

ALAN R. PACHECO, PH.D.

Institute of Microbiology, ETH Zurich
Vladimir-Prelog-Weg 1-5/10
8093 Zurich, Switzerland

Office: HCI F433
E-mail: apacheco@ethz.ch
Web: alanrpacheco.com

ACADEMIC APPOINTMENT

ETH Zurich Institute of Microbiology	Zurich, Switzerland
Branco Weiss Fellow	2024-
James S. McDonnell Postdoctoral Fellow	2021-2024
Advisor: Prof. Dr. Julia Vorholt	

EDUCATION

Boston University Graduate Program in Bioinformatics	Boston, MA, USA
Ph.D. in Bioinformatics	2021
Advisor: Prof. Daniel Segrè; Dissertation: "Environmental modulation of microbial ecosystems"	
<i>Visiting researcher at Harvard Medical School and Wyss Institute at Harvard University</i>	
<i>Groups of Pamela Silver and Donald E. Ingber (2016-2017)</i>	
Boston University College of Engineering	Boston, MA, USA
Bachelor of Science in Biomedical Engineering, <i>cum laude</i>	2015

ADDITIONAL TRAINING

Boston University
Biological Design Center Student Program for Industry Networking (2020-2021)
Massachusetts Institute of Technology
NSF Innovation Corps Spark (2020)
Santa Fe Institute
Complex Systems Summer School (2018)
Technische Universität Dresden
Study Abroad (2013)

AWARDS AND FUNDING

Fellowships and grants
Branco Weiss Fellowship (2024-)
CHF 600,000; 7 awarded
James S. McDonnell Foundation Postdoctoral Fellowship in Understanding Dynamic & Multi-scale Systems (2021-2024)
\$200,000; 10 awarded
Howard Hughes Medical Institute Gilliam Fellowship for Advanced Study (2017-2021)
\$138,000; 39 awarded
US National Academies of Sciences, Engineering, and Medicine Ford Predoctoral Fellowship (2017-2021)
\$72,000; 67 awarded
Boston University Lazzaro Memorial Scholarship, Presidential Scholarship, National Hispanic Scholar (2011-2015)
Merit-based, covered ¾ tuition
Travel and academic awards
Santa Fe Institute Micro Working Group Grant (2022, 2024; \$19,000)
Student Service Award, Boston University Graduate Program in Bioinformatics (2018)
iGEM Foundation Delegate to United Nations Convention on Biological Diversity (2016)

PUBLICATIONS

H. Todorov, B. Bentvelsen, S. Ugolini, A.R. Pacheco, A. Convers, T.M. Trabajo, J.R. van der Meer, Dimalis: A complete standalone pipeline to analyse prokaryotic cell growth from time-lapse imaging. *bioRxiv*. (2024).
S.D. Burz *et al.*, From microbiome composition to functional engineering, one step at a time. *Microbiology and Molecular Biology Reviews*. **87**, 4 (2023).
M. Schäfer*, A.R. Pacheco*, R. Künzler, M. Bortfeld-Miller, C.M. Field, E. Vayena, V. Hatzimanikatis, J.A. Vorholt, Metabolic interaction models recapitulate leaf microbiota ecology. *Science*. **380**, eadf5121 (2023). *Contributed equally
A.R. Pacheco, J.A. Vorholt, Resolving metabolic interaction mechanisms in plant microbiomes. *Current Opinion in Microbiology*. **74**, 102317 (2023).
A.R. Pacheco*, C. Pauvert*, D. Kishore, D. Segrè, Toward FAIR representations of microbial interactions. *mSystems*. **7**, e00659-22 (2022). *Contributed equally
N. Ankrah, D.B. Bernstein, M. Biggs, M. Carey, M. Engevik, B. García-Jiménez, M. Lakshmanan, A.R. Pacheco, S. Sulheim, G. Medlock, Enhancing microbiome research through trustworthy genome-scale metabolic modeling. *mSystems*. **6**, e00599-21 (2021).
I. Dukovski, D. Bajić, J.M. Chacón, M. Quintin, J.C.C. Vila, S. Sulheim, A.R. Pacheco, D.B. Bernstein, W.J. Riehl, K.S. Korolev, A. Sanchez, W.R. Harcombe, D. Segrè, A metabolic modeling platform for the computation of microbial ecosystems in time and space (COMETS). *Nature Protocols*. **16**, 5020-5082 (2021).
A.R. Pacheco, D. Segrè, An evolutionary algorithm for microbial community design via environmental modification. *Journal of the Royal Society Interface*. **18**, 20210348 (2021).

