

THE NATIONAL ACADEMIES **IN FOCUS**

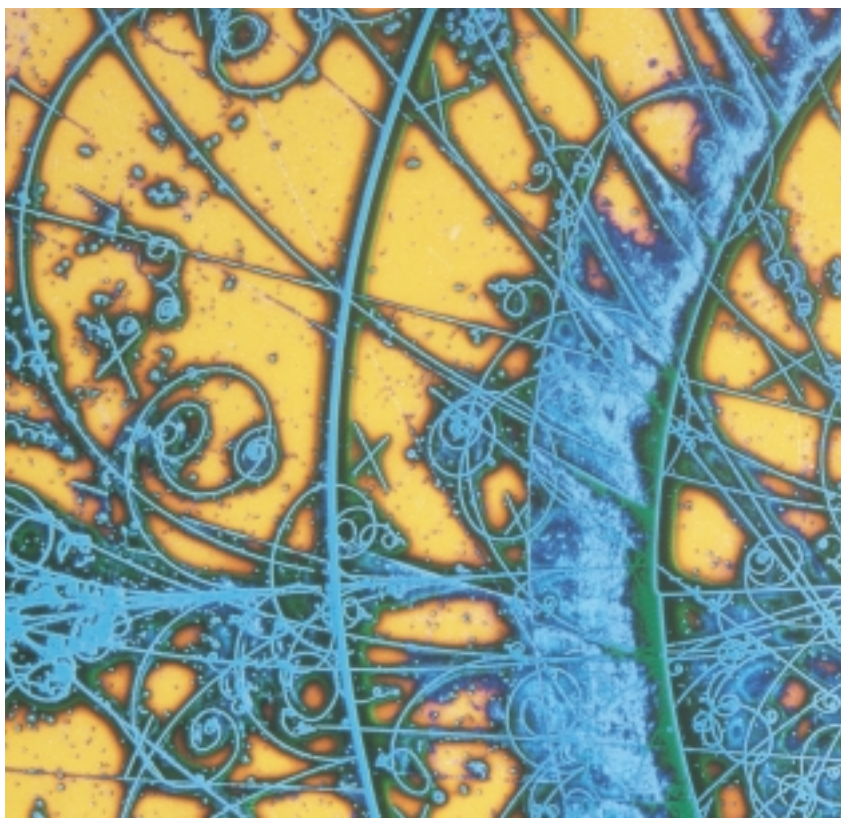
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Oil & Gas Development on
Alaska's North Slope

Neutrinos May Help Answer
Big Questions

Learning More From International
Studies in Education



Winter/Spring 2003

THE NATIONAL ACADEMIES

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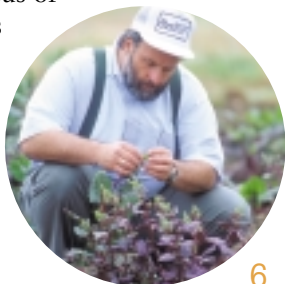
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Adjusting the Balance Point Between Openness and Security

Since September 11, 2001, the National Academies — and indeed the engineering and science communities in general — have significantly stepped up work on national security issues. These efforts, however, have thrust us into a classic conflict between openness and the now painfully obvious need to safeguard certain knowledge.

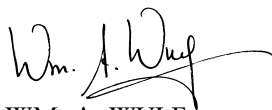
The current balance point between these two extremes was delicately set by competing superpowers during the Cold War, when the main issue was guarding nuclear secrets. Now, powerful technologies are even within the reach of individuals. Terrorists employing asymmetric warfare tactics are forcing the need to shift the fulcrum sharply.

But openness and security aren't necessarily competing forces. While restrictions on some information are essential to our security, so is openness. Sharing research is not only essential for improving our quality of life but it protects us as well, producing technologies to counter terrorism.

The engineering and science communities must play a leadership role in adjusting the balance point, which will change, with or without us. To that end, the National Academies hosted a one-day workshop in January to explore, in particular, how to deal with the publication of biotechnology research that might facilitate the creation of terrorist weapons (the workshop is summarized in an article beginning on page 18 of this *In Focus*). The next day, inspired by the workshop's discussion, a group of 32 journal editors and authors convened to formulate a statement both asserting the importance of open publication and acknowledging that the potential harm of some information could preclude publication.

Another important part of determining where to balance openness and security is dealing with the notion of the new realm of "sensitive but unclassified" information. Current law defines what information can and cannot be classified but, with the perspective of 9/11 and the anthrax attacks, it's now clear that the law doesn't cover everything should be kept from terrorists. This new concept is largely undefined and can lead to the sort of uncertainty that stifles research and weakens our security.

The National Academies will continue to work — within our own community, with the government, and with the rest of the world — to find the right balance point. At the same time, we'll continue our efforts to help ensure that counterterrorism technology stays ahead of the bad guys' ability to turn knowledge into terror.



WM. A. WULF

President, National Academy of Engineering



In October of last year, the presidents of the NAS, NAE, and IOM issued a joint statement on the issue of openness and security, available at <national-academies.org> in the Presidents' Corner.

Beyond Our Own Backyard



What the United States has learned from international studies in education often is limited to comparisons showing that Uncle Sam's kids fall short in math and science achievement. Root causes of the performance gaps are seldom fully understood.

Teachers sometimes pair off children who have different talents so that each can learn something meaningful from the other. In the same way, America's efforts to improve its education system can benefit from taking a look at teaching and learning in other countries around the world.

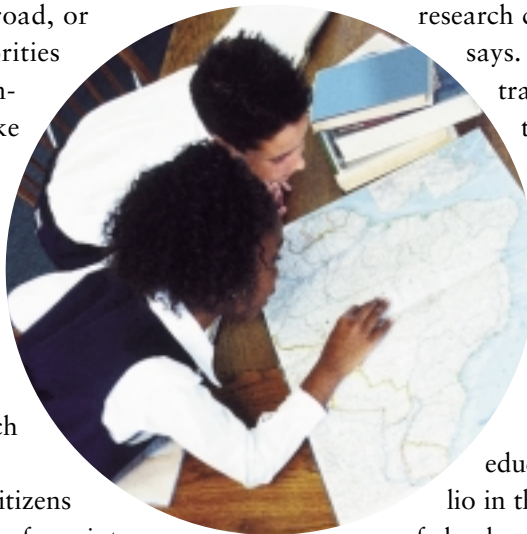
The federal government has boosted spending in recent decades on research that sizes up education outcomes across national borders. However, the types of projects typically funded are ill-suited to developing a deeper understanding of key

issues at home or abroad, or to helping U.S. authorities craft sound education-reform initiatives. Like blunt instruments, these studies tend to identify major patterns and miss fine points.

A new National Research Council report offers a research agenda to help the nation's leaders and citizens not only place findings from international education assessments in context, but also determine the role of this information in shaping domestic policies. A good understanding of other countries' education systems and strategies can help America generate new ideas that would benefit its students and teachers as well as society at large.

For starters, U.S. administrators who oversee research in comparative education should devote more resources to scientifically interpreting practices in various countries and cultures, and to exploring how certain policies have played out in other countries. To track general trends, the federal government still should support high-quality, large-scale comparisons of student achievement across the globe, the report says. But these efforts should be balanced with increased investment in studies that dig far beneath the surface of broad surveys.

