Featured Exhibitor Spotlights

McGraw Hill

hhmi BioInteractive

Pearson

wooclap

CAROLINA DISTANCE LEARNING

Interactive Laboratory Microbiology – Basic, Applied & Health Sciences

Atlas of Bacterial and Archaeal Cell Structure
# Table of Contents

- Featured Exhibitor Spotlights ....................................................................................................................... 2
- Table of Contents .......................................................................................................................................... 3
- Welcome from ASMCUE Chair ...................................................................................................................... 5
- Conference Planning Community ................................................................................................................. 6
- Plenary Speaker Bios ..................................................................................................................................... 8
  - Jenny Dauer, Ph.D. ................................................................................................................................ 8
  - Catherine Quinlan, Ed.D. ......................................................................................................................... 8
  - Nancy Boury, Ph.D. ................................................................................................................................ 9
- ASMCUE Leadership .................................................................................................................................... 11
  - Amy Siegesmund, Ph.D. ...................................................................................................................... 11
  - Jordan Moberg-Parker, Ph.D. .............................................................................................................. 11
  - David Westenberg, Ph.D. .................................................................................................................... 12
- Wednesday, July 13 .................................................................................................................................... 14
- Thursday, July 14 ....................................................................................................................................... 22
4:05 PM - 4:20 PM ET.............................................................................................................................. 26
4:20 PM - 4:55 PM ET.............................................................................................................................. 28
5:00 PM - 5:30 PM ET.............................................................................................................................. 28
5:35 PM - 6:05 PM ET.............................................................................................................................. 29
Friday, July 15.............................................................................................................................................. 32
12:00 PM - 12:15 PM ET.......................................................................................................................... 32
12:20 PM - 12:35 PM ET.......................................................................................................................... 33
12:40 PM - 12:55 PM ET.......................................................................................................................... 34
1:05 PM - 1:25 PM ET.............................................................................................................................. 35
1:25 PM - 2:00 PM ET.............................................................................................................................. 36
2:00 PM - 2:30 PM ET.............................................................................................................................. 36
2:30 PM - 2:50 PM ET.............................................................................................................................. 36
3:00 PM - 3:15 PM ET.............................................................................................................................. 36
3:20 PM - 3:35 PM ET.............................................................................................................................. 38
3:40 PM - 3:55 PM ET.............................................................................................................................. 39
4:00 PM - 4:30 PM ET.............................................................................................................................. 40
4:30 PM - 5:10 PM ET.............................................................................................................................. 41
5:15 PM - 6:00 PM ET.............................................................................................................................. 41
Poster Abstracts .......................................................................................................................................... 44
On-Demand Sessions and Microbrews ....................................................................................................... 58
Welcome from ASMCUE Chair

Hello Friends and Colleagues!

I am so thrilled to be welcoming you to the 2022 ASM Conference for Undergraduate Educators (ASMCUE)! This is absolutely my favorite conference and I have been attending since I was a graduate student, ASMCUE and the ASM Education community have been my academic family ever since. I have a very distinct memory from that first ASMCUE, my brain was a swirl of new ideas, and I had the warm realization that “these are my people.” People who think deeply and care passionately about teaching and learning. ASMCUE is a singular opportunity to meet, incubate ideas with, and learn from educators at every level and gathered from around the world. This year we have our biggest program in ASMCUE’s 29-year history, with 18 hours of live programming, 150 talks, 15 live networking sessions and 40 hours of pre-recorded content. Don’t worry if your brain gets full, all ASMCUE content will be available on the conference platform through the December 31, 2022!

I am really excited about this year’s theme of “Empowering Undergraduates with Science Literacy,” because it is a topic that I think about a lot. As educators, we often ask ourselves: What do I want my students to remember from my class in one year? Five years? Ten years? Undoubtedly there are fundamental concepts no student should walk away from your class without. The overarching concepts and fundamental statements identified in the ASM Recommended Curriculum Guidelines for Undergraduate Microbiology, for example. But if you asked educators from across any discipline what skills are the most important for undergraduates to learn, the skills encompassing scientific literacy would likely be right near the top.

To me, scientific literacy is a layered and multifactorial set of skills. It starts with curiosity and the ability to ask questions and to identify reliable information, be it reputable internet news sources or statistical biases in datasets. It means a person can understand how the scientific community produces scientific information, how that information is packaged and delivered to the public and other scientists, and how to use critical thinking to inform their personal decision making. These skills are more crucial than ever as undergraduates become science producers themselves, and as they navigate the sheer volume of available (mis)information in their everyday lives. Fortunately, as science educators we have a direct role in shaping our students’ understanding of the role of science in society. For ASMCUE 2022, we invite you to reflect on how your teaching and learning practices can empower undergraduates with scientific literacy.

ASMCUE is a conference for, and driven by, the education community and would not be possible without the ASM Education staff and a host of volunteers. I’d like to thank Vice-Chair David Westerberg, Loretta Brancaccio-Taras, John Buchner, Sean Coleman, Adronisha Frazier, Brian Gentry, Julia Massimelli-Sewall, Philip Mixter, Sandra Porter, Rebecca Sanchez, Amy Siegesmund, and everyone who reviewed proposals for all their hard work.

If you are first time attendee at ASMCUE, or even if you have been to a dozen ‘CUEs, please don’t hesitate to reach out to me or to any of the Planning Committee for any questions or just to chat about the latest and greatest idea on your mind. I hope you enjoy ASMCUE as much as I do, and welcome to the family!

Jordan Moberg Parker
Chair, 2022 ASMCUE Planning Committee
Conference Planning Community

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ASM Marketing and Meetings Department
Plenary Speaker Bios

Jenny Dauer, Ph.D.

University of Nebraska-Lincoln

Jenny Dauer is an associate professor in science literacy and the Associate Director for Undergraduate Education in the School of Natural Resources at the University of Nebraska-Lincoln. She is interested in understanding how best to prepare students for decision-making around complex socioscientific issues, and how best to support students in being empowered to use science in their future professional and personal lives. She is the lead instructor for a required undergraduate large-enrollment course called Science and Decision-Making for a Complex World. She is the PI of several NSF grants to support this work and authors peer-reviewed literature on students’ science literacy. She has a BS in Secondary Education and Biology and an MS in Ecology from Penn State University. Her Ph.D. was in Forest Science at Oregon State University and she completed a post-doc at Michigan State University.

Catherine Quinlan, Ed.D.

Howard University

Dr. Catherine L. Quinlan is Assistant Professor in Science Education in the Department of Curriculum and Instruction. She graduated from Teachers College, Columbia University with her doctorate in Science Education. Prior to Howard University, Dr. Quinlan taught high school biology and chemistry for sixteen years and was an instructor for U.S. Satellite’s Endeavor STEM Teaching Certificate Project where she taught Life in Space: NASA ISS and Astrobiology to teachers around the United States. Currently, she prepares Howard undergraduate and graduate students in science education methods and education foundations. Dr. Quinlan was funded by the National Science Foundation to create culturally representative STEM curricula and products for the K-12 setting. Dr. Quinlan is committed to creating practical curriculum products that impact the classroom, along with her research publications that highlight the cognitive resources of Black students. Her recent publication, Creating an Instrument to Measure Social and Cultural Self-efficacy Indicators for Persistence of HBCU Undergraduates in STEM capitalizes on her expertise in both science and education, and her interdisciplinary approaches to understanding how students learn and perform in science. Dr. Quinlan continues to explore factors influencing Black students’ sense of belonging and persistence in STEM. Her chapter book series for early readers, Keystone Passage, uses interdisciplinary approaches to create Black representation. While this series was created for early readers, the feedback she received suggests benefits for older students and teachers. For example, one Black teacher reported how excited she was to learn about her heritage in the stories. The series not only captures ideas about science concepts and other subjects but also situates the narratives in social, cultural, and historical ideas. Visit her author website: https://keystonepassage.com and main personal website: https://www.visibilityinstem.com/ for more information and for science connections.
Nancy Boury, Ph.D.

Iowa State University

Dr. Boury regularly teaches introductory courses in biology, genetics and microbiology at Iowa State University. She uses case studies to connect course content to current events and to communicate science in a wide variety of contexts. In the fall of 2019, she created and taught a new course: "Preparing for the Next Pandemic: Living in a One Health World." Six short months later, in March 2020, the world was disrupted by the COVID-19 pandemic. When students reported losing internships because of COVID-19 precautions in the summer of 2020, she created a digital internship focused on ASM’s scientific thinking competencies that is still being used to teach undergraduate students scientific literacy skills. Boury’s research program is focused on the continuous improvement cycle of student learning by refining learning objectives, assessments and student activities. This includes using game-based learning, developing concept inventories to reliably measure student learning and mentoring other instructors on active learning strategies.
Introducing the new Connect Virtual Labs

Connect Virtual Labs is a fully online lab solution that can be used as an online lab replacement, preparation, supplement, or make-up lab to bridge the gap between lab and lecture. These simulations help a student learn the practical and conceptual skills needed, then check for understanding and provide feedback. With adaptive pre-lab and post-lab assessment available, instructors can customize each assignment. Learn More »

List of Microbiology Titles

- Microbiology Fundamentals: A Clinical Approach, 4th edition by Cowan »
- Nester’s Microbiology: A Human Perspective, 10th edition by Anderson »
- Microbiology: A Systems Approach, 6th edition by Cowan »
- Talaro’s Foundations in Microbiology, 11th edition by Chess »
- Talaro’s Foundations in Microbiology: Basic Principles: 11th edition by Chess »
- Prescott’s Microbiology, 12th edition by Willey »
- Benson’s Microbiological Applications Laboratory Manual, 15th edition by Smith »
- Laboratory Applications in Microbiology: A Case Study Approach, 4th edition by Smith »
- Lab Manual and Workbook in Microbiology: Applications to Patient Care, 12th edition by Morello »
- Microbiology Experiments: A Health Science Perspective, 8th edition by Kleyn Et Al »

The Lab is always open!

For more information, visit mheducation.com/highered/microbiology »
ASMCUE Leadership

Amy Siegesmund, Ph.D.

Chair, ASM Subcommittee on Undergraduate Education

Amy is currently an Associate Professor of Biology at Pacific Lutheran University in Tacoma Washington. She holds a Ph.D. in microbiology from Washington State University and a B.A. in biology from Alverno College. Her current research focuses on student metacognition and learning; the use of self-assessment to increase metacognition; student theories of intelligence, learning, and failure; and student sense of belonging.

Amy has regularly presented at ASMCUE and has served as Vice-Chair and Chair of the meeting. She is an alumni of the National Science Foundation (NSF) Biology Scholars Research Residency (2010) and was a member of the ASM Microbiology Task Force on Curriculum Guidelines. Within PLU she is a leader in departmental curriculum and assessment. Amy has been awarded the PLU Faculty Awards for Excellence in Teaching (2015) and Excellence in Service (2019).

Jordan Moberg-Parker, Ph.D.

Chair, ASMCUE Planning Committee

Dr. Parker is the Director of Undergraduate Laboratory Curriculum and Assessment for the Microbiology, Immunology & Molecular Genetics Department at the University of California, Los Angeles (UCLA). She also earned her Ph.D. in Molecular Biology from UCLA. During her time at UCLA, she developed the curricula for and taught Course-based Undergraduate Research Experience laboratories in virology and microbiology, as well as teaching introductory and medical microbiology courses. Dr. Parker is active in the fields of the Scholarship of Teaching and Learning (SoTL) and Discipline-Based Education Research (DBER). She was a 2014 American Society for Microbiology Biology Scholar, an NSF sponsored program to advance SoTL in biology, where she participated in a year-long Assessment Residency devoted to developing measurable student learning outcomes. She has also been a facilitator and mentor for the Biology Scholars DBER Program, as well as a workshop facilitator for the National Institute on Scientific Teaching.
Dr. Dave Westenberg, Vice Chair ASMCUE Planning Committee, is Professor of Biological Sciences at Missouri University of Science and Technology. His laboratory primarily focuses on the role of rhizosphere microorganisms on plant nutrition and bioremediation. His lab has additional projects studying the antimicrobial properties of bioactive glass and oil smoke vapors. He has been active in microbiology education and was awarded the 2020 American Society for Microbiology Carski Award for undergraduate education. He is an ASM Scholar-in-Residence (now called Biology Scholars) which provides training and guidance for faculty interested in the scholarship of teaching and learning. Dr. Westenberg chaired the ASM Committee on K-12 Education and Outreach for seven years. In 2017 he was recognized with the Science Educator Award from the Academy of Sciences, Saint Louis for his work in public science outreach. He was named a Missouri S&T Dean’s Teaching Scholar, National Academy of Science Education Fellow in Life Sciences and an HHMI Biointeractive Teaching Ambassador and has presented at local, regional and national education conferences.
Dr. Lourdes Norman-McKay’s *Microbiology: Basic and Clinical Principles* teaches microbiology fundamentals in a manner that encourages students to think clinically and critically.

Learn more about what this talented author has to offer.

Watch the webinar recording of *Intentionally Cultivating STEM Identity to Promote Diversity and Inclusion*.

Spend 30 minutes with Dr. Lourdes Norman-McKay and explore ways to shape students’ STEM identity as a means of encouraging success and retention of underrepresented groups in STEM disciplines.

NEW from Dr. Lourdes Norman-McKay, *Microbiology: Basic and Clinical Principles*, 2nd Edition was built from the ground up specifically for your diverse allied health students taking Introductory Microbiology. Interested in the 2nd Edition?

Visit our website to find out more.
Plenary 1

Teaching Using Socioscientific Issues to Support Students’ Science Literacy Skills

Jenny Dauer

A major goal of STEM education is science literacy, or the ability to access and make sense of science to reach one’s own goals. Putting learning in the context of socioscientific issues (SSIs) can increase STEM relevance to real-world issues and provide practice in evidence evaluation and decision-making. SSIs are complex and open-ended, and feature elements of both science and society (economics, policy, culture, ethics). In the context of microbiology, some SSIs include COVID-19 policies, antibiotic resistance, microbiome-based health treatments, and biotechnology (e.g. Bt corn). I highlight how we used SSIs in a required introductory science literacy course. I briefly review our research that indicates that not all SSIs are equal, because students bring their assumptions, experiences and identities to bear differently on each issue. I also present ideas about how best to approach SSIs that are especially controversial and fraught with identity issues (like COVID-19).

1:00 PM - 1:30 PM ET

Session

Developing undergraduates’ scientific literacy and identity using preprint peer review

Rebecca Lijek, Mount Holyoke College
Gary McDowell, Lightoller, LLC

Peer review is integral to science and so teaching peer review should be integral to science education. Yet our data show this form of scientific literacy is often untaught, though required for success in STEM classes and careers. This session outlines a new curriculum on peer review, evidence of its effectiveness, and examples of how to adapt it to different courses. From our IUSE-funded research, we show that preprint peer review assignments teach students how to engage critically with relevant literature. They also demystify hidden curriculum and help students see themselves as scientists, crucial for retaining PEERs in STEM.

Session

Virtual Versus Hands-On Learning Activities—What Works Best for Today’s Students?

Delaney Worthington, Colorado State University
Amelia Hines, Colorado State University
Katriana Popichak, Colorado State University
Jennifer McLean, Colorado State University

During this session, we will discuss different methods (virtual, hands-on, and hybrid) of delivering active learning activities for historically difficult topics in a college-level General Microbiology course. We will also share performance, satisfaction, and engagement data collected from a yearlong study that
illuminates whether one delivery method is superior to another. Then, attendees will use free, online resources to create an engaging virtual learning activity that can be utilized directly in their classrooms.

Session

Measuring Critical Thinking in Introductory Ecology Courses Using the Biology Lab Inventory of Critical Thinking in Ecology (Eco-BLIC)

Ashley Heim, Cornell University

This session will introduce attendees to the Biology Lab Inventory of Critical Thinking in Ecology (Eco-BLIC), an instrument instructors can use to measure students' critical thinking skills at the start and end of an ecology course. We will discuss the importance of critical thinking in ecology lab and field settings and how the Eco-BLIC is intended to measure critical thinking using two different predator-prey research scenarios. We will also present findings on how students respond to different question formats on the Eco-BLIC and will encourage attendees to reflect on how critical thinking is integrated in their own courses.

Session

Partnerships: Linking Two-year Colleges and Four-Year Colleges and Universities to Create a Successful STEM Education Project

Kalyn Owens, National Science Foundation
Michael Davis, National Science Foundation

NSF’s partnerships unite a broad range of diverse communities in the pursuit of discovery and innovation by leveraging the individual and unique experiences and strengths of each partner. Many NSF programs that are focused on improving STEM education either require or encourage these types of partnerships with the aim of cultivating innovation ecosystems, broadening participation and increasing the number of individuals impacted. Partnerships that link two-year colleges (2YC) and 4-year colleges and universities (4YCU) are one type of collaboration that has the potential to strengthen both existing and new undergraduate STEM education projects. According to the National Academy of Sciences (2016), an increasing number of students follow complex pathways to earn STEM degrees and take longer than four years to obtain a degree. Students often begin at a 2YC, co-enroll across institutions or may enter and then leave STEM programs several times before achieving their goal. Creating partnerships between 2YCs and 4YCU presents an opportunity to address this and other challenges by developing high impact projects that expand opportunities for more students, create clear pathways to degree completion, enhance expertise at both institution types and provide the space to co-create innovative ideas. This presentation will discuss opportunities for creating these partnerships and strategies for building authentic 2YC-4YCU partnerships as part of producing a successful proposal.

