

THE NATIONAL ACADEMIES **INFOCUS**

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Researching the Power That Fuels the Stars
Better Protection Against Earthquakes and Fire
Investigating Asian Oysters in the Chesapeake
Ensuring Vaccines for Everyone

Fall 2003

THE NATIONAL ACADEMIES

Advisers to the Nation on Science, Engineering, and Medicine

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'Science Education' Needs to Be Redefined at All Levels, and the Effort Will Depend on College Science Faculty



During my first two years as president of the National Academy of Sciences, half of my time was devoted to guiding the preparation of the first-ever National Science Education Standards for the United States. These standards, requested by the nation's 50 governors and published in early 1996, call for a revolutionary change in how we teach science in kindergarten through high school. New emphasis should be placed on teaching science as inquiry, so that all Americans can acquire some of the evidence-based problem-solving skills of scientists.

In the years that followed, however, it became obvious to me that any major change at the precollege level can only be sustained if we also redefine how science is taught in the first few years of college. In 1999 the National Academies published *Transforming Undergraduate Education in Science, Mathematics, Engineering, and Technology*, a report aimed at improving the introductory courses offered to all students — both the majors in these subjects and non-majors. Then, last fall we released an important study of undergraduate college biology education titled *Bio 2010: Transforming Undergraduate Education for Future Research Biologists*. As these two reports make clear, our experts have repeatedly concluded that the current way of teaching science at most colleges and universities fails to prepare future scientists adequately, and it also leaves our other college graduates ill-prepared to make countless day-to-day decisions.

But reports such as these are not enough to change the nature of college science teaching. Many faculty are quite set in their ways, and they are comfortable teaching large lecture courses exactly as they were taught. Might direct person-to-person contact between educational innovators and their faculty peers responsible for the introductory biology courses at major research universities be a more effective way to kick-start change? As an experiment, the National Academies held a special institute for college science faculty this past summer at the University of Wisconsin. An article in this issue describes the enthusiastic response to this pilot institute. For the summer of 2004, the National Academies hope to expand this effort with institutes to address multiple teams of faculty in biology. We may also explore the possibility of similar institutes in other disciplines, including chemistry.

A handwritten signature in black ink that reads "Bruce Alberts". The signature is written in a cursive, flowing style.

BRUCE ALBERTS
President, National Academy of Sciences



HEAD OF THE CLASS

New Project Schools University Faculty in Effective Teaching

Early in his career, professor Daniel J. Kliensky was pretty satisfied with how he ran his introductory biology class for undergraduates. He was passionate about the subject as well as about teaching. But his enthusiasm didn't rub off on many students. They'd freeze up when he asked them to explain concepts. Colleagues who got his students in subsequent courses would question whether Kliensky had taught them anything at all. He soon realized that heavy doses of traditional lecturing made students too passive. He wanted active learners who soaked up real knowledge.

Kliensky ultimately crafted a plan that moved students from the sidelines into the game. He focused the course on material that he considered crucial, and based grades entirely on quizzes that would be given at the beginning of each class to spur students

to stay on top of assignments. He organized everyone into groups that drew on each member's knowledge and understanding to tackle challenging science problems. Over the past seven years, the plan has paid off. Students are more motivated to keep up with coursework. He devotes more class time to demonstrating scientific techniques in depth. Class participation has increased. And quiz results offer daily feedback on both his performance and his students' improvement.

This year the University of Michigan cell biologist received a National Science Foundation Director's Award for Distinguished Teaching Scholars — a grant of \$300,000 over four years — which he will use to reshape the university's introductory biology curriculum to an active-learning format. "It's great to be recognized for excellent teaching," he said.

Klionsky was one of about 30 biology professors, primarily from large, research-centered universities, who attended the National Research Council's pilot summer institute held on the University of Wisconsin's Madison campus to exchange ideas about effective undergraduate biology instruction and discuss how teaching could inform their research activities. They also brainstormed about ideas for next year's institute, which will officially debut an ongoing series of these meetings.

The project stems from the Research Council's 2002 report *Bio2010: Transforming Undergraduate Education for Future Research Biologists*. Undergraduate biology education has not kept pace with revolutionary changes in the field, including new laboratory techniques and greater computer power, the report says. The U.S. biotechnology industry in particular has seen a shrinking pool of homegrown graduates who are adequately prepared to join its work force. And on the whole, society will suffer if citizens know too little about science to make informed decisions in their everyday lives, said William B. Wood, co-chair of the organizing committee that planned the pilot institute and an eminent geneticist at the University of Colorado.

At the three-day gathering in August, scholars explored innovative teaching methods and lessons that encourage students to learn — as scientists do — through active problem solving and discussion. They also looked at the role of technology, and ways to pierce an academic culture that typically subordinates teaching to research. And they experienced the creative spark that appears when people from different disciplines and backgrounds collaborate.



Their enthusiasm was unmistakable. While fleshing out his team's project about how crickets communicate, one participant practically jumped out of his seat. "I feel like I want to do this as soon as I get back!" Such passion for teaching is what the institute hopes to nurture in scholars who are basic researchers at heart, and then spread among a community of like-minded colleagues.

Scientific evidence on how people learn supports the effectiveness of inquiry-based, hands-on learning strategies. Still, many participants expressed a need for more comprehensive studies to assess the impact of these methods.

Robin Wright, an associate dean and professor at the University of Minnesota, emphasized that high-quality instruction and solid research are not mutually exclusive. And teaching, she said, "is about sharing ourselves with our students."

Chris Day, an assistant professor of botany at the Madison campus, agreed. Plus, he said that he and other young professors could start with baby steps when trying out novel approaches in the classroom. "It could be a lot of fun — not just for me, but for the students. Why not give it a try?" — *Vanee Vines*

(For additional information on the institute series, contact Kerry Brenner, Board on Life Sciences, tel. 202-334-1245 or e-mail <kbrenner@nas.edu>.)



Structuring NIH Today for the Research of Tomorrow

Over the years, the National Institutes of Health has grown alongside the nation's investment in biomedical research. As it expanded, NIH adapted its research portfolio to advances in science and emerging health concerns, responding in a dynamic fashion to new challenges like mapping the human genome. But with the pace of scientific discovery quickening and its reliance on interdisciplinary collaboration increasing, concerns have been raised that NIH's decentralized structure may no longer be able to adapt adequately.

