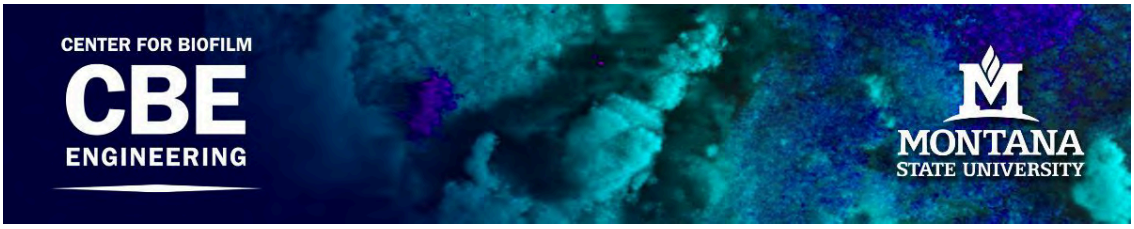


**NEWSLETTER**
**Volume 25, Issue 3 ● June 2022**

## INDUSTRY HIGHLIGHTS

### CBE 2022 Montana Biofilm Science & Technology Meeting


After two successful virtual meetings, the Center for Biofilm Engineering is pleased to host its annual Montana Biofilm Science & Technology meeting in an in-person format. The goal of the meeting is to connect CBE industrial associates and interdisciplinary collaborators for discussion on the latest developments in biofilm research and technology. The meeting will convene at the Hilton Garden Inn in Bozeman July 12 through midday Thursday, July 14. Session topics include:

- Biofilms in Space
- Medical Biofilms
- Defining a Biofilm
- Engineered Biofilms
- CBE Imaging and Analysis Capabilities

Meeting Draft Agenda

We are offering a pre-meeting workshop, Biofilm Basics, on Monday, July 11 at the CBE labs. If you are new to biofilms or need a refresher, this workshop is for you! The Standardized Biofilm Methods Lab will lead you from experimental design to data analysis. Along the way we will follow the component approach to biofilm study where growing and sampling will be highlighted. These components will be demonstrated in the lab with an opportunity for participants to get hands-on experience. For the demos, the CDC reactor and the industrial surfaces biofilm reactor will be used. Join us for a day of biofilm basics!

Workshop Draft Agenda

This invite-only workshop is available to CBE Industrial Associates at no charge. However, availability is limited and sign up is required. If you are interested in attending, please email Paul Sturman. Invited non-members are welcome to join the waitlist and may attend the workshop for a fee of $500. Contact Paul Sturman if you are interested.

#### Registration Fees

| | |
|---|---|
| Member | $600 |
| Non-Member | $1,200 |

If you are interested in membership and would like an invitation to this meeting, please contact Paul Sturman.
For CBE members who need an invitation, please contact Kristen Griffin.

**Young Investigators**
We are pleased to announce two awardees who will be presenting their biofilm research as Young Investigators at the upcoming Montana Biofilm Meeting.

- **Laura Cerqueira**, junior researcher in the Department of Chemical Engineering at the University of Porto, will present "Application of PNA-FISH based-methods for bacterial detection and localization in biofilms."
- **Joey Lockhart**, postdoctoral researcher at the University of Calgary will present "Accumulation of protoporphyrin IX by biofilm bacteria attenuates bovine neutrophil functional responses."

The CBE launched the Young Investigator program in 2009 to encourage the participation of outstanding non-Montana State University biofilm investigators at our annual Montana Biofilm Meeting. Targeting postdoctoral researchers and newly hired faculty, investigators are invited to present research at MBM and are provided funds toward travel and waived meeting registration. New this year, each investigator will receive a waiver on the fee to publish one article in *Biofilm Journal*. The call for abstracts for this award is posted each April.

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## *NEW STAFF*

**Sandra Rincon Miranda**
*Postdoc Researcher, Gerlach Lab*
Miranda is working on alkaliphilic microalgae for bioproduct and biofuel generation in the Gerlach Lab. Originally from Bogotá, Colombia, she earned her PhD from Washington State University in Chemical Engineering with an emphasis in algae biofilm. Previously, she worked as a senior associate scientist at Team Foods USA conducting research and development of plant-based products.

**Taylor Hophan-Nichols**
*Lab Manager, Bioprocess Lab*
Originally from Elkton, SD, Hophan-Nichols earned her bachelor's degree in cell biology and neuroscience from Montana State University. Previously she worked as a spore lab analyst at Mesa Laboratories, and as an analytical scientist at Nature's Fynd.

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## *PUBLICATIONS*

"Experimental designs to study the aggregation and colonization of biofilms by video microscopy with statistical confidence"
**Pettygrove, Brian A., Heidi J. Smith**, Kyler B. Pallister, Jovanka M. Voyich, **Philip S. Stewart**, **Albert E. Parker**
*Frontiers in Microbiol.*, 2022, 12: 785182.
Read abstract

"*In situ* enhancement and isotopic labeling of biogenic coalbed methane"
**Barnhart, Elliott P.**, Leslie F. Ruppert, **Randy Hiebert**, **Heidi J. Smith**, **Hannah D.**

Kilian Ashley, Shuhei Ono, Anna M. Martini, Keith C. Hackley, **Robin Gerlach**, Lee Spangler, **Adrienne J. Phillips**, Mark Barry, **Alfred B. Cunningham**, **Matthew W. Fields**
*Environ Sci Technol.*, 2022, 56(5):3225–3233.
Read abstract

"Subsurface hydrocarbon degradation strategies in low- and high-sulfate coal seam communities identified with activity-based metagenomics"
**Schweitzer, Hannah D.**, **Heidi J. Smith**, **Elliott P. Barnhart**, Luke J. McKay, **Robin Gerlach**, **Alfred B. Cunningham**, Rex R. Malmstrom, Danielle Goudeau, **Matthew Fields**
*npj Biofilms and Microbiomes*, 2022, 8: 7.
Read abstract

*View CBE Publications Database*

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# *EDUCATION*

## Thesis Alert

"Improving pH and temperature stability of urease for ureolysis-induced calcium carbonate precipitation," successful thesis defense by **Arda Akyel**, PhD candidate, chemical & biological engineering, Montana State University, April 29, 2022.
*Read thesis abstract*

"Algal biofilms and lipids: Bicarbonate amendment and nitrate stress to stimulate lipid accumulation in algal biofilms," successful thesis defense by **Muneeb Rathore**, PhD candidate, chemical & biological engineering, Montana State University, May 9, 2022.
*Read thesis abstract*

*View CBE Thesis Abstract Database*

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## CBE researchers win College of Engineering awards

Christine Foreman, professor of chemical and biological engineering, was named recently the 2022 Distinguished Professor at the Norm Asbjornson College of Engineering for her sustained record of excellence in research, teaching, and mentoring. Likewise, Markus Dieser, assistant research professor of chemical and biological engineering, took home the Research Excellence award from NACOE the same afternoon. His nominator observed, "Markus has made it his life's work to help others achieve their research goals."

