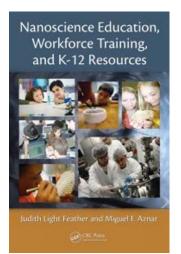BOOK REVIEW

Nanoscience Education, Workforce Training, and K-12 Resources

J. L. Feather and M. F. Aznar xxxi + 280 pages, ISBN 978-1-4200-5394-4, CRC Press, Boca Raton, Florida, USA (2010), paperback.

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Just in time for teachers, students, parents, and researchers, *Nanoscience Education, Workforce Training, and K-12 Resources* offers a comprehensive and wide-ranging toolkit for integrating the transformative effects of nanotechnology into our schools and lives. There's a stack of books on our desk and a cloud of PDFs on our desktop that focus on the social and ethical implications (SEI) of nanotech, but this 2011 collection by Judith Light Feather and Migeul F. Aznar will be among the few "go to" texts for our classes and research in coming years. With critical essays, lively pedagogical ideas and techniques, and a veritable database of resources that more than deliver on the title keyword, the book is a timely tool for growing the best of all plausible nanotechnological futures.

More than technical breakthroughs will be necessary if we are to integrate already existing nanotech research and applications into our planetary infrastructure and curricula. The potential of this new scale of engineering is no doubt well known to readers, with nanoscale solar and water filtration breakthroughs offering particular hope to a planet where many still lack electricity and clean drinking water. What may be less obvious is the role that nanoscale art, gaming, and do-it-yourself nano may play in harnessing this potential through education, public outreach, and (sometimes open-source) innovation. We will get the nanotechnology that we imagine and foster, and *Nanoscience Education, Workforce Training, and K-12 Resources* offers tactics for transforming the "complex system" of history, politics, and educational policy that will shape any integration of nanoscience ideas and applications into our society from the local to the global level.

For teachers and researchers working in the context of K-12 budget cuts in many states in the U.S. and around the world, *Nanoscience Education, Workforce Training, and K-12 Resources* offers education on a new scale and in a new key. The sheer variety of perspectives represented

here helps the volume avoid the usual monotone voice of jargon that too often haunts such compilations. The result is a fresh and lucid take on the metaphorical roadmap to nanotechnology, with a welcome emphasis on bottom-up approaches to education and workforce training. There is much to like here—an impressive, sometimes dizzying array of resources and approaches for educators and administrators in time to make a difference in today's classroom and hacklab.

The book is organized into four sections. Section 1 offers appropriately foundational chapters to provide a rationale and context for the volume. The section looks to systems thinking for a comprehensive approach to an essentially interdisciplinary topic and highlights some of the more remarkable figures in nanotech's history (e.g., Feynman and Smalley) in ways that will both inspire us and remind us of nano's historical context. Section 2, "Teaching Nanotechnology," takes its lead from the observation in Section 1 that students are "shifting the paradigm" in the classroom and the workplace—a welcome change from the recent habit of educators to focus on top-down transformation. Chapter Six takes a particularly insightful approach to the teaching of "nanotechnology's identity," transforming the often fuzzy discussion around the definition of nanotechnology into an opportunity to rethink the range and implications of nanotechnology from the perspective of ten-year-old students. The results and diagrams of the latter may well make you unfashionably optimistic with great ambitions for this generation of budding scientists. An excellent chapter on the evaluation of nanotechnology is too short for the scope of the topic, but the six-fold heuristic (based on the psychologist Abraham Maslow's hierarchy of needs[1]) is promising and useful enough that readers will want to read and do more on this front. And one wonders at the possibilities in a society that systemically recognizes how "four year old children think like scientists." Might an aptitude for biomimicry be worth cultivating alongside core literacy and math skills? Project-based flash mob courses taught by four-year-olds to aging researchers of a more mechanistic mindset might not be out of the question.

And such courses may well feature video gaming. Projects in the last ten years in pedagogical gaming combined with the collective intelligence approach of online massively multiplayer games—e.g., *Collective Detective*—might finally convince us of the strategic and pedagogical promise of gaming for the nanotechnological transformation of society described in Ahklesh Lakhtakia's inspired introduction. He writes that "global problems. . . are so intense that every available mind must be harnessed to overcome their challenges to sustainable ecosystems in which humans continue to play major roles." If we are to tap into and connect the six billion minds of our planet, we must hold their attention and offer participatory interaction in a way that allows us to link up across national, cultural, and generational boundaries while learning from and revering our differences. An excellent index allows you to track discussions of and resources for "learning to learn"[2] gaming across sections.

Introspection has just as much of a future as gaming. Structured "reflections on the relevance of the project to the town, province, nation and world" are not just feel good or politically correct aspects of an otherwise technical project, but integral to the design and implementation of a successful technology. The book's holistic approach offers plenty of ideas, techniques, and case studies for recognizing big picture aspects of nanoscience.

Section 4 does not shirk its obligation to think thoroughly about the implementation of the ideas and tools from the sometimes sprawling list of resources found in Section 3, which would have perhaps been better served by sharing it as a web resource with a Creative Commons license. Fortunately, a good chunk of this section, Chapter 9, is available as a download[3] that will further stoke your enthusiasm for the rest of this excellent and practical volume. Download it now—our nano future will be the better for it.

References

1. A. H. Maslow, "A theory of human motivation," *Psychol. Rev.* **50**, 370–396, (1943).

2. G. Bateson, *Steps to an Ecology of Mind*, The University of Chicago Press, Chicago (1972).
3. J. L. Feather and M. F. Aznar, "K-12 outreach programs," http://www.nanoscienceworks. org/articles/Chapter%209%20from%2053949.pdf, *Nanoscience Education, Workforce Training, and K-12 Resources*, CRC Press, Boca Raton, Florida (2010).