THE UNIVERSITY OF TENNESSEE KNOXVILLE
DEPARTMENT OF MICROBIOLOGY

WINTER 2020-21 **newsletter**

Microscope

Moving forward while the world slows down:

Microbiology Department mobilizes in the face of Covid-19

BY SHELBY CAGLE

A streak of yellow-orange makes its way across campus. This is not a group of vibrantly decorated Vols fans, but rather a crew of researchers, adorned in Tyvek suits. They make their way into an area of student dormitories on campus and sample for traces of Sars-Cov-2 from among the sewers.

Detection levels have been monitored regularly since the early stages of the pandemic, and campus surveillance is one of many tools being used by UT's microbiology department to monitor disease and keep the campus open.

Terry Hazen, joint UT-ORNL Governor's Chair for Environmental Biotechnology, and Frank Loeffler, UT-ORNL Governor's Chair Professor in Microbiology, joined forces to tackle campus surveillance techniques in a two-part process.

When sewer samples are collected, they go through a series of steps that include pasteurization, centrifugation, and filtration, and then qPCR is used to detect the virus.

"We aren't monitoring for Covid-19," Hazen explains. "[but we look for] SARs-Cov-2, the virus that causes the disease."

If the sewer samples test positive, the people living in the buildings will undergo pooled saliva sampling to narrow down where the infected patient is living and to aid in contact tracing. Pooling is the process in which individual samples are added together before analyzing.

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Beyond the cover:

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Analyzing samples in bulk saves time, resources, money, and increases anonymity. Surveying in this way allows hundreds of people and up to 20 buildings to be tested in one day. "I think it's all working to our advantage. We could keep this going indefinitely," Hazen said. "We are so enamored by this technology."

Monitoring is not only an issue of safety, but also one of finances, legality, and timeliness—a lot of factors come into play when developing these techniques. Even the wording on forms can be crucial, which is what Elizabeth Fozo, associate professor, realized when helping develop health and safety screens for students and staff. She spearheaded the transitions among the department. By orchestrating lab safety forms, coordinating with the Biosafety and Emergency Operations Committees, and concentrating on microbiology-driven decisions making, Fozo propelled the department in the right direction.

Tim Sparer, associate professor, led UT in virology expertise by providing information on basic biology, exploring available tests, and developing ELISA serum testing.

Not being limited to the researchers, collaboration and mobilization transpired in the classrooms. Instruction was forced into new forms, but the teaching assistants and professors redesigned the courses to reflect a virtual platform and promote continued learning.

When Covid-19 hit in March 2020, it was as if the world pressed the "pause" button on life. However, UT researchers did not slow down; they shifted gears to a new viral frontier and charged full speed ahead, fueled with knowledge of the environment, microbiology, and advanced survey techniques.

Apocalypse Semester Becomes Reality

A MESSAGE FROM THE DEPARTMENT HEAD
HEIDI GOODRICH-BLAIR

As I write this greeting, we are nearing the end of 2020, a year that tested us in so many ways and that most will be happy to leave behind. At this time last year, my colleagues and I were planning events to participate in a College of Arts and Sciences Apocalypse-themed spring semester, which was inspired by a McClung Museum of Natural History & Culture exhibit called *Visions of the End*. The idea was to have courses, seminars, movie viewings, and other events that considered apocalyptic themes from diverse perspectives: the arts, history, science, and society. As we planned, I learned that the word apocalypse derives from the Greek word Greek *apokálypsis*, or "uncovering," which is a derivative of the verb *apokalýptein* "to take the cover off." This changed my view of the word and its connotation. As scientists, we endeavor to uncover the natural world around us, and each new discovery is a small apocalypse that expands our knowledge and power to do good. In preparation for the thematic semester, we in microbiology integrated into courses and seminars both the apocalyptic threats that microbes pose and the many ways that microbes, and the scientists who study them, can lead the way toward solutions to threats facing humanity.

