Joseph E. Weaver

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Education and Employment

2025-Present	Senior Research Associate, Environmental Biotechnology Innovation Centre Newcastle University, UK PI: Prof. Thomas P. Curtis
2021-2025	NSF Postdoctoral Fellow in Biology Newcastle University, UK Host: Prof. Thomas P. Curtis
2021	Doctor of Philosophy in Civil Engineering Minor in Biotechnology North Carolina State University Advisors: Prof. Francis L. de los Reyes III, Prof. Joel J. Ducoste
2013	Master of Science, Environmental Engineering North Carolina State University Advisor: Prof. Morton A. Barlaz
2002-2011	Software Engineer Sonalysts Incorporated
2002	Bachelor of Science, Electrical Engineering Cornell University

Fellowships and Awards

2021	Postdoctoral Research Fellowship in Biology, National Science Foundation. NSF Award 2007151.
2020	W. Wesley Eckenfelder Graduate Research Award for 2020 from the American Academy of Environmental Engineers.
2017	Fellow, Microbial Biotechnology Training Program, Graduate Assistance in Areas of National Need. US Department of Education GAANN Award P200A140020

Travel Grants

2023	Federation of European Microbiological Societies, travel to FEMS 2023
2022	International Society for Microbial Ecology, travel award to ISME18.
2019	NCSU College of Engineering Travel Award. Covering travel to the IWA MEWE 2019 Conference, Hiroshima.
2019	NCSU Graduate Student Association Travel Award. Covering travel to the IWA MEWE 2019 Conference, Hiroshima.

Poster Awards

2021 Runner-up, *Modeling environmental bioreactors treating wastewater by integrating biological processes, floc microenvironments, and computational fluid dynamics.* EB Network Early Career Researcher Conference.

2017 3rd place poster, *What's Driving Microbial Community Assembly in Full-Scale Wastewater Treatment?* NC-AWWA-WEA Annual Conference, Raleigh, NC

2014 1st place poster, *Effect of Variable Shear on the Formation of Aerobic Granules in an Eccentric Couette Micro-reactor*. CCEE WREE Annual Symposium, Raleigh, NC

2012 2nd place poster, *Anaerobic biodegradability of plastics in laboratory-scale landfill reactors*. Global Waste Management Symposium, Phoenix, AZ

Publications

1. Zhu C., Wu L., Ning D., Tian R., Gao S., Zhang B., Zhao J., Zhang Y., Xiao N., Wang Y., Brown M.R., Tu Q., Acevedo D., Agullo-Barcelo M., de Araujo J.C., de Abreu Mac Conell É.F., Boehnke K., Bond P., Bott C.B., Bovio-Winkler P., Brewster R.K., Bux F., Cabezas A., Cabrol L., Chen S., Etchebehere C., Ford A., Gómez J.S., Griffin J.S., Gu A.Z., Habagil M., Hale L., Harmon M., Horn H., Hu Z., Johnson D.R., Marcantini D.G., Keucken A., Kumari S., Leal C.D., Lee Z.M.P., Li Y., Li Z., Li M., Liu Y., Mendonça-Hagler L.C., de Menezes F.G.R., Meyers A.J., Palmer A., Parameswaran P., Reginatto V., de los Reyes F.L., Rossetti S., Sidhu J., Smith K., de Sousa O.V., Stephens K., Sun C., Tooker N.B., Van Nostrand J.D., Wakelin S., Wang B., **Weaver J.E.***, West S., Woo S-G., Wu J-H., Wu L., Xi C., Yan T., Yang M., Young M., Zhang C., Zhang Q., Zhang W., Zheng W., Zhou H., Zhuang W., Ju F., Wells G.F., Guo J., He Z., Nielsen P.H., Wang A., Zhang Y., Chen T., He Q., Criddle C.S., Wagner M., Tiedje J.M., Curtis T.P., Wen X., Yang Y., Alvarez-Cohen L., Stahl D.A., Alvarez P.J.J., Rittmann B.E. & Zhou J. (2025) Global diversity and distribution of antibiotic resistance genes in human wastewater treatment systems. **Nature Communications** 16, 4006 (2025). https://doi.org/10.1038/s41467-025-59019- 3
*Involvement as part of the Global Water Microbiome Consortium

