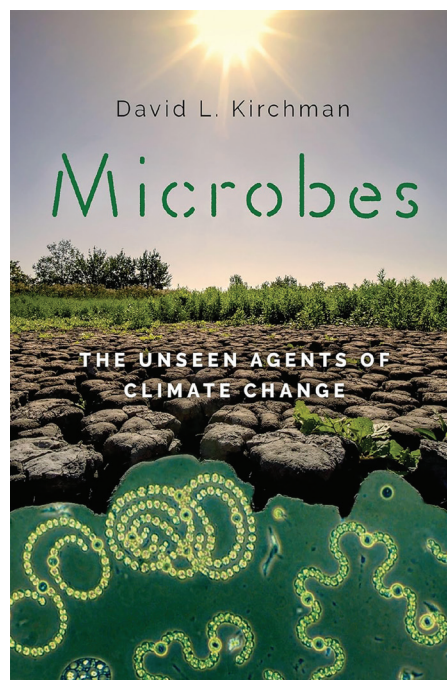


BOOK REVIEWS

KIRSTIN MILKS & FRANK BROWN CLOUD, DEPARTMENT EDITORS

Microbes: The Unseen Agents of Climate Change. By David L. Kirchman. 2024. Oxford University Press Books. (ISBN 978-0197688564). Hardcover. 240 pp. \$34.95.



Microbes: The Unseen Agents of Climate Change clearly steps through the role of microbes in cycling Earth's nutrients, the disruptions due to climate change, and potential solutions. This book is a must read for anyone living in our dramatically changing world. The importance of microbial processes in climate change models has only recently been acknowledged, perhaps because we've been needing a book like this one to bridge the gap between microbial ecosystems and planetary change in an

approachable, concise way. Thank goodness it's here now!

David Kirchman's extensive knowledge of microbial ecology and physiology combined with his teaching prowess come together to create a powerful, concise reference text. An emeritus professor at University of Delaware, Kirchman's research focuses on microbial carbon cycling across the globe. *Microbes* eloquently summarizes his deep understanding of the history, present, and future of this field. In only 176 pages of this well-referenced book, Kirchman leads the reader through microbial physiology, biogeochemistry, and climate science in an engaging way for readers at a high school level and beyond. From van Leeuwenhoek's discovery of "tiny animalcules" under his microscopes to Father Secchi's measurements of water turbidity measurements with black and white "Secchi" discs, *Microbes* weaves the stories of scientific discovery throughout the ages into modern understandings. In intertwining these stories from different fields with the evolution of our understanding of the role of microbes over time, Kirchman teaches us not only about the science, but also the process of science.

Carbon dioxide, methane, nitrous oxide—which of these is the most damaging greenhouse gas? Where does it come from? How do cow farts, canned whip cream, and rock-eating microbes influence climate change? Kirchman steps through the different sources and sinks of carbon, sulfur, and nitrogen on land and in the ocean, then deftly connects Earth's planetary conditions throughout time with microbial processes to highlight future concerns, areas for research, and potential solutions. Kirchman presents the information in a clear, thoughtful way that makes these topics approachable.

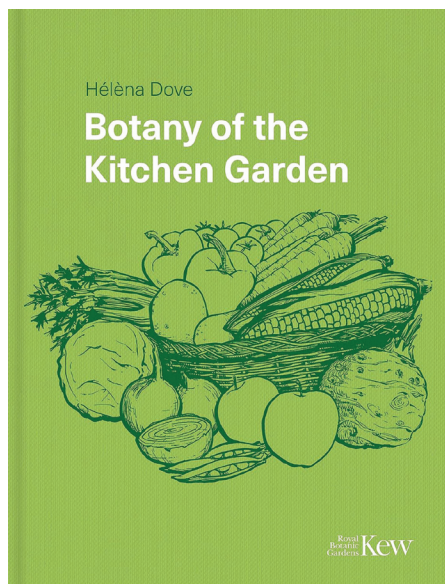
I especially appreciated how he shows the interconnectedness and complexity of Earth's different ecosystems. For example, peat bogs can release large amounts of methane and nitrous oxide, while storing some carbon. What are the costs and benefits? Should the peatlands be drained to halt these two more damaging greenhouse gases? If adding iron to ocean waters can stimulate phytoplankton growth, providing a carbon sink over time, should we dump iron in the ocean? Kirchman thoughtfully walks the reader through the pros and cons of several different scenarios for mitigating climate change using microbes.