Of course, the apocalypse semester became much more of a reality than we expected and unfortunately emphasized microbial threats instead of solutions. Still, as it became apparent that we were facing a pandemic, our microbiology community rallied with strength and compassion. Within one single week, faculty and graduate student teaching assistants converted their curriculum to an online format, including what are normally hands-on instructional labs. Students swiftly adjusted to learning from home rather than the classroom. Faculty, staff, graduate students, and undergraduate researchers quickly distilled their lab-based efforts to the most critical elements as our campus buildings shut down, and creatively transferred their energies to discoveries achievable from off-campus locations. Our faculty and graduate students contributed to university efforts to establish and implement campus testing strategies and helped field questions and disseminate information about SARS-CoV-2 with our colleagues and the general public. Without pause, the summer brought planning for a transformed fall semester, including teaching and learning workshops on how to offer hybrid courses that combine both in-person and online learners. Research slowly ramped back up in spaces reorganized to maximize distances and with personnel being vigilant in mask-wearing, hand-washing, and disinfecting. And through it all, our staff was there supporting us. There simply are not words to adequately convey the tremendous dedication, resilience, and hard work of our staff in helping the Microbiology community meet the challenges of this year.

Even with all the changes to our normal operations there are many successes and accomplishments to celebrate. We have been able to maintain a sense of community. We reinvented our spring awards ceremony and fall microbiology retreats and held virtual gatherings to connect with each other. We held the first annual Biomembranes Symposium featuring virtual inter-disciplinary talks and posters. We created a video to welcome first year undergraduate students and tell them about the microbiology concentration. You can find it at micro.utk.edu/microbiology. We used social media and digital platforms to speak out against racial injustice and developed a strategic plan for ensuring we actively and consciously fight against bias in our microbiology community and beyond. Many of our faculty and graduate students received notable accolades.

To highlight just a few here:

- **David Talmy** was awarded a Simons Early Career Investigator in Marine Microbial Ecology and Evolution Award
- **Ben Parker** was named a Pew Biomedical Scholar, the first at UT
- **Terry Hazen** received the 2021 ASM Award for Environmental Research
- **Erik Zinser** and his co-authors published the newest edition of the textbook *Microbiology: An Evolving Science*
- **Jill Mikucki** was interviewed for a SETI Institute discussion on *Finding Life on Europa: Do we have the chemistry*
- **Drew Steen**, who joined our faculty in August of 2019, was featured in a February 2020 "Tap into Newark" article for his work with students at Malcolm X Shabazz high school in New Jersey

We welcomed 14 new graduate students to our campus in fall 2020, one of our largest incoming classes yet. Amongst our current graduate students who were recognized and rewarded for their work, Lena Pound, Brittany Zepernick, Katie McCullough, Spiridon Papoulis, Elizabeth Denison, Jordon Cannon, and Jonelle Basso all received federal and/or UT Graduate Fellowships this past year.

Finally, Sarah Lebeis was recognized for her excellence in research and was recruited to join the faculty at her undergraduate Alma Mater, Michigan State University. While we will miss her here in Tennessee, we look forward to continuing to collaborate with her.

These are just a few of the many exciting and positive newsworthy developments since our last communication. I hope you enjoy reading through the rest of this newsletter to find out more.

With wishes for a happy, healthy, and productive 2021,

Heidi Goodrich-Blair

Perspective:

First Time Field Research

BY **SHELBY CAGLE**

As sea water splashes into the flask before me, I watch the measurement line carefully, looking for the meniscus to hit exactly 100 ml and trying to account for the rocking of the ship. Measurements in the ship's lab were more difficult than any I had ever taken inside the laboratories of UT. However, with six days at sea and sampling times every four hours, I had plenty of opportunities to practice.

A group of scientists from around the world—of which I was the youngest member—had gathered into the close quarters of the R/V Atlantic Explorer for a research cruise on the *Sargasso Sea* with a common objective: to gain understanding of how viral communities were interacting in the waters around us and creating a plethora of ecological effects. Contributing to this understanding was my main goal, and with that, building my confidence, not just as a student researcher, but as an established microbiologist.

Any other October while in school at UT, I would be attending classes for my undergraduate degree. But the rare opportunity to live on a ship and work in a laboratory floating on the sea was a whole new form of microbiology research for me.

The instruction was like being thrown overboard in order to learn how to swim (sea pun intended).

