

Diversity of Discovery:

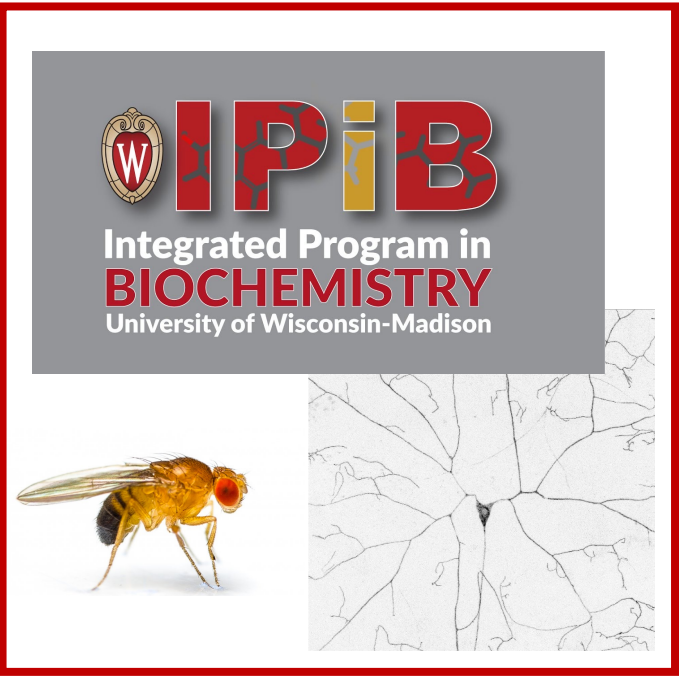
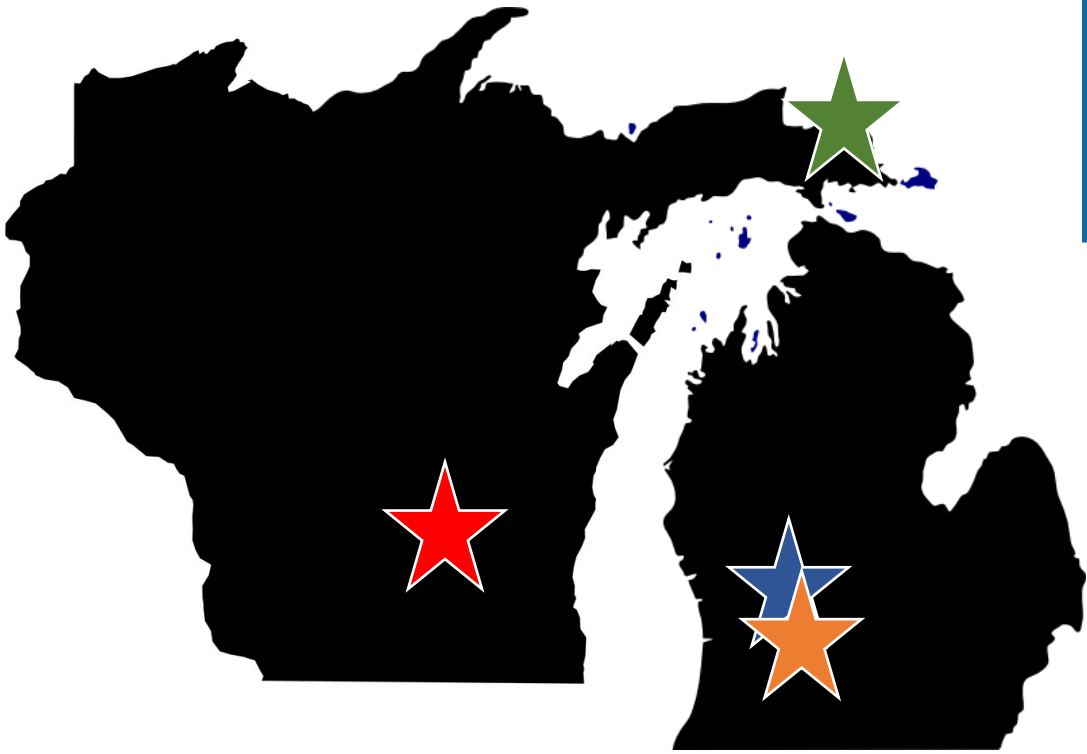
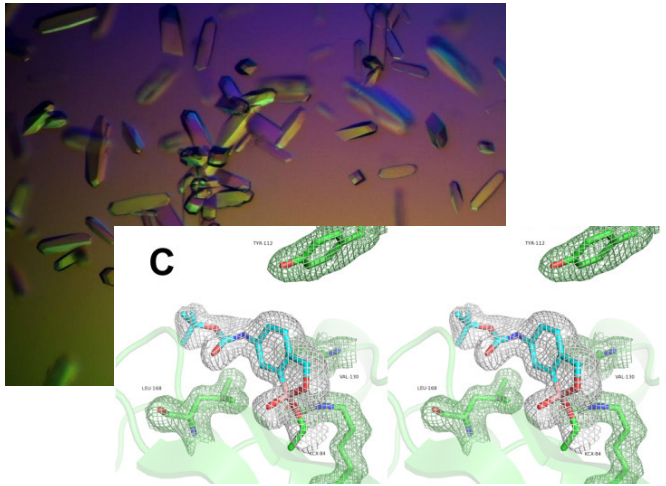
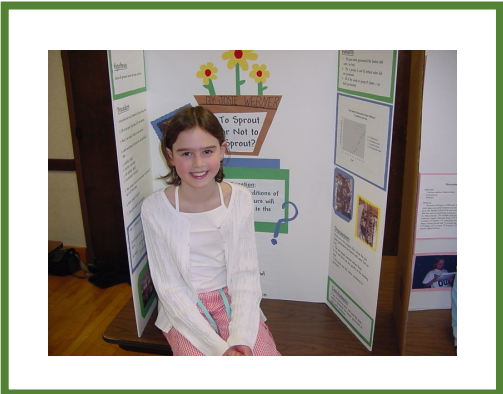
Using primary literature to learn about discoveries made by scientists from underrepresented and minoritized backgrounds