NIH's current configuration of 27 different institutes and centers makes it very difficult for the agency to marshal resources to confront strategic, crosscutting issues, says a new report from the National Research Council and Institute of Medicine. Dramatic changes in the number of institutes and centers are not the remedy, however. "A wholesale consolidation could undermine the social and political coalitions that have been central to NIH's success," said Harold T. Shapiro, chair of the committee that wrote the report, and former president and current professor of

economics and public affairs at Princeton University. “But given the changing nature of the scientific enterprise, NIH needs to make major organizational changes that give it the ability to respond *as a whole*.”

In particular, the report says NIH needs a new mechanism for mobilizing resources to address immediate strategic objectives that are of interest to multiple institutes but cannot be pursued efficiently by any one. Each institute and center should commit 5 percent, and eventually as much as 10 percent, of its budget to its participation in “trans-NIH” research that results from strategic planning. The committee cited fields such as obesity and proteomics — the study of how proteins change, perhaps triggering a disease, when genes are turned on and off — as good examples of research that could fall under the new trans-NIH initiative.

The committee also suggested that the NIH research portfolio has become too risk averse. Noting that highly innovative, “risky” research is not being adequately funded through the traditional peer-review grant process, the committee called for such research to be supported via a new special projects program — modeled after the Pentagon’s Defense Advanced Research Projects Agency. The program should receive a separate budget of \$100 million the first year, rising to \$1 billion within five.

The trans-NIH research and special projects proposals are among many recommendations aimed at increasing the authority and flexibility of the NIH director. “We think that giving the director greater influence in the development of strategic initiatives will prove more practical than simply combining institutes,” Shapiro noted.

Although the report does not call for a major restructuring, it does say that a formal public process should be established to review whether institutes should be added, dropped, or combined with others, and the committee recommended a couple of mergers with which to begin: uniting the drug- and alcohol-abuse institutes, and folding the human genome institute into the general medical sciences institute. Clinical research programs also should be consolidated in an effort to improve collaboration and data sharing, and the special status granted to the National Cancer Institute, which largely runs outside the control of the NIH director, should be re-examined.

The report also suggested a number of changes related to personnel, including up to two six-year terms for the presidentially appointed director and two five-year terms for heads of the institutes and centers. In addition, any effort to consolidate or outsource administrative functions as part of the “One HHS” initiative should be carefully reviewed before being applied to positions inextricably tied to NIH’s scientific mission, such as grants-management personnel. — *Bill Kearney*

■ ***Enhancing the Vitality of the National Institutes of Health: Organizational Change to Meet New Challenges.***

Committee on the Organizational Structure of the National Institutes of Health, Board on Life Sciences, Division on Earth and Life Studies; and Board on Health Sciences Policy, Institute of Medicine (2003, approx. 137 pp.; ISBN 0-309-08967-0; available from the National Academies Press, tel. 1-800-624-6242; \$31.00 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10779.html>).

Harold T. Shapiro, president emeritus and professor of economics and public affairs, Princeton University, Princeton, N.J., chaired the committee. The study was mandated by Congress and funded by the National Institutes of Health.



Despite considerable progress made over the past 40 years in reducing the damage that fires and earthquakes cause, the human and financial losses are still unacceptably high. The costs from fire-related property losses and implementation of fire safety measures total between \$100 billion to \$200 billion per year. The Federal Emergency Management Agency has estimated that expected annual financial losses from earthquakes are on the order of \$4.4 billion, while a single, large metropolitan earthquake could cause \$100 billion to \$200 billion in damage.

These dramatic figures are highlighted in two new reports from the National Research Council that call for increased efforts to reduce such losses. New engineering tools and simulations should be developed, the reports say, because fire

safety practices need to be more scientifically based and much remains to be learned about minimizing earthquakes' destructive effects.

“There are still significant gaps in our knowledge of fire safety science and fire loss mitigation strategies,” said David Lucht, director of the Center for Firesafety Studies at the Worcester Polytechnic Institute in Worcester, Mass. “We need to more aggressively pursue an integrated approach to improve building performance and reduce the human suffering and economic losses due to fire.”

Likewise, progress in understanding the detailed mechanisms by which earthquakes cause damage is still relatively slow. “Earthquakes will continue to occur, but the disasters that they cause will be a thing of the past if we can minimize damage to

the built environment,” said W.F. Marcuson III, director emeritus of the Geotechnical Laboratory at the U.S. Army Corps of Engineers’ Waterways Experiment Station in Vicksburg, Miss.

To improve fire mitigation, one of the reports recommends that the National Science Foundation provide funding and leadership for a national multidisciplinary program to enhance design and construction of buildings and develop better strategies to protect the people and equipment housed in them. The program would help not only to advance the state of knowledge in this field but also to strengthen university-based fire research, which has “all but evaporated in the United States over the past three decades,” the report says.

The second report reviews a major NSF initiative called the Network for Earthquake Engineering Simulation (NEES), which will allow researchers and earthquake engineers around the world to interact and learn from each other, and increase the talent pool and knowledge base about earthquakes. A longtime major supporter of earthquake engineering research, NSF has awarded \$80 million in grants to establish NEES. The experimental sites funded through this program will allow simulation of complex problems in seismology that formerly had to await an actual earthquake in order to be studied and involved random, uncontrolled conditions.

Important outcomes of the NEES program would be the development of performance-based codes to make buildings safer with innovative and inexpensive materials and practical guidelines for building occupants to follow during an earthquake. For example, a code for seismic design

would require that buildings perform a certain way for a given intensity of ground movement and not exceed a specified level of damage.

To be successful, these programs will require effective partnerships between physical scientists, engineers, and social and policy scientists and should include education and outreach activities to the greatest extent possible, the two reports say. For instance, visualization tools should be used to communicate findings to stakeholders, such as government officials, students, teachers, and the public at large.

“Better coordination of research efforts and increased outreach under these multidisciplinary initiatives could create significant opportunities to leverage research dollars and improve emergency planning and response, and post-event assessment and recovery,” Lucht said. — *Patrice Pages*

■ ***Making the Nation Safe From Fire: A Path Forward in Research.*** Committee to Identify Innovative Research Needs to Foster Improved Fire Safety in the United States, Board on Infrastructure and the Constructed Environment, Division on Engineering and Physical Sciences (ISBN 0-309-08970-0; \$18.00 plus \$4.50 shipping for single copies). The committee was chaired by **David Lucht**, professor and director, Center for Firesafety Studies, Worcester Polytechnic Institute, Worcester, Mass. The study was funded by the National Science Foundation.