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# *OUTREACH*

## Recently launched 'Biofilm First' podcast surpasses 300 downloads

its 300th download after just four episodes. The following episodes from Season 1 are available for downloading: Heidi Smith, Erika Espinosa-Ortiz, Darla Goeres, Garth James, and Dana Skorupa. Forthcoming interviews include Heidi Smith, Matthew Fields, and Paul Sturman. We invite you to subscribe to the "Biofilm First" podcast.

## 2022 'CBE Annual Report' to be available at MBM


The CBE moved up its publication schedule to ensure the 2022 *CBE Annual Report* will be ready to distribute at the 2022 Montana Biofilm Meeting July 12-14. The cover story is on the recent acquisition of microscopy equipment that will allow researchers to peer deeper into the biofilm matrix than previously possible. Also, we're featuring an insightful interview with Tony Rook, the designated representative of longtime Industrial Associate Sherwin-Williams.

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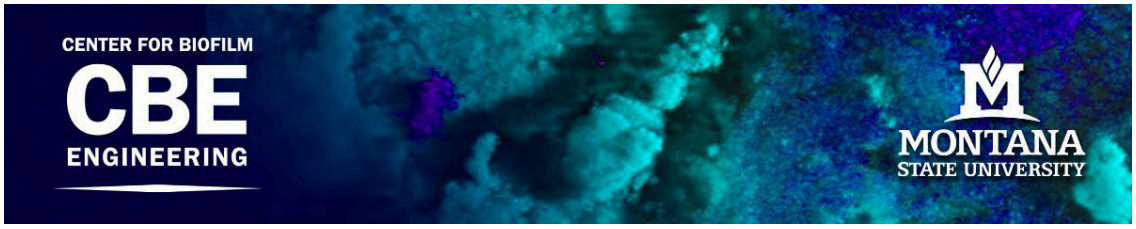
**Our mailing address is:**
Center for Biofilm Engineering
Montana State University, 366 Barnard Hall
Bozeman, MT 59717

**Contact:** cbeinfo@biofilm.montana.edu




CBE NEWSLETTER • Volume 26, Issue 2 • May 2023

## *INDUSTRY*

### *Register today* for our biggest meeting of the year!


**Registration is open** for the 2023 Montana Biofilm Science and Technology Meeting to be held at the Hilton Garden Inn in beautiful Bozeman, Montana, July 11-13. The meeting will blend fundamental and applied presentations on biofilm research happening at CBE and select other facilities, with time for connecting with industry and academia to discuss the latest developments in biofilm research and technology. *Importantly*, this year, we will feature a full-day workshop on **Engineered Living Materials** (ELM), on Thursday, July 13. Additional topic sessions include medical biofilms and the hospital environment, biofilms and surface interactions, multi-species biofilm, and measuring biofilm.

ELMs are a developing class of material that have additional or unique functionalities resulting from the inclusion of living cells on or within the material. These functionalities could include self-assembly, self-repair, and sensing that can enable secondary functions such as increased resilience, conversion of compounds, biomaterial production, drug manufacturing, and energy generation or storage. ELMs are expected to provide improved sustainability in material development, manufacturing, and use. ELM programming does not have a dedicated venue where academic and industry participants across multiple fields can exchange ideas, challenges, and solutions that move the field forward. Academic attendees wishing to register for the ELM workshop only, will be able to do so, complimentary, via the registration website. Funds are available to help support the participation of individuals from underrepresented groups; an application for these funds is available via registration. Contact Kristen Griffin for the link to register for the ELM.

See the Draft Agenda for more information on this three-day meeting.

| | Early Registration | Regular Registration (after June 9) |
|---|---|---|
| Member | $750 | $800 |
| Non-Member | $1,200 | $1,300 |
| Gov't & Academic | $750 | $800 |

Is your company not yet a member of the CBE's longstanding Industrial Associates Program but would like to attend this meeting? Please contact Darla Goeres.

**CBE undergraduates present at major research conference**

Several students at the Center for Biofilm Engineering presented at the 2023 National Conference on Undergraduate Research. NCUR, an annual major research conference, brings together thousands of students and their faculty mentors.

**CBE NCUR presenters ...**

- **Aspen Burke**, Chemical Engineering
- **Taylor Carey**, Chemical Engineering
- **Lydia Diehl**, Biological Sciences
- **Emory Hoelscher-Hull**, Microbiology
- **Ruby Jackson**, Mechanical Engineering
- **Natasha Peterson**, Cell Biology & Neuroscience
- **Rory Rasch**, Mechanical Engineering
- **Christy Teska**, Chemical Engineering


## LATEST PUBLICATIONS

"A desiccated dual-species subaerial biofilm reprograms its metabolism and affects water dynamics in limestone"
Villa, F., N. Ludwig, S. Mazzini, L. Scaglioni, A.L. Fuchs, B. Tripet, V. Copié, **Phil S. Stewart**, F. Cappitelli
*Science of the Total Environment,* 2023, 868:161666.
Read abstract

"Genome sequence, phylogenetic analysis, and structure-based annotation reveal metabolic potential of *Chlorella* sp. SLA-04"
**Goemann, Calvin L.C.,** Royce Wilkinson, Willam Henriques, **Huyen Bui**, **Hannah M. Goemann**, **Ross P. Carlson**, Sridhar Viamajala, **Robin Gerlach**, Blake Wiedenheft
*Algal Research,* 2023, 69:102943.
Read abstract

"Longitudinal analysis of the Five Sisters hot springs in Yellowstone National Park reveals a dynamic thermoalkaline environment"
Peach, Jesse T., Rebecca C. Mueller, Dana J. Skorupa, Margaux M. Mesle, Sutton Kanta, Eric Boltinghouse, Bailey Sharon, Valerie Copié, Brian Bothner, Brent M. Peyton
*Scientific Reports*, 2023, 12:18707.
Read abstract