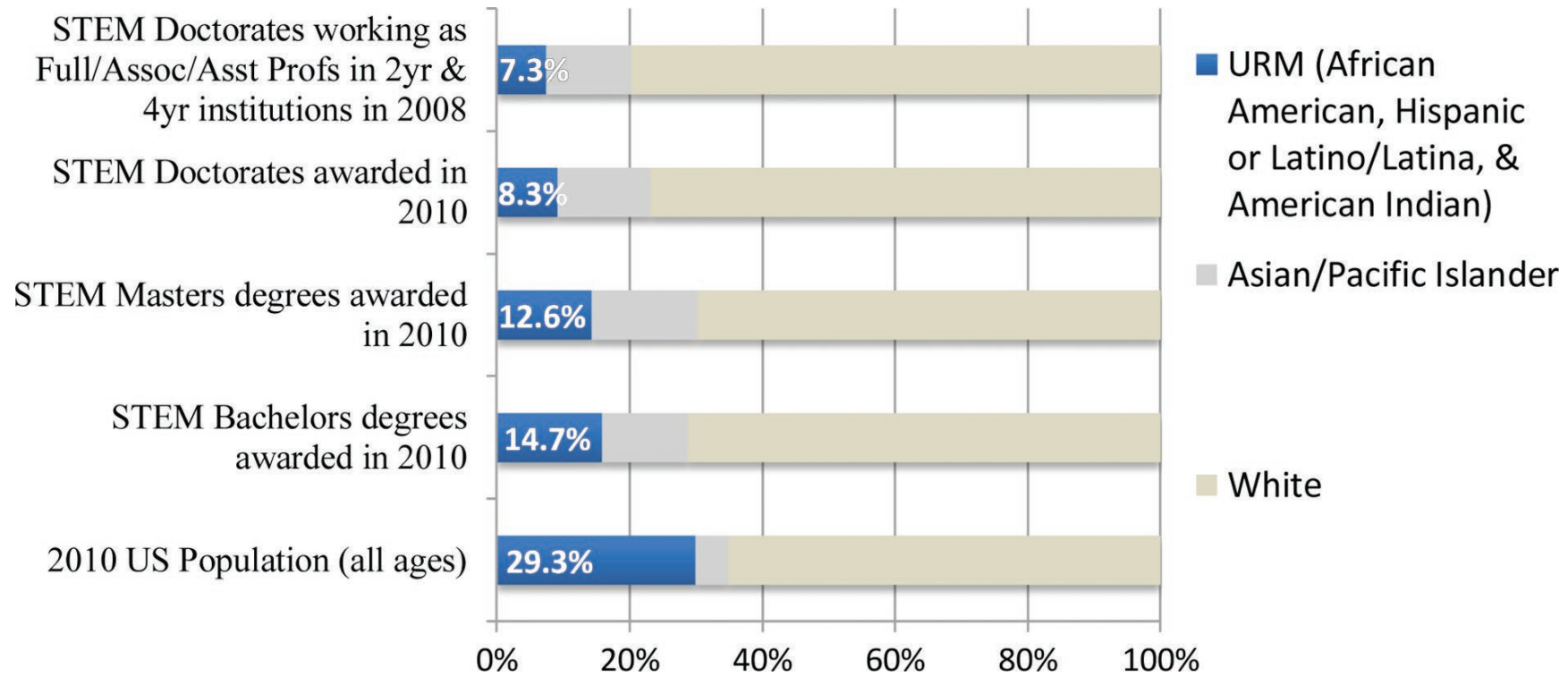
Josie Mitchell

Assistant Professor, Kalamazoo College
Chemistry and Biochemistry Department

BREWMOR, July 2023



Disparity in STEM degree attainment



Microaggressions

Lack of inclusion

Racial discrimination

Stereotype threat

Differential treatment in the classroom

Negative self-perceptions

Language barriers

Classroom materials

Barriers

Socioeconomic resources

Lack of representation

Challenges first-generation students overcome to pursue education

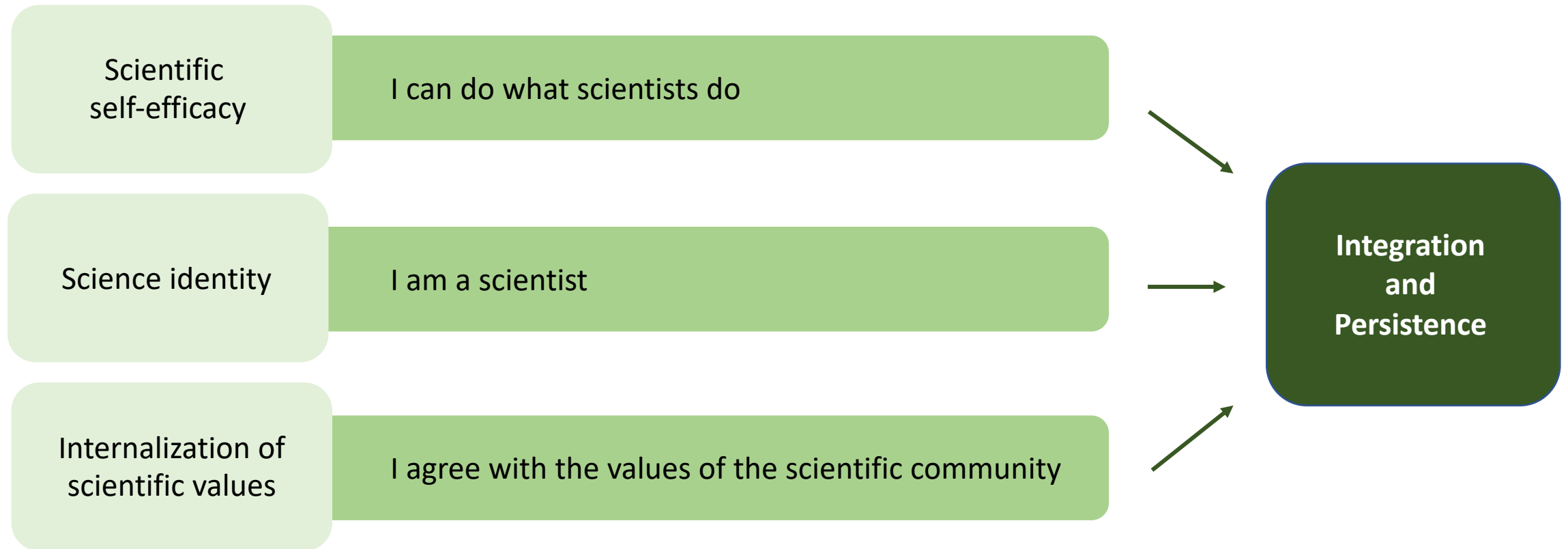
Negative generalizations

Perceived image of a scientist or engineer

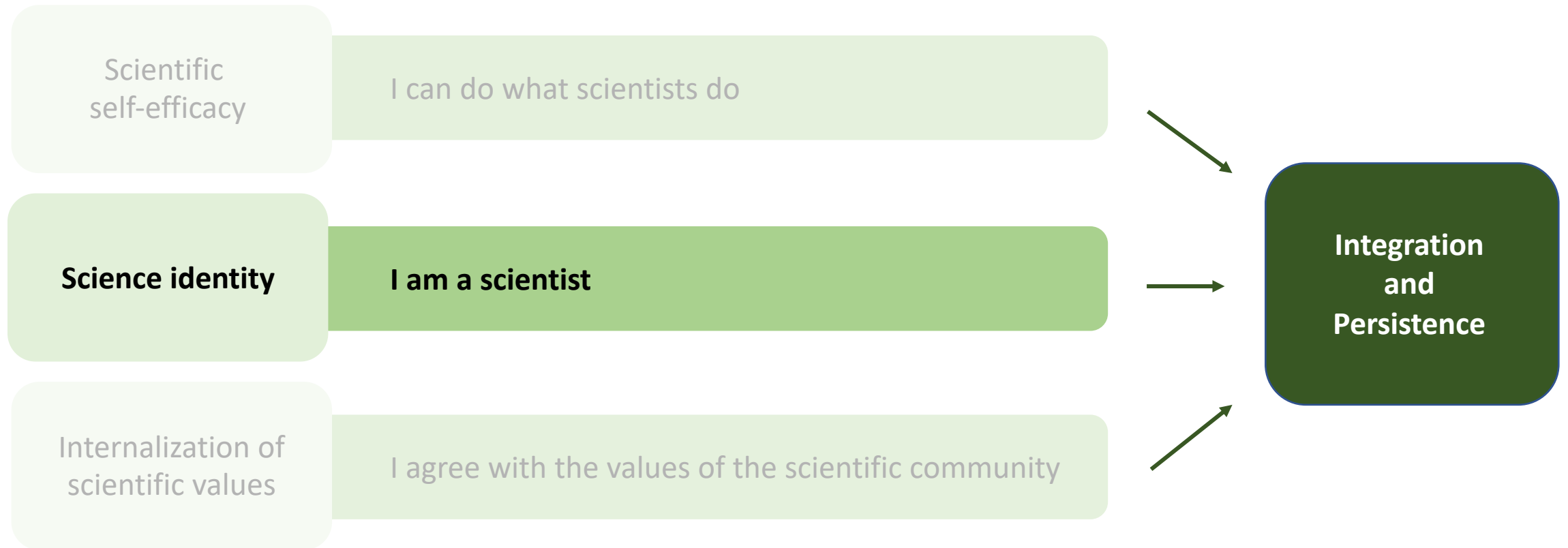
Competitive nature