1:35 PM - 2:05 PM ET

Session

JMBE Highlight: Teaching basic calculations in an introductory Biology Lab

Jack Horne, University of New Orleans

Quantitative reasoning is one of the core competencies identified as a priority for transforming the undergraduate biology curriculum. However, first-year biology majors often lack confidence in their quantitative skills. We revised an introductory biology lab to emphasize the teaching of basic laboratory calculations, utilizing multiple teaching tools, including online prelab quizzes, minilab lectures, calculation worksheets, and online video tutorials. In addition, we implemented a repetitive assessment approach whereby three types of basic calculations—unit conversions, calculating molar concentrations, and calculating dilutions—were assessed on all quizzes and exams throughout the semester. The results showed that learning improved for each of the three quantitative problem types assessed and that these learning gains were statistically significant, both from first assessment to midterm and, notably, from midterm to final. Additionally, the most challenging problem type for students, calculating molar concentrations, showed the greatest normalized learning gains in the second half of the semester. The latter result suggests that persistent assessment resulted in continued learning even after formal, in-class teaching of these approaches had ended. This approach can easily be applied to other courses in the curriculum and, given the learning gains achieved, could provide a powerful means to target other quantitative skills.

Session

Equipping Students’ Science Writing Skills

Nicole Kelp, Colorado State University
Phil Mixter, Washington State University
Shelby Cagle, Colorado State University
Dave Wessner, Davidson College

In this session, we will build on ASMCUE’s theme of science literacy by focusing on a key science literacy/communication skill: science writing. Attendees will practice some evidence-based methods in science journalism and consider how this might be useful for their students. Then, presenters will share about inclusive science writing and grant writing along with data about the efficacy of classroom activities to promote these skills for undergraduate STEM students. Finally, the presenters will share about a peer-reviewed journal, Prompt, that attendees could consider reading and publishing in regarding science writing activities implemented in class.

Session

Two Easy Steps to Improve Student Exam Performance

Timothy Paustian, University of Wisconsin-Madison

A significant fraction of students struggle to perform well on multiple-choice questions (MCQ). These difficulties often come down to two issues: Poor study habits and poor recall alignment. Poor study habits can be diagnosed and fixed with an exam wrapper and a short interview. A second problem students face is not practicing the recall of the information in a manner that aligns with an MCQ exam. To address this issue, I have developed an exam question writing platform. In this session, I will present data showing the success of both these practices in my courses.

Session

The Medical Laboratory Scientist: What They Do and How to be One

Amy Leber, Nationwide Children’s Hospital
Ellena Peterson, University of California Irvine
Erin Ley, Loyola Medical Center

There is a critical shortage of Medical Laboratory Scientists (MLS) that is anticipated to worsen, especially in areas like clinical microbiology. This can adversely affect patient care in hospitals and other healthcare settings. Key to increasing the number of MLS is the dissemination of information about the profession;
undergraduate educators who have direct students contact are integral to this process. This session will cover the role of a MLS and their critical shortage, the different paths to becoming a MLS, and personal insights about this journey. This will be followed by a question and answer period.

2:15 PM - 3:15 PM ET

2:15 - 2:33 PM Carolina Distance Learning

There are many ways to teach lab science courses online. Why use a hands-on approach with a lab kit? Research shows that students who only view experiments (rather than engaging in them) perform worse on conceptual knowledge exams than those who participate in physical or virtual labs (Zacharia and Olympiou, 2011). Let’s explore this topic together.

2:35 - 2:53 PM Interactive Laboratory Microbiology

Interactive Laboratory Microbiology (ILM), 2nd Edition, teaches introductory and intermediate laboratory microbiology to new instructors and students. ILM includes both virtual and in-lab components.

The in-lab manual includes
(i) Orientation with Key Concepts,
(ii) Microbiology Procedures,
(iii) Best Practice and
(iv) Notes and Observations. Students record their laboratory observations by handwritten notes and diagrams or digitally.

The in-lab manual is supported by a wealth of virtual microbiology: Techniques and Best Practice Animations, Techniques Videos, Observations, Quick Quizzes, Best Practice Quick Quizzes, Question Bank and Scenic Microbiology. Question Bank includes additional laboratory observations for students to investigate. Scenic Microbiology provides insights into historical and contemporary microbiology to emphasize relevance of laboratory microbiology. The ILM Study Guide follows a student's progress and understanding through the microbiology.

2:55 - 3:13 PM WooClap, Discover the 4 pillars of learning and how Wooclap can improve your teaching.

Are you a teacher or a trainer who would like to make your lessons interactive both in class and remotely? Join the Wooclap team for a training session! Are you a teacher or a trainer who would like to make your lessons interactive both in class and remotely? Join the Wooclap team for a training session! On the agenda:
• How to make your students active learners with the four pillars of education?
• Wooclap in real time: discover how to interact with your learners in class or remotely thanks to a multitude of question types
• Wooclap’s functionalities: learn how to make your material more dynamic and analyze your students’ understanding

This session will be punctuated with inspiring examples and will of course end with a moment for your questions!
3:15 PM – 3:45 PM ET

Break

Live Chat with McGraw Hill
Live Chat with Interactive Lab Microbiology

3:45 PM - 4:15 PM ET

Session
The status of women and other historically underrepresented groups - past, present, and future. Who is missing and why? Improving the pipeline for Diversity, Equity, and Inclusion in science education Part I
Rachel Roper, East Carolina University

Universities and government agencies have been trying to increase Diversity, Equity, and Inclusion in science education for decades with mixed success. We will discuss the data here on how women and other historically underrepresented groups are making inroads into academia and science, how far they are succeeding, what barriers exist at different steps, and strategies to improve DEI.

Roundtable
First-time attendee orientation: getting the most out of ASMCUE.

Join ASMCUE Chair, Vice Chair, and Planning Committee for an orientation about 2022 ASMCUE and networking with other first-time attendees. Topics we expect to discuss include: Why do people attend ASMCUE, how to get the best experience, and what makes ASMCUE different from other conferences.

Roundtable
Meet and greet with NSF Program officers Kalyn Owens and Michael Davis

Roundtable
Undergraduate research on a shoestring budget
4:20 PM - 4:50 PM ET

Session

Bringing conversations of racism, eugenics, & stereotype threat into science classrooms

Amy Reese, University of Health Sciences and Pharmacy in St. Louis

Science is missing out on ideas and solutions from population members that have been traditionally marginalized. This session will explore topics that have not always been a part of mainstream science discussions to provide participants with information and strategies that they can take to their classrooms. Topics to be addressed include scientific racism & eugenics, ways to decolonize your science classroom, approaches to value student experiences, challenges that stereotype threat & imposter syndrome can present for students, the value of your role in tackling these topics, and ways to recharge so you can continue to serve students.

Session

A cheatsheet for academic integrity: strategies to reduce cheating in your class

Miriam Markum, University of California, Davis

Academic misconduct has profound impacts on student learning outcomes, erodes good faith between student and instructor, and diminishes the perceived value of degrees. Coincident with the COVID pandemic, the incidence of cheating has risen to an alarming degree. How can we restore and promote academic integrity in our classes? In this session, we will define academic integrity and misconduct; describe the current landscape of cheating, including the expansion of commercial cheating services; explore factors that influence student decisions to cheat; and provide a tool kit of teaching practices instructors can use to make their courses cheat resistant.

Session

What can you do? Credentialing Skilled Biotechnology Talent

Heather Seitz, Johnson County Community College
Angela Consani, Kansas City Kansas Community College

In this session we will discuss the use of digital micro-credentials to document laboratory skills mastery in biotechnology related training courses and programs. Bioscience Core Skills Institute (BCSI) is a nonprofit organization whose mission is to provide workforce skills assessment and issue digital micro-credentials that are recognized by industry and educational partners. We will provide a case study overview of the model used by BCSI and describe the assessment and credentialing process utilized. Lastly, we will share data compiled from our skill assessments and provide insights on curriculum alignment and a gaps analysis in industry recognized biotechnology skills.

Session

Wicked Problems, Wolfpack Solutions: An innovative online experience for incoming students

Melissa Ramirez, NC State University
Carlos Goller, NC State University

Wicked Problems, Wolfpack Solutions (WPWS) is a common experience for incoming NC State students exploring a complex problem through multiple disciplines, and featuring speakers from across NC State sharing their perspectives on understanding and addressing the wicked problem being considered. WPWS is presented as an online course utilizing NC State’s suite of academic technologies, providing
students practice with technologies they'll use during their academic careers. Our interdisciplinary approach highlights the importance of bringing together people with varied expertise, experiences, and perspectives to address complex problems, and invites students to consider the roles they can have in addressing wicked problems.

5:00 PM - 6:00 PM ET

Exhibitor Spotlight

5:00 - 5:18 PM, Cal Tech Library

Looking for an open-access multimedia resource to show your students what microbes actually look like? The Atlas of Bacterial & Archaeal Cell Structure highlights state-of-the-art 3D cryo-EM images of ~70 different species to showcase the surprisingly complex structures that enable bacteria and archaea to survive and thrive. Targeted to undergraduates, with optional additional details for more advanced readers, it makes an ideal complement to cell biology and microbiology courses. Published by the Caltech Library as an open-access digital resource, the book is available from https://cellstructureatlas.org. Check out the Exhibitor Spotlight to learn more and meet the authors!
The Annual Biomedical Research Conference for Minoritized Scientists (ABRCMS) is back in-person in 2022! Join us November 9-12, in Anaheim, California, for an empowering event as we celebrate the 20th anniversary of ABRCMS.

Share Your Expertise
Help us develop a robust program for all scientists at various stages of their professional and educational trajectories. Submit a session proposal and add your name to the list of established scientists who have shared their work at ABRCMS.

**Session Proposal Deadline: July 29**

Contribute to the Future of STEM
Not quite ready to present at ABRCMS? You can still get involved and make an impact on rising scientists. Volunteer to serve as a judge or abstract reviewer. Plus, you could be eligible for a Judge Travel Award to help offset the cost of attending the conference.

**Judge Travel Award Deadline: August 4**

Encourage Your Students -- Abstract Submission is Open
Spread the word and let your students know about this opportunity to present their science to a national audience.

**Abstract Submission Deadline: September 9**

abrcms.org/getinvolved
Thursday, July 14

12:00 PM - 12:30 PM ET

Plenary 2

Getting to Know Yourself and Understand Others

*Catherine Quinlan, Howard University*

Even with the best of intentions, approaches to equity and inclusion are as good as one’s awareness of factors that influence one’s own perspectives, identity, and engagements. For example, our own sense of belonging might even influence how we help others to belong. The greater the barriers, the more need we have for critical perspectives in order to navigate spaces. Without racial or socio-economic barriers, one might be less reflective about navigating these spaces. As a well-represented majority, one might only need to reflect on these influences if we experience conflict, such as when our perspectives about who we are or about our own ability are challenged, whether through failure or discrepant events. Interdisciplinary and multidisciplinary research and personal experiences as insider-outsider to cultures and races, are used to provide insights into belonging, persistence, and identity as well as misunderstandings that might lead to a lack of empathy.

12:32 PM - 12:50 PM ET

Exhibitor Spotlight

**Pearson: Intentionally Cultivating STEM identity to promote diversity and inclusion**

*Lourdes Norman-McKay*

Research reveals that students who have a STEM identity — that is, they can envision themselves as belonging in STEM careers — are more likely to succeed in STEM courses and thereby pursue STEM careers as compared to students who lack a STEM identity. Fortunately, we can intentionally help our allied health students cultivate their STEM identity. Join us to explore ways to shape students’ STEM identity as a means of encouraging success and retention of underrepresented groups in healthcare and other STEM disciplines.

12:50 PM - 1:30 PM ET

Roundtable

Meet the editors of Journal of Microbiology & Biology Education

Want to turn your classroom and lab creativity into a publication? JMBE publishes articles addressing such topics as good pedagogy and design, student interest and motivation, recruitment and retention, citizen science, and institutional transformation. In this roundtable, editors of Journal of Microbiology and Biology Education will discuss an overview of how to get started in getting recognized for your teaching scholarship with a JMBE publication.
Roundtable
Strategies for increasing diversity, equity, and inclusion in your biology classes

Roundtable
Networking with educators living outside the United States
Do you live outside the United States? Join this networking session to find other educators and address current challenges and opportunities you are facing.

1:40 PM - 2:15 PM ET

Session
Agar art: Hands-on activities for your microbiology classroom

Dave Westenberg, Missouri S&T
Dawn Foster-Hartnett, University of Minnesota
Geoff Hunt, American Society for Microbiology
Julie Torruellas Garcia, Nova Southeastern University
Kandy Lopez- Moreno, Nova Southeastern University

Looking for an engaging activity to bring to your microbiology classroom? Try agar art! Using colored microbes to create drawings and paintings on nutritional agar plates, undergraduate instructors around the world have long been using agar art as a tool for teaching students about microbiology. Students who create agar art can also submit their work to ASM’s annual Agar Art Contest, where they are eligible to win prizes worth up to $100 (along with worldwide fame)! In this interactive session, you’ll have a chance to hear from, and interact with, instructors who have used agar art in their classes. You’ll also get a chance to see agar art in action by participating in a virtual workshop demo. This is a great opportunity to bring an engaging, hands-on, and artistic learning activity to your classroom!

Session
Resilience Equilibrium Leads to Professional Homeostasis

Heather Townsend, Community College of Rhode Island
Maureen Whitehurst, Trident Technical College
Diana Katz Amburn, Oklahoma State University - Center for Health Sciences
Carlos Goller, North Carolina State University

Even without COVID-related issues, faculty experience multiple professional challenges that are not directly related to pedagogy. These include service and research requirements, interactions with colleagues, budget limitations, and advising and administrative duties... not to mention home life. Responding to these challenges can upset your academic equilibrium and deplete your reservoir of resilience. These mounting pressures especially impact mid-career faculty. Our presentation will guide attendees to recognize their current resilience level relevant to their academic duties. This session will provide strategies to increase self-awareness and augment your agility to respond. This session is particularly targeted at developing individual support networks.
Session
The Deep Teaching Residency

Bryan Dewsbury, Florida International University
Tess Killpack, Salem State University

In this session we describe the development and implementation of the Deep Teaching Residency (DTR). This program comprises an immersive face-to-face inclusive pedagogy workshop followed by a year of virtual meetings to support participants in implementing classroom projects related to inclusive practices. Our goal with DTR is to support the shifting of faculty mindsets to reconsider and recentralize the humanistic aspect of college classroom teaching. Details of the Deep Teaching philosophy and expectations of DTR participants, as well as mechanisms designed to support and nurture participants within the experience will also be discussed.

2:15 PM – 2:45 PM ET

Break
Live Chat with Pearson
Live Chat with Atlas of Bacterial and Archaeal Cell Structure

2:45 PM - 3:15 PM ET

Live Q&A with poster presenters, posters numbered 1 - 13

3:25 PM - 3:40 PM ET

Microbrew

Microbiomes for All Begins with your Budget

Davida Smyth, Texas A&M University-San Antonio
Carlos Goller, North Carolina State University

Many of us are interested in integrating microbiomes into our teaching, through case studies, lab activities, projects and authentic research experiences. However, there are limits to what we can do owing to budgetary, computational and temporal constraints. The REMNet team has compiled materials and resources that will enable anyone to incorporate teaching through microbiomes at any budget, on any timescale and with a variety of tools, many freely available, that have extensive support and documentation. We will also present materials available at microbiomesforall.com that span from annotated papers and case studies, to microbiome datasets and metadata to manuals and student-generated guides that will allow you to analyze your own data.
Make Your Move: An Active Learning Card Game to Teach Microbial Pathogenesis and Host Defense

Elias Taylor-Cornejo, Randolph-Macon College

This innovative card game engages students in a battle between microbial pathogens and the host immune system. Each student is given a set of cards that consist of common host defenses and pathogen evasion strategies, then play a riff on the classic card game “war.” In pairs, students alternate playing a host defense card versus a pathogenesis card. Host defense cards include neutralize (antibody production), eat (phagocytosis), and destroy (degranulation). Pathogenesis cards include mimic (molecular mimicry), attack (toxins), escape (hemolysin), hide (capsule), defend (antioxidant defense), and disguise (antigenic variation). Students deliberate each evasion strategy to develop a mastery microbial pathogenesis through active game play.

Addressing Naïve Theories and Misconceptions Using the Nature of Science

Adronisha Frazier, Northshore Technical Community College

As we enter the second year of the COVID-19 pandemic, misconceptions of the nature of science (NOS) are visible in the classroom. Misconceptions exist in various forms, including preconceived notions, nonscientific beliefs, conceptual misunderstandings, vernacular misconceptions, and factual misconceptions. Naïve theories rely on knowledge and beliefs of early teachings or prior exposure. Misconceptions and naïve theories can be addressed using the NOS. Attendees will reflect on misconceptions that their students may have and participate in an activity elaborating on the NOS. Attendees will hear about the two-question assignment incorporated into the lecture to gauge students’ prior knowledge.

GIS as a Teaching Tool in Microbiology

Maura Pavao, Worcester State University

The pandemic led to the development of creative strategies to engage students, build skills and offer research opportunities within the classroom. The mapping tools qGIS (open source) and ArcGIS online offer ways for students to learn ASM curriculum guidelines by mapping infectious disease data using real world examples and can be adapted to online modality. Data sets are found in the primary literature and in CDC databases. In a public health first year seminar course, students mapped historical and current disease incidence rates and later in the semester, they were able to choose research areas of interest to map. The projects were presented to the class, resulting in great discussions on health equity.