■ ***Preventing Earthquake Disasters: The Grand Challenge in Earthquake Engineering.*** Committee to Develop a Long-Term Research Agenda for the Network for Earthquake Engineering Simulation, Board on Infrastructure and the Constructed Environment, Division on Engineering and Physical Sciences (ISBN 0-309-09064-4; \$32.00 plus \$4.50 shipping for single copies). **W.F. Marcuson III**, director emeritus, Geotechnical Laboratory, U.S. Army Corps of Engineers’ Waterways Experiment Station, Vicksburg, Miss., chaired the committee. The study was funded by the National Science Foundation.

Both reports are available from the National Academies Press, tel. 1-800-624-6242; also on the Internet at <books.nap.edu>.

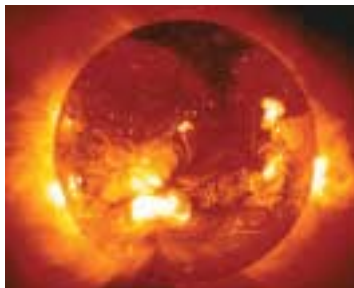
Burning Plasma

BRINGING THE POWER OF THE SUN TO EARTH

Scientists have been trying for six decades to produce energy the same way the sun does: by converting hydrogen into helium in a process called nuclear fusion. Unlike nuclear fission, in which nuclei of atoms are split to create power or a massive explosion, fusion — as the name implies — fuses, or brings together, atomic nuclei. Fusion could provide an inexhaustible supply of energy, lessening our dependence on fossil fuels. And while it leaves behind some low-level radioactive waste, fusion eliminates the risk of a catastrophic accident that is possible in a traditional nuclear reactor.

For fusion to occur, atomic nuclei need to be heated to an extremely high temperature — on the sun, it is 10 million to 15 million degrees Celsius. To reach such incredible temperatures here on Earth, scientists have devised experiments using lasers or powerful magnets to create a state of matter that is neither a solid, liquid, nor gas, but a very hot plasma — a mixture of fast-moving nuclei and electrons.

But to produce sustainable fusion, scientists need to create a “burning” plasma, where fusion itself provides much of the heat required. The most promising experiment of this type is an international effort called the International Thermonuclear Experimental Reactor (ITER). Fusion researchers sponsored by the U.S. Department of Energy are scientifically and technically ready to — and should — undertake a burning plasma experiment, preferably by participating in ITER, says a new report from the National Research Council.



ITER began as a joint U.S.-Soviet program in 1988, but the United States withdrew 10 years later amid cost concerns. Now scientists from Russia, Canada, Japan, and the European Union are preparing to build this facility,

which is “the most mature design and both sound and carefully planned,” the report says. It calls ITER “the best opportunity for the United States to engage in a burning plasma experiment.”

In the past year, the Bush administration has announced its willingness to rejoin ITER, and negotiations of the U.S. role in the construction of the \$5 billion project are under way. Regardless of whether those negotiations succeed, the U.S. fusion program should be strengthened and diversified, the report says.

DOE officials should map out a multi-year strategic plan that includes a balanced portfolio of theoretical and experimental research that could be conducted in parallel with ITER, the report adds. If the negotiations to participate in this project fail, the United States should pursue a burning plasma experiment with other international partners. — *Patrice Puges & Bill Kearney*

■ **Burning Plasma: Bringing a Star to Earth.** Burning Plasma Assessment Committee, Board on Physics and Astronomy, Division on Engineering and Physical Sciences (2003, approx. 185 pp.; ISBN 0-309-09082-2; available from the National Academies Press, tel. 1-800-624-6242; \$39.00 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10816.html>).

The committee was co-chaired by **John F. Ahearne**, director of the Ethics Program at the Sigma Xi Center in Research Triangle Park, N.C., and **Raymond J. Fonck**, nuclear engineering and engineering physics professor at the University of Wisconsin, Madison. The study was funded by the U.S. Department of Energy.



More young people drink alcohol than smoke or use other drugs — a problem that costs the nation an estimated \$53 billion annually in losses stemming from traffic fatalities, violent crime, and other behaviors that threaten the well-being and long-term development of America's youth.

Underage Drinking

A National Wake-Up Call Needed

Most adults voice concern about underage drinking, but the trouble is, too many of them are — as teens might say — “clueless.” Surveys show that kids often get alcohol from grown-ups. Parents underestimate the extent of the problem and their own children's drinking habits in particular.

Alcohol is a deeply engrained part of American culture, although people have vastly different beliefs about its consumption. But alcohol use by young people is clearly dangerous. A nationwide strategy is

needed to prevent and reduce underage drinking, with parents and other adults as central players in the effort, says a new report from the National Research Council and the Institute of Medicine.

The report offers a comprehensive approach that requires a shared commitment to tackle the issue — not only from adults, but also from many public and private institutions, alcohol manufacturers, retail businesses, and the entertainment industry. Parents, for example, should more closely monitor their children's behavior. And the

alcohol and entertainment industries need to do more to shield young people from unsuitable messages about drinking.

The strategy's proposals include calls for states and localities to use a variety of measures to boost compliance with laws that prohibit selling or providing alcohol to people under the legal drinking age of 21. For instance, officials ought to increase the frequency of compliance checks, in which authorities monitor whether businesses are obeying minimum-drinking-age laws, and levy fines when necessary. States that allow Internet sales and home delivery of alcohol should adopt regulations that require customers to sign statements verifying their identity and age at the time of delivery. Local police, together with community leaders, must work on ways to detect and shut down underage drinking parties.

The federal government has an important role to play, too. It needs to better organize and beef up research in this area. The U.S. Department of Health and Human Services also should routinely monitor advertising practices in the alcohol industry, the report says. Likewise, the department ought to regularly review a representative sample of movies, TV programs, music recordings, and videos offered to audiences where at least 15 percent of the viewers or listeners are under 21, and report its findings to Congress and the public.

In addition, the federal government needs to fund and actively support the creation of a national media campaign to encourage parents and other adults to

take steps in their own homes and neighborhoods to discourage underage drinking. State and community leaders must develop efforts to prevent and reduce underage drinking that are tailored to the specific circumstances in their localities, the report says.

