NASA examined its tech-transfer programs and concluded that "all too often, NASA employees, managers, contractors, and grantees don't consider tech transfer to be part of their jobs." But that attitude may be changing: Earlier this year, NASA Administrator Daniel Goldin sent a memo to all employees extolling the importance of tech transfer in the agency's mission, and a call to reform the agency's attitude even showed up in last month's report by Vice President Al Gore on reinventing government.

NIST finds the key

Among the top research agencies, only NIST appears to have managed to embrace CRADAs without getting smothered. Its budget is just one-fifth of the $1 billion that NIH spends on in-house research, but it supports more than twice as many active CRADAs. Industry officials attribute this mostly to NIST's mission—its researchers have traditionally been focused on industrial research issues, and their work tends to be among the most applied in the government. In contrast, "the bulk of NIH research is very fundamental and not of immediate commercial interest," explains NIH's Adler. Although NIST, like the other agencies, still has few products on the market to show for its CRADAs, it is gaining a reputation for exemplary technology transfer, a performance that has helped it to win a promise from President Clinton to more than triple its budget over the next 4 years. Companies attribute NIST's success to a compact bureaucracy, healthy funding, a culture of applied research, and a long history of industrial collaborations that could easily be converted to CRADAs.

Congress initiated the CRADA process and it is now starting to respond to the swelling chorus of complaints. Senators Jay Rockefeller (D–WV) and Dennis DeConcini (D–AZ) have just introduced a bill intended to reduce much of the delay in negotiating CRADAs by giving the industrial partner automatic ownership of any technology developed, with the government retaining only a paid-up license for its own use. In return, the corporate partner would either reimburse the federal lab for its research costs, or pay the equivalent of royalties, with the first $10,000 going to the government scientists themselves. Rockefeller will hold a hearing on the bill next week, where it is expected to be endorsed by the Clinton Administration. If so, the bill is expected to be folded into related legislation now on a congressional fast track, and could become law before the end of the year. As other legislators consider additional reforms of everything from DOE's budgeting to NASA's bureaucracy, it seems that industry's CRADA complaints may finally be having their intended effect.

–Christopher Anderson

Curriculum Reform: Project 2061 Offers a Benchmark

What should children learn about science, and when should they learn it? Educators have been grappling with those questions since the 1980s, when report after report concluded that traditional lesson plans are overstuffed with detail, alienate students, and often create confusion about the nature of science. On the basis of those findings, teachers and scientists alike decided science education needed a drastic overhaul.

As a result, reformers in all 50 states have been busy designing new ways to teach science, with several independent national projects and dozens of state efforts progressing simultaneously. The latest product is from Project 2061, sponsored by the American Association for the Advancement of Science (publisher of *Science*). On 29 October, the project is slated to release a major report called *Benchmarks for Scientific Literacy*, which offers detailed recommendations for the concepts students in each grade from K through 12 need to know. "It's a step toward recasting how we all think about the nature of science literacy. It promotes the notion that all children can understand how science operates, and how it connects to real life," says F. James Rutherford, who directs the project.

The recommendations of Project 2061 share common ground with those from the other major players in the science education reform, including the National Science Teachers Association (NSTA) and the National Research Council (NRC), as well as a chorus of states now redoing their science frameworks. Most of these efforts advocate fewer facts, more concepts, and giving students concrete, hands-on experiences (*Science*, 7 December 1990, p. 1327). Drafts of each reform are constantly circlating throughout the community, so that "We're all part of the same conversation," says Elizabeth Stage, who has just left the NRC's education project to co-direct a new multi-state effort on new ways of testing students, called the New Standards Project.

But not everything is sweet harmony in this field. There are key points of difference among the players, such as whether science lessons should be taught in a truly interdisciplinary fashion, and when to introduce certain tough concepts. The NRC, which is part of the National Academy of Sciences, is charged with identifying some order in the babel of reforms and creating national standards in curriculum, teaching, and assessment; a first draft is due early next year. But the academy is relatively new to K through 12 education, and some grumble that the independent projects should take the lead. "We've been doing this for 8 years," says Andrew

NATIONAL REFORM EFFORTS

Project & Year	Sponsor	Goal	Products
Standards for School Mathematics 1986	National Council of Teachers of Mathematics	National standards in math curricula, teaching and testing, K-12	Curriculum and Evaluation Standards, 1989; Professional Standards 1991
National Science Education Standards 1991	National Research Council	National standards in natural science curricula, teaching, and assessment, K-12	Draft samplers circulating; complete draft due in early1994
New Standards Project 1991	Learning, Research and Development Center; Natl. Center on Education and the Economy	New ways to assess students' science achievement K-12	Science exams to be available in 1995-96.
Project 2061 1985	Amer. Assoc. for the Advancement of Science	Comprehensive, systemic reform K-12, including curricula goals in natural, social sciences, math and technology	Science for All Americans, 1989 rev.1993; *Benchmarks* for Science Literacy 1993.
Scope, Sequence and Coordination 1989	Natl. Science Teachers Assoc.	Revised curriculum, sequence of instruction in natural sciences, grades 6-12	Content Core revised ed. 1993

Ahlgren of Project 2061. "From our perspective, everyone else is a johnny-come-lately." Indeed, *Benchmarks* essentially fulfills a big chunk of the NRC's mission—but doesn't carry the stamp of authority of "national standards." Of course, even those standards will be voluntary, and states will continue to choose what and when to teach in science. And since 28 states have received grants from the Department of Education to revise their science education programs, a lot of choosing will be done over the next few years.

