

THE NATIONAL ACADEMIES **IN FOCUS**

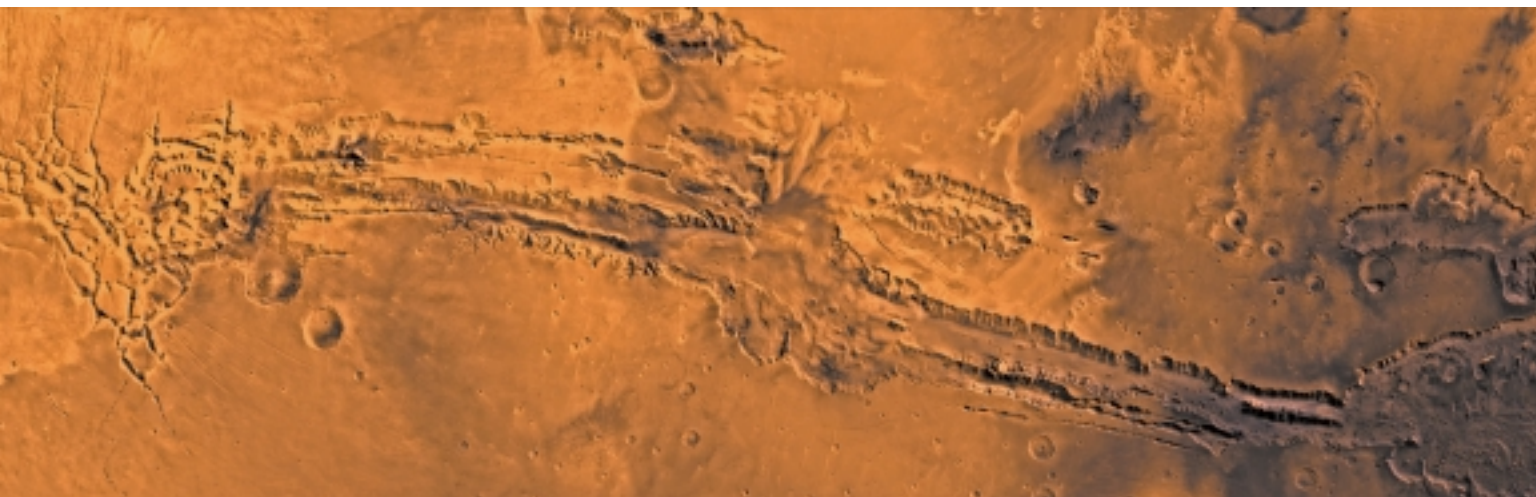
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How to Keep Astronauts Safe and Sound

A Look at the Nation's Wetlands Policy

Building a Home for Martian Samples



Fall/Winter 2001

Note from the editor: As many magazines do, *NewsReport* magazine has undergone a facelift. With *The National Academies In Focus*, we offer our readers broader coverage of the Academies' activities and expanded content, coupled with an updated, visually appealing design. We welcome your comments; e-mail us at <infocusmagazine@nas.edu>.

The National Academies In Focus is a magazine featuring activities of the National Academies, which serve as independent advisers to the federal government on scientific and technical questions of national importance. The National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine are self-perpetuating, honorific societies of distinguished scientists, engineers, and medical professionals. The National Research Council, along with the Institute of Medicine, brings the resources of the entire scientific and technical community to bear on national problems through its volunteer advisory committees. The Research Council is jointly administered by the National Academy of Sciences and National Academy of Engineering.

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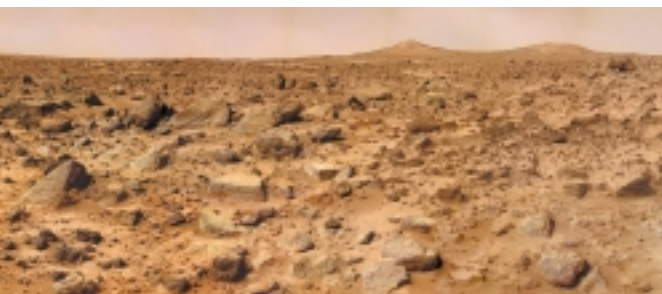
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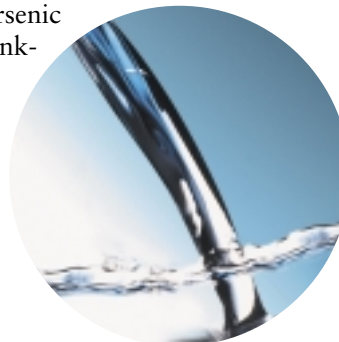
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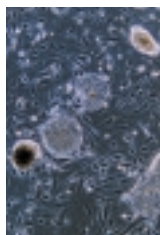
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Expert, Independent Advice Is Critical to Inform Science Policy, Perhaps Now More Than Ever

It's trite to note the impact of science, engineering, and technology on every aspect of our society — but it's only trite because it is *so* true. It's also true that the pace of technological development and adoption is accelerating.

In this environment of increasing societal dependence on science and engineering, more and more public policy needs to be informed by the best advice possible, so the role of a trusted, authoritative, unbiased adviser played by the Academies is critical — and particularly important given the horrific events of Sept. 11. Counter-terrorism efforts always have been strongly supported by science and technology, and the Academies stand ready to contribute in any way possible.

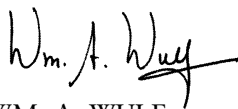
But this comes in addition to important work addressing many other challenges of modern society. Inevitably, some topics we examine are controversial; there are several examples of that in this issue of *In Focus*: arsenic in drinking water, the effectiveness and impact of the Corporate Average Fuel Economy standards, and stem cells, to mention just three.

Not surprisingly, when we take on these tough issues, we sometimes get slammed by all sides hoping to promote their agendas. What typically happens, however, is that a different tone is struck once the study is finalized and the report released; people are finally able to examine the report on its own merits.

The reason for the Academies' reputation for authoritative, unbiased advice rests, in large measure, on the scrupulous process we use to develop it — here are some of the major features of that process:

- Advice is generated by a committee of unpaid experts chosen for just that purpose; they are among the “best there is” on the topic, their areas of expertise span those needed to address the issue, and they have been carefully vetted to ensure no conflicts of interest and a balance of biases.
- Committees seek broad input from all interested parties. Their information-gathering meetings are open to the public and announced well in advance.
- The resulting reports are based on fact, not opinion. Although the people on our committees are excellent, we're not seeking their own opinions — just the facts with evidence-based judgments.
- Reports are peer-reviewed by a group comparable in expertise to that of the committee and representing a broad spectrum of views — including extreme views. We require every comment by a reviewer to be addressed by the committee and carefully monitor whether the responses are adequate.

No process is perfect, but this one has evolved over nearly 140 years — and it works pretty well. We continue to fine-tune it, but it has stood the test of time, even for the important, controversial issues.



WM. A. WULF
President, National Academy of Engineering





Early Intervention Is Key to Easing Autism's Effects

Imagine trying to get around in a foreign country without a good map, adequate communication skills, or the ability to perceive others' feelings. Now imagine that such an existence is how many people with autism and related developmental disorders often experience the world.

Children with autism typically lack basic social impulses, resulting in problems communicating or interacting with people. They're stumped when it comes to reading body language or even making friends. In some cases, they may spend their lives speechless. Autism and autistic spectrum disorders have many faces, however. The problems vary with respect to when symptoms begin to appear, the severity of symptoms, and the presence of other disabilities, such as mental retardation or severe language impairment.

What causes autism is unknown. What is known is that the reported incidence is rising steadily. Nationally, autistic spectrum disorders may affect as many as one in 500 people, making the conditions more common than childhood cancer or Down syndrome. The increased incidence could

reflect a real upsurge, improved diagnosis, better reporting and record keeping, or a combination of these factors. Still, education is the single most common and effective treatment for the disorders.

Because prompt educational intervention is the key to helping affected children develop into competent and productive adults, authorities should promote routine early screenings of children for the disorders, much like the screening done for vision and hearing problems, says a new report from the National Research Council.

Experienced professionals can reliably diagnose autism as early as age 2. And researchers have long recognized the benefits of intensive schooling for young children with such conditions within their first decade of life. But what now exists across the country is a mixed bag of intervention measures, said the committee that wrote the report. This hodgepodge has fueled an increasing number of lawsuits brought against school systems by parents dissatisfied with the level or types of services available for their kids.

“Given the often considerable effort required to help children with autistic disorders, authorities and advocates at all levels should join forces to ensure that treatments meet certain standards and lead to real progress,” said Catherine Lord, committee chair and professor of psychology, University of Michigan, Ann Arbor. “Scientists also should tackle more rigorous studies to identify which methods are most beneficial under a range of circumstances.”

At a minimum, instruction in academic and social skills — which is required under federal special-education laws — should be provided for 25 hours every

week year-round, the committee said. And the individual needs of children and their families should factor into decisions about how that time is spent. Parental involvement also should be encouraged and supported.

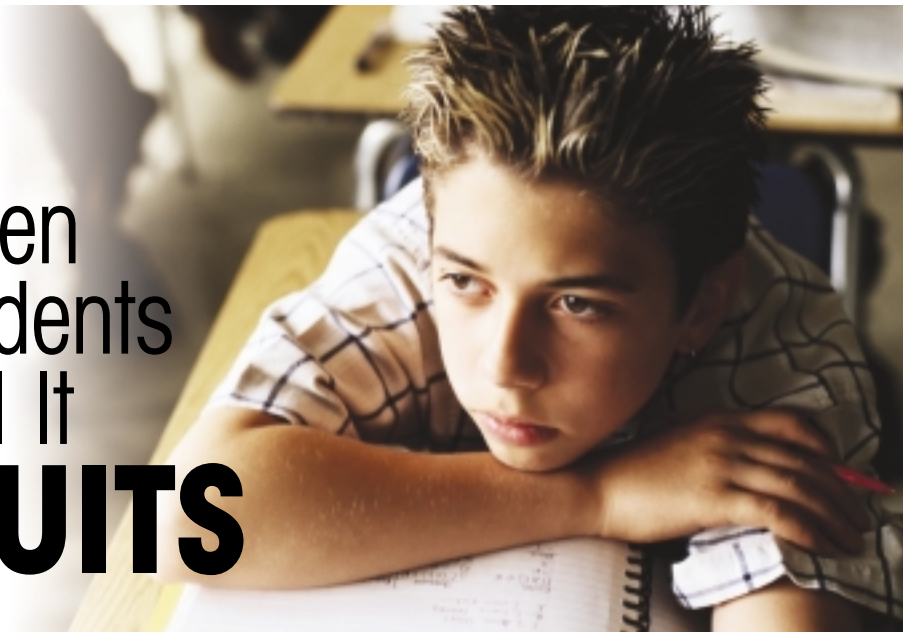
Because effective instruction is critical, more should be done to educate teachers and classroom aides in the field, the committee added. Specifically, they need frequent opportunities to observe experts working with children who are autistic, fine-tune their own skills, and study numerous instructional methods.