Teaching About Research through a Biology Education Course-based Undergraduate Research Experience

Emma Goodwin, Arizona State University
In course-based undergraduate research experiences (CUREs), undergraduates enroll in a course where they conduct novel and broadly relevant research. Because CUREs can reach large numbers of students, CUREs can increase equity in access to research. In this Microbrew, we provide an overview of how we conduct a biology education CURE and will share a recent and yet-unpublished biology education research project conducted by CURE students. In this project, students developed and administered a nationwide survey to individuals who have been included as a co-author on a scientific publication resulting from research contributions in a CURE, with the goal of understanding how co-authorship has impacted previous CURE participants.

Microbrew

Incorporating ethics and the responsible conduct of research into community college CUREs

*Heather Townsend, Community College of Rhode Island*
*Jaclyn Madden, Harford Community College*

Teaching students about ethical considerations when conducting research is an important concept. The Office of Research Integrity lists nine core competencies that help to further responsible and ethical conduct of research (RECR). CUREs engage students in authentic scientific research, yet often do not provide instruction regarding the principles underlying responsible research behaviors. It is essential to engage students in RECR training early and often so that these behaviors become ingrained in their scientific identities. Preparing students to think ethically about the process of science in turn promotes their scientific literacy. Using a backwards design method, we integrated RECR into our CUREs at the community colleges we teach at.

Microbrew

Exploring gut microbial fermentation through tactile teaching tools

*Laura Ott, University of North Carolina at Chapel Hill*
*Katie French, North Carolina State University*

Previous research has shown that tactile teaching tools help students learn complex biological concepts. We have created a novel tactile teaching tool activity where students explore the gut microbiome and how specific microbes digest and ferment different carbohydrate structures to produce short chain fatty acids. Our tactile teaching tool kit includes K’nex, instructions to build three carbohydrates with different structural complexity, a card deck representing bacterial taxa with different fermentative properties, and instructional slides and worksheets to guide the activity, drawing on POGIL. We developed a pre- and post-assessment to evaluate how this activity promotes students’ achievement of the activity learning objectives.

4:05 PM - 4:20 PM ET

Microbrew

Capturing Student Attention by Escaping Traditional Pedagogy

*Antonio Mele, University of Central Florida*

Traditional pedagogy places the student in a passive position rather than actively participating in the learning process. This model of teaching perturbs students’ development of independence and bolsters dependency on the instructor. To capture student interest, encourage diversity, and nurture critical thinking an Escape Room was created for a Molecular Biology I classroom. In the Escape Room clues included in the background storyline are deciphered by students to answer a series of questions, each
increasing in difficulty to represent more challenging locks. Utilizing this popular form of entertainment as an educational tool facilitates student engagement in a novel manner, ultimately leading to improved learning outcomes.

Microbrew

Antibiotic Sensitivity and Metabolism: A Course-Based Undergraduate Research Experience Module

*Rachael Barry, UC Irvine*
*Jean-Louis Bru, UC Irvine*

Rising rates of antibiotic resistance among pathogenic bacteria are a looming public health concern. We are launching an inquiry-based lab course module that allows undergraduate students to study novel combination therapies that may improve the efficacy of existing antibiotics. Most antibiotics target metabolically active cells only, sparing dormant members of a population. Thus, supplementing microbes with metabolites may increase their metabolic activity, sensitizing them to antibiotics, and leading to more complete elimination. This project requires students to generate a hypothesis, perform experiments, and ultimately present their conclusions in the form of a manuscript style report with a structured peer review activity.

Microbrew

ImmunoReach: An Interdisciplinary Active Learning Approach to Cell Staining

*Archana Lal, Labette Community College*
*Thiru Vanniasinkam, Charles Sturt University*

Interdisciplinary learning is a key part of biology education and activities that promote interdisciplinary learning in the classroom promote broad understanding important for all STEM students. In this microbrew session we will present chemistry of stains and cell staining lesson and activities that we have developed. These activities include games, case studies and class debates that focus on promoting active and interdisciplinary learning in immunology and related STEM disciplines like chemistry, biochemistry, and microbiology. In this microbrew session, the participants will work through one of these activities with a view to implementing this in their classes. Examples of summative and formative assessments will also be shared.

Microbrew

Emphasizing the Scientific Process Behind the Rise of 16S rRNA Sequencing in Microbiology

*Melinda Grosser, University of North Carolina Asheville*

Undergraduate microbiology courses commonly teach 16S rRNA gene sequencing for microbial classification, yet the complex historical development of this technique is often overlooked. In this 1-2 lab module, students discuss the seminal publications that first suggested rRNA as an evolutionary marker (*Woese and Fox, 1977*) and first used rRNA universal primers (*Norman Pace et al., including his wife Bernadette Pace, 1985*). Students then use Benchling to perform an alignment of several 16S rRNA genes and design their own universal primers. The goal is to improve student understanding of the scientific process by delving into the decades-long evolution of the technique and performing a hands-on activity mimicking the work of 16S rRNA pioneers.
4:20 PM - 4:55 PM ET

Roundtable (by invitation only)

Getting Started in BER: course participants networking time

This networking roundtable is only for registrants in the Getting Started in Biology Education Research course. We will gather to talk about what we are learning during the ASMCUE posters (which are unpublished BER studies)

Roundtable

Networking with educators by career position

In this informal roundtable chat, meet other educators who live in your approximate geographical location and come together to discuss current challenges and opportunities in education. There are 4 floors in the Remo space. After entering the Remo platform, find the space corresponding to your career position: students & postdocs, early-career, mid-career, later-career.

Roundtable

Networking with CURE instructors and those who want to start CUREs

5:00 PM - 5:30 PM ET

Session

An active learning intervention based on evaluating alternative hypotheses increases scientific literacy of controlled experiments in introductory biology

Scott Kreher, Dominican University

We analyzed scientific literacy related to causality and controlled experiments in undergraduate introductory biology students at two institutions and found that students did not account for confounding factors. We developed a flexible framework of teaching science as a process of evaluating alternative explanations/hypotheses and created a two-tiered assessment, using both closed-ended questions and analysis of open-ended writing. We found that students taught using our framework were better able to account for confounding factors, when comparing control and intervention courses. Attendees will learn about our flexible and adaptable framework and our assessment methods for analyzing scientific literacy.

Session

Can’t we all be scientists? Examining science identity in science majors/non-majors at a teaching-focused institution

Josh Premo, Utah Valley University
Brittney Wyatt, Utah Valley University

Promoting student success for all students is critical. Student success can take the form of increased student identity shifts. This study compared science identity formation between non-major biology and majors. Results showed that non-major students did have significantly higher orientation towards their
community and the science community, while science majors had greater science identities. Overall, major and non-major students at open-enrollment teaching-focused institutions may not vary in many of their sources of science identity formation, but that communal orientation and communal views of science may be critical differentiating factors in the science identity formation between groups.

Session

Faculty mentorship policy - A career development approach to effective teaching practices

Diane Price Banks, City University of New York

This session will introduce attendees to the Faculty Preparation policy, a strategy to mentor newly hired faculty in MLT/MLS programs. Importantly, newly hired faculty are mentored by veteran instructors to assist in the development of effective teaching practices. The objective of this interactive talk is to understand the dynamics of career development at attendee institutions, introduce the faculty preparation policy and strategize on ways to implement the policy at attendee institutions. We will discuss how the faculty mentorship policy promotes effective teaching practices and improved student learning outcomes.

Scientific Primer

Using Lectin-Glycan Interactions to Unlock the Biofilm Matrix Code

Courtney Kleeschulte, University of Washington

Bacteria produce polysaccharides and other glyco-conjugates (known as glycans). Glycans have a variety of functions including contributing to the formation of microbial communities known as biofilms. This session will introduce enzyme/fluorophore-linked lectinsorbent assay (ELLA/FLLA) and lectin histochemistry, which use lectins, carbohydrate binding proteins, to study glycans. The ELLA/FLLA and lectin histochemistry techniques will be discussed through the context of research exploring the exopolysaccharide compositions, locations, and interactions within Pseudomonas aeruginosa biofilms. Upon conclusion of the session, attendees will understand ELLA/FLLA and lectin histochemistry, consider their compatibility with their courses, and practice developing student thinking questions.

5:35 PM - 6:05 PM ET

Session

KBase Educators: Bioinformatics Teaching Resources, Community, and Student Impact

Ellen Dow, Lawrence Berkeley National Laboratory
Achala Narayanan, University of Massachusetts Amherst
Elisha Wood-Charlson, BKbase, Berkeley Lab

The Department of Energy Systems Biology Knowledgebase (KBase) initiated a collaborative effort with instructors to develop curriculum for bioinformatics education using KBase. Educators taught a range of levels, from high school to undergraduate and graduate students, all with a common need for resources that enable virtual, interactive bioinformatics courses. The KBase Educators community provides a growing network of resources, complete with instructional templates, guidelines, and peer support for using KBase with students (virtual & in-person). This session will demonstrate resources, while also providing a student perspective on how KBase enabled learning by making bioinformatic analysis more accessible.
Session

Equipping students’ science literacy/communication skills for career preparedness

Nicole Kelp, Colorado State University
Phil Mixter, Washington State University
Candace Mathiason, Colorado State University
Peter Coward, Unaffiliated

In this session, we will expand on ASMCUE’s conference theme of science literacy by discussing science communication and how it relates to career preparedness. There are a wide variety of careers that rely on a science education and scientific way of thinking, but students and their instructors may not be aware of many of them. Tracking the career trajectory of former students, providing training in science communication, and implementing student support systems are ways that instructors can help students to better learn about and explore these careers.

Session

Taking the bias, and some of the pain, out of writing letters of recommendation.

Jordan Moberg Parker, University of California, Los Angeles
Delores Amorelli, Kaiser Permanente School of Medicine

Writing strong unbiased letters of recommendation (LOR) for students is vital, but also a significant burden to do well. In this session we will share an example of a LOR questionnaire that provides students with a series prompts for them to describe the reasoning, science, and professional skills they gained in the context of a course. The responses are then used as the framework for writing an LOR using detail-rich competency-based language. We will then discuss and practice the use of a bias mitigation checklist that faculty can use to assess their LORs for evidence of biases.

Session

Faculty professional development for the digital age – promoting student engagement through video-based learning

Jack Wang, The University of Queensland

Online instructors need to deliver synchronous learning activities while creating asynchronous multimedia resources. This study applied Mayer’s Multimedia Theory of Learning to adapt existing learning materials in an undergraduate microbiology course into online videos. In 2020, 34 videos were produced by filming instructors presenting to camera, and intersplicing this footage with slide-show presentations, laboratory demonstrations, and hand-drawn animations. Student engagement in video-based learning increased significantly in response to this redesign, and student perceptions revealed strong agreement with the underlying design principles. This session will engage attendees using an evidence-based approach towards video production as a strategy for Faculty professional development.
Call for Papers

Journal of Microbiology & Biology Education®
2023 Special Series on Scientific Literacy

Now is your chance to address the ever-vital topic of scientific literacy in the classroom and beyond – while getting your work published!

Get the details and submit your paper by October 1, 2022:

journals.asm.org/journal/jmbe/call-for-papers
Friday, July 15

12:00 PM - 12:15 PM ET

Microbrew

Utilizing BioRender in the Classroom for the Visualization of Scientific Concepts

*Sally Chamberland, Springfield College*

BioRender is a freely available online tool that has thousands of pre-made scientific icons and can be used in a variety of ways in the classroom. In one course it is used multiple times when asking students to create a visual abstract of an article, a visual glossary to learn complex terminology, and even to create a more informative version of a concept map or Venn diagram. By asking students to portray scientific concepts through visuals, students gain better understanding of effective science communication as well. These assignments can be done in class as review or assigned to students outside of class. BioRender allows to students to more easily create these images and facilitates greater autonomy and creativity.

Microbrew

Science in the News Activity for Introductory Majors

*Rachel Bleich, Appalachian State University*

When teaching introductory science courses, it can be a challenge to engage students while conveying the foundational information. Incorporating opportunities to connect course concepts to current events and new scientific discoveries should help students learn the material in their introductory courses and improve their ability to read and analyze scientific literature. This science in the news activity prompts students to read a science in the news article for each major unit in the course, build initial connections through concept mapping, and analyze a key piece of data in the context of the conclusions drawn by the article. Students will have a scaffolded introduction into the scientific literature that reinforces course topics.

Microbrew

Immunoreach: An Activity That Investigates Immune System Scaling

*Samantha Elliott, St Mary’s College of Maryland
Cynthia Downs, SUNY-ESF*

The Immunoreach project seeks to create classroom activities that bridge biological disciplines. We have developed a multi-day activity that includes aspects of physiology and comparative immunology to address the following fundamental question: is an elephant basically a very large mouse? Leukocyte classification, development and identification are introduced and scaling of lymphocytes and neutrophils across mammalian species is investigated, with an emphasis on quantitative skills. Modules within this activity can be stand-alone or used in its full sequence based upon time and student level.
Instructor Perceptions of Race, Racism, and Racial Equity Discussion in Introductory Biology

Candice Idlebird, Harris-Stowe State University

Guidance exists for how to make biology classrooms more inclusive (Dewsbury & Brame, 2019). However, little is known about the adoption of inclusive teaching practices. One such practice is engaging students in discussions about race, racism, and racial equity (DARE) as prompted by recent global events (Asai, 2020a; 2020b). Resources exist to help instructors facilitate discussions about race in biology classrooms (Hubbard, 2017; McChesney, 2015) but little is known about occurrence and frequency of these discussions, instructor approaches to these discussions, and if discussions expand to topics of racism and racial equity. In this study, we investigate instructors’ perceptions and pedagogical decisions for discussing DARE in introductory biology courses. Evaluating instructors’ propensity to facilitate DARE in biology introductory courses will lead to a more nuanced understanding of how these discussions are conducted in instructors’ classes, their motivations for doing so (or not), the resources they are aware of and use, and their perceived barriers, incentives, benefits, and costs of including DARE in their classes. We used a researcher-generated survey to canvas instructors on the prevalence of discussions related to DARE in courses and contextual information that may be influencing these practices. The survey disseminated in March 2022, was designed based on a framework for understanding teaching practices, the Teacher-Centered Systemic Reform (TCSR) Model of Educational Reform (Woodbury & Gess-Newsome, 2002). Statistical modeling will be used to analyze how contextual factors defined in the TCSR framework predict the likelihood of instructors including discussion of DARE in their courses. By understanding instructors’ motivations, barriers, and supports for discussing issues of race, racism, and racial equity, we can make recommendations to help facilitate these discussions.

12:20 PM - 12:35 PM ET

Cultivating Conversations: Talking about racial justice & inclusion with faculty and students

Amy Siegesmund, Pacific Lutheran University

The ongoing pandemic, continued online learning, and Black Lives Matter intersected to provide our department with an opportunity to reimagine what departmental seminar could look like and what it could do for our students and faculty. We used SABER’s Striving Toward Racial Justice in Biology seminar series as the foundation for structured conversations between faculty and students. Prompts were provided, and small group discussions took place in Zoom breakout rooms followed by large group debriefing. Informal feedback and participant survey data indicated that the seminar and discussion series provided a supportive space for engaging in meaningful conversation and identifying anti-racist strategies we could use at our institution.

Using Social Media to Enhance Science Literacy

Judy Brown, Trevecca Nazarene University

The popularity and convenience of social media has elevated its status above other news outlets, especially in younger individuals. Several studies have identified health misinformation in social media platforms. This provides opportunities to educate students on how to critique information in social media. To develop such skills, we generated a social media evaluation assignment. Students were required to
find a social media post relevant to the course material that referenced a primary research article. After locating the article, students compared the findings to the original social media post reflecting on the validity of the statements. This assignment provides multiple avenues to enhance critical thinking and scientific literacy.

Microbrew

When Plan B Becomes Plan A; Incorporating Content Created Virtually into In-person Classes

Sarah Shoemaker, North Country Community College
Heather Townsend, Community College of Rhode Island

You spent hours creating new, innovative content for online courses when the pandemic hit. Now with the return to in-person teaching, is all that lost? In this microbrew we evaluate how we took the online content and incorporated it into in-person classes to improve lab preparation, skills, accessibility, and comprehension. We will discuss the use of various remote lab modalities, from virtual labs to lab kits and student-made video recordings. Incorporating remote-learning elements into in-person labs can result in students being more competent in the lab, allows for more efficient use of lab time, and creates more mental space for critical thinking and analysis. Finally, discussions on using these techniques to incorporate UDL principles.

Microbrew

ImmunoReach: An interactive approach to understanding T-cell receptor diversity

Claudette Davis, LaGuardia Community College, CUNY
Timothy Paustian, University of Wisconsin-Madison

The activity will create a deeper understanding of T-cell receptor diversity. Undergraduate students enrolled in an introductory biology, immunology, or microbiology course may not fully grasp the magnitude of receptor diversity in our T-cells. Instructors can use this activity in a lecture or laboratory setting. Students will work in small groups and use clay to construct different T-cell receptors. Students will determine T-cell receptor diversity with the use of an interactive VDJ table of codes and a random number generator. We will also present an assessment tool to use for the activity.

