

of the species is the key” (p. 12) to understanding their cognition.

For anyone who has ever wondered about animal behavior, whether animals think and how we go about determining the outcomes of animal studies, this book serves as a wonderful catchment of information. One redeeming quality of the book is that the author attempts, in many cases, to show the protagonists’ side of many studies. This allows one to see where differing views are coming from and, perhaps more importantly, to reaffirm that not everyone agrees in scientific outcomes. In fact, the more answers we get, the more questions we have. The author challenges us to consider many questions when we read about animal behavior studies. Chief among these is whether animal behavior is influenced by the scientists conducting any given study. Animal studies (even those that put the best controls in place) are still run by humans in human settings. Would the outcomes be different if we could train the animals to conduct the studies, instead of the scientists?

This book is a wonderful primer on animal studies. Written in easily understood and engaging language, the author makes us dig deep in thinking about our own cognition as well as that of other animals. Although this book would be difficult to place in a high school curriculum, many students may find it a fascinating read (especially those who have an interest in veterinary science). The information presented led this reader to conclude that the more we know, the more we need to know. We are not alone in our cognitive thoughts, and we perhaps the answer to the author’s title question is that we will never be smart enough to know how smart the animals are because they, like us, are constantly evolving in cognition, and the closer we get, the further away we are.

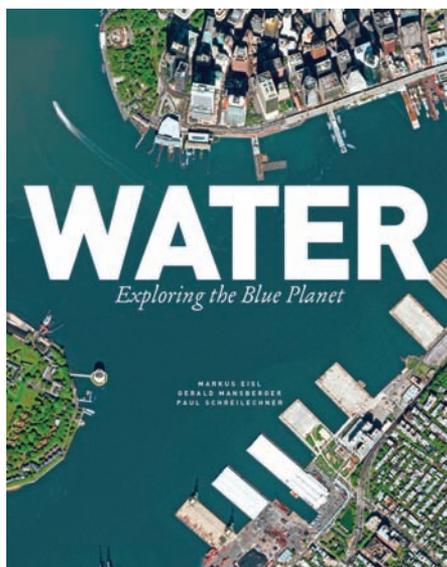


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## EVOLUTION

***Monarchs and Milkweed: A migrating butterfly, a poisonous plant, and their remarkable story of coevolution.*** By Anurag Agrawal. 2017. Princeton University Press. (ISBN 978-0-691-16635-3). 296 pp. Paperback. \$29.95.

The monarch is one of only a handful of insects that can survive the bite into the milkweed plant with its interior, sticky white latex substance. In fact, half of monarch caterpillars that bite into the milkweed plant may not survive, as



the fast drying latex substance is capable of gluing their mouthparts shut. This long-standing, plant-animal interaction provides a fascinating and dramatic example of an evolutionary arms race in nature. And there is still so much to learn and discover about the dynamic relationship. The monarch needs the milkweed, but the book emphasizes that the milkweed does not necessarily need the monarch. In terms of the relationship between the monarch and the milkweed, author Anurag Agrawal writes, “Unlike many other co-evolutionary relationships, that between the monarchs and milkweeds is not symbiotic.”

*Monarchs and Milkweed* does a phenomenal job in blending historical, foundational research on the monarch butterfly with emerging findings related to monarch and milkweed biology, while concurrently weaving in life science concepts that connect to major themes in biology. The book is informative and engaging, and it would appeal to a diverse audience. Beautiful images are included, which serve to effectively highlight aspects of the monarch’s biology and relationship with the milkweed plant. In addition to fantastic quotes leading into each chapter, the chapters also begin with an image of a metamorphosing monarch that grows and changes in form as the chapters progress—a very thoughtful and creative addition.

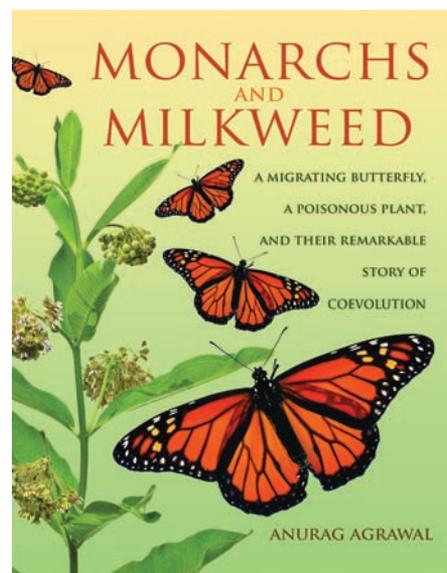
This publication could be used in secondary science and university life science classrooms as part of a project-based learning unit with connections to monarch butterflies, biology, ecology, evolution, chemistry, and much more. Students would be able to refer back to primary research literature that is described in the book for further investigation into select topics. Biology classrooms could also replicate some of the studies described in the book, and students could generate new

driving research questions based on the readings. Teachers could make great use of readings in the book to engage students in biological concepts such as evolution, natural selection, and plant and animal interactions, among others. In a 5E unit on the biology and ecology of monarch butterflies, educators could use the book as part of the “explain” portion of the 5E model, where students immerse in literature that covers what we know and questions that remain to be answered related to monarchs and milkweed. This could lead into the “elaborate” portion, where students conduct further research into concepts covered in the book. The book can also be a great tool to highlight the process of science—how science is done, showing how one study leads to future questions, and follow-up research.

Given the many questions and challenges related to 21st-century monarch butterfly biology and conservation, this book would be a wonderful addition to the science curriculum to encourage students to ask questions and investigate solutions. I could envision scenarios where educators utilize the whole book, or choose to use portions of the book to address specific areas in the biology curriculum.



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## LIFE ON EARTH

***Water, Exploring the Blue Planet.*** Marcus Eiel, Gerald Mansberger, and Paul Schreilechner. 2016. Firefly Books (ISBN 13-978-1-77085-813-8). 302 pp. Hardcover \$49.95.