

# Improving ecological education through a four-dimensional framework

At its November 2018 meeting, the ESA's Governing Board made the important decision to endorse the 4-Dimensional Ecology Education (4DEE) framework. Developed over the past 3 years by a task force of ESA members who solicited input from a variety of groups, the framework takes a fresh and innovative approach toward the teaching of ecology.

Early on, the task force recognized that a simple listing of concepts would neither fully address ESA member needs for fostering excellence in ecology education, nor capture the way that ecology has matured as a diverse, multidisciplinary science. Development of the 4DEE framework was informed by other initiatives such as AAAS's *Vision and Change in Undergraduate Biology Education* (<https://bit.ly/2sPupbX>) and the Next Generation Science Standards ([www.nextgenscience.org](http://www.nextgenscience.org)). Those approaches are also explicitly multidimensional, but we believe they do not go far enough to fully inform ecology educators. Instead, the 4DEE framework ([www.esa.org/4DEE](http://www.esa.org/4DEE)) involves four dimensions that educators should incorporate when teaching ecology: Core Ecological Concepts (the familiar hierarchy of ecology, from the individual to the biosphere), Ecology Practices (relevant skills that students should have), Human–Environment Interactions (ways that humans and nature affect each other), and Cross-cutting Themes (topics like scale and evolution).

Some may ask: "What's new here?" We contend that 4DEE is innovative for several reasons. First, with its distinctive emphasis on human–environment interactions, on practices like the natural history approach and field-based ways of doing science, and on the prominence of cross-cutting themes like spatial/temporal scale and disturbance, a multidimensional approach is far superior to the traditional one-dimensional approach to teaching ecology. The inclusion of multiple dimensions beyond just Core Ecological Concepts allows integration of various ways of thinking and doing ecology with teaching big ideas (eg population processes, community theory, transfer of nutrients and energy in ecosystems) in the discipline.

Second, the 4DEE framework elevates the Human–Environment dimension so that it is integrated with the teaching of the Core Ecology Concepts and not just included as an addendum to a course. Increasing emphasis on human dependency on the environment, ecosystem management, and related ideas will highlight the relevance of ecological knowledge to human welfare. By enhancing our ability to communicate ecology broadly, the framework aids in developing policies and practices that address current global environmental problems, especially those affecting otherwise disenfranchised groups.

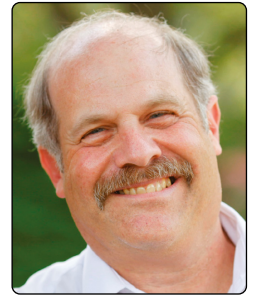
Third, we expect a tremendous amount of innovation will emerge from the community of ecology educators as they use, modify, and extend 4DEE in research and practice. Their creative and critical research-based work will explore how to realize and assess multi-dimensional teaching at different scales (eg a single lesson, course, course sequence, degree program, certification program) and in different contexts (eg non-majors, majors, etc). We foresee opportunities for numerous presentations, posters, and published papers documenting their successes and insights.

Having a professional-society-endorsed framework will strengthen ecology education in a number of ways. (1) 4DEE will help guide ecology educators seeking to teach ESA-endorsed sets of concepts, ways of thinking, and skills to their students, and enable those teachers to connect students to relevant issues related to global environmental problems through experiential learning in the classroom and the field. (2) The framework will allow students to better understand the scope of, as well as topics and skills in, ecology. With an emphasis on useful skills and ways of thinking, we hope that students will find practical support for pursuing a diversity of careers beyond those in traditional academic pathways. (3) 4DEE will inform ESA efforts to provide standards of skills, practices, and ecological knowledge used in evaluating the overall academic preparation required by ESA's certification program, thereby supplying guidelines for appropriate continuing education and professional development opportunities for environmental professionals seeking certification. (4) The framework can be used to leverage support from college and university administrators to strengthen ecology-based curricula by validating best faculty practices. Similarly, we foresee 4DEE informing ecology textbook authors interested in aligning with ESA's endorsed framework.

We also believe that 4DEE will support ESA efforts to "Extend the Tent" to a broad range of environmental professionals not engaged in other activities of the Society. The emphasis on human–environment interactions and a range of practices including collaboration, communication, and application will prepare ecology graduates with valuable career skills for use in jobs beyond those in academia. ESA will thus become a hub of professional development in ecology for all environmental professionals.

Finally, we hope that 4DEE will greatly enhance ecological literacy, thereby helping to fulfill a call made by ESA Past-president Paul Risser in his 1986 address. Embracing this approach can lead to more informed decision-making, resulting in a more sustainable future. The Governing Board's decision to endorse 4DEE will prove to be a wise one, indeed.

*This essay benefitted from valuable input by Bob Pohlada (Ferrum College) and Teresa Mourad (ESA).*



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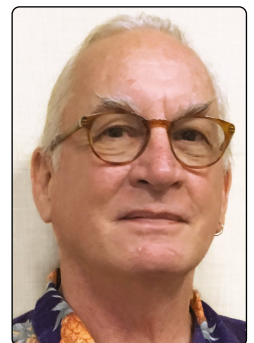
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