I had been an undergraduate researcher in the Wilhelm lab for three years, I had been through all the laboratory classes at UT, and we had been planning for this cruise for months, but I still felt like a fish out of water at the first sampling time (another pun, yes).

I looked to the senior researchers and graduate students around me for guidance, and they led by example, showing me how to label tubes, gather materials, clean the bench, and sample from the deck. The skills I had gained from my past experiences were being reconfigured and expanded upon; I was learning by doing.

Additionally, we had modelers and physicists aboard, new to ship-life like I was. I found myself teaching them some microbiology techniques. A flow of mutual questions and answers filled the laboratory space—as did the sound of Gary LeCleir's well-curated playlists blaring over the bluetooth speakers.

The experience exposed the holes in my own knowledge, but filled in the holes with real-world experience. Rather than being unable to contribute due to my lack of knowledge, I was able to learn at an accelerated pace. From my first sampling to my last, my progress was tangible.

An unfathomable wealth of knowledge was accessible to me by field research, like the relationships I formed with other scientists spanning Ohio to Israel, and the sea legs I gained from holding a flask in one hand and a ship's rail in the other. Ultimately, field research exposed me to what my future as a microbiologist may be like if I keep pursuing research and keep venturing outside of my comfort zone.

Perhaps the greatest learning experience was seeing that science benefits from a range of contributions, whether senior researchers or undergraduates, modelers or microbiologists. Science depends on collaboration and people who brave the waves to board the ship.

ALUMNI SPOTLIGHT

Kyle Bonifer

By Shelby Cagle

Two things influenced Kyle Bonifer's career decisions after graduating from UT's microbiology doctoral program in 2019: an opportunity to work at a world-renowned lab and the option to stay in Knoxville. Bonifer currently applies his knowledge of microbial physiology as a postdoctoral associate in the Synthetic Biology Group at Oak Ridge National Laboratory.

During much of his doctoral research, Bonifer focused on infectious diseases, but his dissertation research led him towards industry and the environment as he investigated plastic degradation by microbes. This shift in focus exposed Bonifer to new avenues of microbial research outside of medicine, but with many applications, such as using bioproducts and biorefineries to create the chemicals needed for a more sustainable future.

> "Because of limitations in a lot of forms of renewable energy, it behooves us to look at biology to fill in the gaps for a couple of renewable sources of fuel."

ORNL has noted the diverse potential of microbes, and has recently established an independent Biology Directorate (which was previously housed under Environmental Sciences). Specific microbiology projects include topics of polymers and bioremediation; Bonifer examines both.

How microbial membranes respond to solvent stress can give key insights into bioproduct and biofuel development. In order to visualize the membrane structure of microbes, live cells are shot with a particle beam that accelerates neutrons, and the neutron scattering creates a detailed topographical map of the membrane. The membrane knowledge is crucial because many fuels are solvents that do serious damage to membranes.

In another project concentrating on membranes, genetic manipulations are performed on Clostridium thermocellum to discern how the organism can better produce a synthetic membrane that yields higher amounts of ethanol, butanol, and isobutanol.

"We are a small part of a bigger project trying to create these solvents and metabolically engineer the organism," Bonifer said. "Now instead of looking at the physiological mechanisms of degradation, I'm looking at the physiological mechanisms of production."

Bonifer's time at UT working in Todd Reynold's lab provided key tools for transitioning to ORNL. Reynolds allowed Bonifer independence and creative freedom for project development, while still being available for guidance along the way. This individualistic training kept Bonifer afloat when starting a new job amidst a global pandemic.

"It's been kind of a weird transition because of the state of the world " Bonifer said. "For now it's trying to do what you can, trying to work on some papers, and trying to get some writing done."

Despite the roadblocks, Bonifer says being an early career scientist at a national lab has many benefits, such as networking opportunities and resource availability. The intersection of industry and academia allows Bonifer exposure to various career avenues, while still using the microbiology skills he holds dear.

"Even if you do a completely different field, the fundamentals of your training are going to seep through," Bonifer said. "How you think, and how you write, and how you approach a problem, all that is still the same. It's just you're applying it to a different sort of piece of research."

