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MAJOR CHANGES NEEDED TO BOOST K-8 SCIENCE ACHIEVEMENT

WASHINGTON -- Improving science education in kindergarten through eighth grade will require major changes in how science is taught in America's classrooms, as well as shifts in commonly held views of what young children know and how they learn, says a new report from the National Research Council. After decades of education reform efforts that have produced only modest gains in science performance, the need for change is clear. And the issue takes on even greater significance with the looming mandate of the federal No Child Left Behind Act, which says that states must measure students' annual progress in science beginning in 2007.

Being proficient in science means that students must both understand scientific ideas and demonstrate a firm grasp of scientific practices. The report emphasizes that doing science entails much more than reciting facts or being able to design experiments. In addition, the next generation of science standards and curricula at the national and state levels should be centered on a few core ideas and should expand on them each year, at increasing levels of complexity, across grades K-8. Today's standards are still too broad, resulting in superficial coverage of science that fails to link concepts or develop them over successive grades, the report says. Teachers also need more opportunities to learn how to teach science as an integrated whole -- and to diverse student populations.

"Current teaching approaches are insufficient to launch students on a path to participation in a society infused with job opportunities in scientific and technical fields, as well as scientific issues such as alternative fuels, avian influenza, global warming, and nanotechnology," said Richard A. Duschl, professor of science education, Graduate School of Education, Rutgers University, New Brunswick, N.J., and chair of the committee that wrote the report. "To improve science education, a curriculum coordinated across grade levels and broad changes in assessment and instruction are urgently needed."

Four intertwined and equally important strands comprise the committee's definition of proficiency in science. First, students should know, use, and interpret scientific explanations of

the natural world. Second, they should be able to generate and evaluate scientific evidence and explanations. Third, they should understand the nature and development of scientific knowledge. And finally, students' work should include active participation in scientific collaboration and discussion. All K-8 education should offer students opportunities to engage in the four strands of science proficiency.

The commonly held view that young children are simplistic thinkers is outmoded, the report adds. Studies show that children think in surprisingly sophisticated ways. Yet much science education is based on old assumptions, and it focuses on what children cannot do instead of what they can. All children have basic reasoning skills, personal knowledge of the natural world, and curiosity that teachers can build on to achieve proficiency in science.

The four strands, plus current scientific understandings of how children think, should be the basis for new science standards, assessments, and curricula, the report says. In a new, coordinated system, standards and curriculum should have coherent learning goals that can be achieved through instruction over several grades. Assessments should provide teachers and students with timely feedback about students' knowledge. And teacher preparation and professional development programs should focus on boosting teachers' knowledge of science, how students learn the subject, and methods and technologies that aid science learning for all.

Students should have a wide variety of learning experiences in science classes, the committee said. Those experiences should include conducting investigations; sharing ideas with peers; talking and writing in specialized ways; and using mechanical, mathematical, and computer-based models. Science should be presented as a process of using evidence to build explanatory theories and models, and then checking how well the evidence supports them.

The report also urges education leaders, policymakers, researchers, and school administrators to tackle gaps in science achievement among different groups of students. Such gaps exist between white students and non-Asian minority students; they also remain between economically advantaged and disadvantaged students. The problems can be traced, in part, to inequities in learning opportunities and differences in how children are taught. All U.S. students should have adequate time and resources for high-quality science learning, the report says.

A solid base of evidence supports the committee's call for action to help all students become proficient in science, but additional research is needed to shed more light on how learning occurs across the four strands, how instruction should change with children's development, and which scientific ideas have the broadest reach across disciplines.

The study was sponsored by the National Science Foundation, National Institute of Child and Human Development, and the Merck Institute for Science Education. The National Academy of Sciences, National Academy of Engineering, Institute of Medicine, and National Research Council make up the National Academies. They are private, nonprofit institutions that provide science, technology, and health policy advice under a congressional charter. The Research Council is the principal operating agency of the National Academy of Sciences and the National Academy of Engineering. A committee roster follows.

Copies of **TAKING SCIENCE TO SCHOOL: LEARNING AND TEACHING SCIENCE IN GRADES K-8** will be available from the National Academies Press; tel. 202-334-3313 or 1-800-624-6242 or on the Internet at [HTTP://WWW.NAP.EDU](http://www.nap.edu). Reporters may obtain a pre-publication copy from the Office of News and Public Information (contacts listed above).

[This news release and report are available at [HTTP://NATIONAL-ACADEMIES.ORG](http://national-academies.org)]

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