NATIONAL ACADEMY OF SCIENCES
NATIONAL ACADEMY OF ENGINEERING
INSTITUTE OF MEDICINE
NATIONAL RESEARCH COUNCIL

THE NATIONAL ACADEMIES
IN FOCUS

infocusmagazine.org

Climate Change and Transportation

Gauging the Efficiency of Research

What Works Best in Health Care

Winter/Spring 2008
vol. 8 number 1

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

The nation turns to the National Academy of Sciences, National Academy of Engineering, Institute of Medicine, and National Research Council for independent, objective advice on issues that affect people's lives worldwide. Additional information about the National Academies and their work can be found online at <national-academies.org>.

The National Academies In Focus features broad coverage of the National Academies' activities. We welcome your comments on the magazine; e-mail us at <infocusmagazine@nas.edu>.

In Focus (ISSN 1534-8334) is published three times a year by the National Academies, 500 Fifth St., N.W., Washington, DC 20001. Subscription (three issues): $10; Canada and foreign, $12 (U.S. currency only). Subscription address: *In Focus,* P.O. Box 665, Holmes, PA 19043. Bulk-rate U.S. postage is paid at Washington, D.C. Back issues and back volumes can be ordered in microform from National Archive Publishing Company, 300 North Zeeb Road, Ann Arbor, MI 48103.

Postmaster: Send address changes to In Focus, P.O. Box 665, Holmes, PA 19043.

Credits:

Cover:	(clockwise from upper right) ©Photodisc; ©Trinette Reed/Photographer's Choice/Getty Images; ©Corbis
Page 1:	(col. 1, from top) ©Photodisc; ©C. Sherburne/Photodisc; (col. 2) ©Steve Cole/Photodisc
Page 2:	Participants at "The Future of Human Healthspan: Demography, Evolution, Medicine, and Bioengineering," the fifth annual conference of the National Academies Keck *Futures Initiative,* held November 2007, photo by Paul R. Kennedy
Page 3:	Photo by Donna Coveney, Massachusetts Institute of Technology News Office
Page 4:	Damage caused by severe rain and flooding on Maryland's Eastern Shore in 2006, photo by Leif Skoogfors/Federal Emergency Management Agency
Page 5:	Flooding of New Orleans streets caused by Hurricane Katrina in 2005, photo by Marty Bahamonde/Federal Emergency Management Agency
Page 6:	©moodboard/Corbis
Page 7:	©Joshua Sheldon/The Image Bank/Getty Images
Page 9:	©Photodisc/Getty Images
Page 10:	©Photodisc
Page 11:	Geneticist Ken Vogel, who is conducting breeding and genetics research on switchgrass to improve its biomass yield; switchgrass can yield almost twice as much ethanol as corn, photo by Brett Hampton, USDA Agricultural Research Service
Page 12:	©Jason Reed/Ryan McVay/Digital Vision/Getty Images
Page 13:	©Andersen Ross/Digital Vision/Getty Images
Page 14:	©Comstock/Jupiterimages
Pages 15&16:	Speakers and participants at December 2007 symposium to celebrate 60 years of research on atomic bomb survivors and radiation effects, held at the National Academy of Sciences, photos by William Geiger
Pages 17&18:	Participants at "The Future of Human Healthspan: Demography, Evolution, Medicine, and Bioengineering," the fifth annual conference of the National Academies Keck *Futures Initiative,* photos by Paul R. Kennedy
Page 19:	Narcisco Matos (col. 1), executive director of the Foundation for Community Development in Mozambique, and other participants at the third annual conference of the African Science Academy Development Initiative, held November 2007 in Dakar, Senegal, photos by Bill Kearney
Page 20:	©Comstock/Jupiterimages

