

Impact Report

Biodesign Swette Center for Environmental Biotechnology



January – December 2021

Strategic Investment - Annual Impact Report





By using the building blocks of Nature's grand designs, our talented researchers have pushed the frontiers of knowledge and advanced research and discovery to make a **major impact** on our community, nation, and world.

Despite the many difficulties posed by Covid-19, the members of BSCEB were productive and mutually supportive in 2021.

This Impact Report documents that many activities and achievements within BSCEB for 2021: e.g., features about our people and activities, awards received, degrees granted, papers published, grants awarded, and service rendered.

The report highlights key advances that are paving the way for greater discoveries in the future.

We are most grateful for the generous support and confidence that the Swette family has provided. Without that help, these achievements would not have occurred.

The Swette Strategic Investment Fund has advanced our ability to create new solutions to improve the sustainability of society

The Swette Strategic Investment Fund has supported the Biodesign Swette Center for Environmental Biotechnology (Swette Center) as its researchers develop preliminary results, publish seminal papers, give talks across the world to enthusiastic audiences, and have time to seek funding for new projects. We have been fortunate in our ability to attract outstanding researchers and integrate them effectively into our team and our work. Their talents and inspiration are ongoing sources of ideas making new discoveries.

The Swette funds have been the fuel that has enabled us to take giant leaps in our search for solutions that will help the world create a more sustainable environment. Here are a few examples of projects that have gained traction due to the Swette funds:

Swette investments over the past year were focused on two major areas. First, Swette investments allowed us to extend our work with membrane-film reactors to bioremediate waters contaminated with perfluorinated alkanolic substances (PFAS) and with metals from mining, ore-processing, and recycling. The former case is finding a practical means to detoxify the so-called “forever” contaminants. The latter allows us to detoxify wastewaters while also recovering highly valuable metals that are classified as “critical elements”. This is leading to major research support from the Department of Defense and private industry.

Second, Swette researchers advanced two technologies as part of the NSF-sponsored Center for Bio-inspired and Bio-mediated Geotechnics (CBBG). One is microbiology-based processes to improve soil properties to resist earthquakes. Two is electrokinetics to help bioremediate soils contaminated with chlorinated solvents.

Finally, Swette Center researchers are now leading in two other NSF-sponsored research centers: Science and Technology of Sustainable Phosphorus (STEPS) and Nano-Enabled Water Treatment (NEWT).

OUR MISSION

The mission of the Biodesign Swette Center for Environmental Biotechnology is to manage microbial communities that provide services to society. Many of the services make our society more environmentally sustainable, for example, generating renewable resources and making polluted water and soil clean.

The microbial services also make humans healthier – directly and indirectly.

The Swette Center is noted for its culture of cross-disciplinary and team-based research. This culture begins with our researchers who come from diverse disciplines within engineering, life sciences, chemistry, and more.

The Center embraces systems thinking, sustainable engineering, and disruptive innovation. Partnerships are common within the different research groups in the Swette Center, other groups in ASU, national and international universities, and practitioners.



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New People Chris Muse. Our intention when hiring a laboratory technician for the first 6 months was to train our researchers on use of IC, HPLC, UPLC, and GC instruments, as well as doing routine maintenance, writing standard operating procedures, and assisting with method development. Chris has deep knowledge of all of the instruments and has achieved wildly beyond all expectations, saving us thousands of dollars and hundreds of hours of research time with his quick and efficient repairs. He has also gone out of his way to build relationships with the students and the staff.



Progressing Research to Application.

For three years, a field project led by Assistant Research Scientist [Everett Eustance](#), in [Bruce Rittmann's Lab](#) in BSCEB, has focused on feeding biogas produced in wastewater treatment to microalgae to create clean, high-value products. This system was implemented for a six-week trial with the City of Mesa's North West Water Reclamation Plant.

(Pictured: Everett Eustance, Assistant Research Scientist). See the Biodesign News feature [Zero Waste Water here](#). Also, ABC15 Arizona interviewed Everett Eustance and [Justin Flory](#) about it. [Watch here!](#) KJZZ 91.5FM ran a story on 12/13/21 that you can read [HERE](#).

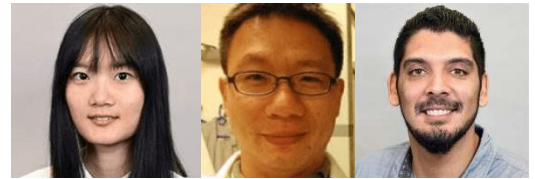


Shanghai Honors Bruce Rittmann. [Dr. Bruce Rittmann](#) of [BSCEB](#) was awarded the International Science and Technology Cooperation Award for his dedication to international biotechnology cooperation in China! [Read all about it.](#)



Remediating Chlorinated Solvents. Aide Robles, Theodora Yellowman, Sayalee Joshi, Srivatsan Mohana Rangan, and Anca Delgado of the Delgado Lab published a paper on bioremediating chlorinated solvents in *Environmental Science & Technology*. [Here's the article](#), as well as a [feature story by ASU Fulton Schools of Engineering by Joe Kullman](#).

IWA Virtual Biofilms Conference. Several BSCEB presenters were featured, including [Chenwei Zheng](#), [Bruce Rittmann](#), [Cesar Torres](#), and [Josh Boltz](#), along with BSCEB alumni [Aura Ontiveros-Valencia](#), [Prathap Parameswaran](#), and [Rashmi Chandra](#). Read about it [here](#)!



Swette Alumni Influencing in Big Ways! [Bradley Lusk](#), SWETTE alumni, CEO and cofounder (with SWETTE's [Bruce Rittmann](#)) of Precient Technologies, joined [U.S. Agency for International Development \(USAID\)](#) via a [Science and Technology Policy Fellowship](#), administered by the American Association for the Advancement of Science. Read about it [here](#)!



Water Environment Federation Camp Applied Research Award. Congratulations to Dr. Bruce Rittmann of BSCEB in his being awarded the Water Environment Federation Camp Applied Research Award! WEF awards the most innovative, proactive, capable professionals and organizations who contribute to the long-term sustainability of our most precious resource! Dr. Rittmann is pictured with another award winner, Dr. Krishna Pagilla of the University of Nevada, Reno.



ASU joins STEPS: Science and Technologies for Phosphorus Sustainability Center

The Swette Center for Environmental Biotechnology is joining a new multi-disciplined center, [STEPS](#), dedicated to investigating ways to [decrease phosphorus loss and mining](#). STEPs users also collaborate with the [NSF-funded Nanotechnology Collaborative Infrastructure Southwest](#) (NCI-SW) and [Central Arizona-Phoenix Long-Term Ecological Research](#) (CAP-LTER). Read all about it at [Full Circle](#)!



Sean Lai in C&EN. [Sean \(Yen-Jung\) Lai](#) was featured in a C&EN article [Quat disinfectants are helping during the pandemic. But could they contribute to antibiotic resistance?](#)



Van Paassen Making Waves. Congratulation to Associate Professor [Leon Van Paassen](#) and [team](#) on their 2021 [Western States Seismic Policy Council](#) Award in Excellence for their project in earthquake soil impact!

Geosyntec Internship. PhD student [Ben Agbo](#) completed an internship at Geosyntec, in Columbia, Maryland over Summer 2021 as part of a NSF Grant Opportunities for Academic Liaison with Industry (GOALI) Proposal. He worked on projects related to his ASU research involving soil improvement through enhanced transport of microbes and chemicals using electro-kinetic transport mechanisms.



Delgado Exhorts Soil Reservoir for Chain Elongators. Anca Delgado clarifies the link between microbial chain elongation and soils and sediments in a [piece featured in Nature Portfolio Microbiology Community](#). Referencing the history of chain elongation research as well as [her group's paper in the ISME Journal](#).



Discover Magazine. Dr. Bruce Rittmann was interviewed for Discover Magazine for his expertise in bioreactor-facilitated remediation of wastewater. “We’ve got our brains and our organizational ability, and the microorganisms have their incredible metabolic diversity to transform chemicals that we consider pollutants and they consider food,” Dr. Rittmann summarized. Read all about fascinating applications in bioremediation of per- and polyfluoroalkyl substances (PFAS) and wastewater bioreactors and more at [Discover Magazine!](#)



Wastewater as a Resource. [Dr. Bruce Rittmann](#) from the [Fulton Schools](#) and the Swette Center for Environmental Biotechnology provides insight for PNAS (Proceedings of the National Academy of Sciences of the United States of America) regarding [the beginnings and ongoing](#) evolution of scientific efforts involved in treating wastewater as more than just waste, but as a valuable resource. Read about it [here!](#)



Nanopitcher. [Juliana Levi](#) who is a PhD student in the Westerhoff and Rittmann Labs, placed 2nd in the annual [Nanopitch](#) competition from the [Sustainable Nanotechnology Organization](#) on March 24th. Her topic of focus was based on her research with technology removing nitrate from drinking water. We are so proud of Juliana and look forward to seeing her future successes!