Also, more researchers need faster and easier access to data from international studies overall. This would encourage further scientific review by the broader



research community, the report says. In addition, administrators should seek ways to link teachers who want to try out innovations with researchers who can shed light on the conditions that made certain measures successful.

Enhancing America's education research portfolio in this area requires a larger federal role, the report notes.

Specifically, the government — with input from a wide range of scholars, administrators, teachers, and others — should improve the planning and coordination of the comparative education studies that it funds.

— *Vanee Vines*

■ ***Understanding Others, Educating Ourselves: Getting More From International Comparative Studies in Education.***

Committee on a Framework and Long-Term Research Agenda for International Comparative Education Studies, Board on International Comparative Studies in Education, Board on Testing and Assessment, Center for Education, Division of Behavioral and Social Sciences and Education (2003, 100 pp.; ISBN 0-309-08855-0; available from the National Academies Press, tel. 1-800-624-6242; \$18.00 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10622.html>).

The committee was chaired by **Emerson J. Elliott**, director, Program Standards and Evaluation, National Council for Accreditation of Teacher Education, Washington, D.C. The study was sponsored by the U.S. Department of Education's National Center for Education Statistics and the National Science Foundation.

Agriculture

More Than Just Farming



The U.S. Department of Agriculture may not be the first agency that comes to mind when thinking about where federal research dollars are spent, but the department invests more than \$2 billion annually in R&D. Over the years, USDA's research funds have gone mainly toward increasing harvest size, the results of which have been enormously successful — corn yields alone have tripled in the last half century.

More food is not enough these days. The nation now demands food with higher nutritional value, and environmentally sound farming practices. Crops and livestock need to be protected against the possibility of bioterrorism. Preserving the vitality of rural communities is a concern, and how global economic forces affect American agriculture needs to be better understood. And despite increased food production, there are still people in this country, and millions worldwide, who go hungry each day.

To take on these emerging issues, USDA should shift the focus of its research efforts, says a new report from the National Research Council. Increasing food and fiber production should remain a primary concern, but USDA needs to adopt

a vision that also emphasizes research on the social, environmental, and health aspects of the agricultural enterprise.

For example, although genetically modified plants offer the promise of improving agricultural productivity around the world, public acceptance of these foods is still an issue. The report says improved methods for screening transgenic plants and animals for potential allergens and adverse environmental impacts can help.

Congress asked the Research Council to assess the quality and future direction of USDA research, which is administered by its research, education, and economics (REE) mission area. The committee that wrote the report found that REE has already helped meet some of the rising challenges in agricultural research. A water-quality initiative substantially reduced the application of pesticides and fertilizers on 500,000 acres of Midwest farmlands, for



example. USDA research also led to the eradication of the screwworm pest, and the recommended daily allowance for folic acid was doubled after USDA-sponsored scientists showed that the vitamin lowered the risk of heart disease.

Some research in emerging areas will require long-term study and the participation of scientists from multiple disciplines, the report adds. As an example, it cites a recent study showing that it can take as long as 20 years for nitrogen fertilizer to get from a field in Illinois to the Mississippi River, where it can be transported to the Gulf of Mexico and deplete oxygen to levels that endanger fish populations.

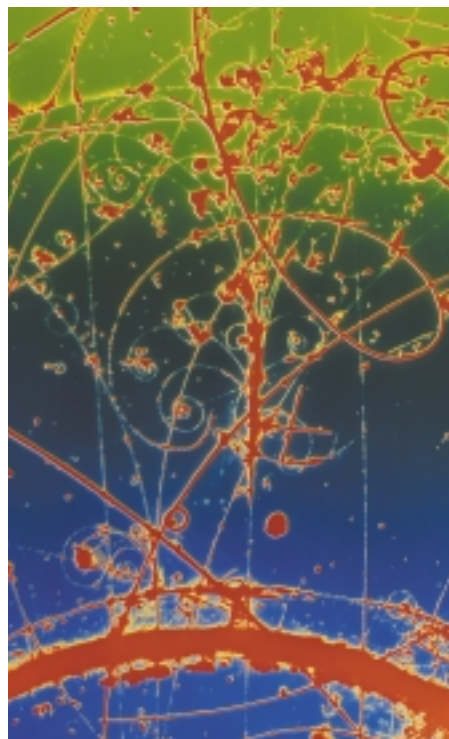
To achieve greater flexibility and to engage new talent and expertise in addressing emerging research opportunities, REE should devote a higher percentage of its research budget to merit-reviewed competitive grants and to cooperative agreements between governments scientists and researchers in other institutions. Scientists from key fields, such as ecology, human genetics, and bioinformatics should be hired, the report adds. REE also should quickly publish peer-reviewed research results on the Web, and interpret those results for the media and general public.

— *Bill Kearney*

■ **Frontiers in Agricultural Research: Food, Health, Environment, and Communities.** Committee on Opportunities in Agriculture, Board on Agriculture and Natural Resources, Division on Earth and Life Studies (2003, 268 pp.; ISBN 0-309-08494-6; 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/10585.html>).

The committee was chaired by **Laurian J. Unnevehr**, professor, department of agricultural and consumer economics, University of Illinois, Urbana-Champaign. The study was funded by the U.S. Department of Agriculture.

What is the nature of the dark matter that makes up most of the universe? What laws govern all of the forces and particles that exist? For clues that could help answer weighty questions like these, scientists are increasingly turning to the least substantial of objects, the neutrino.



Tracking the Elusive Neutrino

Tiny Particles May Help Answer Big Questions

Smaller than atoms and having almost no mass, neutrinos are emitted by explosions within the sun, supernovas, and other cosmic phenomena. These invisible particles rarely interact with other matter — a quality that makes them extremely hard to detect. Each second, trillions of neutrinos glide through our bodies and almost all other things on Earth as if they weren't even there.

For astronomers, this ability to pass through matter unscathed is the neutrino's greatest appeal. Neutrinos emitted by distant exploding stars and supermassive black holes can travel through space without being absorbed or altered by objects en route.

They reach the Earth as evidence that hasn't been tampered with — giving astronomers a “direct line of sight” into phenomena that occur at the edges of the universe.

The tiny neutrino might also ultimately challenge the “standard model” of physics — the currently accepted description of the building blocks of matter and how these particles interact. The recent discovery that neutrinos have mass showed the standard model to be partly incorrect, and a better understanding of neutrinos may alter the model in other ways as well.