2. Smith, S., **Weaver, J.E.,** Ducoste, J.J., de los Reyes III, F.L. (2024) Microbial community assembly in engineered bioreactors. **Water Research** 255:121495 doi:10.1016/j.watres.2024.121495

3. Haq, A., Malik, A., Khan, A., **Weaver, J.E.,** Wang,L., Khan, H., Khan, S., Shah, A.A., Ahmed, S., Asif, J., de los Reyes III, F.L., Badshah, M. (2023) Effect of removal of inhibitors on microbial communities and biogas yield of *Jatropha curcas* during continuous anaerobic digestion. **Journal of Cleaner Production** 426:139154 doi:10.1016/j.jclepro.2023.139154

4. **Weaver, J.E.** (2023) Quantifying drift-selection balance using an agent-based biofilm model of identical heterotrophs under low nutrient conditions. **Royal Society Interface Focus**. 13: 20230010. doi:10.1098/rsfs.2023.0010

5. **Weaver, J.E.** (2021) From Floc to Reactor Scales: A Multi-Faceted Investigation Integrating Microbial Ecological Experiments and Computational Modeling to Understand Aerobic Wastewater Systems. Under the direction of de los Reyes III, F.L., Ducoste, J.J., Call, D.E., and Goller, C.G. **PhD Dissertation**, North Carolina State University, Raleigh, NC.

6. Wu, L., Ning, D., Zhang, B., Li, Y., Zhang, P., Shan, X., Zhang, Q., Brown, M.R., Li, Z., Van Nostrand, J.D., Ling, F., Xiao, N., Zhang, Y., Vierheilig, J., Wells, G.F., Yang, Y., Deng, Y., Tu, Q., Wang, A., Acevedo, D., Agullo-Barcelo, M., Andersen, G.L., de Araujo, J.C., Boehnke, K.F., Bond, P., Bott, C.B., Bovio, P., Brewster, R.K., Bux, F., Cabezas, A., Cabrol, L., Chen, S., Etchebehere, C., Ford, A., Frigon, D., Gómez, J.S., Griffin, J.S., Gu, A.Z., Habagil, M., Hale, L., Hardeman, S.D., Harmon, M., Horn, H., Hu, Z., Jauffur, S., Johnson, D.R., Keucken, A., Kumari, S., Leal, C.D., Lebrun, L.A., Lee, J., Lee, M., Lee, Z.M.P., Li, M., Li, X., Liu, Y., Luthy, R.G., Mendonça-Hagler, L.C., de Menezes, F.G.R., Meyers, A.J., Mohebbi, A., Noyola, A., Oehmen, A., Palmer, A., Parameswaran, P., Park, J., Patsch, D., Reginatto, V., de los Reyes, F.L., Rossetti, S., Sidhu, J., Sloan, W.T., Smith, K., de Sousa, O.V., Stephens, K., Tian, R., Tooker, N.B., De los Cobos Vasconcelos, D., Wakelin, S., Wang, B., **Weaver, J.E.*,** West, S., Wilmes, P., Woo, S-G., Wu, J-H., Wu, L., Xi, C., Xu, M., Yan, T., Yang, M., Young, M., Yue, H., Zhang, Q., Zhang, W., Zhang, Y., Zhou, H., Zhang, T., He, Z., Keller, J., Nielsen, P.H., Alvarez, P.J.J., Criddle, C.S., Wagner, M., Tiedje, J.M., He, Q., Curtis, T.P., Stahl, D.A., Alvarez-Cohen, L., Rittmann, B.E., Wen, X. and Zhou, J. (2019) Global diversity and biogeography of bacterial communities in wastewater treatment plants. **Nature Microbiology** 4, 1183–1195 doi:10.1038/s41564-019-0426-5 *Involvement as part of the Global Water Microbiome Consortium

7. **Weaver, J.E.,** Wang, L., de los Reyes III, F.L., and Barlaz, M.A (2019) Systems and Methods for Studying Microbial Processes and Communities in Landfills. in **Understanding Terrestrial Microbial Communities** Hurst, CJ ed. Springer ISBN:978-3-030-10777-2

8. **Weaver, J.E.,** Williams, J.C., Ducoste, J.J., and de los Reyes III, F.L. (2019) Measuring the Shape and Size of Activated Sludge Particles Immobilized in Agar with an Open Source Software Pipeline. **Journal of Visualized Experiments** v143, e58963. doi:10.3791/58963