Perry McCarty Symposium. To celebrate Professor Perry L. McCarty’s 90th birthday and honor his outstanding contributions to environmental biotechnology, iFAST-Environmental Biotechnology organized a 3-day symposium at which [Bruce Rittmann](#) and [Anca Delgado](#) gave presentations.



BSCEB Donates Food to Pitchfork Pantry for 2nd Year in a Row. Our Center members were looking for a way to volunteer during the holiday season. We collected food to donate to the ASU Pitchfork Pantry throughout December of 2021. “The Pitchfork Pantry is a student-run food pantry that serves ALL ASU students. The Pitchfork Pantry serves to fight food insecurity and promote well-being, sustainability and food recovery. We provide packages containing a variety of non-perishable foods and toiletries.” [LINK TO WEBSITE](#)



STATS and MEMBERSHIP - [Back to CONTENTS](#)

	2021
Peer-Review Articles	67
Presentations	110
Patent Disclosures	8
Patent Licenses	3
PhDs Degrees	3
Master's Degrees	3
Bachelor's Degrees	3
# of Mentors	25
Visiting Scholars	6
countries	5
continents	4
High School Interns	0
Teacher Interns	2
Volunteers	0
Staff	4
Undergraduates	28
FURI & SOLUR	0
Honors	1
4+1	3
PhD & Masters Students	37
Dean's Scholars	3
President's Scholars	1
Postdocs	4
Research Scientists	2
Research Professors	4
Academic Faculty	6
Outreach Activities	15
Awards	18
individuals	14
Promotions	4
Funded Projects	29

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	Position	First	Last	Lab (Mentor)	Project
1	Manager, Business	Carole	Flores	All	Business Management
2	Manager, Laboratory	Sarah	Arrowsmith	All	Lab Management
3	Manager, Project	Matthew	Scholz	Rittmann, Elser	Phosphorus Alliance Project Mgr
4	Masters Student	Marc	Fontanez Ortiz	Cadillo Quiroz	Electrochemistry
5	Masters Student	Deepesh	Karmacharya	Van Paassen	CBBG-MIDP-Microbially Induced Desaturation and Precipitation
6	Masters Student	Christian	Kassar	Boyer (Rebecca)	
7	Masters Student	Jacqueline	Kuo	Rittmann	
8	Masters Student	Rayanna	Pearson	Van Paassen	
9	Masters Student	Brian	Roman	Rittmann (Josh)	Advancing the Anaerobic Biofilm Membrane Bioreactor
10	Masters Student	Skanda Vishnu	Sundar	Delgado	CBBG-Microbial Chain Elongation Delgado
11	Masters Student, 4+1	Jillian	Ayers	Cadillo	
12	Masters Student, 4+1	Anna	Mangus	Torres (Christine)	Electrical power production from blackwater using MXCs and cryogenic electron tomography
13	Masters Student, 4+1	Andrea	Russell	Torres	Electrical power from blackwater using microbial fuel cells
14	PhD Student	Ben	Agbo	Torres	Enzyme Induced Calcium Precipitate (EICP)
15	PhD student	Anwar	Alsanea	Rittmann (Chen)	Recovery of Sulfur and Rare-earth Metals from Ortho-Phosphate Production
16	PhD Student	Camila	Delgado-Montes	Cadillo	
17	PhD Student	Rebecca	Dietz	Boyer (Rain)	Removal of PFAS/PFOS using Ion Exchange
18	PhD Student	Michael	Edgar	Boyer	
19	PhD Student	Farideh	Ehsasi	Van Paassen	
20	PhD Student	Andrew (Drew)	Enns	Van Paassen	
21	PhD Student	Ethan	Howley	Torres	Microbial electrochemical cells and omics
22	PhD Student	Zachary	Hubbard	Torres	Bio-Based Barriers by Stimulating Microbial Induced Iron Precipitation
23	PhD student	Patrick	Kwon	Van Paassen	CBBG MIDP - Microbially Induced Desaturation and Precipitation
24	PhD student	Juliana	Levi	Rittmann/Westerhoff	MBfR - Membrane Biofilm Reactors
25	PhD Student	Christine	Lewis	Torres, Fromme	MEPS -Microbial electro-photosynthesis
26	PhD Student	Xiwei	Li	Van Paassen	
27	PhD Student	Xiangxing	Long	Rittmann, Westerhoff	Nanoparticles
28	PhD Student	Yihao	Luo	Rittmann	BioMetals; MPfR
29	PhD Student	Maheen	Mahmood	Rittmann	Anaerobic Digestion of Cow Waste
30	PhD Student	Evelyn	Miranda	Delgado	BioMetals; dechlorination, acid mine drainage remediation and microbial chain elongation
31	PhD Student	Srivatsan	Mohana Rangan	Delgado, RKB	BioMetals; soil dechlorination and microbial metabolic exploration
32	PhD Student	Anderson	Nyaga	Van Paassen	
33	PhD Student	Michael	Pavia	Cadillo	
34	PhD Student	Rain	Richard	Boyer	Biodesign C Water Quality

	Position	First	Last	Lab (Mentor)	Project
35	PhD Student	Aide	Robles	Delgado	Microbial Chain Elongation CBBG
36	PhD Student	Burcu	Yavuz	Rittmann	Heavy hydrocarbon soil remediation
37	PhD Student	Elizabeth	Young	Van Paassen	
38	PhD Student	Chenwei	Zheng	Rittmann (Chen, Sean)	BioMetals; photobioreactors/QAC/MBfR/MPfR
39	PhD Student, Conacyt Fellow	Isaias (Isa)	Peraza	Rittmann, Marcus	Microbial electrochemical cell modeling
40	PhD Student, Dean's Scholar	Caitlyn	Hall	Rittmann (CBBG)	Soil stabilization
41	PhD Student, Dean's Scholar	Kyle	Reep	Rittmann (Chen)	CBBG sulfate bioreactors
42	PhD Student, Dean's Scholar	Justin	Skinner	Delgado	Microbial Metabolic ExplorationE-Enrichment-DeFluorination-PFASs
43	PhD Student, Pres Scholar	Kelsie	Herzer	Delgado	Microbial chain elongation and bioremediation
44	Postdoctoral Fellow	Paul	Brewer	Cadillo	
45	Postdoctoral Fellow	Diana	Calvo Martinez	Rittmann, Torres	MBfR - Membrane Biofilm Reactors
46	Postdoctoral Fellow	Hamed	Khodadaditirkolaei	CBBG	CBBG
47	Postdoctoral Fellow	Chung-Seop	Lee	Rittmann/Westerhoff	Collaborating with Juliana Levi
48	Postdoctoral Fellow	Min	Long	Rittmann (Chen)	BioMetals; chromate reduction; palladium MBfRs and photocatalysis
49	Postdoctoral Fellow	Thuy	Nguyen	Dahlen (Delgado)	Sharing GC and TOC w/ Delgado group
50	Professor	Treavor	Boyer	Boyer	Faculty
51	Professor, Assoc	César	Torres	Torres	Faculty
52	Professor, Ast	Hinsby	Cadillo Quiroz	Cadillo	Faculty
53	Professor, Ast	Anca	Delgado	Delgado	Dechlorination bioreactors
54	Professor, Ast	Leon	van Paassen	Van Paassen	Faculty
55	Professor, Director	Bruce	Rittmann	Rittmann	Faculty
56	Research Engineer	Carlos	Leyva	Boyer	Project H2O, Biodeign C Water Monitoring
57	Research Professor, Ast	Joshua	Boltz	Rittmann	Mathematical Modeling
58	Research Professor, Ast	Yen-Jung	Lai	Rittmann	Algae biofuels, resource recovery, membrane carbonation, microbial antibiotic resistance
59	Research Professor, Ast	Andrew	Marcus AAM3	All	Modeling of NIH bioenergetics project and modeling leadership/mentorship
60	Research Professor, Ast	Chen	Zhou	Rittmann	MBfR - Membrane Biofilm Reactors
61	Research Scientist, Ast	Everett	Eustance	Rittmann	Photobioreactors, Membrane Carbonation
62	Research Scientist, Ast	Michelle	Young	Rittmann	Lignocellulose degrad, H2O2 & emerging contaminants, MC modeling
63	Student Worker II	Sergio	Avalle	All (Sarah)	Lab Manager Aide and MBfR - Membrane Biofilm Reactors
64	Student Worker II	Emma	Nelson	Rittmann (Sarah)	Lab and office assistant
65	Student Worker IV	Zoe	Frias	Rittmann (Everett)	Membrane Carbonation
66	Teacher Intern	Sheena	Carbaugh	Rittmann (Min)	Catalyzing PFOs and PFAs in drinking water into biodegradable materials
67	Teacher Intern	Ana	Marti-Subirana	Delgado (Justin)	Bioremediation of chlorinated solvents
68	Technician, Instruments	Chris	Muse	All	Maintenance of all instruments
69	Techno-Economic Analyst	Rob	Stirling	All	Techno-Economic Analysis
70	Visiting Scholar	Dirk	Wallschläger	Rittmann (Josh)	Selenium removal, methods for analyzing selenium-containing species