Cosmologists hope that studying these particles may shed light on the dark matter that holds the universe together. A small

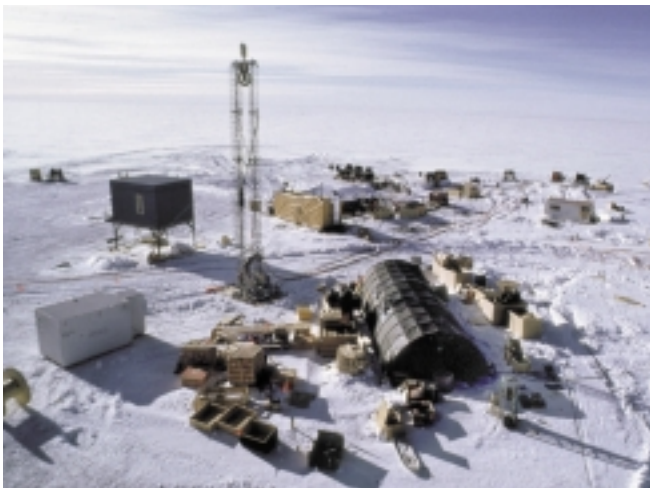
portion of this matter is made up of neutrinos, but the remainder is still a mystery. The most tantalizing possibility is that if a powerful new detector is built, it may spot more than neutrinos and reveal the other particles that make up dark matter as well.

But before new knowledge can be gained or paradigms challenged, scientists first need to be able to study neutrinos more closely. And this isn't easy, because the Earth is constantly bombarded with cosmic rays — protons, photons, electrons, and other particles — from space. These create a distracting “background” against which neutrinos are hard to detect. To elude this interference, scientists have begun taking their observations below the Earth's surface, where it is more difficult for cosmic rays to reach. Two new initiatives are being considered for future funding, and the Bush administration asked the National Research Council to evaluate their scientific merits.

One proposed laboratory would be built deep underground. So far, underground experiments have been conducted in mines, but there isn't enough space available to meet scientific demand. A laboratory built from scratch in the United States could be deeper, larger, and more versatile, allowing a broader range of experiments, a Research Council committee concluded in a new report.

Also of strong scientific promise for the detection and observation of neutrinos, the report says, is the proposed international collaboration called IceCube. This project would place instruments in a cubic kilometer of ice far beneath the surface at the South Pole. Scientists hope that the neutrinos which shower the Earth will interact with the ice, and produce particles called

muons; these release light, which could be seen and measured through the ice. The path and brightness of the light would reveal the neutrinos' direction and level of



energy, and the light's pattern would indicate which of the three known types of neutrino is present.

The two facilities' capabilities would complement — not duplicate — each other, the report says. And though the projects are ambitious, at least some of the rewards would be swift. IceCube could be completed in five or six years, and experiments could begin even during construction.

— *Sara Frueh*

■ **Neutrinos and Beyond: New Windows on Nature.**

Neutrino Facilities Assessment Committee, Board on Physics and Astronomy, Division on Engineering and Physical Sciences (2002, approx. 95 pp.; ISBN 0-309-08716-3; available from the National Academies Press, tel. 1-800-624-6242; \$18.00 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10583.html>).

The committee was chaired by **Barry C. Barish**, Ronald and Maxine Linde Professor of Physics, California Institute of Technology, Pasadena. The study was funded by the National Science Foundation.

Geographic Information Systems for Housing and Urban Development

Housing for the poor in America's cities is often separated from where the middle class lives, and isolated from basic services, such as health care, daycare, retail stores, and libraries. But now urban planners are using Geographic Information Systems, or GIS, to build low-income housing with improved access to such places as medical clinics, supermarkets, public transportation, and job-training facilities. GIS is a computer system that stores and analyzes all the data relevant to a particular place, but it's more than just a map. With layers of information about local geography, roads, building sites, socio-economic conditions, and more, GIS can give planners and prospective residents alike answers to questions such as what environmental hazards are nearby and what the best commuting options are for residents.

Recognizing the potential of GIS, the U.S. Department of Housing and Urban Development has begun to collect and analyze GIS data. Recently, it asked the National Research Council for advice on how to improve the agency's use of GIS in fulfilling its mission of providing affordable housing and promoting home ownership in vibrant, safe communities, free from discrimination.

The Research Council's report says that as a first step HUD should meet the standard data format used by the Federal Geographic Data Committee, an interagency group set up by President Clinton in 1994 to establish the National Spatial Data Infrastructure (NSDI), a one-stop shop for GIS information. HUD should also make



its GIS data available on the Internet. This will give low-income households access to the same type of property and neighborhood information that buyers of more expensive homes can

currently obtain from such sources as Realtor.com. In collecting and disseminating data, the agency will need to ensure that confidential information about residents is not made public, especially on the Internet, the report adds.

The agency should take advantage of the wealth of data collected by its 81 field offices to create an agency-wide GIS that assesses such things as how HUD ventures have affected neighborhood stability and what the educational and employment opportunities are in areas under consideration for investment, the report says. The agency should also use data about metropolitan conditions provided by its field offices to create an urban component to the NSDI.

In addition, HUD should expand its research into housing trends, the changing demographics of neighborhoods, and the geographic distribution of poverty in the United States. — *Bill Kearney*

■ **GIS for Housing and Urban Development.**

Committee on Review of Geographic Information Systems Research and Applications at HUD: Current Programs and Future Prospects; Committee on Geography, Board on Earth Sciences and Resources, Division on Earth and Life Studies (2003, 142 pp.; ISBN 0-309-08874-7; available from National Academies Press, tel. 1-800-624-6242; \$31.75 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10674.html>).

The GIS committee was chaired by **Eric A. Anderson**, chief executive officer and city manager of Des Moines, Iowa. The study was funded by the U.S. Department of Housing and Urban Development.



BUILDING BLOCKS TO **Health Care** REFORM

So many challenges face America's ailing health care system. The costs of health care are rising at an annual rate of 12 percent. The ranks of the uninsured swelled to 41 million in 2001. Doctors have gone on strike to protest exorbitant malpractice insurance rates. And medical errors continue to claim tens of thousands of lives each year.

In light of the many problems threatening to overwhelm the system, U.S. Secretary of Health and Human Services Tommy Thompson turned to the Institute of Medicine to help find solutions. Calling on its experts to offer "bold ideas," Thompson asked the IOM to propose a series of model projects that would test innovative approaches to some of the most serious problems.

In a new report, an IOM committee chose five key areas that, with proper attention, would offer the greatest potential for catalyzing further improvements. "Targeted demonstration projects in these areas can serve as a starting point, the planting of seeds of innovation that will grow into a robust 21st-century health care system," said committee chair Gail Warden, president and CEO of the Henry Ford Health System in Detroit.

One of the selected strategic areas is harnessing information technology to create a "paperless health care system." The health

care sector has lagged behind virtually all other industries in adopting information technology, which could be applied to areas such as clinical record keeping and decision-support systems. The report calls for eight to 10 communities initially — and another 25 follow-on sites — to develop secure information systems that provide patients, care providers, and other authorized users with immediate access to computer-based patient records and the ability to exchange information electronically.

Health care has experienced a notable shift from treatment of mostly acute, episodic cases, such as broken bones or food poisoning, to managing a rising tide of chronic illnesses that can persist over years. The committee proposed that 10 to 12 demonstration projects should be undertaken to develop care programs for patients with chronic conditions and establish community-wide health promotion and prevention strategies to curtail the rapid increase of chronic disease.

At the same time, basic primary care in America frequently does not give patients the level and quality of care they deserve, the committee noted. A set of about 40 community health centers would provide an ideal testing ground to reinvent primary care. The centers should be encouraged to experiment with new, systematic approaches that would encompass acute, chronic, and preventive care.