To pay for the proposed activities and to help reduce underage consumption, Congress and state legislatures should raise excise tax rates on alcohol — particularly



on beer, which studies show is the alcoholic beverage that most young people prefer. Alcohol is much cheaper today, after adjusting for inflation, than it was 30 to 40 years ago. Higher tax rates should be tied to the Consumer Price Index to keep pace with inflation.

Increasing the cost of alcohol has well-documented deterrent effects on underage drinkers, the report points out.

All intervention and education programs, and the proposed strategy itself, should be rigorously evaluated and fine-tuned over time, said the committee that wrote the report. — *Vanee Vines*

■ **Reducing Underage Drinking: A Collective Responsibility.** Committee on Developing a Strategy to Reduce and Prevent Underage Drinking, Board on Children, Youth, and Families, National Research Council and Institute of Medicine (2003, approx. 295 pp.; ISBN 0-309-08935-2, available from the National Academies Press, tel. 1-800-624-6242; \$42.95 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10729.html>).

The committee was chaired by **Richard J. Bonnie**, John S. Battle Professor of Law and director of the Institute of Law, Psychiatry, and Public Policy, University of Virginia, Charlottesville. The study was sponsored by the U.S. Department of Health and Human Services.

A Booster Shot for Vaccine Production and Access

Vaccines once represented a good business opportunity for drug makers. But where 25 companies used to churn out vaccines for the American market, today only five remain. If any one of them cannot produce its usual quantities, the nation faces the prospect of vaccine shortages, such as those that occurred in 2001 and 2002.



vaccine products and also induce firms to focus on vaccines that would have the broadest benefits.

The value of the subsidy for each existing and new vaccine would be based on the product's societal benefits, such as its ability to enhance quality of life, increase life spans, reduce future medical costs, and increase individuals' pro-

ductivity by keeping them healthy. Even when supplies are plentiful, fully one-fourth of preschool children do not get all of their recommended shots. Many factors, including lack of health insurance and decisions by insurance providers not to cover immunizations, keep both children and adults from getting all of the vaccinations they need to fend off potentially fatal but very preventable diseases.

The nation needs a new approach to financing and distributing vaccines, one that shifts the federal government's role from simply purchasing large quantities of vaccines to ensuring that everyone gets fully immunized, says a new report from the Institute of Medicine. The report proposes a three-part plan that includes a federal mandate to insurers to cover required immunizations, a subsidy to fund this mandate, and a voucher program to enable those without insurance to receive vaccines, too.

Currently, for children alone, the U.S. government purchases up to 55 percent of vaccines in that market, using its buying clout to negotiate large discounts that save money, but these savings also dampen manufacturers' enthusiasm to pursue vaccine production. The subsidy would create incentives for companies to develop new

others besides the recipient from disease will also be an important factor. Vaccine makers could charge more than the subsidy value, or make vaccines that do not meet the requirements for subsidizing — such as products that protect only the recipient — if they see a good market opportunity, but insurance plans should not be mandated to cover these products, the report says.

If the federal government implements this plan, it will probably spend more on vaccines. However, these increases would be offset at least in part by savings generated through greater disease prevention and a healthier, more productive work force as well as benefits associated with future innovations in vaccine development. — *Christine Stencel*

■ **Financing Vaccines in the 21st Century: Assuring Access and Availability.** Committee on Evaluation of Vaccine Purchase Financing in the United States, Board on Health Care Services, Institute of Medicine (2003, approx. 200 pp.; ISBN 0-309-08979-4; available from the National Academies Press, tel. 1-800-624-6242; \$32.00 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10782.html>).

The committee was chaired by **Frank Sloan, J.** Alexander McMahon Professor of Health Policy and Management, and professor of economics, Duke University, Durham, N.C. The study was funded by the Centers for Disease Control and Prevention.



From the **FAR EAST** to the **EASTERN SHORE**

Will Asian Oysters Help or Harm Chesapeake Bay?

Oysters were once so abundant in Chesapeake Bay that ships found it hard to navigate around the huge oyster reefs that filled the waters. For hundreds of years, Chesapeake residents — both human and animal — benefited from this bounty. The oysters' plentiful numbers and natural filtering ability helped keep the waters clear, and thousands of watermen made a living fishing for oysters. The Chesapeake oyster industry provided jobs to many in bay communities, shipping catches to markets and restaurants around the country. As recently as 1980, in fact, the Chesapeake yielded about half of the U.S. oyster harvest.

But today the oysters you encounter at a raw bar or at the supermarket are far more likely to come from the Gulf of Mexico or

the Pacific Northwest than the Chesapeake. Decimated by parasitic diseases, overfishing, and a decline in water quality, Chesapeake oysters now make up no more than 5 percent of the U.S. harvest.

As the oysters have dwindled, so have the fortunes of the watermen and communities who depend on them. States, private organizations, and the EPA have recently launched efforts aimed at restoring the population of native oysters. But the urgency of the watermen's economic plight has prompted industry groups to push for a more radical approach — introducing the Asian Suminoe oyster into the Chesapeake.

Supporters of the plan hope that the Asian newcomers, which are resistant to the diseases killing the native oyster, will thrive in the bay and revive the industry.

But the danger — always present when a new species is introduced into an ecosystem — is that the oysters could instead become a pest, clinging to boats and docks and possibly displacing native species. And the consequences could ripple beyond the bay; Asian oysters could be transported throughout the Atlantic coast and Gulf of Mexico, threatening productive oyster fisheries in other regions.



Several state and federal agencies asked the National Research Council to assess the risks and benefits of introducing the Asian oysters either by raising sterile oysters in a controlled setting — a method currently being pursued in Virginia — or as a reproductive population in the wild, the alternative favored by Maryland.

Introducing breeding oysters into the bay would be unwise now, the Research Council's report concludes, given that little is known about the potential consequences and that this step would be irreversible. But doing nothing has its dangers too, said the committee that wrote the report. Desperation among watermen — which may increase if the government fails to act — could provoke an unauthorized or “rogue” introduction of oysters, which poses the greatest threat to the bay's ecosystem. If proper protocols aren't followed, diseases and undesirable marine creatures would likely hitchhike into the bay along with the oysters.

As for large-scale aquaculture, the committee cautioned that the process used to generate sterile oysters is not failsafe. One in every 1,000 oysters produced is likely to

be a normal reproductive oyster, and even some of the sterile oysters may become capable of breeding, if allowed to grow for many years.