12:40 PM - 12:55 PM ET

Microbrew

Toward “Inclusifying” the Underrepresented “Minority” in STEM Education Research

Haider Ali Bhatti, University of California, Berkeley

STEM education research often requires the collection of student demographic data to assess outcomes related to diversity, equity, and inclusion. However, in our evaluation of these data, the categorization of “URM” needs to be rethought. Classifications of “underrepresented” and “minority” are more nuanced than simple racial categories. Though there are alternative terms to URM, each with their own affordances, the goal of this microbrew is not to advocate for one term over another. Instead, we must engage in a much-needed dialogue on how we can “inclusify” our collection of demographic data, particularly through data disaggregation and expanding our definition of what it means to be both “underrepresented” and a “minority” within STEM.
Using laboratory simulations as pre-lab activity

Manuela Tripepi, Thomas Jefferson University

During the Covid-19 shutdown, many microbiology educators faced the challenging task that required them to move the laboratory curriculum outside the lab. Due to the supply chain being overwhelmed, I could not adopt at-home lab experiments and pivoted to online simulations powered by Labster. During the lockdown, I analyzed how students perceived and liked the simulations and decided to continue using them even after coming back in person. I found that using online simulations as pre laboratory improved students’ experience and learning. I have set up a semester-long microbiology in-person laboratory curriculum that uses online simulation as a pre-lab activity.

3D printing to observe bacterial interactions

Nikolas Stasulli, University of New Haven

It can be difficult to incorporate relevant, student-accessible technology into microbiology courses. By incorporating a makerspace-linked 3D printing activity into lab work, students can become more involved outside of the classroom and retain ownership over the experiments they will be performing; increasing project engagement and active participation. 3D printing technology used to study bacterial interactions is easily incorporated into preexisting labs; readily linking to projects like Tiny Earth and Small World Initiative. While project goals can be as simple as pairwise exchange of metabolites without physical contact between bacteria, students can be further encouraged to expand the questions that they can address via 3D printing.

Teaching microbiology with poetry: Connecting lower and higher order cognitive skills

Suparna Chatterjee, Arkansas Tech University

The two lower-order cognitive skills (LOCS) (remember and understand) in Bloom’s taxonomy require learners to memorize information. It has been found that LOCS are useful for understanding the content and developing the four higher-order cognitive skills (HOGS) (apply, analyze, evaluate, and create). In-class activities during lectures are effective for maintaining students’ attention. Students read poetry and learn basic concepts which they utilize to solve problems and apply the information. Engaging students in an alternative way with the content using a variety of resources provides affordances to diverse student learning and communication preferences through incorporating multiple options for learners to engage and express themselves.

1:05 PM - 1:25 PM ET

Exhibitor Spotlight

McGraw Hill, Back to Business as usual? Post-pandemic Changes to consider (and keep) in Education

Do we go back to business as usual in education? That may be the question we are asking ourselves as students and educators return to the classroom. If there is a silver lining to be found from experiencing a pandemic which shut down face-to-face instruction, it would be that many of us have been forced to employ new, and possibly improved, ways to present material to educate our students. Have we found improvements in instruction that we want and need to keep? Have our students’ expectations changed?
after 2 years of remote learning, and do they desire to have more opportunities for online education? Join us to explore ways to integrate online learning options into your face-to-face class or to offer a new remote-only learning experience.

**1:25 PM - 2:00 PM ET**

**Roundtable**

**Current challenges in teaching at 2-year institutions**

About 25% of ASMCUE attendees teach at 2-year schools! Come to this networking roundtable to meet other ASMCUE educators at 2-year schools and work together to overcome current challenges, such as teaching laboratories and Allied Health or nursing students.

**Roundtable**

**Mitigating the "great student disengagement"**

This is an informal discussion about the current topic "The Great Student Disengagement" or "disconnection". Are you seeing high levels of disengagement? What changes or adaptations can you make to address this concern?

**Roundtable**

**Networking with educators who teach large enrollment classes**

This is an opportunity to network and learn from other educators who also teach large enrollment classes.

**2:00 PM - 2:30 PM ET**

**Live Q&A with poster presenters, for posters numbered 14 - 25**

**2:30 PM - 2:50 PM ET**

**Meditation and Yoga Session**

**3:00 PM - 3:15 PM ET**

**Microbrew**

**Measures Taken to Increase Belonging and Retention in a First Semester Majors Biology Course.**

*Sean Coleman, Wartburg College*

A growing mountain of evidence suggests that belonging can increase persistence and retention in STEM fields. Furthermore, diversity, equity, and inclusion (DEI) methods increase satisfaction and persistence in underrepresented students and other demographic groups. We redesigned the first course of our two-semester introductory sequence, we incorporated small group days that involved critical thinking about
important scientific topics that highlighted DEI. Furthermore, we increased the value of smaller non-exam-related assessments in lectures and laboratories. We hope to share what we did and then call on the ASMCUE community to strengthen what we all do to increase belonging, persistence, and retention in the biological sciences.

Microbrew

Undergraduates as Science Communicators: How to Engage Students in SciComm

*Jaclyn Madden, Harford Community College*

In the social media age, where click bait and misinformation have become the “scientific” norm, our roles as educators can no longer end at the classroom door. From COVID to climate change, we are called upon to explain complex concepts to our communities in an empathetic and engaging manner. As scientific mentors, why shouldn’t we call on our undergraduate students to join us in this role? Attendees will learn how to implement a SciComm project to improve students’ abilities to evaluate scientific sources and communicate science to non-scientist audiences using a blog post, infographic, Twitter thread, or 3-minute scientist presentation. They will engage in discussion regarding how the technique could be used in their own courses.

Microbrew

Peer Troubleshooting: Crowdsourcing KBase to Reinforce Bioinformatics Learning

*Carlos Goller, North Carolina State University*

*Claire Gordy, North Carolina State University*

Web-based tools such as KBase allow students in course-based research experiences to perform sophisticated genomic and metagenomic analyses including taxonomic classifications, assemblies, and metabolic reconstructions. How best to implement bioinformatics tasks to promote reflection and reduce frustration is particularly important in online classes where face-to-face troubleshooting may not be possible. We share our experience from two courses, a multi-section introductory genetics lab, and an upper-division metagenomics lab module. This session challenges instructors to consider the active learning opportunities in empowering peer discussion of difficulties in using bioinformatics tools in a way that is supportive and social.

Microbrew

Too long for a CURE: Building a Semester of Short-term Research Experiences (SREs) for Microbiology

*Mary Ann Smith, Penn State Schuylkill*

Traditional Course-Based Undergraduate Research Experiences (CUREs) have typically been implemented over a semester and have students build up to the major research work and then spend their time developing their project. Working with pre-Nursing students has demonstrated that this group can have the same buy-in to the purpose of the CURE work and show growth as learners and scientists, but they may grow tired of a single concept with repetitive actions. What if we could keep the learning gains but give students exposure to multiple research projects? The Short-term Research experience (SRE) provides a mechanism and pairing them keeps the research experience going. This microbrew discusses pairing multiple SREs for a new semester structure.
Major-Specific Tracks Equalize and Engage Diverse Students in a Semester-Long Disease Project

*Sara Reynolds, Shepherd University*

For many institutions with declining enrollment, microbiology classrooms must teach multiple students with different prerequisites and interests in nursing, allied health, biology and ecology. This proposal explores multiple different tracks for a semester-long disease project to engage and assess students equally by recognizing differences in previous experiences and goals after graduation. All students would select an infectious disease to explore, but expectations and rubrics for final presentations would vary by track. Nursing students could emphasize public health, medical students immune responses and drug resistance, and ecology majors have the option to choose non-human pathogens.

Enhancing communication skills through discussion of primary literature and phenotypic variation

*Daryn Stover, Arizona State University*

Direct participation in undergraduate research (CUREs, employment) is not easily accessible for all students, especially those attending small rural or online institutions. Without such exposure, training in effective scientific communication may be limited. We developed a discussion-based course focusing on enhancing scientific literacy and written/oral communication skills with the goal of better preparing students with limited research experience for graduate school/the job market. Through critical analysis of primary literature related to phenotypes of the students’ choosing, they learn about such topics as experimental design, the peer-review process, and how to communicate effectively to both science and non-science target audiences.

Alpha, Delta, Omicron- Oh My! A SARS-CoV2 Genome Alignment Activity to Understand Mutations and COVID

*J. Jordan Steel, US Air Force Academy*

COVID dominated the world from 2020-2021. Everyone “knew” about the novel coronavirus, but how much do they actually know about the virus behind COVID-19? This classroom activity gets students dealing with actual genetic sequences from SARS-CoV2 and working with genome alignments in order to identify mutations and cluster different emergence patterns. This 3 part activity works through alignments, mutations/variants, and medical/immunology implications of the different variants. This assignment can be done as a homework assignment or lab/class activity.
Implementing team science training in course-based undergraduate research experiences (CUREs)

Anna Ward, East Carolina University
Heather Vance-Chalcraft, East Carolina University

Collaborative teamwork is fundamental to successful work across industries and is a desirable skillset for employers. Yet, students receive little training in how to effectively work in teams (team science). We are implementing team science training in course-based undergraduate research experiences (CUREs) to support the development of transportable team competencies (skills, knowledge, and attitudes) in undergraduates. Training includes content delivery (e.g., fundamentals of team science, effective team communication strategies) and development of team communication and research plans. We include a research-focused mixed method design to investigate the effectiveness of the team science training in developing transportable competencies.

3:40 PM - 3:55 PM ET

Empathetically Engaging With Our Community Through A Service Learning Project

Pete Chandrangsu, Claremont McKenna, Pitzer and Scripps Colleges
Jessie Mills, Pomona College

Service learning provides an opportunity for students to connect class material to community needs and can prepare students to contribute to a just and equitable society. As part of a Microbiology course, we partnered with a community action organization and the Pitzer Community Engagement Center to co-create an outreach program. We took an asset-based mindset where the experiences and knowledge from all involved are valued. After an empathy workshop and conversations between students and community members, we collectively identified pressing questions and co-created informational materials to communicate the science behind COVID19 safety measures. Here, we will describe our service learning module and share lessons learned.

Exploring the anti-vax movement - assignment design to promote scientific literacy and communication

Aarthi Ashok, University of Toronto, Scarborough

As a university that sat amid a recent anti-vaccine protest (initiated by truckers) in Toronto, Canada, we are inspired to ensure that our graduates are equipped with the scientific literacy and effective communication skills necessary to carefully evaluate and present scientific evidence on vaccine safety and development. Through this creative assignment design we seek to encourage students to explore anti-vaccination stances touted by groups/organizations on social media, evaluate their claims using scientific literature and develop succinct arguments to demonstrate the social, economic, or other cultural influences likely contributing to anti-vaccination sentiments.
Microbrew

Blogging about biotechnology: Replacing the term paper with an accessible writing style assignment

Chadene Tremaglio, University of Saint Joseph
Michelle Kraczkowski, University of Saint Joseph

Traditional term papers can be difficult to implement in first-year courses where students display wide variation in writing ability. Students with weaker skills are at a disadvantage unless significant amounts of class time are earmarked for teaching basic writing skills. By contrast, blog-style writing is accessible and familiar, and has been shown to develop critical thinking skills, with noted positive effects on student perceptions of learning and motivation. Therefore, we reformatted our traditional term paper into a blog-style paper. This was largely successful at getting students to demonstrate meaningful understanding of scientific journal articles about biotechnology, by translating them into engaging blog-style summaries.

Microbrew

MicroCURE – A Hybrid, Team Approach to Course-based Research Experiences

Michael LaMontagne, University of Houston - Clear Lake

Course-based undergraduate experiences (CURE) improve student learning and outcomes; however, the majority of microbiology instructors teach “cookbook” laboratories. This may reflect requirements that faculty teach particular techniques. To address this, we developed a hybrid CURE, where students complete both traditional microbiological laboratories and work together in teams on a semester-long project. These projects all apply matrix assisted laser desorption - time of flight mass spectrometry mass spec (MALDI-TOF). Members of teams take responsibility for specific tasks as tracked in GAANT charts. This team approach to CUREs appears effective in terms of student performance, surveys and poster presentations at scientific meetings.

4:00 PM - 4:30 PM ET

Session

Inspiring Evidence-Based Teaching Innovations in Biology Classrooms with the Journal CourseSource

Jenny Knight, University of Colorado, Boulder

CourseSource is an open access and peer-reviewed journal of undergraduate biology and physics teaching materials that implement evidence-based instructional approaches. The journal is organized by courses, one of which is Microbiology. At this session, attendees will learn about what CourseSource is, how to use it as a resource when searching for teaching materials, as well as how to submit their own teaching activities as an article for publication.

Session

A storytelling approach to microbial metabolism: improving attitudes and functional knowledge

James McKinlay, Indiana University

Metabolism is at the foundation of nearly all aspects of cellular life, yet it is often viewed as a required chore in memorization. As such, students often fail to appreciate the importance of metabolism, let alone achieve functional knowledge. I am leveraging my own illustrations and the human predisposition to learn by storytelling in an attempt to facilitate gain of functional knowledge in a detail-intensive course on
bacterial metabolism. At most, students have gained a small improvement in functional knowledge. However, storytelling has positively affected the learning experience and attitudes towards a traditionally unpopular but undeniably important topic.

Session

What makes a good question? Examining Assessment Practices in Undergraduate Biology

Heather Seitz, Johnson County Community College

The Assessment Skills in Biology network (ASK BIO) is an NSF funded project helping faculty write high cognitive level selected response questions. Workshops offered throughout the year have helped us collect questions and insight from faculty. In this session we will share data and resources that will help support faculty as they create new assessment items.

4:30 PM - 5:10 PM ET

Roundtable

Overview and discussion: Find your next scholarly Project.

Discussion topics will be separated by FLOOR. There is a floor navigation space in the lower left corner of your screen.

1. Task Force for the revision of the ASM Curriculum Guidelines
2. Immunology Education

Roundtable

Reflection & discussion: "How Have You as An Educator and Your Teaching Changed Since March 2020?"

Roundtable

Reflection & discussion: "How will you change your instruction to improve science literacy?"

5:15 PM - 6:00 PM ET

Plenary 3

Communicating Science: Building Bridges not Barriers & Closing comments from ASMCUE Planning Committee

Nancy Boury, Iowa State University

As we teach our students about the nature of science and scientific information, we often use specific terminology to describe specific structures, phenomena, or processes. While this jargon has value in framing how we think about research questions in the sciences, it is often a barrier to clear communication. We need to consider our use of scientific language when communicating with both introductory students and the lay public. Excessive jargon often excludes many students, particularly
those from disadvantaged backgrounds. Poor communication of scientific concepts opens the door to the spread of misinformation. As science educators, we need to welcome fledgling scientists to our disciplines, acting as guides and teaching students the culture and language of our scientific endeavors. In this session we will discuss and demonstrate several activities aimed at bridging this jargon-gap.

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- August 2, 2 - 3:30 p.m. EDT | Career Pathways at a Foundation/Nonprofit
- August 9, 2 - 3:30 p.m. EDT | Career Pathways in Industry/Biotechnology

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- October 26, 1-2 p.m. EDT | Tools for further exploration - digging deeper into the data

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Poster Abstracts

Poster 1. Online Microbiology Students Perceive Lesser Educational Impacts during the COVID-19 Pandemic

Alexandria Ardissone, University of Florida
Jennifer Drew, University of Florida

To better understand the impact of the COVID-19 pandemic on Microbiology and Cell Science majors at the University of Florida, a survey was conducted spring and fall semesters in 2020 and 2021. The program is unique in that all upper division lecture courses adopted an online modality in 2011, prior to the pandemic, regardless of whether students are residential or remote. There are three distinct student groups for comparison: first-time in college (FTIC), on-campus transfer (OC-TR) and online transfer students (ONL-TR) students. Response items captured student perceptions of the educational impact of the pandemic and were analyzed using regression methods. It was hypothesized that transfer students would report more adverse educational effects due the pandemic because transfer students often face increased barriers and lesser outcomes than FTIC students. However, when asked if the pandemic would have a significant, negative impact on their education, ONL-TR students were 5.6 times (CI:2.5-13.2; p-value <0.001) more likely to express neutrality over agreement compared to on-campus students, regardless of transfer status. Additional survey items further explored this result and were validated with academic records when possible. On-campus transfer students were 2.7 times (CI:1.3-5.6; p-value=0.008) more likely to report feeling nervous, anxious or on edge than FTIC and ONL-TR students. While the pandemic certainly affected all students, ONL-TR students' perceptions were more resilient to the educational impacts of the pandemic. Perhaps more concerning is the increased frequency of nervous/anxiousness expressed by OC-TR students, highlighting the need for heightened awareness and resources for this student population. The difference in findings of the two transfer groups warns against the generalization of transfer students and prompts further investigation of the costs and benefits of modality for various student populations.

Poster 2. Analysis of science self-efficacy, science identity, and project ownership in a CURE

Melissa Beaty, Johnson County Community College

A course based undergraduate research experience (CURE) is a type of laboratory experience where students participate in a semester long research project. For this descriptive statistic study, it was hypothesized that students would have high levels of project ownership and science self-efficacy while having lower levels of science identity after participating in a microbiology CURE regardless of the background characteristics or lab exercises students participated in. 54 CURE microbiology students participated in an end of semester survey. The mean and standard deviation for each survey item was investigated based on background characteristics of gender, first generation status, college major, number of lab classes taken, and healthcare/research career fields for each construct of science identity, science self-efficacy, and project ownership. Students had high scores (mean= 4) for all three constructs in the laboratory course regardless of the background characteristics of students for the 5-point likert-scale items. One item scored lower stating "I had a personal reason for choosing the research project I worked on" (mean=3). A lab exercise where students sent their samples for sequencing had the least number of students say it pertained to their science identity (88%), science self-efficacy (90%), and project ownership (85.4%). An open-ended statement asked students “to describe something that made this lab different from other lab classes you have taken” which
generated themes after open coding. Themes included the lab is personal \( (f=16) \), positive feelings of the lab class \( (f=12) \), hands on \( (f=10) \), and a supportive class environment \( (f=9) \). In conclusion, CURE curriculum provides high levels of student project ownership, student self-efficacy, and science, but students relate specific lab exercises as less helpful to their science identity, science self-efficacy, and project ownership. The open-ended question yielded factors contributing to the three constructs.

