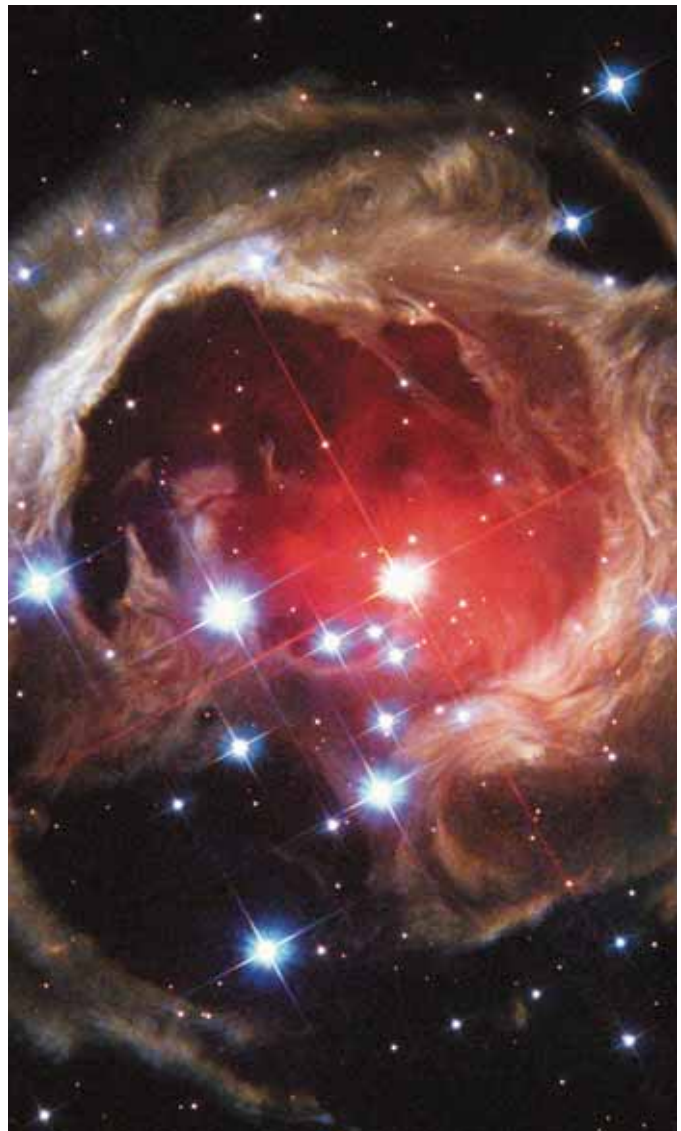


THE NATIONAL ACADEMIES **INFOCUS**

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What Are the Facts on Guns and Violence?
How to Save the Hubble Space Telescope
Complementary and Alternative Medicine

Spring 2005
vol. 5 number 1

THE NATIONAL ACADEMIES

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Celebrating Innovation

I recently had the opportunity to speak to a group of middle and high school students about engineering. I mentioned that my grandfather was about their age in 1900, and described how different his life was from ours today. For instance, in 1900 few people had electricity, telephones, or cars; there were no airplanes; there was no radio or television; there was no air conditioning or even refrigerators; there were no washing machines, dishwashers, or other electric household appliances; and, of course, there were no computers, PDAs, iPods, or Internet.



As I said these things, there were audible gasps from the students. Each of these engineered artifacts is now so essential to our way of life that it's hard to imagine that they didn't exist just two generations ago. Yet we do little to celebrate their creation, or the people who create them. The National Academy of Engineering is trying to do something about that. We now give three \$500,000 prizes — the Draper Prize, the Russ Prize, and the Gordon Prize — to acknowledge the contributions that engineers make to our quality of life. The Draper and Russ prizes are awarded to living innovators who have created things like those listed above. The Gordon Prize is for innovations in engineering education, the necessary precursor to such invention.

The Draper and Russ prizes have been given for the integrated circuit, the jet engine, the Internet, fiber optics, GPS, the implantable heart pacemaker, and the artificial kidney — just to mention a few. And the Gordon Prize, which is quite new, has been awarded for fundamental curriculum reform, a new interdisciplinary telecommunications program, and a program that involves student engineers in solving community problems.

As described in this issue of *In Focus*, NAE is now experimenting with a different kind of prize — an “inducement prize,” which is awarded to the first person or group that achieves some future objective. Charles Lindberg, for example, was responding to an inducement prize for the first flight from New York City to Paris. Our experiment, the \$1 million Grainger Challenge Prize for Sustainability, will be focused on solving problems in sustainable development, and will — we hope — serve to get more American engineers thinking about these problems. The first Grainger Challenge Prize will be awarded for a practical and inexpensive technology for removing arsenic from contaminated drinking water, a problem that affects tens of millions of people worldwide.

Prizes are a powerful way that NAE can both draw attention of the public to the accomplishments of engineers, and spur engineers to greater heights in the service of the public.

A handwritten signature in black ink that reads "Wm. A. Wulf". The signature is stylized and cursive.

WM. A. WULF

President, National Academy of Engineering



Can **Hubble** Be Saved?

After 14 years of service and 650,000 amazing images of the solar system and the far reaches of the universe, the Hubble Space Telescope is starting to lose power. By replacing its batteries and some of its key instruments, the telescope could go on providing stunning images until at least 2010. After the 2003 crash of the space shuttle Columbia, however, NASA immediately grounded the shuttle fleet until the agency could determine the cause of the accident and take measures to prevent it from happening again.

This put the Hubble telescope's future in jeopardy. To reach its full potential and operate for 15 to 20 years, the telescope needed to be serviced by several space shuttle

Academies Weigh Mission Options to Telescope

missions. Four have already occurred, on which shuttle crews replaced some of the telescope's instruments and upgraded the resolution of its cameras.

At first, the Columbia accident left a fifth mission in limbo, but in January 2004, NASA Administrator Sean O'Keefe announced its cancellation due to safety risks. This prompted a groundswell of criticism from astronomers, the public, and Congress, arguing vehemently that Hubble was worth saving. Sen. Barbara Mikulski, D-Md., whose district includes the Space Telescope Science Institute and the Goddard Space Flight Center, requested an independent assessment of the risk associated with a shuttle servicing mission to

Hubble. O’Keefe asked the National Research Council to take on this task.

In early June, O’Keefe announced that NASA would pursue proposals regarding the feasibility of a robotic mission. NASA started developing a robotic mission that would be capable of replacing aging batteries, fine-guidance sensors, gyroscopes, and two scientific instruments, as originally planned for in the fifth shuttle mission.

However, the National Research Council committee charged with examining options for extending the life of the telescope called on NASA to send a manned mission, not a robotic one, to save Hubble. The agency should consider launching the shuttle mission as early as possible — at least before 2008 — after the space shuttle is deemed safe to fly again, because some of the telescope’s components could soon degrade to the point where it would no longer be usable, the committee said issuing its final recommendations in December.

