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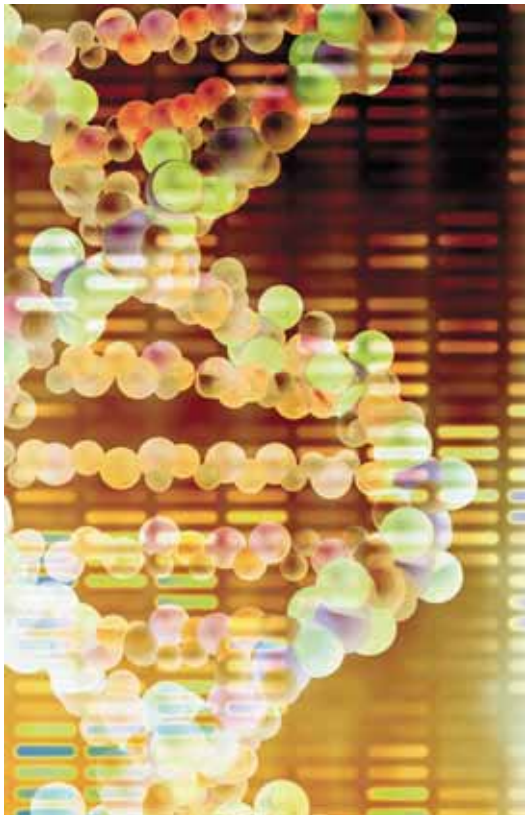

Fighting AIDS and Malaria in the Third World

The Debate Over Access to Genetic Data

Responding to Attacks in U.S. Seaports

How to Determine the Worth of Ecosystems

Fall/Winter 2004

THE NATIONAL ACADEMIES
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Science in Society for the 21st Century

Through the knowledge accumulated by centuries of investigation of the natural world, science has enabled people to gain a remarkable degree of control over their lives. It is an immensely successful endeavor that has led to an abundance of labor-saving devices, afforded the security provided by modern medicine and public health, and produced powerful communication and transportation technologies. Science and technology have also allowed humans to harness vast natural resources to meet their needs. But, as an indirect effect, the world's population has increased dramatically — heading for some 9 billion by 2050 — requiring ever more resources. As exemplified by the global climate change induced by greenhouse gases, we are now altering the Earth in irreparable ways.

Science and technology must be more effectively harnessed to reverse these trends. In an increasingly more crowded and dangerous world, we also need to discredit dogmatism and promote the scientific spirit of tolerance, reason, and rationality. The good news is that, in a world full of conflicting cultural values and competing needs, scientists everywhere share a powerful common culture that respects honesty, generosity, and good ideas, independent of their source. India's Prime Minister Jawaharlal Nehru had it right when he emphasized, some 50 years ago, the importance of imparting a "scientific temper" to his nation.

Achieving a scientific temper for the world will require strong merit-based institutions in each nation that are capable of harnessing science and technology to meet both national and global needs. It will also require an education system that imparts both scientific abilities and scientific values to all citizens — an "every child a scientist" education goal, in which students everywhere carry out activities that resemble science in their classrooms, starting at age 5.

I have just returned from the inaugural meeting of the Science and Technology in Society Forum in Kyoto, Japan — designed as an annual event that mixes scientists with leaders from the political and business communities in order to help fill many urgent needs in both industrialized and developing nations. The sense of this forum was perhaps best summarized by Taizo Nishimuro, the chairman of Toshiba Corp., when he stated that "In the past, science has shaped society; in the future, society must also shape science." It is clear that — as our enterprise becomes even more important to society — those of us who are scientists must pay more attention to societal concerns: Simply put, we can no longer pretend that we are doing our jobs if we exclusively pursue our own science, while hiding out in our laboratories. Meeting such challenges will require new types of interfaces between scientists and society.

BRUCE ALBERTS
President, National Academy of Sciences

THE BATTLE OF THE **BULGE**

National Campaign Needed to Curb Childhood Obesity

The key to avoiding obesity is elementary: consume no more calories than your body needs to fuel itself. But if that simple prescription was so easy to follow, rates of obesity among U.S. children and youth would not have tripled over the past three decades, inciting America's public health leaders to dub childhood obesity a national epidemic.

Debate rages over what factors are to blame for the increase in childhood obesity, with fingers pointing to everything from the abundance of fast food and soft drink ads to the dwindling of physical education in schools to the changing lifestyles and wavering willpower of kids and parents. Several recommendations have been made for steps that would curb the rise in obesity. But unhealthy eating and inactivity are too ingrained in today's culture to be solved by actions undertaken by one or a few segments of society, says a recent report from the Institute of Medicine. It will take a concerted, far-reaching campaign similar to national efforts to curb tobacco use to begin reversing the obesity trend, the report says. Families, schools, the food and entertainment industries, communities, and governments all share the

burdens of — and blame for — childhood obesity, and so all have roles to play.

"We've drifted into the current situation over the past 30 years because of gradual changes in society, but we're not going to just drift back out," said Jeffrey Koplan, chair of the committee that wrote the report, and vice president for academic health affairs, Emory University, Atlanta. "We need to launch a multilevel assault on obesity in kids, and this report offers the blueprint for a comprehensive campaign."

Several of the report's recommendations challenge entrenched aspects of American life. But preventing childhood obesity will require tough choices and a significant shift in many social norms, Kaplan noted.

The report calls for schools to apply nutritional standards developed at the national level to all foods and beverages served on school grounds, including vending machine products. The standards might entail setting upper limits on particular nutrients, such as fat and sugar. To counter downward trends in activity levels, schools should ensure that students engage in at least 30 minutes of physical activity each day and should expand opportunities for exercise beyond gym classes.

Because research suggests that exposure to food, beverage, and entertainment advertisements may adversely affect kids' eating habits and activity levels, these industries should develop and implement guidelines for advertising directed at kids. Congress should give the Federal Trade Commission the authority to monitor compliance and take action against ads that fail to comply. The restaurant industry should continue to expand offerings of nutritious foods and beverages, and restaurants should provide calorie content and other nutrition information.

The report also outlines several specific measures that parents should take, including providing healthy foods in the home, actively discussing their children's weight with health care providers, and limiting their children's TV, video game, and recreational computer time to less than two hours daily. It calls on community groups and state and local governments to support zoning ordinances and plans to enhance sidewalks, bike paths, playgrounds, and other recreational facilities.

While some might say that these and other aspects of the report's ambitious plan will be too hard to execute, the committee points to other national public health efforts that have proved successful over time, such as the campaigns to reduce tobacco use and to promote auto safety. People used to shun seat belts and even laugh at those who wore them, the committee members noted. Now, the vast majority of people buckle up automatically.