As a biologist who is passionate about our microbial world, I greatly appreciate well-written books with microbes as the central focus. *Microbes: The Unseen Agents of Climate Change* is certainly a new favorite of mine, but my appreciation goes well beyond simply good writing about microbes. It is the kind of book we've been needing for scientists, the public, and policymakers. I can see this book being required reading for biology, sustainability, and environmental engineering classes. I will be using this as the text for my next environmental microbiology course and will use it to restructure key lectures in my general microbiology course. However, I think it's also the kind of book that high school students could pick up to help them see a future for our world and inspire them to learn more about microbes—the invisible organisms that shape our Earth.



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Botany of the Kitchen Garden: The Science and Horticulture of Our Favorite Crops. By Hélène Dove. 2023. Royal Botanic Gardens, Kew. Distributed in North America by University of Chicago Press. (ISBN 978-1-84246-783-1). Hardcover. 158 pp. \$30.00.



Ever wonder where tomatoes originated, or why blueberries need soil with a low pH? *Botany of the Kitchen Garden* includes a brief history of beloved plants including the climate and country of origin. By describing the climate of origin, one can understand why each plant thrives in certain growing conditions through the lens of evolutionary biology. This catalog of garden species is interspersed with additional gardening topics such as grafting and composting. While this book is not a manual about gardening, the information contained within would be particularly useful to teachers working in a school garden and planning teachable moments from the experience.

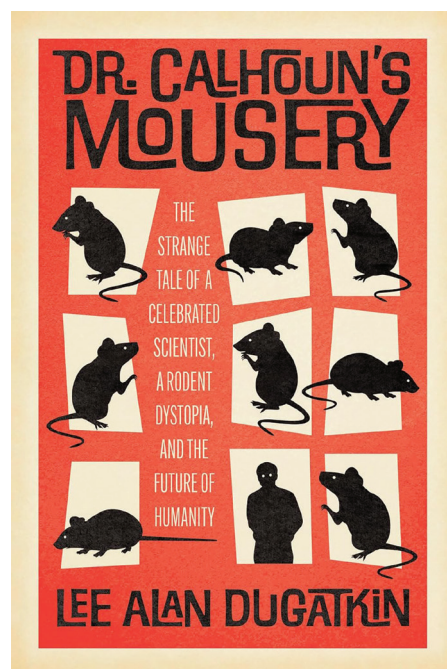
I am constantly looking to make content connections to students' lives as I teach biology, and this book will help teachers do just that. It can be used as a source about knowledge on plant adaptations and other fun facts about the fruits and vegetables students eat, as well as on the growing conditions needed for different fruits and vegetables. As an example, readers will learn why beans are legumes, information about nitrogen fixation, the botanical names of the different parts of a bean pod, and the function of the string in string beans. Botanical terminology is explained and examples are provided throughout. I'm excited that

the next time my students plant bean seeds I will be able to create a lesson richer in content.