	Position	First	Last	Lab (Mentor)	Project
71	Visiting Student	Yuhang	Cai (call him CHAI)	Rittmann (Chen, Josh)	Mathematical Modeling
72	Visiting Student	Felipe	CASTANO GONZALEZ	Rittmann (Diana)	Modeling of vector-borne diseases influenced by climate change
73	Visiting Student	Jie	Cheng	Rittmann (Chenwei)	Dechlor of γ -HCH in H ₂ -based membrane biofilm/palladium-film reactors
74	Visiting Student	Kari	Gallego Bravo	Cadillo	Methanogenic bacteria for bioproduction of methane & post-transformation
75	Visiting Student	Hannah	Molitor	Rittmann (Everett)	Photobioreactors, Membrane Carbonation, Microalgae
76	Volunteer, Graduate	Muthukaruppan	Kathiresan	Rittmann (Josh)	Advancing the Anaerobic Biofilm Membrane Bioreactor
77	Volunteer, Graduate	Mohammad Abu	Talha	Rittmann (Josh)	SUMO modeling
78	Volunteer, Undergrad	Channing	Allen	Delgado (Justin)	Bioremediation of chlorinated solvents
79	Volunteer, Undergrad	Isabel	Angulo Lopez	Torres (Michelle)	microbial electrochemical cells for H ₂ O ₂ production and remediation
80	Volunteer, Undergrad	Leslie	Bautista	Van Paassen	
81	Volunteer, Undergrad	Presley	Blake	Delgado (Justin)	bioremediation of chlorinated solvents
82	Volunteer, Undergrad	Natalie	Blum	Rittmann/Zhou (Min)	PFAS removal in the MCFRs
83	Volunteer, Undergrad	Hannah	Collins	Rittmann (Michelle)	MXC bioremed; PFOA + nitrate removal in membrane-catalysts-biofilm reactor
84	Volunteer, Undergrad	Lucas	Crane	Boyer (Rain)	Biodesign C Water Quality
85	Volunteer, Undergrad	Katherine	Currier	Van Paassen	
86	Volunteer, Undergrad	Nabhan	Fakrudin	Rittmann (Michelle)	Membrane Carbonation Modeling, Lignocellulose Degradation
87	Volunteer, Undergrad	Alex	Gaura	Delgado (Aide)	Microbial Chain Elongation CBBG
88	Volunteer, Undergrad	Erick	Gonzalez	Torres (Ben)	Enzyme Induced Calcium Precipitate (EICP)
89	Volunteer, Undergrad	Aaron	Greenfield	Rittmann (Michelle)	Lignocellulose degradation and H ₂ O ₂ -producing MXCs projects
90	Volunteer, Undergrad	Caleb	McLaughlin	Delgado (Moni)	Acid mine drainage remediation and microbial chain elongation
91	Volunteer, Undergrad	Shree	Modukuri	Rittmann (Michelle)	Microbial electrochemical cells for H ₂ O ₂ production and remediation
92	Volunteer, Undergrad	Gloria Appiah	Nsiah	Rittmann (Anwar)	MBfR treatment if mining wastewater treatment
93	Volunteer, Undergrad	Jorja	Overbey	Rittmann (Michelle)	Modeling Emissions from Wastewater Treatment Plants (no lab work)
94	Volunteer, Undergrad	Skye	Palar	Delgado (Justin)	Bioremediation of chlorinated solvents
95	Volunteer, Undergrad	Smith	Pittman	Rittmann (Michelle)	Lignocellulose degradation and H ₂ O ₂ and emerging contaminants
96	Volunteer, Undergrad	Alia	Raderstorf	Delgado (Justin)	Bioremediation of chlorinated solvents
97	Volunteer, Undergrad	Labanya	Rahman	Rittmann (Anwar)	Recovering Elemental Sulfur from Phosphate Mining Waste
98	Volunteer, Undergrad	Rammy	Rayes	Rittmann (Everett)	Membrane carbonation, microalgae
99	Volunteer, Undergrad	Maxwell	Silverman	Delgado (Aide)	Chain elongation and bioremediation
100	Volunteer, Undergrad	Maggie	Trias	Cadillo	Needs to use BSCEB IC
101	Volunteer, Undergrad	Samuel	Watson	Torres (Ben)	CBBG-Electrokinetics and Iron Precipitation
102	Volunteer, Undergrad	Chung Tin	Wong	Van Paassen	

GRADUATES - [Back to CONTENTS](#)

1. Davis, TL (2021 Dec. 31). M.S., Chemical Engineering, Fulton Schools of Engineering, 2021 May 14.
2. Enns, A.C. (2021 June 29), M.S. Geotechnical and Geo-environmental Engineering, Arizona State University, Computational Modeling of 2D Mangrove Forests for Scour Mitigation around Bridge Piers, 2021 June 29 (chair)
3. Hall, C.A. (2021 April 1), Ph.D. Environmental Engineering, Arizona State University, Modelling and field scale implementation of Microbial induced desaturation and precipitation, 2021 April 1 (co-advisor/committee member)
4. Mangus, A (2021 May 3). Bachelors of Science, Engineering (B.S.E.), Chemical Engineering, Fulton School for Matter, Transport and Energy, (2021 May 3).
5. Martin, K. (2021 March 31), Ph.D. Geotechnical and Geo-environmental Engineering, Arizona State University, Field-Scale Trial of Enzyme-Induced Carbonate Precipitation (EICP) as a Ground Improvement Technology, 2021 March 31 (co-advisor/committee member)
6. Raderstorf, A.(2021/05). B.S., Environmental Engineering, School of Sustainable Engineering and the Built Environment.
7. Roman, B. (2021, December). B.S. and M.S. Environmental Engineering, School of Sustainable Engineering and the Built Environment, Advancing the Anaerobic Biofilm Membrane Bioreactor Environmental Engineering in the School of Sustainable Engineering and the Built Environment.
8. Stallings-Young E.G. (2021 March 21), Ph.D. Geotechnical and Geo-environmental Engineering, Arizona State University, Microbial Induced Desaturation and Carbonate Precipitation through denitrification, effect of biogas formation on hydraulic conductivity o MIDP treated sand, 2021 March 21. (co-chair)

JOB PLACEMENTS - [Back to CONTENTS](#)

1. Enns, A.C. (2021) Geologist/Geotechnical Engineer, Soil and Material Consultants Inc, Chicago
2. Hall, C.A. (2021) Assistant Professor of Practice - Climate Change, Sustainability, and Environmental Justice, University of Arizona, June 2021
3. Martin, K. (2020) Senior Engineer - Innovation & Sustainability, Keller, December 2020
4. Pittman, S. Graduate Research Assistant, Colorado State University, May 15, 2022.
5. Stallings-Young E.G. (2021) Senior Staff Geotechnical Engineer, Aecom, August 2021

VISITNG SCHOLARS - [Back to CONTENTS](#)

1. Yuhang Cai, Mentors: Bruce Rittmann and Josh Boltz, College of Power and Energy Engineering, Harbin Engineering University, Harbin, China, October 4, 2019 to March 28, 2021, mathematical model of anaerobic microbiological systems used for wastewater treatment.
2. Felipe Castaño González, Mentors: Bruce Rittmann and Diana Calvo Martinez, Dept of Biomedical Engineering, Universidad Autónoma de Manizales, Manizales (Caldas), Colombia, August – December 2021, Modeling of vector-borne diseases influenced by climate change.
3. Jie Cheng, Ph.D., China Scholarship Council, Mentors: Bruce Rittmann and Chenwei Zheng, Zhejiang University, Hangzhou, China (December 2021 – June 2023, Reductive dichlorination of γ -hexachlorocyclohexane in H₂-based membrane-film reactors.
4. Kari Gallego Bravo, Hinsby Cadillo Quiroz, Instituto Politécnico Nacional, Ciudad de México, México, August 2020 - present; Methanogenic bacteria for bioproduction of methane & post-transformation.
5. Hannah Molitor, Mentors: Bruce Rittmann and Everett Eustance, Department of Civil and Environmental Engineering, University of Iowa, Iowa City, IA, USA, January – April 2021; bench-scale tests, outdoor pilot and modeling using membrane carbonation with biogas.
6. Dirk Wallschläger, Bruce Rittmann and Josh Boltz, School of the Environment and Dept. of Chemistry, Trent University, Peterborough, ON, Canada, January – June 2021; Selenium Removal Team, developing advanced methods for analyzing selenium-containing chemical species.