— *Christine Stencel*

Preventing Childhood Obesity: Health in the Balance. Committee on Prevention of Obesity in Children and Youth, Food and Nutrition Board, Institute of Medicine (2004, approx. 482 pp.; ISBN 0-309-09196-9; available from the National Academies Press, tel. 1-800-624-6242; $44.95 plus $4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/11015.html>).

The committee was chaired by **Jeffrey Koplan,** vice president for academic health affairs, Emory University, Atlanta. The study was funded by the U.S. Department of Health and Human Services' Office of Disease Prevention and Health Promotion; Centers for Disease Control and Prevention; National Institute of Diabetes and Digestive and Kidney Diseases; National Institute of Child Health and Human Development; National Heart, Lung, and Blood Institute; National Institutes of Health's Division of Nutrition Research Coordination; and the Robert Wood Johnson Foundation.

The Fight Against **AIDS** and **MALARIA**

Dealing a Blow to Third World Diseases

A glance at the health of developing nations reveals a grim picture. Over the past 25 years, HIV and AIDS have swept through these countries like a microbial wildfire and now kill 5,000 people a day and infect an additional 5 million every year. Meanwhile, the age-old disease malaria is resurging with a vengeance because of increasing resistance to old-line drugs.

To curb malaria and AIDS in the developing world, the United States and other industrialized nations will have to provide adequate financial aid and other resources, say two recent reports from the Institute of Medicine. The reports offer bold plans for tackling these diseases in ways that minimize drug resistance and ensure the treatments reach those who need them.

Drug combinations containing artemisinins, a new type of antimalarial compound derived from a Chinese herbal remedy, could deal malaria a powerful blow, says a report that focuses on the disease. The cost, however, presents a formidable impediment to the widespread use of artemisinin-based combination therapies (ACTs); at $1 to $2 per course of treatment, few people in poor nations can afford them.

If international organizations and world leaders collectively began to contribute $300 million to $500 million annually to create a global subsidy for ACTs, these drugs could be made available for as little as 10 cents per treatment course, the report says. That would make them as affordable as chloroquine, the inexpensive drug to which people

most frequently turn, but that, unfortunately, is being rendered useless by resistance.

The key to success is making sure that ACTs at subsidized prices reach people in these nations, where individuals most often purchase malaria drugs themselves from corner kiosks or other private sellers. The report recommends the creation of a centralized procurement system to buy ACTs at competitive prices and then resell them at much lower prices to public and private distributors in these nations. Also, processes for monitoring quality control should be established, as should incentives for countries to follow prudent malaria prevention and treatment policies.

Tackling malaria will be relatively inexpensive compared with solving the global HIV/AIDS crisis. In a report that offers an expert assessment of existing and proposed initiatives to scale up HIV treatment in the Third World, IOM provided a framework and key principles to guide the rollout and expansion of these programs.

The best chances for success will require donor organizations to commit to providing continuous funding for decades. UNAIDS estimates the total annual need for HIV/AIDS funding to be $10.7 billion for 2005 and $14.9 billion by 2007. The total estimated funding provided in 2003 was only $4.2 billion.

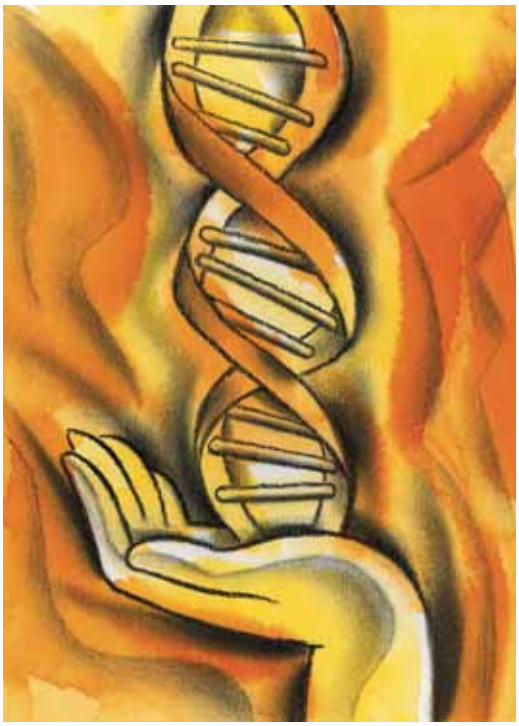
But even if there was enough money available now to treat every infected individual, global expansion of HIV/AIDS care could fail just because of the scarcity of trained personnel and adequate infrastructures to distribute safe and effective therapies in resource-poor nations. To address the work-force crisis, a variety of innovative programs should be created to bring an "HIV/AIDS corps" of volunteer medical and other professionals into developing countries to train their citizens in treatment and prevention and to provide technical assistance. Technology transfer and knowledge sharing among academic institutions, industry, public health agencies, and nongovernment organizations in industrialized and developing nations also should be boosted.

Tackling AIDS on a global scale will necessarily involve much learning by doing, the report says, acknowledging that problems with organization and patient adherence to complex therapy regimens could lead to faster development of drug resistance, which ultimately might result in widespread treatment failure. Therefore, about 5 percent to 10 percent of funding should be earmarked upfront for monitoring and evaluation to help discern what is working and what needs improvement. — *Christine Stencel*

Scaling Up Treatment for the Global AIDS Pandemic: Challenges and Opportunities. Committee on Examining the Probable Consequences of Alternative Patterns of Widespread Antiretroviral Drug Use in Resource-Constrained Settings, Board on Global Health, Institute of Medicine (ISBN 0-309-09264-7; $43.00 plus $4.50 shipping for single copies). The committee was chaired by **James Curran,** dean and professor of epidemiology, Rollins School of Public Health, Emory University, Atlanta. The study was funded by the Fogarty International Center and the Office of AIDS Research at the National Institutes of Health; and the Bill & Melinda Gates Foundation.

Saving Lives, Buying Time: Economics of Malaria Drugs in an Age of Resistance. Committee on the Economics of Antimalarial Drugs, Board on Global Health, Institute of Medicine (ISBN 0-309-09218-3; $49.95 plus $4.50 shipping for single copies). The committee was chaired by **Kenneth J. Arrow,** professor emeritus, department of economics, Stanford University, Stanford, Calif. The study was funded by the U.S. Agency for International Development and the Bill & Melinda Gates Foundation.

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



Public **or** Private?

THE **DEBATE** OVER OPEN ACCESS TO GENETIC DATA ON **PATHOGENS**

Roughly three years ago a team of scientists at St. Louis University inserted a particular mouse gene — one that regulates the creature's immunity — into a mousepox virus. The researchers then injected the altered virus into mice, where it "jammed" the animals' immune systems, flooding them with a natural chemical that blunted their ability to fight off infection. The new virus resulted in an extraordinarily lethal form of the disease, affecting even mice that had been vaccinated previously.