Still, raising the oysters in this type of controlled setting is the best option of the alternatives under consideration, the committee concluded.

Following strict standards for confining and monitoring the oysters would minimize the odds that breeding oysters would be released into the bay. And not only would oyster “farming” create employment opportunities in the bay area, it may also give the native oyster time to recover.

Most important, this option will give scientists a chance to study how the Asian oysters behave in bay waters. With several years of research, scientists will be better able to predict whether, if released to breed in the wild, the Asian oyster would be the Chesapeake's friend or foe. — *Sara Frueh*

■ **Non-Native Oysters in the Chesapeake Bay.**

Committee on Non-Native Oysters in the Chesapeake Bay, Ocean Studies Board, Division on Earth and Life Studies (2003, approx. 250 pp.; ISBN 0-309-09052-0; available from the National Academies Press, tel. 1-800-624-6242; \$36.00 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10796.html>).

The committee was co-chaired by **James Anderson**, professor, department of environmental and natural resource economics, University of Rhode Island, Kingston; and **Dennis Hedgecock**, professor, Bodega Marine Laboratory, University of California, Davis. The project was sponsored by the U.S. Environmental Protection Agency, National Oceanic and Atmospheric Administration, U.S. Fish and Wildlife Service, Maryland Department of Natural Resources, Virginia Department of Environmental Quality, Maryland Sea Grant, Virginia Sea Grant, Connecticut Sea Grant, and the National Fish and Wildlife Foundation; a contribution was made by the Scientific and Technical Advisory Committee of the Chesapeake Bay Program.



Cut the **Fat** to Lose the Dioxins

We all know that cutting back on saturated fat could help prevent heart disease, obesity, and other chronic health problems, but who would think that an environmental pollutant is another good reason for Americans to trim the fat?

Produced by waste incineration, forest fires, and various industrial processes, dioxins and dioxin-like compounds are ubiquitous pollutants in the soil, water, and air. Animals take in dioxins during feeding, accumulating the toxic compounds in their fatty tissues where they persist for years. Consumption of these fats, in turn, is the principal route of exposure in humans.

Studies of accidental or industrial exposures to high levels of dioxins indicate that they can cause cancer and affect reproduction, development, and immunity. However, because information on the health effects of smaller amounts is so limited and tests to quantify dioxins in samples are so expensive — costing as much as \$1,000 per sample — the scientific jury is still out on the extent to which low levels of dioxins trigger health problems and how small an amount still presents a risk. Moreover, changes in industrial processes have dramatically reduced overall dioxin levels in the environment, by as much as 76 percent over the past three decades.

Given the gaps in knowledge, the government should encourage people to minimize their consumption of animal fat to reduce their dioxin exposure while more

information is gathered, says a new report from the Institute of Medicine.

“Because we don’t know for certain what health effects may be associated with the levels of dioxins present in foods, we outlined simple, prudent steps that the government could take now to help Americans decrease their exposure without necessitating any radical lifestyle changes or new regulations,” explained Robert Lawrence, associate dean of the Bloomberg School of Public Health, Johns Hopkins University, Baltimore, and chair of the committee that wrote the report. “We’re essentially saying, follow the U.S. Dietary Guidelines.”

Specifically, the federal agencies responsible for food safety should encourage Americans, particularly girls and women of childbearing age, to keep their consumption of saturated fat to no more than 10 percent of their daily calories, as recommended by the guidelines. The agencies should educate people about the importance of choosing lower-fat milk and other dairy products, selecting lean cuts of meat, and trimming fat from meats, among other strategies. In addition, making lower-fat milk more widely available in the National School Lunch Program and urging participants in various public food programs to choose low-fat products can also foster less animal-fat consumption.

The report’s emphasis on young girls and women stems from the particular vulnerability of developing fetuses and breast-feeding infants to the effects of toxic compounds. Because dioxins are passed on through the placenta and the fat in breast milk, fetuses’ and nursing infants’ exposure to dioxin is a direct result of how much of the compounds have accumulated in their

mothers’ bodies over the years. The only practical way to reduce their exposure is to minimize their mothers’ intake of dioxins well before pregnancy. Given the health and social benefits of breast-feeding, the committee opposed any strategies that would discourage its practice.

Fatty fish present unique challenges because it is difficult to trim away the fat. Moreover, omega-3 fatty acids in fish are beneficial for health. Therefore, the report seconded the U.S. Dietary Guidelines’ recommendation that people eat two fish meals a week.

While regulatory limits on dioxins in foods should not be set until more complete data are available, the government and food producers should collaborate on voluntary actions to stem accumulation of the compounds in food animals. One route of animal exposure is the recycling of rendered animal fats and contaminated grasses into feeds. The government should make it a priority to work with food producers on ways to curtail this recycling and to develop voluntary guidelines for practices that would minimize animals’ exposure.

— *Christine Stencel*

■ **Dioxins and Dioxin-like Compounds in the Food Supply: Strategies to Decrease Exposure.** Committee on the Implications of Dioxins in the Food Supply, Food and Nutrition Board, Institute of Medicine (2003, approx. 295 pp.; ISBN 0-309-08961-1; available from the National Academies Press, tel. 1-800-624-6242; \$42.00 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10763.html>).

The committee was chaired by **Robert S. Lawrence**, associate dean for professional practice and programs, Bloomberg School of Public Health, Johns Hopkins University, Baltimore. The study was funded by the U.S. Department of Agriculture and Food and Drug Administration.

Internships at Academies Give a Unique Window on Science Careers

A feature about astronomy on the television show “Bill Nye the Science Guy” was the bait that hooked her on science. The bright images and talk of faraway galaxies seized her young imagination, recalled Rahel Menghestab.

Now a freshman at Tufts University in Medford, Mass., she’s weighing all of her options before picking a major, but she



knows that it will be something in a scientific or technical field. As an intern at the National Academies this past summer, her experiences only strengthened her resolve to follow such a career path, she said. The internship centered on exploring ways to enhance workplace safety for employees in chemical industries and the uses of nanotechnology.

“It’s given me real-life work experience, and I learned a lot about responsibility, time management, and research,” said Menghestab, a graduate of Benjamin Banneker Academic High School in

Washington, D.C. She was one of seven Anderson Interns this year, the second wave of student participants in an Academies project with Banneker to expand opportunities for students attracted to scientific fields.