“A shuttle servicing mission is the best option for extending the life of the Hubble telescope and ultimately de-orbiting it safely,” said committee chair Louis J. Lanzerotti, distinguished research professor at the New Jersey Institute of Technology, Newark, and consultant, Bell Laboratories, Lucent Technologies, Murray Hill, N.J. “NASA’s

current planned mission is significantly more technologically risky, so a robotic mission should be pursued only for the eventual removal of the Hubble telescope from orbit, not for an attempt to upgrade it.”

The committee’s principal concerns about a robotic mission are the risk of failing to develop it in time and the risk of a mission failure, as well as the possibility that a robot could critically damage the telescope.

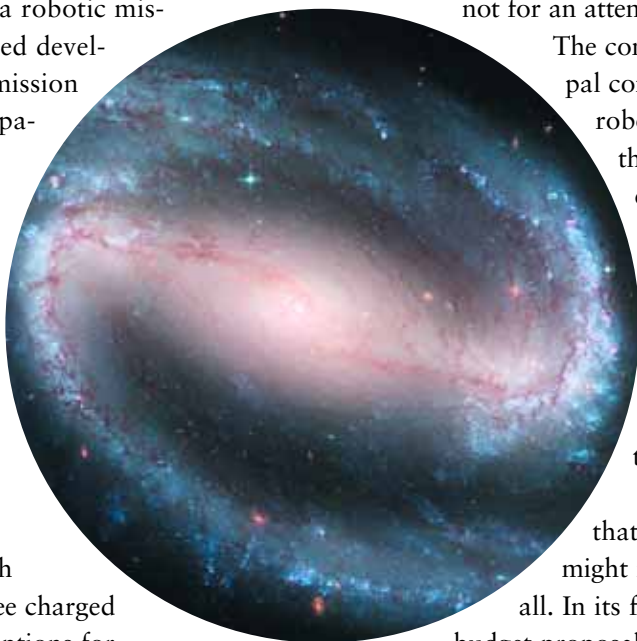
It now seems that the telescope might not be rescued at all. In its fiscal year 2006

budget proposal recently submitted to Congress, the Bush administration deemed any proposal to upgrade the orbiting telescope too costly and did not include the funding necessary for such upgrade. If upheld by Congress, NASA’s budget could sound the death knell for a telescope that for nearly 15 years has been shedding light on previously unknown parts of the universe.

— *Patrice Pages*

■ **Assessment of Options for Extending the Life of the Hubble Space Telescope — Final Report.** Committee on the Assessment of Options for Extending the Life of the Hubble Space Telescope, Division on Engineering and Physical Sciences (2005, 160 pp.; ISBN 0-309-09530-1; available from the National Academies Press, tel. 1-800-624-6242; \$32.50 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/11169.html>).

Louis Lanzerotti, distinguished research professor at the New Jersey Institute of Technology, Newark, and consultant, Bell Laboratories, Lucent Technologies, Murray Hill, N.J., chaired the committee. The study was funded by NASA.





Can the Structure of Neighborhoods and Workplaces Make Us More Active?

More than half of the U.S. adult population fails to get the recommended amount of daily physical activity, putting them at risk for a number of major health problems including heart disease, colon cancer, and diabetes. One way to encourage people to be more active could be to change the environment in which they work and live.

Research increasingly shows a link between physical activity and the “built” environment — buildings, roads, parks, and other structures that physically define a community, says a new report from a committee of the Transportation Research Board and the Institute of Medicine. This area of study is garnering more attention as suburban sprawl and longer commutes seem to contribute to less active lifestyles, and technological innovations reduce physical activity. But more studies are needed to clarify whether and to what extent the built environment affects total levels of daily physical activity.

“We know from empirical evidence that the built environment can encourage some forms of physical activity, such as walking and cycling, for some population groups,” said committee chair Susan Hanson, Landry University Professor, Clark University, Worcester, Mass. “But we don’t know yet how important it is to meeting recommended levels of physical activity — at least 30 minutes of moderate activity on five or more days per week — or how much of a person’s decision to be physically active depends on their physical surroundings as opposed to personal inclination.”

A collaborative effort to fund interdisciplinary research into causal relationships

Let’s Get **PHYSICAL**

between the built environment and physical activity should be developed by an interagency working group led by the U.S. Department of Health and Human Services and the U.S. Department of Transportation. Such research could help policy-makers design cost-effective strategies for increasing physical activity, the committee said.

Also, national public health and travel surveys, such as the Centers for Disease Control and Prevention’s Behavioral Risk Factor Surveillance System and the National Household Travel Survey, conducted by DOT’s Bureau of Transportation Statistics, should be expanded to provide more detailed information about where and why people exercise and engage in active forms of travel such as walking and cycling.

These surveys should be used to compare how various settings encourage or deter physical activity. For example, survey results could help determine if the deteriorated physical condition of some poor inner-city neighborhoods discourages outdoor physical activity and whether “neo-traditional” neighborhoods, which provide a small-town atmosphere with grid street patterns, front porches, sidewalks, and common public spaces, attract people who are more active. — *Patrice Pages*

■ **Does the Built Environment Influence Physical Activity? Examining the Evidence.** Committee on Physical Activity, Health, Transportation, and Land Use, Transportation Research Board and Institute of Medicine (2005, approx. 224 pp.; ISBN 0-309-09498-4; a PDF file of the forthcoming report is available from the National Academies Press, on the Internet at <books.nap.edu/catalog/11203.html>).

Susan Hanson, Landry University Professor, Clark University, Worcester, Mass., chaired the committee.

Bobbie Berkowitz, professor and chair, University of Washington School of Nursing, Seattle, was vice chair. The study was funded by the Robert Wood Johnson Foundation and the Centers for Disease Control and Prevention.

Off Target

WEAK DATA ON
GUNS AND VIOLENCE
THWART SOUND
POLICY-MAKING



Current research on guns and violent crime often misses the mark, leaving unanswered the questions that most people have. The science base is too weak to settle policy disputes or to support clear-cut positions about what can be done to prevent or control gun violence, says a new report from the National Research Council.

Some of today's most pressing policy questions regarding gun use simply cannot be answered because existing data and research methods are inadequate. Take, for example, studies of "right-to-carry" laws, which allow eligible adults to carry concealed handguns. To date, nearly three dozen states have enacted such measures, but existing studies that use similar methods and data to gauge their effects yield conflicting results. Certain studies indicate that these laws reduce violent crime. Other studies show negligible effects, while still others suggest an increase — making it impossible to draw strong conclusions from

available evidence, said the committee that wrote the report.

Those inconclusive and contradictory findings are a recurring theme in the committee's assessment of the scientific literature in this area. If criminal-justice and crime-prevention policy is to have a sound basis, a comprehensive research program on firearms is needed, and the federal government should support such an effort, the report says.

The committee was asked to evaluate the quality of scientific data and research on firearms injury and violence. It found a scientific foundation that is shaky and full of holes. The report identifies information that is needed not only to strengthen that foundation, but also to inform decision-making.

The inadequacy of data on gun ownership and use is a critical barrier to better understanding gun violence, the report says. Furthermore, many studies have design flaws or offer contradictory evidence. Assessing the potential of several ongoing national surveys to provide useful data on firearms should be a starting point. Also, a key research question is whether ownership data can be accurately collected while protecting privacy. And to conduct more rigorous and comprehensive studies, scientists need appropriate access to federal and state data on gun use, manufacturing, and sales.