9. **Weaver, J.E.,** Hong, H., Ducoste, J.J., and de los Reyes III, F.L. (2018) Controlling aerobic biological floc size using Couette-Taylor bioreactors. **Water Research** v147, pp 177-183. doi:10.1016/j.watres.2018.09.060

10. **Weaver, J.E.,** Ducoste, J.J., and de los Reyes III, F.L. (2016) Fluid shear variation potentially plays a role in aerobic granular sludge formation. **Proceedings of the Water Environment Federation**, WEFTEC 2016, v2016 i11 pp 5737-5744. doi:10.2175/193864716819706734

11. de los Reyes III, F.L., **Weaver, J.E.** and Wang, L. (2015) A methodological framework for linking bioreactor function to microbial communities and environmental conditions. **Current Opinion in Biotechnology** v33, pp 112-118. doi:10.1016/j.copbio.2015.02.002

12. **Weaver, J.E.,** (2013) Effect of Inoculum Source on the Rate and Extent of Anaerobic Biodegradation Under the direction of Barlaz, M.A., and de los Reyes III, F.L. **MS Thesis**, North Carolina State University, Raleigh, NC.

In Submission

1. Tiwarary, A., **Weaver, J.E.**, Heidrich, O., Artificial Intelligence (AI) and machine learning advanced industrial metabolism: A new paradigm in engineering sustainability, **Environmental Technology & Innovation**

In Prep

1. *Weaver, J.E.,* de los Reyes III, F.L., and Ducoste, J.J. A combined CFD-Biokinetic Model of Aerobic Wastewater Treatment Using an Open Source Pipeline

2. *Weaver, J.E.,* Ducoste, J.J., and de los Reyes III Microbial Community Assembly of Two Full Scale Wastewater Treatment Plants with Initially Identical Populations

3. *Weaver, J.E*., Zuliani, P., Chen, J., McGough S., Li, B., Allen, B., Ofiţeru, I.D., Wipat, A., Davenport, R., Swailes, D., Curtis, T.P. Accelerating Environmental Bioreactor Design: Why your car and phone are getting better faster than your sewage works and anaerobic digester. **Environmental Science and Technology** (viewpoint)

Presentations, Invited Seminars, Workshops, and Conferences

Presented

1. Weaver, J.E. (2025) “Making it relevant, engaging, and accessible: My experience adapting massive biofilm simulations into key stage 3-4 activities aligned to the national curriculum.” Interactive Demonstration at the **Microbiology Society 2025 Annual Conference.** Liverpool, UK.

2. Weaver, J.E. (2024) “Diversity and ecological role of the Type VI Secretion System in anammox biofilms.” **2024 Microbiology Olympiad Symposium**, Newcastle, UK

3. Weaver, J.E. (2023) “Understanding the balance between drift and selection in biofilm formation using agent-based biofilm modelling.” **Association of Environmental Engineering Scientists and Professors (AEESP) Conference 2023**. Boston, US.

4. Weaver, J.E. (2023) “Illuminating the balance between drift and kinetics in biofilm formation using an agent-based model to manipulate luck.” **Federation of European Microbiological Societies (FEMS) Conference 2023**. Hamburg, Germany

5. Weaver, J.E. (2022) “Fit or just luck? Using agent-based biofilm models to quantify the selection advantage required to overcome negative selection via random drift.” **1St Annual Microbiology Olympiad Symposium**, Newcastle, UK

6. Weaver, J.E. (2021) “Drift Matters, Until it Doesn’t: Quantifying the Fitness Advantage Necessary to Overcome Negative Drift Selection using an Agent-Based Model of Spatially Competing Heterotrophic Bacteria”, **9th IWA Microbial Ecology and Water Engineering Specialist Conference (MEWE2021),** Delft, Netherlands. (presented virtually)

7. Weaver, J.E., de los Reyes III, F.L. and *Ducoste J.J.* (2021) “Implementing a Single Modeling Approach that Combines Computational Fluid Dynamics (CFD), Biokinetics, Micro-floc Scale Diffusion, and Particle Sizes.” **WEFTEC,** Chicago IL. n.b. Ducoste presented on Weaver’s behalf due to conference schedule conflicts

8. *Weaver, J.E.,* and de los Reyes III, F.L. (2019). “Microbial Community Assembly in Two Full Scale Aerobic Basins Containing Identical Starting Populations: Drivers and Implications”, **8th IWA Microbial Ecology and Water Engineering Specialist Conference (MEWE2019)**, Hiroshima, Japan.

