Bruce Alberts is Editor-in-Chief of *Science*.

Failure of Skin-Deep Learning

THERE IS A DISCONNECT AT THE HEART OF THE U.S. EDUCATION SYSTEM THAT IS HAVING A DEVASTATING effect on how and what children learn. Research shows that the most meaningful learning takes place when students are challenged to address an issue in depth, which can only be done for a relatively small number of topics in any school year.* But the traditional process of setting standards tends to promote a superficial "comprehensive coverage" of a field, whether it be biology or history, leaving little room for in-depth learning. The curricula and textbooks that result are skin-deep and severely flawed.

The factoid-filled textbooks that most young U.S. students are assigned for biology class make science seem like gibberish—an unending list of dry, meaningless names and relationships to be memorized. Take, for example, my 12-year-old grandson's life science textbook. Approved by the State of California, it is filled with elaborate drawings and covers an astonishingly broad range of biology. But the text is largely incomprehensible for its student audience, reminding me of a commercial exam-cramming guide that proudly states: "We'll show you that you don't really have to understand anything. You just have to make a couple of simple *associations*, like these. Aerobic respiration with: presence of oxygen, more ATP produced . . . Anaerobic respiration with: absence of oxygen, less ATP produced." When my grandson and his classmates successfully complete that book and the class based on it, it is clear that they will know nothing of the kind of biology that inspires passion in the souls of the scientists working in the labs around me at the University of California, San Francisco. How might we instead give schoolchildren the gift of experiencing the profound joys of science, or history, or literature?

My answer is based on a remarkable year-long history course I took as an undergraduate at Harvard—Social Sciences 2, Western Thought and Institutions—that demonstrated the critical importance of in-depth learning for students. The course, taught for three decades by the legendary Professor Samuel Beer, focused intensively on six brief periods of time from the Magna Carta to the rise of Communism. In attempting to analyze each period of 50 or so years in depth, we read original documents as well as essays by famous historians, and through term papers and exams we explored the forces that have shaped human history. Although I had taken history courses in high school, memorizing enough facts and dates to be awarded an A grade, I had learned nothing essential about history. It was only in Professor Beer's class that history came alive for me as a critical tool for understanding human societies.

I believe that the above course has important lessons for all educators. At all levels of schooling, we need to replace the current "comprehensive" overviews of subjects with a series of in-depth explorations. To do so, we will need to abandon the one-size-fits-all textbooks used in schools in favor of a large set of much shorter curriculum units, each designed to facilitate the active exploration of one important topic in depth for a month or so. Importantly, the teachers in each school district should be empowered to cover only a fraction of the topics available for their grade level. Rather than attempt to cover an entire subject such as biology, an impossible task, the goal of each unit should be to challenge students to explore one narrow topic deeply. To this end, it will be important to avoid the fatally flawed, state-based textbook-adoption process.† For science education, could a national process of curriculum unit validation be parceled out to a set of major scientific societies? More about this in my next Editorial, focused on the biology of cells and organisms. **– Bruce Alberts**

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*M. S. Schwartz, P. M. Sadler, G. Sonnert, R. H. Tai, *Sci. Educ.* **93**, 798 (2009); W. B. Wood, *Science* **325**, 1627 (2009).
†H. Tyson-Bernstein, *A Conspiracy of Good Intentions: America's Textbook Fiasco* (Council for Basic Education, Washington, DC, 1988).

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