"Mitigation and Use of Biofilms in Space for the Benefit of Human Space Exploration"
Vélez Justiniano, Yo-Ann, **Darla M. Goeres**, **Elizabeth L. Sandvik**, **Birthe Veno Kjellerup**, Tatyana A. Sysoeva, Jacob S. Harris, **Stephan Warnat**, **Matthew McGlennen, Christine M. Foreman,** Jiseon Yang, Wenyan Li, Chelsi D. Cassilly, Katelyn Lott, Lauren E. HerrNeckar
*Biofilm*, 2023, 5:100102.
Read abstract

"Rapid parallel generation of a fluorescently barcoded drop library from a microtiter plate using the plate-interfacing parallel encapsulation (PIPE) chip"
**Zath, Geoffrey K.**, Ralph A. Sperling, **Carter W. Hoffman**, **Dimitri Bikos**, **Reha Abbasi**, Adam R. Abate, David A. Weitz, **Connie Chang**
*Lab on a Chip*, 2022, 23: 4735-4745.
Read abstract

"Single-cell infection of influenza A virus using drop-based microfluidics"
**Loveday, Emma K.**, **Humberto S. Sanchez**, **Mallory M. Thomas**, **Connie Chang**

View the comprehensive CBE Publications Database that contains 1,403 publications dating back to the 1970s.

## OUTREACH

**Goeres to serve as ERA Chair at Portugal facility**

**Matthew Fields** and **Darla Goeres** participated in the kickoff meeting for e.BIOFILMS, a project funded by an EU Horizons grant. The grants will support Goeres as an ERA Chair in the Laboratory for Process Engineering, Environment, Biotechnology and Engineering in the Faculty of Engineering-University of Porto, Portugal. e.BIOFILMS will focus on developing a center of excellence on engineered biofilms in Biofilm Engineering Laboratory at LEPABE.

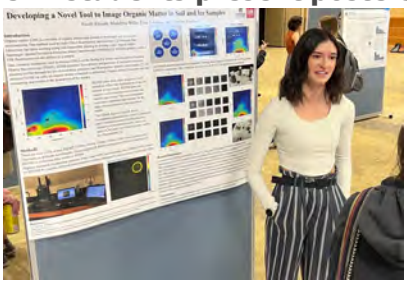
**CBE collaborator Wade helps launch biofilm training center in Australia**

**Scott Wade**, former visiting researcher at the CBE, was instrumental in planning and launching the Training Centre for Biofilm Research and Innovation based at Australia's Flinders University. According to its website, the new center "will explore the microbiological complexities of biofilms commonly found on shipping vessels. Marine biofilms cause billions of dollars a year in loss of infrastructure, contamination and cleaning worldwide." Wade's research interests at Swinburne University of Technology include microbially influenced corrosion, aka bio corrosion.

**MSU's STEAM Day draws students from around Montana**

**Ellen Lauchnor**, CBE Principal Investigator and MSU associate professor of civil engineering (left), and CBE graduate students **Stephanie Ayotte** (center) and **Jenna Delwiche**, participated in MSU's STEAM Day in April. The trio hosted a workshop for students about water treatment by cleaning up our own samples of dirty water using various filtration techniques. Environmental engineers work to make our water safe to drink and use. In towns like Bozeman, water from natural sources is purified to clean, tasty drinking water in a treatment plant. In the workshop, students learned about water treatment by cleaning up our own samples of dirty water using various filtration techniques.

**CBE students present posters at MSU's Student Research Celebration**



CBE students participated in Montana State University's 2023 Student Research Celebration held in April. The event featured the work of both graduate and undergraduate students from disciplines across all of MSU's colleges. About 160 students presented their research posters, offering explanations and results of their projects to the Bozeman community. Participating CBE students include **Lexia Dauenhauer**, **Ruby Jackson**, **Nicole Krysiak** (pictured), **Steven Watson**, and **Eric Welch**.

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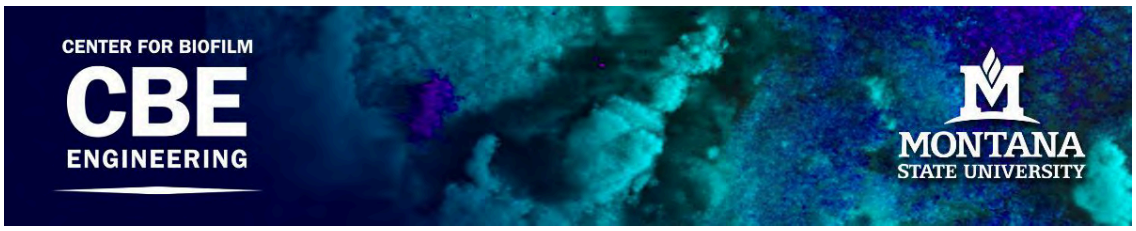


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## *INDUSTRY*

### Jackhammers aside, our 2023 regulatory pathways meeting was a success


The 2023 Anti-Biofilm Technologies: Pathways to Product Development meeting convened 70 industrial associates, potential members, academic researcherspeers from overseas, and, of course, scientists and policymakers from the US EPA and US FDA. By all counts, attendees and presenters alike found the annual conference to be informative and a valuable forum for networking, according to the post-conference survey results. Generously, none of the survey respondents noted the persistent jackhammering during Michael Eppihimer's keynote address. Eppihimer, director of the FDA's Division of Biology, Chemistry and Material Sciences, stated his desire to work more closely with academic researchers to perhaps increase the productivity of existing cooperative pipelines. Sessions during the two-day gathering were "Reusable Medical Devices," Bioremediation," "Emerging Surface Disinfection Methods," "Global Perspectives on Biofilm Claims," and a panel discussion titled, "Assessing cleaning and disinfecting procedures for reusable medical devices to improve patient safety," moderated by Darla Goeres from the CBE.