How brisk is the gun trade overall? It is difficult to say because information on gun markets is virtually nonexistent. In

addition, research should be carried out to investigate any potential links between firearms policies and suicide rates. Also needed are much better studies on the benefits and costs of policing and other criminal-justice interventions, the report says.

And to amass reliable and accurate data about violent injuries and deaths, the development of a National Violent Death Reporting System and a National Incident-Based Reporting System should be a priority.

Many violence-prevention programs intended to steer children away from firearms receive, at best, an incomplete grade. There

is almost no evidence that these initiatives have had any effects on youths' behavior, knowledge, or attitudes regarding guns, the report says. Thorough evaluation of the programs should be standard practice.

Firearms violence is a serious problem in the United States. The report's call for better data and research reflects that reality.

— *Vanee Vines*

■ **Firearms and Violence: A Critical Review.** Committee to Improve Research Information and Data on Firearms, Committee on Law and Justice, Division of Behavioral and Social Sciences and Education (2004, 340 pp.; ISBN 0-309-09124-1, available from the National Academies Press, tel. 1-800-624-6242; \$47.95 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/10881.html>).

The committee was chaired by **Charles F. Wellford**, professor, department of criminology and criminal justice, University of Maryland, College Park. The study was sponsored by the National Institute of Justice, U.S. Department of Health and Human Services, Joyce Foundation, Annie E. Casey Foundation, and the David and Lucile Packard Foundation.



The Road to Adulthood

Stretching Opportunities for Youth in the Developing World

In the past, young people in developing countries often had to quickly jump from being children to playing adult roles out of necessity. But the economic, cultural, and demographic influences of globalization have delayed the transition to adulthood — giving them more time to learn and to engage in civic activities.

Compared with the same age group 20 years ago, young people in the developing world are now more likely to enroll in school and to spend more years there — postponing entry into the labor force and delaying marriage and childbearing. But they are also exposed to more ideas that may clash with traditional values, and to information about global inequities.

Decisive steps should be taken to ensure that more youth in the Third World acquire the skills and knowledge necessary to thrive as adults and to compete for a wider array of jobs in the global marketplace, says a new report from the National Research Council and the Institute of Medicine.

Adequate schooling is critical. In developing countries, recent gains in the rate of school participation and in the grade level attained have been historically unprecedented and greater for girls than boys. The economic payoffs have been significant, too. These trends are not universal, however. For example, school attendance rates vary significantly based on family wealth. The dismal quality of some schools also hinders learning and discourages enrollment, the report says.

Although young people are reaching adulthood healthier than before, sub-Saharan Africa remains a region of special concern, the report says. HIV/AIDS is the leading cause of death among young people



there. The region's poverty rates are also climbing, and studies show that impoverished youth are more likely to engage in risky sexual behavior.

Among young women in many developing nations, mortality and morbidity related to pregnancy and childbirth and to unsafe abortions are still huge health risks, the report adds.

Poverty is the greatest enemy of successful transitions to adulthood, the report stresses. Policies and programs for youth in developing countries should target the poor, particularly impoverished girls. Policy-makers should also boost school quality and expand enrollment in secondary schools to better prepare students who can contribute to their societies. In addition, officials should provide youth with more information about sex and good health practices — and increase the availability of reproductive health services for those who are sexually active.

If they are well-prepared, the report says, adolescents and young adults in developing nations can benefit from the global forces that are transforming their worlds.

— *Vanee Vines*

■ ***Growing Up Global: The Changing Transitions to Adulthood in Developing Countries.*** Panel on Transitions to Adulthood in Developing Countries, Committee on Population, Board on Children, Youth, and Families, National Research Council and Institute of Medicine (2005, 736 pp.; ISBN 0-309-09528-X, available from the National Academies Press, tel. 1-800-624-6242; \$74.00 plus \$4.50 shipping for single copies; also on the Internet at books.nap.edu/catalog/11174.html).

The panel was chaired by **Cynthia B. Lloyd**, director of social science research at the Population Council in New York City. The study was funded by the U.S. Agency for International Development, Andrew W. Mellon Foundation, William and Flora Hewlett Foundation, David and Lucile Packard Foundation, John D. and Catherine T. MacArthur Foundation, and the World Bank.

PERCHLORATE



Setting a Safe Dose

When the National Research Council early this year issued its assessment of the health risks of perchlorate, a chemical contaminating water supplies in 35 states, both advocates and opponents of a tough federal drinking-water standard seized upon the study to support their position. Some environmental groups claimed the new study would lead to a standard near one part per billion, a level proposed in 2002 by the U.S. Environmental Protection Agency. But the defense community argued that the standard should be much higher. Perchlorate has mainly been used as a component in rocket fuel and munitions, and if a cleanup

is required, the defense industry would largely be responsible for its cost.

The Research Council report, however, did not directly support either stance, according to the committee that wrote it. The report emphasizes that drinking-water standards are based on assumptions the committee was not asked to make, such as average water consumption and average body weight. Regulators also need to consider other sources of human exposure to perchlorate, such as contaminated food and milk.

What the report does propose is a safe daily dose of the chemical, regardless of the source. It says that up to 0.0007 milligrams

per kilogram (mg/kg) of body weight can be consumed daily without adversely affecting even the most sensitive populations — fetuses of pregnant women with thyroid problems.

Perchlorate inhibits the thyroid's uptake of iodide, which is crucial for the production of thyroid hormones. There have been some studies of the effects of perchlorate exposure on human populations, but such studies may not be applicable at the individual level. The committee therefore chose to base its safe reference dose primarily on five human clinical studies, particularly one issued in 2000 that found no inhibition of iodide uptake in adult participants who took 0.007 mg/kg of body weight per day. This led to the 0.0007 reference dose after the committee applied an uncertainty factor of 10 to protect the fetuses of pregnant women who might have a pre-existing thyroid condition or insufficient iodide consumption.

The fact that no inhibition of iodide uptake — which needs to occur before an adverse health effect is triggered — was observed at the level selected from the clinical study, coupled with the uncertainty factor, prompted the committee to call its determination of a reference dose a “conservative, health-protective approach to perchlorate risk assessment,” although one committee member who thought the data were inadequate contended that an additional uncertainty factor of three should be applied.

EPA said in its draft assessment that a standard of one part per billion in drinking water corresponded with a reference dose of 0.00003 mg/kg — 23 times less than the one recommended by the Research Council. EPA's reference dose was lower because it is based on animal studies — which generally

require higher uncertainty factors — including one study in rats that the agency said showed perchlorate exposure caused thyroid tumors in two offspring. However, the Research Council committee concluded that it was highly unlikely that disruption of thyroid function from perchlorate exposure would lead to thyroid cancer in humans.

Besides the standards that interest groups declared would be supported by the committee's assessment, some press reports also offered standards that journalists said corresponded with the committee's reference dose. Reporters contacted for comment said they calculated the standards — which varied from one news story to the next — by applying perchlorate-exposure assumptions used by EPA or by states that had set a standard.

