changes in understanding, knowledge of, or engagement with the subject matter (Box 1). Guidance on performance assessment can be sought from other fields (e.g., informal science learning) that explore the role that the arts have in science learning outside of the classroom [5,14]. Some work suggests that it is helpful to engage professional evaluators who have training in education research or the social sciences and experience assessing arts-based or arts-science projects [15].

Consideration should be given to developing a common reporting platform for data and metadata on project outcomes and assessment. This process can be informed by examples of well-articulated arts-based science communication projects supported by research and evaluation. One example is the climate science-based play, *The Great Immensity*, created by the New York-based theater group *The Civilians*, which debuted in Kansas City in 2012 [11]. Scientists were engaged as collaborators as the play was developed, the theater company worked with a professional evaluator to assess the outcomes of the play, audience engagement was incorporated into the performance and assessment, and the evaluation report is publicly available through The Center for Advancement of Informal Science Education (www.informalscience.org/great-immensity-conveying-science-through-performing-arts-assessment). Although carrying out rigorous and lasting evaluation can be challenging in some circumstances (e.g., long-term projects or projects with wide-ranging goals), and although many do not have the resources necessary to carry out a project like *The Great Immensity* (which was funded by the National Science Foundation), it remains a useful case study for communities of researchers and practitioners to gauge how to frame, develop, carry out, and evaluate their endeavors. Addressing several considerations central to project development and execution (Box 1) can provide additional guidance for assessment and reporting. Having these in mind from the onset of project development can also better ensure that projects proceed according to measurable goals and that meeting project goals yields intended outcomes. Other added benefits, such as further conceptualization of arts–science collaborations, could bolster an already flourishing field.

Appendix A Supplemental Information

Supplemental Information associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.tree.2016.06.004.

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http://dx.doi.org/10.1016/j.tree.2016.06.004

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Book Review

The Design of Life's Interactions: Biomechanics as a Key Tool in Ecology and Evolutionary Biology

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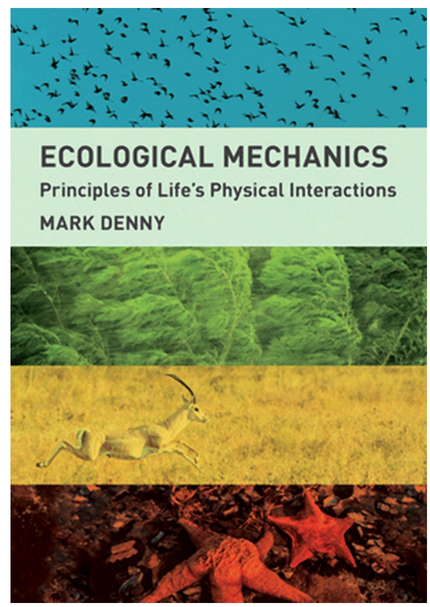

2015 and 2016 were sad years for the field of biomechanics as they saw the passing of two giants in the field, Steven Vogel and Robert McNeill Alexander. Despite their very different research programs both were exceptionally gifted in transmitting their science to the general public by rendering complex problems simple and by using everyday examples to illustrate the principles at work in nature [1–3]. Mark Denny follows in the footsteps of these exceptional scholars and with his book *Ecological Mechanics* tries to explain how biomechanics can be used to gain understanding in ecology. Although his target audience is clearly different (upper-level Masters and PhD students), he also tries to demonstrate how complex problems in ecology can be tackled through the use of mechanics. Denny has his own unique style that often finds inspiration in questions related to his specialty, the ecology and mechanics of wave-swept shore environments. The many original examples focusing on aquatic invertebrates and plants make this book different from most other books in the field [1–5].

Denny uses first principles derived from the mechanics of the essential building blocks of nature, atoms and molecules, to explain concepts ranging from fluid dynamics to the fracture mechanics of composite materials. He goes on to provide examples of how an ecomechanics approach can be used to tackle real-world problems in ecology. Although extremely enticing and intuitively pleasing for the engineers that we humans are, this approach quickly risks entering into the fallacy of a perfectly adapted world [6]. In nature, selection can work only with the building blocks available, within the design limits set largely by Newtonian mechanics. So the approach is at its most useful and interesting in setting the boundaries and limits of organismal design. When applied properly, a mechanical or engineering approach can give powerful and unique insights into the design of organisms, the interactions between them, and even problems of community ecology as argued cogently by Denny. However, the one pitfall of this approach is that selection does not act on the building blocks themselves but rather on the function of the organism as a whole [7]. Denny is clearly aware of these limitations and often explicitly states them at the end of a chapter. For example, the shapes of corals often depart from the optimal shapes predicted by mechanics as the ‘truly optimal shape is that which best serves all an organism's needs’ (p. 340).

Despite these caveats Denny nicely illustrates how an understanding of the principles of mechanics can have far-reaching implications. For example, an understanding of the mechanics of fracture under repeated loads can help explain the behavioral strategies observed in crabs, birds, fish, and lizards that eat hard or tough food items. By loading the shell or nut repeatedly at values much lower than those needed to break the object, crack propagation resulting from stress concentration leads to failure. Similarly, Denny demonstrates how an understanding of fluid mechanics, especially flow at low Reynolds number, can help us understand sensory ecology in many invertebrates and even the predator–prey dynamics between crickets and wolf spiders. Wolf spiders clearly know their fluid dynamics and adapt their behavior to prevent the generation of bow waves that stimulate the sensory hairs on the cricket abdomen. That an understanding of mechanics can also have far-reaching applications in conservation biology is nicely illustrated by Denny's review of thermal mechanics. At the end of the chapter he explains how thermal mechanics can provide insights into current and future spatial distributions of plants and animals through environmental niche modeling (see also [8] for an excellent synthesis on the subject).

The final part of the book is where the reading really becomes fun and exciting as Denny starts tackling general ecological problems through the use of mechanical and engineering theory. Denny starts with scale transition theory, moves on to spectral analysis and the effects of scale, and ends with the biology of extremes and pattern and self-organization. These chapters are extremely insightful and push the reader to think more broadly about how, for example, environmental variation structures the lives of organisms and their survival. The summary in chapter 24 is exceptionally lucid. Readers that only read these pages will have already have learned a lot and will be incited to return to previous chapters to learn more about the topics they find most interesting.

Overall, an excellent read and a highly original contribution to the fields of biomechanics and ecology.

Ecological Mechanics: Principles of Life's Physical Interactions by Mark Denny, Princeton University Press, 2016. US$79.95/£59.95, hbk (503 pp.) ISBN 978-0-691-16315-4

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http://dx.doi.org/10.1016/j.tree.2016.06.005

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Book Review

Soil and Society

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