### Selected videos from our DC meeting are available exclusively to IAs

*Benefits exclusive to member of the CBE Industrial Associates include access to proprietary content, such as select videos from our conferences and seminars. If your organization would like to become a member, please contact Paul Sturman for more information. To view some of the talks from the 2023 Biofilm Technologies: Pathways to Product Development meeting, please login to the CBE Industrial Associates members only page.* ***For information on becoming a member to the CBE's innovative Industrial Associates program, please contact Paul Sturman.***

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### CBE sees surge in new Industrial Associates

Membership in the CBE's innovative Industrial Associates program surged to 29 members, after five companies joined in recent weeks.

**BioSure North America** joined the IA program as a Small Business member. BioSure

PROFESSIONAL [BioSure developed] a water-based sanitizer via an ozonation method that uses water to produce oxygen, and then super-pure ozone that reverts back to oxygen. BioSure's core technology was born."

**Newell Brands** also joined the IA program. Newell makes a wide variety of high-profile consumer products, including Elmer's Glue, pens and markers (Sharpie, Paper Mate), food and beverage storage (Rubbermaid, Ball mason jars), outdoor products (Coleman, Marmot), home appliances (Crockpot, Mr. Coffee, Osterizer) baby products (Baby Jogger, Graco) and commercial cleaning products. The designated representative from Newell is R&D Director **Bryan Koepp**.

Two companies joined the IA program on the same day: **Johnson & Johnson Consumer Health** and **ProEdge Dental**. According to Paul Sturman, coordinator for the IA program, J&JCH, a leader in the skin health and beauty products industry, is interested in methods development. It's designated representative is **Francisco (Pancho) Fields**, a senior research scientist.

**ProEdge Dental**, which makes antimicrobial products for dental unit water lines, has joined our IA program as a small member. The designated representative is **Mark Frampton**, ProEdge Dental's chief executive officer.

**Halomine, Inc.**, also recently joined the CBE IA program as a small-business member. Halomine has developed a rechargeable chlorine-containing surface coating for use in a wide variety of applications from critical care to industry. Halomine's designated representative is chief technical officer.

## LATEST PUBLICATIONS

"18β-glycyrrhetinic acid induces metabolic changes and reduces *Staphylococcus aureus b*acterial cell-to-cell interactions"
Weaver, Alan J., Jr., **Timothy R. Borgogna**, Galen O'Shea-Stone, Tami R. Peters, Valérie Copié, Jovanka Voyich, and Martin Teintze
*Antibiotics*, 2022, 11(6): 781.
Read abstract

"Attraction, entrance, and passage efficiency of Arctic grayling, trout, and suckers at Denil fishways in the Big Hole River Basin, Montana"
Triano, Ben, Kevin M. Kappenman, Thomas E. McMahon, Matt Blank, Kurt C. Heim, **Albert E. Parker**, Alexander V. Zale, Nolan Platt, Katey Plymesser
*Transactions of the American Fisheries Society*, July 2022, 151(4):453-473.
Read abstract

"Biochar as a renewable substitute for carbon black in lithium-Ion battery electrodes"
**Kane, Seth**, Aksiin Storer, Wei Xu, **Cecily Ryan**, Nicolas P. Stadie
*ACS Sustainable Chem Eng.*, September 2022, 10(37): 12226-12233.
Read abstract

"Carpenter bee thorax vibration and force generation inform pollen release mechanisms during floral buzzing"
Jankauski, Mark, **Cailin Casey**, **Chelsea Heveran**, Stephen Buchmann

"Environment constrains fitness advantages of division of labor in microbial consortia engineered for metabolite push or pull interactions"
**Beck, Ashley E., Kathryn Pintar**, **Ashley Schrammeck**, Timothy Johnson, Alissa Bleem, **Martina Du**, William R. Harcombe, Hans C. Bernstein, **Jeffrey J. Heys**, Tomas Gedeon, **Ross P. Carlson**
*mSystems*, June 2022, 7(4): e00051-22.
Read abstract

"Evaluation of the bonding properties between low-value plastic fibers treated with microbially-induced calcium carbonate precipitation and cement mortar"
**Espinal, Michael**, **Seth Kane**, **Cecily Ryan**, **Adrienne Phillips**, **Chelsea Heveran**
*Construction and Building Materials*, November 2022, 357:129331.
Read abstract

"Formability characterization of fiber reinforced polymer composites using a novel test method"
Janicki, Joseph C., Matthew C. Egloff, **Roberta Amendola**, **Cecily A. Ryan**, Dilpreet S. Bajwa, Alexey Dynkin, Douglas S. Cairns
*Journal of Testing and Evaluation*, 2022, 50(2):1140-1154.
Read abstract

"Hypochlorous acid produced at the counter electrode inhibits catalase and increases bactericidal activity of a hydrogen peroxide generating electrochemical bandage"
Anoy, Md Monzurul Islam, Suzanne Gelston, Abdelrhman Mohamed, Laure Flurin, Yash S. Raval, Kerryl Greenwood-Quaintance, Robin Patel, **Zbigniew Lewandowski**
*Bioelectrochemistry*, December 2022, 148:108261.
Read abstract

"Imaging and plate counting to quantify the effect of an antimicrobial: A case study of a photo-activated chlorine dioxide treatment"
**Parker, Albert E.**, **Lindsey Miller**, **Jacob Adams**, **Charles Pettigrew**, **Kelli Buckingham-Meyer**, **Jennifer Summers**, Andres Christen, **Darla Goeres**
*J Appl Microbiol.*, December 2022, 133(6):3413-3423.
Read abstract

"Interactions of microorganisms within a urinary catheter polymicrobial biofilm model"
**Allkja, Jontana**, **Darla M. Goeres**, Andrea S. Azevedo, Nuno F. Azevedo
*Biotechnol Bioeng.*, September 2022, 120(1):239-249.
Read abstract

"Pharmaceutical sorption to lab materials may overestimate rates of removal in lab-scale bioreactors"
**Bodle, Kylie B.**, **Madeline R. Pernat**, **Catherine M. Kirkland**
*Water, Air, & Soil Pollution*, 2022, 233:505.
Read abstract

"Subchondral bone structure and synovial fluid metabolism are altered in injured and contralateral limbs 7 days after non-invasive joint injury in skeletally-mature C57BL/6 mice"
**Hislop, Brady D.**, C. Devin, R.K. June, **Chelsea M. Heveran**
*Osteoarthritis and Cartilage*, December 2022, 30(12):1593-1605.
Read abstract

"The biofilm life cycle: Expanding the conceptual model of biofilm formation"
Sauer, Karin, Paul Stoodley, **Darla M. Goeres**, Luanne Hall-Stoodley, Mette Burmølle, **Philip S. Stewart**, Thomas Bjarnsholt

"Transfer and persistence of bovine immunoglobulins in lambs fed a colostrum replacer" Johnson, Thea, Bryan Tegner Jacobson, Kerri Jones, Cassie Mosdal, Steve Jones, Maia Vitkovic, Sam Kruppenbacher, Andy Sebrell, **Diane Bimczok**
*Vet Record*, November 2022, 191(10):e1974.
Read abstract

View the comprehensive CBE Publications Database that contains 1,397 publications dating back to the 1970s.