Six weeks after the report's release, EPA announced that it was officially adopting the committee's reference dose. The agency determined that the dose corresponds with a drinking-water equivalent concentration of 24.5 parts per billion, but that perchlorate concentrations in food and milk still need to be examined. — *Bill Kearney*

■ **Health Implications of Perchlorate Ingestion.**

Committee to Assess the Health Implications of Perchlorate Ingestion, Board on Environmental Studies and Toxicology, Division on Earth and Life Studies (2005, 278 pp.; ISBN 0-309-09568-9; available from the National Academies Press, tel. 1-800-624-6242; \$42.00 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/11202.html>).

The committee was chaired by **Richard B. Johnston Jr.**, associate dean, research development, and professor, department of pediatrics, University of Colorado School of Medicine; and executive vice president for academic affairs, National Jewish Medical and Research Center, Denver. The study was funded by the U.S. Environmental Protection Agency, U.S. departments of Defense and Energy, and NASA.



Equal Treatment

Holding Complementary and Alternative Medicine and Conventional Medicine to the Same Standards

These days it is not unusual for people to take herbal remedies along with their prescription drugs, or for physicians to field questions from patients about how well acupuncture alleviates arthritis pain. About one-third of all American adults have used some form of complementary and alternative medicine (CAM). As the popularity these treatments has grown in the United States, debate has flared over how much is known about their safety and

efficacy, whether they can and should undergo clinical testing, and the extent to which CAM and conventional medicine can and should be integrated.

In a recent report, a committee of the Institute of Medicine examined these issues from the perspective of what is needed to improve the quality of health care delivery in America. The goal is to achieve care centered on patients' needs and preferences and based on the best available scientific evidence.

“Health professionals and patients need sufficient information about safety and efficacy to take advantage of all useful therapies,” said committee chair Stuart Bondurant, interim executive vice president for health sciences and executive dean, Georgetown University Medical Center, Washington, D.C. “What matters is not a particular therapy’s origins, but rather that there is evidence that it is safe and that it works.”

To that end, the committee called for conventional treatments and complementary and alternative treatments to be held to the same standards for demonstrating clinical effectiveness. While this means that both types of therapies should undergo some form of clinical testing, innovative methods may have to be used to test some treatments that do not lend themselves to randomized controlled trials — the gold standard for developing reliable evidence. This is as much the case for a surgical procedure that depends upon the administering professional’s skills as for naturopathy, for example, the committee noted. Data from other types of studies, such as observational and case-controlled studies, can provide useful information about safety and effectiveness, the report says.

CAM practitioners who know the methods and goals of a particular product or therapy should be involved in its testing to ensure that it is applied correctly and in the right context. To prepare them for this new role, CAM training programs should begin teaching students research skills and principles. At the same time, health professional schools should provide future doctors, nurses, and other health providers with education about CAM.



Testing of dietary supplements — among the most frequently used forms of CAM — runs into particular difficulties because these products are regulated as foods rather than drugs. There is no requirement and little incentive for supplement manufacturers to conduct safety and efficacy tests of their products, and quality control in supplement manufacturing is often lacking, leading to inconsistency among and within brands. Consistent products are essential to do studies that yield reliable and broadly applicable results. Health practitioners need to know that the supplements their clients use are safe and effective, so the report calls on Congress to implement quality-control standards for each step of the supplement manufacturing process and to enforce more accurate labeling and disclosures and other consumer protections.

Resources to conduct testing of medical therapies are finite, however. The report offers several criteria to help guide decisions about which CAM therapies to prioritize for study. These criteria apply equally well to help prioritize untested conventional treatments. — *Christine Stencel*

■ **Complementary and Alternative Medicine in the United States.** Committee on the Use of Complementary and Alternative Medicine by the American Public, Board on Health Promotion and Disease Prevention, Institute of Medicine (2005, approx. 368 pp.; ISBN 0-309-09270-1; available from the National Academies Press, tel. 1-800-624-6242; \$47.95 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/11182.html>).

The committee was chaired by **Stuart Bondurant**, interim executive vice president for health sciences and executive dean, Georgetown University Medical Center, Washington, D.C. The study was funded by the National Institutes of Health and the Agency for Healthcare Research and Quality.



REWARDING RESEARCH

In the 1970s, United Nations health experts and engineers searching for a solution to unsafe drinking water in South Asia suggested tapping into underground water supplies. “Tube wells” dug 20-75 feet deep provided clean water to millions of people who previously drank from bacteria-tainted ponds, rivers, and lakes. Indeed, cases of waterborne diseases dropped dramatically as thousands of the new wells were drilled. Years later, however, many of the people drinking water from these wells began suffering from a new ailment: arsenic poisoning.

Unbeknownst to the officials installing them, tube wells in some parts of the world were drawing on aquifers contaminated by naturally occurring arsenic. The illnesses caused by chronic arsenic exposure — skin lesions, loss of limb movement, kidney and liver failure, and cancer among them — are often debilitating and sometimes fatal, although it can take more than a decade before symptoms of the poisoning become visible. In fact, some regions did not recognize they had a new public health problem until the mid-1990s. The epidemic is most extreme in

Bangladesh where it is estimated that one-quarter of the population drinks water laced with arsenic at levels up to 50 times higher than what the U.S. Environmental Protection Agency considers safe.

Now researchers are back at the drawing board, looking for ways to remove arsenic from water, and this time there is a \$1 million prize to spur them on. The National Academy of Engineering is offering the Grainger Challenge Prize for Sustainability to any individual or team who creates a viable arsenic treatment system.

The winning design must be affordable and low tech. Expensive, centralized water treatment facilities are available to purify arsenic-contaminated water in wealthier nations, but what is needed in countries such as Bangladesh, India, and Nepal, is an inexpensive system that can be widely distributed to remote villages and households.

Fortunately, some small and cheap methods for removing arsenic from drinking and cooking water are already finding their way to places that need them. Engineering professor Susan Murcott and her graduate students at the Massachusetts Institute of Technology in Cambridge developed a \$16 filter filled with sand, brick chips, gravel, and iron. When water is poured through the device — about the size of a small trash can — arsenic clings to the iron. Two thousand of these filters are now serving 15,000 Nepalese.

And a partnership among researchers from George Mason University in Fairfax, Va., Wagner College in Staten Island, N.Y., and the University of Dhaka in Bangladesh led to a three-bucket sand and iron system that costs \$35 and is capable of filtering 20 liters of water per hour. Ten thousand of

these filters, which can be used up to five years, are producing cleaner water in schools and homes throughout Bangladesh.

The effectiveness of the bucket system was confirmed by a Columbia University study of a two-bucket design being used by six households in Bangladesh. In four of the homes, arsenic levels in filtered water fell below the World Health Organization's



standard of 10 micrograms per liter. Misuse of the filters probably led to slightly higher levels in the other two homes, researchers said, clearly indicating the need for easy-to-use filters — another criteria of the Grainger prize. They also cautioned that unsafe levels of the element manganese were found in some of the filtered water samples.