THE NATIONAL ACADEMIES **INFOCUS**
Volume 8 Number 1 infocusmagazine.org

CONTENTS

FEATURES

ENGINEERING & TECHNOLOGY

4 Climate Change and Its Impact on U.S. Transportation
The negative and positive effects of warming on transportation

6 In Their Wake
Turbulence trailing planes is challenge in crowded skies


6

RESEARCH & POLICY

7 Not Picture Perfect
Report advises against national database of ballistic images


7

9 Gauging the Efficiency of Federal Research
A new approach to measuring effectiveness

ENVIRONMENT & RESOURCES

10 Fuel for Thought
Water implications of biofuels

12

12 Cracking the Code of Plant DNA
Achievements and future of the National Plant Genome Initiative

HEALTH & SAFETY

13 The Road to Effective Health Care
A new approach to determining what works best

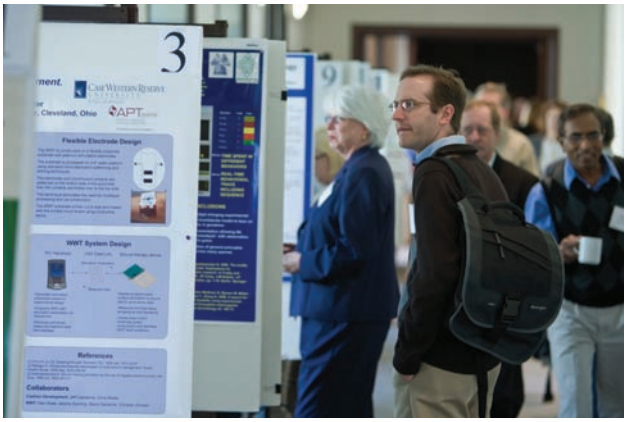
15 After the Fallout
Study on atomic bomb survivors marks 60 years

CONTENTS

17 Meetings

Aging, Longevity, and 'Healthspan'

Conference explores the nature of aging and lengthening the healthy span of our lives



17

19 Spotlight

A Call for African Scientists to Speak Up

Excerpts from an interview with Narcisco Matos, executive director of the Foundation for Community Development in Mozambique, and keynote speaker at the third annual conference of the African Science Academy Development Initiative, held in Dakar, Senegal

20 Brief Takes

- **NAE Launches New Web Site for Girls**
- **Grand Challenges for Engineering**
- **NAS to Post Hundreds of Memoirs Online**

22 New Projects & Publications

THE NATIONAL ACADEMIES

In Focus is prepared by the Office of News and Public Information.

Executive Director: William Skane

In Focus Editor: Valerie Chase

Assistant Editor: Amanda Blyth

Staff Writers: Sara Frueh, Bill Kearney, Maureen O'Leary, Christine Stencel, Jennifer Walsh

Original Design: Francesca Moghari

Rising to the Challenge

I am privileged to address my first letter to the entire Academies community as president of the National Academy of Engineering. This gives me an opportunity to report to you on an important NAE project.

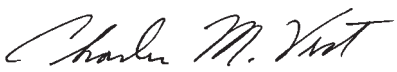
In August of 2006, my predecessor Bill Wulf appointed an international committee of extraordinarily innovative and accomplished engineers, scientists, and medical doctors to suggest a number of grand challenges to which engineers could respond to improve the human condition in the 21st century. The challenges were to be things that the committee believed could actually be accomplished during the next few decades. The committee, chaired by NAE member and former U.S. defense secretary William J. Perry, made use of a highly interactive Web site to receive suggestions from the public as it conducted its study.

Last February, the committee announced 14 Grand Challenges at a press conference during the AAAS meeting in Boston. These challenges, which appear on pages 20 and 21 of this issue of *In Focus* and are detailed at <www.engineeringchallenges.org>, involve energy and sustainability, medicine and health care, reducing our vulnerability to natural and human threats, and advancing human capabilities and our understanding of the world and ourselves. Meeting some of these challenges is imperative for human survival, meeting some will make us more secure, and all will improve quality of life. The public is invited to help prioritize the importance of these challenges through the Web site.

I encourage you to visit the site to read the crisp and interesting descriptions of each challenge, view a brief video about the critical problems the world is facing, and learn more about the project in general.

Sadly, traditional U.S. media paid almost no attention to the release of the Engineering Grand Challenges, whereas in Europe and Asia it garnered a lot of attention. The good news is that it is getting heavy interest in the "blogosphere," which implies that we are reaching young people. We very much hope that it will inspire them and promote an understanding of the critical and exciting role that engineering must play to meet their generation's world challenges and in advancing the human condition.

In the 20th century we were "stovepiped." Scientists discovered, engineers designed and created, and doctors healed, each separately in their own corners of the scientific community. The Grand Challenges make clear that in the 21st century engineering is melding in important ways with science and medicine, and that the context and scale of our work is increasingly global and relevant to rich and poor, in both developed and developing nations.