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# *EDUCATION*

## CBE continues to dominate '3-Minute Thesis' competition

CBE PhD student **Madelyn Mettler** won the Judge's Award in this year's 3-Minute Thesis for "Space Slime vs. Material Coatings?" For her strong — and speedy! — performance, Mettler won an iPad. This competition was limited to doctoral students in the Norm Asbjornson College of Engineering. By virtue of her win, Mettler, who works in the Peyton Lab, will compete in the campus-wide 3MT competition later this semester. CBE students have dominated the "3-Minute Thesis," winning eight of nine competitions since its debut at the Norm Asbjornson College of Engineering in 2015.

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# *OUTREACH*

## LinkedIn becoming important communications tool for CBE

The CBE is leveraging LinkedIn as a key tool in its communication and outreach efforts. Although we've had a LinkedIn presence as a networking tool for many years, we've begun using it as an important forum to engage our myriad constituencies that span from members of our industrial associates program to undergraduates considering joining the CBE as emerging researchers. Please connect with us at LinkedIn by following this link.

## CBE celebrates in International Women in Science Day


Fun fact: There are far more female students, faculty, and staff at the CBE than male and nonbinary. So, of course we celebrating this important day with outreach to tomorrow's potential Women in STEM. Faculty, staff, and students hosted tables at the Museum of the Rockies and the Montana Science Center to engage the public with their research and to encourage young, bright minds to consider careers in science, technology, math, and engineering. Seen here is Christine Foreman conducting an experiment with a 5-year-old girl on IWSD.

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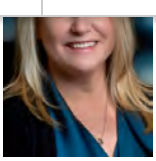
## Foreman delivers Provost's Lecture

The vast expanses of ice found in the Earth's polar regions may seem like an inhospitable wasteland devoid of life. But if you look closely, and in the right places, you'll find a plethora of microorganisms eking out a living in awe-inspiring ways, according to CBE-affiliated faculty member Christine Foreman. Foreman, who has conducted 11 seasons of



Distinguished Lecturer Series.

## MSU honors Richards with mentorship award

Montana State University bestowed upon CBE-affiliated faculty member **Abigail Richards**, associate professor and head of the Department of Chemical and Biological Engineering, the 2023 Women's Faculty Caucus Distinguished Mentor Award. The campus-wide award recognizes extraordinary efforts by a faculty or staff member in mentoring women students, staff, research associates and faculty at MSU. Richards is a heavily decorated faculty, having won five awards at MSU since 2011.

## CBE recognizes faculty, students, and staff for outstanding performances

Industrial Coordinator **Paul Sturman won the 2022 CBE Faculty Award**. According to the nomination letter, he was "recognized for his 20 years of dedication to the CBE Mission of industrial interaction, interdisciplinary research, and hands-on learning. The steady growth and global admiration of the CBE Industry Program can be attributed to Paul's intelligence, adaptability, and talent for engaging and nurturing relationships with industry and academia."

PhD student **Hannah Goemann won the 2022 W.G. Characklis Award**, which is presented annually to a CBE doctoral student based on their contributions to research and education. The award honors CBE founder Bill Characklis who died at the age of 50 in 1992, shortly after the center won its seed money from the National Science Foundation in the form of an Engineering Research Center grant.

PhD student **Kylie Boyle won the 2022 John Newman Student Citizen Award**, which is presented in honor of Neuman, who served as CBE technical operations manager from 1994–2008. According to Bodle's nomination letter, "We recognize Kylie for her productive and respectful use of CBE instruments and her impeccable job of troubleshooting issues, and helping her students. … Kylie uses the same level of analytical precision as John Neuman (the award namesake), but with great speed, covering a lot of ground in a day. She is one of the hardest workers at the CBE."

Program coordinator **Sarah Huth, who staffs the front desk at the CBE, won the 2022 Staff Award**. According to Huth's nomination letter, she "is recognized for their exemplary job as the first line of contact of the CBE. … Sarah manages an enormous breadth of job duties and tackles them with intelligence, enthusiasm, and care. Finally, Sarah is a role model for hospitality, welcoming all who walk through our door with an open mind and heart."

JOBS

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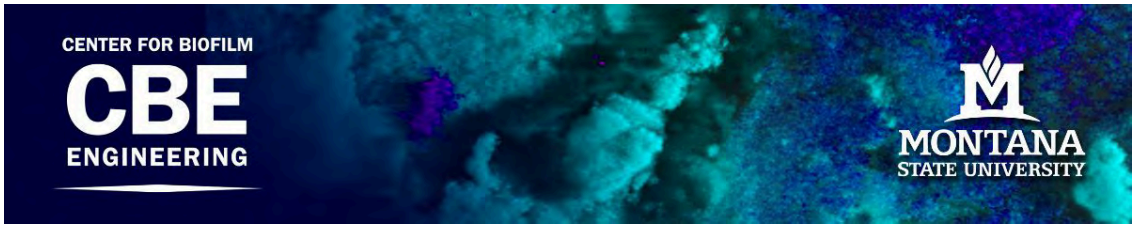


CBE NEWSLETTER • Volume 25, Issue 5 • November 2022

## INDUSTRY HIGHLIGHTS

### IMPORTANT: 2023 CBE Regulatory Pathways Meeting


The CBE is pleased to host its annual regulatory meeting, Anti-Biofilm Technologies: Pathways to Product Development, in an in-person format in 2023. The invite-only meeting will be held on February 7 & 8, 2023 at the Hilton Arlington National Landing Hotel in Arlington, Virginia. Don't miss this opportunity to be part of a meeting that engages industry, academia, and federal agencies on the impact of biofilm in our daily lives.