The committee also took on the thorny issue of medical liability. Its proposed solution is a non-judicial compensation system that would promote more timely payments and the acknowledgement of error to a greater number of patients. Reasonable ceilings should be put on the providers' liability,

but in exchange, providers would have to develop systems for reporting errors so that they can be analyzed and reduced.

Of course, to enjoy any benefits from these reforms, patients must have access to care. Millions of Americans currently have no health insurance, which severely hinders their ability to get care. The committee urged that three to five states conduct projects aimed at making affordable coverage available to all residents through tax credits to the uninsured to help offset coverage premiums, expanded eligibility for existing public coverage programs, or a combination of the two. Whereas the other demonstration projects are expected to be budget-neutral over time, extending health coverage would require significant, ongoing influxes of funds. A minimum commitment of 10 years is necessary to alleviate this intractable problem, the committee added.

Fixing the broken health care system will require significant resolve and commitment from both the public and private sectors. The committee hopes that its demonstration projects will prove to be the transforming building blocks that lead to significant improvements for all patients. "Nobody says it will be easy," Warden said. "However, the time for change is now." — *Christine Stencel*

■ **Fostering Rapid Advances in Health Care:**

Learning from System Demonstrations. Committee on Rapid Advance Demonstration Projects: Health Care Finance and Delivery Systems, Board on Health Care Services, Institute of Medicine (2002, 108 pp.; ISBN 0-309-08707-4; available from the National Academies Press, tel. 1-800-624-6242; \$35.00 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10565.html>).

The committee was chaired by **Gail Warden**, president and CEO of Henry Ford Health System, Detroit. The study was sponsored by the Institute of Medicine and the National Academy of Sciences.

A Prescription for Public Health



Prior to 9/11, few people gave much thought to the vitality of America's public health system. Now that public health initiatives and advances in medicine have tamed once-common killers, such as measles and polio, the importance of public health services has come to be taken for granted. Over the last few decades, this system has been consistently underfunded and politically neglected, its largely behind-the-scenes efforts to keep populations healthy generally overlooked.

The events of autumn 2001 threw a glaring spotlight on the consequences of that neglect, highlighting a lack of coordinated communications, shortages of resources and funding, and reliance on outdated technology. The publicity served as a wake-up call that the nation's public health

infrastructure needs to be overhauled if it is to meet a new era of health challenges.

Two reports by the Institute of Medicine offer blueprints for the reforms needed. Both emphasize that while public health departments and the professionals who staff them remain the backbone of the system, public health should no longer be thought of as limited to those functions historically provided by government health departments and clinics. Rather, it should operate as a concerted effort that also includes the medical care community, businesses, nonprofit groups, and other public and private partners.

The reports emphasize the need to bridge the schism that has gradually split public health and the medical care industry. This divergence hinders the nation's ability to cope with health issues that cannot be

solved through medical treatment alone. Community action and policy change are needed to address chronic conditions and other health problems shaped by behavioral and environmental factors. Currently, only a fraction of public health workers earn public health degrees, and most medical and nursing students receive little or no public health training. The curricula of medical and nursing schools should include basic public health instruction, and these schools should pursue partnerships with schools of public health, such as joint classes and new degree programs.

But partnerships need not end with those between the health sector and academia. Many other entities can influence population health and hence play an important role in promoting and protecting it. For example, businesses provide the majority of health care coverage and affect workers' health and safety through the design of their workplaces. The media influence behavior through the images they portray and the issues they focus on. These and other groups could serve as valuable partners with public health professionals in devising and trying out new approaches to addressing the behavioral, environmental, and societal factors shaping the health of communities and individuals.

Even with a new partnering approach, however, public health departments and clinics remain the pre-eminent actors in health promotion and disease prevention, and they must be given funding and other resources commensurate with their central role. Of the \$1.3 trillion America spent on health in 2002, only 1 percent to 2 percent went to prevention. Yet, as many as 1 million



Americans die each year from health problems related to preventable factors, such as tobacco use and inactivity coupled with unhealthy diets.

Recent influxes of funding to improve public health departments' abilities to respond to terrorist attacks have helped alleviate some of the system's shortfalls. However, public health needs a concerted and sustained boost to adequately meet all of its obligations. Federal, state, and local governments must appropriately allocate the dollars earmarked for health to ensure that every community has access to essential services and that the public health system can meet new health challenges as successfully as it tackled those in the past.

— *Christine Stencel*

■ **The Future of the Public's Health in the 21st Century.** Committee on Assuring the Health of the Public in the 21st Century, Board on Health Promotion and Disease Prevention, Institute of Medicine (ISBN 0-309-08622-1; \$39.95 plus \$4.50 shipping for single copies). The committee was co-chaired by **Jo Ivey Boufford**, former principal deputy assistant secretary for health, U.S. Department of Health and Human Services, and dean, Robert F. Wagner Graduate School of Public Service, New York University, New York City; and **Christine Cassel**, dean, School of Medicine, Oregon Health and Science University, Portland. The study was sponsored by the U.S. Department of Health and Human Services.

Who Will Keep the Public Healthy? Educating Public Health Professionals for the 21st Century. Committee on Educating Public Health Professionals for the 21st Century, Board on Health Promotion and Disease Prevention, Institute of Medicine (ISBN 0-309-08542-X; \$42.95 plus \$4.50 shipping for single copies). The committee was co-chaired by **Kristine Gebbie**, director, center for health policy and the doctor of nursing science program, Columbia University, New York City; and **Linda Rosenstock**, dean, School of Public Health, University of California, Los Angeles. The study was sponsored by the Robert Wood Johnson Foundation.

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

Adding Up the Effects of Oil and Gas Development in **Alaska**



Like all states, Alaska has hubs of industrial activity, and in this corner of the United States, much of it is centered on the North Slope, an 89,000 square-mile area where large-scale oil development has been taking place since the 1960s. In Alaska, industrial activity is having effects on the environment, just as it is apt to anywhere. But the extent of its effects over the course of many years has been unclear — until now.

In the most exhaustive study to date, a National Research Council committee has documented more than three decades of environmental and social effects — both positive and negative — on the North Slope.

The North Slope Borough is responsible for governing a single municipality that is larger than 39 of the states. It employs 60 percent of the area's citizens, most of whom are Inupiat Eskimos. Besides jobs, the borough provides schools, housing, health care, utilities, police and fire protection, and other services, in large part paid for by taxes levied on oil companies.

When the Research Council committee interviewed area residents, it heard many positive comments about how the revenue stream from local industrial activities had changed people's lives. It also noted, however, that oil development has had some environmental consequences that have directly affected the Inupiat. Bowhead whales, for example, have diverted their normal migration paths to avoid the noise of seismic exploration activities, forcing

Inupiat whalers to travel farther out to sea and raising their chances of running into bad weather or of whale meat spoiling before they can return to shore.

Just as the Inupiat have relied on the bowhead whale for subsistence for hundreds of years, another group of Alaska natives, the Gwich'in Indians, have depended for centuries on caribou for food and clothing. The committee found that so far oil development has not resulted in declines in the overall size of the Central Arctic caribou herd, but it has affected their geographical distribution and reproductive success at times.