CHARLES M. VEST
President, National Academy of Engineering

Climate Change
AND ITS IMPACT ON U.S. TRANSPORTATION

Much research has looked at the adverse impacts of transportation on global climate from the burning of fossil fuels, but only a few studies have examined the impacts climate change could have on transportation. A new report from the National Research Council does that and much more.

The committee that wrote the report, which included experts in climate science, geology, risk assessment, transportation planning and engineering, and infrastructure, agreed unanimously that climate change will have a significant impact on transportation infrastructure and operations. "Now is the time to pinpoint vulnerabilities and incorporate present scientific knowledge into the planning, design, construction, operation, and maintenance of transportation systems," said Henry Schwartz Jr., chair of the committee that wrote the report.

Every mode of transportation in the U.S. will be affected as the climate warms, but potentially the greatest impact will be flooding of roads, railways, transit systems, and airport runways in coastal areas because of rising sea levels and surges brought on by storms. Some 60,000 miles of coastal highways are already exposed to periodic storm flooding, and erosion and loss of wetlands have removed crucial buffer zones that once protected many roads.

The U.S. transportation system was designed and built for typical local weather and climate, assuming a reasonable range of temperatures and precipitation levels based on historical data. The report finds that these data may no longer be a reliable guide for transportation planners, however, as warming temperatures trigger new weather and climate extremes.

Infrastructure pushed beyond the range for which it was designed can become stressed and fail, as seen with the loss of the U.S. 90 Biloxi Bay Bridge after Hurricane Katrina.

The next 50 to 100 years will see increases in very hot days and heat waves, increases in Arctic temperatures, sea-level rise coupled with storm surges and land subsidence, more frequent intense precipitation events, and increases in the intensity of strong hurricanes. And the impacts of some of these changes will extend well beyond coastal areas. In the Midwest, for instance, increased intense precipitation could augment the severity of flooding as occurred in the "Great Flood" of 1993 that damaged farmland, towns, and transportation routes along 500 miles of the Mississippi and Missouri river systems. On the other hand, drier conditions are likely to prevail in the watersheds supplying the St. Lawrence Seaway, Great Lakes, and Upper Midwest river system. Lower water levels would reduce vessel shipping capacity, seriously impairing freight movement in the region. And in California, heat waves may increase wildfires that can destroy transportation infrastructure.

Not all climate changes will be negative, though. Marine transportation could benefit from more open seas in the Arctic, creating new and shorter shipping routes and reducing transport time and costs. In cold regions, warming temperatures could reduce the costs of snow and ice control, making travel conditions safer for passenger vehicles and freight.

The report calls for a concerted federal role in implementing many of its recommendations such as creation of an information clearinghouse on transportation and climate change, establishment of a research program to re-evaluate design standards in light of climate change, creation of an interagency working group on adaptation, and re-evaluation of the National Flood Insurance Program.

Many of the recommendations need not wait for federal action, the committee said. Local governments and private infrastructure providers can begin to identify critical infrastructure particularly vulnerable to

climate change. Professional organizations can single out examples of good adaptation practices, and transportation planners and climate scientists can begin collaborating on the development of regional scenarios for likely climate-related changes and collection of data needed to analyze their impacts.

Focusing on the problem now should help avoid costly future transportation investments and disruptions to operations. — *Maureen O'Leary*

Potential Impacts of Climate Change on U.S. Transportation. Committee on Climate Change and U.S. Transportation, Transportation Research Board and Division on Earth and Life Studies (2008, approx. 234 pp.; ISBN 0-309-11306-7; 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 <www.nap.edu/catalog/12179.html>).

Henry Schwartz Jr., past president and chairman of Sverdrup/Jacobs Civil Inc., chaired the committee. The study was funded by the Transportation Research Board; National Cooperative Highway Research Program; U.S. Department of Transportation; Transit Cooperative Research Program; U.S. Environmental Protection Agency; and the U.S. Army Corps of Engineers.

In Their Wake

Turbulence Trailing Planes Is Challenge in Crowded Skies

The Next Generation Air Transportation System, or "NextGen," is an interagency federal effort to accommodate increasing demand for air travel, which is expected to double or even triple by 2025. One goal of NextGen, for example, is to take advantage of GPS to safely permit planes to fly more closely spaced.