Less pre-college prep and pre-college advising for URM students

Science identity helps students persist in STEM



Science identity helps students persist in STEM



Highlighting discoveries made by a diversity of scientists

Scientist Spotlight Homework Assignments Shift Students' Stereotypes of Scientists and Enhance Science Identity in a Diverse Introductory Science Class

Jeffrey N. Schinske,^{1*} Heather Perkins,[‡] Amanda Snyder,¹ and Mary Wyer[‡]

¹Biology Department, De Anza College, Cupertino, CA 95014; [‡]Psychology Department, North Carolina State University, Raleigh, NC 27695

<https://pubmed.ncbi.nlm.nih.gov/27587856/>

SCIENTIST SPOTLIGHTS INITIATIVE

Home Spotlight Search Implementation Tips & Strategies Submit a Spotlight About Us Contact

Engaging students in reflective writing to teach science content and promote diversity & inclusion.

Search for A Scientist Spotlight for Your Class

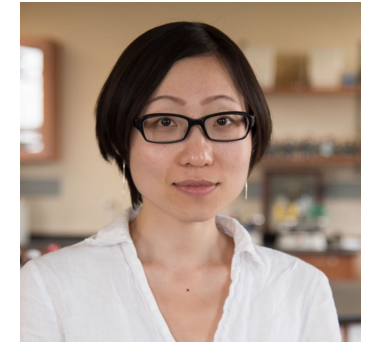
Grade Span Standards Search Scientists

Select Options Select Options By Name, Content, NGSS, Vision & Change GO

The Scientist Spotlights Initiative

<https://scientistspotlights.org/>

Biochemistry Capstone Lab + Seminar



Dr. Erica Shu

- Weekly seminar as part of capstone biochemistry lab course
- Senior biochemistry majors
- Weekly seminars had 8 students per seminar and were facilitated by graduate students, postdocs, and sometimes faculty