AWARDS AND PROMOTIONS - [Back to CONTENTS](#)

1. Arrowsmith, S. Promoted from Lab Coordinator to Lab Manager, Jan 1, 2021.
2. Avasle, S. 2021. Sun Award, Biodesign SWETTE EB, Alumni/Current researchers home map project; Sun Award, Biodesign SWETTE EB, Complete BSCEB and HTM chemical inventories.
3. Boyer, T. (May 2021) Promoted to Full Professor
4. Collins, H. (2021 November 1). Acceptance into Grand Challenges Scholars Program (GCSP) at ASU, Fulton Schools of Engineering at Arizona State University, prepare to solve the world's grand challenges and conduct research to improve environmental health.
5. Collins, H. (2021 December 23). Acceptance into FURI Program at ASU, Fulton Schools of Engineering at Arizona State University, obtain hands-on lab experience and conduct research to improve environmental health.
6. Delgado, A. Faculty Fellowship Program in Israel, Awardee for the Winter 2022 program.
7. Herzer K. (August, 2021). Presidential Graduate Fellowship, ASU.
8. Howley, E. (2021). Einstein Award for best use of physical principles in a poster. Biodesign Fusion Retreat.
9. Lai, YJ (Sept, 2021). Promoted to Assistant Research Professor.
10. Levi, J (2021, March 21st). 2nd place Nanopitch, Sustainable Nanotechnology Organization, an award-winning elevator pitch.
11. Levi, J (2021, July). Finalist. Story Exchange [Women in Science Incentive Prize](#) for women in science working on water crisis.
12. Long M., CAPEES Best Poster Presentation Award, CAPEES.
13. Muse, C. (07/29/2021) Finalist for Rookie Employee of the Year, Knowledge Enterprise.
14. Palar, S. (2022 Jan. 10). Received grant to perform FURI experiment in Spring 2022.
15. Rittmann, B. (2021). Camp Applied Research Award, Water Environment Federation.
16. Rittmann, B. (2021). Rudolph Hering Medal, American Society of Civil Engineers.
17. Rittmann, B. (2021). Shanghai Government International Collaboration Award.
18. Scholtz, M. (2021). Promotion to Senior Project Manager.
19. Zhou, C. 2021. The American Society of Civil Engineers (ASCE) Rudolph Hering Medal



1Juliana Levi

OUTREACH AND SERVICE ACTIVITIES - [Back to CONTENTS](#)

OUTREACH

1. Arrowsmith, A. (2021, Sept-Oct) ASU Homecoming Committee
2. McLaughlin, C (2021/10/30), CBBG Table for ASU Homecoming Football Game, Tabler, I helped present CBBG research projects and information to passersby.
3. Robles, A. (2021, Oct). Homecoming, Fulbright Scholar visitor lab tours.
4. Van Paassen, L.A. (2021, Oct). ASU Homecoming.

OTHER SERVICE ACTIVITIES

1. Boyer, T. (2021 November 17) started as Editor at Water Research.
2. Delgado, A. (2021). Center for Bio-mediated and Bio-inspired Geotechnics Faculty Search Committee Member, School of Sustainable Engineering and the Built Environment.

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3. Delgado, A. (2020-2023). Member at Large of the Executive Committee of the Graduate Faculty Mentor Academy, Graduate College, Arizona State University.
 4. Delgado, A. (2019-present). National Science Foundation, Division of Chemical, Bioengineering, Environmental and Transport Systems (CBET) Reviewer,
 5. Eustance, E. (2021). Algae Biomass Summit. Track chair for Cultivation and Harvesting Practices; Process R&D.
 6. Long, M. (2021). Journal Reviewer of Environmental Science & Technology Member of CAPEES (Chinese-American Professors in Environmental Engineering and Science).
 7. Rittmann, B. (2021). Chair, Organizing Committed for the Perry McCarty Symposium, virtual via iFAST (2021)
 8. Rittmann, B. (2021). Program Committee for the 2022 IWA Leading Edge Technology Conference, to be held in Reno, NV in March 2022.
 9. Rittmann, B. (2021). Chair, SSEBE Awards Committee
 10. Rittmann, B. (2021). Chair, Biodesign Chalk Talk Committee Program Committee, 2021
 11. Rittmann, B. (2021). LET Biofilm Specialists (Virtual) Conference



APPENDIX

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FUNDING AWARDS - [Back to CONTENTS](#)

PI Last	Short Title	Sponsor Award Number	Sponsor/Prime Sponsor	Lead Financial Unit	Award Start Date	Award End Date	Proposed Total
Boltz	Applications of SeSANS (Mathematical and process model for biological transformation of selenium oxyanions) to Test Beds	10013385	Electric Power Research Institute (EPRI)	Biodesign: Swette Center for EB	2/24/2021	12/31/2021	\$32,738
Boltz	Mathematical and Process Model for Biological Transformation of Selenium Oxyanions	10009615	Electric Power Research Institute (EPRI)	Biodesign: Swette Center for EB	7/16/2018	12/31/2021	\$298,033
Boltz	A model of nitrous oxide production in biological used-water treatment - Revision - 1	AGR 04/22/21	Brown and Caldwell	Biodesign: Swette Center for EB	1/1/2021	12/31/2021	\$10,000
Boyer	Advancing water and energy efficiency for food and beverage and aerospace manufacturing through technology and knowledge transfer	NP-98T14401-0	US Environmental Protection Agency (EPA)	IAFSE-SEBE: Civil and Environmental Engineering	10/1/2020	11/30/2022	\$376,343
Boyer	REGENERABLE RESIN SORBENT TECHNOLOGIES WITH REGENERANT SOLUTION RECYCLING FOR SU	401466-5801	Colorado School of Mines/US Department of Defense (DOD)	IAFSE-SEBE: Civil and Environmental Engineering	9/6/2018	9/5/2022	\$317,848
Boyer	Sharing technical and educational innovations on water and energy efficiency for	99T77901	US Environmental Protection Agency (EPA)	IAFSE-SEBE: Civil and Environmental Engineering	10/1/2018	11/30/2021	\$312,150
Boyer	NEWT Non-core Project: RPS3: Optimizing Water Use through Complementary Sensing Modalities	2020-9916276	Pepsico Inc	IAFSE-SEBE: NEWT	7/27/2020	7/26/2021	\$96,860
Cadillo-Quiroz	CAREER: Geochemical and functional controls of methane-mediating microbes in Amaz	1749252	National Science Foundation (NSF)	CLAS-NS: SOLS	12/1/2018	11/30/2023	\$650,013
Cadillo-Quiroz	Biophysical processes and feedback mechanisms controlling the methane budget of an Amazonian peatland	H007829702	University of Minnesota/US Department of Energy (DOE)	CLAS-NS: SOLS	9/1/2019	8/31/2022	\$138,452
Cadillo-Quiroz	Monitoring the changes in methane (CH4) emissions and microbes of manipulated cells of the Salt River Landfill, an Arid Zone Landfill case study (SRL)	AGR 10/1/2019	IAFSE-SEBE: CBBG	IAFSE-SEBE: CBBG	8/1/2019	7/31/2022	\$307,492
Delgado	CBBG Project: MCE Project Collaboration to Perform a Bench-scale Feasibility Study (Haley & Aldrich)	TBD	IAFSE-SEBE: CBBG	IAFSE-SEBE: CBBG	5/17/2021	7/31/2022	\$11,700
Delgado	CBBG Project: MCE Project Collaboration to Perform a Bench-scale Feasibility Study (Haley & Aldrich)	TBD	IAFSE-SEBE: CBBG	IAFSE-SEBE: CBBG	5/17/2021	7/31/2022	\$11,700
Delgado	CBBG Center Project: Enhanced Control of Microbial Activity and Substrate Delivery Via Inhibitors (Haley & Aldrich)	TBD	IAFSE-SEBE: CBBG	IAFSE-SEBE: CBBG	8/1/2020	7/31/2022	\$16,531

