Marysol Carty Chu
2021 Michael Foster

Service
2022 Session Chair: Gordon Conference on Signal Transduction by Engineered Extracellular Matrices.
2022 Session Chair: Keystone conference, Engineering Multi-Cellular Living Systems.
2021 Penn Engineering Strategic Initiatives discussion leader – Engineering Regeneration and Repair.
2021 Member, NIH MIRA grant review panel

2021 Editorial Board Member, Computational Physiology and Medicine (specialty section of Frontiers in Physiology and Frontiers in Bioeng. and Biotech.)
2020 Member, NSF CMMI grant review panel
2020 Co-Organizer: Penn IRM Symposium on Engineered Cell & Tissue Organization.
2019 Session Co-Chair: BMES, Biomaterials Scaffolds II.
2018 Member: Vice Provost for Education Fellowship Selection Committee.
2018- Qualifying Exam and Thesis Committee Member: Sunghee Estelle Park, Ryan Boe, Ian Dardani, Dylan Schaff, Sam Reffsin, Margaret Prendergast, Victoria Muir, Thomas Mumford, Hanfei Shen, Raul Reyes-Hueros, Brandon Hayes, Rodrigo Gier.
2018 Penn Engineering Planning Retreat.
2017- Member: Penn BE Admissions Committee.
2010- Reviewer: Nature, PNAS, Nature Communications, Lab Chip, Analytical Chemistry, Translational Research, Advanced Science.

Patents Published/Issued

5. Gartner, Z.J., Hughes, A.J. (2016) Folding Biological Tissue via Programmed Cellular Contractility. U.S. Patent 10,920,190. Issued 2/16/2021.

4. Hughes, A.J., Herr, A.E. et al. (2013) Electrophoretic Separation Devices and Methods for Using the Same. U.S. Patent 10,267,795. Issued 4/23/2019.

3. Herr, A.E., Tentori, A.M., Hughes, A.J. (2012) Microfluidic Methods of Assaying Molecule Switching and Devices for Practicing the Same. U.S. Patent 10,393,701. Issued 8/27/2019.

2. Hughes, A.J., Herr, A.E. (2012) Microfluidic Devices and Methods for Separating and Detecting Constituents in a Fluid Sample. U.S. Patent 9,523,684. Issued 12/20/2016.

1. Herr, A.E., Chen, X., Hughes, A.J. (2009) Pore-Limit Electrophoresis (PLE) Microchannel Assays. World Intellectual Property Organization WO 2011/142781. Published 11/17/2011.

Patent Applications at Penn

1. Viola, J.M., Liu, J., Prahl, L.S., Huang, A., Porter, C.M. (2022) Manipulating Nephron Differentiation Rate in Induced Human Pluripotent Stem Cell Organoids and Tissues by Engineering Mechanics of the Microenvironment. Provisional application, 22-10094 - 103241.006845.

Consulting Activities

2013 Bio-Rad Laboratories

Startup Ventures/Company Ownership

2018- Co-founder, Quanti.us, San Francisco, CA

Media Publicity

2018 Quanta Magazine: “Tissue Engineers Hack Life’s Code for 3D Folded Shapes”
2017 TechCrunch: “It’s Surprisingly Easy to Program Living Tissue to Form New 3D Shapes”
2015 MIT Technology Review: “Sticky DNA Could be the Key to Making Organs in a Lab”