**Poster 3. Evaluating If a Simple Seating Intervention Can Foster Community Within Large Undergraduate Courses**

*Shaun Chaudhari, UC San Diego*
*Stefanie Au, UC San Diego*
*Stanley Lo, UC San Diego*

Large lecture sizes often result in a lack of community within the learning environment. This could potentially lead to a lack of student morale and potentially decreased academic performance. To address this issue, we devised a simple classroom intervention with a seating pattern in lecture halls where every third row of seats was blocked off for the purpose of allowing the instructional team to get to student groups during allotted discussions in class. We hypothesize that this new seating pattern blocking off every third row would help with fostering an improved sense of community among students. The data from clicker questions were collected following every lecture period to test how many interactions each student had with the instructional team. Sense of community for learning support and peer support was measured using an established survey instrument with Likert-like items. The results show that students reported higher sense of community in the large course with the seating intervention \( (\text{learning support} = 4.78 \pm 0.79, \text{peer support} = 4.44 \pm 0.97, n = 293 \text{ in two sections}) \) compared to the large course without the seating intervention \( (\text{learning support} = 3.38 \pm 0.59, \text{peer support} = 3.43 \pm 0.70, n = 185 \text{ in one section}) \). This higher sense of community in the large course with the seating intervention is comparable to that in the same course \( (\text{learning support} = 4.68 \pm 1.12 \text{ and peer support} = 4.60 \pm 1.01, n = 62 \text{ in three sections}) \). Overall, the simple seating intervention of blocking off every third row in the lecture hall can foster a higher sense of community within students in the learning environment.

**Poster 4. Signature Assignment Modality Enhances Student’s Learning and Engagement.**

*Parisa Jazbi, California Northstate University*

Role-playing as active learning and a teaching strategy has been used in various content areas. Although there are multiple studies on the effectiveness of role-playing in teaching, previous studies did not compare role-playing efficacy with the traditional methods such as PowerPoint presentations. In this work, active learning in the form of role-playing was incorporated and assessed in a signature assignment in a Microbiology class. Traditionally, students give PowerPoint group presentations on a case study on one infectious disease to their peers in this class. This study compared the student’s engagement and perception of learning of PowerPoint presentations versus role-playing for the signature assignment in microbiology. Students were divided into two experimental groups, traditional PowerPoint vs. role-play case presentation. In a survey, we used self and peer assessments to measure students’ engagement and perception of learning across groups. It was hypothesized that role-playing case presentations would significantly improve students’ engagement and perception of learning. Students feedback supported the value of the role-playing presentation in 1) engagement and enjoyment of the presentation (reported by 90% of students), 2) exposing students to the more
authentic and real-world based application of what was learned in the class (reported by 80% of students), 3) providing opportunities to reflect on the way knowledge will be gained in real life (reported by 74% of students) and 4) promoting the learning of complex material (reported by 60% of students). In addition, more than 90% of those students who presented via role-playing acknowledged that the method helped them learn complex material and develop critical thinking skills such as logical reasoning. This study is unique in the field of microbiology. In addition to confirming the value of the role-playing technique, it measured its impact on the student perception of learning and engagement.

**Poster 5. Piecing complement together: assessing learning and confidence through Legos**

*Heather Bruns, University of Alabama at Birmingham School of Medicine  
Josh Baty, University of Alabama at Birmingham*

Teaching phenomena that are unable to be observed is often challenging. Highlighting this challenge, students frequently struggle to visualize the intangible components of the immune system and immunologic processes. Offering learning activities that involve a tangible model and foster a visual understanding of concepts can aid students in learning conceptually difficult content. Understanding the complement system can be challenging because of its complexity. To address this, we created a learning activity to supplement subject content provided through lecture that uses Legos to demonstrate the activation pathways of the complement system and formation of the membrane attack complex. We implemented this optional activity in an introductory immunology course and an advanced immunology course on innate immunity and hypothesized that students who completed the activity would have improved exam performance on and increased confidence in subject content compared to students who did not do the activity. Although performance on pre- and post-test questions covering activity content demonstrated student learning in both classes, learning gains were independent of doing the Lego activity. However, confidence in subject content among students in both classes that did the Lego activity was significantly increased compared to those that did not do the activity. Importantly, students in both courses that did the activity had a positive perception of the activity, with a majority of students reporting that they enjoyed the activity and had more interest in the subject of complement. Taken together, these results demonstrate that this complement system Lego activity resulted in student gains in confidence and increased student interest in the topic.

**Poster 6. Learning Gains for All: A Plan to Increase Access and Equity in the Classroom as Inclusive Teaching**

*John Buchner, University of Maryland  
Erin Tran, University of Maryland*

To model inclusive teaching and increase access and equity in the classroom for our 400-seat general microbiology class in the fall of ’21, we flipped the classroom for lecture, live streamed and recorded the lecture sessions, liberalized the attendance policy, removed traditional exams for open note, untimed assessments, and made it easy to get extensions on assignments to encourage completion among other practices. To test our practices for equity, we measured student learning gains using a concept inventory. Our hypothesis is: if we apply practices and policies that increase access to the material, use active learning, and encourage completion classwork, learning gains will be observed across many demographic categories. Our IRB approved study design used a modified HPI concept inventory (Smith 2009) to collect student self-reported data on gender, race, and disability to measure learning gains. The survey is administered at the start of the semester, closing after two weeks to
measure the student's prior knowledge. A post class survey with the same questions opens in the last two weeks of the class to measure what the students learned. We analyzed data from 204 respondents who consented to the study and took both the pre- and post-survey. We measure learning gains by counting the correct responses for each question for the total population and selected demographic groups in the pre- and post-survey. The difference between the two is the learning gain. Our results indicate that learning gains are evenly distributed across the demographic groups, with no group showing consistently high or low learning gains in our classroom environment. We conclude that by thoughtful selection of techniques, we are modeling inclusive teaching as measured by learning gains. These data support our hypothesis that increasing access for students, active learning, and creating an environment that encourages students to complete the work enables learning for many students.

**Poster 7. Peer mentoring and study skills courses support sense of community among transfer students**

*Jennifer Teshera-Levy, East Carolina University*
*Heather Vance-Chalcraft, East Carolina University*

Community colleges are a vital entrance point for students seeking careers in STEM, but the process of transferring from two-year to four-year programs is challenging. The onus for preparing students for transfer is often placed on community colleges, but four-year institutions also have critical roles to play. With this in mind, we established the PRIMER program to support students transferring into our biology department. Students received a weekly academic skills course, peer mentoring, and informal academic and social supports, and we hypothesized that we would observe increases in students’ sense of community and capitalization through use of campus resources. Students participating in the PRIMER program completed a Sense of Community survey and the Learning and Study Strategies Inventory at the beginning and end of the program; we also administered these surveys to students (both transfer and non-transfer) not involved in the program. We observed no difference between PRIMER students (n = 29), other transfer students (n = 13) and non-transfer students (n = 55) in the start-of-semester SoC scores. PRIMER students significantly increased their SoC score at the end of the semester (p = 0.007, Wilcoxon signed rank test), but neither group of non-PRIMER students showed a significant change. We observed fewer differences between PRIMER (n = 53) and non-PRIMER (n = 77) students on the LASSI: both groups of students improved in five of nine subscales, but after correcting for multiple comparisons, there were no differences in the degree of improvement between PRIMER and non-PRIMER students. In the most relevant subscale to our research questions (Using Academic Resources), we observed no significant improvement from beginning to end of semester (paired t-test, p = 0.15), suggesting that this is an area where our program needs improvement. Our program may serve as a model to others trying to improve the sense of community and overall success of transfer students.

**Poster 8. Understanding the Effects of Administration Stakes and Setting on Biology Concept Assessment Scores**

*Crystal Uminski, University of Nebraska - Lincoln*

Biology instructors can use concept assessments to gauge student understanding of important disciplinary ideas. Instructors can administer assessments during class time or as an out-of-class assignment and can choose to grade them based on participation (i.e., low stakes) or correctness (i.e., high stakes). The conditions under which assessments are administered may affect how students
behave when completing an assessment, however, there has been little work to understand how these administration conditions may affect student outcomes and how scores under such conditions should be interpreted. To fill this gap in understanding, we studied student performance on a biology concept assessment over the course of six years, with each year of the study focusing on a different set of administration conditions. Our hypothesis was that students completing the assessment under high-stakes out-of-class conditions would have higher scores than students who completed the assessment under conditions with low stakes or during class time. Results from a mixed-effects regression model supported our hypothesis and we found that students were likely to have significantly higher scores in the high-stakes out-of-class condition (p < .001). Based on this result, we hypothesized that scores from this condition might not accurately reflect content knowledge because students have access and incentive to use external resources. We conducted a survey in which students reported their use of resources after they had completed a concept assessment in a high-stakes out-of-class condition. We found that 70% of students reported using at least one resource to help them. Our results indicate that instructors should use caution when administering assessments in high-stakes out-of-class conditions. We recommend instructors administer concept assessments in low-stakes out-of-class conditions that maximize instructional time and minimize the incentive that students have to use external resources.

**Poster 9. Student Driven Artistic Assignments for Complex Microbiology Processes**

*Ryan Kenton, University of Portland*

All too often, the sciences and the humanities are split and are frequently thought of as two different cultures spheres. Although, at their core, both science and art require observation and interpretation. Many assignments traditionally given to science students (e.g. research papers, worksheet, quizzes/exams, etc.) leave little to no room for artistic creation or expression. Three new student driven artistic assignments were given to parasitology students in the Fall of 2021. The first, allowed students to write a research paper from the perspective of a parasite or as a more traditional paper. The second, had students choose any art medium to create, narrate, and record a life cycle of a parasitic trematode. Third, students created a children’s book on a life cycle of a parasitic nematode using only the 1000 most common words in the English language. It was hypothesized that switching from traditional assignments to student driven artistic assignments would result in greater student understanding and therefore increase overall student grades and student satisfaction with the course. In this study, final course grades as well as quantitative and qualitative end of term evaluation data of students enrolled in this course (n=28) was compared to previous courses (n=108). In both groups, the course was taught by the same instructor using similar curriculum and exam questions. This study found that course evaluations increased slightly (4.84 vs 4.72 out of 5) as well as the the average course grade increased (88% compared to 85%, p=.0003). In addition, course withdrawal rates stayed consistent between these two groups. This data suggests that students, when allowed to have ownership and creativity in their learning, better understand difficult microbiology concepts as well as increase student performance and satisfaction within the classroom.

**Poster 10. A simple intervention to schedule unique weekly office hours increases student access**

*Caitlin Williams, University of North Carolina at Chapel Hill*

Faculty office hours (OH) provide an opportunity for high-quality student-faculty interaction beyond normal classroom sessions. Extensive research has demonstrated that faculty interaction benefits
learning of all students and has even greater impacts for students of color. Despite the benefits of faculty-student interaction and that OH exist to provide such interaction, student usage of OH is typically low. A few studies have investigated the reasons for low engagement and inconvenience has been identified as a major deterrent. I hypothesize that the inconvenience of OH is a major inhibitor for students in the UNC-Pembroke biology department and that scheduling OH based on students’ schedules will increase their availability to attend. To address my first hypothesis, I collected survey responses from students across the biology department about their opinions of OH. Responses were coded for major themes, and top concerns were inconvenience (52% of responses), misunderstanding of the purpose of OH (30%) and approachability/fear (17%). Most students (66%) reported having 2 hours per day or less to attend OH, so it is not surprising that the timing of OH is crucial. To address my second hypothesis, I used a weekly survey in my microbiology course to determine when students were available to attend OH. I scheduled unique OH in addition to standard OH held at the time most convenient to me. The unique OH increased student availability to attend from an average of 59% to 100%. The students perceived that OH in my course were “always” held at a convenient time versus “sometimes” for biology courses in general. I conclude that inconvenience of OH is a major barrier to biology students at UNCP and that scheduling OH at unique times increases student access. It is likely that inconvenience of OH is a barrier for students at many institutions and that a simple scheduling intervention could improve equity through increased student access to and usage of this valuable resource.

Poster 11. Clinical Microbiology Laboratory Simulation for MLS Students-Outcomes Supporting Implementation

Angela Wilson, Old Dominion University

In a non-medical university, it is a challenge to find clinical practicum sites for student clinical rotations. As local healthcare systems centralize microbiology laboratory services the number of clinical microbiology training sites decreases. In the summer of 2018, the faculty at Old Dominion University piloted an on-campus clinical microbiology simulation hybrid model to satisfy Medical Laboratory Science (MLS) entry-level practical competency requirements. After students completed their microbiology clinical practicum final exam and microbiology section of the comprehensive program exit exam, faculty evaluated student learning using two-sample t-tests to establish if statistically significant differences existed in student scores enrolled in the clinical microbiology simulation hybrid model versus the traditional clinical practicum model. We hypothesized that no such differences would exist. Analysis of data spanning two years (n=30) revealed that there were no statistically significant differences between the post practicum exam results achieved by both groups (p>0.05). Additionally, there was no statistical difference in student performance on the MLS American Society of Clinical Pathology Board of Certification exam microbiology content area. We concluded that students had an equally valuable learning experience in both practicum models. We continue to use the on-campus clinical microbiology simulation hybrid model.


Dyan Morgan, University of Kansas

Developmental biology can be a challenging course to teach as it is content-rich and takes place in a 4D frame. Within developmental biology education, there is a push to cut content and focus on
understanding and applying key principles. Additionally, instructors are incorporating active learning techniques to aid student learning. However, it is challenging to decide what topics to include or exclude, how to allocate time, and where to focus active learning. This project contributes to the field by addressing 3 key questions: 1) According to students, what are the most challenging concepts in developmental biology? 2) Does student performance on formative assignments reflect their self-reported challenges? And 3) How do students use a metacognitive assignment? We hypothesized that students and scores would identify detail-rich concepts as most challenging and that students would not recognize the value of the metacognitive exercise. To answer these questions and test our hypotheses, we used a mixed-methods approach. First, we coded results of metacognitive assignments to identify challenging concepts. Next, we compared this list with scores on quizzes. Finally, we surveyed students on use of the metacognitive assignment. This approach yielded a list of topics that were most challenging to students based on self-reports and assessment (n=75 students). Interestingly, each of these topics was assessed via application rather than recall, suggesting students may struggle more with application than with particular topics (n=75). Student surveys indicated that 85% completed more than half of the metacognitive assignments, 77% found the metacognitive assignment beneficial to their learning, and 65% used the metacognitive assignment to plan study time (n=75). Overall, we conclude that students struggled most with application, but find value in metacognitive assignments and will use them for study purposes.

Poster 13. Responsible and Ethical Conduct of Research (RECR) reasoning by undergraduates: experience matters

Laura Diaz-Martinez, Gonzaga University
Elizabeth Monthofer, Gonzaga University

Responsible and ethical conduct of research (RECR) is an integral part of the scientific process. The increase in Course-based Undergraduate Research Experiences (CUREs) has resulted in more undergraduates conducting research as part of their academic curriculum. However, CUREs rarely include education on RECR. We studied reasoning strategies students used when faced with RECR cases, specifically, we asked: 1) What reasoning strategies are utilized by undergraduate students when making RECR decisions? 2) Do reasoning strategies differ between RECR decisions related to misconduct vs. Questionable Research Practices (QRP)?, and 3) Are there differences in reasoning strategies between novice (1st-2nd year) and experienced (3rd+ year) students? We hypothesized that despite a lack of RECR education, experienced students would identify misconduct/QRP issues more easily and would demonstrate more informed reasoning. Responses to two RECR cases were gathered from students in introductory and upper division biology classes (N=245). Both novice and experienced students identified research misconduct as a more severe ethical violation than a QRP. Accordingly, students’ reasoning for these two scenarios varies: In the QRP case, a majority of students (55.43%-60.78%) justified the characters’ actions, while this number is minimal in the misconduct case (<5%). Qualitative analysis of student responses identified several differences between novice and experienced students including a higher number of experienced students identifying research misconduct (51.09% experienced, 35.29% novices) and its negative effect on research integrity (22.83% experienced, 16.34% novices). Our results suggest that undergraduate students increase their awareness of RECR throughout their studies, perhaps via their participation in CUREs, even if these classes do not specifically address RECR topics.