Pre-seminar

Presenter:

- Read and critically analyze article
- Prepare a 25-minute presentation highlighting the authors and their backgrounds
- Meet with me to practice and fine-tune presentation
- Choose 3 questions written by peers in the pre-class assignment to discuss at the end of the presentation

All students:

- Read and critically analyze article
- Complete pre-seminar guided-reading worksheet

During seminar

Presenter:

- 25-minute presentation
- Discuss the authors' backgrounds and career trajectories, major findings, and broad contributions to the field

All students:

- Listen and engage with presentation
- Ask questions (~20 min)

Post-seminar

Presenter:

- Answer questions

All students:

- Complete minute paper to reflect, give presenter feedback, and ask additional questions

Lab and Lecture

Asynchronous lecture material

Lab 1x per week for 3.5 hours

Seminar: Learning goals for students

- Learn how to critically read, evaluate, and discuss peer-reviewed journal articles
- Recognize the contributions made by scientists from underrepresented and minoritized (URM) backgrounds
- Value the importance of having diverse voices for innovation and progress in scientific research

Students' goals

- My goals for this seminar are to gain a deeper understanding and further appreciate the work of minority scientists and understand the impact that that has on research and science. I also hope to gain more skills in presenting and communicating with others.
- I'm incredibly interested in learning about the stories and achievements of people in STEM that are historically underrepresented and I'm excited to hear about the important contributions made in biochemistry specifically.
- Having grown up mostly around, and with close relationships to indigenous communities, I am really excited to explore discoveries made by people in underrepresented communities in the biochemistry world.

How I chose research articles

Consider the students in my classroom and choose articles by scientists with diverse and shared backgrounds.

Primary literature was chosen based on:

- Representation of scientists from various backgrounds: race, ethnicity, age, education, gender
- Both modern and historical contexts
- I got ideas from science artists who did “Scientist Highlights” on their social media

Students could choose and sign up for a week with a paper/scientist that interested them.



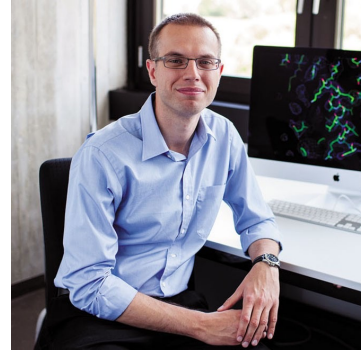
@nina.draws.scientists



@jkxcomics



Jennifer Doudna and
Emmanuelle Charpentier



Martin Jinek



Har Gobind Khorana

Week 1:

Alon, U. 2009. How to give a good talk. Mol Cell 36: 165-7.

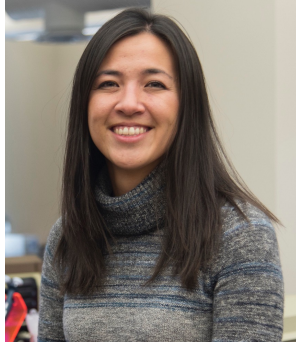
Week 2:

Jinek, M. et al. A Programmable Dual-RNA–Guided DNA Endonuclease in Adaptive Bacterial Immunity. Science 337, 816–821 (2012).

Week 3:

Khorana, H. Total synthesis of a gene. Science 203, 614–625 (1979).

Judi Simcox



Week 4:

Simcox, J. et al. Global Analysis of Plasma Lipids Identifies Liver-Derived Acylcarnitines as a Fuel Source for Brown Fat Thermogenesis. *Cell Metab* 26, 509-522.e6 (2017).

Gertrude B. Elion



Week 5:

Elion, G. B. et al. Selectivity of action of an antiherpetic agent, 9-(2 hydroxyethoxymethyl) guanine. *Proc National Acad Sci* 74, 5716–5720 (1977).

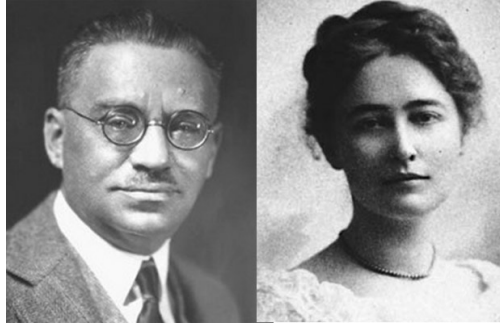
Tracy Johnson



Week 6:

Gunderson, F. Q., Merkhofer, E. C. & Johnson, T. L. Dynamic histone acetylation is critical for cotranscriptional spliceosome assembly and spliceosomal rearrangements. *Proc National Acad Sci* 108, 2004–2009 (2011).