The experiment was conducted with benign motives, as part of a larger effort to explore countermeasures against engineered viruses. But it also illustrated a more sinister possibility: that sooner or later, such genetic engineering might be undertaken by terrorists instead of legitimate researchers, with a disease like smallpox instead of mousepox, and with humans rather than mice.

Policy-makers determined to avoid such a scenario are debating about how to deal with genome data on microbial pathogens. Currently the genome sequences for over 100 pathogens — including those for anthrax, Ebola, and plague — are freely

available in public databases around the world. In fact, the U.S. government requires that all genome sequences decoded using federal funds be made public, with rare exceptions. But some are concerned that data on pathogens could help terrorists develop an enhanced virus to use as a weapon. As federal agencies discuss whether this information should be restricted, they asked the National Research Council to weigh in.

In terms of fighting bioterrorism, restricting access to this data would probably be counterproductive, a Research Council study committee concluded. While it's true that a malefactor could now obtain data on pathogens, any restrictions tight enough to impede this would likely hobble legitimate research as well — including work on vaccines against the very diseases apt to be used in an attack. "Open access is essential if we are to maintain the progress needed to stay ahead of those who would attempt to cause harm," said committee chair Stanley Falkow, a professor of microbiology and immunology at Stanford University.

Given the interconnections between different areas of the life sciences, the report says, it would be impossible to predict which scientists will need access to which data — and this means that some researchers could find themselves barred from information they need. Deciding what data should be restricted would be no less problematic, because pathogen genomes are not the only ones that could potentially aid a terrorist. In the case of the altered mousepox virus, for example, genome data from the "host" animal was as crucial to the bioengineering effort as that from the virus itself. If data on all pathogens and all hosts were restricted, the report says, it would severely damage the fabric of the global scientific enterprise.

Moreover, restrictions probably wouldn't be effective, the committee added. Digital data are notoriously difficult to control, and files that contain entire genome sequences are small and therefore easily stored and transferred. And without a uniform international agreement, users who are denied access because of U.S. policy could simply turn elsewhere. Instead of trying to impose restrictions, policy-makers and researchers should focus on exploiting genome information fully to improve our defenses against infectious disease and bioterrorist threats.

The report adds a caveat to its call for continued openness, however. While now it would require a great deal of sophistication to alter an existing pathogen in a targeted way to make it more dangerous, genetic manipulation will someday become easier and more widespread. A panel should be formed to regularly review advances in genome science, to see if future developments warrant additional monitoring of or restrictions on access to data. — *Sara Frueh*

Seeking Security: Pathogens, Open Access, and Genome Databases. Committee on Genomics Databases for Bioterrorism Threat Agents, Board on Life Sciences, Division on Earth and Life Studies; and Division on Policy and Global Affairs (2004, 88 pp.; ISBN 0-309-09305-8; 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/11087.html>).

The committee was chaired by **Stanley Falkow,** professor of microbiology and immunology, Stanford University, Stanford, Calif. The study was funded by the National Science Foundation, National Institutes of Health, U.S. Department of Homeland Security, and the Central Intelligence Agency.

In the National Interest

ENSURING THE BEST S&T ADVICE AND LEADERSHIP

Many scientists, engineers, and health professionals serve on nearly 1,000 federal advisory committees that offer guidance to U.S. policy-makers and the nation on a host of issues, from how to bolster homeland security to what foods Americans should be encouraged to eat each day. Scientists also are appointed by the president to lead agencies like NASA and the National Science Foundation, where they help set priorities for the nation's research enterprise, the largest in the world.

While there are ample ways for science to make its mark on policy, in practice the system is far from flawless. The process for making science and technology (S&T) appointments is lengthy and rife with red tape, discouraging many well-qualified candidates from serving in leadership positions. Moreover, several groups and members of Congress have voiced concerns that appointments to federal advisory committees are being increasingly politicized. In light of these developments, the National Academies have issued a report — the third on this subject since 1992 — recommending ways to improve the process of recruiting S&T experts.

Soon after an election, the report says, the president or president-elect should choose a confidential science adviser who can help quickly identify candidates for other key S&T appointments in the crucial first days of the administration. This adviser could eventually serve as director of the White House Office of Science and Technology Policy. The president and Senate also should streamline and accelerate the appointment process. For example, they should work to eliminate duplication in background checks — currently one check is required by the White House and another by the Senate — and to simplify the financial disclosure rules. The goal should be to complete each candidate's selection process within four months. Positions that are important to national security should be filled even faster.

The independent guidance given by federal advisory committees is critical, the report says, and this system should not be co-opted by those hoping to promote a foregone conclusion or advance a political agenda. Scientists and health professionals nominated mainly to provide S&T input should be selected for their knowledge, credentials, and integrity; they shouldn't be asked for irrelevant information, such as voting records or political party affiliation. Agency heads should establish an appointment process supported by explicit policies and procedures, and staff must have a clear understanding of what questions are appropriate or inappropriate to ask candidates.

In seeking nominees for both presidential appointments and advisory committees, the government needs to cast a wider net, the report adds. It should better publicize opportunities for service, get input from recognized S&T leaders, and strive to identify women and minorities who could serve. — *Sara Frueh*

Science and Technology in the National Interest: Ensuring the Best Presidential and Federal Advisory Committee Science and Technology Appointments. Committee on Science, Engineering, and Public Policy, the National Academies (2004, 224 pp.; ISBN 0-309-09297-3; available from the National Academies Press, tel. 1-800-624-6242; $45.50 plus $4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/11152.html>).

The committee was chaired by **John Edward Porter,** partner, Hogan & Hartson LLP, Washington, D.C. The study was funded by the William and Flora Hewlett Foundation, the Andrew W. Mellon Foundation, and the National Academies.

Key Steps for Rapid Response to ATTACKS IN U.S. SEAPORTS

A chemical tanker and a cruise ship collide in the Houston Ship Channel after being hijacked by a group of terrorists. This results in a massive blaze, a hazardous materials spill, casualties, and the blockage of the channel, essentially shutting down the Port of Houston to all shipping.

Fortunately, this incident is fictitious. But if it did happen, it is not clear whether the nation could bring together the adequate resources quickly enough to handle the situation and reopen the channel and port with the least economic impact, says a new report from the National Academies' Transportation Research Board. The equipment necessary to conduct such marine salvage operations has not been inventoried recently and evaluated in sufficient detail to document its location and how it could be mobilized rapidly to respond to terrorist incidents in major seaports, said the committee that wrote the report.

"If such an incident occurred in a busy harbor or waterway, water channels could be blocked for days before the situation goes back to normal, and this could have a major impact on the U.S. economy," said committee chair Malcolm MacKinnon III, managing member of MSCL LLC, in Alexandria, Va. "Since marine casualties in U.S. waters are at an all-time low, quantities of marine salvage equipment such as standby tugs and vessels have steadily declined for the past decade and are not available near most harbors, either, because they're too expensive to maintain."