Poster 14. Increasing Interest and Value Of Microbiology In Nursing Students
Background: Nursing students frequently believe microbiology unimportant to nursing practice, worsening issues like healthcare-acquired infections and antibiotic resistance. This issue may stem from a theory-practice gap in nursing microbiology curricula, engendering beliefs that undervalue the role of microbiology in healthcare. Nursing students also report microbiology as difficult, indicating a high perceived cost of learning. Expectancy value theory states that perceiving material as interesting and valuable for achieving long-term goals, like careers, improves performance in college students; increasing interest in and value of microbiology in nursing students while reducing cost may counteract negative beliefs/practices and improve U.S. healthcare outcomes. We hypothesize that “nursifying” laboratory curricula to connect microbiology to nursing practice will increase interest and utility value in microbiology while reducing perceived costs in nursing students. Methods: A nursing microbiology lab curriculum was redesigned to cover literature-recommended topics and competencies (1). Pre- and post-surveys measured microbiology utility value and interest in students (n=117) undergoing the “nursified” curriculum. Non-nursing student responses were used as controls. Surveys used a Likert-type scale of 1-7. Results: Microbiology interest for nursing students did not change, while utility value significantly decreased (p<.001). For non-nursing students, interest significantly increased (p<.04) while utility value did not significantly change. This difference was not explained by perceived cost, as both groups reported a significant decrease (p<.03). Conclusion: “Nursifying” curricula is insufficient to increase interest and utility value of microbiology in nursing students. Bridging this understanding gap is crucial for improving undergraduate nursing education, highlighting a continuing challenge in achieving desired outcomes of microbiology educational standards.


Emma Goodwin, Arizona State University

Individuals with disabilities are significantly underrepresented in the life science workforce. One approach to addressing this issue is engaging students in educational practices known to be particularly beneficial. AAC&U provides a framework of high-impact practices (HIPs), ranging from collaborative projects to learning communities and undergraduate research. However, no study has examined whether students with disabilities are participating in and benefiting from HIPs. We hypothesize that students with disabilities may have less access to engage in HIPs. In this comparative study, we aim to explore how disability identity impacts student experiences with HIPs.

We disseminated a nationwide survey via recruitments sent through life sciences programs and disability resource centers and collected 1,346 student responses from 359 institutions (research-intensive, comprehensive, primarily undergraduate, and community colleges). We collected quantitative and qualitative data from students regarding their engagement with 11 HIPs. For students with disabilities, we collected data on their disability-related experiences, their comfort in the college environment and the support their institutions provide.

We used linear regressions to determine how disability status and disability-related experiences impact student participation in HIPs, while controlling for other student-level characteristics. We found that students with disabilities are less likely to participate in certain HIPs, including undergraduate research.
Coding of open-ended student responses will reveal specific barriers that undermine participation in HIPs for students with disabilities.

As we identify evidence-based practices and experiences that support learning and persistence in life sciences, we must consider the accessibility and equity of these experiences for students with disabilities. This work will result in recommendations for addressing specific barriers for students with disabilities.

**Poster 16. Scientific communication skills development and assessment in undergraduate STEM classes**

*Michaelyn Hartmann, Boston University*

*Mara Laslo, Harvard Medical School*

It is increasingly important that science curricula include transferrable skills such as critical review of the literature, collaboration, and scientific communication. To help our students develop these skills, we created assignments structured around reading, interpreting, and presenting scientific literature and deployed them in two intermediate-level large cell biology courses. The semester culminated in a group poster presentation of a scientific paper. The assignments and poster presentation were assigned to groups, also helping to facilitate collaborative and communication skills. Our hypothesis was that these assignments would help students develop scientific communication skills throughout the semester, increase self-efficacy in those skills, and that the poster presentation would effectively assess scientific communication skills. We evaluated the effectiveness of the assignments through assessments as well as surveys to measure student self-efficacy before and throughout the semester. We analyzed the five surveys with either Friedman’s two-way analysis of variance by ranks for comparison of distribution across all five surveys, or a related samples Wilcoxon signed rank test for questions compared between only two surveys. We found that student self-efficacy increased in all areas measured, including many aspects of scientific communication such as reading scientific papers, analyzing data, presenting data, creating figures, and talking about science with peers and faculty. Students agreed that the scientific literature assignments throughout the semester contributed to the development of these skills and that the papers helped them learn and engage with class content. These assignments could easily be adapted to other STEM courses or other disciplines.

**Poster 17. Hybrid Inquiry Based Lab Highlights Scientific Method Using Bacterial Conjugation as a Model.**

*Eileen Hotze, University of Kansas*

*Joan Klages, University of Kansas*

A challenge in laboratory science education is the lack of inquiry-based labs (IBLs) curricula that emphasize critical thinking. IBLs, which include the students in the experimental design process, are designed to mirror authentic scientific research. Limited resources in teaching labs and the COVID pandemic have also hastened the need for innovation and implementation of hybrid labs, where some or all of the content is presented online. Here we present a hybrid IBL for a pathogenic microbiology course using the Enterococcus faecalis pheromone induced conjugation as a model system. The IBL learning objectives (LOs) focus on the scientific method, experimental design, data analysis, and the conjugative process. We hypothesized students would meet these LOs after completing this IBL. We
tracked student learning to provide an assessment of the structure and success of the IBL using pre- and post-IBL quizzes and the Laboratory Course Assessment Survey (LCAS). LCAS results were reported on a six-point scale, with a score of 6 indicating that students strongly agreed and a 1 indicating strong disagreement. We grouped results for survey questions into the three thematic categories (collaboration, discovery and relevance, and iteration). Students were most in agreement that they were asked to “discuss elements of investigation with classmates or instructors” (mean 5.63, sd=0.56) and to “contribute ideas and suggestions during class discussions” (mean 5.63, sd=0.67). Scores were highest related to collaboration, suggesting that this lesson was strong in this area. Quiz results reflected student progress in all learning objectives with particular growth in the LOs that focused on the conjugation process. Quiz questions linked to this LO showed an average increase in score of 54% from pre to post IBL analysis (n=30). Overall our results show positive student learning gains from this IBL which could be adapted for lower-level microbiology laboratory courses.

Poster 18. Medical Experiences' Influence on Science Motivation

Porter Bischoff, Utah Valley University
Annette Lewis, Utah Valley University
Josh Premo, Utah Valley University
Brittney Wyatt, Utah Valley University

Understanding different aspects of science motivation allows educators to appropriately tailor their pedagogy and increase success in the science fields. The Self Determination Theory (Deci, 2012), which explores the importance of autonomy, competence, and relatedness in identifying self-determination is foundational in understanding science motivation. One aspect that may influence self-determination for science motivation could be the presence of medical experiences in the life of the student (having a medical experience/condition or being a caregiver for one who has medical conditions). Based on the Self-Determination Theory, we hypothesized that self-determination and intrinsic motivation would be increased if a student identified as having a medical experience(s). Based on data analysis from surveys given to different introductory biology classes, aspects influenced by the Self-Determination Theory were explored as well as if one has a medical experience/condition or cares for one who does. Results show that students with medical conditions had significantly higher science motivation overall (d = .37. medium effect), particularly for intrinsic motivation (d = .50. medium effect). These results suggest that those with medical conditions enjoy learning science and understand the importance of science in one’s daily life more than those who do not. In addition, students with medical experiences had significantly higher science identities (d= .38). This suggests that those with medical conditions see themselves as science people and scientists. Further analysis will be run through focus groups to allow us to better understand individual experiences surrounding the connection of medical conditions in science motivation. This study will provide insight into understanding the influence of medical conditions on science motivation and thus, allow educators, doctors, parents, and others to encourage science experiences in those that have medical experiences.

Poster 19. The Effect of Covid-19 Pandemic on Students Views on Fair Distribution of Healthcare Resources

Anni Moore, Morningside University

While ethical dilemmas about fair distribution of health care resources are nothing new, the Covid-19 pandemic brought these topics into sharper focus for everybody, from the lack of hospital beds and...
ventilators to who should be given a priority for vaccines. Because of this, we hypothesized that as the students become more aware of these issues throughout the pandemic, the overall distribution of which theories of distributive justice they identify with would change depending on which issues were specifically relevant at the time of the assignment. The data was collected from bioethics assignments in genetics and microbiology courses from 2018-2022. In the assignment, the students were asked to read Dividing up Healthcare Resources in “Bioethics: Principles, Issues, and Cases” by Lewis Vaughn (2013) and determine which theory of distributive justice (egalitarian, utilitarian, or libertarian) they identified with. Overall, there was a clear shift in the distribution of which distributive justice theories the students identified with from before and during the pandemic. Before the pandemic, students identified with all three theories in roughly equal proportion. However, they identified significantly more with utilitarian theory early in the pandemic (“maximize the benefit to the whole society”) with an increase from 32% pre-pandemic to 56% at the height of the pandemic in the fall of 2020, and more with egalitarian theory one year into the pandemic when the vaccine came out (“we are all in it together”), with an increase from 38% pre-pandemic to 51% in the spring of 2021. Students who knew someone who had complications (or had died from) Covid-19 identified significantly less with libertarian view of justice. It shows that what students consider to be fair distribution is influenced by their personal experience as well as increased awareness of the issues, underscoring the importance of including discussions about bioethical reasoning into biology curriculum.

Poster 20. A CURE for the COVID-19 Era: A Vaccine-Focused Online Immunology Laboratory

Dyan Morgan, University of Kansas

During the COVID-19 pandemic, universities across the globe quickly shifted to online education. Laboratory courses faced unique challenges and were forced to reevaluate learning objectives and identify creative projects to engage students online. This study describes an innovative online immunology laboratory curriculum focused on vaccine development. The course learning objectives focus on the scientific process, key experimental design components, and immunology techniques to evaluate vaccine efficacy. The curriculum, a course-based undergraduate research experience (CURE), asked students to engage in the research literature, propose a vaccine design and assessment strategy, and interpret mock results. It was hypothesized that an online immunology laboratory curriculum would be effective at preparing students to meet learning objectives. To test this hypothesis and evaluate whether students met learning objectives, instructors scored student work via a rubric on a 4-point scale for each learning objective and found that all average scores were above a 3 out of 4 (avgs: 3.1-3.6; n=44). Students self-evaluated their ability to meet each learning objective using a Likert scale survey. The results of this survey reflected this same mastery of the curriculum’s learning objectives with most students agreeing or strongly agreeing that they could meet each learning objective (n=42). Finally, results from the laboratory course assessment survey (LCAS) indicate that this curriculum incorporated the CURE elements of collaboration, discovery and relevance, and iteration (n=42). Altogether, these data support the conclusion that this online immunology laboratory curriculum is effective at helping students learn appropriate experimental design, scientific literacy skills, and the theory behind immunology techniques. This curriculum can be easily adopted in full as an online or hybrid lab course or adapted as a new project in a lecture or lab course.

Poster 21. Assessment of Laboratory Kits in a Remote Course-Based Undergraduate Experience on Soil Microbiomes
Course-based undergraduate research experiences (CUREs) serve as innovative avenues for increasing accessibility of early research experience to a larger number of students, including underrepresented minority students. Previously, we reported the implementation of a large-enrollment introductory in-person CURE on soil microbiomes. The COVID-19 pandemic necessitated the shift to remote learning, where hands-on experience in physical laboratories ceased. To address this, we created and distributed lab kits that allowed students to complete half of the hands-on experiments that were previously present in the in-person CURE. In this study, we describe student outcomes on self-efficacy on research skills from 3 course modalities: in-person CURE, remote CURE without lab kits, and remote CURE with lab kits. Student outcomes were measured pre- and post-course using a modified version of the classroom undergraduate research experience survey. We hypothesized that students would report decreases in self-efficacy on research skills in the remote CUREs (with or without lab kits) compared to the in-person CURE. We further hypothesized that students in the remote CURE with lab kits would report increased gains in self-efficacy on research skills compared to the remote CURE without lab kits. One-way ANOVA analyses revealed that students in the in-person CURE (n=596) and remote CURE with lab kits (n=696) reported significant self-efficacy gains in 20 out of 21 items. In contrast, students in the remote CURE without lab kits (n=201) showed gains in only 16 out of 21 items. Notably, students in the remote CURE with lab kits did not report significant gains in performing laboratory procedures.

Poster 22. COVID-19 Remote Instruction Prepares STEM Students for the Return to Face-to-Face Learning

Jeffrey Olimpo, The University of Texas at El Paso
Aaron Esparza, The University of Texas at El Paso

Student involvement in distance education has been accelerated by the transition to remote instruction caused by the COVID-19 pandemic. Empirical data demonstrate variable levels of student learning and engagement in such environments; consequently, it is perhaps unsurprising that recent literature examining the influence of COVID-19 on student outcomes has largely revealed negative impacts. Yet, we contend that this may unintentionally portray a deficit viewpoint. In an effort to explore the potential positive outcomes of COVID-19 remote instruction on [under]graduate STEM student learning following the return to face-to-face modalities, we conducted a mixed methods study employing both closed- and open-ended (OE) survey items. Specifically, students enrolled in the College of Science at an R1, HSI (N = 105) responded to Likert-item statements found on the Online Self-Regulated Learning Questionnaire and Adaptability Scale, and provided written feedback to one additional question concerning what skills they feel they acquired from COVID-19 remote instruction. These data allowed us to address two questions: 1) What relationship exists between students’ ability to adapt to novel situations and their online learning behaviors?; and 2) How did COVID-19 remote instruction contribute to students' skill sets? We hypothesized that a positive relationship would exist between increasing adaptability and use of productive online learning behaviors; we further predicted that a diversity of skills would be reported by participants. Correlation analyses confirmed our hypothesis (e.g., r = 0.494; p < 0.001 for the correlation between cognitive-behavioral adaptability and goal setting). Thematic analysis of OE data further revealed that time management, effective note-taking, and technology...
literacy skills were identified by more than 75% of respondents. Together, these data provide insights into the benefits of COVID-19 remote instruction on [under]graduate STEM student learning.

**Poster 23. A Guided Learning and Tactile Teaching Tool Activity to Learn About Membrane Potentials of a Neuron**

Laura Ott, University of North Carolina at Chapel Hill

In a Human Anatomy & Physiology course, many students struggle with the concept of how the resting membrane potential of a neuron is established, as students must visualize the movement of ions across a membrane. Drawing on previous studies that demonstrated the effectiveness of tactile teaching tools (TTTs) and a guided learning approach to teach concepts in Genetics (Gordy, et al., 2020), we hypothesized that a similar guided inquiry and/or TTTs approach could be used to promote student learning of membrane potentials. We developed an activity where students participated in a guided inquiry activity that involved manipulation of TTTs that consisted of a 3D-printed N+/K+ ATPase and other objects (3D print files and instructor materials will be shared). The learning objectives of this activity aligned to higher-order levels of Bloom’s Taxonomy (apply and evaluate) and the activity was implemented in two sections of a hyflex, large-enrollment Human Anatomy & Physiology course in the Spring of 2022. All students completed an online pre-assignment before class. Students who attended class in-person completed the guided inquiry activity with the TTTs, while students who attended class remotely completed the guided inquiry activity without the TTTs. Six pre- and post-assessment questions that were mapped to the activity learning objectives were given, with the pre-assessment given the first week of the semester and the post-assessment given on the unit exam. A total of 234 students consented to this study, with the average of the pre-assessment being 2.71 (+/- 1.40). Preliminary post-assessment data revealed gains of approximately 2 points, and we have evidence that students in both the in-person and remote learning environments demonstrated gains associated with the activity learning objectives. Our assessment data therefore suggests that this guided learning and/or TTTs approach may be an effective way to teach this foundational concept.

**Poster 24. Barriers to Online Formative Assessments in Introductory Biology Courses**

Allison Upchurch, University of Nebraska-Lincoln

Instructors often use online platforms to deliver their formative assessments (FAs), such as homework assignments, to students outside of class. Previous studies have revealed barriers for students in online courses, but little is known about barriers for online FAs. Understanding these barriers is a critical step in fostering more inclusive learning for all students. We examined barriers with respect to technology, instructor organization, social interactions, personal engagement, and learning environment in the context of online FAs. We hypothesize that demographics may predict barriers and that these barriers can hinder course performance. We administered a survey to over 1200 undergraduate biology students at both two and four-year institutions. Students responded to closed-ended Likert statements and an open-ended prompt. Through mixed models, we found statistically significant differences between mean scores in each barrier category. We also found that certain barrier categories could be predicted by various demographics, and all barrier categories except social predict course performance. We coded open-ended responses, finding students most frequently suggested changes to scheduling logistics, course delivery, and FA format in order to alleviate their perceived barriers. With knowledge of demographic predictors, along with improved understanding of
how barriers may predict course performance, instructors can adjust FAs to better suit the student population they serve.

**Poster 25. Instructional and Retention Strategies for STEM Students Using Co-Curricular Science Courses**

*Matthew Mastropaolo, Neumann University*

*Louise Whitelaw, Neumann University*

Many STEM students at Neumann University struggle in their first year at college. Neumann, like many other schools, uses a first-year experience course to help students navigate the college experience. Even with this course, we have seen lower first-to-second year retention rates in 2018 for STEM students (60%) than other majors (75%). Of the students that do not return to the university, approximately 75% do not return for financial reasons. The focus of this project was to examine the use of financial assistance and co-curricular activities (academic and non-academic) to increase retention of STEM majors and build a sense of community. As the main mechanism to increase retention, the financial burden of our STEM students was reduced by providing NSF-funded scholarships to STEM students with financial need. Other mechanisms included involving scholars in extra co-curricular activities (course-based and social events), a common mentor and advisor for these students, and a research project that monitors the students’ academic progression, agency, and needs for success in their majors. This includes using research projects and national courses based undergraduate research programs like SEA-PHAGES. Students are surveyed and interviewed once a year by faculty and outside evaluators. Data obtained from surveys (Likert scale, 1-4) and interviews of both STEM students in the NSF scholar program and non-scholars were compared. Our overall hypothesis was that the use of these different tools and activities will result in increased STEM retention by at least 10%. These overall efforts have helped increase freshman retention in 2020 for STEM majors (67%) as compared to other majors (73%). Although our initial retention goals were not met, we learned that STEM students strongly felt they had access to academic support (range from 3 to 3.4), however, they do not participate in faculty office hours (range from 1 to 1.7). This new finding is under further investigation.
On-Demand Sessions and Microbrews

A Powerful Interactive Online Database For Unknown Pathogen Identification And Much More

Monika Oli, University of Florida

This activity can be used in lecture or lab classes, synchronously or asynchronously and attendees will be able to practice during the Microbrew. There are many activities that can be done with this software, though this session will focus specifically on the biochemical identification of a true unknown bacterial isolate.