It is impossible to predict the degree to which caribou would be affected by the spread of industrial activity on the North Slope without knowing more precisely where that activity is going to take place, the committee added. Oil and gas activities are currently confined to coastal areas and a swath of land about a hundred miles wide in the middle of the North Slope tundra, but the slope also includes parts of the Arctic National Wildlife Refuge, where thousands of caribou return every spring to calve and where exploration for oil has been proposed.

The report says that more people on the North Slope has meant more garbage for scavenging animals, such as foxes, bears, and ravens, boosting their numbers. These animals also eat the eggs of many bird species, including some that are endangered or threatened.

An extensive network of exploration trails has damaged vegetation and caused erosion on the North Slope tundra and altered the scenery of the Alaskan wilderness, the report adds. Roads built to support oil development have helped connect villages to the outside world, but the thick

foundation of gravel that is needed as insulation to protect the underlying permafrost also can cause problems, both where it is applied and where it is mined.

In other areas of concern, the committee found no evidence that environmental effects are accumulating. Spills, for example, generally have been small and reasonably contained. And while the web of roads, pipelines, and oil facilities on the North Slope has clearly impacted the environment over time, the oil industry and regulatory agencies have made enormous strides in reducing some of the effects. Oil platforms are smaller, and more precise drilling techniques have cut down on the number of wells. In addition, some roads are now built with ice instead of gravel.

Because of the high cost of restoring damaged habitats and removing industrial infrastructure, it is likely that some environmental effects will persist for many years, the committee said. It called for a comprehensive plan that addresses long-term environmental effects and the dismantling of equipment. Further research also is needed, especially on how climate change — a continued warming trend, in particular — is affecting the relationship between oil development and the environment. — *Bill Kearney*

■ **Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope.** Committee on the Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope, Board on Environmental Studies and Toxicology, Polar Research Board, Division on Earth and Life Studies (2003, approx. 465 pp.; ISBN 0-309-08737-6; available from the National Academies Press, tel. 1-800-624-6242; \$69.00 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10639.html>).

The committee was chaired by **Gordon Orians**, professor emeritus of zoology, University of Washington, Seattle. The study was funded by the U.S. Environmental Protection Agency.

Fair Weather

Public vs. Private FORECASTING

— *The National Weather Service has issued a severe thunderstorm warning for the following locations . . .* —

People are accustomed to hearing this familiar refrain when dangerous weather approaches. They know the government and news media are keeping a watchful eye open for them. What they may not realize, however, is that there are some 400 private companies in the business of weather forecasting, a \$500 million-a-year enterprise in the United States.

For the most part, these companies issue forecasts tailored to specific industries, such as trucking or shipping, although some supply general weather forecasts as well, often delivered to the public via a radio or TV station that pays for the service. Some companies deliver weather information directly to the public; WeatherBug, for instance, is a popular Internet product that sends real-time forecasts, including National Weather Service warnings, straight to computer users.

But because NWS issues general forecasts in addition to weather advisories and warnings, a few of the private companies think the government agency is unfairly competing with them. In 1991, NWS tried to alleviate these concerns by adopting a “public-private partnership” policy that said the agency would not provide services that the private sector could. Although NWS intended the policy to mean that it would not issue forecasts tailored to a specific industry, it did not believe general forecasts had to be stopped.

A new report from the National Research Council calls the 1991 policy ambiguous and says NWS indeed should continue to



issue general forecasts. For NWS to provide timely warnings, it must collect substantial amounts of data and run several atmospheric models to interpret the data, so the large and expensive infrastructure needed for general forecasting is already in place and paid for by taxpayers, the report notes.

Interpretation of the 1991 policy was further affected by federal “e-government” initiatives and rules requiring full and open access to all publicly funded data. NWS should continue to provide unrestricted access to its data, not only because federal regulations require it, but also so meteorologists and researchers from the academic and private sectors can use the data in their work, the report says.

The current policy should be replaced with one that allows decisions to be made on an ongoing basis about whether a forecast should be made by NWS or the private sector, the report says, adding that meteorologists from business and academia should be involved in the decision-making. NWS needs to take steps to ensure that its many regional offices are given guidelines for discontinuing certain forecasts. A local office, for example, should not be providing forecasts designed specifically for a ski resort. — *Bill Kearney*

■ **Fair Weather: Effective Partnerships in Weather and Climate Services.** Committee on Partnerships in Weather and Climate Services, Committee on Geophysical and Environmental Data, Board on Earth Sciences and Resources, Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies; and Computer Science and Telecommunications Board, Division on Engineering and Physical Sciences (2003, approx. 128 pp.; ISBN 0-309-08746-5; available from the National Academies Press, tel. 1-800-624-6242; \$25.00 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10610.html>).

The committee was chaired by **John Armstrong**, retired vice president of research, IBM Corp., now living in Amherst, Mass. The study was funded by the National Weather Service.

SAFEGUARDING National Security and Science

January 9, 2003, has become a memorable date in the history of the National Academies and its commitment to advise the nation on science, engineering, and medicine. That day, National Academy of Sciences President Bruce Alberts welcomed an auditorium packed with scientists, national security officials, policy analysts, and journalists. The Academies, in partnership with the Center for Strategic and



International Studies (CSIS), hosted a day-long “town hall meeting” to search for answers to a series of complex, interconnected questions that — post-Sept. 11 — have haunted many researchers in the life sciences: Could the results of their work — widely available in print and online in peer-reviewed journals — be hijacked and turned against civilized society? If so, does the risk of terrorists appropriating certain

kinds of “sensitive” information justify limiting or even prohibiting its publication? If publication were restricted, who would decide what should be published or not? How could the standards be more than just arbitrary? And, what exactly makes some information sensitive?

The tension at the meeting was palpable. John Hamre, president of CSIS and a former deputy secretary of defense, began by warning that officials charged with safeguarding national security and scientists approach the subject of terrorism with very different attitudes, goals, and knowledge bases. “The political climate we are in,” Hamre explained, “is leaning toward the direction of imposing security regulations that buy precious little security but have terribly negative consequences for the conduct of science. The scientific community ... tends to discount this as just ‘the security guys are a bunch of dopes, and if only they’d be smarter they’d leave us alone.’”

Certain kinds of knowledge in the physical sciences — the design of nuclear weapons, for example — have long been considered too dangerous to make public. Since the beginning of the atomic age, physicists and governments have readily agreed that most research about nuclear technology needs to be classified and kept secret.

But application of this approach to the biological sciences is more problematic. The very same detailed knowledge that could be used to fight a disease or disable a plant or animal pathogen might, in the world after 9/11, also serve as a “cook-book” for terrorists wanting to create a powerful biological weapon. Although unclassified, might some information in the

life sciences be too “sensitive” to be published in a journal or posted online? But, if it was not published, how could fellow scientists assess the latest data and build upon the findings of others? Scientists need to openly share their findings through scientific literature, so that results from one group can be challenged and extended by others, with each new advance being built upon the findings of others. That, in fact, is how science works best.

Several scientists said they had already come face to face with these dilemmas. Last year Ariella Rosengard, a University of Pennsylvania immunologist, published a paper which described how part of the smallpox virus functions. “As a mother of two wonderful children,” she said, “I ask myself the following question: Could our work help to make the world they inherit more or less secure?” As a scientist, she expressed another worry: “... if we eliminate our ability to freely express our research results, we will end up saying it’s not just worth it.”