Research awards have propelled many ideas into realities and NAE President Wm. A. Wulf hopes the Grainger prize will do the same. “It focuses the talents of the engineering community on solving a tremendous problem and improving the quality of life for all people,” he said. — *Bill Kearney*

The Grainger Challenge Prize for Sustainability is sponsored by The Grainger Foundation. Prize applications must be submitted to NAE by June 2006. After monitored pilot tests, the prize will be awarded in early 2007. For more information, visit <www.graingerchallenge.org>.

What's Driving Climate Change?

Scientists know from temperatures observed at the Earth's surface that the planet is warming. There are factors that drive this warming, as well as others that cause cooling. Carbon dioxide in the atmosphere, for example, increases temperatures by absorbing infrared radiation emitted by the Earth's surface, radiation that would otherwise escape to space, in what we know as the greenhouse effect. Small droplets and dust found in the atmosphere after large volcanic eruptions, on the other hand, reflect sunlight back to space before it ever reaches the planet, thereby having a cooling effect. In addition to pollution and volcanoes, other "forcings" of the climate include changes in land use and variation in the amount of energy received each year from the sun.

But how do scientists quantify the effect of a particular forcing on temperatures? Traditionally they have relied upon a concept known as "radiative forcing," a disturbance in the energy balance at the top of the atmosphere resulting from an external driver, such as industrial activity. For solar variability and many greenhouse gases, there is a direct relationship between top-of-the-atmosphere radiative forcing and fluctuations in surface temperature.

A new report from the Research Council says radiative forcing is an observable quantity that is relatively easy to compute. It also gives policy-makers an extremely useful tool for making decisions about climate change. In particular, it provides a way to compare the impact of different pollutants on global warming.



The concept has some limitations, however. By only diagnosing the change in global mean surface temperature, for example, the regional impact of some industrial pollutants and changes in land use, such as deforestation, may be underestimated. And it offers little information

on other types of climate change, such as precipitation levels or ecological functioning.

The report says scientists should examine how forcings behave at different altitudes and in different regions of the world. Further research also is needed to quantify how forcings affect climate other than through temperature change.

In addition, the report says that more needs to be known about the role airborne particles play in the creation of clouds, which not only affect rainfall but also reflect sunlight. It is important to understand such effects because pollutants — including some that cause cooling and others that cause warming — are likely to decrease with tougher air-quality regulations. The report emphasizes that an expanded understanding will give governments a better idea of how pollution-control strategies impact climate.

— *Bill Kearney*

■ **Radiative Forcing of Climate Change: Expanding the Concept and Addressing Uncertainties.** Committee on Radiative Forcing Effects on Climate, Climate Research Committee, Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies (2005, approx. 225 pp.; ISBN 0-309-09506-9; available from the National Academies Press, tel. 1-800-624-6242; \$37.00 plus \$4.50 shipping for single copies; also on the Internet at <books.nap.edu/catalog/11175.html>).

The committee that wrote the report was chaired by **Daniel J. Jacob**, Gordon McKay Professor of Atmospheric Chemistry and Environmental Engineering, Harvard University, Cambridge, Mass. The study was funded by the U.S. Climate Change Science Program.

Journal Celebrates 90 Years of Publication

This year *Proceedings of the National Academy of Sciences* (PNAS) celebrates its 90th anniversary — with more than 1,500 issues by over 35,000 authors published since its inception in 1914. PNAS is one of the world's most-cited multidisciplinary scientific journals, covering the biological, physical, and social sciences in cutting-edge research reports, commentaries, perspectives, biographies, colloquium papers, and actions of the Academy. PNAS is published



weekly in print, and daily online in the form of PNAS Early Edition. PNAS Online is made freely available to more than 140 developing countries worldwide.

In celebration of its 90th anniversary, PNAS is presenting its online “Classics of Scientific Literature” section, which recognizes and highlights landmark scientific papers published in the journal. This special section is available at www.pnas.org/misc/classics.shtml.

“We are pleased to celebrate our ninth decade,” says Nicholas Cozzarelli, editor in chief of PNAS. “We owe a special thanks to the authors and readers who have contributed so much.” — *Maureen O’Leary*

‘The Agile Gene’ Wins Best Book Award

Each year the National Academies present three \$20,000 awards for excellence in reporting and communicating science, engineering, and medicine to the general public. The 2004 winners were author Matt Ridley for “*The Agile Gene: How Nature Turns on Nurture*.” The judges called his work “an insightful synthesis of the issues surrounding the debate over the influence nature and nurture have on individuals.” The other 2004 winners were Robert Lee Hotz, a reporter for the *The Los Angeles Times*, “for his compelling reporting on the space shuttle Columbia accident,” and producers Sue Norton and David Clark “for presenting stunning imagery and showing the importance of engineering in scientific exploration” in The Science Channel’s “Science of the Deep: Mid-Water Mysteries.”

“It is an honor to recognize not only the achievements of these individuals, but also the vital role they play in increasing the public’s understanding of science, engineering, and medicine,” said NAS President Bruce Alberts. “We hope that these awards inspire many others to report clearly and creatively about the world we live in.” — *Maureen O’Leary*

NAS Elects President, VP, and Council Members

The National Academy of Sciences will add six new faces to its leadership in July. At the helm will be Ralph J. Cicerone, chancellor of the University of California, Irvine, as the next NAS president.

An atmospheric chemist, Cicerone's work has helped shape policy on climate change and pollution. He has conducted research on the plasma physics of Earth's ionosphere, the chemistry of the ozone layer, and radiative forcing of climate change. Cicerone also helped identify the roles nitrous oxide and methane play in climate change and global warming.

Cicerone succeeds Bruce Alberts, who is completing his second term as president,



the maximum allowed by the Academy's bylaws. Alberts and his wife, Betty, plan to return to California.

"NAS members have elected a strong team to lead our efforts to advise the nation on important issues," said Bruce Alberts. "The Academies will be in good hands for years to come."

Other election results are:

VICE PRESIDENT

Barbara A. Schaal, Spencer T. Olin Professor in Arts and Sciences, department of biology, Washington University, St. Louis

COUNCIL MEMBERS

Claude R. Canizares, Bruno Rossi Professor of Experimental Physics and associate provost, Massachusetts Institute of Technology, Cambridge

Gerald D. Fischbach, executive vice president for health and biomedical sciences, and dean, faculty of medicine, Columbia University College of Physicians and Surgeons, New York City

Jerry P. Gollub, JBB Professor in the Natural Sciences, Haverford College, Haverford, Pa., and adjunct professor of physics, University of Pennsylvania, Philadelphia

Joyce Marcus, Elman R. Service Professor of Cultural Evolution and curator of Latin American archaeology, University of Michigan, Ann Arbor

— *Maureen O'Leary*

Foege to Receive Public Welfare Medal

William H. Foege has been selected by the National Academy of Sciences to receive its most prestigious award, the Public Welfare Medal. Established in 1914, the medal is presented annually to honor extraordinary use of science for the public good. The Academy chose Foege for his dedication to eradicating global disease and his leadership in redefining the scope of public health policy in the United States.