Relevant state and federal agencies should set aside extra funds over the next five years to train those who work with or are accountable to children with autistic spectrum disorders and their families, the report says. Educators often face immense and unique challenges in socializing and instructing such children. The disorders typically persist for a lifetime. Successful schooling can make them less disabling.

— *Vanee Vines*

■ **Educating Children with Autism.** Committee on Educational Interventions for Children with Autism, Division of Behavioral and Social Sciences and Education (2001, 324 pp.; ISBN 0-309-07269-7; available from National Academy Press, tel. 1-800-624-6242; \$39.95 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10017.html>).

The committee was chaired by **Catherine Lord**, professor of psychology, University of Michigan, Ann Arbor. The study was sponsored by the U.S. Department of Education.



When Students Call It **QUITS**

Better Information May Help Explain Why

For many young people, quitting school is a process, not an isolated event. Some students drop out in spirit long before they stop showing up for classes. And they frequently send signals indicating their potential to give up on school. Increased absenteeism, poor grades, and discipline problems are common red flags. The outcome can have lifelong impacts. Dropouts are more likely to be unemployed, and, compared with high school graduates, they earn considerably less money over the course of their lives.

Given the intricate web of circumstances that can lead a teen to quit

school, teasing out a single or even primary cause is nearly impossible. Historically, dropout rates have been higher among students who are socially and economically disadvantaged, lack English proficiency, or are learning disabled. But school practices, environments, and resources also factor into decisions to quit. A new report from the National Research Council calls for major improvements in the collection and analysis of dropout statistics to enhance understanding of the issues, including factors that may influence students' decisions to leave school. Early identification of at-risk

children — from preschool through the elementary grades — is also critical. Such students typically need ongoing support, the academic equivalent of intensive care, and counseling to encourage them to stay focused on their education.

With a growing number of states now requiring students to pass “high-stakes” exams as a prerequisite for entering the next grade or graduating from high school, some researchers wonder whether such testing policies will exacerbate the dropout problem among already vulnerable groups. Testing can indeed be a valuable tool, shedding light on student performance and sometimes providing teachers with information they can use to boost instruction and academic achievement. When used improperly, however, it can have negative outcomes that hit students at risk the hardest.

But because many states have only recently begun to use high-stakes exams, limited scientific evidence exists to determine what effects, if any, they have on dropout rates, the report says. Moreover, debates about the consequences of testing and other education reforms have suffered from inadequate data on the scope of the dropout problem itself.

Gauging the extent of the problem is tough because officials at all levels use various methods to define and count high school dropouts, noted the committee that wrote the report. At the national level, for example, federal statistics suggest that the overall dropout rate among 16- to 24-year-olds has fallen during the past two decades — from 14.6 percent in 1979 to 11.2 percent in 1999. But authorities warn that the 1999 data may not be comparable with those from previous years because of

changes in data-collection procedures. In addition, the reported rates for that age group do not include people who may have quit school but later received a general equivalency diploma. And those are only some of the caveats for federal data.

Policy-makers need information that allows better comparisons over time and between jurisdictions, the report says. It’s also important to have a clearer picture of the different ways students can be counted as having completed school — such as obtaining a GED or alternative diploma — and of the students taking various paths. Likewise, researchers should more closely examine risk factors that show up in young children, so that they can be helped before they begin to tune out of school.

The U.S. Department of Education should lead and oversee efforts to coordinate data collection in this area, the committee said. Ultimately, better information could help educators identify kids who would benefit from intervention measures such as individual counseling and smaller school settings that offer more one-on-one attention from teachers. More complete data also could help officials evaluate the effectiveness of such measures.

— *Vanee Vines*

■ **Understanding Dropouts: Statistics, Strategies, and High-Stakes Testing.** Standing Committee on Educational Excellence and Testing Equity, Division of Behavioral and Social Sciences and Education (2001, 66 pp.; ISBN 0-309-07602-1; available from National Academy Press, tel. 1-800-624-6242; \$18.00 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10166.html>).

The committee’s co-chairs are **Ulric Neisser**, professor of psychology, Cornell University, Ithaca, N.Y., and **William T. Trent**, professor of educational policy studies, University of Illinois, Urbana-Champaign. The study was sponsored by the U.S. Department of Education.

How Advances in
Biotechnology Could Take
Tomorrow's Army to
New Levels of
Combat Effectiveness

THE BIOTECH SOLDIER



Three months ago most Americans had likely never heard of a place called Kandahar or Mazar-e Sharif. Today, Afghanistan dominates the news as the United States engages feverishly in a war on terrorism.

But a nagging question persists, particularly in the wake of recent anthrax attacks on U.S. civilians: How can the Army improve its preparedness against an enemy that might use chemical or biological weapons?

Advances in biotechnology could prove essential in protecting soldiers and conducting ground warfare in future conflicts, says a new report of the National Research Council. For example, biosensor technologies have the potential to accurately pinpoint a harmful chemical or biological agent

in the air or water; they also could be used to monitor an individual soldier for fever, swelling, or other reaction to exposure.

"The possibilities in 25 years are fascinating," says Michael Ladisch, director of the Laboratory of Renewable Resource Engineering at Purdue University and chair of the committee that wrote the report. "A soldier could be wearing a wristwatch device, one of a network of many small bioreceptors. If he encounters a particular pathogen, such as anthrax or smallpox, the receptors would bind to the pathogen much like antibodies bind to a virus when a person fights off a cold." If that should happen, Ladisch says, a signal would be produced, triggering the release of a vaccine or activating a protective mask.

Before such futuristic technologies become part of the Army's routine, however, more work needs to be done. For example, in the Gulf War, chemical detectors had trouble distinguishing between harmful chemicals and substances such as smoke, diesel exhaust, cleaning fluids, and after-shave. Sensors need to be made fool-proof, so that benign chemicals aren't mistaken for harmful ones, and harmful chemicals aren't passed over either, the report says. Furthermore, biosensors need to be made smaller and more portable, without compromising their sensitivity to miniscule molecular clues, so that large numbers of samples could be collected on the battlefield. Finally, because any number of chemicals and biological agents could be used against troops, a variety of sensors — each detecting a different agent — would need to be used simultaneously to provide full protection.

The report describes other biotechnological innovations that could be used by the Army to help it become a leaner, stronger, and more effective fighting force.

A soldier who has been seriously injured might be treated with biomaterials — organic or synthetic materials that are compatible with the human body. By providing a suitable environment for the cells to grow, these materials could vastly accelerate the pace at which wounds heal.

A soldier's fatigues might be manufactured of materials that mimic nature, or that incorporate naturally occurring materials. Uniforms might be fitted with protective armor as hard and lightweight as an abalone shell or made of materials that change color to blend in with the environ-

ment, much like the camouflage ability of a chameleon. Likewise, tanks and aircraft could be covered with paint derived from a bacterial protein capable of absorbing radiation, thus enabling them to elude radar detection by an enemy.

Troops could lighten their loads significantly by reducing their use of cumbersome fossil fuels and batteries and using smaller, lighter, renewable forms of energy instead. Solar-cell energy converters that imitate the photosynthetic processes of plants could more efficiently convert solar energy into electricity when compared to current commercial technologies. What's more, the solar cell itself might be a thin coating on a soldier's helmet.

And electronics and computing can benefit from research into the structure and function of proteins. Computer memories incorporating the protein *bacteriorhodopsin* have demonstrated vast increases in memory capacity. The protein is also resistant to electromagnetic radiation, and could be used to make military computer, communications, and electronics systems capable of withstanding the effects of nuclear or other high-radiation weapons.

— *Jennifer Wenger*

■ **Opportunities in Biotechnology for Future Army Applications.** Committee on Opportunities in Biotechnology for Future Army Applications, Board on Army Science and Technology, Division on Engineering and Physical Sciences (2001, 118 pp.; ISBN 0-309-07555-6; available from the National Academy Press, tel. 1-800-624-6242; \$27.75 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10142.html>).

The chair of the committee was **Michael Ladisch**, distinguished professor in agricultural and biological engineering and biomedical engineering, and director of the Laboratory of Renewable Resource Engineering, Purdue University, West Lafayette, Ind. The study was funded by the U.S. Department of the Army.



Building a **HOME AWAY FROM HOME** for Martian Samples

Who on this planet hasn't wondered if life exists elsewhere? Will we ever know for sure? Researchers aim to get a little closer to an answer when they retrieve samples from Mars and examine them for, among other things, signs of life.

NASA, which has already devoted substantial resources to exploration of the Red Planet, is tentatively planning its first mission to collect samples for 2011, with soil, rocks, and other materials due to arrive on Earth as early as 2014. Although the probability is low that anything brought back will be hazardous to people or the terrestrial environment, there is still a chance that they could be, making it necessary to handle these specimens with extreme care.

After a six-month excursion through space, the first stop for these samples should be a facility capable of minimizing the possible contamination of Earth's environment and the specimens themselves, says a new report from the National

Research Council. Samples would be housed and examined in quarantine before being sent off to various laboratories across the United States and abroad for more in-depth and specialized study.

But creating such a facility poses enormous technical challenges. Just as Earth's environment must be protected from potentially hazardous extraterrestrial materials, martian samples also must be protected from terrestrial contaminants that might confuse the results of later scientific studies. These challenges call for a seemingly incompatible system of two-way protection to be set up. In fact, establishing such a system has never been attempted before. To protect Earth's environment, the samples must be "biologically contained." This involves storing them at lower-than-ambient air pressures so that air and its contaminants move toward the sample chamber and away from the surrounding environment. At the same time, clean room conditions will be needed to protect the samples from any contamination from the outside, requiring samples to be kept at greater-than-ambient air pressures so that air and its contaminants move away from the sample chamber.

One possible solution would be to nest the biological containment room — where the samples would be located — within the clean room — where the researchers would conduct their work — and separating the two areas by a double wall. Air would flow from both rooms to a low-pressure space between the double wall, where the air would be collected, sterilized, and discharged as exhaust. This and other potential solutions need to be developed and tested, and soon, the committee said.

The committee estimated that the design, construction, and testing of the facility will take at least seven years before it is ready and capable of handling specimens. And because samples are expected to begin arriving not long thereafter, it is imperative that the planning and construction begin quickly to allow adequate time to test and staff the facility in advance.

Moreover, to reduce costs and avoid needless complexity, only the most basic operations — such as unpacking, weighing, taking photos, splitting, repacking, and storing the martian samples — should be conducted at the quarantine facility, the committee said. As a fundamental precaution, all of the samples should be treated as though they contain dangerous microorganisms or other hazardous materials until preliminary examinations are performed. If unmistakable signs of life are found, the specimens should not be released until an expert panel of scientists is convened to discuss in detail how to deal with them. If possible signs of life are present, the specimens should be sterilized by heat or radiation before being shipped out for biological study. And if no life is found, specimens could then be sent to specialized labs for further study.