After the January meeting, editors and publishers of 32 of the world’s leading scientific journals decided they had heard enough to begin taking action. “We recognize,” they said in a joint statement published in February in the *Proceedings of the National Academy of Sciences*, *Nature*, and *Science*, “that the prospect of bioterrorism has raised legitimate concerns about the potential abuse of published information, but [we] also recognize that



research in the very same fields will be critical to society in meeting the challenges of defense.” Based on what it had learned, the group agreed that “on occasions an editor may con-

clude that the potential harm of publication outweighs the potential societal benefits. Under such circumstances, the paper should be modified, or not be published.”

Ronald Atlas, president of the American Society of Microbiology, called this new sci-

entific publishers’ policy a work in progress that should “begin by defining what is sensitive and then move to considering how best to protect that information, going beyond classification to ethically responsible citizenship.”

January’s meeting was only the beginning of dialogue-building between scientists and the national security community. This spring, the National Academies and CSIS are taking the next step, jointly underwriting a series of roundtable meetings about the complex issues at the intersection of the life sciences and national security. The roundtable, whose members include leading scientists and former government leaders, will hear concerns from both communities in an effort to solve problems in real time and build consensus, as well as trust. This joint initiative will be co-chaired by David Baltimore, president of the California Institute of Technology, and Harold Brown, former secretary of defense under President Carter.

— William Skane

Preventing Obesity in America's Children

People used to distinguish between “juvenile diabetes” and “adult-onset diabetes,” but about six years ago, these monikers were scrapped in favor of more generic labels — “type 1” and “type 2” diabetes. Part of the reason is that the form of the disease that once occurred mostly in adults over age 50 is now showing up in teens and even preteens. The principal suspect behind the rise of type 2 diabetes in children is the growing waistline of America's youth.

In the early 1970s, only 4 percent of children between 6 and 11 and 6 percent of those ages 12 through 19 were overweight. By 2000, the numbers had more than doubled, with 15 percent of children and teens carrying excess pounds.

Research shows that overweight children are at risk for serious health problems, including diabetes and cardiovascular disease. Signs of these disorders are becoming increasingly evident even before these children reach adulthood. According to one report, about 60 percent of children ages 5 to 10 who are overweight or obese already have at least one cardiovascular disease risk factor, such as elevated total cholesterol levels or higher blood pressure, and 25 percent have two or more. Data suggest that 70 percent of overweight children will remain so as adults, with all the attendant risks for greater health problems and earlier mortality.

In 2001, the U.S. Surgeon General issued a call to action to prevent and decrease overweight and obesity in the United States. The



next step is development of specific strategies. Recognizing the need for greater attention directed to children and youth, Congress requested that the Institute of Medicine develop an action plan targeted specifically at the prevention of obesity among youngsters. The study committee, whose work got under way this winter, is assessing the factors responsible for the increasing prevalence of obesity in children and youth and identifying the most promising methods for prevention, including interventions and policies, as well as research opportunities. Its report is slated for release in mid-2004. — *Christine Stencel* (See listing on page 22.)

The New M.O. of Business

With the demise of the dot.com boom and predictions of hitting bottom in the business cycle, people have begun to question whether the “New Economy” is still alive and well. The short answer is that its pulse can indeed be felt across all sectors of today’s marketplace. The wide-ranging application of advanced communications technology, the cornerstone of the New Economy, continues to change and enrich the way we work, live, and play.

Semiconductors and computers are the source of unprecedented gains that have fostered services like new means of communication, more efficient trucking, and more and better choices for consumers through

online shopping. These technologies are exceptional in that they benefit from constantly falling costs and dramatically improved performance. But all too often, policy-makers know little about how these advances actually impact the economy. A National Research Council committee is working to shed more light on the area.

The committee is reviewing and identifying key issues regarding the measurement, development, and growth of the New Economy, as well as technologies that underpin its expansion. The roles of academia, government, and industry in sustaining its growth also are being explored. A final report is expected next year.

— *Vanee Vines*
(See listing on page 22.)



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 Need for Clinical Trials of Testosterone Replacement Therapy.

Board on Health Sciences Policy, Institute of Medicine. Project director: Cathy Liverman. Chair: Dan G. Blazer, J.P. Gibbons Professor of Psychiatry and Behavioral Sciences, Duke University Medical Center, Durham, N.C. Sponsors: National Institute on Aging and National Cancer Institute.

Extending the Effective Lifetimes of Earth Observing Research Missions. Space Studies Board, Division on Engineering and Physical Sciences. Project director: Art Charo. Chair: Michael Freilich, professor, College of Oceanic and Atmospheric Sciences, Oregon State University, Corvallis. Sponsors: NASA and National Oceanic and Atmospheric Administration.

Measuring and Sustaining the New Economy.

Board on Science, Technology, and Economic Policy, Division on Policy and Global Affairs. Project director: Charles Wessner. Chair: Dale W. Jorgenson, Frederic E. Abbe Professor of Economics, Harvard University, Boston. Sponsors: U.S. Department of Energy, National Science Foundation, NASA, the Advanced Technology Program of the National Institute of Standards and Technology, and Sandia National Laboratories. (See page 21 in this issue of *In Focus*.)

Prevention of Obesity in Children and Youth.

Food and Nutrition Board and Board on Health Promotion and Disease Prevention, Institute of Medicine. Project director: Linda Meyers. Chair: Jeffrey P. Koplan, vice president for academic health affairs, Woodruff Health Sciences Center, Emory University, Atlanta. Sponsors: Centers for Disease Control and Prevention, National Institutes of Health, and the U.S. Department of Health and Human Services’ Office of Public Health and Science, and the Robert Wood Johnson Foundation. (See page 20 in this issue of *In Focus*.)

Research Agenda for the Social Psychology of Aging.

Board on Behavioral, Cognitive, and Sensory Sciences, Division of Behavioral and Social Sciences and Education. Project director: Tracy Myers. Chair: Laura L. Carstensen, professor, department of psychology, Stanford University, Stanford, Calif. Sponsor: National Institute on Aging.

Toxicologic Assessment of Low-Level Exposures to Chemical Warfare Agents.

Board on Environmental Studies and Toxicology, Division on Earth and Life Studies. Project director: Kulbir Bakshi. Chair: Gary P. Carlson, professor of toxicology and associate head, School of Health Sciences, Purdue University, West Lafayette, Ind. Sponsor: U.S. Department of Defense.

Weather Research for Surface Transportation: The Roadway Environment.

Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies; and Transportation Research Board. Project director: Amanda Staudt. Chair: John T. Snow, director, Oklahoma Weather Center Programs, and dean, College of Geosciences, University of Oklahoma, Norman. Sponsor: Federal Highway Administration.

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.

Advancing Prion Science: Guidance for the National Prion Research Program — Interim Report Medical Follow-Up Agency, Institute of Medicine (2003, 126 pp.; ISBN 0-309-08744-9; available from NAP, \$28.75 plus \$4.50 shipping).