Unfortunately, GPS does not solve the problem of wake turbulence, the counter-rotating vortex of air — an inevitable byproduct of lift — that trails aircraft and is a danger for planes, especially smaller ones, flying too close behind. The heavier an aircraft, the stronger its wake, and the greater the wingspan, the longer a wake lasts. Thus, FAA's standards for how close planes can fly to each other at a similar altitude, or between takeoffs and landings, are based on size. To illustrate, heavy aircraft must stay four miles behind other heavy aircraft, while large planes need to remain five miles back and smaller ones must keep six miles distance.

A National Research Council committee asked by Congress to study the issue found that the current separation requirements, while conservative and safe, indeed prevent taking full advantage of GPS and other technologies that would allow closer flying. However, there is no meaningful metric to tell by how much the spacing could be safely reduced.

While wake turbulence is not the only obstacle to increased air capacity, the committee concluded that a robust wake turbulence R&D effort is needed to maximize the air transportation system's efficiency. For starters, wake vortices of new airplanes need to be characterized prior to the crafts' introduction into service so that appropriate separation criteria can be established. And the current heavy, large, and small designations are extremely broad, with planes varying in weight by hundreds of thousands of pounds within the same category. Among several technical challenges identified by the committee is recategorizing planes to account for detailed characteristics. More accurate wind monitoring and prediction, along with modeling and measurement of wake vortices, would permit pilots to continually adjust their spacing and allow for closer parallel approaches when two runways are available for landing. Vortex alleviation ideas should be explored as well.

Historically, FAA and NASA shared leadership of federal wake turbulence research, but given the space agency's current funding priorities, the committee recommended that FAA take the lead and become a vocal advocate for sustained R&D in this field. — *Bill Kearney*

Wake Turbulence: An Obstacle to Increased Air Traffic Capacity. Committee to Conduct an Independent Assessment of the Nation's Wake Turbulence Research and Development Program, Aeronautics and Space Engineering Board, Division on Engineering and Physical Sciences (2008, approx. 70 pp.; ISBN 0-309-11379-2; available from the National Academies Press, tel. 1-800-624-6242; $21.00 plus $4.50 shipping for single copies; also on the Internet at <www.nap.edu/catalog/12044.html>).

The committee was chaired by **Anthony Broderick,** former associate administrator for regulation and certification at the FAA. The study was funded by NASA.

Not PICTURE PERFECT

REPORT ADVISES AGAINST NATIONAL DATABASE OF **BALLISTIC IMAGES**

Firearms are used in about two-thirds of the homicides committed each year in the U.S., and detectives investigating these and other gun crimes often turn to the bullets and cartridge cases a shooter leaves behind. Manufacturing processes leave microscopic marks on guns, which in turn leave "toolmarks" on bullets and cartridge cases during the firing process. These marks are thought to be unique to each gun. A firearms examiner might compare the toolmarks on a crime-scene bullet to those on a bullet test-fired from a suspect's gun, to see whether they match. Computerized imaging can help this process on a far larger scale. For example, an investigator can put images of a bullet or casing into a database and search through large numbers of images from other crime scenes and suspects' guns, to see if any have similar toolmarks.

The National Institute of Justice asked the National Research Council to assess whether a national database should be created to hold the images of toolmarks from all new and imported guns. Whenever a gun is sold, images would be entered into the database. The argument for such a database is that it could help investigators

track down where the gun used in a crime was first sold.

The Research Council's report advises against creating such a database, in large part because existing technologies could not effectively sort through the many images involved. Images from millions of guns might be entered each year, and many would have similar toolmarks. Current technologies could not reliably distinguish very fine differences between them, and searches would turn up too many possible "matches" to be useful. And the type of ammunition used in a crime may not be the type used when the gun was originally test-fired — a difference that could be a significant source of error in generating possible matches.

The report does not assess whether toolmark evidence should be allowed in legal proceedings. However, it does note that the assumption that each gun leaves unique toolmarks has not yet been fully demonstrated scientifically. And it advises against a statement often made by firearms examiners in court — that a bullet or cartridge casing came from a particular gun "to the exclusion of all other firearms." Such statements of absolute certainty lack a firm statistical basis and fail to account for the element of subjectivity involved in declaring a "match," a determination always made by a person. More studies would be needed to determine the extent to which the toolmarks made by a gun are unique and remain the same over time, despite repeated firings.

