pectations for students. "I think they're perfect," says Michael Morgan, a chemistry teacher and chair of the science department at Francisco Bravo Medical Magnet School in Los Angeles, who helped to draft the document. "The average student with a caring teacher can get through this."

At the heart of the debate is the role of the state standards. Should they represent a realistic goal for all students, or should they be a challenge for even the brightest ones? Supporters say the new standards set high expectations and will prepare students for tomorrow's technology-driven economy. The California standards "are not designed to be a description of basic literacy," says biologist Stan Metzenberg of California State University in Northridge, one of the lead consultants on the writing committee. "It's obviously much more than what you might expect every student to leave high school with." But the standards will provide a basis for tests that will allow school districts and parents to gauge how well students are doing, he adds.

In contrast, detractors fear that the quantity of material required by the standards will drive students away from science by making it unappealing. "These standards are so chock-full of factoids," says American Physical Society President Andrew Sessler, "the only way you can get them across is by rote learning." Critics also complain that abstract concepts are introduced too early (see figure). "When you start teaching first- and third-graders about abstract things like atoms and molecules," says Alberts, "what we actually do is not have kids understand anything."

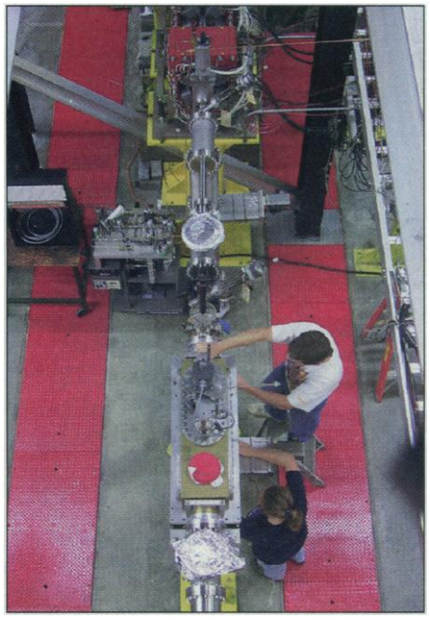
The state board is expected in the next few weeks to form a committee that will draft a set of curriculum frameworks based on the standards. But opponents are clinging to one last hope. "My hope is that the next governor takes care of this" by commissioning a major overhaul of the standards, says Alberts. Such a decision, say political observers, might well set a new standard for controversy. —GRETCHEN VOGEL

NUCLEAR PHYSICS

Tight Budget Could Shut Down MIT Accelerator

Unless the U.S. government finds more money for medium-energy physics research, the Siberian Snake may never slither into the Massachusetts Institute of Technology's (MIT's) Bates Linear Accelerator. Last week, a government advisory panel recommended that the MIT accelerator be shut down in 2 years and that other nuclear physics experiments elsewhere be abandoned if the Department of Energy (DOE) and the National Science Foundation do not boost funding for the field. DOE officials plan to use the report* to convince the Administration to do exactly that in its upcoming 2000 budget. If they succeed, physicists at the suburban Boston laboratory will be able to complete studies that require installation of the snake, a ring of magnets that organizes the accelerator's beam of electrons.

The Bates facility, which has operated since 1968, has been a training ground for many medium-energy physicists, who explore the properties of the atomic nucleus, including the forces that bind it together. However, 2 years ago DOE opened the $600 million Continuous Electron Beam Accelerator Facility at the Thomas Jefferson National Accelerator Facility in Newport News, Virginia, a larger facility that provides researchers with higher energy electron beams.



Scattered to the wind? Researchers won't be able to finish electron scattering experiments unless Bates lab gets funding boost.

Despite the increased capacity, DOE funding for the $116 million program has failed to keep pace with inflation over the last few years and has fallen at least 10% below levels suggested in a 1996 plan. "The budget pressure has been building—not everything can continue under a flat [funding] scenario," says James Symon, a physicist at the Lawrence Berkeley National Laboratory in California. In June, Symon was appointed head of an 11-member Nuclear Science Advisory Committee (NSAC) charged with recommending how scarce DOE funds should be spent.