To increase readiness for terrorist attacks at sea, the U.S. Navy's Office of the

Supervisor of Salvage and Diving — the agency in charge of DOD maritime salvage and underwater search operations — should continue to work with the U.S. Coast Guard — the agency in charge of maritime homeland security — and with major salvage companies to rapidly identify which equipment is available to respond to maritime emergencies, the report says.

"The problem is that there is limited amount of specialized heavy-salvage equipment available, and because there is a limited amount, it is frequently in use," said

Captain Jim Wilkins, the U.S. Navy's supervisor of salvage and diving and director of ocean engineering. "Availability of the equipment for immediate, emergency response varies from day to day. Our best means to keep up to date with actual availability of commercial heavy-salvage equipment is through direct dialogue with our colleagues in that industry — a method that has proved itself over time."

To evaluate readiness, experts from the government, academia, and industry should conduct exercises in which they discuss terrorist scenarios and how equipment could be mobilized to clear harbors and water channels in the event of an attack, the committee said. Individual agencies — such as the FBI, U.S. Army Corps of Engineers, Coast Guard, National Safety Transportation Board, and local fire and police departments — should conduct exercises to test their own responses as well.

The report also recommends that the secretary of homeland security's National Maritime Security Advisory Committee include a marine salvage expert and that the Coast Guard's director of homeland security create a liaison position with the Navy's Office of the Supervisor of Salvage and Diving. Also, salvage expertise should be part of the National Incident Management System, a national plan being developed by the Department of Homeland Security to integrate prevention, preparedness, response, and recovery activities.

"The attacks on the World Trade Center and the Pentagon, as well as the attack on the USS Cole, suggest that support for national salvage capabilities should be increased," MacKinnon said. "We shouldn't wait for a major incident to happen to get a feel for the equipment required."
— *Patrice Pages*

Marine Salvage Capabilities: Responding to Terrorist Attacks in U.S. Ports — Actions to Improve Readiness. Marine Board, Transportation Research Board (2004, 38 pp.; ISBN 0-309-09459-3; available from the National Academies Press, tel. 1-800-624-6242; $29.00 plus $4.50 shipping for single copies; also on the Internet at <national-academies.org/trb/bookstore>).

Malcolm MacKinnon III, managing member, MSCL LLC, Alexandria, Va., chaired the committee. The study was funded by the Maritime Administration, U.S. Coast Guard, U.S. Army Corps of Engineers, U.S. Navy Supervisor of Salvage and Diving, Office of Naval Research, U.S. Department of Energy, National Oceanic and Atmospheric Administration, and the National Science Foundation.

Nanotechnology Conference Encourages Interdisciplinary Collaboration

Operating on a scale 100,000 times smaller than the width of a human hair, the science of manipulating tiny particles too small to see promises new materials and techniques that could overcome the limits of conventional medicine. Nanotechnology holds great potential for merging fields as disparate as cell biology and robotics, presenting opportunities for collaboration between researchers in very different disciplines. That's one reason 100 scientists, engineers, and medical researchers gathered to attend a two-day, bicoastal conference on nanotechnology in September. Sponsored by the National Academies Keck *Futures Initiative,* the event offered a venue for researchers to share information about advances and challenges in their fields related to nanotechnology. The result: The researchers developed a common language to discuss their work, and they recognized the need for interdisciplinary collaboration to further their efforts.

"Nanotechnology research has a wide intersection between science, engineering, and medicine," said Cherry Murray, senior vice president of physical sciences research, Bell Laboratories, Lucent Technologies, and chair of the conference planning and steering committees. "We want these researchers to forge teams and explore new ideas to spark discovery."

Conference topics ranged from biological machines to tissue engineering. Speaker Peter Singer, director of the Joint Centre for Bioethics at the University of Toronto, began the conference with a session on ethics and philosophical issues surrounding nanotechnology. He called the divide between the nanoscience and nanotechnology community and the technology-wary public one of the biggest challenges facing the field and urged the researchers to engage the public and talk about the ethics of nanotechnology before its opponents shape the debate, as happened with the issue of genetically modified organisms.

Perhaps one of the most intriguing sessions was on the future of medicine. Judith Swain, chair of the department of medicine at Stanford University School of Medicine, delivered a presentation on the emerging field of pharmacogenomics, which uses the genome to understand an individual's different responses to drugs. This field offers the potential to prevent, diagnose, and treat diseases by understanding genetic variations. Swain also touched on promising treatments that incorporate the use of technologies, such as regenerative medicine, stem cell replacement biology, and brain-machine interface in treatment therapies.

In November at the second annual *Futures* conference, participants continued their discussions on nanotechnology, explored collaborations, and competed for $1 million in research seed grants. This year's grants are designed to encourage interdisciplinary collaboration specifically in the field of nanotechnology. Detailed summaries of both conferences are available at <national-academies.org/keck>.
— *Maureen O'Leary*

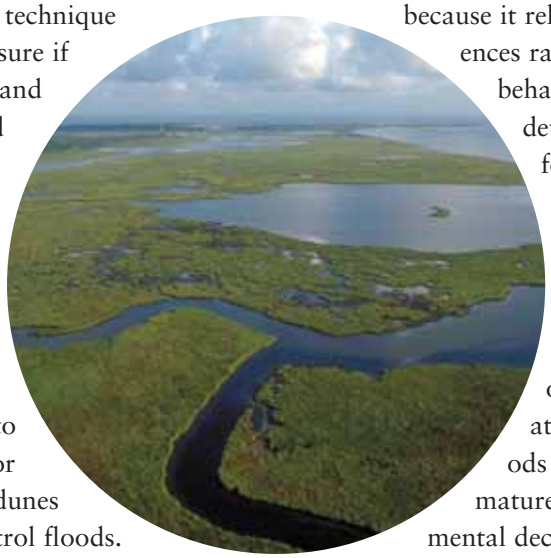
Putting a Price Tag on **ECOSYSTEMS**

Assigning a dollar figure to the commercial, recreational, or even aesthetic value of a crystal clear river, or to the value of preserving an endangered species, is no easy task, but a new report from the National Research Council says that such calculations are a must to accurately weigh the trade-offs among environmental policy options. Too often, the report says, goods and services provided by an ecosystem are overlooked in the decision-making process because they are assigned a value of zero in the all-important cost-benefit analyses that form the basis for many environmental policies.

Some ecosystem commodities are more tangible than others. While the market sets a price on fish sold in stores or on real estate located next to a Superfund site, for instance, it is harder to put a price on fish caught for fun or on the scenic worth of an undisturbed wilderness. A value for recreational fishing could be determined, however, using a "travel-cost" model based on anglers' responses to questions about how many more days they would fish if the stock were bountiful and edible, and how much they might spend at local restaurants, hotels, and tackle shops.

