

education division. In South Carolina, for example, an individual who has taken just one science course in college—whether that be introductory geology, chemistry or astronomy—can be certified to teach any science subject at any grade level.

NSTA is now considering SS&C for kindergarten through sixth grade, grades in which science education has typically been weak. According to Aldridge, development of an elementary school program may start as soon as next year. But here, too, finding qualified teachers may present a problem.

The NSTA models recommends a total of seven hours of science per week, which for most students means that other courses would be displaced if the new approach is adopted. Where will the extra time come from? In Houston seventh-graders would

normally take only five hours of science per week. To make room for the additional two hours, the schools have reassigned time that would have been spent in reading class to science, with the stipulation that the students read about science during that time. Other solutions may be to scale back to five hours of science per week, to integrate science with math or science with social studies, or to move such nonacademic courses as driver education or home economics to after school. There has also been talk of lengthening the school day, although that means more money.

The NSTA reform may be vulnerable to the charge of giving science too large a place in the overall curriculum. After all, why should more and more time be devoted to science class when students do poorly in other areas as well?

For all that, NSTA's proposal could end up being the biggest change to come about in science education since the post-Sputnik reforms. Proponents of the SS&C approach are gambling that their way of doing things will retain the best of the old system while getting rid of the worst. They maintain SS&C will keep students in the science "pipeline," thereby funneling more into science careers while raising overall science literacy.

"What we have in the United States is a strong tradition of teaching science through open-ended, laboratory-oriented discovery, which I think in the end makes for more inventive scientists," Moore says. "But what we're missing is getting the average student to be science literate. We're hoping that Scope, Sequence and Coordination can change that."

—JEAN KUMAGAI

PARTICLE PHYSICS EDUCATORS DESIGN 'PERIODIC TABLE,' SOFTWARE PROGRAM

In an effort to infuse modern physics into the traditional introductory curriculum, a group of physics teachers and researchers, with the backing of some of the largest US particle accelerator laboratories, has put together a package of teaching material on particle physics that includes a giant color wall chart and an interactive computer program.

The package is geared toward high school and first-year college physics classes. Its designers, who are known collectively as the Contemporary Physics Education Project, hope that the wall chart will someday enjoy the same position in physics classrooms that the periodic table of elements now does in chemistry classes.

The chart, measuring 1 meter by 1.5 meters, is a colorful compilation of figures, tables and text set against a black background. At the center is a representation of the atom's structure. On either side are tables that list the properties of fermions and bosons; below is a table on the various particle interactions. Short definitions of widely used terms—spin, matter and antimatter, and so on—are interspersed throughout the chart. Across the bottom of the chart are illustrated examples of three particle reactions: neutron decay, electron-positron annihilation and decay of an unstable hadron.

The idea for a chart originated with Frederick S. Priebe, a physics teacher at Palmyra Area High School in Pennsylvania, who proposed it at a

conference on teaching modern physics held in 1986 at Fermilab (see PHYSICS TODAY, March 1986, page 103). The purpose of the conference was to promote the teaching of particle physics and cosmology in high school and introductory physics courses; among

the other big projects to result from the conference is a teacher's guide on modern physics topics (see box).

Following the conference, the CPEP group was formed. From the outset the committee decided to restrict the wall chart to what was

Teacher's Guide Covers Modern Physics Topics

Two major projects arose from the 1986 conference on teaching modern physics. One project has resulted in the particle physics wall chart, as described in the accompanying news story. The other, called Topics in Modern Physics, has yielded a teacher's guide and a training program for teachers.

The Topics in Modern Physics project was organized by Friends of Fermilab and Fermilab's education office and was funded by a two-year, \$190 000 NSF grant. According to the project's director, Marjorie G. Bardeen, the teacher's guide is written for the high school or first-year college teacher and covers six specific areas in modern physics: accelerators and detectors, cosmology with general relativity, and elementary particles with symmetry. The idea is to allow modern physics to be "sprinkled" throughout the introductory curriculum. The guide contains background information as well as classroom activities. For example, the section on accelerators and detectors includes descriptions of Fermilab and SLAC, sample problems, lab assignments, diagrams of detector components, and a list of educational videotapes available from Fermilab. Following a pilot test in 1988, the guide was revised and a new edition was published in June 1990.

The project has also spawned a series of workshops that have been held throughout North America. Participants learn about a specific topic from a researcher in that field and then discuss how to incorporate the information into their courses. Bardeen says that about 3000 teachers have already taken part in the one-day workshops.

The *Topics in Modern Physics Teacher Resource Book* and a schedule of upcoming workshops are available from Friends of Fermilab, Fermi National Accelerator Laboratory, Batavia IL 60510. A Spanish-language edition of the teacher's guide is also available.