- A.R. Pacheco, M.L. Osborne, D. Segrè, Non-additive microbial community responses to environmental complexity. *Nature Communications*. **12**, 2365 (2021).
- D.C. Moyer, A.R. Pacheco, D.B. Bernstein, D. Segrè, Stoichiometric modeling of artificial string chemistries reveals constraints on metabolic network structure. *Journal of Molecular Evolution*. **89**, 472–483 (2021).
- A.R. Pacheco, D. Segrè, A multidimensional perspective on microbial interactions. *FEMS Microbiology Letters*. **366**, 1–11 (2019).
- A.R. Pacheco, M. Moel, D. Segrè, Costless metabolic secretions as drivers of interspecies interactions in microbial ecosystems. *Nature Communications*. **10**, 103 (2019).
- B.M. Maoz, A. Herland, E.A. FitzGerald, T. Grevesse, C. Vidoulez, A.R. Pacheco, S.P. Sheehy, T.E. Park, S. Dauth, R. Mannix, N. Budnik, K. Shores, A. Cho, J.C. Nawroth, D. Segrè, B. Budnik, D.E. Ingber, K.K. Parker, Endothelial-neuronal cell metabolic coupling across the blood-brain barrier revealed using linked human organs-on-chips. *Nature Biotechnology*. **36**, 865–874 (2018).
- J. Beal, T. Haddock-Angelli, M. Gershater, K. de Mora, M. Lizarazo, J. Hollenhorst, R. Rettberg, iGEM Interlab Study Contributors (incl. A.R. Pacheco). Reproducibility of fluorescent expression from engineered biological constructs in *E. coli*. *PLOS ONE*. **11**, e0150182 (2016).
- T. Haddock, D. Densmore, E. Appleton, S. Carr, S. Iverson, A.R. Pacheco, *et al.*, The modular cloning assembly: standardized assembly of bacterial transcriptional units using type IIS restriction enzymes *BsaI* and *BpiI*. *BioBricks Foundation RFC*. **94** (2015).

PRESENTATIONS

Invited talks

- “The taming of the μ : model-guided approaches for mapping and designing microbial ecosystems.” Center for the Origin and Prevalence of Life Seminar, Zurich, Switzerland, May 2024.
- “Predicting leaf microbiome structure *in situ* through metabolic modeling of resource competition.” John Innes Centre Young Microbiologists Symposium, Norwich, UK, Sep. 2023.
- “Mapping interaction networks of plant leaf microbiomes.” Boston University Graduate Program in Bioinformatics Student-Organized Symposium, Boston, MA, USA, Jun. 2023.
- “Metabolic interaction modeling for plant microbiomes.” MIT Physics of Living Systems Seminar, Cambridge, MA, USA, Jun. 2023.
- “Metadata standards for microbiome data.” NCCR Network Ventures Open Research Meeting, Lausanne, Switzerland, May 2023.
- “Applying the FAIR principles to microbial ecology.” NCCR Open Science Meeting, Charmey en Gruyère, Switzerland, Nov. 2022.
- “Synthetic biology in global policymaking.” iGEM Grand Jamboree, Paris, France, Oct. 2022.
- “Predicting microbiome structure *in situ* through modeling of resource competition.” ISME18, Lausanne, Switzerland, Aug. 2022.
- “Metabolic networks of the *Arabidopsis* phyllosphere microbiome.” ETHZ USYS Seminar, Zurich, Switzerland, May 2022.
- “Learning from complex interactions in the microbial world.” UC Davis Complexity Group, Davis, CA, USA, Mar. 2021.
- “Environmental modulation of microbial ecosystems.” ETHZ Geobiology Seminar, Zurich, Switzerland, Nov. 2020.