The report identifies several methods for applying value to ecosystem goods and services that are not easily quantifiable, often because there is no obvious market for them, but that affect other things with

definite market values. For example, the "production function" method looks at whether a change in the health of an ecosystem improves or diminishes the services it provides. Along the Florida and Louisiana coasts, this technique has been used to measure if the expansion of wetland marshes has increased the size of the crab population and therefore the value of the fishery. "Hedonic" methods can be employed to detect fluctuations in real estate value due to area pollution levels or the ability of nearby dunes or river banks to control floods.



In other cases, surveys can determine how willing people are to give up property rights for conservation purposes or how much they are willing to pay for an environmental improvement that may be of no direct use to them. After the Exxon *Valdez* disaster, surveys revealed that Americans were willing to spend an average of $33 each on efforts to prevent a similar tragedy in Prince William Sound, even though most of them would never see the Alaska coastline.

Measuring so-called non-use values, including perceived aesthetic and intrinsic values, is important because they may be the largest source of an ecosystem's worth to society, the report says. It also recommends that the "total economic value" framework, which incorporates non-use values, be applied in environmental cost-benefit analyses. Appraising multiple ecosystem services is more difficult, the report adds, but doing so provides a better picture of the importance of the entire ecosystem.

The use of surveys to calculate the value of ecosystem services has been criticized because it relies on stated preferences rather than observed behavior. Techniques to determine values not founded on market pricing also are subject to uncertainty and bias. Nevertheless, the report concludes that based on the scientific literature, valuation methods are sufficiently mature to support environmental decision-making.

Additional funding is needed to foster collaborations between ecologists and economists on ways to better integrate the study of ecosystems and their worth to society.
— *Bill Kearney*

Valuing Ecosystem Services: Toward Better Environmental Decision-Making. Committee on Assessing and Valuing the Services of Aquatic and Related Terrestrial Ecosystems, Water Science and Technology Board, Division on Earth and Life Studies (2004, approx. 313 pp.; ISBN 0-309-09318-X; available from the National Academies Press, tel. 1-800-624-6242; $45.00 plus $4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/11139.html>).

The committee was chaired by **Geoffrey M. Heal,** Paul Garrett Professor of Public Policy and Business Responsibility and professor of finance and economics, Graduate School of Business, and professor of international and public affairs, School of International and Public Affairs, Columbia University, New York City. The study was funded by the U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, and U.S. Department of Agriculture.

Untapped Potential

FOCUS NEEDED TO FIRE UP RESEARCH ON NATURAL GAS SOURCE

Plentiful in Arctic regions and beneath the ocean floor, methane hydrate is a highly concentrated and potent source of natural gas. If methane could be efficiently plucked from hydrate deposits, energy supplies from natural gas could be extended for decades — perhaps centuries — to come.

Producing gas from hydrate can be a risky business, however. For starters, accurately identifying hydrate deposits remains a challenge. And there are no hard numbers on how much of the world's vast reserves can actually be recovered. Also, methane is a greenhouse gas that has been widely cited as a factor in previous episodes of global warming; releasing methane from hydrate could affect global climate change.

But the potential of this natural resource is so great that the United States, Canada, Japan, Korea, and India have established research programs to study it. Congress authorized the U.S. Department of Energy to conduct or oversee America's investigations in this area. It also called for the National Research Council to assess DOE's methane hydrate R&D program.

On the whole, the program boosts the ability of U.S. commercial interests and scientists to develop energy from gas hydrate and to understand potential geological constraints on drilling through hydrate, says a new Research Council report. Still, improvements are needed.

About 60 percent of the program's annual budget of roughly $9 million has gone to three industry-managed research projects. Because of their large size and price tags, special checks and balances should be implemented to aid such efforts, the report says. For example, reviews of how projects have progressed ought to be based on solid science. The results of these projects also should be available in public databases because tax dollars supported the initiatives and other scholars might find the information useful.

The program should fund postdoctoral fellowships to enhance training in the field, and it should closely examine any links between methane hydrate and climate change, the report adds. Program officials also should seek more opportunities to form partnerships with international groups that are conducting similar research.

Several specific research topics need to be tackled systematically because they are not well-understood, such as effective ways to identify hydrate deposits, design comprehensive field experiments, and make the most of technology in gas-hydrate recovery and production processes. Overall, greater scientific oversight of DOE's program is needed to ensure that its key goals are met, the report says. — *Vanee Vines*

Charting the Future of Methane Hydrate Research in the United States. Committee to Review the Activities Authorized Under the Methane Hydrate Research and Development Act of 2000, Ocean Studies Board and the Board on Earth Sciences and Resources, Division on Earth and Life Studies (2004, 202 pp.; ISBN 0-309-09292-2, available from the National Academies Press, tel. 1-800-624-6242; $43.00 plus $4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/11094.html>).

The committee was chaired by **Earl H. Doyle,** an independent consultant who specializes in the integration of marine geology, geophysics, and geotechnical engineering, and a former employee of Shell Oil Co., where he worked for 30 years in senior engineering positions. The study was sponsored by the U.S. Department of Energy.

BY RICHARD B. ALLEY

Making Sense of a ***Big Screen Ice Age***

The environment appears to be somewhat less stable in Hollywood than out here in the real world. We barely had time to recover from an impossibly big earthquake shaking our TV sets in the movie "10.5," before we had to face an impossibly large and rapid climate change freezing over our movie theaters and New York City last summer in "The Day After Tomorrow."

Fortunately, the prospect of a new ice age "the day after tomorrow" is fiction of the humorously entertaining sort. But what is the average person to make of the science hiding behind movie fiction?

Much is clear. Climate has changed, and will change. There are many humans in the world, more all the time, and we're affecting a lot of things including the composition of the air. A car produces nearly 300 pounds of carbon dioxide a week, some of which is absorbed by the oceans or plants, but a lot stays in the air. More atmospheric carbon dioxide leads to a warmer planet, based on physical principles that have been well-understood for more than a century. Measurements show that carbon dioxide is rising in the atmosphere, and that the planet is warming, whether you look at melting glaciers, satellite measurements, or thermometers in the air, on the ground, or under the oceans.

Ice cores, tree rings, and other "histories" of climate show that at certain times in the past, large and rapid jumps occurred locally across much of the globe, more than 15 degrees Fahrenheit in as little as a decade or less. The last of these really big abrupt changes was more than 8,000 years ago, and most were during the last ice age. Ecosystems were forced to move to other locations — had there been more civilizations then, people likely would have moved, too. Smaller, regional abrupt climate changes have persisted into the current warm period, often as quick-starting and persistent droughts that may have contributed to the fall of civilizations such as the Mayan empire in the ninth century.

Richard B. Alley is the Evan Pugh Professor of Geosciences at Pennsylvania State University. Alley conducts research on the paleoclimatic records, dynamics, and sedimentary deposits of large ice sheets, as a means of understanding the climate system and its history, and projecting future changes in climate and sea level.