Delgado	Phoenix/Scottsdale Groundwater Contamination Endowment: Metabolic Exploration and Microbial Enrichment for Reductive Defluorination of Per- and Polyfluoroalkyl Substances (PFASs)	Email 11/21/2019	Arizona State University Foundation (ASUF)/Phoenix/Scottsdale Groundwater Contamination Endowment for Research on the Risks and Mitigation of Chemical Releases to the Environment	IAFSE-SEBE: Civil and Environmental Engineering	1/1/2020	12/31/2021	\$50,000
Delgado	Natural organic components in soils interfering with TPH analytical measurements: identification, characterization, and possible solutions	CW1517977	Chevron Energy and Technology Company	Biodesign: Swette Center for EB	8/12/2019	12/31/2021	\$72,642
Rittmann	Master Agreement No. MA330. IRP No. 1 CogniTek (Uranium)	AGR 12/21/2021	Precient Technologies LLC	Biodesign: Swette Center for EB	10/1/2021	1/31/2022	\$22,000
Rittmann	NEWT Non-core Project: Maximizing Value from Dairy-cow Wastewater by Intensifying Anaerobic Digestion	34270	Dairy Management Inc.	IAFSE-SEBE: NEWT	7/1/2021	6/30/2023	\$320,902
Rittmann	Recovery of Sulfur and Rare-earth Metals from Ortho-Phosphate Production	Specific Agreement No. 1	OCP SA	Biodesign: Swette Center for EB	6/10/2020	6/9/2024	\$838,234
Rittmann	NEWT Non-core Project: Maximizing Value from Dairy-cow Wastewater by Intensifying Anaerobic Digestion	34270	Dairy Management Inc.	IAFSE-SEBE: NEWT	7/1/2021	6/30/2023	\$320,902
Rittmann	Biodegradation of 1,4-Dioxane Using Ethane as the Primary Substrate in the O ₂ -Based Membrane Biofilm Reactor	W912HQ19C0054	US Department of Defense (DOD)	Biodesign: Swette Center for EB	8/15/2019	8/14/2022	\$327,394
Rittmann	Enhancing Biodegradation of Quaternary Ammonium Compounds (QAC)	1702445	National Science Foundation (NSF)	Biodesign: Swette Center for EB	7/1/2017	6/30/2022	\$379,738
Rittmann	Membrane Carbonation for 100% Efficient Delivery of Industrial CO ₂ Gases	DE-EE0008517	DOE: Office of Energy Efficiency and Renewable Energy (EERE)	Biodesign: Swette Center for EB	10/1/2018	6/30/2022	\$1,992,766
Rittmann	A Synergistic Platform for Defluorination of Perfluoroalkyl Acids (PFAAs) through Catalytic Reduction Followed by Microbial Oxidation	W912HQ20P0006	US Department of Defense (DOD)	Biodesign: Swette Center for EB	4/3/2020	4/2/2022	\$200,000
Rittmann	NEWT Non-core Project: RPS 2: Advancing the Anaerobic Biofilm Membrane Bioreactor	2020-9916244	Pepsico Inc	IAFSE-SEBE: NEWT	7/27/2020	2/28/2022	\$178,432
Rittmann	Master Agreement No. MA330. IRP No. 1 CogniTek (Uranium)	AGR 12/21/2021	Precient Technologies LLC	Biodesign: Swette Center for EB	10/1/2021	1/31/2022	\$22,000
Rittmann	NEWT Non-Core Project - Reductive Defluorination and Mineralization of PFOA	AGR 05/13/19	Xylem, Inc.	IAFSE-SEBE: NEWT	4/1/2019	12/31/2021	\$280,799
Torres	Cryogenic electron tomography of the intracellular/extracellular interface of Geobacter sulfurreducens	N00014-20-1-2269	DOD-NAVY: Office of Naval Research (ONR)	Biodesign: Swette Center for EB	4/1/2020	9/30/2022	\$138,781
Torres	Generating electrical power from blackwater using microbial fuel cells	N00014-19-1-2125	DOD-NAVY: Office of Naval Research (ONR)	Biodesign: Swette Center for EB	2/18/2019	5/31/2022	\$275,807
Torres	Enabling 3D Fluorescence Imaging Under Anaerobic Environments	N00014-19-1-2531	DOD-NAVY: Office of Naval Research (ONR)	Biodesign: Swette Center for EB	6/1/2019	5/31/2021	\$182,326

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POSTERS & TALKS - [Back to CONTENTS](#)

68. Collins, H. J., Muenich, R., and Hamilton, K. (2021, July). Movement and quantification of pathogens in a managed aquifer recharge (MAR) site. [Video presentation].*
69. Delgado AG. When Kluyver(i) meets McCarty(i): reductive dechlorination mediated by chain elongation. iFAST Symposium, Environmental Biotechnology to Celebrate Professor Perry L. McCarty's 90th Birthday and Honor His Outstanding Contributions to Environmental Biotechnology, December 16-18, 2021, virtual (Invited oral presentation).
70. Eustance, E. (2021, Oct. 6th). Tracking Carbon in Algal Cultivation. DOE-BETO DISCOVER group*
71. Goldschmidt 2021, Lyon, France, online. <https://doi.org/10.7185/goId2021.8243> Van Paassen, L.A. (2021, August) How Burping Bacteria Prevent Buildings from Collapse during Earthquakes, Biodesign Chalktalk, Tempe, Arizona
72. Howley, ET; Krajmalnik-Brown, R; Torres, CI. (2021 November). Modeling cyclic voltammetry of *G. sulfurreducens* biofilms. NA-ISMET, Los Angeles, CA, USA. Poster presentation
73. Krishnan V., Ehsasi F., Kazembeyki M, van Paassen L., Hoover C., Khodadadi Tirkolaei H. & Kavazanjian E. (2021) Measurement of the Hardness and Indentation Modulus of Sands Treated with Enzyme Induced Carbonate Precipitation.
74. Lai YS, Eustance E, Frias Z, Rittmann BE. A bleed- and venting-valve strategy enables membrane carbonation to achieve superior carbon transfer efficiency with industrial gas streams. Algal Biomass Summit, Virtual Conference, Sept. 28- Oct 27, 2021.
75. Lai YS. How microalgal biotechnology leverage the circular carbon economy for environmental sustainability? International Joint-Research and Training Program on Circular Economy Based Environmentally Green Technology for Sustainable Development, Taiwan, Virtual Conference, Aug, 2–12, 2021
76. Levi, J., Jacobs, H., Hong, K., Henke, A., Garcia-Segura, S., Zhou, C., Wong, M., Rittmann, B., Westerhoff, P. (2021, Nov 10th). Continuous Flow Catalytic Hydrogenation of Groundwater Nitrate Using Hydrogen-Permeable Hollow-Fiber Membranes. [Poster Presentation]. American Institute of Chemical Engineers Annual Meeting, Boston, Massachusetts, USA.
77. Long M., Defluorination of Perfluoroalkyl Substances (PFAS) by PGM (platinum-group metals) catalysts, CAPEES Poster Presentation
78. Mangus, AM. (2021, November 17). Cryogenic electron tomography and 3D reconstructions of the intracellular/extracellular nanowire interface of *Geobacter sulfurreducens*. [Paper Presentation]. NA-ISMET 2021, Los Angeles, California, USA.
79. Rittmann, BE (2021, January 27). "The H₂-based Membrane Biofilm Reactor (MBfR) for Reducing Many Oxidized Contaminants," Arizona Department of Environmental Quality (virtual)
80. Rittmann, BE (2021, March 2). "Fundamentals of Selenium, Sulfur, and Nitrogen Bioreduction," International Workshop on Selenium, Sulfur, and Nitrogen species (SeSANS) Modeling, Arizona State University (virtual)