Each year, school faculty members nominate and select students for the internships. These paid summer positions are offered to four graduating seniors who want to pursue careers in science, engineering, or medicine. The interns begin working at the Academies after high school graduation and may be invited to return for up to three successive summers during their college studies.

Their work assignments range from reviewing scientific data to helping prepare major presentations or identify scholars to serve on Academies studies. The students also network with top researchers, said Warren R. Muir, executive director of the Research Council’s Division on Earth and Life Studies, which has promoted and nurtured the project from the outset.

The 2003 internships were funded with a grant from the Rose-Marie and Jack R. Anderson Foundation in Dallas. Jack Anderson, a pioneer in the management of health care companies, and his wife have long supported efforts to improve public education.

The division’s associate executive director William A. Anderson — no relation to the couple — coordinates the internship program. “This is a rich environment that



we're sharing with the students," he said. "On the other hand, they're leaving something here, too. We learn to understand their perspectives. We may discover better ways to disseminate information and explain who we are and what we do as a result of our interaction with them. As an institution, we gain as much as we give to these young people."

The internships are the cornerstone of the Academies' broader partnership with Banneker, a predominantly black, inner-city school known for academic excellence. The Academies have donated books to the school, provided guest speakers for classes, and sponsored its robotics team in a multi-national competition. This fall, several employees from the Information and Technology Services department will help the school organize its computer lab, plus teach students how to maintain the equipment. More outreach activities are in the works, including plans to offer some

Banneker students part-time jobs as docents at the Marian Koshland Science Museum, which the National Academy of Sciences will open early next year in Washington. (See article on page 20.)

The partnership fills a need, said Jack Anderson. "We're talking about young people who, in many cases, have disadvantages. Those are important children to invest in," he said in an interview. Mrs. Anderson said America could do more to recruit and train its next generation of scientists and engineers.

Christopher Rogers, 19, returned to the Academies this year for his second tour in the program. In 2002 he co-authored two papers — one on air emissions from livestock and poultry; the other, an update on activities of the Research Council's Committee on Animal Nutrition — which were later published in scientific journals. He also accompanied division staff to a symposium in Antwerp, Belgium, where he presented the update. This year, Rogers pitched in with research for a study on infectious diseases. A sophomore at Haverford College, he's on the pre-med track and aims to someday operate his own health care company. His mother, a former nurse who currently runs a nursing home, encouraged him to pursue his lifelong passion for medicine, he said.

The internships have been valuable, Rogers explained, because "I've always been most interested in the connection between policy and health care."

Patricia Tucker, Banneker's principal, described the program as a boon for teens. "These kinds of opportunities were not available for me when I was growing up."
— *Vanee Vines*

Koshland Science Museum to Open in Spring 2004

The National Academy of Sciences is developing a new, dynamic venue to present some of the most important scientific issues facing the nation. Opening in April 2004, the Marian Koshland Science Museum is the National Academies' latest effort to extend their reach to the public and engage a wider group of our citizens in science, medicine, and engineering.

The 6,000-square-foot space located in the Academies' Keck Center in downtown Washington will house three major exhibits. Each exhibit includes a series of interactive displays that allows visitors to piece together the scientific evidence behind an interesting, sometimes controversial issue of the day. The first exhibit topics will be on global climate change, DNA and gene sequencing, and scientific discovery.

Aimed at people ages 13 and older, the museum is intended to offer a novel museum experience. Visitors will be captivated by sophisticated visualization technology, while learning how scientists gather and evaluate evidence about matters that affect us every day.

The exhibits will incorporate scientific findings from recent reports published by the National Academies. To ensure scientific and technical accuracy of the exhibits, the National Academies tapped 22 scientists to help develop the content.

"Because of the complex subject matter, we arranged for a group of outstanding scientists to be on hand every step of the way to make sure that the exhibits were both clear and accurate," said NAS President



Bruce Alberts. "The museum is an extension of the National Academies' public service. The reports we developed used to remain on paper; now some of the work we do will become visual and interactive."

Interactive exhibits explaining scientific discoveries in depth are rare and expensive to develop. The National Academies hope to fill the void by sending the exhibits to partner museums across the country, once they have been displayed in Washington.

Named after National Academy of Sciences member Marian Koshland (1921-1997), who made major contributions in the field of immunology and molecular biology throughout her career, this new museum has been made possible by a generous gift from her husband, Daniel Koshland, also an NAS member.

— *Maureen O'Leary*

Terrorism in Real Time

How quickly would first responders in the nation's capital mobilize after a terrorist attack? How well would the news media perform in the crucial first minutes? And how successfully could government agencies and the media work together to get the word out and protect area residents closest to the terrorist incident?

Much has been written and theorized about how such communications ought to work, but in June the National Academies, in cooperation with the U.S. Department of Homeland Security and the Washington Board of Trade, discovered what might actually happen. Federal and local government officials, together with national and local media, became participants in a day-long simulation of a terrorist incident played out on the NAS auditorium stage.

The event was led by Mike McCurry, White House press secretary under President Clinton, and former CNN Washington Bureau Chief Frank Sesno. With the prodding from the moderator, presidential adviser and editor David Gergen, dozens of participants from institutions as diverse as the

FBI, the U.S. Department of Transportation, the D.C. Mayor's Office, WTOP Radio, WRC-TV, and CNN attempted to cope with a fast-moving sequence of events. Using simulated video and radio broadcasts, the players witnessed and reacted to an explosion above a Metro station in Northwest Washington at the height of morning rush hour.

The scenario was pressure-packed, complete with traffic jams and an evacuation of the rail line, as well as many unknowns. Participants from government wanted to delay saying anything to the public until they were certain what had really happened. That frustrated TV and radio reporters, who were on the air and at the scene. WTOP's traffic reporter, Bob Marbourg, was ready to give motorists routes of evacuation from the scene. Bob Ryan, WRC-TV's chief meteorologist, described the tools he would use to predict how a potentially toxic cloud might blow across the city. The national media, especially 24/7 cable news, were calling the same inundated local officials who were still trying to learn the facts.