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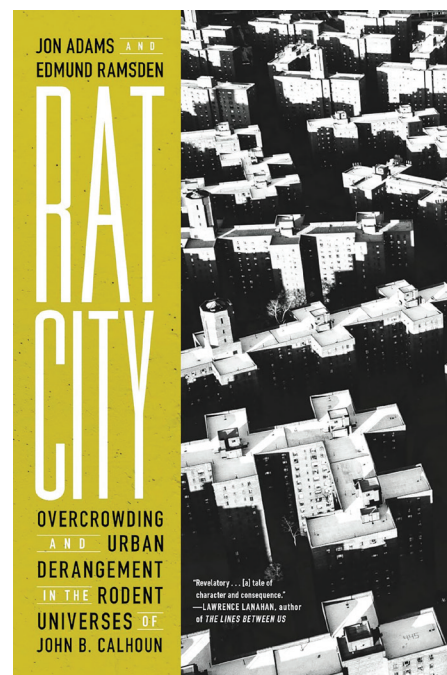
Dr. Calhoun's Mousery: The Strange Tale of a Celebrated Scientist, a Rodent Dystopia, and the Future of Humanity. By Lee Alan Dugatkin. 2024. The University of Chicago Press. (ISBN: 9780226827858). Cloth. 240 pp. \$27.50. Ebook also available.



Rat City: Overcrowding and Urban Derangement in the Rodent Universes of John B. Calhoun. By Jon Adams and Edmund Ramsden. 2024. Melville House. (ISBN: 9781685890995). Hardcover. 384 pp. \$32.50. Ebook also available.

About a decade ago, a friend was rehabilitating a wounded squirrel and asked for ideas: the squirrel had stopped eating. My personal expertise in squirrels extends only as far as an unbridled glee at seeing them pillage various neighbors' "squirrel-proof" birdfeeders, but I offered to help. The squirrel seemed healthy. The food seemed appropriate. We felt stumped.

On a whim, I removed all the food from the squirrel's serving bowl, tied some



to a string, and dangled it awkwardly out of reach. That is, I dangled the food in a position that I naively assumed would be out of reach. Within fifteen minutes, the squirrel had found a way to climb a nearby curtain, sway it purposefully, then arch its back across empty space to nab a snack. The squirrel engaged in dramatic acrobatics to obtain the exact same food it hadn't touched in the food bowl.

I found myself thinking of this squirrel while reading *Dr. Calhoun's Mousery* and *Rat City*, a pair of recently published books that both discuss the life, experiments, and legacy of biologist John Calhoun. The most famous of Calhoun's experiments featured an indoor colony of mice. With no predation and unlimited access to food and water, Calhoun wanted to determine how crowded the seventy-square-foot enclosure would get. After several generations, the mice in this colony ceased breeding; five years later, the last denizens died of old age.

From this single finding (which was contradicted by prior results from other researchers studying overpopulation in mice, and which none of Calhoun's own future experiments ever reproduced), Calhoun extrapolated a wide range of conclusions about human behavior and the dire ramifications of humanity's increasing urbanization.

Calhoun's ideas were widely celebrated in the popular press—in the late 1960s and early 1970s, journalists were eager to promulgate sweeping theories that could explain social unrest—and authors such as Tom Wolfe and Hunter S. Thompson began

to incorporate the term “behavioral sink” into their writing, the idea that an overly urban population would inevitably reach a state of terminal decrepitude.

But upon Calhoun’s first formal presentation of his findings to a scientific audience, his work was panned. No effort had been made to control the rodents’ olfactory environment over time (and we now know that mouse olfaction is so sensitive that the presence of a T-shirt previously worn by a male rather than a female lab technician is enough to trigger a dramatic spike in cortisol and a nearly two-fold dampening of pain response)—the mice were living in an indoor space with recycled air and impermeable floors that was never cleaned during the five-year experiment, with a visiting *Newsweek* journalist describing the “rank mouse smell” as “overpowering.” There was virtually no genetic variation among the mice, heavily inbred to create a near-clonal true breeding line before the experiment began. And inside the habitat, there was no novel visual, auditory, or olfactory stimulation other than the occasional visits of human researchers, which caused the mice to swarm.