Although it advises against creating a national reference database of ballistic images, the report concludes that an existing image database — limited to evidence associated with crimes — has strong potential for generating leads in criminal investigation. That database is used by more than 200 state and local law enforcement agencies and is administered by the U.S. Bureau of Alcohol, Tobacco, Firearms, and Explosives. The report suggests more than a dozen possible enhancements to promote more effective use of the current system.

It also recommends further research on an alternative approach, "microstamping." This technique imprints a tiny identifier on bullets or guns — substituting a known unique marking for the toolmarks left by variations in gun manufacturing and firing. Such markings could be inspected at a crime scene with equipment as simple as a magnifying glass, the report says. But before such a system could be implemented, research is needed on whether microstamped identifiers endure repeated firings, how vulnerable they are to tampering, and how using them would affect costs for manufacturers and consumers.

— *Sara Frueh*

Ballistic Imaging. Committee to Assess the Feasibility, Accuracy, and Technical Capability of a National Ballistics Database. Committee on Law and Justice and Committee on National Statistics, Division of Behavioral and Social Sciences and Education, and National Materials Advisory Board, Division on Engineering and Physical Sciences (2008, approx. 386 pp.; ISBN 0-309-11724-0; available from the National Academies Press, tel. 1-800-624-6242; $39.00 plus $4.50 shipping for single copies; also on the Internet at <www.nap.edu/catalog/12162.html>).

The committee was chaired by **John E. Rolph,** professor of statistics, Marshall School of Business, University of Southern California. The study was funded by the National Institute of Justice of the U.S. Department of Justice.

Gauging the Efficiency of Federal Research

Research at federal agencies like the U.S. Environmental Protection Agency, NASA, and the National Institutes of Health underpins government efforts to regulate the safety of everything from drugs and drinking water to airplanes and roadways. Federal research also adds to our knowledge on subjects as varied as emerging viruses, nanotechnology, and dark energy.

Congress and oversight bodies such as the White House Office of Management and Budget naturally want to know whether the tax money invested in these programs — which totals over 100 billion dollars annually — is being used wisely and efficiently. But what's the best way to measure the efficiency of something as unpredictable as research?

Currently OMB urges EPA and other agencies to gauge the efficiency of their research based on its ultimate outcomes — for example, whether a research program eventually leads to cleaner air or fewer deaths. But measuring efficiency this way isn't achievable or valid for most programs, says a new report from the National Research Council that recommends a new approach to making these assessments.

Ultimate outcomes happen far in the future and can't be known at the time the research is evaluated, making them inappropriate measures of efficiency, the report notes. They are also usually out of the hands of researchers. A program might discover that a certain level of an industrial chemical in drinking water is hazardous, for instance, but it cannot control whether regulators use that knowledge to limit the amount of the chemical that enters the water supply.

Agencies and OMB would find it easier to gauge efficiency accurately if they split the concept in two, the report says.

Assessments of "process efficiency" should look at how well research processes are managed, and whether program managers exercise skill in using and conserving resources. This type of efficiency can be measured quantitatively — for example, by comparing the number of grants awarded or journal articles published against benchmarks — as well as by panels of experts.