9. *Weaver, J.E.,* de los Reyes III, F.L. and Ducoste, J.J. (2016) “Inducing aerobic granular sludge formation through unevenly distributed hydrodynamic shear rates.” **NC AWWA-WEA**, Raleigh, NC.

10. *Weaver, J.E.,* de los Reyes III, F.L. and Ducoste, J.J. (2016) “Fluid shear variation potentially plays a role in aerobic granular sludge formation.” **WEFTEC**, New Orleans, LA.

11. *Weaver, J.E.,* and Barlaz, M.A. (2015) “Effect of Inoculum source on the rate and extent of anaerobic biodegradation.” **A&WMA National Conference**, Raleigh, NC.

Workshops Organized

1. "Hooked on Science: Engaging Secondary School Students with Lessons Based on Your Research" (2025) To be held during the **11th Microbial Ecology and Water Engineering (MEWE) Conference: Managing Water Microbiomes**, Atlanta, USA.

2. "The Importance of the Microenvironment in Environmental Biotechnology Applications: Paths to Progress" (2025). **Invited to coordinate by the Environmental Biotechnology Network (EBNet).** Held in Newcastle, UK. Report in progress.

Invited Seminars, Conferences, and Workshops

1. "Advancing Gas Fermentation Technologies: A multi-disciplinary challenge" (2024) Report of the joint EBNet / Carbon Recycling Network workshop on microbial systems with gaseous feedstocks. Result of Workshop held in March 2024, Cheshire, UK.

2. *Weaver, J.E.* (2022) "Inferring Drift Prevalence Using Agent-Based Biofilm Models and Its Implications in Environmental Biotechnology" **Les Ecologistes Seminar Series, Simon Fraser University**, Burnaby, CA (presented remotely)

3. *Weaver, J.E.* (2021) "From Floc to Reactor Scales: A Multi-Faceted Investigation Integrating Microbial Ecological Experiments and Computational Modeling to Understand Aerobic Wastewater Systems." **Environmental Engineering Research Group Seminar Series, Newcastle University**, Newcastle UK

4. *Microbial ecology for engineering biology (2022),* the Theo Murphy international scientific meeting of **The Royal Society,** Buckinghamshire UK.

As co-author

1. *Mcgough S.A.,* Fuentes-Cabrera M., Sakkos J., Taniguchi D., Maheshwari K., Zuliani P., Weaver J., Ducat D., Li B., Birnsheed A., Somnath S., and Curtis,T.P. "A Deep Learning HPC Agent-Based Modeling Framework: Applications to Microbiology" (2021) **eScience2021** (online)

Selected Posters

Presented, selective list from recent years.

1. Weaver, J.E. (2024) "Loading the Dice: Controlling 'bad luck' within an agent-based biofilm model to quantify the balance between stochastic and deterministic factors during biofilm formation under varied spatial competition." **Microbial Ecology and Evolution Hub-based Conference** (**MEEHubs).** Oxford, UK.

2. Weaver, J.E. (2023) “Illuminating the balance between drift and kinetics in biofilm formation using an agent-based model to manipulate luck.” **Federation of European Microbiological Societies (FEMS) Conference 2023**. Hamburg, Germany

3. Weaver. J.E. (2022) “Overcoming Fate: Using Agent Based Models of Bacteria to Quantify the Fitness Advantage Required to Counteract Negative Drift Selection.” **Royal Society Theo Murphy Meeting 2023.** Abingdon, UK

4. Weaver, J.E. (2022) “Beating the odds: Using agent based models to quantify the selective advantage required to mitigate disadvantageous drift under increasing competitive pressure during biofilm formation.” **International Society for Microbial Ecology (ISME) 18.** Lausanne, CH

5. Weaver, J.E., de los Reyes III, F.L. and Ducoste, J.J. (2021) “Modeling environmental bioreactors treating wastewater by integrating biological processes, floc microenvironments, and computational fluid dynamics.” **Environmental Biotechnology Network (EBNet) ECR Conference 2021.** Virtual/Remote.