— *Mark Chesnek & Jennifer Wenger*

■ **The Quarantine and Certification of Martian Samples.** Committee on Planetary and Lunar Exploration, Space Studies Board, Division on Engineering and Physical Sciences (2001, 132 pp.; ISBN 0-309-07571-8; available from National Academy Press, tel. 1-800-624-6242; \$30.00 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10138.html>).

The committee was chaired by **John A. Wood**, senior scientist, Harvard-Smithsonian Center for Astrophysics, Cambridge, Mass. The study was sponsored by NASA.



Preventing **DISASTERS** by Design

A New Tool for Evaluating
Oil Tanker Performance

Say the words *Exxon Valdez* to almost anyone over the age of 18, and you're sure to evoke the same memories of oil-soaked loons, cormorants, otters, and seals struggling along the shore and in the frigid water.

People everywhere were moved by the tragedy, including Congress. Not long after the tanker ran aground, spilling more than 11 million gallons of crude oil into the Prince William Sound, the Oil Pollution Act of 1990 was passed, requiring, among other things, that all oil tankers traveling in U.S. waters be equipped with double hulls. And, because most countries conduct trade — or would like to conduct trade — with the United States, the double hull quickly became the *de facto* standard worldwide for tanker designs.

The legislation seems to have accomplished what Congress intended. According to a 1996 National Research Council study, not only were there no accidents even one-tenth the magnitude of the *Valdez*

in the five years that followed, but the amount of oil spilled from vessels — and the number of spills of more than 100 gallons — also declined.

Despite these results, some groups would like to see the standards revisited. They argue that new and innovative designs could meet or surpass the performance of the double hull. Currently, the International Maritime Organization (IMO), a United Nations agency responsible for improving safety and minimizing pollution in international shipping, has approved two alternative designs deemed to be as effective as the double hull in preventing oil spills. But tankers with these designs may never be built as long as the United States will only permit double-hull tankers to call on its ports.

The 1990 law made provisions for addressing these concerns. It directed the U.S. Coast Guard to look for alternative designs that could perform as well as or better than the double hull in preventing

oil spills. However, there has been no systematic way to evaluate how one ship design would perform over another in a grounding or collision.

A National Research Council report offers a new method by which oil tanker designs can be compared for the amount of environmental damage they would cause if involved in an accident. By predicting how a tanker would perform — before the tanker has even been built — the method could give rise to innovative designs that are less costly and give equal or better environmental protection than current fleets provide.

The new methodology assesses a ship's chances of causing an oil spill by analyzing three features: the amount of structural damage to the ship if a specific collision or grounding occurred, and the resulting spillage; the environmental consequences of



the spill, including physical measures such as the thickness and area of oil in the water and the extent of shoreline damage; and how ships of similar size but different design would compare in the same imaginary incident.

One of the most important points of the methodology — and counterintuitive to what most people would guess — is that the environmental consequence is not directly related to the amount of oil that is spilled. Small spills were found to cause a



disproportionately higher amount of environmental damage, gallon for gallon, than one would expect. Once the environment has been heavily damaged, the relative harm done by extra oil diminishes. For this reason, a tanker design that may result in many small spills would be less desirable than one that could cause a few large ones, according to the report.

In addition to continued testing and refining of the methodology, the Coast Guard should establish a procedure by which innovative designs can be submitted for their consideration, the report says. They should also encourage the IMO to adopt the methodology so that tankers worldwide can be uniformly evaluated.

— *Jennifer Wenger*

■ ***Environmental Performance of Tanker Designs in Collision and Grounding: Method for Comparison (TRB Special Report 259)***. Committee on Evaluating Double-Hull Tanker Design Alternatives, Marine Board, Transportation Research Board (2001, approx. 160 pp.; available from the Transportation Research Board, tel. 202-334-3214; \$24.00 for single copies; also on the Internet at <books.nap.edu/catalog/10199.html>).

Kirsi Tikka, formerly a professor at the Webb Institute of Naval Architecture, Glen Cove, N.Y., chaired the committee. The study was funded by the U.S. Coast Guard.

To Infinity and Beyond



What It Takes to Keep Astronauts Safe and Sound on Long Space Missions

Space travel today is dramatically different from what it was when John Glenn orbited the Earth three times in 1962 and Neil Armstrong set foot on the moon's barren surface more than 30 years ago. And the changes will continue as flights to the International Space Station begin to include guests, and human missions to the moon, Mars, and beyond become a strong possibility in the 21st century.

On journeys of long duration, the health risks and challenges inherent in space travel — including loss of bone density, excessive radiation exposure, and behavioral

adaptation to being confined in potentially hazardous living conditions — are greatly increased. Because of this, NASA asked the Institute of Medicine for additional perspective on its health care research, to help “create a vision” of clinical care for astronauts during and following long missions beyond Earth's orbit.

The IOM report's overarching message is that before sending humans into deep space for long periods of time, NASA must learn more about the risks to human health and life posed by such missions and how to effectively mitigate those risks. NASA must

also clearly and candidly communicate these risks to astronauts, scientists, and the general public.

Unlike other kinds of health research, clinical information relevant to space travel can be collected only from astronauts. One way to deal with the ethical issues that might arise from conducting such research is to consider the spacecraft as a workplace environment and apply occupational health principles to the research. In a workplace model of health care, the individual's safety and health would be weighed against the needs of those who are to benefit from the research.



Beyond studying astronaut physiology, consideration must be given to behavioral and social factors that may come into play. A mission to and from Mars, for example, could take three years to complete and involve a diverse crew of men and women inhabiting a confined space. NASA must conduct more research on behavioral health, including coping strategies and interpersonal dynamics under stressful conditions. With the mission's success depending



in large part on individuals working and living in a healthy team environment, selection and training of the crew will take on far greater significance.

NASA also needs to focus more sharply on man-machine interactions and what makes an environment habitable over the long term. The agency could benefit greatly from facilitating the steady convergence of engineering and biology that is already under way.

By developing and instituting a comprehensive health care system for astronauts, NASA can create a knowledge base for decision-making that will allow long-duration exploration of deep space to proceed while offering travelers a healthier environment — and a safe passage.

— *Saira Moini*

■ **Safe Passage: Astronaut Care for Exploration Missions.** Committee on Creating a Vision for Space Medicine During Travel Beyond Earth Orbit, Board on Health Sciences Policy, Institute of Medicine (2001, 318 pp.; ISBN 0-309-07585-8; available from National Academy Press, tel. 1-800-624-6242; \$80.00 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10218.html>).

The panel was chaired by **John R. Ball**, executive vice president emeritus, American College of Physicians, Havre de Grace, Md. The study was funded by NASA.



BEYOND CURE

Cancer Patients Need Better Care for Symptoms

Cancer often brings with it a host of distressing symptoms including pain, labored breathing, anxiety, and depression. And the treatments can produce side effects equally difficult to cope with, such as nausea, fatigue, and confusion.

Providing adequate relief from such distress, however, is not the norm among health care providers, says a new report from the National Research Council and Institute of Medicine's National Cancer Policy Board. Improvements in palliative care — the management of symptoms and side effects — have not kept pace with the medical advances that have extended the lives of cancer patients. Where the willingness and means exist to provide adequate pain control or compassionate care, insurance regulations, lack of coverage, or both often make it difficult or impossible to do so.

Nine million Americans — 3 percent of the population — are now living with cancer as a chronic illness. For many of these individuals, lack of treatment or undertreatment of their symptoms vastly diminishes the quality of their day-to-day lives.

In its report, the board explains why this situation exists and what might be done about it. A single-minded focus on cure, compounded by society's ambivalence

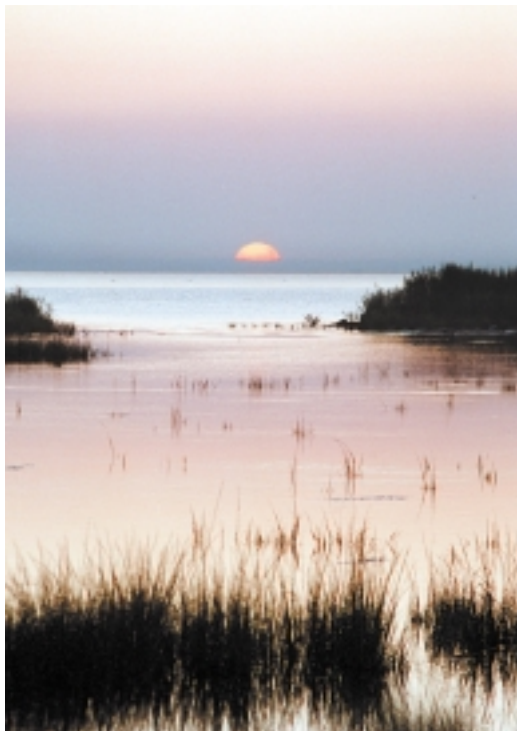
toward death and dying, has resulted in relatively little attention being paid to palliative cancer care. Of its \$2.9 billion budget in 1999, the National Cancer Institute — the federal government's leader in cancer research and training — spent less than 1 percent on research and training related to palliative and end-of-life care.

"While our health care specialists labor toward curing the many different kinds of cancer, nothing would have a greater impact on the daily lives of cancer patients and their families than good symptom control and supportive therapy," said board member Kathleen Foley.

The National Cancer Institute must step up its commitment to research and training on palliative care and serve as a model for others, the report says. Meanwhile, public and private insurers must re-examine their coverage of palliative care services. In particular, the federal Centers for Medicare and Medicaid Services should fund projects to devise better ways to deliver and reimburse this care when and where cancer patients need it — whether at home or in a hospital or hospice setting. And just as important, information on palliative care and related options must be made readily available to patients and families. — *Saira Moini*

■ **Improving Palliative Care for Cancer: Summary and Recommendations.** National Cancer Policy Board, Institute of Medicine and National Research Council (2001, 78 pp.; ISBN 0-309-07563-7; available from National Academy Press, tel. 1-800-624-6242; \$18.00 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10147.html>).

The study was led by **Kathleen M. Foley**, neurologist and pain specialist, Memorial Sloan-Kettering Cancer Center, and director, Project on Death in America, New York City. It was funded by the National Cancer Institute, the Centers for Disease Control and Prevention, the American Cancer Society, American Society of Clinical Oncology, Abbott Laboratories, Amgen Inc., and Aventis.



A Wetland **GAINED** for a Wetland **LOST?**

When a National Research Council committee studying wetlands visited a site in southern California, it found a variety of vibrant wetland vegetation and heard from local officials there that several species of wildlife — including at least one cougar — had been seen visiting the habitat. This particular wetland, however, was not the work of nature, but rather of human engineering.