81. Rittmann, BE (2021, April 5). "The Microorganisms Always Close the Mass Balance," Michigan Technological University (virtual)
82. Rittmann BE (2021, April 27). "Introducing the Membrane Catalyst-film Reactor (MCfR)," Olivet Nazarene College (virtual)
83. Rittmann, BE (2021, May 7). "Introducing the Membrane Catalyst-film Reactor (MCfR), University of California, Riverside (virtual)
84. Rittmann, BE (2021, July 20). "PFAS removal with the MCfR and MBfR," DoE PFAS Symposium, San Pedro, CA (in person)
85. Rittmann, BE (2021, August 10). "Moving from Treatment to Resource," TUBA World Conference on Energy Science and Technology, Ankara, Turkey (virtual)
86. Rittmann, BE (2021, September 16). "Opportunities in Microbial Bioenergy," FSE 150, Prof. Haolin Zhu.
87. Rittmann, BE (2021, October 27). "Advancing Urban Sustainability Using Environmental Biotechnology," International Conference on Urban Drainage, Melbourne, Australia (virtual).
88. Rittmann, BE (2021, October 28). "Hydrogen-based Selenate Reduction, Selenium Summit, Electric Power Research Institute (virtual).
89. Rittmann, BE (2021, November 1). "The Membrane Biofilm Reactor (MBfR): a sustainable technology for reducing carbon emissions in water and wastewater treatment," International Conference on Sustainable Development and Technology, Shenzhen, China (virtual).
90. Rittmann, BE (2021, November 4). "Environmental Biotechnology, the Means to Maximize the Value of Resources Recovered from Wastewaters," Lehigh University (in person).
91. Rittmann, BE (2021, November 6). "Direct Wastewater Treatment with Anaerobic Membrane Bioreactors," Shanghai Normal University (virtual).
92. Rittmann, BE (2021, December 8). "Making the MBfR do more by depositing catalytic nanoparticles," IWA International Biofilm Reactors Conference, University of Notre Dame (virtual).
93. Rittmann, BE (2021, December 16). "Energetic analysis of ammonium-oxidizing bacteria and why they produce nitrous oxide (N₂O)," Special Perry McCarty 90th Birthday Symposium, iFAST (virtual).
94. Robles A, Yellowman TL, Joshi S, Mohana Rangan S, Delgado AG. (2021, September 27th-30th). Reductive dechlorination sustained by microbial chain elongation. [PPT presentation]. 3rd International Conference on Anaerobic Biological Dehalogenation- Virtual, DehaloCon III, Rome, Italy.
95. Robles A, Yellowman TL, Joshi S, Mohana Rangan S, Delgado AG. (2021, February 19th). Hydrogen production during microbial chain elongation drives complete reductive dechlorination of trichloroethylene. [Poster presentation]. 11th Annual SSEBE Graduate Research Symposium- Virtual, Arizona State University, Tempe, Arizona, USA.
96. Skinner, J. (2021,09). Meta-analysis of Anaerobic Biodegradation and Biotransformation of Simple and Polyfluorinated Compounds. Dehalcon III 2021, Italy
97. Skinner, J. (2021,10). Enhanced Control of Microbial Activity And Substrate Delivery Via Inhibitors For In-situ Contaminant Treatment. CBBG Annual Meeting. Tempe, AZ, USA.
98. Van Paassen, L.A. (2021, April). How burping bacteria mitigate earthquake induced liquefaction, from lab to the field and back again. CBBG Midyear meeting 2021, Tempe, Arizona, USA*
99. Van Paassen, L.A. (2021, May). Bio-mediated ground improvement. CBBG Summer RET/REU/YS program 2021, Tempe, Arizona, USA*
100. Van Paassen, L.A. (2021, May). Microbial induced Desaturation and Precipitation in Stratified Granular Soil. Interpore 2021, online
101. Van Paassen, L.A. (2021, May). Microbial induced Desaturation and Precipitation in Stratified Granular Soil. Interpore 2021, online
102. Van Paassen, L.A. (2021, May). Field trials on bio-based ground improvements. Lunch lecture series, Minnesota Geotechnical Society Geo-Institute Chapter, online*
103. Van Paassen, L.A. (2021, July) How Burping Bacteria Prevent Buildings from Collapse during Earthquakes by Microbial Induced Desaturation and Precipitation, Goldschmidt 2021, Lyon, France, online. <https://doi.org/10.7185/gold2021.8240>
104. Van Paassen, L.A. (2021, September) The challenges of scale up and commercialization of bio-mediated geotechnics, CBBG webinar, Tempe Arizona

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105. Van Paassen, L.A. (2021, December) How burping bacteria can mitigate earthquake induced liquefaction: distribution and durability of entrapped biogenic gas in the subsurface, Geo-Institute Arizona Chapter meeting, Scottsdale, Arizona
 106. Van Paassen, L.A. (2021, December) How burping bacteria can mitigate earthquake induced liquefaction: distribution and durability of entrapped biogenic gas in the subsurface, 6th annual webconference Geo-institute, online
 107. Van Paassen, L.A. (2021, December) Numerical modeling of biogenic desaturation and precipitation, B35J-1533, AGU Fall meeting 2021, New Orleans, Louisiana, USA
 108. Van Paassen, L. A., and Mahabadi, N. (2021, December). "Bio-mediated and Bio-inspired Mechanisms for Hydromechanical Modification of the Subsurface, summary session," AGU, online
 109. Yuan, F., Ricciuto, D. M., Xu, X., Roman, D. T., Wood, J. D., Lilleskov, E., Cadillo-Quiroz, H., Kolka, R. K., Fachin, L., and Griffis, T. J. (2021, December). "Improving the E3SM Land Model Simulations of Carbon Fluxes for an Amazonian Palm Swamp Peatland," AGU
 110. Zheng, CW*; Lai YL; Rittmann BE. (2021, Dec 6). Emergence of Antibiotic Resistance during Treating Various Surfactants in Membrane Biofilm Reactors, IWA Biofilm Reactors 2021, Virtual Conference.

CONFERENCES & WORKSHOPS (ATTENDED) - [Back to CONTENTS](#)

1. Eustance, E. Algae Biomass Summit (2021, October). Virtual
2. Levi, J. Nanotechnology-Enabled Water Treatment Center Annual Meeting (2021, May 18th & 19th), Virtual.
3. Kuo, J. Intensifying Continuous-flow WWT Processes through Biological and Physical Selectors Workshop at the IWA Biofilm Reactors Conference (2021 Dec 5), University of Notre Dame, Notre Dame, Indiana.
4. Reep, J.K. SeSANS Workshop (2021 March 2-4), Arizona State University, Tempe, Arizona.
5. Reep, J.K. Selenium Summit (2021 October 26-28), EPRI, Virtual Conference.
6. Rittmann, B.E. SERDP & ESTCP PFAS Project Meeting (2021 July 18-22), Department of Defense, San Pedro, California.
7. Skinner, J. Short Course in Emerging Contaminants in Water and Wastewater (2021/10/26) Marquette University, Milwaukee, WI.
8. Van Paassen, L.A. Decarbonization Leaders Network, decarb connect (2021, monthly), online
9. Van Paassen, L.A. Geo-Institute Arizona chapter, 2021 Southwest Symposium, (2021, September), ASCE Geo-Institute, Tempe Arizona
10. Young, M. Perry McCarty symposium, online, December 2021

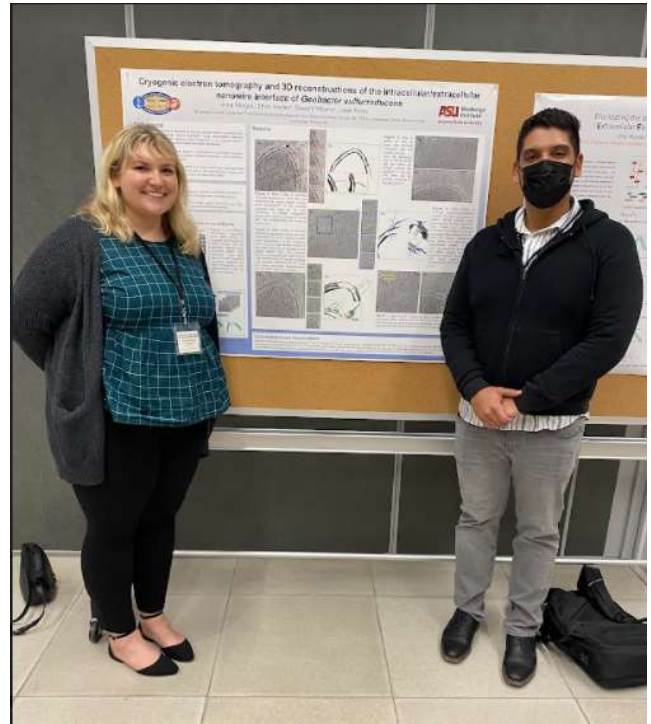


Figure 2 Anna Mangus and Cesar Torres at NA-ISMET

PATENTS & DISCLOSURES - [Back to CONTENTS](#)

PATENT DISCLOSURES/APPLICATIONS

1. Min Long, Chen Zhou, Bruce E. Rittmann. Methods of recovering gold and silver from waste streams. (Submitted to Skysong Innovation)
2. Min Long, Bruce E. Rittmann, Chen Zhou, Michael Wong, 2021, A novel bimetallic catalyst-film reactor for removing contamination from water and wastewater. (Submitted to Skysong Innovation)
3. Yihao Luo, Min Long, Chen Zhou, Bruce E. Rittmann. Systems for Catalytically Removing Per- and Polyfluorinated Substances from Fluid and Related Methods. (US Application # 63/214,140)
4. Justin Skinner, Nasser Hamdan, Anca Delgado, Jacob Chu (2021) 11157.115PROV. Tempe: ASU.
5. Chen Zhou, Bruce E. Rittmann, Min Long. A novel method of recovering Rare Earth Elements (REE) from various wastewater streams. (US Application # 63/256,472)
6. Chen Zhou, Bruce E. Rittmann, Dandan Zhou, Yihao Luo, Min Long, Chenwei Zheng. Systems for Catalytically Removing Oxidized Contaminants from Fluid and Related Methods. (PCT Application # PCT/US21/37959 ; US Application # 63/040,513)
7. Chen Zhou, Bruce E. Rittmann, Chenwei Zheng. An Apparatus and Method for Treating Ammunition-Contaminated Water and Ammunition Wastewater. (PCT Application # PCT/US21/59789 ; US Application # 63/115,017)
8. Chen Zhou, Andrew Marcus, Bruce Rittmann, Zhaocheng Wang,, Aura Ontiveros-valencia, and Rosa Krajmalnik-brown (2021). "Methods of Recovering Platinum Group Metals from Waste Streams."; (US Patent Application 20210179463)