Symon and others hope their report will help the department win a 10% to 15% in-

* "Scientific Opportunities and Funding Priorities for the DOE Medium Energy Nuclear Physics Program" (http://www.er.doe.gov/production/henp/nucphys.html)

CREDIT: (TOP) MIT/BATES LINEAR ACCELERATOR; (BOTTOM) NASA

ScienceScope

DOE Mulls Restarting Spacecraft Fuel Production

In a proposal that promises to spark further furor over the use of nuclear power aboard spacecraft, the U.S. Department of Energy (DOE) wants to begin making radioactive spacecraft fuel at home again. Department officials announced on 5 October that they are considering restarting production of plutonium-238—used to produce heat and electricity aboard some of NASA's planetary probes—at government reactors.

The move comes amid worries that future political instability in Russia could threaten NASA's supply of plutonium, which has come mainly from Russia since domestic production ceased in the early 1990s. It also follows protests against launches of several NASA craft carrying plutonium-powered generators, such as last year's Cassini mission to Saturn, which activists say could shower Earth with radioactive debris in the event of an accident (*Science*, 12 September 1997, p. 1598).

DOE officials estimate that the United States needs to make 2 to 5 kilograms of Pu-238 a year over the next 25 years to fuel NASA spacecraft. Before production can begin, however, DOE must complete an environmental study, which is due next spring.

X-ray Telescope Delayed Again

In a move that could scramble space shuttle schedules, NASA has again delayed the launch of its $2 billion x-ray observatory. Last week, space agency officials announced that flight software troubles will prevent manufacturer TRW Inc. from shipping the Advanced X-ray Astrophysics Facility from its California plant to the Kennedy Space Center in Florida in time for a planned launch aboard the shuttle next January. That launch date was set following a 5-month delay announced last January (*Science*, 16 January, p. 318).

NASA officials say that this time, they don't know when the troubled satellite will finally fly. While TRW tries to exterminate software bugs, NASA Chief Engineer Dan Mulville will lead a top-to-bottom review of the program aimed at producing a realistic schedule. But the report isn't due until January, and some scientists worry that reshuffling launch plans will delay missions critical to assembling the international space station and maintaining the Hubble Space Telescope.

crease for its entire $323 million nuclear physics program in the Administration's 2000 budget request to Congress now being assembled. A 6-year boost would enable Bates's 85 employees to finish three experiments scheduled through 2004 and plan for "an orderly shutdown without disrupting a lot of people's careers," says physicist Konrad Gelbke of Michigan State University in East Lansing, who chairs the NSAC. New funds would also preserve experiments planned for the Alternating Gradient Synchrotron at Brookhaven National Laboratory in New York, which produces hadron particle beams prized by physicists. The experiments are imperiled by the loss of funding from DOE's high-energy physics program at the end of 1999.

The squeeze on Bates is caused in part by the growing demands of the Jefferson accelerator, with 423 full-time staff and more than 1000 users. Jefferson officials have estimated their $70 million annual budget needs to be raised by at least $3 million to avoid cutting back on experiment time. "The hard decision is whether you need to have two electron machines," says Hamish Robertson, a panel member from the University of Washington, Seattle.

Funds saved by canceling the hadron experiments and closing Bates—which has a budget of about $8 million a year—would also be used to preserve smaller grants to university-based researchers. DOE spends about $15 million on 40 projects at 32 universities. The panel noted that the projects, most of which have budgets of less than $500,000, help maintain "a balanced scientific program."

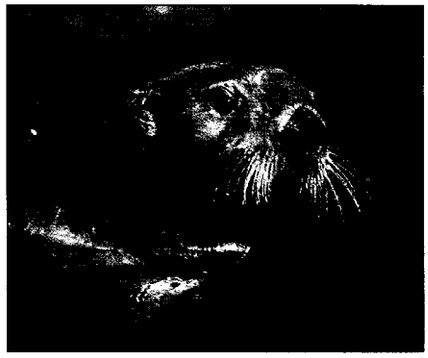
At MIT, however, officials are bullish that their accelerator will survive. "The quality of our science is not the issue," says Bates director Richard Milner, noting that the Symon report gave "excellent" and "outstanding" ratings to the facility's experiments. Such arguments have already won over one key DOE official. Acting nuclear science chief Dennis Kovar says the report "is going to help us make the case that added funds would realize real benefits to research." –DAVID MALAKOFF

ECOLOGY

Sea Otter Declines Blamed on Hungry Killers

Sea otters spend much of their days playing, drifting with the tide, and filling their bellies with the soft meat of shellfish and sea urchins—a lazy lifestyle that many of us might envy. But ecologists know that sea otters off the Alaskan coast, at least, play a pivotal role in marine ecosystems: By dining on sea urchins, the animals help preserve kelp forests that feed a range of species, from barnacles to bald eagles. Now, however, this "poster child of marine near-shore ecology," as Robert Paine of the University of Washington, Seattle, calls the sea otter, appears to be fighting for its survival.