It was created by a development company in exchange for a permit to build on nearby natural wetlands. The company graded and contoured part of a regional park, rerouted the flow of water, and removed nonindigenous weeds, planting typical wetland vegetation in their place. The result was a 25-acre wetland that appeared to replicate the natural structure of the 20-acre wetland that was filled.

Up until the 1970s, when the Clean Water Act became law, wetlands were

generally considered nothing more than breeding grounds for mosquitoes. Developers regularly filled them in, transforming them into prime real estate for new houses, businesses, and farms. By the 1980s, wetland area in the contiguous United States was half what it had been two centuries earlier. But wetlands, such as marshes, swamps, and bogs, are in fact complex ecosystems that can improve water quality, control floods, diminish droughts, and stabilize shorelines. They also are home to many endangered species.

These and other environmental benefits are why the Clean Water Act prohibits wetlands from being filled unless otherwise authorized by a permit issued under Section 404 of the act. Such permits are usually handed out by the U.S. Army Corps of Engineers, which first requires permit applicants to steer clear of, or at least minimize, damage to wetlands. If

damage cannot be avoided, the Corps requires the permit holder, or a third party paid by the permit holder, to restore or create nearby wetlands as compensation. In 1989 the White House said the goal of this program should be “no net loss” of wetlands, which federal agencies have taken to mean no loss of acreage or of ecological function.

However, the committee found that, at least as far as ecological function is concerned, the goal was not being met. Although the annual rate of wetland loss has been decreasing in recent years — perhaps in part because developers have been deterred by the permit process — the committee found that some required mitigation projects are never undertaken or are not completed. Of those that are, many do not replicate the ecological function of nearby natural wetlands, though the magnitude of



loss in function is hard to determine because data are not kept on the ecological status of wetlands that are lost or those that are restored or created.

Insufficient data made it difficult for the committee to determine whether there has been no net loss of wetland acreage, which led it to call on the Corps to create a national database to track the wetland area and functions gained and lost. The Corps also should require permit holders to provide a stewardship organization, such as the Nature Conservancy, with an easement on or title to wetland sites along with sufficient funds for long-term monitoring and maintenance.

It is easier to restore a natural wetland than to create a brand new one, the committee said, adding that rehabilitated or constructed wetlands will be most successful if their functions are considered in terms of their role in the overall surrounding watershed. Strong enforcement by the Corps and other responsible agencies will be needed to ensure that mitigation projects begin on time and meet the design criteria outlined in the permit.

The Corps recently acknowledged what it called “legitimate concerns” raised in the report and issued new guidelines to promote a no-net-loss policy.

— *Bill Kearney*

■ **Compensating for Wetland Losses Under the Clean Water Act.** Committee on Mitigating Wetland Losses, Board on Environmental Studies and Toxicology and Water Science and Technology Board, Division on Earth and Life Studies (2001, 348 pp.; ISBN 0-309-07432-0; available from National Academy Press, tel. 1-800-624-6242; \$49.95 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10134.html>).

The study was chaired by **Joy Zedler**, professor of botany and Aldo Leopold Chair of Restoration Ecology, University of Wisconsin, Madison. **Leonard Shabman**, professor, Virginia Polytechnic Institute and State University, Blacksburg, served as vice chair. The study was funded by the U.S. Environmental Protection Agency, the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, and the National Marine Fisheries Service.

Arsenic Reconsidered

EPA ASKS FOR ADVICE ON RISK

While the nation grapples with securing its drinking water supplies from possible terrorist attacks, it still must contend with a concern being debated well before Sept. 11 — how to keep levels of arsenic down. Drinking water can become contaminated when arsenic seeps in from natural sources or is discharged into water supplies by agricultural and industrial processes. The Safe Drinking Water Act requires the U.S. Environmental Protection Agency to limit the level of arsenic in drinking water. What that limit should be, however, has been the subject of intense public discussion, and the National Research Council has been called upon twice in recent years to make sure that any resulting regulations are based on the best available science.

In its 1999 report, a Research Council committee concluded that EPA's maximum allowable level for arsenic in drinking water at the time — 50 parts per billion — was too high given the chance of developing cancer from consuming that much on a daily basis.

EPA lowered the standard to 10 parts per billion in January 2001, but when the Bush administration entered office, it determined that new research conducted since 1999 warranted a look by the Research Council before the standard was implemented. In particular, EPA wanted to know what the risks were of drinking water with arsenic concentrations between 3 and 20 parts per billion.

The committee assigned to the new study found that a link could be found between bladder and lung cancer and exposure to

arsenic in drinking water, and that the evidence for this association is stronger than it was only two years earlier. For example, men and women who daily consume water with 3 parts per billion of arsenic in it have a 1 in 1,000 increased risk of cancer. The risk jumps to greater than 3 in 1,000 at 10 parts per billion, and is close to 7 in 1,000 at 20 parts per billion.

The committee was not asked to recommend a new standard to EPA, nor was it asked to conduct the cost-benefit analyses that are needed to make such a decision. It did recommend that new research be carried out to determine the extent to which chronic arsenic exposure causes diseases other than cancer, since some foreign studies have linked arsenic exposure to diabetes, heart and respiratory ailments, and birth defects.

Following public release of the report, the Bush administration announced in early November its intent to adopt the earlier proposed level of 10 parts per billion.

— *Bill Kearney*

■ **Arsenic in Drinking Water: 2001 Update.**

Subcommittee to Update the 1999 Arsenic in Drinking Water Report, Committee on Toxicology, Board on Environmental Studies and Toxicology, Division on Earth and Life Studies (2001, 244 pp.; ISBN 0-309-07629-3; available from National Academy Press, tel. 1-800-624-6242; \$39.00 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10194.html>).

The study was chaired by **Robert A. Goyer**, professor emeritus of pathology, University of Western Ontario (retired), Chapel Hill, N.C. The study was funded by EPA.



Protecting the environment through government intervention

How well does
it work?



Federal pollution-control programs have been controversial almost since their inception, with policy-makers questioning whether they really work and are worth the expense and effort. Several new Research Council reports examine some of the government's environmental programs in detail.

Retrofitting Federal Fuel Economy Standards

The need for improved fuel efficiency was obvious back in 1975. Memories of the energy crisis during the preceding two years were still vivid, and people were concerned that they might again have to wait in long lines to buy gasoline at inflated prices. That is when the federal program known as the Corporate Average Fuel Economy (CAFE) standards was established — regulating the minimum gas mileage required for new cars and light-duty trucks sold in this country.

But much has changed since 1975. The long lines are gone, and in spite of fluctuating and sometimes rapid spikes in gasoline prices, consumers are buying larger vehicles — especially sport utility vehicles, minivans, and pickup trucks — that are held to less



stringent standards for fuel economy and typically use more gas than passenger cars. Given this trend, it should come as no surprise that the nation's overall fuel economy has been slipping. And with this slippage, the worry over U.S. dependence on foreign oil, as well as concerns about the contribution of vehicle emissions to global warming, continues to mount.

Against this backdrop, Congress asked the National Research Council to study the effects of CAFE standards over the past 25 years, along with the effects that potential changes to the program might have. Here's what the study committee concluded: While the standards have helped reduce dependence on imported oil and lower emissions of greenhouse gases, changes to the CAFE program could achieve the same end more efficiently and more equitably — and provide more flexibility to carmakers.

"Technologies already exist today that could significantly reduce fuel consumption of new cars over the next 15 years," said Paul Portney, committee chair and president of Resources for the Future in Washington, D.C. These include engine advances that reduce internal losses of energy, more efficient powertrains such as five-speed automatic transmissions, and aerodynamically improved vehicle designs. While these upgrades would add to the purchase price of new vehicles, the committee identified combinations of technologies that would produce gasoline savings more than sufficient to offset the initial increase in cost. Even so, it could take decades before new, more fuel-efficient vehicles have replaced the 200 million cars currently on the road.

Better fuel economy also can be achieved by reducing a vehicle's size or weight, but one risk of downsizing is that smaller cars involved in crashes with larger vehicles tend to "lose." After examining analyses conducted by the National Highway Traffic Safety Administration (NHTSA), the committee estimated that the downsizing of vehicles — whether spurred by the market or a result of CAFE standards — has slowed the rate of decline in fatalities. However, this area is quite controversial among analysts and the committee called on NHTSA to conduct further research.

The report identifies a number of changes that could be made to improve the CAFE program. For example, the program's system of fuel economy credits should be expanded to give automakers financial incentives for improving fuel efficiency. Currently automakers can accumulate these credits if their fleets of cars or trucks exceed the standards, and use them to make up for deficiencies in their fleets another year. In an expanded scenario, those credits could be traded. Automakers could buy credits from other automakers if their fleets are below the standards, or they could buy credits from the government at a fixed price. Under this scheme, the ability for automakers to profit from each gain in fuel efficiency would motivate them to continue making improvements even if their fleet's average fuel economy exceeded federal targets.

In addition, Congress should consider switching the CAFE program to standards



that are based partially on weight instead of setting fuel economy standards on the basis of whether a vehicle is a car or truck. A weight-based system that encourages car manufacturers to downsize their largest vehicles could ultimately reduce the enormous variance between large and small vehicles, which is an important safety risk.

■ **Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards.** Committee on Effectiveness and Impact of Corporate Average Fuel Economy Standards; Board on Energy and Environmental Systems, Division on Engineering and Physical Sciences; and the Transportation Research Board (2001, approx. 250 pp.; ISBN 0-309-07601-3; available from National Academy Press, tel. 1-800-624-6242; \$40.00 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10172.html>).

The committee was chaired by **Paul R. Portney**, president, Resources for the Future, Washington, D.C. The study was funded by the U.S. Department of Transportation.

A Closer Look At Car Inspections

Reducing harmful emissions from vehicles is another challenge that policy-makers have been grappling with for years. In addition to contributing to a host of environmental ills, these pollutants have been linked to serious respiratory and other health ailments. Such woes spurred the government to institute vehicle inspection and maintenance programs in jurisdictions that violate federal clean air standards.

Although the programs vary from state to state, they typically involve regularly testing cars and trucks to measure emissions of carbon monoxide, hydrocarbons, and in some cases nitrogen oxides. Those cars that fail are required to have their pollution-control systems repaired. But independent and state-sponsored evaluations have shown that



flawed computer models used by the Environmental Protection Agency and state agencies overestimate the reduction in vehicle emissions that is attributable to inspection and maintenance programs. In addition, many motorists view the programs as a nuisance and wonder whether they're necessary.