Abrupt changes occur when the Earth's system is forced just enough to cross a threshold. Lean a little in a canoe and you're still dry. Lean too far, and it flips over. Usually, the climate has "leaned" slowly in response to changes in sunlight or orbits or carbon dioxide. But occasionally, it has flipped to a new state and stayed there for centuries or longer. Without even knowing where all the flipping points are in the climate, we can't control or even skillfully navigate those changes.

Much attention has been focused on a possible change in the ocean circulation in the North Atlantic — a shutdown of the cycle in which cold Arctic water sinks and flows toward the equator and then brings warmth gained there back to the poles. This shutdown, which has been implicated in past abrupt climate changes, would likely cause cold, dry, and windy conditions across much of the northern hemisphere. Although not impossible, a large change soon seems quite unlikely, and would not in any case trigger the next ice age or flash-freeze New York City. Smaller impacts of North Atlantic changes remain possible, and the slight chance of a big change draws attention. Shifts in droughts or floods, in such natural variability as El Niño — the warming of ocean currents that affects rain patterns across much of the world — and in the stability of ice sheets are also of interest, and might impact humans and ecosystems in many ways.

Faster and less-expected changes are harder to deal with, potentially causing societal disruption, economic hardship, and ecological stress. Emerging knowledge of abrupt climate change may prove useful to reduce or avoid these dangers. In deciding what to do about climate change, we weigh costs and benefits for us and future generations. Planning for smooth global warming over centuries is in some sense highly optimistic; all histories of climate show faster and less-predictable bumps and wiggles.

I chaired the National Research Council's Committee on Abrupt Climate Change, which authored a 2002 report that recommends the study of possible abrupt climate changes and impacts they might have. The report also recommends that we look for low-cost or no-cost ways — we called them "no-regrets" strategies — that could minimize the possibility of abrupt changes, and maximize the ability of economies and ecosystems to bend rather than break, in case an abrupt change occurs.

Climate change and warming are highly likely to continue, but this knowledge provides only a starting place for our ability to predict the future. Confident prediction of climate in your backyard decades from now is still a dream. Those of us who study the climate don't expect to rival movie heroes, but we hope to help.

BY FATEEMA BLACKWELL

Anderson Interns Bring a Fresh View to the National Academies

"When I walked into the building, I felt a scientific vibe, which probably derived from the many science-related images on the walls of the main lobby here at the Academies' new building," said Dexter Mackie upon entering the Keck Center on his first day. "I didn't necessarily feel like Albert Einstein, but I was enthused by the employees here, who seem to be deeply interested in their specialties."

On June 14, six recent graduates from Benjamin Banneker Academic High School in Washington, D.C., stepped through the doors of the National Academies, excited to embark on a 10-week journey into the work world. My fellow interns and I made our way to the Marian Koshland Science Museum after an employee orientation. Newly graduated and now starting my first term as an Anderson Intern in the Office of News and Public Information, I was amazed by the museum's DNA exhibit, which explains various uses of forensic science — a subject I intend to major in at Virginia Commonwealth University.

Each intern is placed in a particular unit of the National Academies based on his or her interests and skills. Intern Johnny Hernandez said, "The way they place interns is strategic not only for them but also for us, because even if we were not placed according to our specific science career interests, we still learn a skill important to science and can apply it to our upcoming college year."

Our group, along with five returning interns, all have a vested interest in science, though each steering us in a different direction. Zainep Mahmoud, who interned in

the Division on Policy and Global Affairs, wants to know and understand the connections between science and law and apply it to her studies in economics at Dartmouth College in the fall. Zainep desires to make a positive change in the restrictions placed on scientists by the law.

The Anderson Interns contributed to various projects this summer, including helping produce a four-page report brief for high school students, and working on studies about retaining and recruiting minorities in the sciences at the undergraduate level, environmental policies of pharmaceutical companies, and much more.

For some of the interns, working at the Academies sparked new interests in areas of science. Rahel Menghestab, a second-year intern in the Division on Earth and Life Sciences, said that working at the Academies last summer sealed her decision to study environmental science.

The interns agree that working at the National Academies is a learning experience. They gained knowledge in different areas through reading, editing, and producing reports, attending meetings, and even traveling. Danielle Green, a returning intern in the Board on Radiation Effects Research, attended a meeting in Salt Lake City to hear the testimony of concerned citizens who were potentially exposed to radiation from fallout of nuclear weapons testing during the 1950s and '60s. Back then, they had no knowledge that radiation exposure could cause health problems. She was saddened yet impressed at how these individuals still fight for their lives.

The interns' mentors also enjoyed being a part of the Anderson Intern program. They felt that the interns' ideas and work brought a fresh perspective to the National Academies. Employee Lauren Alexander supports this program because it opens a door for minorities to enter the science field.

It is important for the National Academies to continue this program because of its effect on the participants. "I think the internship is a wonderful experience that fosters interaction with talented people and various aspects of science," concluded third-year Anderson Intern LaTeya Foxx.

Each year, Banneker faculty nominate and select four graduating seniors for the Anderson internships. These paid summer positions are offered to students who want to pursue careers in science, engineering, or medicine. The interns begin work after graduation and may be invited to return for up to three successive summers during their college studies. The internships are funded in part by a grant from the Rose-Marie and Jack R. Anderson Foundation in Dallas.

A Nuclear TIPPING POINT?

NAS Hosts Symposium on Post-Cold War U.S. Nuclear Strategy

More than a decade after the fall of the Soviet Union, why do the United States and Russia still keep their ICBMs on hair-trigger alert? What is the probability that terrorists will obtain, transport, and detonate a "suitcase" nuclear bomb in an American city? And, despite decades-long anti-proliferation efforts, is the United States about to watch helplessly as many more nations choose the nuclear option for defense or as a way to threaten their neighbors?

These were among the sobering questions raised at a daylong public symposium on post-Cold War U.S. nuclear strategy, sponsored by the National Academy of Sciences' Committee on International Security and Arms Control in August. In his keynote address, former Secretary of Defense William Perry warned that he believes the chance of a terrorist nuclear blast somewhere in the United States by the end of the decade now exceeds 50 percent. The world today seems poised at a "nuclear tipping point," Perry added. "If Iran and North Korea go nuclear, a new widespread arms race will be virtually unstoppable, especially in the Middle East," he said.

What about the strategic U.S. nuclear arsenal? Rep. David Hobson (R-Ohio), who chairs a key House appropriations subcommittee on nuclear weapons development, said he doubts the utility of a large nuclear arsenal in an age of hit-and-run terrorism. In addition, he said, "we have too many unmet conventional defense needs in the present day to afford spending over $6 billion

annually to support a large and antiquated nuclear-weapons complex."