Selected contributed talks

- “Model-guided discovery and design of plant-associated microbial interaction networks.” Stochastic Models and Experiments in Ecology and Biology Conference, L’Aquila, Italy, May 2024.
- “An open database of microbial interactions.” Swiss National Centres of Competence in Research (NCCR) *Microbiomes* Annual Meeting, Kandersteg, Switzerland, Mar. 2024.
- “Metabolic mechanisms of bacterial interactions in leaf microbiomes.” ETH Zurich Microbiology Institute Symposium, Zurich, Switzerland, Jun. 2023.
- “Metabolic models for prediction of interaction outcomes in the *Arabidopsis* phyllosphere.” Phyllosphere 2022: 11th International Symposium on Leaf Surface Microbiology, Davis, CA, USA, Jun. 2022.
- “Metabolic interactions and community assembly in the *Arabidopsis* phyllosphere.” Swiss National Centres of Competence in Research (NCCR) *Microbiomes* Annual Retreat, Kandersteg, Switzerland, Oct. 2021.
- “Integrated approaches for microbial community design.” HHMI Gilliam Meeting, Chevy Chase, MD, USA, Sep. 2019.
- “Combining mechanistic modeling and machine learning for microbial community design.” Boston University Biological Design Center Annual Symposium, Boston, MA, USA, May 2019.
- “Trade and Ownership Networks.” Santa Fe Institute Complex Systems Summer School, Santa Fe, NM, USA, Jul. 2018.
- “Costless metabolic byproduct exchange contributes to microbial community diversity.” Intl. Workshop for Bioinformatics and Systems Biology, Humboldt Universität zu Berlin, Berlin, Germany, Jul. 2017.

Selected posters

- “Microbial interactions descriptions for humans and machines alike,” (with C. Pauvert). 10th FEMS Congress of European Microbiologists, Hamburg, Germany, Jul. 2023.
- “A microfluidic workflow for live tracking of bacterial interactions.” Swiss National Centres of Competence in Research (NCCR) *Microbiomes* Annual Meeting, Lausanne, Switzerland, Sept. 2022.
- “Mapping the metabolic exchange networks of the *Arabidopsis* phyllosphere microbiota.” Swiss National Centres of Competence in Research (NCCR) *Microbiomes* Annual Meeting, Lausanne, Switzerland, Jun. 2021.
- “Evolutionary algorithms for microbial community design.” Boston University Bioinformatics Student-organized Symposium, Boston, MA, USA, Jun. 2019.
- “Generation of microbial community phenotypes through reinforcement learning.” Harvard Quantitative Biology Symposium, Cambridge, MA, USA, May 2019.
- “Modeling spatiotemporal dynamics of an engineered gut bacterial consortium.” Boston University Microbiome Day, Boston University, Boston, MA, USA, Feb. 2017.
- Award for best poster presentation*
- “Modeling spatiotemporal dynamics of an engineered gut bacterial consortium.” Wyss Institute at Harvard University Retreat, Boston, MA, USA, Nov. 2016.
- “Predicting circadian gene expression in *Neurospora crassa*.” International Workshop for Bioinformatics and Systems Biology 2016, Tokyo University, Tokyo, Japan, Aug. 2016.

“Multicellular logic through conversion of genetic circuit outputs into electrical signals.” Synberc 2015 Fall Retreat, Massachusetts Institute of Technology, Cambridge, MA, USA, Sep. 2015.

“The Joy of Cloning: *Chimera*, a recipe for integrating computational tools with experimental protocols” International Genetically Engineered Machine Giant Jamboree, Boston, MA, USA, Nov. 2014.