Benchmarks is the second phase of Project 2061—the first phase, *Science for All Americans*, described what high school graduates should know about science. The new report reflects a 4-year effort by teachers in six teams around the country. Their goal was to devise a science education system for all students, not just future scientists, to produce scientifically literate graduates.

In *Benchmarks*, concepts are introduced in early grades and slowly built up into more sophisticated understandings. For example, the report says second-graders should understand that offspring are similar, but not identical, to their parents. Fifth-graders should know that some traits are inherited, some learned. Eighth-graders should understand genes and selective breeding; high school graduates are to know about DNA and mutation.

Some of these items are currently introduced earlier—for example some students today are taught about DNA in middle school. But reformers in almost every project argue that students are missing the point of those lessons, and that the understanding of core concepts should be acquired and buttressed over many years. For example, another national project, Scope, Sequence, and Coordination (SSC), run by the NSTA, emphasizes the importance of giving students concrete examples before expecting them to understand theory. The intricacies of how DNA carries information requires a theoretical understanding, says Russell Aiuto, director of research and development at SSC, who agrees with the Project 2061 recommendation that study of DNA molecules should be left until high school.

In spite of such agreement, the Project 2061 and SSC teams don't quite see eye to eye on everything, including such other key concepts as energy. The SSC *Content Core* suggests that in grades six to eight, students of middle achievement levels do hands-on activities that illustrate kinetic and potential energy, electricity, the concept of work. But *Benchmarks* argues that technical definitions of kinetic and potential energy, heat and temperature, work, power, and so on are so difficult that, "For purposes of literacy, [they] are not worth the extraordinary time required to learn them."

The question of when—if ever—to introduce difficult concepts isn't the only one that divides science education reformers. Another is how to organize curriculum content. Project 2061 builds on common ideas from social science, natural science, technology, and math and is not constrained by traditional subject distinctions such as biology or geology. SSC, in contrast, focuses solely on natural science and divvies up content into traditional subjects; so far, draft samples of the national standards, and most state frameworks, do too.

Melting away disciplinary structure makes some educators—and scientists—nervous. For example, some chemists were initially concerned about how much of their discipline was included in *Benchmarks*. "If you look only in the section labeled 'matter,' you might panic," says Sylvia Ware, head of the education division at the American Chemical Society. She had a team of educators trace chemical topics through the various interdisciplinary chapters. To their surprise and relief, the chemistry educators found that chemistry pops up in many places in *Benchmarks* in addition to the section on matter. "We were surprised at how much chemistry was actually in there," says Ware. In fact, in some areas, Project 2061 did better than the SSC, which emphasizes physical chemistry.

ACS did urge Project 2061 to make some changes, such as adding more on acidity, and some of those changes are incorporated into the newest version of *Benchmarks*, says Project 2061 curriculum director Jo Ellen Roseman. But pH is still out; so are moles and chemical formulae. In fact, Rutherford believes one of the projects's chief strengths is what *isn't* included. He worries that in trying to forge consensus, the NRC's national standards will restore the "mountain of detail" his team labored so hard to take out. "There's always a tendency to stuff things back in again...but the key is that kids can't learn all the stuff we're trying to teach them now," agrees Ahlgren. Over at the NRC, educators insist they're heading in the general direction of a lean and mean curriculum but admit their program isn't there yet. "The most frequent comment around the table is, 'I think we still have too much,'" says Angelo Collins, who has directed the standards project for about 6 months.

Some educators characterize the most recent draft excerpts from the national standards as rather traditional. Says Jim Collins of the Texas Education Agency: "They describe what we've got now, but don't push us forward that much. And some of us need to be pushed." Kenneth Hoffman, associate executive officer for education at the NRC, counters that national standards must not be so far ahead of current practice that they are beyond the reach of most schools.

While these science educators thrash out their differences, those in other disciplines from geography to language arts are busy drafting their own standards. (The math standards are already done and widely acclaimed—although they don't always mesh perfectly with Project 2061's interdisciplinary ideas.) If each discipline packs the day full of its subject, states will simply shrug off the standards as unworkable, warns Shirley Malcom of AAAS, who serves on a national advisory panel for all the standards efforts. The real test for new curricular guidelines, after all, is whether states and local districts actually use them in classrooms.

–Elizabeth Culotta

SCIENCE FUNDING

NSF Gains From NASA Budget Cut

Officials at the National Science Foundation (NSF) often lament the fact that each year NSF must compete with agencies responsible for space, housing, veterans affairs, the environment, and a host of other programs for its share of the budget pie. The reason: All these agencies are lumped together in the same appropriations bill. Last week, however, NSF benefited from that fiscal proximity, as Congress redistributed $57.5 million it had saved by canceling a $3.8 billion program in the National Aeronautics and Space Administration (NASA) to build a motor for a new advanced solid-fuel rocket.

NSF's windfall amounts to $22.5 million, raising its overall 1994 budget to $3.027 billion. Congress added $10 million to one of its favorite programs—academic facilities and large instrumentation—and $12.5 million to NSF's general research account. That boosts the research budget to $2 billion, an 8% increase over 1993, and the facilities program to $110 million, more than double its 1993 level. The Environmental Protection Agency's Superfund program received $15 million to clean up toxic waste sites and NASA got $20 million from the National Aerospace Plane.

The rocket motor program is a favorite of Representative Jamie Whitten (D–MS), chairman of the House Appropriations Committee, because it is located in his state. The Clinton Administration had asked for $280 million in 1994, the House rejected the request, the Senate restored the money in its version of the bill, and House-Senate conferees compromised on $157.5 million. But cost-conscious members of the House prevailed on their Senate colleagues to ax the program, providing NASA with $100 million to terminate it. The agreement is expected to be ratified this week in separate votes by each house.

–Jeffrey Mervis