A new report by a Research Council committee examines the effectiveness of vehicle inspection programs and concludes that the programs are actually targeting the wrong cars. Most states are using too many resources on inspecting newer cars, which have the latest pollution-control technologies and are generally cleaner than older, faulty models, the report says. In contrast, these malfunctioning vehicles, which make up only about 10 percent of the nation's fleet, typically emit about 50 percent of the most harmful air pollutants produced by motor vehicles. These high-emitting vehicles should become the primary target of state emissions inspection and maintenance programs.

But focusing on these high emitters raises legitimate concerns about fairness, the report acknowledges. Malfunctioning vehicles are more likely to be owned by people with limited economic means. Since many of the owners of these cars may not be able to afford to fix them, policies should be promoted that provide financial relief or other incentives so owners will obtain long-lasting repairs or replace faulty vehicles. There also

is growing evidence that less testing of vehicles with a low probability of failure — including exemptions for testing recent-year models — could be very cost-effective.

Part of the credibility problem for vehicle inspection programs lies in the methods used to predict emissions reductions. States are allowed to use overly optimistic assumptions in projection models, leaving them little incentive to verify whether the estimated emission reductions actually are occurring. Evaluation of the emissions benefits from inspection and maintenance programs should be based on information collected from vehicles as they are being driven. For example, remote-sensing devices could be used to estimate actual emissions from the on-road fleet, rather than relying on current technology that tests only those vehicles that participate in the inspection program.

EPA also grants emissions-reduction credits to states for inspection programs as part of the process for states to demonstrate compliance with air-quality standards. These credits should be closely tied to actual reductions that are based on observational and empirical data, not projections from models, the report says.

New technology may change how vehicle emissions tests are conducted in the future. For example, onboard diagnostic systems in cars built since 1996 illuminate a light on the dashboard to alert motorists to potential problems in both the exhaust and the emission-control components. But these systems do not actually measure emissions. EPA has issued a rule requiring states to use these systems for testing individual cars and trucks. An independent examination is needed to determine whether this technology will be effective as a testing device.

■ **Evaluating Vehicle Emissions Inspection and Maintenance Programs.** Committee on Vehicle Emission Inspection and Maintenance Programs; Board on Environmental Studies and Toxicology, Division on Earth and Life Studies; and the Transportation Research Board (2001, 260 pp.; ISBN 0-309-07446-0; available from National Academy Press, tel. 1-800-624-6242; \$40.00 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10133.html>).

The committee was chaired by **Ralph Cicerone**, chancellor at the University of California at Irvine. The study was funded by the Environmental Protection Agency.

How Much Do We Really Benefit From Energy R&D?

In the aftermath of the 1970s energy crisis, the U.S. Department of Energy was formed, in large part to conduct research on and create new energy-efficient technologies. Since then, the government has spent billions of dollars on energy research, mostly through DOE programs. Have these huge expenditures provided tangible returns?

A Research Council committee charged with answering the question found that these programs not only have benefited the economy, but also have been good for the environment and, to a lesser degree, national security as well. In fact, the funding provided by the government stimulated worthwhile research and development in areas where there was little incentive for the private sector to make improvements on its own.

Of 39 programs in energy efficiency and fossil energy examined by the committee, the economic returns amounted to an estimated \$40 billion from an investment of \$13 billion. Nearly three-quarters of the benefit came from three energy-efficiency programs that cost only about \$11 million, the report says. For example, significant advances were made in developing better compressors for refrigerators and freezers,

energy-efficient fluorescent-lighting components, and heat-resistant window glass. Government standards and regulations encouraged adoption nationwide, dramatically multiplying their impact.

DOE research also has produced significant benefits that cannot easily be quantified in terms of dollars, the report says. For example, big environmental gains were made in fossil energy with two technologies — a cleaner, more efficient method for burning coal called atmospheric fluidized bed combustion, and nitrogen-oxides control to reduce emissions. Both of these technologies decreased harmful nitrogen oxides in the atmosphere by more than 26 million tons and sulfur dioxide by 2 million tons. The committee estimated that the resulting savings could translate to more than \$60 billion in avoided damage and mitigation costs.

However, not all of DOE's programs have lived up to their expectations. Research programs that attempted to introduce new technologies without the necessary incentives for

the private sector to adopt them were most likely to falter. Market incentives, such as new standards and regulations, can be useful for increasing the chances that a technology will be adopted, the committee said. And DOE should continue cost-

sharing efforts with industry, so that the most promising programs — with the greatest potential for success in the marketplace — are funded.

■ **Energy Research at DOE: Was It Worth It? Energy Efficiency and Fossil Energy Research 1978 to 2000.** Committee on Benefits of DOE R&D in Energy Efficiency and Fossil Energy, Board on Energy and Environmental Systems, Division on Engineering and Physical Sciences

(2001, 240 pp.; ISBN 0-309-07448-7; available from National Academy Press, tel. 1-800-624-6242; \$45.00 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10165.html>).

The committee was chaired by **Robert Fri**, senior fellow emeritus, Resources for the Future, and former director, National Museum for Natural History, Smithsonian Institution, Washington D.C. The study was funded by the U.S. Department of Energy.

A Clearer Process For Clean Water

Despite considerable success by the federal and state governments in controlling discharges from wastewater treatment plants and industry, pollution from other sources continues to jeopardize water quality. Nutrients, bacteria, sediment, pesticides, and chemicals from lawns and farms make their way into the nation's lakes and streams, resulting in declining fish and wildlife populations and waterways choked by "red tides" and algal blooms.

Now, as part of its comprehensive strategy to clean up these waters, the federal government is focusing anew on "nonpoint" sources of pollution in addition to its ongoing mission of targeting "point" sources, namely drain pipes or channels. Under the 1972 Clean Water Act, each state is required to identify polluted bodies of water, put them on a cleanup list, and establish what are known as Total Maximum Daily Loads (TMDLs), which determine the amount by which sources of pollution would need to be reduced to meet the state's standards. There are now about 21,000 bodies of water that have been identified for cleanup, from the Anacostia River in Washington, D.C., to the San Francisco Bay. In addition, regulations enacted in 1992 by EPA require states to



meet a deadline of eight to 13 years for establishing TMDLs.

A new rule published last year by the agency to update the 1992 regulations has come under fire, however. Only six states have enough data to fully assess the condition of their waters, according to the General Accounting Office. What's more, the enormous time and resource constraints, coupled with legal pressures, caused many states to list bodies of water without adequate data, creating a large caseload requiring cleanup efforts. Given these concerns, Congress asked the National Research Council to step in and look at the scientific basis of the TMDL program.

The Research Council's report says that sufficient scientific information exists for the TMDL program to move forward, although technical and policy-related issues need addressing to improve the effort. For example, considerable uncertainties exist about whether some of the waters on state lists actually violate water-quality standards. Not only that, other bodies of water are impaired but have yet to be identified formally. To make sure precious resources are going to the most polluted waterways, EPA should implement a two-step process that first puts waters in question on a preliminary list before moving them to the final list of those that require cleanup, the report says. This would give states time to study those bodies of water for which scant data exist, while at the same time concentrating efforts on sites that are in the greatest need of cleanup. If no legal mechanisms exist for states to create these preliminary lists, Congress should create one.

These preliminary lists, however, should not be viewed as a way to delay cleanup efforts, the report says. No body of water

should be permitted to remain on a preliminary list for more than a predetermined period that allows for problems to be identified and solutions to be developed. To make up for any lack of scientific information that might cause a delay, states should adopt an approach called adaptive implementation, whereby cleanup plans are periodically assessed and revised using new data and scientific tools. This would allow the TMDL program to move forward in the face of uncertainties about the effectiveness of cleanup efforts.

An important part of improving the TMDL program is developing more refined water-quality standards at the state level. Rather than focusing on broad criteria based on whether bodies of water are suitable for fishing or swimming, states should establish standards for more specific uses, such as supporting aquatic life or maintaining clean drinking water supplies — a practice that is already in place in Ohio.

In response to the report's recommendations, EPA put the new rule on hold for 18 months, pending further review.

■ **Assessing the TMDL Approach to Water Quality Management.** Committee to Assess the Scientific Basis of the Total Maximum Daily Load Approach to Water Pollution Reduction, Water Science and Technology Board, Division on Earth and Life Studies (2001, 122 pp.; ISBN 0-309-07579-3; available from National Academy Press, tel. 1-800-624-6242; \$28.25 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10146.html>).

The committee was chaired by **Kenneth Reckhow**, professor of water resources at Duke University, Durham, N.C. The study was funded by the U.S. Environmental Protection Agency.

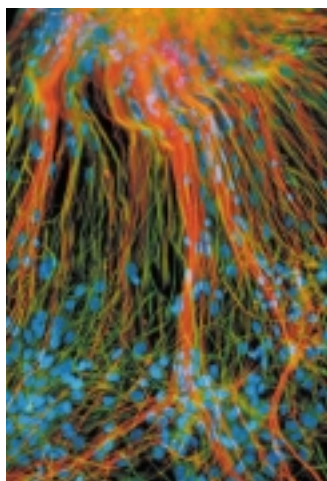
— Molly Galvin, William Kearney, & Jennifer Wenger



THE PROMISE AND PERPLEXITIES OF STEM CELLS

Academies Weigh In on Hotly
Debated Research Area of
Regenerative Medicine

To individuals suffering from certain types of debilitating illnesses and to medical researchers seeking to help them, the potential of stem cell research seems limitless. Regenerative medicine offers the possibility of someday providing healthy, new



red blood cells for patients with leukemia, neurons for those afflicted by stroke or Alzheimer's or Parkinson's, pancreatic cells for diabetics, and more.

No less profound, however, are the ethical and public-policy questions raised by using embryonic stem cells, primarily drawn from frozen human embryos left over from *in vitro* fertilization procedures. Another potential source of stem cells includes certain adult organs, but adult stem cells are difficult to isolate and not as versatile, which is why their embryonic counterparts are more attractive to researchers.

Although stem cell research is on the cutting edge of biological science today, it is still in its infancy. An enormous amount of basic research must first be done to achieve advances in medical treatments that could be widely available to patients. Publicly sponsored research — on stem cells from both embryos and adults — would provide the most efficient and responsible means to fulfill the promise of stem cells, according to a new report from

the National Research Council and Institute of Medicine.

Without government funding of basic research on stem cells, progress toward medical therapies is likely to be hindered. Private industry may be reluctant to fund research that could take many years and with no guarantee of the results yielding profitable applications. Moreover, public sponsorship of basic research would help ensure that many more scientists with a broader spectrum of perspectives could pursue a variety of research questions and that their results would be made widely accessible through scientific publication — two factors that can significantly speed progress. Public funding also offers greater opportunities for regulatory oversight and scrutiny.

President Bush announced in August that he would allow federal financial support of research that uses embryonic stem cells being cultured in laboratories around the world, but would prohibit funding for the development of new lines that involved creating and destroying additional embryos.