Over the past decade, academic research advances and private company R&D efforts have led to the development of innovative anti-biofilm technologies with transformative potential in the consumer products and healthcare arenas. Likewise, advances in methods for studying and assessing biofilms have provided new insights into important biofilm characteristics such as why biofilms are difficult to kill and remove from surfaces. The CBE is sponsoring this meeting for the tenth consecutive year in an effort to bring together industry, regulatory agencies, and academia to discuss anti-biofilm-related technologies, research, and regulatory pathways.

The two-day, in-person meeting will feature sessions on FDA- and EPA-specific regulatory topics as well as an FDA Keynote presentation on the OSEL Sterility and Infection Control Regulatory Science Program and stakeholder needs.

#### Session topics include ...

- Reusable medical devices (talks & panel)
- Emerging surface disinfection methods
- Bioremediation
- Global perspectives on biofilm claims

Draft Agenda

#### Costs

| | Early Registration (Until January 13, 2023) | Regular Registration (After January 13, 2023) |
|---|---|---|
| Member | $750 | $800 |

| | | |
|---|---|---|
| Government | n/c | n/c |

If you are interested in membership and would like an invitation to this meeting, please contact Paul Sturman.

For CBE members or government personnel who need an invitation, please contact Kristen Griffin.

About the CBE Industrial Associates Program.

## *RESEARCH*

### USDA grant seeks to improve quality of maple syrup

Maple candies, glazes, and the syrup drizzled on a hot stack of pancakes could all get a little sweeter and fresher-tasting thanks to research at Montana State University. Backed by a new three-year, $500,000 grant from the US Department of Agriculture, a team led by CBE-affiliated faculty Stephan Warnat is developing innovative sensor networks to monitor microbes that accumulate in equipment used to harvest maple sap that are known to degrade the taste of finished products. Read more

### Yellowstone offers undergrads unique research experience

During their multi-day visit to the remote Heart Lake Geyser Basin, the 12 undergraduate students measured the temperature, acidity, and other characteristics of colorful hot springs and collected small samples of the water to analyze in a lab back on the MSU campus. Their goal: to find microbes that, by being adapted to the extreme environment, may be able to break down plastic into usable chemicals. "This is really unique experience in a place that not a lot of other people see," said Dana Skorupa, a CBE-affiliated faculty member.

## *LATEST PUBLICATIONS*

"A novel irrigant to eliminate planktonic bacteria and eradicate biofilm superstructure with persistent effect during total hip arthroplasty"
Bashyal, Ravi K., Matt Mathew, Edward Bowen, **Garth A. James**, David Stulberg
*J Arthroplasty*, 2022, 37(7):s647-S652.
Read abstract

Fishways in the Big Hole River Basin, Montana"
Triano, Ben, Kevin M. Kappenman, Thomas E. McMahon, Matt Blank, Kurt C. Heim, **Albert E. Parker,** Alexander V. Zale, Nolan Platt, Katey Plymesser
*Transactions of the American Fisheries Society*, July 2022, 151(4):453-473.
Read abstract

"Chickensplash! Exploring the health concerns of washing raw chicken"
**Carmody, Caitlin D.**, **Rebecca C. Mueller**, Benjamin Michael Grodner, **Ondrej Chlumsky**, **James N. Wilking**, **Scott G. McCalla**
*Physics of Fluids*, 2022, 34(3).
Read abstract

"Correlative SIP-FISH-Raman-SEM-NanoSIMS links identity, morphology, biochemistry, and physiology of environmental microbes"
**Schaible, George A.**, **Anthony Kohtz**, John Cliff, **Roland Hatzenpichler**
*ISME Communications*, June 2022, 2:52.
Read abstract

"Granular Matrigel: Restructuring a trusted extracellular matrix material for improved permeability"
**Mahdieh, Zahra,** Michelle D. Cherne, **Jacob P. Fredrikson**, **Barkan Sidar, Humberto S. Sanchez, Connie B. Chang, Diane Bimczok, James Wilking**
*Biomedical Materials*, June 2022, 17(4):045020.
Read abstract

"Harvesting and disaggregation: An overlooked step in biofilm methods research"
**Buckingham-Meyer, Kelli**, **Lindsey A. Miller**, **Albert E. Parker**, **Diane K. Walker**, **Paul Sturman**, **Ian Novak**, **Darla M. Goeres**
*J Visualized Experiment*, 2022, 182:e62390.
Read abstract

"Interlaboratory evaluations of a standardized quantitative test method for determining the bactericidal and tuberculocidal efficacy of antimicrobial substances on hard non-porous surfaces"
Tomasino, Stephen F., Rebecca M. Pines, **Darla M. Goeres**, **Albert E. Parker**
*J Microbiol Methods*, 2022, 196:106460.
Read abstract

"Metabolomic profiling and mechanotransduction of single chondrocytes encapsulated in alginate microgels"
**Fredrikson, Jacob. P.**, Priyanka P. Brahmachary, **Ayten E. Erdoğan**, Zackary K. Archambault, **James N. Wilking**, Ronald K. June, **Connie B. Chang**
*Cells*, 2022, 11(5):900.
Read abstract

"Microbiologically influenced corrosion of copper and its alloys in anaerobic aqueous environments: A review"
**Amendola, Roberta**, **Amit Acharjee**
*Frontiers Microbiol*, 2022, 13:806688.
Read abstract

"Search for a shared genetic or biochemical basis for biofilm tolerance to antibiotics across bacterial species"
**Stewart, Philip S.**, **Kerry S. Williamson**, **Laura Boegli**, Timothy Hamerly, Ben White,

*Antimicrob Agents Chemother*, 2022, 66(4): e0002122.
Read abstract

View the comprehensive CBE Publications Database that contains 1,383 publications dating back to the 1970s.