And yet, Calhoun still clung dogmatically to his initial conclusions, espousing the theory that individuals (whether inbred mice or urban-dwelling humans) who had been exposed to crowded conditions in youth were likely to become permanently deviant and adopt “unnatural” practices such as excessive self-beautification or homosexuality. (Interested readers might consult Eliot Schafer’s *Queer Ducks*, which stresses that researchers of that era did not understand the frequency of homosexual behavior in nature because their internal biases caused them to assume that all mating events were between heterosexual pairs, even in species with such subtle sexual dimorphisms that it is difficult to assess biological sex in the field.) Then, near the end of his career, Calhoun became infatuated with supposedly utopian ideals such as cybernetic brain uploading and other technological replacements of our essential nature as embodied biological organisms.

Beneath the surface of either of these books, there are hints of a tragic cautionary tale that echoes Calhoun’s own conclusions about rodents: an acute period of deprivation can have lifelong consequences. There was a time when Calhoun was thirty-six years old with two kids and a mortgage and impending unemployment. Up until that time, Calhoun had been an assiduous ecologist who studied birds and rodents simply

to learn more about their behaviors in the wild. But that is not where the big research money lies. And so during that year, as Calhoun scrambled to find a new source of income, he began to talk about the importance of studying rodents to gain insight into our own mental health, and he never stopped. Even when the conclusions that he could draw about human behavior based on the rodent studies were tendentious at best.

And as his (tendentious) ideas were translated into the popular press, the consequences often grew even worse. Citing how many more rodents could be stored in a given space if they were stacked in isolated cages than if they were allowed to congregate, developers constructing housing for underserved human populations adopted isolation and segregation as their design goals rather than considering what type of interactions would best foster a sense of community, leading to travesties such as the Pruitt-Igoe housing complex.

I assume that most readers, even if interested in Calhoun’s life and works, will read only one of these new books. *Dr. Calhoun’s Mousery* has more detail linking Calhoun’s life to popular culture at the time, noting almost every moment when his ideas were alluded to in songs, television spots, magazine articles, and more. Written by a biologist, this book also amply describes Calhoun’s struggles to find lab space and funding commensurate with his visions. *Rat City* has more detail about other researchers’ studies that were being conducted contemporaneously with Calhoun’s, and the authors strive to link Calhoun’s ideas to current issues such as the shut-in phenomenon in modern Japan, the shift in funding from psychiatric care to the prison-industrial complex in America, and the dramatic increase in the use of prescription medications to address mental conditions. *Rat City* also uses a mix of past and present tense to describe past events—writing that Calhoun is building a mouse enclosure, to make the prose sound more immediate—that I dislike, especially since there are several sections where the verb tense careens from past to present within the space of a paragraph or even a single sentence.

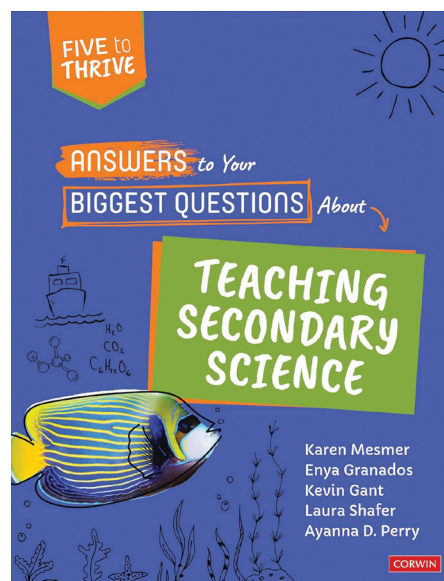
To my mind, both books seem excessively laudatory of Calhoun’s work, but I imagine that someone would have to believe that Calhoun was an insightful thinker in order to write such carefully researched biographies. I agree with the sentiment that we can better understand human minds through the study of other animals; we share neural architecture and our cognitive

capabilities seem to exist on the same continuum. And yet, it seems odd to me that Calhoun chose to draft press releases, scientific reports, and research lectures with such strident conclusions. His private notes make clear that Calhoun was aware that the quirks of a particularly instantiated history would have a major influence on the result of experiments like his—another researcher had already shown that mice would exhibit less territoriality if a slightly larger initial seed population was used—but Calhoun still spent much of his life making grand claims extrapolated from an experimental result he’d observed ... once.