“We believe that new embryonic stem cell lines will need to be developed in the long run to replace existing lines that become compromised by age, and to address concerns about culture with animal cells and serum that could result in health risks for humans,” said Bert Vogelstein, chair of the committee that wrote the report, professor of oncology and pathology at the Johns Hopkins University School of Medicine, Baltimore, and a Howard Hughes Medical Institute investigator.

Another problem relates to the possible rejection of transplanted stem cells by a patient's immune system. The committee called for the aggressive pursuit of research on immune rejection, including further study of somatic cell nuclear transfer, a technique that can overcome rejection problems. Sometimes referred to as therapeutic cloning, and ethically controversial, the

practice involves removing the nucleus of an egg cell, inserting genetic material from the transplant recipient, and triggering cell division. Because there is no intention of ever implanting the resulting embryo to produce a child, the nuclear transfer technique should not be confused with reproductive cloning, the committee said.

In light of the numerous ethical concerns raised by stem cell research, the committee called for a national advisory board to be established at the National Institutes of Health — similar to one that was set up to oversee genetic engineering research — comprising outstanding scientists, ethicists, and others. The board would ensure that proposals for federally funded work were scientifically sound and met mandated codes of conduct.

Aware of the wide array of social, political, legal, and economic considerations involved in the issue, the committee's consensus report was informed in large part by a workshop held in June, where some two dozen experts spoke to an audience of hundreds of stem cell scientists from academia and industry, policy-makers, ethicists, and religious leaders.

"A complex and confusing reality is involved in this contentious issue," said Father Kevin FitzGerald, assistant professor of medicine at Loyola University Medical Center and one of several speakers who argued against the use of embryonic stem cells in research and of cells derived from those original lines. "What is the difference between a natural embryo and an 'engineered' entity? What is the moral status of human embryos? This is society's dilemma."

Stem cells are prized by medical science because, unlike any other cell in the body, some are able to renew themselves indefinitely, explained Irving Weissman, professor of cancer biology and cell and developmental biology at Stanford University. Because they are unspecialized, they serve



From top: Bert Vogelstein, Johns Hopkins University School of Medicine; Patricia King, Georgetown University Law Center; Corey Goodman, University of California, Berkeley, and Paul Berg, Stanford University School of Medicine (left to right); Father Kevin FitzGerald, Loyola University Medical Center; Barry Bloom, Harvard University, Irving Weissman, Stanford University School of Medicine, and Ernest Beutler, Scripps Research Institute (left to right).

Photographs by Greg Hadley

as a kind of raw material that can give rise to specialized cells that constitute blood, the brain, specific tissues such as those that make up muscle and bone, and organs such as the heart and kidneys.

The biotech industry has already tapped into the potential of stem cells. “Living cells will be tomorrow’s ‘pharmaceuticals,’” said speaker Thomas Okarma, chief executive officer of Geron Corp., about a commercialization strategy for regenerative medicine. Holding exclusive license to certain stem cell discoveries made by researchers, Geron has made progress in growing a variety of specialized cells from stem cells. “We want to have frozen, packaged products [e.g., heart cells] to sell to hospitals for use in patients. This work offers high value for medicine and a huge potential impact on society,” said Okarma.

But in spite of early progress in stem cell research, and reason for optimism, much remains to be understood. Researchers have yet to determine, for example, how a neuron “knows” that it isn’t a liver cell. Or why a stem cell taken from an adult organ seems limited in its potential, compared with an embryonic stem cell. While some studies in lab animals have shown promising results, scientists’ ability to use stem cells for restoring function in humans may be many years away, the report says.

With the complexity of the science presenting more questions than answers, the enthusiasm of certain researchers is tempered by the caution of others.

“This research should be pursued with great care,” said Olle Lindvall, chair of the department of clinical neuroscience at Lund University, Sweden. “Before applying a new therapy widely, it must show effectiveness in the reversal of actual symptoms and be successful in restoring normal function.” It must also be shown to be safe, he noted.

And so, the debate and the work on stem cells continue, with both the promise of medical breakthroughs and the perplexities inherent in such a complex enterprise.
— *Saira Moini & Bill Kearney*

■ **Stem Cells and the Future of Regenerative**

Medicine. Committee on the Biological and Biomedical Applications of Stem Cell Research; Board on Life Sciences, Division on Earth and Life Studies; and Board on Neuroscience and Behavioral Health, Institute of Medicine (2001, approx. 71 pp.; ISBN 0-309-07630-7; available from National Academy Press, tel. 1-800-624-6242; \$17.95 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10195.html>).

The study was led by **Bert Vogelstein**, professor of oncology and pathology at the Johns Hopkins University School of Medicine, Baltimore, and a Howard Hughes Medical Institute investigator. The study was sponsored by the National Academies with additional funding from the Ellison Foundation.



From left: Ihor Lemischka, Princeton University, and Markus Grompe, Oregon Health and Science University; Patricia King, Georgetown University Law Center; Thomas Okarma, Geron Corp. Photographs by Greg Hadley

BY MARY-LOU PARDUE



Studying Differences Between the Sexes *May Spur Improvements in Medicine*

It's hard to believe that only a little more than two decades ago, the U.S. government issued guidelines recommending that pharmaceutical companies exclude women of childbearing age from participating in clinical trials. Now the National Institutes of Health has an office devoted to women's health research, and more women are being included in critical medical research.

That is progress, to be sure. But it has become increasingly clear that to improve medicine for both men and women, more also needs to be done to study differences between the sexes. For too long, the research community has ignored the fact that being male or female encompasses far more than reproductive systems and hormones. Sexually determined characteristics can be found all the way down to the cellular level, and they have important implications that influence how long we live, how we are affected by disease and medication, and even how our brains function.

I recently chaired a panel of the Institute of Medicine that examined the scientific literature on how molecular and biological differences between the sexes affect health. We concluded that it would benefit everyone — men and women alike — if biomedical researchers started paying more attention to these differences. Doing so could identify new ways to promote good health and improve the way diseases are diagnosed and treated.

Of course, it's obvious why only males can develop prostate cancer, and only females get ovarian cancer. But it's not at all obvious why women are more likely than men to recover language ability after suffering a stroke, or have a far greater risk of developing life-threatening irregular heart rhythms in response to potassium channel-blocking drugs. Sex differences appear to play a role in the severity and incidence of several diseases; they need to be studied at the cellular level to determine how sex influences susceptibility to disease and functioning of organs and organ systems.

Being male or female is a basic human variable that should be routinely considered when designing and analyzing studies in all areas of biomedical and health-related research. Until it is and the results — positive or negative — are routinely reported, many opportunities to obtain a better understanding of disease and to advance human health will surely be missed. It is widely known that studies on variables such as sex, age, race, or ethnicity have all too often been biased and have led to discriminatory practices. History must be taken into consideration so that discriminatory practices will not be repeated.

Mary-Lou Pardue, Boris Magasanik Professor at the Massachusetts Institute of Technology, Cambridge, recently chaired an Institute of Medicine panel that wrote the report *Exploring the Biological Contributions to Human Health: Does Sex Matter?*

This article was adapted from a piece distributed by the National Academies Op-Ed Service, which produces accessible, compelling, and timely articles written by prominent scientists, engineers, physicians, and other experts. Visit the Service's Web site at national-academies.org/op-ed for a comprehensive collection of authoritative commentary on issues involving science, technology, and medicine.

Resolving Internet Identity Disputes

The stories abound: Owners of a mom and pop store purchase an Internet domain name — the part of a Web address that follows the three w's — before a similarly named mega-business can get to it; an enterprising 12-year-old creates a home page with an address named for his favorite rap star; an unhappy car owner registers her disapproval with a derogatory URL.

Such cases and others are being prosecuted under the 1999 Anticybersquatting Consumer Protection Act. The alleged crime is using a trademarked name — or something very close to a trademark — for one's Web address. Trademark owners charge that these users are “diluting” their trademarks by causing confusion or even tarnishing their corporate images. Defendants claim that their rights, such as freedom of speech, are being violated.

In response to a request from Congress, a new committee of the National Research Council is looking into the matter. Specifically, it will determine whether new or existing technologies could help prevent such conflicts. It also is considering new, more effective ways for Internet users to locate information on the Web

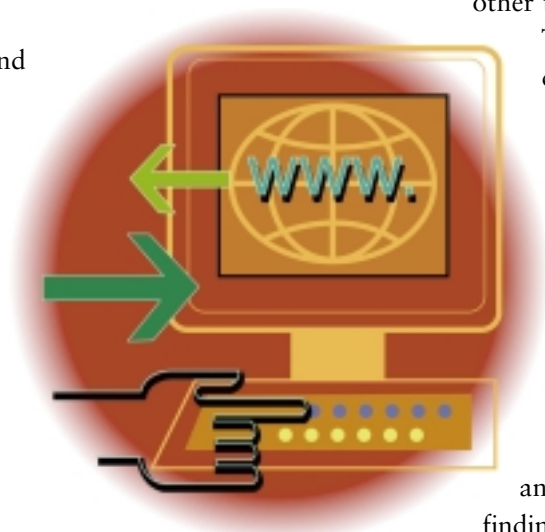
and ascertaining whether the domain name system could be reconfigured to recognize characters from languages other than English.

The committee will consider such suggested remedies as adding more top-level domains — in addition to the dot-coms, dot-orgs, and dot-nets — to create more options for Internet addresses; new methods to assign names; and new directories for finding pertinent information on the Web, wholly eliminat-

ing the need to type in a specific domain name. A final report is expected in 2002.

— *Jennifer Wenger*

(See listing on page 34.)



The Battle for Young Recruits

It's unclear whether the nation's war on terrorism will spur waves of young Americans to enlist in the armed forces.

Over the past several years, most branches of the U.S. armed forces have struggled to meet their recruitment goals. Some observers have questioned whether increased competition from the private sector as well as lukewarm feelings about military service among today's youth and their parents have contributed to the difficulties.

To bolster thinning ranks, many military planners have adopted strategies that include not only aggressive advertising



campaigns, but also offers of larger enlistment bonuses or more money for college. Officials in all branches have even turned to cyberspace, where many twentysomethings “hang out,” to encourage young Americans to join up.

A new National Research Council project is exploring what implications the makeup of the nation’s youth population and trends in military recruitment will have on efforts to meet future defense needs. The goal is to identify ways to ensure an adequate applicant pool. The study committee is examining a broad range of questions about the characteristics of 21st-century youngsters, the changing nature of work, and the effectiveness of various military advertising and incentive programs. A final report is expected in 2002. — *Vanee Vines*

(See listing on page 34.)