In post-mortem sessions, scientists and emergency workers familiar with the actual risks in the day's scenario began laying out practical "rules of the road" for journalists covering this and other terrorist incidents, especially those in which the media itself could be at risk. This fall, the National Academies, working with the Radio-Television News Directors Association, plan to stage additional simulations for journalists as well as begin providing newsrooms with reliable information on how to prepare for terrorist incidents. — *William Skane*



Projects

The following projects have been recently undertaken by units of the National Academies. The latest information about all current committee activities — including project descriptions, committee rosters, and meeting information — is available in “Current Projects” on the National Academies’ Web site.

Assessing the Feasibility, Accuracy, and Technical Capability of a National Ballistics Database.

Committee on Law and Justice and Committee on National Statistics, Division of Behavioral and Social Sciences and Education; and National Materials Advisory Board, Division on Engineering and Physical Sciences. Project director: Carol Petrie. Chair: to be selected. Sponsor: National Institute of Justice.

Assessment of Security Technologies for Transportation.

National Materials Advisory Board, Division on Engineering and Physical Sciences; and Transportation Research Board. Project director: James Killian. Chair: Thomas S. Hartwick, manager, satellite payload program and system design activities, TRW (retired). Sponsor: Transportation Security Administration.

Building a 21st-Century Community Health Care System in Rural America.

Board on Health Care Services, Institute of Medicine. Project director: Gooloo Wunderlich. Chair: Mary Wakefield, director and professor, Center for Rural Health, School of Medicine and Health Sciences, University of North Dakota, Grand Forks. Sponsors: Health Resources and Services Administration, Agency

for Healthcare Research and Quality, Substance Abuse and Mental Health Services Administration, and the W.K. Kellogg Foundation.

Gender Differences in Careers of Science, Engineering, and Mathematics Faculty.

Committee on Women in Science and Engineering, Division on Policy and Global Affairs; and Committee on National Statistics, Division of Behavioral and Social Sciences and Education. Project director: Jong-on Hahm. Chair: to be selected. Sponsor: National Science Foundation.

Spinal Cord Injury: Strategies in a Search for a Cure.

Board on Neuroscience and Behavioral Health, Institute of Medicine. Project director: Janet Joy. Chair: Richard T. Johnson, Distinguished Service Professor of Neurology, Microbiology, and Neuroscience, Johns Hopkins University School of Medicine, Baltimore. Sponsor: State of New York Department of Health.

Toxicologic Assessment of Fluoride in Drinking Water.

Board on Environmental Studies and Toxicology, Division on Earth and Life Studies. Project director: Susan Martel. Chair: John Doull, professor emeritus of pharmacology and toxicology, University of Kansas Medical School, Kansas City. Sponsor: U.S. Environmental Protection Agency.

Wireless Technology Prospects and Policy Options.

Computer Science and Telecommunications Board, Division on Engineering and Physical Sciences. Project director: Jon Eisenberg. Chair: to be selected. Sponsor: National Science Foundation.

Publications

For documents shown as available from the National Academies Press (NAP), write to 500 Fifth St., N.W., Lockbox 285, Washington, D.C. 20055; tel. 202-334-3313 or 1-800-624-6242; or order on the Internet at <www.nap.edu>. Documents from a specific unit of the National Academies are available from the source as noted. Prices and availability of all documents are subject to change. Charges listed are for single copies; discounts are available for bulk orders.

Academic Health Centers: Leading Change in the 21st Century
Board on Health Care Services, Institute of Medicine (2003, 279 pp.; ISBN 0-309-08893-3; available from NAP, \$39.00 plus \$4.50 shipping).

Assessment of NASA’s Draft 2003 Earth Science Enterprise Strategy — Letter Report
Space Studies Board, Division on Engineering and Physical Sciences (2003, 22 pp.; available only online at <www.nap.edu>).

Assessment of Scientific Information for the Radiation Exposure Screening and Education Program — Interim Report
Board on Radiation Effects Research, Division on Earth and Life Studies (2003, 29 pp.; available only online at <www.nap.edu>).

The Carbon Dioxide Dilemma: Promising Technologies and Policies — Proceedings of a Symposium
National Academy of Engineering, and Board on Energy and Environmental Systems, Division on Engineering

and Physical Sciences (2003, 150 pp.; ISBN 0-309-08921-2; available from NAP, \$32.00 plus \$4.50 shipping).

Childhood Cancer Survivorship: Improving Care and Quality of Life

National Cancer Policy Board, Institute of Medicine and National Research Council (2003; 224 pp.; ISBN 0-309-08898-4; available from NAP, \$33.00 plus \$4.50 shipping).

Cybersecurity of Freight Information Systems: A Scoping Study — TRB Special Report 274

Computer Science and Telecommunications Board, Division on Engineering and Physical Sciences; and Transportation Research Board (2003, 80 pp.; ISBN 0-309-08555-1; available from TRB, tel. 202-334-3213; \$21.00).

Designing Nonmarket Accounts for the United States — Interim Report

Committee on National Statistics, Division of Behavioral and Social Sciences and Education (2003, 48 pp.; available only online at <www.nap.edu>).

Does Water Flow Influence Everglades Landscape Patterns?

Water Science and Technology Board and Board on Environmental Studies and Toxicology, Division on Earth and Life Studies (2003, 50 pp.; ISBN 0-309-08963-8; available from NAP, \$18.00 plus \$4.50 shipping).

Dynamic Social Network Modeling and Analysis — Workshop Summary and Papers

Committee on Human Factors, Board on Behavioral, Cognitive, and Sensory Sciences, Division of

Behavioral and Social Sciences and Education (2003, 392 pp.; ISBN 0-309-08952-2; available from NAP, \$54.00 plus \$4.50 shipping).

The Emergency Manager of the Future — Summary of a Workshop, June 13, 2003, Washington, D.C.

A Summary to the Disasters Roundtable, Division on Earth and Life Studies (2003, 31 pp.; available only online at <www.nap.edu>).

Enabling Ocean Research in the 21st Century: Implementation of a Network of Ocean Observatories

Ocean Studies Board, Division on Earth and Life Studies (2003, approx. 224 pp.; ISBN 0-309-08990-5; available from NAP, \$45.00 plus \$4.50 shipping).

The Environment: Challenges for the Chemical Sciences in the 21st Century

Board on Chemical Sciences and Technology, Division on Earth and Life Studies (2003, 190 pp.; ISBN 0-309-08719-8; available from NAP, \$40.00 plus \$4.50 shipping).

Estimating Climate Sensitivity — Report of a Workshop

Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies (2003, 62 pp.; ISBN 0-309-09056-3; available from NAP, \$18.00 plus \$4.50 shipping).