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Answers to Your Biggest Questions About Teaching Secondary Science: Five to Thrive [series] (1st Edition). By Karen Mesmer, Enya Granados, Kevin Gant, Laura Shafer, & Ayanna D. Perry. 2024. Corwin Press, Inc. (ISBN 978-1-0719-1637-7). Paperback. 192 pp. \$33.95. Ebook also available.



While sitting in my secondary science methods course last week, the topic of being prepared for full-time teaching was brought up. As all seven of us looked around, in our last semester before student teaching, an air of nervousness arose. We’ve been in courses

for almost four years now that focused on preparing us for our future careers as educators; however, we still have questions that we can't even put into words. It is often said that you're never truly prepared to be a teacher, and as I was sitting in my class this issue became more pressing than ever. How can I get answers to questions about teaching that I might not even realize I have?

As if the universe was listening, I was offered the opportunity to review *Answers to Your Biggest Questions About Teaching Secondary Science: Five to Thrive*, by a team of educators including NABT member Enya Granados. This book is a guide focused on helping newer teachers answer big questions about teaching and managing a classroom ranging from "How do I build a positive science community?" to "Where do I go from here?" These main questions are further broken into smaller questions, similar to the process done to create a good lesson plan (p. 60). Throughout the book, resources are given in the margins to offer readers various forms of learning and ways to help answer the question of where to go from here? *Answers to Your Biggest Questions* is an essential guidebook that I think not only newer teachers should read, but also those experienced teachers who want to refine and reflect on their practice.

Throughout its six chapters the book examines the roles of identity, interaction, and management. The first chapter focuses on the idea of building a positive science community. This is done by consistently

trying to learn about and understand a student's identity, integrating healthy conversations within the classroom, and creating relationships with caregivers. Noted in this part is how to shift a student's narrative regarding their science identity to a positive one. This chapter is for those who want to build a more equitable and supportive classroom and offers great resources on how to build cultural competency as well.

Chapter 2, the longest chapter, focuses on the broad but critical topic of classroom management. A very helpful tool within this chapter is a chart of helpful items to stock within a science classroom. Further, this section covers various areas of classroom management, from planning a unit to grouping students. I think this chapter is the most beneficial for teachers who are not yet confident in their classroom management abilities. Not only does this chapter help with various logistical aspects of a classroom, but it also offers a focus on how to incorporate the three NGSS aspects of disciplinary core ideas, science and engineering practices, and crosscutting concepts into lessons.

The next three chapters focus on engagement, discussion, and assessment. Chapter 3 utilizes the idea of project-based learning within the classroom and proper integration. Covered in this chapter are various ways to shift the role of students from learning about science to figuring out and doing science. Chapter 4 covers discussions and how to foster positive discourse within the classroom, as interaction

is a main point in this book. I liked the subsections that discussed how to plan for various forms of discussion (partner, small-group, whole group), as I often struggle with not only choosing the most effective form but also how to integrate planning and timing. Chapter 5 covered the idea of assessment: planning assessment, the various forms, and using assessment as a measurement for student learning. Educators are constantly being asked about the topic of assessment and why specific assessments are used. This chapter helps build a foundational understanding of assessment and its various uses.

The last chapter focuses on growth, which has occurred for me just by reading this book. *Answers to Your Biggest Questions About Teaching Secondary Science* offers resources and ways to improve on being the best educators we can be, even if that is a role we haven't stepped into yet. This guide offers beneficial information for everyone in an easy-to-read, color-coded format, a teacher's dream! When the topic of being prepared to be an educator is brought up again, I don't think I'll feel as nervous, having read this book.



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