“Dr. Foege’s impact on the world’s health has been extraordinary,” said John Brauman, NAS home secretary and chair of the selection committee. “In terms of lives saved and freed from disease, he has changed the world as we know it.”

An epidemiologist, Foege is perhaps best known for his contributions to the successful global effort to eliminate smallpox. Early in his career, he traveled to Nigeria, where he worked to inoculate local populations against the disease. When faced with a critical vaccine shortage, Foege and his colleagues made the difficult decision to vaccinate only those they determined to be at greatest risk of infection — people in close contact with known victims. Later, as director of CDC’s Smallpox Eradication Program, Foege demonstrated the effectiveness of this “ring vaccination” approach,



which made it possible to vanquish smallpox from many countries in which as little as one-half of the population had been immunized.

Shifting his focus from the global to national, Foege was appointed director of CDC in 1977. Under his leadership, the agency first addressed the emerging problem of HIV/AIDS, implemented a childhood vaccination initiative that resulted in unprecedented immunization levels in school-aged children, and discovered the link between aspirin and Reye’s syndrome. Foege now serves as an emeritus professor at Emory University and a fellow at the Bill & Melinda Gates Foundation.

— *Lauren Morello*

Stem Cell Research

FROM PROPOSITION TO REALITY IN CALIFORNIA

Shortly after California voters approved a proposition on their November ballot to spend \$3 billion over the next decade on stem cell research, backers of the initiative asked the National Academies for help getting started. The proposition created a new institute to administer the research funding, which meant advice was needed on grant-making, licensing agreements, ethical oversight, and more. “We wanted to identify currently accepted best practices that could be used as a foundation,” explained Robert



Klein, who led the campaign to pass the proposition and was later named head of the new California Institute for Regenerative Medicine — so named because of the potential for stem cells to provide replacement cells of any type to individuals suffering from certain types of debilitating illnesses.

In December, the Academies responded to the request for help by gathering many

of the nation’s leading authorities on research management at a two-day workshop in Irvine, Calif.

Several of the speakers there urged those running the California initiative to be innovative in their approach to grant-making. In opening remarks, NAS President Bruce Alberts said not to be afraid of supporting young scientists, who have novel ideas but are often overlooked in federal grant competitions. Robert A. Goldstein, chief scientific officer from the Juvenile Diabetes Research Foundation, emphasized the importance of setting priorities and issuing grants aimed at meeting those goals. He added that given the controversial nature of stem cell research and lack of federal guidelines, it may be necessary to include ethicists and patient advocates in the review of grant applications. Larry Gruder, who oversees state-funded grants administered by the University of California system, noted that having out-of-state reviewers reduces the chances of a real or perceived conflict of interest.

Part of the discussion also focused on intellectual property rights. The proposition called for a percentage of royalties from money-making discoveries to be returned to state coffers, which its promoters had argued would offset taxpayer costs. But Ann Hammersla, an intellectual property attorney at the Massachusetts Institute of Technology, said that it will likely be 10 years before any royalties arrive, although

California residents may reap other benefits in the meantime, such as job growth.

Of particular interest to the audience were speakers from nonprofit groups affiliated with the University of Wisconsin, Madison. These groups hold patents on several stem cell lines as well as on techniques for harvesting stem cells from human embryos. They allow outside scientists to use these lines and techniques at no charge, but only for research purposes. Because the proposition requires that royalties be shared with the state, however, special agreements will need to be hammered out for California-funded scientists using the patented Wisconsin lines and techniques. California-based Geron Corp. also needs to be part of these discussions since it owns some exclusive rights to therapies developed with the Wisconsin technology.

Workshop participants also discussed the necessity of keeping human embryonic stem cell research funded by a state or private source separate from research funded by the U.S. government, which only allows federal money to be spent on the study of certain pre-existing lines.

R. Alto Charo, a professor of law and bioethics at the University of Wisconsin, Madison, discussed the prudence of gaining the consent of donors of embryos from which stem cells are to be derived. A National Academies report on responsible stem cell research, expected to be released this spring, will provide further guidance on such issues.

Klein said he expects the new institute to make its first grants this year, an ambitious schedule given the number of issues that workshop participants said need to be tackled. — *Bill Kearney*



The workshop was chaired by **Ralph J. Cicerone**, chancellor of the University of California, Irvine. The workshop was funded by the California Research and Cures Coalition.

Projects

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

Food Marketing and the Diets of Children and Youth.

Food and Nutrition Board, Institute of Medicine, and Board on Children, Youth, and Families, Institute of Medicine and National Research Council. Project co-directors: Jennifer Gootman and Vivica Kraak. Chair: J. Michael McGinnis, senior scholar, Institute of Medicine, Washington, D.C. Sponsor: U.S. Centers for Disease Control and Prevention.

Human Biomonitoring for Environmental Toxicants.

Board on Environmental Studies and Toxicology, Division on Earth and Life Studies. Project Director: Eileen Abt. Chair: Thomas A. Burke, professor and associate chair, department of health policy and management, and founding co-director, Risk Sciences and Public Policy Institute, Bloomberg School of Public Health, Johns Hopkins University, Baltimore. Sponsor: U.S. Environmental Protection Agency.

Identifying and Preventing Medication Errors.

Board on Health Care Services, Institute of Medicine. Project director: Philip Aspden. Co-chairs: J. Lyle Bootman, dean and professor, College of Pharmacy, and executive director, Center for Health Outcomes and Pharmacoeconomic Research, University of Arizona, Tucson; and Linda R. Cronenwett, dean and professor, School of Nursing, University of North Carolina, Chapel Hill. Sponsor: U.S. Department of Health and Human

Services’ Centers for Medicare & Medicaid Services.

Increasing Rates of Organ Donation.

Board on Health Sciences Policy, Institute of Medicine. Project director: Cathy Liverman. Chair: James F. Childress, John Allen Hollingsworth Professor of Ethics and professor of medical education; and director, Institute for Practical Ethics and Public Life, University of Virginia, Charlottesville. Sponsors: U.S. Department of Health and Human Services’ Health Resources and Services Administration and the Greenwall Foundation.

Information for Terrorism Prevention: Balancing Privacy and National Security.

Committee on Law and Justice, Division of Behavioral and Social Sciences and Education. Project director: Carol Petrie. Chair: Charles Vest, professor of mechanical engineering and president emeritus, Massachusetts Institute of Technology, Cambridge. Sponsors: National Science Foundation and U.S. Department of Homeland Security.

Technologies to Deter Currency Counterfeiting.

Board on Manufacturing and Engineering Design, Division on Engineering and Physical Sciences. Project director: Toni Marechaux. Chair: To be selected. Sponsor: U.S. Department of the Treasury’s Bureau of Engraving and Printing.

Technology Pathways: Assessing the Integrated Plan for a Next Generation Air Transportation System.

Aeronautics and Space Engineering Board, Division on Engineering and Physical Sciences. Project director: Alan Angleman. Chair: S. Michael Hudson, former vice chair, Rolls Royce North America, and former president, chief executive officer, and chief operating officer, Allison

Engine Company Inc., Indianapolis. Sponsor: NASA.