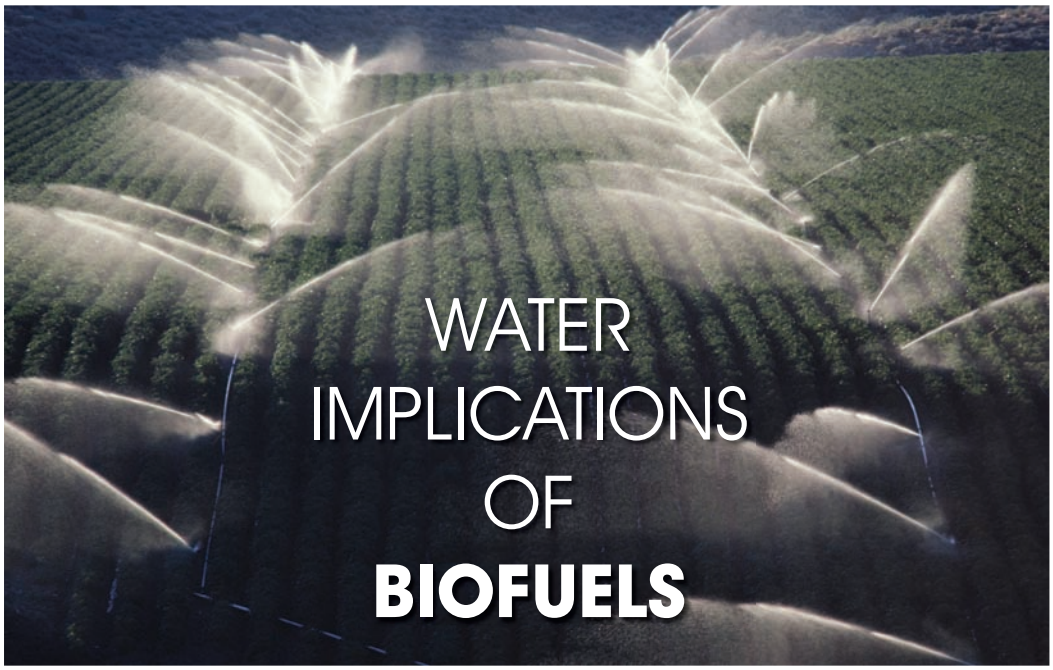
Expert review panels also are key to assessing "investment efficiency," a second aspect that concerns whether an agency is investing in high-quality research in areas that further its mission. So-called intermediate outcomes can also be helpful, the report adds; an evaluation might consider whether a program has increased the knowledge available for making regulatory decisions, for example.

Evaluations of research should not overemphasize efficiency, however. Efficiency should be weighed as just one factor in the overall context of a program's quality, relevance, and effectiveness, the report stresses. — *Sara Frueh*

Evaluating Research Efficiency in the U.S. Environmental Protection Agency. Committee on Evaluating the Efficiency of Research and Development Programs at the U.S. Environmental Protection Agency, Committee on Science, Engineering, and Public Policy, The National Academies; and Board on Environmental Studies and Toxicology, Division on Earth and Life Studies (2008, approx. 144 pp.; ISBN 0-309-11684-8; available from the National Academies Press, tel. 1-800-624-6242; $35.00 plus $4.50 shipping for single copies; also on the Internet at <www.nap.edu/catalog/12150.html>).

The committee was chaired by **Gilbert Omenn,** professor of internal medicine, human genetics, public health, and computational biology, University of Michigan, Ann Arbor. The study was funded by the U.S. Environmental Protection Agency.

Fuel for Thought



Ever since the "going green" movement captured the American consciousness, corn-based ethanol has been at the forefront as a viable alternative energy choice. Its status was elevated further last year when the Bush administration called for the production of more ethanol — 35 billion gallons by 2017, compared with 4.5 billion gallons in 2006. As more and more farmers begin to grow corn to keep up with ethanol demand, a central question for the nation is how this agricultural shift will impact water supplies and other resources.

A National Research Council committee found that the surge would likely lead to adverse effects on local water sources and water quality if new practices are not put into use promptly. Expanding corn and other biofuel crops into regions with little agriculture, especially dry areas, could change current irrigation practices and greatly increase pressure on water resources, particularly limited or dwindling supplies. For example, large portions of the Ogallala aquifer — which includes a highly agricultural area extending from west Texas into South Dakota and Wyoming — have shown water-table declines of more than 100 feet. The report stresses that these reduced levels and unsustainable sources should be examined when determining future water-availability scenarios.

Although modest compared with the water needed to grow biofuel crops, water consumed at biorefineries during the ethanol production process could also diminish local water supplies, the report says. A biorefinery that produces 100 million

gallons of ethanol a year would use the equivalent of the water supply for a town of about 5,000 people.

More crops also means increased use of fertilizers and pesticides, which would impact the water quality of groundwater, rivers, and coastal and offshore waters. Corn has higher application rates of both fertilizer and pesticides per acre than soybeans and mixed-species grassland biomass do. If farmers switch from growing other crops and plants to corn, larger amounts of soluble nitrogen could run off and migrate to drinking water wells, rivers, and streams. Nitrate and nitrite — products of nitrogen fertilizers — could impact human health considerably if their levels are not lowered to below drinking water standards before consumption.