Leonor Michaelis and
Maud Leonora Menten



Week 7:

Michaelis, L and Menten, M. L. The Kinetics of Invertase Action. *Biochem. Z.* 49, 333–369 (1913).

Kizzmekia S. Corbett



Week 8:

Corbett, K. S. et al. SARS-CoV-2 mRNA vaccine design enabled by prototype pathogen preparedness. *Nature* 586, 567–571 (2020).

Barbara McClintock



Week 9:

McClintock, B. The origin and behavior of mutable loci in maize. *Proc National Acad Sci* 36, 344–355 (1950).

Example of pre-class guided-reading assignment

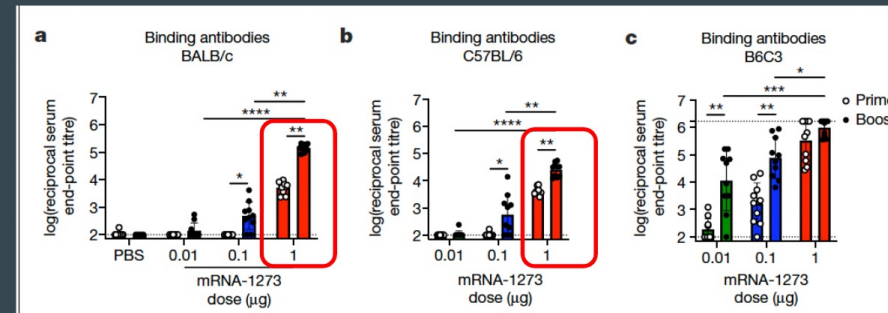
- 1** Kizzmekia S. Corbett has made important discoveries in the development of the mRNA vaccine against COVID-19, which has since been produced by Moderna. **Spend some time researching Kizzmekia's scientific career and reflect on what you learn.** What are Kizzmekia's scientific interests? What was her career trajectory like? What are some of her accomplishments and discoveries?
- 2** What **"research gap" or "gap of knowledge"** is the paper by Kizzmekia S. Corbett, et al. seeking to address?
- 3** After reading the short paper by Robert N. Kirchdoerfer, et al., reflect on the importance of this structural work on the HKU1 spike protein in relation to the COVID-19 pandemic and vaccine design by Kizzmekia Corbett and others.
- 4** **Write at least 2 questions you have after reading this paper. Several of the questions written by you and your peers will be selected by the presenter each week to discuss in class.** Your question may be something you did not understand in the paper, something you are curious about after reading the paper, or questions about the scientists doing the research. You may even ask a question about the data or how an experiment was performed. You may have a question about whether or not the data supports a certain conclusion (this will help you learn how to critically analyze a scientific article). Please write in complete sentences and be very specific so that the presenter can easily read and understand your questions.

Kizzmekia Corbett



- American immunologist
- Work on universal influenza vaccine
- 2014: becomes scientific lead for the Coronavirus Vaccines and Immunopathogenesis Team at NIAID Vaccine Research Center
 - Focused on development of novel coronavirus vaccines
- 2021: becomes Shutzer Assistant Professor at Harvard Radcliffe Institute and Assistant Professor of Immunology and Infectious Disease at Harvard school of Public Health
- Frequently speaks out against medical racism and bias

mRNA-1273 elicits robust binding and pseudovirus-neutralizing antibody responses in multiple mouse strains

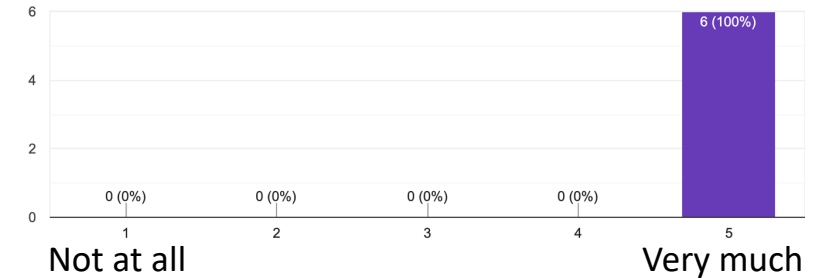


- 3 mice strains
- prime-only and a prime-boost protocol was followed
- ELISA used to measure antibody levels