Beyond the Molecular Frontier: Challenges for Chemistry and Chemical Engineering Board on Chemical Sciences and Technology, Division on Earth and Life Studies (2003, 240 pp.; ISBN 0-309-08477-6; available from NAP, \$34.95 plus \$4.50 shipping).

Combat Hybrid Power System Component Technologies: Technical Challenges and Research Priorities National Materials Advisory Board and Board on Manufacturing and Engineering Design, Division on Engineering and Physical Sciences (2002, 88 pp.; available online at <www.nap.edu> and in limited supply from the National Materials Advisory Board, tel. 202-334-3505).

Completing the “Big Dig”: Managing the Final Stages of Boston’s Central Artery/Tunnel Project

Board on Infrastructure and the Constructed Environment, Division on Engineering and Physical

Sciences; National Academy of Engineering; and Transportation Research Board (2003, 60 pp.; ISBN 0-309-08887-9; available from NAP, \$18.00 plus \$4.50 shipping).

Diagnosis and Control of John's Disease

Board on Agriculture and Natural Resources, Division on Earth and Life Studies (2003, 232 pp.; ISBN 0-309-08611-6; available from NAP, \$47.00 plus \$4.50 shipping).

Dietary Reference Intakes:

Applications in Dietary Planning

Food and Nutrition Board, Institute of Medicine (2003, approx. 161 pp.; ISBN 0-309-08853-4; available from NAP, \$54.95 plus \$4.50 shipping).

Environmental Cleanup at Navy Facilities: Adaptive Site Management

Water Science and Technology Board, Division on Earth and Life Studies (2003, approx. 272 pp.; ISBN 0-309-08748-1; available from NAP, \$37.00 plus \$4.50 shipping).

Environmental Information for Naval Warfare

Ocean Studies Board, Division on Earth and Life Studies (2003, 218 pp.; ISBN 0-309-08860-7; available from NAP, \$44.75 plus \$4.50 shipping).

Evaluation of Manufacturing Vision and Strategies for the Production of Military Combat Vehicles: *The Crusader Artillery System*

Board on Manufacturing and Engineering Design, Division on Engineering and Physical Sciences (2003, 40 pp.; available online at <www.nap.edu> and in limited supply from the board, tel. 202-334-3505).

Exploration of the Seas — Interim Report

Ocean Studies Board, Division on Earth and Life Studies (2003, 48 pp.; ISBN 0-309-08631-0; available from NAP, \$12.00 plus \$4.50 shipping).

Exposure of the American Population to Radioactive Fallout from Nuclear Weapons Tests: A Review of the CDC-NCI Draft Report on a Feasibility Study of the Health Consequences to the American Population from Nuclear Weapons Tests Conducted by the United States and Other Nations

Board on Radiation Effects Research, Division on Earth and Life Studies (2003, 82 pp.; ISBN 0-309-08713-9; available from NAP, \$18.00 plus \$4.50 shipping).

Frontiers in Polar Biology in the Genomic Era

Polar Research Board, Division on Earth and Life Studies (2003, approx. 159 pp.; ISBN 0-309-08727-9; available from NAP, \$34.75 plus \$4.50 shipping).

Frontiers of Engineering: Reports on Leading-Edge Engineering From the 2002 NAE Symposium on Frontiers of Engineering

National Academy of Engineering (2003, 152 pp.; ISBN 0-309-08732-5; available from NAP, \$33.50 plus \$4.50 shipping).

Fulfilling the Potential of Cancer Prevention and Early Detection

National Cancer Policy Board, Institute of Medicine and National Research Council (2003, 560 pp.; ISBN 0-309-08254-4; available from NAP, \$59.95 plus \$4.50 shipping).

Government Data Centers: Meeting Increasing Demands

Board on Earth Sciences and Resources, Division on Earth and Life Studies (2003, 70 pp.; ISBN 0-309-08742-2; available from NAP, \$18.00 plus \$4.50 shipping).

Gulf War and Health, Vol. 2: Insecticides and Solvents

Board on Health Promotion and Disease Prevention, Institute of Medicine (2003, approx. 650 pp.; ISBN 0-309-08458-X; available from NAP, \$85.00 plus \$4.50 shipping).

Immunization Safety Review: Vaccinations and Sudden

Unexpected Death in Infancy
Board on Health Promotion and Disease Prevention, Institute of Medicine (2003, approx. 67 pp.; ISBN 0-309-08886-0; available from NAP, \$18.00 plus \$4.50 shipping).

Implications of Emerging Micro- and Nanotechnologies

Air Force Science and Technology Board, Division on Engineering and Physical Sciences (2002, 266 pp.; ISBN 0-309-08623-X; available from NAP, \$54.00 plus \$4.50 shipping).

Information Technology for Counterterrorism: Immediate Actions and Future Possibilities

Computer Science and Telecommunications Board, Division on Engineering and Physical Sciences (2003, 144 pp.; ISBN 0-309-08736-8; available from NAP, \$32.00 plus \$4.50 shipping).

Integrating Research and Education: Biocomplexity Investigators Explore the Possibilities — Summary of a Workshop

Board on Life Sciences, Division on Earth and Life Studies (2003, 71 pp.; ISBN 0-309-08871-2; available from NAP, \$18.00 plus \$4.50 shipping).

Interim Report of the NRC Review of NASA's Pioneering Revolutionary Technology Program

Aeronautics and Space Engineering Board, Division on Engineering and Physical Sciences (2003, 18 pp.; available only online at <www.nap.edu>).

Microbial Threats to Health:

Emergence, Detection, and Response
Board on Global Health, Institute of Medicine (2003, approx. 350 pp.; ISBN 0-309-08864-X; available from NAP, \$44.95 plus \$4.50 shipping).

Ocean Noise and Marine Mammals
Ocean Studies Board, Division on Earth and Life Studies (2003, approx. 160 pp.; ISBN 0-309-08536-5; available from NAP, \$39.00 plus \$4.50 shipping).

One Step at a Time: The Staged Development of Geologic Repositories for High-Level Radioactive Waste
Board on Radioactive Waste Management, Division on Earth and Life Studies (2002, 216 pp.; ISBN 0-309-08708-2; available from NAP, \$42.00 plus \$4.50 shipping).

Personal Cars and China
National Research Council, National Academy of Engineering, and Chinese Academy of Engineering (2003, 280 pp.; ISBN 0-309-08492-X; available from NAP, \$55.25 plus \$4.50 shipping).

Planning Climate and Global Change Research: A Review of the Draft U.S. Climate Change Science Program Strategic Plan
Division on Earth and Life Studies, Division of Behavioral and Social Sciences and Education, and Division on Engineering and Physical Sciences (2003, approx. 99 pp.; ISBN 0-309-08865-8; available from NAP, \$18.00 plus \$4.50 shipping).

Priority Areas for National Action: Transforming Health Care Quality
Board on Health Care Services, Institute of Medicine (2003, 160 pp.; ISBN 0-309-08543-8; available from NAP, \$32.00 plus \$4.50 shipping).

Review of the Centers for Disease Control and Prevention's Smallpox Vaccination Program Implementation — Letter Report #1
Board on Health Promotion and Disease Prevention, Institute of Medicine (2003, 52 pp.; available only online at <www.nap.edu>).