However, Ambassador Linton Brooks, administrator of DOE's National Nuclear Security Administration, suggested that the U.S. nuclear arsenal remains a crucial deterrent in the face of new threats. Brooks stated, "Deterrence means we have to hold at risk things which an adversary values. More and more we see potential opponents putting important military facilities underground; our efforts to determine the effectiveness of [an earth-penetrating weapon] reflect a continued emphasis on deterrence."

Speakers agreed on the pressing need to bring "loose nukes," such as small 10-kiloton devices from the old Soviet arsenal, under tighter security controls. Others emphasized the need to "de-alert" U.S. and Russian ICBMs to prevent an accidental launch primed by computer errors or ambiguous signals following a major terrorist attack. But many at the symposium, including Sidney Drell, emeritus deputy director at the Stanford Linear Accelerator Center, pressed hard on the threat of further nuclear proliferation. They emphasized the need to change the way nations that already have nuclear weapons look upon nuclear have-nots. The biggest problem in proliferation, Drell said, is that the non-nuclear world has tired of nuclear nations moving ahead with enhancements to their arsenals while asking others to show restraint. "We have to stop the attitude that nuclear weapons are good for us, but bad for others," he said. Rep. Hobson put it as follows: "We cannot advocate for nuclear non-proliferation around the globe and pursue more useable nuclear weapon options here at home. That inconsistency is not lost on anyone in the international community."

— *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.

Analyzing the U.S. Content of Imports and Foreign Content of Exports.
Center for Economic, Governance, and International Studies, Division of Behavioral and Social Sciences and Education. Project director: Nevzer Stacey. Chair: Edward E. Leamer, director, UCLA Anderson Forecast, and Chauncey J. Medberry Chair in Management, Anderson School of Management, University of California, Los Angeles. Sponsor: U.S. House of Representatives Small Business Committee, through the U.S. Department of Commerce.

A Framework for Understanding Electronic Voting.
Computer Science and Telecommunications Board, Division on Engineering and Physical Sciences. Project director: Herb Lin. Co-chairs: Richard Thornburgh, counsel, Kirkpatrick & Lockhart LLP, Washington, D.C.; and Richard Celeste, president, Colorado College, Colorado Springs. Sponsor: National Science Foundation.

Guidelines for Human Embryonic Stem Cell Research.
Board on Life Sciences, Division on Earth and Life Studies; and Board on Health Sciences Policy, Institute of Medicine. Project director: Fran Sharples. Co-chairs: Richard O. Hynes, Daniel K. Ludwig Professor of Cancer Research, Center for Cancer Research and department of biology, Massachusetts Institute of Technology, Cambridge; and Jonathan D. Moreno, professor of biomedical ethics and director, Center for Biomedical Ethics, University of Virginia, Charlottesville. Sponsors: Greenwall Foundation, Ellison Medical Foundation, and the National Academies.

Improving Cybersecurity Research in the United States.
Computer Science and Telecommunications Board, Division on Engineering and Physical Sciences; and National Academy of Engineering. Project director: Charles Brownstein. Chair: Joel S. Birnbaum, senior technical adviser to the chief executive officer, Hewlett-Packard Co., Palo Alto, Calif. Sponsors: National Institute of Standards and Technology, Defense Advanced Research Project Agency, National Science Foundation, and National Academy of Engineering.

Redesigning Insurance Benefits, Provider Payments, and Performance Improvement Programs to Promote Quality of Health Care Delivery.
Board on Health Care Services, Institute of Medicine. Project director: Janet M. Corrigan. Chair: Steven A. Schroeder, Distinguished Professor of Health and Health Care, University of California, San Francisco. Sponsors: Centers for Medicare and Medicaid Services, and the National Academies.

Review of EPA's Assessment of the Health Implications of Exposure to Dioxins.
Board on Environmental Studies and Toxicology and Board on Agriculture and Natural Resources, Division on Earth and Life Studies; and Food and Nutrition Board, Institute of Medicine. Project director: Suzanne van Drunick. Chair: David Eaton, associate dean for research, School of Public Health and Community Medicine; director, Center for Ecogenetics and Environmental Health; and professor, department of environmental and occupational health sciences and the public health genetics program, University of Washington, Seattle. Sponsors: U.S. Environmental Protection Agency, U.S. Department of Agriculture, and U.S. Department of Health and Human Services.

Science Learning, Kindergarten Through Eighth Grade.
Board on Science Education, Center for Education, Division of Behavioral and Social Sciences and Education. Project co-directors: Heidi Schweingruber and Andrew Shouse. Chair: Richard Duschl, professor of science education, Rutgers University, New Brunswick, N.J. Sponsors: National Science Foundation, National Institute of Child Health and Human Development, and Merck Institute for Science Education.

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.

Accelerating Technology Transition: Bridging the Valley of Death for Materials and Processes in Defense Systems
National Materials Advisory Board and Board on Manufacturing and Engineering Design, Division on Engineering and Physical Sciences (2004, 68 pp.; ISBN 0-309-09317-1; available from NAP, $18.00 plus $4.50 shipping).

Accident Precursor Analysis and Management: Reducing Technological Risk Through Diligence
National Academy of Engineering (2004, 220 pp.; ISBN 0-309-09216-7; available from NAP, $35.00 plus $4.50 shipping).

Advancing Scientific Research in Education
Center for Education, Division of Behavioral and Social Sciences and Education (2004, 140 pp.; ISBN 0-309-09321-X; available from NAP, $32.00 plus $4.50 shipping).

Army Science and Technology for Homeland Security, Report 2: C4ISR
Board on Army Science and Technology, Division on Engineering and Physical Sciences (2004, 170 pp.; ISBN 0-309-09164-0; available from NAP, $36.50 plus $4.50 shipping).

California Agricultural Research Priorities: Pierce's Disease
Board on Agriculture and Natural Resources, Division on Earth and Life Studies (2004, 178 pp.; ISBN 0-309-09289-2; available from NAP, $35.00 plus $4.50 shipping).

Children's Health, The Nation's Wealth: Assessing and Improving Child Health
Board on Children, Youth, and Families, National Research Council and Institute of Medicine (2004, 340 pp.; ISBN 0-309-09118-7; available from NAP, $47.95 plus $4.50 shipping).

Computer Science: Reflections on the Field, Reflections From the Field
Computer Science and Telecommunications Board, Division on Engineering and Physical Sciences (2004, 208 pp.; ISBN 0-309-09301-5; available from NAP, $35.00 plus $4.50 shipping).

Confronting the Nation's Water Problems: The Role of Research
Water Science and Technology Board, Division on Earth and Life Studies (2004, 324 pp.; ISBN 0-309-09258-2; available from NAP, $47.00 plus $4.50 shipping).

Critical Perspectives on Racial and Ethnic Differences in Health in Late Life
Committee on Population, Division of Behavioral and Social Sciences and Education (2004, 752 pp.; ISBN 0-309-09211-6; available from NAP, $69.00 plus $4.50 shipping).