Community & Connection

How to be **connected while we are apart...**

BY SHELBY CAGLE

The past year has emphasized the importance of community and has redesigned how we connect. The department has expanded its ability to mobilize virtually, seeking to keep the lines of communication unhindered by new virtual restraints. From hosting colloquiums to attending conferences, from holding social events and to organizing lab meetings, the department was forced to adapt, and it did so swiftly, allowing for the continued collaboration and scientific progress.

Necessity has spurred a creative refiguring of much, and there is no doubt that when the pandemic ends, new ways of communicating may remain. Not even a pandemic can sever the ties of scientists and the progress of microbial discovery.

STAY CONNECTED WITH UT MICROBIOLOGY THROUGHOUT THE YEAR:

Facebook: **@utkmicrobiology** Twitter: **@UTKMicrobiology**
Email: **microbiology@utk.edu** Web: **micro.utk.edu**

Microbiology Retreat 2020

Faculty, staff, and students
experienced a virtual retreat safely inside their homes.

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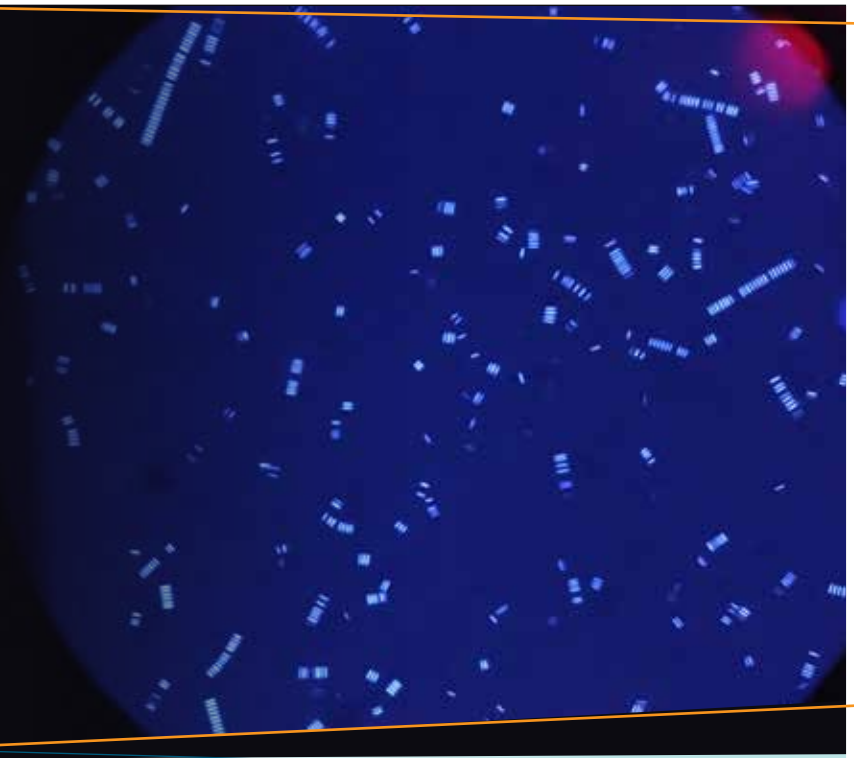
DATA AS ART CONTEST WINNER:

Starry Night: Diatom Edition

Brittany Zepernick took this image using the DAPI filter on an Epifluorescent microscope as part of ongoing research assessing the effects of environmental factors on diatom silica deposition (using the dye PDMPO). The bright purple/blue rectangles are diatom cells that have co-deposited silicic acid along with the fluorescent dye PDMPO.



"When viewed through the scope, it is easy to forget you're staring at a sea of diatoms, rather than a sea of stars," Zepernick said. "For this reason, I have named it *Starry Night: Diatom Edition*, after the impressionist piece by Vincent van Gogh. I am certainly biased, but the beauty of these microscopic eukaryotic algae never cease to astound me. To me, this picture demonstrates the beauty and mystery of the microbiological galaxies that we are often unaware of due to their size."

Learn more about honors and awards for students, faculty, and staff at micro.utk.edu/about/awards.

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micro.utk.edu