Estimating Eligibility and Participation for the WIC Program — Final Report

Committee on National Statistics, Division of Behavioral and Social Sciences and Education (2003, 218 pp.; ISBN 0-309-08962-X; available from NAP, \$45.00 plus \$4.50 shipping).

Exploring Challenges, Progress, and New Models for Engaging the Public in the Clinical Research Enterprise — Clinical Research Roundtable Workshop Summary
Clinical Research Roundtable, Board on Health Sciences Policy, Institute of Medicine (2003, 98 pp.; ISBN 0-309-08946-8; available from NAP, \$18.00 plus \$4.50 shipping).

The Future of Supercomputing — An Interim Report

Computer Science and Telecommunications Board, Division on Engineering and Physical Sciences (2003, 58 pp.; ISBN 0-309-08995-6; available from NAP, \$18.00 plus \$4.50 shipping).

Hidden Costs, Value Lost:

Uninsurance in America

Board on Health Care Services, Institute of Medicine (2003, 212 pp.; ISBN 0-309-08931-X; available from NAP, \$27.00 plus \$4.50 shipping).

Improving Palliative Care: We Can Take Better Care of People With Cancer

National Cancer Policy Board, Institute of Medicine and National Research Council (2003, 20 pp.; 0-309-08984-0; available from NAP, \$10.00 plus \$4.50 shipping; also available in Spanish).

Information Technology (IT)-Based Educational Materials — Workshop Report With Recommendations

National Academy of Engineering (2003, 66 pp.; ISBN 0-309-08974-3; available from NAP, \$18.00 plus \$4.50 shipping).

Innovation in Information Technology

Computer Science and Telecommunications Board, Division on Engineering and Physical Sciences (2003, 84 pp.; ISBN 0-309-08980-8; available from NAP, \$18.00 plus \$4.50 shipping).

International Perspectives: The Future of Nonhuman Primate Resources — Proceedings of the Workshop Held April 17-19, 2002
Institute for Laboratory Animal Research, Division on Earth and Life Studies (2003, 262 pp.; ISBN 0-309-08945-X; available from NAP, \$52.25 plus \$4.50 shipping).

Key Capabilities of an Electronic Health Record System — Letter Report
Board on Health Care Services, Institute of Medicine (2003, 35 pp.; available only online at <www.nap.edu>).

Large-Scale Biomedical Science: Exploring Strategies for Future Research
National Cancer Policy Board, Institute of Medicine and National Research Council (2003, 296 pp.; ISBN 0-309-08912-3; available from NAP, \$47.95 plus \$4.50 shipping).

Materials Count: The Case for Material Flows Analysis
Board on Earth Sciences and Resources, Division on Earth and Life Studies (2003, approx. 166 pp.; ISBN 0-309-08944-1; available from NAP, \$26.00 plus \$4.50 shipping).

Medicolegal Death Investigation System — Workshop Summary
Board on Health Promotion and

Disease Prevention, Institute of Medicine (2003, 86 pp.; ISBN 0-309-08986-7; available from NAP, \$18.00 plus \$4.50 shipping).

Ninth Interim Report of the Subcommittee on Acute Exposure Guideline Levels
Committee on Toxicology, Board on Environmental Studies and Toxicology, Division on Earth and Life Studies (2003, 42 pp.; available only online at <www.nap.edu>).

Nutrient Requirements of Dogs and Cats
Committee on Animal Nutrition, Board on Agriculture and Natural Resources, Division on Earth and Life Studies (2003, 600 pp.; ISBN 0-309-08628-0; available from NAP, \$295.00 plus \$4.50 shipping).

Pan-Organizational Summit on the U.S. Science and Engineering Workforce — Meeting Summary
Report to the Government-University-Industry Research Roundtable, National Academy of Sciences, National Academy of Engineering, and Institute of Medicine (2003, approx. 280 pp.; ISBN 0-309-08960-3; available from NAP, \$55.25 plus \$4.50 shipping).

Patents in the Knowledge-Based Economy
Board on Science, Technology, and Economic Policy, Division on Policy and Global Affairs (2003, 352 pp.; ISBN 0-309-08636-1; available from NAP, \$67.50 plus \$4.50 shipping).

Planning for Two Transformations in Education and Learning Technology — Report of a Workshop
Center for Education and Board on Behavioral, Cognitive, and

Sensory Sciences, Division of Behavioral and Social Sciences and Education; and Computer Science and Telecommunications Board, Division on Engineering and Physical Sciences (2003, 144 pp.; ISBN 0-309-08954-9; available from NAP, \$35.00 plus \$4.50 shipping).

Planning the 2010 Census — Second Interim Report
Committee on National Statistics, Division of Behavioral and Social Sciences and Education (2003, 148 pp.; ISBN 0-309-08968-9; available from NAP, \$34.75 plus \$4.50 shipping).

Review of the Centers for Disease Control and Prevention's Smallpox Vaccination Program Implementation — Letter Report #4
Board on Health Promotion and Disease Prevention, Institute of Medicine (2003, 54 pp.; available only online at <www.nap.edu>).

A Review of the EPA Water Security Research and Technical Support Action Plan
Water Science and Technology Board, Division on Earth and Life Studies (2003, approx. 61 pp.; ISBN 0-309-08982-4; available from NAP, \$18.00 plus \$4.50 shipping).

The Role of Scientific and Technical Data and Information in the Public Domain — Proceedings of a Symposium
Office of International Scientific and Technical Information Programs, Board on International Scientific Organizations, Division on Policy and Global Affairs (2003, 238 pp.; ISBN 0-309-08850-X; available from NAP, \$50.00 plus \$4.50 shipping).

Summary of a Workshop on U.S. Natural Gas Demand, Supply, and Technology: Looking Toward the Future

Board on Earth Sciences and Resources, Division on Earth and Life Studies (2003, approx. 121 pp.; ISBN 0-309-08964-6; available from NAP, \$30.00 plus \$4.50 shipping).

Weight Management: State of the Science and Opportunities for Military Programs

Committee on Military Nutrition Research, Food and Nutrition Board, Institute of Medicine (2003, approx. 287 pp.; ISBN 0-309-08996-4; available from NAP, \$41.00 plus \$4.50 shipping).

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The Silent Landscape

The Scientific Voyage of HMS *Challenger*

Richard Corfield

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