On page 473, a team led by James Estes of the Biological Resources Division of the U.S. Geological Survey and the University of California, Santa Cruz (UCSC), has documented a 90% crash in sea otter populations in western Alaska's Aleutian Islands since 1990, with devastating effects on kelp forests. The reason for the crash, Estes believes, is that killer whales, never before known to eat sea otters, appear to be snacking on the creatures, apparently because their usual food source—seals and sea lions—is declining. "This reflects real desperation for the orca. They're eating popcorn instead of steaks," says ecologist Paul Dayton of the Scripps Institution of Oceanography in La Jolla, California.



Orca fodder. Alaskan sea otters may be victims of shifts in the whales' food chain.

CREDIT: T. M. WILLIAMS/UCSC

Experts call the study a vivid example of an ecological cascade operating on a vast scale. "It's a heroic effort, and it's a terrific find," says Paine. The research has policy implications, too: Estes asserts that the chain of events leading to the otter's decline may have been triggered by a boom in commercial fishing in the Bering Sea. "It raises the possibility that overfishing can have a wide array of effects on species that we wouldn't expect to be impacted," he says.

Once hunted to the brink of extinction by fur traders, Alaska's sea otters resurged in the 20th century. But near some Aleutian islands, the otters were slow to rebound. In the 1970s, Estes and others found that off these islands, sea urchins had mowed down Pacific kelp beds, depriving fish of vital habitat and leaving the sea floor barren. Around islands with healthy otter populations, however, the kelp and its associated species flourished.

Despite the patchiness of their recovery, otter populations seemed healthy overall through the 1980s. Beginning around 1990, however, Estes's group and others noticed that the animals were becoming scarcer. Along a necklace of the Aleutians spanning 800 kilometers, Estes's group estimates that otter numbers have plummeted from about 53,000 in the 1970s to 6000 last year. The ecological consequences have been severe, the team reports: On Adak Island, for example, where otters now number about 300, sea urchin are booming and kelp density is down 12-fold.

A clue to this puzzling decline appeared in 1991, when researchers witnessed for the first time a killer whale eating an otter. The whales had been thought to shun otters because the animals provide few calories compared to larger, fat-laden harbor seals and Stellar sea lions. Since that initial shocker, ecologists have documented 12 cases of orcas eating otters, often swallowing them whole or first crashing down on the otters, perhaps to stun them.

Estes says he "was really skeptical" at first that the orca attacks could explain the otter declines. But if otters were dying of disease or starvation, their carcasses should be washing up on beaches—and they are not. A series of observations persuaded his group that orcas are the likely culprit. Estes and his colleagues figured that, given the thousands of days they have logged watching otters and the six attacks they've seen, the probability that attacks had occurred, unwitnessed, before 1991 was near zero. They also tagged with radio transmitters 17 otters in a lagoon that orcas can't reach and 37 otters in an open bay; over 2 years, deaths were much higher in the bay. "That provided a very startling contrast," Estes says. Finally, the team calculated that the number of observed killer whale attacks on otters, extrapolated to the general population, could account entirely for the observed declines. Remarkably, as few as four whales could be decimating otters along 3300 kilometers of shoreline between the Kiska and Seaguam islands. Says ecologist Mary Power of the University of California, Berkeley, "It's just mind-blowing that as few as four whales could cause an ecosystem effect over such a huge part of the Earth."

The researchers don't know exactly what is prompting the whales to eat otters, but they suspect it's related to a plunge in sea lion and seal populations in the western North Pacific since the 1970s. The reason for those declines is itself controversial, although one possibility is that intensified trawler fishing in the Bering Sea has sharply curtailed or altered the food supply for sea lions and seals. But as a National Research Council report noted in 1996, changes in fish populations could also be related to warmer ocean temperatures stemming from a shift in deep currents since the mid-1970s, as well as the local extinction of baleen whales, which has allowed one fish—pollock, which are low in fat—to flourish. Andrew Trites of the Uni-