Awarded gold medal at 2014 iGEM competition

TEACHING AND MENTORING EXPERIENCE

Lectures and courses

Lecturer, Microbiome Analysis (Master’s level course), University of Lausanne (Spring 2023, 2024, 2 x 3.5h)

Lecturer, Technologies in Molecular Microbiology (Master’s level course), ETH Zurich (Spring 2022-2024, 3 x 2h)

Lecturer, Microbiome Research Block Course (2023, 2h)

Lecturer, Graduate Program in Bioinformatics Student Seminar, Boston University (2018-2019, 4 x 1h)

Workshops

Organizer, NCCR *Microbiomes* Workshops on FAIR Microbiome Datasets (March/May/October 2023)

Instructor, NCCR *Microbiomes* Workshop on Community Modeling (January 2022)

Doctoral students

Paul Kramer y Rosado: “Engineering microbial interactions for the *Arabidopsis* phyllosphere” (2023-)

Recipient of “la Caixa” Foundation Doctoral INPhINIT Fellowship, 2023; Group of Julia Vorholt, ETH Zurich

Casimir Fisch: “Modelling resource dynamics in endolithic microbial communities” (2023-2024)

Group of Cara Magnabosco, ETH Zurich

Master’s students

Clément Lefebvre: “Ecological modeling of methylotrophy in the phyllosphere microbiota” (2024)

Andrea Zamuner: “A metabolic atlas of the phyllosphere microbiota” (2022-2024)

Simona Candea: “Predicting bacterial interaction outcomes *in planta*” (2023-2024)

Michael Berger: “A microfluidic device for probing intermicrobial interactions” (2022)

Miguel Ángel Salazar Jurado: “Metabolic succession in *Arabidopsis* phyllosphere communities” (2021-2022)

Charles Jo: “Obligate metabolic exchange in synthetic microbial communities” (2017-2018)

Devlin Moyer: “Stoichiometric modeling of string chemistries” (2019-2020)

Undergraduate students

Bella Kessel: “Generation and comparative analysis of metabolic interaction spaces for leaf-associated bacteria” (2024)

Mauricio Moel Miranda: “Costless metabolic secretions as drivers of microbial interactions” (2017-2019)

Lead Instructor for 2017 Boston University International Genetically Engineered Machine (iGEM) Team: “Using toehold switches to drive recombinase-based logic.” Students: Thomas Costa, Saimrunali Dadigala, Abigail Sasdelli, Madeline Simota, Stephen

Tucker, Shuyi Xu

Raised 10,000 USD via academic and industry partnerships, awarded silver medal at 2017 iGEM competition

Consulting Mentor for 2016 Boston University iGEM Team: “Gemini: combining digital and analog expression systems.” Students:

William Benman, Kamila Drezek, Jeffrey Marano, Marisa Mendes, Rachel Petherbridge

Awarded gold medal, nominated for Top Foundational Advance, Best Basic Part, Best Part Collection at 2016 iGEM competition

Graham Kulig: “High-throughput phenotyping of *E. coli* growth and extracellular pH” (2016)

Presented at Annual Biomedical Research Conference for Minoritized Scientists (ABRCMS) 2016

High School students

Andover High School BioBuilderClub Team (2016-2017)

SERVICE ACTIVITIES

Peer review

Ad hoc reviewer for: *BMC Bioinformatics*, *Cell*, *Computational and Structural Biotechnology Journal*, *eLife*, *ISME*, *ISME Communications*, *mSystems*, *Nature Ecology & Evolution*, US National Science Foundation

Committees

Co-chair of iGEM Foundation Diversity and Inclusion Committee (2022-2024, member since 2021)

Organizing committee chair for Boston University Underrepresented Graduate Student Symposium (2018-2019)

Raised 15,000 USD

Organizing committee member for Boston University Microbiome Initiative (2017-2018)

Organizing committee chair for Boston University Bioinformatics Student-Organized Symposium (2017-2018)

Volunteer activities

Ford Foundation one-on-one mentorship on graduate research fellowship applications (2021-)

Competition judge and volunteer for iGEM Giant Jamboree (2015-)

Exhibitor at ETH Zurich “Scientifica” (2021, 2023)

Speaker and student guide for Boston University Bioinformatics Program Open House (2016-2020)

Recruiter for Boston University Bioinformatics Program at SACNAS Diversity in STEM Conference (2016-2017)

Delegate to United Nations Convention on Biological Diversity for iGEM Foundation (2016)

Mentor for Boston Museum of Science Building with Biology Program (2015-2016)

President, Vice President, and Technical Lead for Engineers Without Borders, Boston University Chapter (2011-2015)

LANGUAGES

English (native), Spanish (native), French (working proficiency), German (working proficiency), Polish (beginner)