Publications

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

An Assessment of Potential Health Effects From Exposure to PAVE PAWS Low-Level Phased-Array Radiofrequency Energy

Board on Radiation Effects Research, Division on Earth and Life Studies (2005, approx. 207 pp.; ISBN 0-309-09309-0; available from NAP, \$42.50 plus \$4.50 shipping).

An Assessment of the Small Business Innovation Research Program: Project Methodology
Division on Policy and Global Affairs (2004, 124 pp.; ISBN 0-309-09322-8; available from NAP, \$28.50 plus \$4.50 shipping).

Animal Care and Management at the National Zoo — Final Report
Board on Agriculture and Natural Resources and Institute for Laboratory Animal Research, Division on Earth and Life Studies (2005, 304 pp.; ISBN 0-309-09583-2; available from NAP, \$59.00 plus \$4.50 shipping).

Assessment of Department of Defense Basic Research
Air Force Science and Technology Board, Division on Engineering and Physical Sciences (2005, 70 pp.;

ISBN 0-309-09443-7; available from NAP, \$18.00 plus \$4.50 shipping).

Assessment of the Benefits of Extending the Tropical Rainfall Measuring Mission: A Perspective From the Research and Operations Communities — Interim Report
Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies (2004, 103 pp.; available only online at <www.nap.edu>).

Beyond the Market: Designing Nonmarket Accounts for the United States
Committee on National Statistics, Division of Behavioral and Social Sciences and Education (2005, 224 pp.; ISBN 0-309-09319-8; available from NAP, \$37.00 plus \$4.50 shipping).

Communicating Toxicogenomics Information to Nonexperts — A Workshop Summary
Board on Environmental Studies and Toxicology and Board on Life Sciences, Division on Earth and Life Studies (2005, 60 pp.; ISBN 0-309-09538-7; available from NAP, \$18.00 plus \$4.50 shipping).

Contaminants in the Subsurface: Source Zone Assessment and Remediation
Water Science and Technology Board, Division on Earth and Life Studies (2005, 370 pp.; ISBN 0-309-09447-X; available from NAP, \$57.00 plus \$4.50 shipping).

Decision Making for the Environment: Social and Behavioral Science Research Priorities
Committee on the Human Dimensions of Global Change, Center for Governance, Economics, and International Studies, Division of Behavioral and Social Sciences and Education (2005, 160 pp.; ISBN 0-309-09540-9; available from NAP, \$32.00 plus \$4.50 shipping).

Emergency and Continuous Exposure Guidance Levels for Selected Submarine Contaminants
Committee on Toxicology, Board on Environmental Studies and Toxicology, Division on Earth and Life Studies (2004, approx. 320 pp.; ISBN 0-309-09225-6; available from NAP, \$62.00 plus \$4.50 shipping).

Emerging Technologies and Ethical Issues in Engineering — Papers From a Workshop, Oct. 14-15, 2003
National Academy of Engineering (2004, 166 pp.; ISBN 0-309-09271-X; available from NAP, \$36.00 plus \$4.50 shipping).

Environmental Health Indicators: Bridging the Chasm of Public Health and the Environment — Workshop Summary
Roundtable on Environmental Health Sciences, Research, and Medicine, Board on Health Sciences Policy, Institute of Medicine (2004, 136 pp.; ISBN 0-309-09265-5; available from NAP, \$30.50 plus \$4.50 shipping).

Evolution in Hawaii: A Supplement to *Teaching About Evolution and the Nature of Science*
National Academy of Sciences (2004, 56 pp.; ISBN 0-309-08991-3; available from NAP, \$14.95 plus \$4.50 shipping).

Experimental Poverty Measures — Summary of a Workshop
Committee on National Statistics, Division of Behavioral and Social Sciences and Education (2005, 56 pp.; ISBN 0-309-09520-4; available from NAP, \$18.00 plus \$4.50 shipping).

Facilitating Interdisciplinary Research
Committee on Science, Engineering, and Public Policy, the National Academies (2005, 306 pp.; ISBN 0-309-09435-6; available from NAP, \$42.00 plus \$4.50 shipping).

Flash Flood Forecasting Over Complex Terrain: With An Assessment of the Sulphur Mountain NEXRAD in Southern California
Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies (2005, 206 pp.; ISBN 0-309-09316-3; available from NAP, \$34.25 plus \$4.50 shipping).

Frameworks for Higher Education in Homeland Security
Division on Policy and Global Affairs (2004, 82 pp.; ISBN 0-309-09295-7; available from NAP, \$12.00 plus \$4.50 shipping).

From Source Water to Drinking Water — Workshop Summary
Roundtable on Environmental Health Sciences, Research, and Medicine, Board on Health Sciences Policy, Institute of Medicine (2004, 126 pp.; ISBN 0-309-09306-6; available from NAP, \$28.75 plus \$4.50 shipping).

Getting Up to Speed: The Future of Supercomputing
Computer Science and Telecommunications Board, Division on Engineering and Physical Sciences (2005, 308 pp.; ISBN 0-309-09502-6; available from NAP, \$35.00 plus \$4.50 shipping).

Gulf War and Health, Vol. 3: Fuels, Combustion Products, and Propellants
Board on Health Promotion and Disease Prevention, Institute of Medicine (2005, approx. 600 pp.; ISBN 0-309-09527-1; available from NAP, \$85.00 plus \$4.50).

How Students Learn: History, Mathematics, and Science in the Classroom
Center for Studies of Behavior and Development, Division of Behavioral and Social Sciences and Education (2005, 636 pp.; ISBN 0-309-07433-9; available from NAP, \$54.95 plus \$4.50 shipping).

Intelligent Sustainment and Renewal of Department of Energy Facilities and Infrastructure

Board on Infrastructure and the Constructed Environment, Division on Engineering and Physical Sciences (2004, 121 pp.; ISBN 0-309-09444-5; available from NAP, \$28.00 plus \$4.50 shipping).

Interim Report of the Committee on Changes in New Source Review Programs for Stationary Sources of Air Pollutants

Board on Environmental Studies and Toxicology, Division on Earth and Life Studies (2005, approx. 208 pp.; ISBN 0-309-09578-6; available from NAP, \$42.75 plus \$4.50 shipping).

International Polar Year 2007-2008 — Report of the Implementation Workshop

Polar Research Board, Division on Earth and Life Studies (2005, 65 pp.; ISBN 0-309-09437-2; available from NAP, \$18.00 plus \$4.50 shipping).

Marine Mammal Populations and Ocean Noise: Determining When Noise Causes Biologically Significant Effects

Ocean Studies Board, Division on Earth and Life Studies (2005, 142 pp.; ISBN 0-309-09449-6; available from NAP, \$35.00 plus \$4.50 shipping).

Mathematical and Scientific Development in Early Childhood — A Workshop Summary

Board on Science Education, Center for Education, Division of Behavioral and Social Sciences and Education (2005, 54 pp.; ISBN 0-309-09503-4; available from NAP, \$18.00 plus \$4.50 shipping).

Measuring International Trade on U.S. Highways

Committee on National Statistics, Division of Behavioral and Social Sciences and Education (2005, 62 pp.; ISBN 0-309-09519-0; available from NAP, \$18.00 plus \$4.50 shipping).