Direct and Indirect Human Contributions to Terrestrial Carbon Fluxes — A Workshop Summary
Board on Agriculture and Natural Resources, Division on Earth and Life Studies (2004, 92 pp.; ISBN 0-309-09226-4; available from NAP, $18.00 plus $4.50 shipping).

Gulf War and Health: Updated Literature Review of Sarin
Board on Health Promotion and Disease Prevention, Institute of Medicine (2004, 132 pp.; ISBN 0-309-09294-9; available from NAP, $30.75 plus $4.50 shipping).

Hearing Loss: Determining Eligibility for Social Security Benefits
Board on Behavioral, Cognitive, and Sensory Sciences, Division of Behavioral and Social Sciences and Education (2004, approx. 320 pp.; ISBN 0-309-09296-5; available from NAP, $49.00 plus $4.50 shipping).

Improving the Use of the 'Best Scientific Information Available' Standard in Fisheries Management
Ocean Studies Board, Division on Earth and Life Studies (2004, 118 pp.; ISBN 0-309-09263-9; available from NAP, $18.00 plus $4.50 shipping).

Keeping Score for All: The Effects of Inclusion and Accommodation Policies on Large-Scale Educational Assessments
Board on Testing and Assessment, Center for Education, Division of Behavioral and Social Sciences and Education (2004, 150 pp.; ISBN 0-309-09253-1; available from NAP, $36.00 plus $4.50 shipping).

Naval Forces' Defense Capabilities Against Chemical and Biological Warfare Threats
Naval Studies Board, Division on Engineering and Physical Sciences (2004, 212 pp.; ISBN 0-309-08872-0; available from NAP, $28.00 plus $4.50 shipping).

Open Access and the Public Domain in Digital Data and Information for Science — Proceedings of an International Symposium
Board on International Scientific Organizations, Division on Policy and Global Affairs (2004, 196 pp.; ISBN 0-309-09145-4; available from NAP, $40.50 plus $4.50 shipping).

Proposed Criteria for Selecting the WIC Food Packages — A Preliminary Report of the Committee to Review the WIC Food Packages
Food and Nutrition Board, Institute of Medicine (2004, 132 pp.; ISBN 0-309-09298-1; available from NAP, $30.25 plus $4.50 shipping).

Retooling Manufacturing: Bridging Design, Materials, and Production
Board on Manufacturing and Engineering Design and National Materials Advisory Board, Division on Engineering and Physical Sciences (2004, 123 pp.; ISBN 0-309-09266-3; available from NAP, $28.50 plus $4.50 shipping).

Review of the U.S. Army Corps of Engineers Restructured Upper Mississippi River-Illinois Waterway Feasibility Study — Second Report
Water Science and Technology Board, Division on Earth and Life Studies; and Transportation Research Board (2004, 80 pp.; ISBN 0-309-09436-4; available from NAP, $18.00 plus $4.50 shipping).

Safety of Genetically Engineered Foods: Approaches to Assessing Unintended Health Effects
Board on Life Sciences and Board on Agriculture and Natural Resources, Division on Earth and Life Studies; and Food and Nutrition Board, Institute of Medicine (2004, 256 pp.; ISBN 0-309-09209-4; available from NAP, $35.00 plus $4.50 shipping).

Saving Women's Lives: Strategies for Improving Breast Cancer Detection and Diagnosis
National Cancer Policy Board, Institute of Medicine and Division on Earth and Life Studies; and Board on Science, Technology, and Economic Policy, Division on Policy and Global Affairs (2004, approx. 280 pp.; ISBN 0-309-09213-2; available from NAP, $44.95 plus $4.50 shipping).

Science and Technology in Armenia: Toward a Knowledge-Based Economy
Office for Central Europe and Eurasia, Development, Security, and Cooperation, Division on Policy and Global Affairs (2004, approx. 150 pp.; ISBN 0-309-09278-7; available from NAP, $33.00 plus $4.50 shipping).

Strategies to Leverage Research Funding: Guiding DOD's Peer Reviewed Medical Research Programs
Medical Follow-Up Agency and Board on Health Sciences Policy, Institute of Medicine (2004, 192 pp.; ISBN 0-309-09277-9; available from NAP, $34.00 plus $4.50 shipping).

Strengthening Peer Review in Federal Agencies That Support Education Research
Center for Education, Division of Behavioral and Social Sciences and Education (2004, 106 pp.; ISBN 0-309-09099-7; available from NAP, $25.25 plus $4.50 shipping).

Terrorism: Reducing Vulnerabilities and Improving Responses — U.S.-Russian Workshop Proceedings
Office for Central Europe and Eurasia, Development, Security, and Cooperation, Division on Policy and Global Affairs, in cooperation with the Russian Academy of Sciences (2004, 254 pp.; ISBN 0-309-08971-9; available from NAP, $44.00 plus $4.50 shipping).

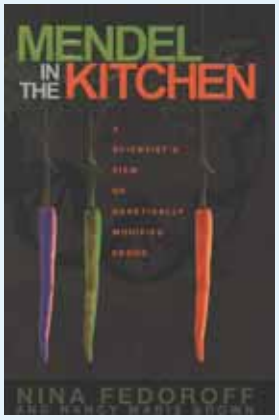
Understanding Racial and Ethnic Differences in Health in Late Life: A Research Agenda
Committee on Population, Division of Behavioral and Social Sciences and Education (2004, 184 pp.; ISBN 0-309-09247-7; available from NAP, $37.00 plus $4.50 shipping).

HOT OFF THE PRESS

Mendel in the Kitchen

A Scientist's View of Genetically Modified Foods

Nina Fedoroff and Nancy Marie Brown



Any farmer could tell you that we've been manipulating the genetic makeup of food for millennia, carefully coaxing nature to do our bidding. The practice dates back to the 19th century, when Gregor Mendel — not a scientist, but an Augustinian monk — spent hours toiling in his garden, testing and cultivating more than 28,000 pea plants and selectively determining specific characteristics of the peas that were produced. His work ultimately gave birth to the idea of heredity and the now very common practice of modifying foods.

But as science takes the helm, steering field practices into the laboratory, the world is keenly aware of how adept we have become at tinkering with nature, which in turn has led to many questions. Are genetically modified foods really safe? Will the foods ultimately make us sick, perhaps in ways we can't even imagine? Isn't it dangerous to change the nature of nature itself?

In *Mendel in the Kitchen,* leading geneticist and molecular biologist Nina Fedoroff answers these questions and more. Fedoroff — a member of the National Academy of Sciences who has contributed to the development of techniques used to study and modify plants today — and her co-author, science writer Nancy Brown, weave a narrative rich in history, technology, and science to dispel myths and misunderstandings about genetically modified foods.

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