PATENTS AWARDED

1. Prathap Parameswaran, Rosa Krajmalnik-Brown, Sudeep Papat, Bruce Rittmann, Cesar Torres. (Oct 26, 2021). Membrane Biofilm Reactors, Systems, and Methods for Producing Organic Products. (US Patent no. 11,155,766).
2. Bruce E. Rittmann, Youneng Tang, Chen Zhou, Yihao Luo, Rosa Krajmalnik-Brown. Methods and Systems for Removing Trichloroethane, Trichloroethene, and 1,4-Dioxane from Contaminated Water and Wastewater. (PCT publication # PCT/US21/37922).
3. Chen Zhou, Bruce E. Rittmann, Min Long. A Method for Maximizing Elemental Selenium Production and Minimizing Selenide or Organic-Se Production during Selenate Removal from Water. (PCT Publication # WO2021207039A1).

SPIN-OFF COMPANIES - [Back to CONTENTS](#)

Rittmann, B.E. and Zhou, C. et al. Jianguo Rittmann Ecological and Environmental Technologies, LLC (JS-REET) 12-24-2021.

WORKSHOPS (HOSTED) - [Back to CONTENTS](#)

1. Boltz, J. and Rittman, B.E. (March 2-4, 2021) A Model of Selenium, Sulfur, and Nitrogen Species (SeSANS): Principles and Application, ASU, virtual.
2. Van Paassen L.A. (2021 December 17) AGU Fall meeting 2021, AGU, New Orleans, Louisiana, session chair B35J - Bio-mediated and Bio-inspired Mechanisms for Hydromechanical Modification of the Subsurface, summary session

SUMMER PROGRAMS & INTERNSHIPS - [Back to CONTENTS](#)

1. Collins, H. (2021 May 26). SURI, Ira A. Fulton Schools of Engineering at Arizona State University, Protégé = Anca Castillo, FultonSchools@asu.edu.
2. Davis, T.L. (2021 Dec. 31). Chemical engineering internship, Merck Kga, Mentor = Sam Wood. 2021 Jan. 1 - 2021 Dec. 31.
3. Long, M. (Summer 2021) I mentored NEWT-ERC RET summer intern, Protégé = Sheena Carbaugh.
4. Mangus, A (2021 June-2021 August). Summer Research Internship, ASU Fulton Schools of Engineering, Protégé = Anca Castillo, FultonSchools@asu.edu.
5. Rahman, L. (Summer 2021) Internship, Swette Center, Mentor = Anwar Alsanea.
6. Skinner, J (2021/06/07) CBBG RET Program, CBBG, POC Jean Larson Jean.Larson@asu.edu, 06/01/21-06/25/21).
7. Van Paassen Hosted and mentored several attendees for the CBBG summer program 2021 including providing research experience for one teacher (RET), 2 undergraduate students (REU and one young scholar (YS).

COURSES DEVELOPED - [Back to CONTENTS](#)

1. Cadillo-Quiroz, H (2021, Fall). MIC-470/598, Bacterial Diversity & Systematics, module in which students analyze microbiome data (16S rRNA gene composition) from environmental samples to compare diversity and isolate recovery.
2. Herzer, K (2022, Spring) EVE 303 Environmental Microbiology. Changing the curriculum to address topics of environmental justice alongside the relevant objectives of the course.

ASU
Biodesign
Institute
Arizona State University



Advancement toward
renewable energy

Membrane biofilm reactors, systems, and methods for producing organic products

U.S. Patent No. 11, 155,776

Inventors: Prathap Parameswaran, Rosa Krajmalnik-Brown,
Sudeep Papat, Bruce Rittmann, Cesar Torres

Oct. 26, 2021



3. Van Paassen, L.A. (2021, spring) CEE598 Engineering Geology, provides an introduction to rock and soil identification, structural geology, geohazards and site investigation methods and strategies.
4. Van Paassen, L.A. (2021, fall) CEE598 Bio-mediated Geotechnics, Integrative course in which learn, apply and combine skills in geotechnical engineering, environmental biotechnology, geohydrology, numerical reactive transport modeling, monitoring and data analysis to develop, write and present a proposal for a field trial in which a biological process is used, which alters the hydrological and/or mechanical properties of the ground for geotechnical or geo-environmental applications.

POPULAR PRESS COVERAGE - [Back to CONTENTS](#)

1. Eustance, E. (2021, Dec. 9th). <https://www.abc15.com/weather/impact-earth/algae-could-be-key-to-reducing-carbon-emission-in-wastewater-treatment-process>
2. Eustance, E. (2021, Nov. 30th). <https://news.asu.edu/20211129-solutions-zero-waste-water>
3. Lim, XZ. (August 30, 2021). Quat disinfectants are helping during the pandemic. But could they contribute to antibiotic resistance? Features work of Rittmann Lab <https://cen.acs.org/environment/water/Quat-disinfectants-helping-during-pandemic/99/i31> (journal feature). A version of this story appeared in C&EN [Volume 99, Issue 31](#).
4. Robles A., and Delgado AG. (2021 Aug 24) Bio-based process promises better contaminant cleanup. Written by Joe Kullman. <https://fullcircle.asu.edu/research/bio-based-process-promises-better-contaminant-cleanup/> (news)
5. Robles A., and Delgado AG. Microbial chain elongation of carboxylates- a mud and soil business. Written by Anca Delgado. <https://naturemicrobiologycommunity.nature.com/posts/microbial-chain-elongation-of-carboxylates-a-mud-and-soil-business> (journal feature)
6. Robles A., Silverman MI, Delgado AG. Waste into wealth: harvesting useful products from microbial growth. Written by Richard Harth. <https://biodesign.asu.edu/news/waste-wealth-harvesting-useful-products-microbial-growth> (news)
7. Van Paassen Kullman J. (2021 July 23) Sustaining solid ground. Written by Joe Kulman. <https://engineering.asu.edu/news/sustaining-solid-ground/>



PROCESS



Figure 34 Fulton Schools Associate Professor Leon van Paassen takes samples of extracted water at the site of the project to test microbially induced desaturation for mitigating



Figure 43 Recent Fulton Schools doctoral graduate Elizabeth Stallings Young (second from the right) is shown with Portland State University students and staff members involved in characterizing soils near the Portland

COLLABORATORS - [Back to CONTENTS](#)