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## *THESIS ALERT*

"Performance of aerobic granular sludge (AGS) to remove Poly-perfluoroalkyl substances (PFAS)," successful thesis defense by **Tasnim Ritu**, masters candidate, civil and environmental engineering, Montana State University, November 29, 2022.
*Read thesis abstract*

*View the comprehensive CBE Thesis Abstract Database.*

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## *OUTREACH*

### CBE researchers present at ASM Conference on Biofilms

*The following CBE faculty and students were invited to give presentations and poster presentations at ASM Conference on Biofilms in Charlotte, NC, Nov. 13–17, 2022:*

PRESENTATIONS
**Shawna Pratt**, PhD candidate, chemical & biological engineering, on behalf of CBE Director **Matthew Fields**, professor, microbiology & cell biology: "Building synthetic biofilm via 3-D printing"

**Phil Stewart**, Regents Professor, chemical & biological engineering: "Sorbed host proteins mediate neutrophil adhesion, motility, and discovery of *Staphylococcus aureus* on an antibiotic surface"

POSTER PRESENTATIONS
**Christine Foreman**, professor, chemical & biological engineering: "Ice nucleation activity of microplastics"

**Garth James**, professor, chemical & biological engineering: "Microscopic detection and semi-quantitative scoring of biofilms in venous leg ulcers"

**Matthew McGlennen**, PhD candidate, mechanical & industrial engineering: "Real-time sensing of biofilm"

**Shawna Pratt**, PhD candidate, chemical & biological engineering: "Hydrogel-shelled microcapasules enable permeable, single-cell bacterial culture"

**Elizabeth Sandvik**, Research Engineer: "Nutrient removal as a biofilm fouling control strategy in an International Space Station water recovery system"

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### In case you missed these CBE podcasts …


Dr. Garth James
"The devastating impact of biofilms in chronic wounds"


Dr. Darla Goeres
"Biofilms and skunky smelling, funky tasting draft beer"


Dr. Heidi Smith
"The future of biofilm research is microscopic"


Dr. Dana Skorupa
"Thermophiles, and Yellowstone's caustic waters"


Dr. Erika Espinosa-Ortiz
"Myriad uses for fungal-based technologies"

Is there a CBE researcher you'd like to hear featured in the forthcoming Season 2 of our "Biofilm First" podcast? Email your suggestion to Skip Anderson.

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## Selected Videos from our fall 2022 Seminar Series

*Benefits exclusive to member of the CBE Industrial Associates include access to proprietary content. If your organization would like to become a member, please contact Paul Sturman for more information. To view any of the three featured talks listed below, please login to the CBE Industrial Associates members only page.*

Sept. 22, 2022
"Removal of polymeric substrates from wastewater by aerobic granular sludge technology"
**Sara Toja-Ortega**, Visiting PhD Student, TU Delft

Sept. 29, 2022
"Microbes and Biomechanics"
**Christopher Hernandez**, Professor, Sibley School of Mechanical and Aerospace Engineering, Cornell University

Oct. 6, 2022
"Sustainable protein production for food applications from a microbe, Fusarium strain flavolapis, isolated from Yellowstone National Park"
**Dr. Christopher Smith**, Director, R&D-Bozeman, Nature's Fynd

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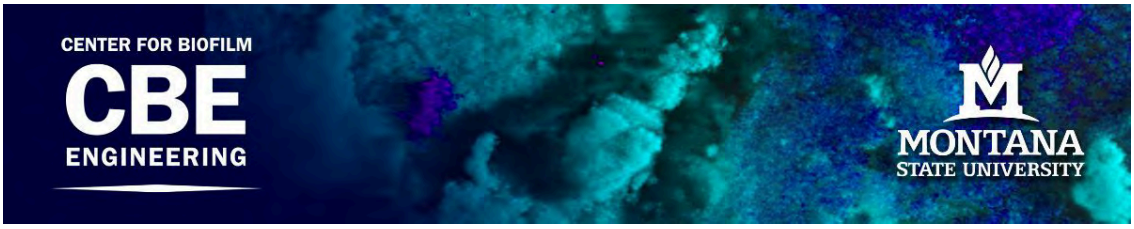


# NEWSLETTER
## Volume 25, Issue 4 ● August 2022

## INDUSTRY HIGHLIGHTS

### RECAP: CBE 2022 Montana Biofilm Science & Technology Meeting


After two successful virtual meetings, the Center for Biofilm Engineering was genuinely delighted to host its annual **Montana Biofilm Science & Technology meeting** in-person! It was terrific to see everybody, and the presentations were outstanding. The sessions included Biofilms in Space, Medical Biofilms, Defining a Biofilm, Engineered Biofilms, and CBE Imaging and Analysis Capabilities.

Prior to the first day of presentations, the CBE hosted a hands-on **biofilm basics workshop**. The CBE's Standardized Biofilm Methods Lab walked attendees through concepts and practices including experimental design and data analysis. Participants were provided hands-on experience with the CDC reactor and the industrial surfaces biofilm reactor.

**Heidi Smith**, CBE Bioimaging Facility manger, shared details about the potential offered by the recent $1.5 million upgrade to the microscopy equipment, which she oversaw. **Darla Goeres** administered a survey at the beginning of the session Defining a Biofilm, and again at the end of the session, demonstrating that there is still a ways to go in agreement on what constitutes (and doesn't) a biofilm. **Garth James** led the Medical Biofilms session, which featured **Phil Stewart** exploring a fundamental question: "Is there a universal biofilm defense?" The session also included talks by two "Young Investigators:" **Laura Cerqueira**, a junior researcher from the University of Porto, and **Joey Lockhart**, a postdoc from the University of Calgary. Speakers in the Engineered Biofilms session examined the use of biofilms in creating adhesives, "bones," and more sustainable building materials; as well as the use of 3D printing in biofilm research. The meeting closed out with riveting presentations about eliminating and preventing biofilm growth in spacecrafts, as well as growing foods in microgravity that could sustain astronauts 1.5-year-long roundtrip missions to Mars. **Liz Sandvik** chaired that session.

### Save the Date!

The CBE will be pulling into Arlington, VA, in early February 2023 for our annual **Pathways to Product Development** regulatory meeting, which features speakers from academia, industry, and regulatory officials. The dates of the conference and registration details will be available soon.

BIOFILM TECHNOLOGIES PATHWAYS TO PRODUCT DEVELOPMENT

# RESEARCH

## PhD students use 3D printing to advance biofilm science

Tapping into advances in 3D printing, two CBE PhD students are developing a tool to deposit microbes and create biofilms, resulting in microbial mosaics so that innovative anti-biofilm treatments can be studied. **Isaak Thornton**, who is earning his doctorate in mechanical engineering; and **Kathryn Zimlich**, a microbiology doctoral student, are mapping out microbes within drops of liquid hydrogel resin, then use laser light to solidify the material, constructing a rudimentary biofilm. They presented their work at the 2022 Montana Biofilm Meeting.

