LETTERS

Educating Students to Appreciate Physics

After several years of decline, the number of physics BA degrees awarded by colleges and universities has leveled off (see PHYSICS TODAY, March 2000, page 68), and high-school enrollments are increasing somewhat. However, we can improve on these figures. My experience as a physics teacher suggests that it is the high-school course that generates the college and university enrollments in physics. In many US high schools, only the upper 20% or so of the student population takes physics. The rest are often excluded by either the unnecessary rigor of a course that emphasizes theory and questioning rather than tools and problem solving, or by poor performance on standardized tests. This exclusion leads directly to lower physics enrollments in higher education.

In some school districts—for example, New York City and Chicago—physics and chemistry are required high-school courses. Student populations in these urban schools are often considered to be at risk. However, I have taught in urban schools with mostly African American and Hispanic students, and my experience is that minority and other at-risk students can do well in a basic physics course with the standard mathematical components. Students need drills and practices so that, with individual help from the teacher, they can use a formula and solve for a variable, use scientific notation, take and analyze data, and understand how to do simple modeling.

In the past, high-school physics texts were badly written, often emphasizing "thinking," while lacking problem-solving examples and the drills that might have helped inexperienced students. Almost any student can solve even a difficult and advanced physics problem if an example is given or if the teacher provides individual help. Making students struggle with a problem without first giving them the basic tools to solve it discourages many who are capable and interested.

By making the high-school course more user-friendly and more applicable without sacrificing quality of content, we will generate more students taking physics at all levels of instruction. Motivated students will then encourage their friends to take physics. More teaching positions will result and fewer physicists will be lost to other professions.

Stewart E. Brekke
(sbrekk@cs.com)
Chicago, Illinois

Letters submitted for publication should be sent to Letters, PHYSICS TODAY, American Center for Physics, One Physics Ellipse, College Park, MD 20740-3842 or by e-mail to ptletter@aip.org (using your surname as "Subject"). Please include your affiliation, mailing address, and daytime phone number. We reserve the right to edit letters.

When Did the Science Wars Start?

In their book review "Bringing Reason and Context to the Science Wars" (PHYSICS TODAY, May 2001, page 57), Craig McConnell and Robert H. March stated: "By the 1990s, a number of scientists struck back, and the fat was in the fire." The statement might be mistaken to mean that, before the 1990s, no scientists struck back, but that is not the case.

On 8 January 1988, Jon Turney, then science editor of the *London* (England) *Times Higher Education Supplement*, reported on page 2 the outcry over our *Nature* commentary "Where Science Has Gone Wrong."[1] Turney wrote:

> Teachers of history, philosophy and sociology of science . . . are up in arms over an attack by two Imperial College [London] physicists, . . . who charge that the plight of . . . science stems from wrong-headed theories of knowledge. . . . Scholars who hold that facts are theory-laden, and that experiments do not give a clear fix on reality, are denounced. . . . Staff on *Nature*, which published a cut-down version of the paper after the authors' lengthy attempts to find an outlet for their views, say they cannot recall such a response from readers. "It really touched a nerve," said

one. There is unhappiness that Nature lent its reputation to the piece.

How would one designate this particular conflict from the 1980s?

Reference

1. T. Theocharis, M. Psimopoulos, *Nature* **329**, 595 (1987).

Theo Theocharis
(theotheocharis@ic4life.net)
Mihalis Psimopoulos
(M.Psimopoulos@ic.ac.uk)
Imperial College
London, England

A Proposal for Rescaling Units

Several physical quantities are thought of as having "obvious" upper or lower bounds in their magnitudes. Temperature, for example, cannot go below absolute zero, the magnitude of any velocity is at most c, the speed of light, and time cannot go back past the Big Bang.

In life outside the laboratory, we never get very close to any of these bounds, so they pose no problem. However, researchers in cryogenics, cosmology, and high-energy physics work at values that are perceived to be close to these limits. We read of temperatures one one-hundredth of a degree above absolute zero (that is, 0.01 K); of velocities at 99.95% of the speed of light; and of the state of the cosmos at 10^{-8} seconds after the Big Bang. In these cases, the standard system of units is inconvenient. Getting three orders of magnitude closer to 0 K, or to the time of the Big Bang, or to the speed of light, should not be obscured by the appearance that the change is merely an infinitesimal improvement.

A change of units that maps zero to minus infinity and, in the case of velocity, maps c to plus infinity makes it easier to appreciate improvements that get closer to these bounds by orders of magnitude. This principle has been in use for a long time by engineers who measure changes in intensity in decibels (dB), where an increase or decrease by n orders of magnitude is a change of $+10n$ dB or $-10n$ dB, respectively.

For physical quantities like time and temperature, the new units may simply be taken as the common logarithms of the old units. Using **T** to represent the new unit of temperature, we set 1 K = 0 **T** with (10^n) K = n **T** for negative as well as positive values for n. Thus, 0.01 K = –2 **T**. More generally, x K = $(\log_{10}x)$ **T**, for any positive real number x. A similar approach applies to time since the Big Bang, where "x seconds after the Big Bang" becomes $(\log_{10}x)$ **U**, where **U** is our new, logarithmic measure of time.

For velocity magnitudes v, with $0 \leq v \leq c$, we can rescale to $\mathbf{V} = \tan(\pi v/2c)$, with $0 \leq V \leq +\infty$. At $v = \frac{1}{2}c$, this gives $\mathbf{V} = \tan(\pi/4) = 1$.

For nanotechnology researchers, the lower limit of zero for weight, length, and so forth can be moved to minus infinity by the same logarithmic technique used above for time and temperature. Names and symbols for these new units should be recommended by appropriate standards committees for each of the research areas involved.

Solomon W. Golomb
University of Southern California
Los Angeles

Strings 2000's Top 10 Bemuse Belfast

David Mermin is entitled to disagree with the list of top 10 questions in fundamental physics (Physics Today, February 2001, page 11), but