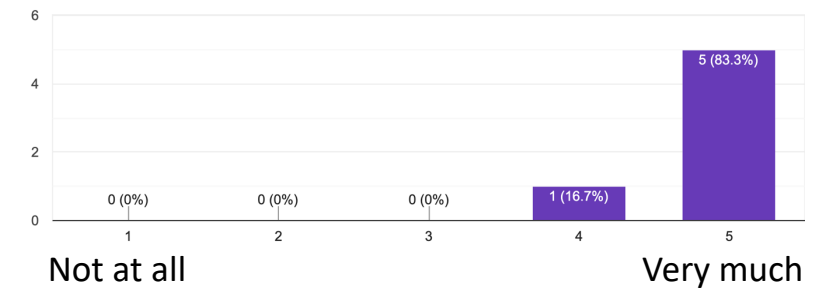
- Measured level of S-binding antibodies
 - Bind to SARS-CoV-2 S protein and kill using CTLs or other T-lymphocytes)

Student reflections and feedback

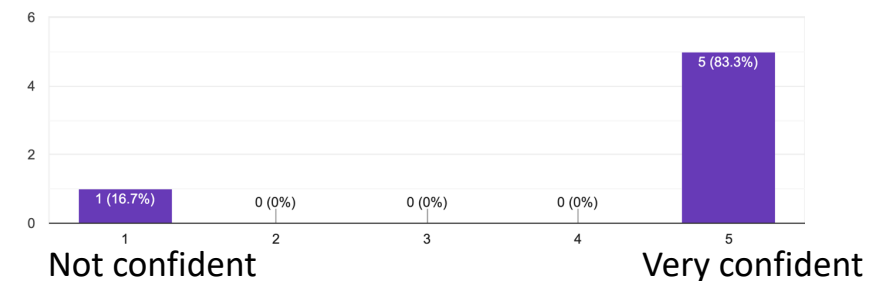
How much did you enjoy the seminar “Diversity of Discovery”?



How much did the seminar meet your expectations?



After this seminar, how confident do you feel in recognizing the contributions made by scientists from URM backgrounds and value the importance of diversity for innovation and progress in scientific research?



Student reflections and feedback

What were some things you liked about the seminar "Diversity of Discovery"?

The focus on the scientist themselves added relevancy and context to the discovery which pushed me to learn more about the research.

I enjoyed the concept a lot and felt that discussions about URM scientists were very productive.

[I liked] the focus on the authors [and] the variety of papers we read.

I really liked how many perspectives of diversity were covered, like gender, race, socioeconomic status, etc. It helped me appreciate those contributions even more.

What were some things you think could be improved in the seminar "Diversity of Discovery"?

*Some **papers felt too dense** at times and required more time for analysis that we did not have.*

*I think that we could have had a **heavier focus on the scientists themselves** in addition to their research. I feel that some students really excelled in highlighting the scientists, and others struggled a bit.*

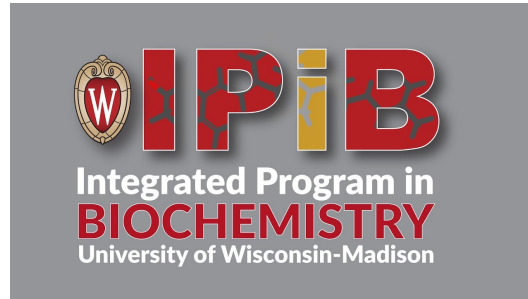
*Provide some way of giving **background knowledge before the papers***

*I think we could be given a little more **guidance in how to determine the gap in the research**, especially before presentations begin so then we know exactly how to approach that aspect when it comes to our own paper presentations.*

Takeaways and Future Iterations

- Students reported feeling confident in recognizing the contributions made by scientists from URM backgrounds
- Overall, this broad topic of highlighting discoveries made by diverse scientists was an effective way to integrate primary literature into a senior biochemistry capstone lab course.
- In my future biochemistry lecture and lab courses, I am planning to include a weekly journal club component where students can learn more about discoveries made by a diversity of scientists.
- In future iterations, I'd like to guide students as they choose their own papers and to help them learn how to find and manage these references (eg. introduce Zotero using a tutorial)

Acknowledgements



University of Wisconsin – Madison

Department of Biochemistry

Students in my seminar, fall 2021

Dr. Erica Shu