## Astronauts may grow, eat biofilms on journey to Mars

Future astronauts heading to Mars may find themselves dining on a nutritious, meat-like product made from a microbe that CBE scientists discovered in a Yellowstone National Park hot spring. In July, a group of small bioreactors arrived at the International Space Station to test how well the microbe can be grown in microgravity. **Ross Carlson**, CBE affiliated faculty member, is leading the experiment along with post-doc researcher **Laura Camilleri**. "We think there's a lot of potential for this fungus to help NASA with its goal of sending humans to Mars," Carlson said. The samples are expected to arrive back at the CBE in the next few weeks at which time Carlson will analyze the results. #BiofilmsInSpace

## NIH awards Roland Hatzenpichler $1.7 million to study gut microbiome

A biochemist focusing on microbiology is the latest Montana State University researcher to have their work recognized and funded through a National Institutes of Health program emphasizing the investigation of broad scientific questions. Roland Hatzenpichler, an assistant professor in MSU's Department of Chemistry and Biochemistry and CBE-affiliated faculty, received the Maximizing Investigators' Research Award, or MIRA, through the NIH's National Institute of General Medical Sciences in August to support his fundamental research into developing new single cell resolving tools to better understand the human gut microbiome. The grant will fund Hatzenpichler's work with $1.7 million over five years.

# PUBLICATIONS

"An inexpensive, versatile, compact, programmable temperature controller and thermocycler for simultaneous analysis and visualization within a microscope"
Cruz, Pablo Martinez, Mikayla A. Wood, **Reha Abbasi**, **Thomas B. LeFevre**, **Stephanie E. McCalla**
*Microfluid Nanofluid*, 2021, 25:40.
Read abstract

"Answer set programming for computing constraints-based elementary flux modes: Application to *Escherichia coli* core metabolism"
Mahout, Maxime, **Ross P. Carlson**, Sabine Press
*Processes*, 2022, 8(12):1649.
Read abstract

Morrow, Jayne B., Aaron I. Packman, Kenneth F. Martinez, Kevin Van Den Wymelenberg, Darla Goeres, Delphine K. Farmer, Jade Mitchell, Lisa Ng, Yair Hazi, Monica Schoch-Spana, Sandra Quinn, William Bahnfleth, Paula Olsiewski
*Frontiers Bioeng Biosec*, 2021, 9:641599.
Read abstract

"Isolation and characterization of lignocellulose-degrading *Geobacillus thermoleovorans* from Yellowstone National Park**"**
**Meslé, Margaux M.**, **Rebecca C. Mueller**, Jesse Peach, Brian Eilers, Brian P. Tripet, Brian Bothner, Valérie Copié, **Brent M. Peyton**
*Applied Environ Microbiol*, 2022, 88(1):e00958-21.
Read abstract

"Limitation by a shared mutualist promotes coexistence of multiple competing partners"
Hammerlund, Sarah P., Tomáš Gedeon, **Ross P. Carlson**, William R. Harcombe
*Nature Communications*, 2021, 12:619.
Read abstract

"Noninflammatory comedones have greater diversity in microbiome and are more prone to biofilm formation than inflammatory lesions of *Acne vulgaris*"
Loss, Manisha, Katherine G. Thompson, Alessandra Agostinho-Hunt, **Garth A. James**, Emmanuel F. Mongodin, Ian Rosenthal, Nancy Cheng, Sherry Leung, Anna L. Chien, Sewon Kang
*Intl J Dermatol*, 2021, 60(5):589-896.
Read abstract

"Novel nitro-heteroaromatic antimicrobial agents for the control and eradication of biofilm-forming bacteria"
**Koenig, Heidi N.**, **Gregory M. Durling**, **Danica J. Walsh**, Tom Livinghouse, **Philip S. Stewart**
*Antibiotics*, 2021, 10(7):855.
Read abstract

"Potential use of fungal-bacterial co-cultures for the removal of organic pollutants"
**Espinosa-Ortiz, Erika J.**, Eldon R. Rene, **Robin Gerlach**
*Critical Reviews Biotechnol*, 2021, 42(3):361-383.
Read abstract

"The impact of mental models on the treatment and research of chronic infections due to biofilms"
Bjarnsholt, Thomas, Enrico Mastroianni, Klaus Kirketerp-Møller, **Philip S. Stewart**, Aline Meret Mähr, Alonso Domínguez Cabañes, Rune Nørager
*APMIS*, 2021, 129:598-606.
Read abstract

"The importance of understanding the infectious microenvironment"
Bjarnsholt, Thomas, Marvin Whiteley, Kendra P. Rumbaugh, **Philip S. Stewart**, Peter O. Jensen, Niels Frimodt-Moller
*Lancet Infectious Diseases*, 2022, 22(3):e88-e92.
Read abstract

*View CBE Publications Database*

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## Thesis Alert

"Stoichiometric modeling of storage compound metabolism in methanotrophs and green algae," successful thesis defense by **Adrienne Arnold**, Masters candidate, microbiology & cell biology, Montana State University, July 19, 2022.
Read thesis abstract

*View CBE Thesis Abstract Database*

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# *VISITORS*

**Sara Ortega** is visiting the CBE from Delft University of Technology in the Netherlands through November. A post-doc at Delft, Sara is working in **Catherine Kirkland's** lab studying biological wastewater treatment.

Research associate **Hunter Spitzer** was a visiting scholar from University of North Carolina at the CBE this summer, working in the **Gerlach and Phillips Labs**.

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# *OUTREACH*

## CBE PhD student Shawna Pratt wins prestigious fellowship

CBE PhD student Shawna Pratt was one of two MSU students awarded prestigious graduate research fellowships from the Philanthropic Educational Organization, known as PEO. Pratt will receive a $20,000 stipend for the upcoming academic year, allowing her to focus on research. "PEO Scholar Awards are tremendously competitive," said Craig Ogilvie, dean of MSU's Graduate School.

## The 2022 'CBE Annual Report' is available online, printed version coming soon to IAs mailboxes


The 2022 *CBE Annual Report* is now available online and your hardcopy will soon be hitting your mailbox. The cover story is on the recent acquisition of microscopy equipment that will allow researchers to peer deeper into the biofilm matrix than previously possible. Also, we're featuring an insightful interview
with Tony Rook, the designated representative of longtime Industrial Associate Sherwin-Williams.

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