Measuring Research and Development Expenditures in the U.S. Economy

Committee on National Statistics, Division of Behavioral and Social Sciences and Education (2005, 212 pp.; ISBN 0-309-09320-1; available from NAP, \$42.00 plus \$4.50 shipping).

National Laboratories and Universities: Building New Ways to Work Together — Report of a Workshop

National Materials Advisory Board and Board on Manufacturing and Engineering Design, Division on Engineering and Physical Sciences; and Division on Policy and Global Affairs (2005, 68 pp.; ISBN 0-309-09314-7; available from NAP, \$18.00 plus \$4.50 shipping).

Opportunities in High Magnetic Field Science — Final Report

Solid State Sciences Committee, Board on Physics and Astronomy, Division on Engineering and Physical Sciences (2004, 115 pp.; ISBN 0-309-09582-4; available from NAP, \$39.00 plus \$4.50 shipping).

The Owner's Role in Project Risk Management

Board on Infrastructure and the Constructed Environment, Division on Engineering and Physical Sciences (2005, 102 pp.; ISBN 0-309-09518-2; available from NAP, \$18.00 plus \$4.50 shipping).

Preliminary Considerations Regarding NASA's Bioastronautics Critical Path Roadmap — Interim Report

Board on Health Sciences Policy, Institute of Medicine (2005, 46 pp.; ISBN 0-309-09523-9; available from NAP, \$12.00 plus \$4.50 shipping).

Productivity and Cyclicity in Semiconductors: Trends, Implications, and Questions — Report of a Symposium

Board on Science, Technology, and

Economic Policy, Division on Policy and Global Affairs (2004, 214 pp.; ISBN 0-309-09274-4; available from NAP, \$43.75 plus \$4.50 shipping).

Public Health Risks of Disasters: Communication, Infrastructure, and Preparedness — Workshop Summary

Roundtable on Environmental Health Sciences, Research, and Medicine, Board on Health Sciences Policy, Institute of Medicine; and Disasters Roundtable, Division on Earth and Life Studies (2005, 88 pp.; ISBN 0-309-09542-5; available from NAP, \$18.00 plus \$4.50 shipping).

Quality Through Collaboration: The Future of Rural Health

Board on Health Care Services, Institute of Medicine (2005, 288 pp.; ISBN 0-309-09448-8; available from NAP, \$45.00 plus \$4.50 shipping).

Rebuilding the Unity of Health and the Environment: The Greater Houston Metropolitan Area — Workshop Summary

Roundtable on Environmental Health Sciences, Research, and Medicine, Board on Health Sciences Policy, Institute of Medicine (2005, 86 pp.; ISBN 0-309-09442-9; available from NAP, \$18.00 plus \$4.50 shipping).

Redesigning the U.S. Naturalization Tests — Interim Report

Board on Testing and Assessment, Center for Education, Division of Behavioral and Social Sciences and Education (2004, 41 pp.; available only online at <www.nap.edu>).

Re-engineering Water Storage in the Everglades: Risks and Opportunities

Water Science and Technology Board and Board on Environmental Studies and Toxicology, Division on Earth and Life Studies (2005, approx. 142 pp.; ISBN 0-309-09529-8; available from NAP, \$31.50 plus \$4.50 shipping).

Regional Cooperation for Water Quality Improvement in Southwestern Pennsylvania
Water Science and Technology Board, Division on Earth and Life Studies (2005, 290 pp.; ISBN 0-309-09524-7; available from NAP, \$47.00 plus \$4.50 shipping).

Review of the U.S. CLIVAR [Climate Variability and Predictability] Project Office
Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies (2004, 50 pp.; ISBN 0-309-09501-8; available from NAP, \$18.00 plus \$4.50 shipping).

The Richard and Hinda Rosenthal Lectures 2003: Keeping Patients Safe — Transforming the Work Environment of Nurses
Institute of Medicine (2005, 40 pp.; ISBN 0-309-09441-0; available from NAP, \$12.00 plus \$4.50 shipping).

SBIR [Small Business Innovation Research] Program Diversity and Assessment Challenges — Report of a Symposium
Division on Policy and Global Affairs (2004, 200 pp.; ISBN 0-309-09123-3; available from NAP, \$41.25 plus \$4.50 shipping).

Science, Medicine, and Animals
Institute for Laboratory Animal Research, Division on Earth and Life Studies (2004, 52 pp.; ISBN 0-309-08894-1; available from NAP, \$8.95 plus \$4.50 shipping).

Sensor Systems for Biological Agent Attacks: Protecting Buildings and Military Bases
Board on Manufacturing and Engineering Design, Division on Engineering and Physical Sciences (2004, approx. 209 pp.; ISBN 0-309-09576-X; available from NAP, \$47.00 plus \$4.50 shipping).

Solar and Space Physics and Its Role in Space Exploration
Space Studies Board, Division on Engineering and Physical Sciences (2004, 72 pp.; ISBN 0-309-09325-2; available from NAP, \$18.00 plus \$4.50 shipping).

Statistical Analysis of Massive Data Streams — Proceedings of a Workshop
Committee on Applied and Theoretical Statistics, Division on Engineering and Physical Sciences (2004, 395 pp.; ISBN 0-309-09308-2; available from NAP, \$74.75 plus \$4.50 shipping).

Summary of a Workshop on Software Certification and Dependability
Computer Science and Telecommunications Board, Division on Engineering and Physical Sciences (2004, 57 pp.; ISBN 0-309-09429-1; available from NAP, \$18.00 plus \$4.50 shipping).

The Threat of Pandemic Influenza: Are We Ready? — Workshop Summary
Forum on Microbial Threats, Board on Global Health, Institute of Medicine (2004, 432 pp.; ISBN 0-309-09504-2; available from NAP, \$49.00 plus \$4.50 shipping).

Twelfth Interim Report of the Subcommittee on Acute Exposure Guideline Levels
Committee on Toxicology, Board on Environmental Studies and Toxicology, Division on Earth and Life Studies (2005, 68 pp.; ISBN 0-309-09588-3; available from NAP, \$18.00 plus \$4.50 shipping).

Understanding the Sun and Solar System Plasmas: Future Directions in Solar and Space Physics
Committee on Solar and Space Physics, Space Studies Board, Division on Engineering and Physical Sciences (2004, 40 pp.; available only online at <www.nap.edu>).

Urbanization, Energy, and Air Pollution in China: The Challenges Ahead — Proceedings of a Symposium
Development, Security, and Cooperation, Division on Policy and Global Affairs; National Academy of Engineering; Chinese Academy of Engineering; and Chinese Academy of Sciences (2004, 308 pp.; ISBN 0-309-09323-6; available from NAP, \$59.75 plus \$4.50 shipping).

Utilization of Operational Environmental Satellite Data: Ensuring Readiness for 2010 and Beyond
Space Studies Board and Aeronautics and Space Engineering Board, Division on Engineering and Physical Sciences; and Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies (2004, 186 pp.; ISBN 0-309-09235-3; available from NAP, \$39.00 plus \$4.50 shipping).

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