A Structured Inquiry Activity for Teaching Membrane Potentials

Jenna Smith, Millikin University

One challenging topic taught during two-semester Anatomy and Physiology courses is electrical signaling, including the maintenance of a resting membrane potential in cells. A structured inquiry activity for teaching this concept, in which the instructor walks students through the dynamic components of establishing a membrane potential but omits the outcomes, allows students to predict and observe ion movements. This activity couples inquiry-based learning concepts with a hands-on component. In this session, attendees will be walked through this inquiry-based approach to teaching resting membrane potentials from the perspective of a student and be encouraged to consider other applications for this teaching approach.

Actively Engaging Microbiology Students from the First Day of class

Michelle Korir, Aurora University

Many students in a non-major microbiology course start off not understanding the importance of microbes; at most, they know they cause disease. Although this is true, the majority of microbes do not cause disease, and many of them in fact are beneficial to humans. To help students understand the importance of microbes, the first day of class focuses the impact of microbes in the everyday lives of humans. By starting the semester off with an interactive activity, it sets the expectation that students should continue to engage in the classroom throughout the semester. Additionally, by learning about all the different things microbes can do, students will likely get excited about what they will be learning throughout the rest of the semester.

Adapting Course-based Undergraduate Research Experiences to the Virtual World

Carrie Spratford, UCLA
Casey Shapiro, UCLA

Course-based undergraduate research experiences (CUREs) have proven to be beneficial in teaching core principles of experimentation and scientific thinking in STEM to undergraduate students (Dolan, 2016). This learning environment is driven by an inquiry-based pedagogy and involves hands on laboratory techniques in conjunction with the development of scientific conceptual thinking and communication skills. Students of all backgrounds who participate in CUREs have an increased retention in STEM including underrepresented minority students. Unfortunately, it can be difficult for primarily undergraduate institutions and community colleges to offer this type of course due to limited space and financial support (Bangera & Brownell, 2014). Being able to adapt the CURE strategy to the virtual format can broaden the number and type of students that are able to access this immersive learning environment and ultimately increase the range of students that wish to be involved in future careers in
An Active Learning Pedagogy That Enhances Students' Learning and Engagement

Hatem Elshabrawy, Sam Houston State University
Hossam Ashour, University of South Florida

Team-based learning (TBL) is an active learning pedagogy that have recently shown positive impact on student engagement, accountability, performance, and knowledge retention. Based on our data, TBL is more effective than traditional lecture-based pedagogy for improving medical students learning of complex concepts and for promoting independent learning. In this session, we will share classroom data showing TBL's positive impact on medical students' learning. At the end of our session, the attendees should be able to: 1. Describe the components of TBL and benefits of TBL in medical education, and 2. Compare and contrast TBL to traditional teaching pedagogies.

BIOTECH Pathways Workshops: Engaging High School Students and Their Families in Biotechnology

Susan Walker, Harford Community College
Breonna Martin, Harford Community College
Jaclyn Madden, Harford Community College

Have you found it difficult to recruit students into a new program? Research indicates that many high school students are unaware of careers in fields like biotechnology and that they often rely on their families or friends when making decisions about college and career choices. In this session, attendees will learn how the BIOTECH Pathways program engages students and their parents/guardians in hands-on workshops to increase awareness of biotechnology as a field and local academic and career options. They will discuss how they can implement similar strategies in their institutions to improve community engagement and to recruit students into new degree programs.

Chasing 'Zebras'...Infectious Diseases Made Fun

Sudha Moorthy, University of the Sciences

In this activity, students role-play as "patients", "doctors" and/or "nurses" to explore/ understand Infectious Diseases. Student groups take on a specific infection (bacterial/ viral/ fungal, etc) to research and then enact a 'House'-style scenario: based on clues provided by the presenting group, the class makes informed guesses to identify the disease. Compared to lecture delivery, this exercise has shown higher student engagement and participation. Students rise to the challenge of devising a puzzle to be solved, and are enthusiastic to share how they "cracked the clue". The game eases students into discussions on why certain symptoms occur or why certain treatment options work. It also connects the microbiology to their real world.

Clinical Microbiology Laboratory Simulations Using QR-codes are Met with High Engagement

Xyanthine Parillon, University of Houston Downtown
Background: Staphylococcus aureus binds to IsdB, a hemoglobin receptor, disrupts red blood cell homeostasis resulting in low hematocrit. Understanding how hematocrit is derived was a model to test how digital lab interventions engage students. QR codes were created as direct assessments and linked to an interactive simulation and digital video centered around hematocrit determination.

Hypothesis Statement: This study hypothesized that students would engage and learn from a QR-coded digital video and interactive digital simulation in a lab course. How access to QR-coded lab activities occurs was investigated. Students scanned the instructor-made QR-coded content generated with a QR Code generator during a lab session and answered questions at laboratory stations. Students were asked to submit their resulting hematocrit in Blackboard to understand QR-coded activity's effect on learning. QR Code Generator analytics was collected to determine engagement and access to digital content.

Results: Engagement of digital video resulted in 48 unique engagement points and the interactive simulation 47 unique points. Interestingly, students accessed the content post-lab with about 10 percent unique point engagement. Access occurred highest by iOS for the interactive simulation (58%) and the digital video (62%) and lowest by windows (6%) for the interactive simulation and OSx (7%) for the digital video. AndroidOS was 10 and 12 percent, respectively, for both. Answers to establishing the hematocrit after interactive simulation engagement resulted in 100% accuracy of the correct hematocrit.

Conclusions: QR-coded contents allow access post initial learning environment engagement with may support further understanding or ability for students who cannot attend class to engage still. QR-coded content is a digital technology that positively engages students in e-learning and may be used more to align with student technology use.

Cultivating meaningful student interaction in a large, asynchronous course by collaborative mind-map

Jessica Hill, University of Toronto

Meaningful student interaction is a key factor contributing to student learning. While asynchronous, online courses provide advantages to students with respect to accessibility and flexibility, creating opportunities for student interaction in this environment requires careful planning. Here I describe a strategy for cultivating student engagement and enhancing student learning using a tool for collaborative mind mapping in small groups. Students are first assigned to create a mind map (a visual representation of interrelated course concepts and information) for a course module, then asked to generate a mind map collaboratively with peers. This activity aims to strengthen student relationships through shared knowledge building.

Current status and implementation of science practices in Course-Based Undergraduate Research Experiences (CUREs): A systematic literature review

Alaina J. Buchanan, University of Northern Colorado

This talk will highlight the current status of CUREs in STEM literature. It will focus on how each CURE curriculum incorporates the core components as well as proposed scientific practices. Attendees will learn about the diversity of CUREs in the literature as well as how those CUREs align with the five core components (discovery, relevance, use of science practices, collaboration, and iteration) as well as four proposed science practices that match the epistemology of authentic reasoning (generating research questions, designing studies, reviewing literature, and dissemination of results).

Developing Mini-Games and Playful Activities to Implement ASM Curriculum Guidelines in Undergraduate Microbiology Courses

Grace L. Axler-DiPerte, CUNY: Kingsborough Community College

Game Based Learning including mini-games and playful activities help students connect, collaborate and explore concepts. Using common game mechanics like randomizers and role playing, can introduce a topic, or help reinforce and allow students to apply a new concept. However, creating such activities can
be overwhelming, due to the perceived time and technology involved. Attendees will be introduced to platforms to easily create mini-games and playful activities for any course modality, including manipulative sorting, digital escape rooms, playful discussion board prompts, and more. Attendees will then brainstorm a mini-game or activity to address an ASM aligned learning outcome.

**Developing Scientific Communication Skills through Analysis of the Primary Literature**

*Emily Ledgerwood, Le Moyne College*

*Jonelle Mattiacio, St. John Fisher College*

In addition to educating students and conferring degrees, colleges have a responsibility to produce biology graduates proficient in scientific literacy. The COVID-19 pandemic has demonstrated that the scientific community has struggled to adequately convey scientific findings to a general audience, highlighting a need to teach beyond data analysis and to instead apply this analytical approach to convey findings in an equitable way. We have designed a lesson series in which students analyze literature, while assessing effective science communication practices for various audiences. This lesson combines principles of ownership and shared purpose while demonstrating the benefit of approaching problems in a collaborative setting.

**Developing STEM Literacy through Scaffolded Pedagogy in Microbiology Courses**

*Samantha T. Parks, Georgia State University*

*Jessica Lee Joyner, Georgia State University*

In comparable microbiology-related courses, scaffolded assignments to improve Data literacy and Reading/Writing literacy were developed using ASM Curriculum Guidelines and the Microbiology Course Inventory (MCI) to structure the course and assignments. Examples of such assignments included a meta-analysis using literature and bioinformatics, as well as a public data presentation and an epidemiological model based on current events. To evaluate the effectiveness of such approaches, assignment components were aligned to determine whether the activities reinforced the MCI concepts. Comparison of pre/post course data indicate relative strengths (and weaknesses) addressed by scaffolded STEM literacy pedagogy.

**Digging in the Dirt: A Novel CURE in the Race Against Antibiotic Resistance**

*Kathy Boyle, Mount Mary University*

*Abby Multerer, Mount Mary University*

We are in year 1 of an NSF S-STEM track 2 proposal providing academically strong, financially in need students with rich, early and sustained opportunities to conduct original research. Through a year long course, our scholars develop their understanding of the nature of science, establish identities as scientists, cultivate a strong sense of belonging within their cohort and the field, and develop authentic research skills that are all correlated with STEM persistence. To this end, our students will isolate and characterize soil bacteria as a source of previously unidentified antibacterial producing organisms. Our students are participating in a student source hunt for new antibiotics that has been adapted from the Tiny Earth Program.

**DNA sequencing in the classroom - use of Oxford Nanopore MinION in a microbial ecology CURE course**

*Katrina Twing, Weber State University*

I have implemented the use of an Oxford Nanopore MinION DNA sequencer into a semester-long CURE in my upper-level Microbial Ecology course to give students hands-on experience with cutting edge
technology and ownership over their project and data. In this MicroBrew session, I'll present the rational, plan, and experience using the DNA sequencer in the classroom.

**Doing Central Dogma: Active Learning Activity for Molecular Biology of Gene Expression**

*Sarah Shoemaker, North Country Community College*

This is a presentation of a hands-on activity that students can perform for kinesthetic learning of molecular biology—a topic that students often struggle with because they can't visualize things on an ultramicroscopic level. In this activity, we enlarge molecules to macroscopic proportions and allow students to manipulate them, as if they were on a Magic School Bus trip inside a cell during gene expression.

**Ethics for STEM Education Researchers**

*Stanley Maloy, San Diego State University*
*Amy Kullas, American Society for Microbiology*

We will engage the audience in a discussion of key issues that influence scientific ethics, including publication ethics, that are relevant to STEM Education Researchers and Educators. The discussions will include examples and questions on related topics from the audience, advice on what to do if you are concerned about an ethical infraction, and ways we can reduce ethical problems.

**Evaluating the Impact of Student-Created Videos in Undergraduate Biology Courses with an Experimental Design**

*Kathleen Hefferon, Cornell University*

This study presents an explanatory video assignment that was designed to incorporate metacognitive and inclusive teaching practices to support learning in undergraduate Biology courses. The assignments intended to offer students an opportunity to express their individuality while attempting to explain complicated course concepts. Instructors in plant science and microbiology courses assigned these video projects to target challenging course concepts, including photosynthesis, tropism, the carbon cycle, and the nitrogen cycle. We applied a mixed-methods research design to evaluate the impact of this assignment on learning and confidence. An experimental research component isolated the impact of the assignment, and content analysis provided evidence about students' perspectives. We found that students showed learning and confidence gains beyond those due to typical course activities. Qualitative evidence suggests that students experienced the assignment as valuable for their learning, and that the assignment enhanced self-expression in the course. The assignment was effective in both face-to-face and remote settings, implemented either as a course requirement or extra-credit option. This versatile video assignment requires few resources and can be used to deepen students’ understanding of any topic while promoting confidence and inclusivity.

**E-waste and E/RCR: Guidance and Flexibility to Promote Ethical Reasoning for Global Challenges**

*Carlos Goller, North Carolina State University*
*Carly Sjogren, North Carolina State University*

Ethical reasoning is a critical skill often taught as a requirement for federal grantees or in upper-division courses. To engage students in the practice of ethical reasoning, we designed a 200-level course-based undergraduate research experience that focuses on a global challenge: the sustainable disposal of electronic waste and the opportunities to use biotechnologies. Through online modules and synchronous and in-person sessions, students revisit the definitions of interdisciplinarity, sustainability and the UN Sustainable Development Goals, electronic waste, and the scientific method. Students are introduced to tools for annotating documents socially (Hypothes.is), collecting reliable sources (PowerNotes.com), and critically evaluating claims (How We Ague and novel How We Evaluate course modules). Students are
challenged to, at their own pace, respond to ten case studies adapted specifically for this course. We hypothesized that the ability to choose the time to respond to case studies and defined guidelines and structure for argument analysis, resource selection, citations, and diagramming would improve student knowledge of ethical issues and awareness of unreliable claims. For this, we conducted pre/post surveys and exploratory analyses of student reflections and responses to discussion questions for case studies. In-depth analysis of participant responses will help evaluate the impact of the tools and modules we developed with the goal of improving the approach and guidelines and prepare interdisciplinary scholars. Our observations suggest that students are engaging with the case studies at their own pace and learning to identify important ethical and interdisciplinary research challenges.

Exploring DNA Delivery to Plants using a Virus-induced Gene Silencing Vector

Jacob Dums, North Carolina State University

One of the largest challenges when approaching plant genetic engineering is getting your genetic message through the plant cell wall. Another challenge is making sure that students understand that the two most widely used techniques, Agrobacterium and biolistics, are not the only options. A biolistics lab activity using a virus-based RNAi vector to knock out chlorophyll production in tobacco was adapted to help students think critically about DNA delivery (pros and cons) and then develop and test an alternate delivery method, preferably an easy, cheap, safe, and accessible method. The RNAi phenotype results in white plant tissue making the success of a method very obvious to students and allows for comparison to an established method.

Finding the Beauty in Viruses and Assessment

Stefanie Chen, North Carolina State University

This microbrew focuses on implementation of a reflective assessment question that can be adapted to a wide variety of uses throughout a course: “What do you find beautiful about viruses and why?” The goal of this activity is to allow students to reflect positively on their choice of subject matter while demonstrating communication skills and mastery of course material. Experience with implementation as a summative assessment as well as variations for metacognition, group work, science communication, and substituting other biology topics will be discussed. Participants will be invited to workshop their own variation of the activity.

Fostering Scientific Literacy through the Identification of Credible Sources

Heather Townsend, Community College of Rhode Island

Scientific literacy is essential to creating a society that makes informed decisions based on facts. In an age of misinformation, thoughtfully and deliberately introducing the importance of credible resources is imperative to develop a students’ scientific literacy. Using these sources to understand the process of science is an essential bridge for students. Through a series of assignments, students learn the importance of reporting based on facts. Students understand how to find credible information, how to carry out the process of science, and then apply this knowledge to make decisions. This session will provide tools and suggestions on how to deliver a robust curriculum over the course of a semester to promote scientific literacy.

How Can We Be Assured Our Water is Safe? A Lab Exercise to Teach the Scientific Method

David Singleton, York College of PA

The process of science is a core competency for Nursing/Allied Health students, and engagement in developing new knowledge is a high impact learning experience. In this exercise, students ask a broad question related to public health and choose a specific method to evaluate as part of a research group. Groups brainstorm and collaboratively submit a proposed procedure/materials list for feedback and
revision prior to the first week of work. Formal graphs/results sections are used for course and program-level assessment. Group planning and freedom of project design provides an inclusive environment by motivating students at all levels of preparation, rewarding collaboration, and giving students ownership of their self-designed experiment.

**IMMUNOLOGY! A Board Game to Learn the Immune Response**

*Alicia Cecil, University of Indianapolis*

*Mary Gobbett, University of Indianapolis*

Attendees will learn how to play IMMUNOLOGY!, a board game developed to teach the basics concepts and interactions of the cells in the adaptive immune response. In the game, players race their white blood cells to an infection to eliminate it. The object of the game to be the first player to get all of the correct immune system components to the infection. Students could play this game in a flipped classroom after learning the basic concepts of immunity. Attendees will be provided with a printable game template, game pieces and rules for game play in this easily reproducible and easily adaptable activity.

**ImmunoReach: At the Intersection of Biochemistry & Immunology**

*Heather Bruns, University of Alabama at Birmingham School of Medicine*

*Sharifa T. Love-Rutledge, The University of Alabama in Huntsville*

Students often compartmentalize content presented in individual courses, so we designed an activity to help students recognize the interrelatedness of content from different science courses. We created an active learning group activity that teaches about receptor-ligand interactions, a foundational concept in biochemistry and immunology. The activity requires students to watch a lecture video and complete a worksheet prior to class. During class, students work in groups to re-evaluate worksheet answers and design a video or infographic that applies their knowledge of receptor-ligand interactions by describing a technique based upon antigen-antibody interactions. Student learning is assessed by presentation quality and exam questions.