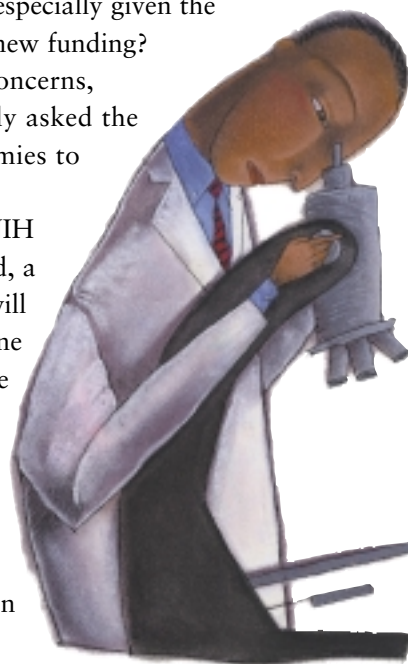
NIH at a Crossroads

Before World War II, the National Institutes of Health consisted of the health institute itself and the National Cancer Institute. Today it comprises 27 institutes and centers that correspond to different diseases, disciplines, and demographics, and its budget is on pace to double from 1998 levels in less than five years. To be sure, the growth over the past six decades has been paralleled by extraordinary medical advances, but are the increasing number of institutes within NIH making it difficult to manage, especially given the recent influx of new funding?

Given these concerns, Congress recently asked the National Academies to study the issue.

Once a new NIH director is named, a one-year study will begin to determine whether there are general principles by which NIH should be organized and whether the current configuration of the institutes reflects these principles or if restructuring is in order. In preparation for the study, a white paper on the present and historical structure of NIH has been commissioned. — *Bill Kearney*

(See listing on page 34.)



BY JOHN M. WALLACE



What I Did on *My Summer Vacation*

In the aftermath of the release of a high-profile report on global climate change, a Research Council committee member reflects on his 15 minutes of fame.

One of the summer's biggest news stories was the National Research Council's report for the White House on climate change. It made headlines not just here but around the world, the coverage seeming to take on a life of its own, reverberating in op-eds, magazine articles, and talk shows for weeks after the report's release.

Having served on the committee that wrote the report and expecting to take part in a press conference on June 7 to release its findings, I arrived in D.C. the evening before, only to find a voice mail message on my hotel room phone from a press officer at the National Academies saying that because of concerns of a news leak, he had been forced to lift the embargo on the report's findings that afternoon and that the story would appear in tomorrow morning's newspapers. Did it ever. "Panel Tells Bush Global Warming Getting Worse," screamed the lead headline in large print on the front page of the *New York Times*.

There was no need to conduct a press conference now that the news was out there, but in his message, the press officer had suggested that I stop by the Academies' headquarters in the morning anyway, in case there were additional interview requests. Most of the newspaper reporters who filed stories the night before had spoken late that afternoon with Ralph Cicerone, chancellor at the University of California, Irvine, and chair of our committee. But as I was soon to find out, the newspaper coverage meant we were now in the television news cycle. Cicerone had taken a red-eye back to California after finishing his interviews the night before, leaving me to appear in front of the cameras. At practically breakneck speed, I zipped through one taped interview after another — at CNN, ABC, NBC, and some syndicated TV news outlets too. (CBS was the only network that had rushed a story on its broadcast the evening before when the embargo was lifted and the news broke.)

John M. Wallace is a professor in the department of atmospheric sciences and co-director of the program on the environment at University of Washington, Seattle. Wallace is a member of the National Academy of Sciences, and a fellow of the American Academy of Arts and Sciences, the American Geophysical Union, and the American Meteorological Society.

When the stories aired, my 15 minutes of fame had been boiled down to shorter than 15 seconds in sound bites that all sounded curiously similar on each of the networks. Every producer seemed to want the same thing: my earnest-looking mug summing up the report's main findings in one sentence to sandwich into a one- to two-minute story speculating on how the report would impact President Bush's forthcoming meetings with European leaders.

My interviews centered on a single question: "Is global warming a serious policy issue?" How does one respond to such a question, given the large uncertainties inherent in projections of greenhouse warming?

In response, I had a choice of answering, "Yes, to the best of our current knowledge, subject to the following qualifications..." — or — "We don't really know for certain, but..." I chose the more affirmative format, mindful that a number of findings are undeniable:

"Every producer seemed to want the same thing: my earnest-looking mug summing up the report's main findings in one sentence."

- The atmospheric concentration of carbon dioxide has already increased by 30 percent since the industrial revolution.
- Unless policies are enacted to slow the growth to pre-industrial levels, the concentration may well double by the year 2100.
- The prevailing view in the scientific community, shared by most committee members, is that a doubling of carbon dioxide would raise global mean temperature on the order of 5 degrees Fahrenheit.
- The adverse ecological and societal ramifications of such a rise in temperature cannot be dismissed as inconsequential.

It was a bit naive of me to think that any qualifications I might have added would survive the editing process for prime time news programs. Yet I think I made the right choice: The resulting set of 15-second sound bites affirming that greenhouse warming is a serious policy issue were a lot closer to the spirit of our report than "We don't really know" would have been.

Fortunately some of the coverage went far beyond these snippets. In lengthier conversations with NPR and the "NewsHour With Jim Lehrer," Ralph Cicerone had the chance to articulate much more clearly the qualifications and uncertainties that were discussed in our report. And for those who want to delve even deeper into the intricacies of what we do and do not know about greenhouse warming, full text of the Research Council report can be viewed online at <books.nap.edu/catalog/10139.html> and the entire series of reports of the Intergovernmental Panel on Climate Change are available online at <www.ipcc.ch>.

Projects

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

Increasing High School Students’ Engagement and Motivation to Learn.

Board on Children, Youth, and Families, National Research Council and Institute of Medicine. Project director: Timothy Ready. Chair: Deborah J. Stipek, dean, School of Education, Stanford University, Stanford, Calif. Sponsor: Carnegie Corp. of New York.

Internet Navigation and the Domain Name System: Technical Alternatives and Policy Implications.

Computer Science and Telecommunications Board, Division of Engineering and Physical Sciences. Project director: Alan Inouye. Chair: Roger Levien, principal and founder, Strategy & Innovation Consulting, Westport, Conn. Sponsors: U.S. Department of Commerce and National Science Foundation. (See p. 30 in this issue of *In Focus*.)

Methods for Assessing Discrimination.

Committee on National Statistics, Division of Behavioral and Social Sciences and Education. Project director: Marilyn Dabady. Chair: Rebecca M. Blank, dean, Gerald R. Ford School of Public Policy, Henry Carter Adams Collegiate Professor of Public Policy, and professor of economics, University of Michigan, Ann Arbor. Sponsors: U.S. Department of Housing and Urban Development, Ford Foundation, U.S. Department of Education, Mellon Foundation, and U.S. Department of Agriculture.

Organizational Structure of NIH.

Board on Life Sciences, Division on Earth and Life Studies; and Board on Health Sciences Policy, Institute of Medicine. Project director: Frances Sharples. Chair: to be selected. Sponsor: National Institutes of Health. (See p. 31 in this issue of *In Focus*.)

Public-Private Partnerships in the Provision of Weather and Climate Services.

Board on Earth Sciences and Resources, Division on Earth and Life Studies. Project director: Anne Marie Linn. Chair: John A. Armstrong, vice president for science and technology, IBM Corp. (retired), Amherst, Mass. Sponsor: National Oceanic and Atmospheric Administration, National Weather Service.

Youth Population and Military Recruitment.

Board on Behavioral, Cognitive, and Sensory Sciences and Education, Division of Behavioral and Social Sciences and Education. Project director: Anne Mavor. Chair: Paul R. Sackett, professor of psychology, department of psychology, University of Minnesota, Twin Cities. Sponsor: U.S. Department of Defense. (See p. 30 in this issue of *In Focus*.)

Publications

For documents shown as available from National Academy Press (NAP), write to 2101 Constitution Avenue N.W., Washington, D.C. 20418; telephone (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.

A Climate Services Vision: First Steps Toward the Future

Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies (2001, 96 pp.; ISBN 0-309-08256-0; available from NAP, \$18.00 plus \$4.50 shipping).

Aging Avionics in Military Aircraft

Air Force Science and Technology Board, Division on Engineering and Physical Sciences (2001, 76 pp.; ISBN 0-309-07449-5; available from NAP, \$18.00 plus \$4.50 shipping).

Analysis of Engineering Design Studies for Demilitarization of Assembled Chemical Weapons at Pueblo Chemical Depot

Board on Army Science and Technology, Division on Engineering and Physical Sciences (2001, 114 pp.; ISBN 0-309-07607-2; available from NAP, \$27.00 plus \$4.50 shipping).

CDC Anthrax Vaccine Safety & Efficacy Research Program: Interim Report

Board of the Medical Follow-Up Agency, Institute of Medicine (2001, approx. 57 pp.; available only online at <www.nap.edu>).

Classifying Drinking Water Contaminants for Regulatory Consideration

Water Science and Technology Board and Board on Environmental Studies and Toxicology, Division on Earth and Life Studies (2001, 255 pp.; ISBN 0-309-07408-8; available from NAP, \$42.00 plus \$4.50 shipping).

Classroom Assessment and the National Science Education Standards

Center for Education, Division of Behavioral and Social Sciences and Education (2001, 128 pp.; ISBN 0-309-06998-X; available from NAP, \$18.95 plus \$4.50 shipping).

Climate Change Science: An Analysis of Some Key Questions

Division on Earth and Life Studies (2001, 42 pp.; ISBN 0-309-07574-2; available from NAP, \$12.00 plus \$4.50 shipping).

Coal Waste Impoundments: Risks, Responses, and Alternatives
Committee on Earth Resources, Board on Earth Sciences and Resources, Division on Earth and Life Studies (2001, 288 pp.; available only online at <www.nap.edu>).

Confronting Chronic Neglect: The Education and Training of Health Professionals on Family Violence
Board on Children, Youth, and Families, National Research Council and Institute of Medicine (2001, approx. 300 pp.; ISBN 0-309-07431-2; available from NAP, \$39.95 plus \$4.50 shipping).

Connecting Quarks with the Cosmos: Eleven Science Questions for the New Century
Board on Physics and Astronomy and Space Studies Board, Division on Engineering and Physical Sciences (2001, approx. 105 pp.; available only online at <www.nap.edu>).

Coverage Matters: Insurance and Health Care
Board on Health Care Services, Institute of Medicine (2001, 192 pp.; ISBN 0-309-07609-9; available from NAP, \$25.00 plus \$4.50 shipping).

Crossing the Quality Chasm: A New Health System for the 21st Century
Institute of Medicine (2001, 364 pp.; ISBN 0-309-07280-8; available from NAP, \$44.95 plus \$4.50 shipping).

Disposition of High-Level Waste and Spent Nuclear Fuel: The Continuing Societal and Technical Challenges
Board on Radioactive Waste Management, Division on Earth and Life Studies (2001, 212 pp.; ISBN 0-309-07317-0; available from NAP, \$32.00 plus \$4.50 shipping).