Higher levels of nitrogen, as well as phosphorus, from fertilizers washing into streams could also lead to low-oxygen or hypoxic bodies of water, commonly known as "dead zones," which are lethal for most creatures. Such areas already cover vast parts of the Gulf of Mexico and Chesapeake Bay.

Streams and rivers could also suffer as a result of soil erosion; sediment both impairs water quality and carries pollutants. The amount of sediment erosion is directly related to land use — the more intensive the use, the greater the erosion. Besides environmental impacts, high sedimentation rates bring financial consequences because they increase the cost of often-mandatory dredging for transportation and recreation.

Erosion could be minimized if perennial crops — like switchgrass, poplars, or willows — or prairie polyculture are used for biofuels instead of corn, the committee

suggested, as these hold the soil and nutrients in place better than most row crops. Conservation tillage and leaving most or all of the cornstalks and cobs in the field after the grain has been harvested are additional ways soil erosion could be reduced.

Although the committee laid out numerous steps in its report that could help reduce these impending problems, it stated that fundamental knowledge gaps prevent making reliable assessments about how feedstocks other than corn could impact water resources. Other aspects of crop production may not be fully anticipated, or genetically modified, water-efficient crops could be developed, both of which could also influence future assessments.
— *Jennifer Walsh*

Water Implications of Biofuels Production in the United States. Committee on Water Implications of Biofuels Production in the United States, Water Science and Technology Board, Division on Earth and Life Studies (2008, 88 pp.; ISBN 0-309-11361-X; available from the National Academies Press, tel. 1-800-624-6242; $21.00 plus $4.50 shipping for single copies; also on the Internet at <www.nap.edu/catalog/12039.html>).

The committee was chaired by **Jerald L. Schnoor,** Allen S. Henry Chair Professor, department of civil and environmental engineering, and co-director of the Center for Global and Regional Environmental Research, University of Iowa, Iowa City. The study was funded by the McKnight Foundation, Energy Foundation, National Science Foundation, U.S. Environmental Protection Agency, and National Research Council Day Fund.

CRACKING THE CODE OF Plant DNA

The Human Genome Project has received a great deal of attention with its promise of personalized treatments and therapies, but little is heard about the National Plant Genome Initiative (NPGI), a long-term venture working to uncover DNA structure and functions in plants. Now closing in on its 10th anniversary, NPGI's achievements and roadmap for the future are examined in a new report by the National Research Council.

The initiative has been extremely successful in its first decade, producing revolutionary breakthroughs in genome sequencing for various plants, including *Arabidopsis* (a plant related to cabbage and mustard), rice, and soon maize.

While the project has made huge strides, sequencing is only the first step to understanding how plants work and breeding them for specific performance characteristics. Ultimately, the goal of NPGI is to translate the knowledge gained into commercial innovations, such as higher yielding, more nutritious crops that grow in extreme conditions or plants for biofuel energy that have less impact on the environment and resources.

Nonetheless, the committee that wrote the report considers plant biology to be at the doorstep of unprecedented discovery. To keep the momentum moving forward, NPGI should broaden its mission by expanding gene sequencing, especially because this serves as the "backbone" on which all data and hypotheses depend.

Sequencing by itself is not a blueprint for understanding genome function, however. A systems-level approach is required to consider how the various components act in concert. Applied to NPGI's objectives, such an approach should be undertaken to better understand plant growth and development in controlled and relevant environments. From this research could stem the creation of computable "iPlants" that predict plant system behavior under a range of environmental conditions — an ambitious objective that some liken to a biological equivalent of sending man to the moon. Essentially, the iPlant would be the basis for creating highly effective, novel plant strains for food, fuel, and fiber.