6. Weaver, J.E., and de los Reyes III, F.L. (2019) “What’s Driving Microbial Community Assembly in Full-Scale Activated Sludge Systems: Implications for System Design and Operation” **Association of Environmental Engineering and Science and Professors (AEESP) 2019.** Phoenix, AZ, USA.

Non-traditional outputs and selected software

Lesson Plans and virtual labs for secondary school

1. “Outcompeting other bacteria: Live fast or stab hard?” A web-based activity aligned to the UK national curriculum encouraging students to understand ecological tradeoffs between adaptations, formulate and test hypotheses via virtual simulations, and interpret interactive figures. https://raw.githack.com/joeweaver/t6ss-outreach/main/welcome.html

Selected Software

1. “NUFEB Designer” A graphical user interface for designing scenarios for NUFEB agent-based models without requiring programming and using biological abstractions of the underlying simulation language https://github.com/joeweaver/nufeb-designer

2. “nufebmgr” A python package which allows programmatic control over generating NUFEB agent-based models and which works at the level of ‘biology’ rather than the underlying simulation language https://github.com/joeweaver/nufebmgr

3. “check-dgsa” A small utility for checking batch downloaded genomes from the NCBI datasets tool. I discovered and reported a bug regarding silent truncations of FASTA files. This tool checks downloaded archives to see if they were affected by the bug.
https://github.com/joeweaver/check-dsga

4. “NUFEB (as a contributor)” NUFEB is an agent-based model of biofilms and was already extant. I am now a contributing developer and am mainly associated with the module enabling simulation the Type VI Secretion System.
https://github.com/nufeb/NUFEB-2

Teaching and Mentoring

Formal Mentoring Positions

2023-present	PhD Co-Supervisor to Maggie White, ‘Harnessing Microbially-mediated Redox Processes for Sustainable Water Treatment’, viva passed
2023 – present	PhD Co-Supervisor to Xiaoqi Yu, working title ‘Spatio-temporal Antimicrobial Resistance (AMR) Patterns in Catchments and AMR Attenuation within Green Infrastructure’
2023	MSc Supervisor to Hongze Li, working title ‘Screening competition between bacteria relevant to environmental biotechnology’
2022	MSc Supervisor to Xiaoqi Yu, ‘Creation of a Pairwise Interaction Database of Antibacterial Type VI Secretion Systems’
2016 – 2018 (Summers)	Research Internship Summer Experience (RISE) Program. Responsible for training and mentoring undergraduate researchers while they performed their own summer research culminating in poster presentation.
2017	Formed and coordinated graduate cohort written prelim study group.
2013	Graduate student mentor to Ally Patrick, *Thermal Acclimation of Mesophilic Inocula for Thermophilic Biochemical Methane Potential Tests.* NCSU Spring Undergraduate Research Symposium.

Curriculum Development & Courses Taught

2023-Present	Core Skills in Environmental Engineering	*(CEG 8114)*

Guest Lectures and Labs

2023-Present	Solving wastewater design problems via Python	*(CEG 8104)*
Spring 2023	Efficiently conducting a literature review	*(CEG 8110)*
Spring 2023	Introduction to coding in Python	*(CEG 8110)*

Spring 2015 thru Fall 2018	Metagenomics: Ordination and data visualization	*(BIT 495/477/577)*
Falls 2014 -2017	Environmental chemistry and microbiology: Identifying problem organisms in wastewater via microscopy.	*(CE 378)*

Pedagogical Training

2019	Completed the NCSU Teaching and Communication Certificate.

Teaching Assistant

Spr. 2021	Environmental Biotechnology	*(CE 774)*
Spr. 2019	Senior Design Project	*(CE 481)*
Spr. 2019	Environmental Biotechnology	*(CE 774)*
Fall 2019	Water Supply and Wastewater Systems	*(CE 484)*
Spr. 2018	Global WASH	*(CE 497/596)*
Fall 2017	Water Supply and Wastewater Systems	*(CE 484)*
Fall 2014	Biological Principles of Environmental Engineering	*(CE 573)*

Internal Workshops Organized

2022	*Peer and Expert MSc Oral Defense Feedback Session*, Newcastle University Environmental Engineering MSc Program
2022	*Performing an Effective Literature Search,* Newcastle University Environmental Engineering MSc Professional Development, special workshop
2022	*Constructing an Individual Development Plan* Newcastle Environmental Engineering Early Career Researcher Development
2014	*Laziness, Levers, and Literature. How to search and manage the literature.* NCSU CCEE Department Seminar.