**ImmunoReach: Bacteria to Brains in Backyard Coyotes Interdisciplinary Pedagogical Case Study**

*Adam Kleinschmit, University of Dubuque*

*Andrea Bixler, Professor, Clarke University*

Two life science faculty, brought together through the NSF-funded ImmunoReach RCN, have generated an active learning classroom resource that emphasizes the interdisciplinary nature of science through concepts that span immunology, microbiology, ecology, and animal behavior. The pedagogical case study focuses on differences between rural and urban coyotes. Urban coyotes’ consumption of carbohydrate-rich anthropogenic food alters their gut microbiome and can influence behavior changes through the gut-brain axis involving multiple physiological systems. This case showcases the interdisciplinary nature of science by having introductory biology students explore the connection between these macro and micro-level systems.

**Improving Student Performance Using Significant Examples to Explain Concepts.**

*Emily Rotich, South College*

Traditional teaching methods in Microbiology have focused on teaching content from a chosen textbook with publisher resources, and creating assessments to meet the learning objectives of the content. In most cases, textbook examples and graphics and publisher created test banks are used. To help students understand and not just memorize the content of the topics, real life applications can be used to achieve a wholistic understanding of the concept. In this study, significant real life examples and stories will be used to cover topics in Microbiology for nursing and allied health majors. These could be introduced as a discussion post, or small group discussion at the beginning or end of the topic.
Increased Confidence and Scientific Literacy using a Semester-Long Case Study and Research Project

Nicole McAllister, Seton Hill University

An understanding of microbiology is a key aspect of the curriculum for basic and clinical science undergraduate majors, yet overall confidence and scientific literacy in microbiology remained low in late-career undergraduate students. To increase overall student confidence and scientific literacy in microbiology, a microbiology lab course was designed to include a semester-long case study and student-driven research projects. A previously published food poisoning case study was utilized. Students were introduced to basic microbiology concepts and laboratory techniques, such as gram staining and the streak plate technique, through this inquiry-based case study. As the case study progressed and students began to master microbiological assays, the development and execution of group research projects were scaffolded into the curriculum. Students developed a microbiology-focused research question, wrote a research proposal to investigate their question, and conducted the research they proposed. Assignment scaffolding, peer-to-instructor and peer-to-peer feedback loops, and collaborative learning were heavily emphasized in the course design. Student confidence and scientific literacy was assessed through anonymous pre- and post-course surveys and online quizzes. Increased student confidence was found in (1) accessing, reading, and analyzing scientific literature, (2) creating research questions and hypotheses, (3) conducting an experiment, (4) writing a research proposal, (5) presenting scientific findings, (6) statistically analyzing and graphing scientific data, and (7) using micropipettes, microscopes, and aseptic technique. End of the semester grades correlated with student confidence reports, and positive student feedback was received about the design of the course. Overall, the implementation of a semester-long case study paired with student-driven research projects increased student confidence and scientific literacy in microbiology.

Integrated Approaches to Teaching Improve Overall Student Learning and Engagement In Large Classes.

Bwalya Lungu, University of California Davis

Food, Folklore and Health is a large (500) undergraduate class that is offered twice a year with no discussion sections or a lab component that would allow students to interact with course content in small settings. Class size places a significant burden on resources/infrastructure and this might negatively impact student learning/engagement. We modified a primarily lecture class by introducing the use of Tophat and other active learning tools. Tophat is an active learning platform that allows for engagement before, during and after class. From 2016-2022, we investigated the use of an integrated approach to teaching that combined lecture with other teaching tools (Tophat, videos, quizzes, peer learning). We wanted to determine whether: 1) students taught using Tophat performed better overall/were more engaged and 2) integrated approaches to teaching improve student learning and engagement. Tophat was used in 9/12 quarters. We collected data from 4 midterm exams, 2 surveys and Tophat. Overall, students with Tophat instruction performed better on midterms and were more engaged in class but less engaged when assignments where given as homework on Tophat. 60% reported a positive response to Tophat use and said it helped them prepare for exams. In addition, students participated more in class discussion following questions or think/pair/share activities on Tophat. Combining lecture with the use of active learning instructional tools improved overall student learning/engagement in large classes.

Online unknowns: a supplement for the microbiology lab

Lauren Brooks, Nazareth College

The microbiology unknown, a staple in the micro lab and potentially high stakes stressful experience for your students. This microbrew will focus on a digital activity in which students are presented with results to interpret before deciding the next test to perform. The online format allows for students to take their time and reason through their choices, interpretation, and identification. This activity has been
implemented in an introductory micro lab (serves STEM and allied health majors) as well as an advanced micro lab with added difficulty (QC, technique videos) and variety of bacteria. The customization and assessment of the activity will be discussed as well as the advantages as a supplement to hands-on micro lab skills.

**Paired and Compared Lessons for the Microbiology Flipped and Hybrid Classroom**

*Shawna Reed, Quinnipiac University*

Microbiology students can construct their own knowledge using either individual or group-based active learning in the classroom. In a flipped and hybrid class, the Microbiology Concept Inventory (MCI) revealed ASM Curriculum Concepts with small learning gains. Students struggled to compare metabolic pathways and to understand the complexities of the microbiome. No study has compared cooperative learning with instructor-guided literature analysis in the microbiology classroom. Paired lessons are presented for each concept, with identical learning goals and either group or individual structure. Lessons may be used in separate class sections to compare the effectiveness of each approach, or together to reinforce student learning.

**Promoting Innovative Thinking in Biotechnology**

*Samantha Orchard, University of Arizona*

In the coming decades, humans will face challenges related to climate change, the increasing human population, antimicrobial resistance, and more. Overcoming these challenges will require creative problem solving and innovation. To help guide students through the transition from being learners of existing knowledge to the creators of new solutions, I use an assignment in which I ask students to propose a biotechnology-related solution to a problem of their choice. This encourages them to think creatively and to see how they can apply their knowledge to tackle new challenges. Out of respect for Universal Design for Learning guidelines, I allow the students to submit their work in a variety of formats, including websites, podcasts, or videos.

**Reading of Original Microbiology and Virology Literature Using the Online Platform Perusall**

*Gwen Knapp, Illinois College*

Reading modern scientific literature can be difficult for undergraduate students due to the sheer amount of scientific knowledge needed to understand complex interdisciplinary studies. Yet, the elegant simplicity of original manuscripts by scientific giants such as Antonie van Leeuwenhoek and Robert Koch provides excellent opportunities for students to engage with primary literature and correlate the original findings to the microbiology or virology coursework. By using Perusall, a social e-reader, students can read a manuscript and collaborate with classmates on analyzing difficult passages while stimulating discussion. Short reflective writing essays with prompts help students to integrate the readings with class learning objectives.

**Showerhead Microbiome and Antibiotic Resistance Case Studies for 200-level Microbiology Courses**

*Stephanie Mathews, Campbell University*

Two case studies have been developed for use in non-majors, 200-level microbiology courses. The first case study is about the showerhead microbiome and engages students in learning objectives focused on cultivation and identification of microorganisms from a showerhead. The second case study uses the work of the Kishony lab with the mega plate experiment. It engages students in identifying the mechanisms of action of antibiotics and the process by which bacteria develop antibiotic resistance. Both case studies introduce high throughput sequencing technology as a tool used to answer questions about bacterial identification or bacterial genetics.
Student-Led, Instructor-Supported Investigations into Diauxic Growth

Matthew B. Crook, Weber State University
Matthew J. Domek, Weber State University

The diauxic growth curve is a fundamental growth curve associated with genetic regulation in E. coli. However, performing even a simple growth curve in a 2–3-hour lab session is virtually impossible. With a plate reader, an entire class can use individual wells to follow a growth curve over an 18–24-hour period. The longer time frame allows investigation of more complex growth behavior, like diauxic growth. We developed a diauxic growth curve lab based on guided inquiry. Students choose their carbohydrate pair based on individual research or instructor input. Students then design a set of experiments that will identify which of the two carbon sources is preferred. Learning gains can be evaluated using pre- and post-quizzes.

Teaching Metabolic Pathways Using Hands-on, Interactive Stations in Introductory Biology

Emily Nowicki, Curry College

One of the most challenging topics for students in an Introductory Biology course is metabolism. Students may be able to memorize pathways, but they have trouble connecting the bigger concepts such as energy flow and the interconnection of the various metabolic pathways in organisms. In my flipped classroom, I shifted from having students practice learning metabolism solely by completing pen-and-paper labeling activities or questions to also engaging in hands-on, interactive stations using 3D printed manipulatives. In this Microbrew, I will share the design and implementation of this interactive course module. I will highlight what was successful and discuss areas for improvement.

Teaching Molecular Biology with Digital Manipulatives in Seesaw

Ashley Nelson, North Carolina State University
Claire Gordy, North Carolina State University

In an effort to retain the constructivist active learning atmosphere of an existing in-person molecular biology course taught asynchronously during the COVID-19 pandemic, we turned to an online learning platform typically used in elementary education. The Seesaw app allows learners to move and arrange digital objects, add text and annotation, and explain their answers using voice recording or video. In this microbrew, we will share examples of how learners used Seesaw to create diagrams of molecular processes in iterative formative assessment activities and demonstrate how instructors can use written and verbal feedback to facilitate revision and concept mastery.

Tetanus Module: Helping First-year Students Connect Molecular Concepts with the Biology of Vaccines

Phil Mixter, Washington State University
Michelle Pearson, Spokane Falls Community College

First-year biology students learn of structures, functions, and interactions between cells and molecules, requiring imaginative conceptualizations. First-year courses rarely address immunological topics. We hypothesized that students engaging with our module would connect topics in immunology with concepts related to sub-cellular structures and interactions. As part of the NSF-sponsored ImmunoReach Network, we created a module introducing students to tetanus. With materials designed to work across instructional modalities, students completed ordered tasks: (1) Pre-quiz; (2) Content videos; (3) Model molecular components of tetanus disease and immunity with a puzzle; (4) Chat-based discussion with prompts pertaining to research ethics and a case study of acute pediatric tetanus; (5) Students give feedback on the module; and (6) Post-module quiz. First-year students at Spokane Falls Community College completed this module (online and hybrid modalities; 5 sections). Post-quiz scores increased 148% over
pre-quiz scores (p<0.001, n=80). Online students completed their puzzles alone; hybrid students completed puzzles individually with peers nearby. Puzzle task submissions received “high” or “low” scores based on correctness and completion. Comparing sections from a single term, online students earning “high” puzzle scores had greater gains on the quiz question assessing comprehension of antibodies and their interactions (p=0.02, n=16). There was no such difference with “high” puzzle scores in the hybrid group (n=15), suggesting that peer presence may enable students to shortcut the activity with less interpretation. Analyses of qualitative data has begun seeking insights into student metacognition and fluency discussing vaccines. This module provided relevant examples for students, enhancing their understanding of structure-function relationships. Future work will use a revised version of the module, which is available upon request to collect additional data.

The use of 3D printed cell models to improve understanding of bacterial cell size and physiology

Emily Wollmuth, Cornell University

Cell size is an important concept for students to grasp to understand cell biology. In bacteria, cell size is limited by reliance on diffusion for nutrient uptake. Bacteria must also meet a minimum size threshold to accommodate essential cellular components such as ribosomes and DNA. Textbooks often display 2D drawings that are misleading in terms of the shape and size of cellular components. The impact of 3D models on student learning is unclear, with some studies showing that 3D models outperform their 2D counterparts and others demonstrating no significant difference. We hypothesize that students will show greater knowledge of and confidence in lesson learning objectives after completing an activity using 3D cell models. A lesson using 3D printed cell models to help students better understand bacterial size and its biological significance was implemented in an introductory microbiology course. Prior to participating in this lesson and completing a pre-lesson survey, students were shown drawings of bacterial cells in lecture. During the lesson, students interacted with 3D models and discussed questions in small groups. Students also considered the surface-area-to-volume ratio of the models and how reliance on diffusion influences bacterial cell physiology. Student performance data and perceptions were evaluated via a pre- and post-lesson quiz and survey. After completing the lesson, students demonstrated knowledge gains related to the lesson learning objectives. Student scores were significantly higher on the post-quiz compared to the pre-quiz (p<0.05). Students also reported significantly higher levels of confidence in their knowledge of the learning objectives after completing the activity (p<0.05). Most students also indicated that the activity “helped them greatly” toward learning the learning objectives. This lesson aims to improve how microbiology students are taught about bacterial cell size and physiology and can be implemented at other institutions.

TikTok Biology: Changes in students views about the importance of science communication

Laura Ott, University of North Carolina at Chapel Hill

The pandemic has highlighted a need for improved science communication with a non-science audience. Here we describe a science communication project where students created biology-relevant TikTok videos about basic cell biology and scientists traditionally underrepresented in STEM. Our student videos were assessed using peer evaluation and a rubric that aligns to accessible science communication learning objectives. Using a validated survey instrument (Edmonston, et al., 2011), we evaluated changes to student perceptions about the importance of science communication to a non-science audience as a result of making their TikTok video assignments. Results revealed modest gains in student perceptions about the value of communicating science.

Use of an Online Discussion Board in Improving Student Confidence in PCR Primer Design

Nancy Magill, Indiana University

Upper-level biology courses in microbiology and biotechnology include a lesson on primer design for PCR. Laboratory courses ask students to design primers for use in projects. Proper primer design
addresses an understanding of the directionality of replication and is critical for further applications such as diagnosis or protein expression. Primer design has challenges for students, such as designing a reverse primer. After an initial assignment, we use a discussion board. Students respond indicating where there are flaws, with the goal of reinforcing what they just learned from feedback. Students comment upon sets of primers and finding the flaws. This discussion board has improved the subsequent design and increased confidence.

Using an At-Home Food Fermentation Project to Reinforce Microbiology Laboratory Skills and Concepts

Todd Funke, University of Kansas

For an end-of-semester project, we challenge students to use their microbiology lab skills and knowledge to perform an at-home fermentation of a food product. The assignment requires each to student to research a fermented food, find a recipe, source all ingredients (prepare 'media', and obtain 'cultures'), then plan and perform a suitable fermentation procedure. The goal for students is to write a formal lab report demonstrating that their fermentation was successful, and we place an emphasis on careful experimental planning and design by requiring the use of controls and three (3) positive signs of successful fermentation. I will highlight some tips, logistics, and lessons learned after several years using this both in-person and online.

Using Dry lab effectively to counter minimalistic to none research laboratory facilities

Rabia Nawaz, The Superior University, Lahore

Traditional concept of 'laboratory work' or 'research thesis' in the fields of biological sciences such as Microbiology, Virology, Biotechnology, Molecular Biology, etc. revolves around good laboratory facilities. Science students from developing countries face several challenges of laboratory required funding, thus no standard/traditional research labs are available for most of the undergrad degrees. This poses a challenge to stay productive for faculty, as well as to train undergrad students in scientific research. Which I planned and successfully implemented in the form of in silico research work. This can be used by anyone, anywhere with a working computer, correct set of information for relevant tools and websites, and basic knowledge.

Using Interactive Discussions to Foster Scientific Literacy Skills

Elise Mosser, Drexel University College of Medicine

A non-traditional discussion board was designed to foster fundamental science literacy skills in Bacteria and Bacterial Infections, a course offered both in face to face and online modalities. In both course modes, students gain access to the learning materials only after reviewing the topic’s learning objectives and posting their previous knowledge about the topic to the discussion board. After completing the assigned reading and presentation, students post questions about the topic and answer each other’s questions using the primary literature to support their claims. As a summative assessment, students post a reflection. This activity provides insights to instructors regarding misconceptions and allows for tailored student feedback.

Virtual Culture Reading Exercises for MLS Students

Erin Rumpke, University of Cincinnati

This session will introduce the use of virtual laboratory culture reading exercises to prepare medical laboratory science students to read patient cultures in the student laboratory. Virtual modules scaffold student participation by focusing on the ‘hear it, see it, try it’ model of clinical training. Students listen to a lecture, watch a demonstration video, and complete the virtual culture reading exercise. Completion of
these activities indicate that the student is ready to begin practicing culture reading at the bench in the student laboratory.

**Visualizing Diversity at the Junctions – a V(D)J Recombination Activity**

*Johanna Schwingel, St. Bonaventure University*

Randomly selecting Variable, Diversity, and Joining segments for rearrangement is often highlighted as the source of antibody diversity. However, this is only part of the story, as exonuclease cleavage and P and N nucleotides contribute to the vast array of possible antibody variable regions too. Using a mock antibody sequence, this activity guides students through random V(D)J segment selection, followed by cleavage and nucleotide additions at the junctions. Comparison of resulting sequences show the diversity generated and the possibility of nonproductive rearrangements. The activity challenges students’ understanding of the V(D)J rearrangement process and increase their appreciation for the range of antibodies that are possible.

**Exploring Effective Testing Strategies for the Upper Level Biology Course**

*Galyna Kufryk, Grand Canyon University*

STEM education requires successful teaching strategies in different learning modalities. There are unique challenges for the content delivery and online testing, especially in the upper level science courses. While the variety of testing and proctoring platforms are currently existing, the information concerning their comparative utility is not readily available. Therefore, when choosing a testing platform, the efficacy of test settings needs to be explored and compared so that the instructors can make an informed decision regarding their utility. This session will focus on the comparative analysis of online testing modalities in the upper division Genetics course. The analysis of outcomes shows their applicability in many Biology courses.