Review of the Centers for Disease Control and Prevention's Smallpox Vaccination Program Implementation — Letter Report #2
Board on Health Promotion and Disease Prevention, Institute of Medicine (2003, 42 pp.; available only online at <www.nap.edu>).

The Richard and Hinda Rosenthal Lectures 2001: Exploring Complementary and Alternative Medicine
Institute of Medicine (2003, 52 pp.; ISBN 0-309-08503-9; available from NAP, \$18.00 plus \$4.50 shipping).

Satellite Observations of the Earth's Environment: Accelerating the Transition of Research to Operations
Space Studies Board and Aeronautics and Space Engineering Board, Division on Engineering and Physical Sciences; and Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies (2003, approx. 142 pp.; ISBN 0-309-08749-X; available from NAP, \$35.00 plus \$4.50 shipping).

Science and the Greater Everglades Ecosystem Restoration: An Assessment of the Critical Ecosystem Studies Initiative
Water Science and Technology Board and Board on Environmental Studies and Toxicology, Division on Earth and Life Studies (2003, 168 pp.; ISBN 0-309-08728-7; available from NAP, \$34.25 plus \$4.50 shipping).

Sea Level Rise and Coastal Disasters — Summary of a Forum, October 25, 2001, Washington, D.C.
Natural Disasters Roundtable, Division on Earth and Life Studies (2002, 24 pp.; available only online at <www.nap.edu>).

Setting the Course: A Strategic Vision for Immunization — Part 2, Summary of the Austin Workshop
Board on Health Care Services, Institute of Medicine (2002, 66 pp.;

ISBN 0-309-08517-9; available from NAP, \$18.00 plus \$4.50 shipping).

Setting the Course: A Strategic Vision for Immunization — Part 3, Summary of the Los Angeles Workshop
Board on Health Care Services, Institute of Medicine (2003, 68 pp.; ISBN 0-309-08712-0; available from NAP, \$18.00 plus \$4.50 shipping).

A Shared Destiny: Community Effects of Uninsurance
Board on Health Care Services, Institute of Medicine (2003, 296 pp.; ISBN 0-309-08726-0; available from NAP, \$29.00 plus \$4.50 shipping).

Sharing Publication-Related Data and Materials: Responsibilities of Authorship in the Life Sciences
Board on Life Sciences, Division on Earth and Life Studies (2003, 120 pp.; ISBN 0-309-08859-3; available from NAP, \$28.00 plus \$4.50 shipping).

Statistical Issues in Allocating Funds by Formula
Committee on National Statistics, Division of Behavioral and Social Sciences and Education (2003, 162 pp.; ISBN 0-309-08710-4; available from NAP, \$39.00 plus \$4.50 shipping).

Technology Development for Army Unmanned Ground Vehicles
Board on Army Science and Technology, Division on Engineering and Physical Sciences (2002, 180 pp.; ISBN 0-309-08620-5; available from NAP, \$36.00 plus \$4.50 shipping).

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Space Studies Board, Division on Engineering and Physical Sciences (2003, 112 pp.; ISBN 0-309-08863-1; available from NAP, \$26.50 plus \$4.50 shipping).

Veterans and Agent Orange: Update 2002
Board on Health Promotion and Disease Prevention, Institute of Medicine (2003, approx. 435 pp.; ISBN 0-309-08616-7; available from NAP, \$79.00 plus \$4.50 shipping).

Weather Forecasting Accuracy for FAA Traffic Flow Management — A Workshop Report
Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies (2003, 68 pp.; ISBN 0-309-08731-7; available from NAP, \$18.00 plus \$4.50 shipping).

Weaving a National Map: A Review of the U.S. Geological Survey Concept of the National Map
Mapping Science Committee, Board on Earth Sciences and Resources, Division on Earth and Life Studies (2003, 140 pp.; ISBN 0-309-08747-3; available from NAP, \$39.00 plus \$4.50 shipping).

Who Goes There? Authentication Through the Lens of Privacy
Computer Science and Telecommunications Board, Division on Engineering and Physical Sciences (2003, approx. 165 pp.; ISBN 0-309-08896-8; available from NAP, \$33.00 plus \$4.50 shipping).

HOT OFF THE PRESS

Making the Nation Safer

The Role of Science and Technology in Countering Terrorism

The National Academies

Vulnerabilities abound in U.S. society. The openness and efficiency of the nation's key infrastructures — transportation, information and telecommunication systems, health systems, the electric power grid, emergency response, food and water supplies, and others — increase their susceptibility to terrorist attack.

Making the Nation Safer discusses technical approaches

to mitigating vulnerabilities in each of these areas, and applying knowledge and technology to deal with immediate problems and protect against future threats.

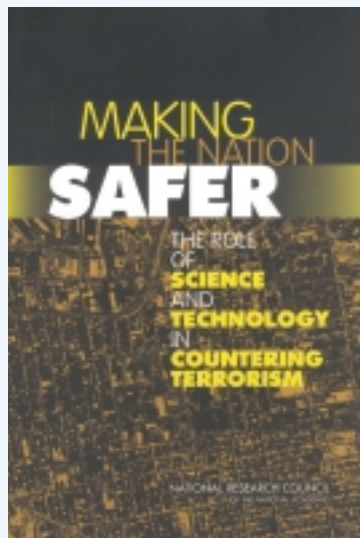
A long-term commitment to homeland security is necessary to make the nation safer, and this book lays out a roadmap of how science and engineering can assist in countering terrorism.

The National Academies Press

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As the author puts it, "A visually impaired person can still touch and smell a flower, or a tree, or an animal, but he or she could only imagine what an astronomical object is like ... until now."

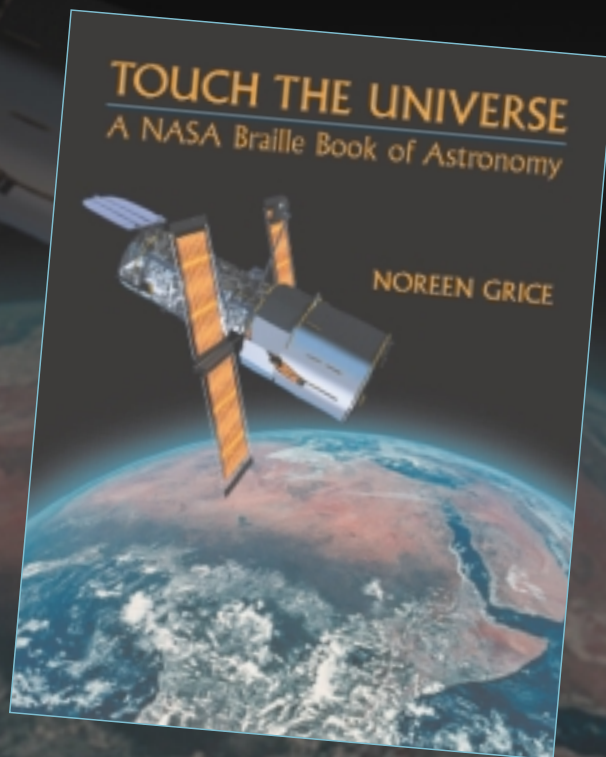
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— Kent Cullers, director of research and development, SETI Institute

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