Early Childhood Development and Learning: New Knowledge for Policy
Division of Behavioral and Social Sciences and Education (2001, 122 pp.; available only online at <www.nap.edu>).

Envisioning the National Health Care Quality Report
Board on Health Care Services, Institute of Medicine (2001, 256 pp.; ISBN 0-309-07343-X; available from NAP, \$35.00 plus \$4.50 shipping).

Estimating Eligibility and Participation for the WIC Program: Phase 1 Report
Committee on National Statistics, Division on Behavioral and Social Sciences and Education (2001, 98 pp.; ISBN 0-309-07590-4; available from NAP, \$18.00 plus \$4.50 shipping).

Evaluating Welfare Reform in an Era of Transition
Committee on National Statistics, Division of Behavioral and Social Sciences and Education (2001, 268 pp.; ISBN 0-309-07274-3; available from NAP, \$42.95 plus \$4.50 shipping).

Exploring the Biological Contributions to Human Health: Does Sex Matter?
Board on Health Sciences Policy, Institute of Medicine (2001, 288 pp.; ISBN 0-309-07281-6; available from NAP, \$44.95 plus \$4.50 shipping).

Forced Migration and Mortality
Committee on Population, Division of Behavioral and Social Sciences and Education (2001, 160 pp.; ISBN 0-309-07334-0; available from NAP, \$32.00 plus \$4.50 shipping).

Global Air Quality: An Imperative for Long-Term Observational Strategies
Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies (2001, 56 pp.; ISBN 0-309-07414-2; available from NAP, \$23.00 plus \$4.50 shipping).

Growing Populations, Changing Landscapes: Studies from India, China, and the United States
U.S. National Academy of Sciences, Indian Science Academy, and Chinese Academy of Sciences (2001, 324 pp.; ISBN 0-309-07554-8; available from NAP, \$35.00 plus \$4.50 shipping).

Gulf War Veterans: Treating Symptoms and Syndromes
Board on Health Promotion and Disease Prevention, Institute of Medicine (2001, 162 pp.; ISBN 0-309-07587-4; available from NAP, \$35.25 plus \$4.50 shipping).

Health and Behavior: The Interplay of Biological, Behavioral, and Societal Influences
Board on Neuroscience and Behavioral Health, Institute of Medicine (2001, 400 pp.; ISBN 0-309-07030-9; available from NAP, \$49.95 plus \$4.50 shipping).

Immunization Safety Review: Measles-Mumps-Rubella Vaccine and Autism
Board on Health Promotion and Disease Prevention, Institute of Medicine (2001, 102 pp.; ISBN 0-309-07447-9; available from NAP, \$25.00 plus \$4.50 shipping).

Immunization Safety Review: Thimerosal-Containing Vaccines and Neurodevelopmental Disorders
Board on Health Promotion and Disease Prevention, Institute of Medicine (2001, 99 pp.; ISBN 0-309-07636-6; available from NAP, \$18.00 plus \$4.50 shipping).

Improving Operations and Long-Term Safety of the Waste Isolation Pilot Plant — Final Report
Board on Radioactive Waste Management, Division on Earth and Life Studies (2001, 156 pp.; ISBN 0-309-07344-8; available from NAP, \$34.25 plus \$4.50 shipping).

Improving the Quality of Long-Term Care
Division of Health Care Services, Institute of Medicine (2001, 348 pp.; ISBN 0-309-06498-8; available from NAP, \$47.95 plus \$4.50 shipping).

Information Systems and the Environment
National Academy of Engineering (2001, 238 pp.; ISBN 0-309-06243-8; available from NAP, \$42.00 plus \$4.50 shipping).

Informing America's Policy on Illegal Drugs: What We Don't Know Keeps Hurting Us

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Interpreting the Volume-Outcome Relationship in the Context of Cancer Care

National Cancer Policy Board, Institute of Medicine and National Research Council (2001, 42 pp.; ISBN 0-309-07586-6; available from NAP, \$12.00 plus \$4.50 shipping).

Issues for Science and Engineering Researchers in the Digital Age

Office of Special Projects, Division on Policy and Global Affairs (2001, 70 pp.; ISBN 0-309-07417-7; available from NAP, \$23.00 plus \$4.50 shipping).

Knowing What Students Know: The Science and Design of Educational Assessment

Board on Testing and Assessment and Center for Education, Division of Behavioral and Social Sciences and Education (2001, 382 pp.; ISBN 0-309-07272-7; available from NAP, \$39.95 plus \$4.50 shipping).

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Aeronautics and Space Engineering Board, Division on Engineering and Physical Sciences (2001, 94 pp.; ISBN 0-309-07597-1; available from NAP, \$18.00 plus \$4.50 shipping).

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A Modified Baseline Incineration Process for Mustard Projectiles at Pueblo Chemical Depot

Board on Army Science and Technology, Division on Engineering and Physical Sciences (2001, 64 pp.; ISBN 0-309-07612-9; available from NAP, \$18.00 plus \$4.50 shipping).

Naval Forces' Capability for Theater Missile Defense

Naval Studies Board, Division on Engineering and Physical Sciences (2001, 204 pp.; ISBN 0-309-07426-6; available from NAP, \$42.25 plus \$4.50 shipping).

Neurological, Psychiatric, and Developmental Disorders: Meeting the Challenge in the Developing World

Board on Global Health, Institute of Medicine (2001, 458 pp.; ISBN 0-309-07192-5; available from NAP, \$46.00 plus \$4.50 shipping).

Occupational Health and Workplace Monitoring at Chemical Agent Disposal Facilities

Board on Army Science and Technology, Division on Engineering and Physical Sciences (2001, 56 pp.; ISBN 0-309-07575-0; available from NAP, \$18.00 plus \$4.50 shipping).

Physics in a New Era: An Overview

Board on Physics and Astronomy, Division on Engineering and Physical Sciences (2001, 208 pp.; ISBN 0-309-07342-1; available from NAP, \$47.00 plus \$4.50 shipping).

Preparing for an Aging World: The Case for Cross-National Research

Committee on Population and Committee on National Statistics, Division of Behavioral and Social Sciences and Education (2001, 328 pp.; ISBN 0-309-07421-5; available from NAP, \$44.00 plus \$4.50 shipping).

Preserving Public Trust: Accreditation and Human Research Participant Protection Programs

Board on Health Sciences Policy, Institute of Medicine (2001, 232 pp.; ISBN 0-309-87328-6; available from NAP, \$44.00 plus \$4.50 shipping).

Publicly Funded Agricultural Research and the Changing Structure of U.S. Agriculture

Board on Agriculture and National Resources, Division on Earth and Life Studies (2001, prepub, 150 pp.; ISBN 0-309-07616-1; available from NAP, \$33.00 plus \$4.50 shipping).

Readiness Issues Related to Research in the Biological and Physical Sciences on the International Space Station

Space Studies Board, Division on Engineering and Physical Sciences (2001, 54 pp.; ISBN 0-309-07361-5; copies available free from the board, tel. 202-334-3477 or e-mail <ssb@nas.edu>).

Research and Development on a Salt Processing Alternative for High-Level Waste at the Savannah River Site

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Research Priorities for Airborne Particulate Matter: III. Early Research Progress

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Review of the Research Program of the Partnership for a New Generation of Vehicles: Seventh Report

Board on Energy and Environmental Systems, Division on Engineering and Physical Sciences; and the Transportation Research Board (2001, 136 pp., ISBN 0-309-07603-X; available from NAP, \$32.00 plus \$4.50 shipping).

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Veterans and Agent Orange — Update 2000

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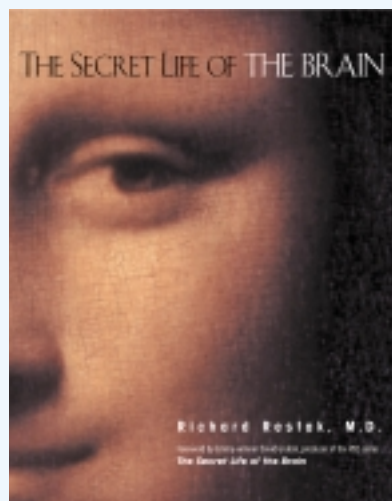
The Secret Life of the Brain

Richard Restak

Ten years since a presidential proclamation ushered in the "Decade of the Brain," scientists today have a better understanding and appreciation of the complexity of the human brain and recognize its awesome power and potential.

In this companion to the five-part television series brought to PBS

by award-winning producer David Grubin, neurologist and neuropsychiatrist Richard Restak takes his readers on a tour of the human brain and explores its many mysteries from infancy to old age. *The Secret Life of the Brain* presents the complex subject of leading-edge brain science in terms accessible to all and brought to life through anecdotes and real-life stories. The book is lavishly illustrated and beautifully presented, with a foreword by David Grubin.



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ARTS IN THE ACADEMY

Exploring the Intersections of Art and Science

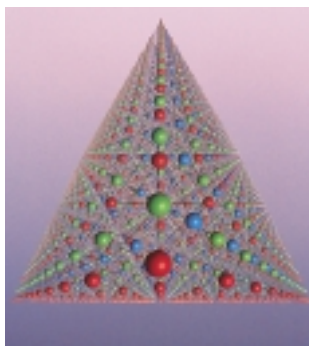
Approaching Chaos: Visions from the Quantum Frontier

Approaching Chaos is an artistic exploration of classical and wave chaos by Harvard physicist Eric J. Heller. This exhibi-



tion features striking images generated by Heller's own research into the mysterious realm of quantum mechanics.

Printed by laser to photographic paper at ultra high resolution, Heller's art pushes the aesthetic beyond the "found" pictures often produced by scientists of photo-



genic subjects like fractals. His impressions of the atomic world, of colliding molecules, electron flow, and quantum waves, are hauntingly organic and familiar. The mega-scale images — many 50 inches or larger — exploit the vast capability of the computer to blur the line between science and art.

On display in the Rotunda Gallery, Feb. 4 to May 12

Sunscapes: Images of Our Magnetic Star presents the most recent research and pictures of the sun. The exhibition includes images from the NASA Transition Region and Coronal Explorer (TRACE), the Extreme Ultraviolet Imaging Telescope (EIT), the Large Area Solar Coronal Observatory (LASCO), and the Michelson Doppler Imager (MDI) telescopes on the ESA/NASA Solar and Heliospheric Observatory (SOHO).



Source: TRACE

On display in the Upstairs Gallery, Feb. 4 to Aug. 15

Gallery hours are weekdays 9 a.m. to 5 p.m. Entrance is at 2100 C St., N.W. Limited parking is available. The nearest metro station is Foggy Bottom. For more information, call 202-334-2436, or see our Web site at <national-academies.org/nas/arts>.

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