Community and Service

Peer Review

2013 - 2023	Articles reviewed for: *Water Science & Technology*, *Waste Management*, *Journal of Environmental Engineering, and others*

Service

2024-Present	Co-Chair of Early Career Researchers in Environmental Engineering Working Group
2023	Postgrad member of invited seminar committee

2019-2020	Lab group representative, Environmental Engineering Lab Condition and Safety Committee
2019	Invited panel member, “Tell It Like It Is”: Teaching Assistant Discussion Panel for the NCSU campus-wide New TA workshop
2015	Chair, program committee. NCSU CCEE WREE Graduate Research Symposium.

Outreach

2023-Present	Developed Year 8 lesson plan based on my research and aligned to Key Stage 3 national curriculum, working title ‘Outcompeting other bacteria: Live fast or stab hard?’
2017–2018	Girl Scouts of America Engineering Day.
2013–2016	Boy Scouts of America Engineering Merit Badge Day.

Grant Writing

As Primary Investigator or Fellow

2019 Weaver, Joseph E*. Individual Based Modelling of Chemically Mediated Microbial Interactions in Biofilms.* NSF-Postdoctoral Research Fellowship in Biology **(Awarded NSF 2007151, $276,000)**

2014 Weaver, Joseph E. “Microbial Biotechnology Training Program, Graduate Assistance in Areas of National Need.” US Department of Education **(Awarded DoE GANN P200A140020, $98,000)**

In Submission

2024 Weaver, Joseph E. “Developing Paper-based Cell Free Biosensors for Wastewater Monitoring and Fostering Collaboration Between Higher and Secondary Education.” Current EPSRC Open Plus **(In Review, fEC budget £859,000)**

As mentor for undergraduate research

2013 Weaver, Joseph E., Patrick, Ally *Thermal Acclimation of Mesosphilic Inocula for Thermophilic Biochemical Methane Potential Tests*. **(Awarded $750)**

As contributing writer

2022 Zuliani, P., Li, B., and Curtis, T.P. *NUFEB: Microbial Communities Simulation for the (Biologists) Masses* EPSRC

2021 Zuliani, P, Li. B., Allen, B., and Curtis, T.P. *BIOHPC: Simulating Microbial Communities on High-Performance Computers* EPSRC IAA **(Awarded £50,000)**

2021 Curtis, T.P., Allen, B., and Zuliani, P.*Accelerating Innovation By Designing Water Treatment Biofilm Media in silico.* NBIC PoC **(Awarded £50,000)**

2017 de los Reyes III, Francis L. and Ducoste, Joel J. *Using Microbial Ecology Theory to Understand Microbial Community Dynamics and Improve Function of Anaerobic Bioreactors.* NSF. **(Awarded $327,000)**

2017 de los Reyes III, Francis L. *Understanding substrate-community interactions to develop resilient anaerobic digestion of food waste* EREF. **(Awarded $155,000)**

2016 de los Reyes III, Francis L. and Ducoste, Joel J. *Microbial ecology theory as a framework for understanding and improving anaerobic co-digestion.* NSF.

Professional Development

Certificates

2022 EBNET Metabolic Modelling (competitive application process)

2019 NCSU Teaching and Communication Certificate

Fellowship: Microbial Biotechnology Training Program, US Department of Education Graduate Assistance in Areas of National Need

2016 Capstone Semester Seminar

2016 Professional Development Semester Seminar

2015 Research Ethics Seminar

Pedagogy

2017 Introduction to Teaching

2017 Responding to Student Writing

2017 Teaching Portfolio

2017 Avoiding Death by PowerPoint

2017 How to Engage with Diverse Learning Styles

2017 Managing Conflict in the Classroom

2017 Teaching Assistant Orientation Symposium

2017 Moodle Essentials

2015 AEESP Case Studies in Project Based Learning

Grant Writing

2019 Semester mini-course on grant identification, drafting, and submission

2018 Broadening the Impacts of Your Research