1. Min Long
 - a. Juan Donoso, Manav Bhati, Welman C. Elias, Kimberly N. Heck, Thomas P. Senftle, Michael S. Wong, Rice University, Newt project, 2019-present
2. Mark C. Reynolds, Dr. Steffen Buessecker, Postdoctoral Scholar, Stanford University, Coupled abiotic-biotic cycling of nitrous oxide in tropical peatlands, Fall 2021.
3. Justin Skinner
 - a. Jacob Chu, Associate Engineer, Haley & Aldrich, Enhanced Control Of Microbial Activity And Substrate Delivery Via Inhibitors For In-situ Contaminant Treatment, 08/2020-present
4. Michelle Young:
 - a. Justin Sluiter, Researcher III-Chemistry, NREL, Lignocellulose quantification, 5-21 to present
 - b. Lauren Whitaker, Special Projects Manager, City of Mesa, AZ, Lignocellulose quantification and general process consulting, since 2018
 - c. Erin Rockafellow, Technical Manager, ADM, Lignocellulose quantification, 5-21 to present
5. Cesar Torres:
 - a. [Dr. Bruce Rittmann](#), Swette Center for Environmental Biotechnology, Biodesign Institute, Arizona State University
 - b. [Dr. Rosa Krajmalnik-Brown](#), Swette Center for Environmental Biotechnology, Biodesign Institute, Arizona State University
 - c. [Dr. Andrew Marcus](#), Swette Center for Environmental Biotechnology, Biodesign Institute, Arizona State University
 - d. [Dr. Konstantinos Tsakalis](#), School of Electrical, Computer and Energy Engineering, Arizona State University
 - e. [Dr. Patrick Evans](#), CDM Smith
6. Bruce Rittmann:
 - a. [Wookeun Bae Ph.D.](#), Hanyang University, Korea
 - b. [John DiBaise M.D.](#), Mayo Clinic, AZ
 - c. [Shuangshi Dong Ph.D.](#), Jilin University, China
 - d. Pat Evans, V.P., CDM Smith, AZ
 - e. [Fatih Karadagli Ph.D.](#), [Sakarya University, Turkey](#)
 - f. [Shilpi Kushwaha Ph.D.](#), [CSIR - National Chemical Laboratory, Pune](#), India
 - g. [Hyung-Sool Lee Ph.D.](#), University of Waterloo, Canada
 - h. Ahmed Librihi Ph.D., University of Mohammad 6 Polytechnic, Morocco
 - i. [Ryan Lively Ph.D.](#), Georgia Tech., GA
 - j. [Brooke Mayer Ph.D.](#), Marquette University, WI
 - k. [Aura Ontiveros-Valencia Ph.D.](#), [University of Notre Dame, IN](#)
 - l. [Prathap Parameswaran Ph.D.](#), Kansas State University, KS
 - m. [Roberto Parra Ph.D.](#), [Intituto Tecnologico Superior De Monterrey](#),
 - n. [Sudeep Popat Ph.D.](#), Clemson University, SC
 - o. [Sen Qiao Ph.D.](#), [Dalian University of Technology, China](#)
 - p. [Sathaa Sathasivan Ph.D.](#), Western Sydney University, Australia
 - q. [Alex Schwarz Ph.D.](#), [University of Concepción](#), Chile
 - r. Yue Shi, Harbin Engineering University, China
 - s. [Steve Smith M.D.](#), Translational Research Institute for Metabolism and Diabetes, FL
 - t. [Youneng Tang Ph.D.](#), Florida Agricultural and Mechanical University, FL
 - u. Yonghong Wu Ph.D., Wuhan University, China
 - v. [Yongming Zhang Ph.D.](#), [Shanghai Normal University](#), China
 - w. [He-Ping Zhao Ph.D.](#), [Zhejiang University](#), China
 - x. Dandan Zhou Ph.D., Northeast Normal University, China
 - y. [Siqing Xia Ph.D.](#), [Tongji University](#), China
 - z. Jianglei Xiong Ph.D., Southeast University, China

NEW ANALYTICAL CAPABILITIES - [Back to CONTENTS](#)

1. Avelle, S. (Fall 2021). MBfR operation and maintenance. MBfR sampling and sample analysis by gas and ion chromatography.
2. Fakrudin, Nabhan. Research Analytics and Data Management.
3. Rahman, L., I learned how to use equipment such as a glove box and spectrophotometer. I've also learned how to interpret and relay data to someone with only 1-2 pages.
4. Reep, J. (2021, Summer). IC-ICP-MS Speciation of Selenium Species.
5. Reep, J. (2021, Summer). Total Recoverable Selenium in Bioreactor Effluent.
6. Mangus, A (2021, Fall). Confocal Microscopy.
7. Mahmood, Maheen (2021, Fall) GC and HPLC training by Michelle Young
8. Long M., 2020, Analysis of HPLC-QTOF-MS, for projects NEWT, XYLEM AND SERDP
9. Reynolds, M. Solid/liquid organic carbon analysis, quantitative polymerase chain reaction, solid waste composition and characterization.
10. Mclaughlin, C (2021, Fall). Ankom Fiber Analyzer analysis, lignocellulosic composition of sulfate-reducing bioreactors treating acid mine drainage.

NEW PURE & MIXED MICROBIAL METABOLISMS -[Back to CONTENTS](#)

1. Skinner, J (2021, Spring). Mixed Aerobic TCE Cometabolizing Culture, To degrade TCE cometabolically, C2-8
2. Skinner, J (2021, Fall), Mixed Aerobic Acetylene Degrading Culture, To degrade acetylene which is being used as a microbial inhibitor in another project, C2-8.
3. Mangus, A (2021, Fall). Geobacter sulfurreducens, pure culture, used for imaging and electrochemical studies, BDA289.
4. Young, Michelle, no name, lignocellulose degradation microcosms from rabbit cecotropes, lignocellulose degradation, 2nd floor hood

UPSCALED BIOPROCESSES - [Back to CONTENTS](#)

1. Mclaughlin, C (2021, Fall). Research in sulfate-reducing bioreactors treating acid mine drainage.
2. Van Paassen, L. (2020) Biogenic gas production for liquefaction mitigation through microbial denitrification, Meso-scale tank tests at ISTB-2 115, and field trials in Portland, Oregon.

EQUIPMENT RESPONSIBILITIES - [Back to CONTENTS](#)

Members of our Center share responsibility for maintaining equipment and training others.

1. Collins, H. (2021, Fall). 13 hours per week. Responsibilities include sampling MBfRs, testing the samples for pH, fluoride, and molybdate, and IC running.
2. Davis, TL (2021, Fall and Spring). Freezer call list. Less than 5 hours per week.
3. Miranda, E (2021). I have the same lab instruments as last year: PCR , Ion chromatography (anions, cations, perchlorate columns). I have inherited the fiber analyzer and the clean room.
4. Muse, C. (2021). Maintenance of all analytical instruments and equipment in Swette/Health Through Microbiomes. Assistance with experiment design. Assistance with method development on IC, HPLC, GC. Design, manufacture and install hood for MBfR's. Design, manufacture and install excess hydrogen capture device for MBfR's. Design, manufacture gas collection and quantification device for field deployment. Coordinate with manufactures and help with installation of Agilent GC, Balances, Metrohm IC, TOC/SMS, Horizon Dryvap (including design improvements).
Muse C. 2021 All 40 hr/wk
5. Palar, S. (2021). Measuring gas samples on the gas chromatography instrument and liquid samples on the spectrophotometer. Palar, S (2021, Summer). 18-20 hours

6. Rahman, L. (2021, Fall) I dedicate about 15-20 hours per week in doing my experiment and cleaning/ maintaining instruments used.
7. Reep, J (2021, Fall), Ankom Fiber Analyzer Responsible Person.
8. Reep, J (2021, Fall), Sparging Station Responsible Person.
9. Reynolds, M (2021). Shimadzu TOC-L & SSM module.
10. Robles, A (2021). Assumed instrument responsibilities of the TOC SSM module (2021, Fall), HPLC, and GC-FID #6. Robles, A. 0-2hrs.
11. Skinner, J. (Fall 2021) GC#5 TCD, 0-3 hours per week.
12. Skinner, J (Fall 2021) qPCR, 0-1 hours per week.
13. Trias, M (2021, Fall) 10-12 hours a week. IC machine, running samples, and analyzing data
14. Young, Michelle, backup Shimadzu HPLC
15. Young, Michelle, backup Shimadzu GC-2010 GC#5

SPECIALIZED TRAINING - [Back to CONTENTS](#)

1. Avelle, S. 2021. Account data entry and maintenance in Workday and Quartzly platforms. Data Entry. Trainer: Carole Flores. BSCEB Laboratory Manager Assistant. To process orders and receiving for interim management duties.
2. Gaura, A., (earned 2021/10/11), LEED Green Associate, USGBC, LEED, <https://www.usgbc.org/credentials/leed-green-associate>, Understanding of sustainable development and practices/ protocols
3. Herzer K (2021, November) Radiation Material Training, ASU.
4. Palar, S. (2021). I have received training throughout my mentorship with Justin Skinner throughout my undergraduate research experience and I have received lab training prior to starting the position. Research aide training, Justin Skinner (and canvas courses), ASU, beginning work in Swette center.
5. Rahman, L. (2021, October) radiation training, Tara, I trained in order to know what to do when exposed to radiation since radioactive materials will be near my workspace
6. Rahman, L. (2021, October) autoclave, information security training, biosafety, gas safety, lab safety, fire safety, hazardous waste management, ASU, the training was required to gain access to the lab and understand the hazards I may encounter.
7. Reep, J. (2021, June 29). HazWOpER 8 hour Refresher, OSHA, Superfund Site Internship.

TESTIMONIALS - [Back to CONTENTS](#)

1. Skinner, Justin. Through my research at the Swette Center I have become more confident in my abilities to solve important novel problems in environmental biotechnology and I am grateful for the culture of this space.
2. Collins, Hannah. As an undergraduate researcher in Dr. Rittmann's lab in the Swette Center, I have worked with my mentor, Chenwei Zheng, to determine which conditions in a membrane biofilm reactor (MBfR) are best for removing a variety of pollutants in wastewater, including nitrate and PFOAs. This past semester (Fall 2021), which was my first semester as a member of Dr. Rittmann's lab group, was an excellent experience for me to learn more about chemistry, microbiology, and bioremediation, which are important subjects to understand to improve environmental health. This coming semester I am looking forward to learning more about MBfRs. I am grateful to Dr. Rittmann for this research opportunity, and I am also grateful to my mentor for teaching me about MBfRs. I highly recommend working in the Swette Center, especially to those who are interested in biology research that will improve health and sustainability.