Moreover, to expand NPGI's efforts and adapt to the challenges ahead, recruitment of the best, broadly trained scientists in plant science is needed. Plant genomic analysis is becoming increasingly interdisciplinary, and scientists could be given incentives to enter the field from other disciplines such as computer science or statistics. — *Jennifer Walsh*

Achievements of the National Plant Genome Initiative and New Horizons in Plant Biology. Committee on the National Plant Genome Initiative: Achievements and Future Directions, Board on Life Sciences and Board on Agriculture and Natural Resources, Division on Earth and Life Studies (2008, approx. 182 pp.; ISBN 0-309-11418-7; available from the National Academies Press, tel. 1-800-624-6242; $39.00 plus $4.50 shipping for single copies; also on the Internet at <www.nap.edu/catalog/12054.html>).

The committee was chaired by **Jeffery L. Dangl,** John N. Couch Distinguished Professor, University of North Carolina, Chapel Hill. The study was funded by the Interagency Working Group on Plant Genomes through the National Science Foundation and U.S. departments of Energy and Agriculture.

The Road to Effective Health Care

A New Approach to Determining WHAT WORKS BEST

The plethora of technologies and services available to diagnose and treat illnesses can boggle the mind. For example, if you have high cholesterol, you might be prescribed any one of more than a dozen medications. Which are the most effective? Do they work the same for all people? Which should insurance plans cover? Are any nonpharmaceutical therapies more effective?

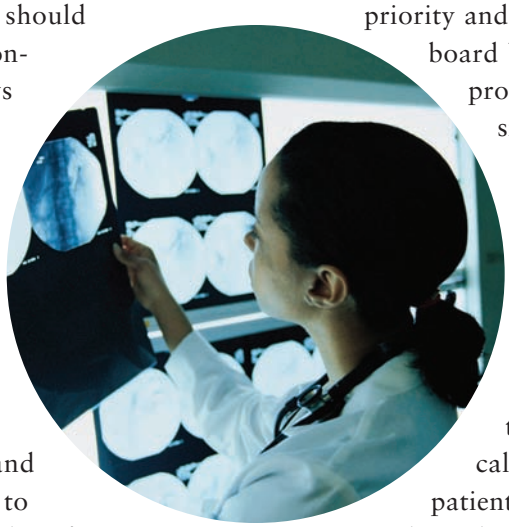
The idea of consumer-directed health plans — in which individuals "shop" for their choice of providers and services — has been gaining popularity recently, and people equipped with good information may indeed have the power to improve the quality of their care. But even the most sophisticated health care consumers struggle to gather reliable information about which treatments are appropriate for their conditions and circumstances. The amount of medical data is staggering, and research sometimes produces contradictory results.

In fact, many decisions by health professionals and patients involve as much guesswork as hard data, a reality demonstrated by variations in how practitioners treat the same conditions and which therapies and services insurance plans cover. The situation gets more complicated every year as dozens of new drugs, devices, and other technologies enter the marketplace.

Efforts are under way to try to make sense of all the data. Several organizations conduct research to compare the effectiveness of different health care products and services and generate evidence on what works and when. But lack of coordination has led to duplication of effort, the creation of competing guidelines for how to diagnose and treat ailments, and uncertainty about which study results and guidelines are the most reliable and objective.

The situation begs for the establishment of a single entity with the authority and resources to help end the confusion,

says a new report from the Institute of Medicine. The report provides a blueprint for a national program to prioritize which clinical services should be evaluated and to conduct systematic reviews of the evidence. This program would also be responsible for developing and promoting rigorous standards for clinical practice guidelines, which could help reduce the use of questionable services and better target therapies to patients most likely to benefit.



The report proposes that the secretary of the U.S. Department of Health and Human Services establish this program under the direction of Congress, which must see that the program is given the authority, expertise, and funding necessary to do the job.

It is also imperative that the new program be established in a way that ensures transparency, objectivity, and scientific rigor, so that stakeholders and the public regard it as an authoritative and trustworthy resource. Most people, including many health professionals, lack the scientific training necessary to evaluate and interpret by themselves the findings from hundreds of new research studies published every year. Moreover, some question how biased previous evidence reviews are, given that a significant proportion has been financed by manufacturers or vendors.

To help ensure objectivity and accountability, the report recommends that an independent, free-standing committee be created to advise the program on determining which evidence reviews merit priority and that an advisory board be established to provide broad oversight of the new program. The committee and board should include representatives of a range of stakeholders, including the organizations that develop clinical practice guidelines, patient groups, health professionals, and insurers, but advisory board members should be selected in a way that minimizes conflicts of interest. — *Christine Stencel*

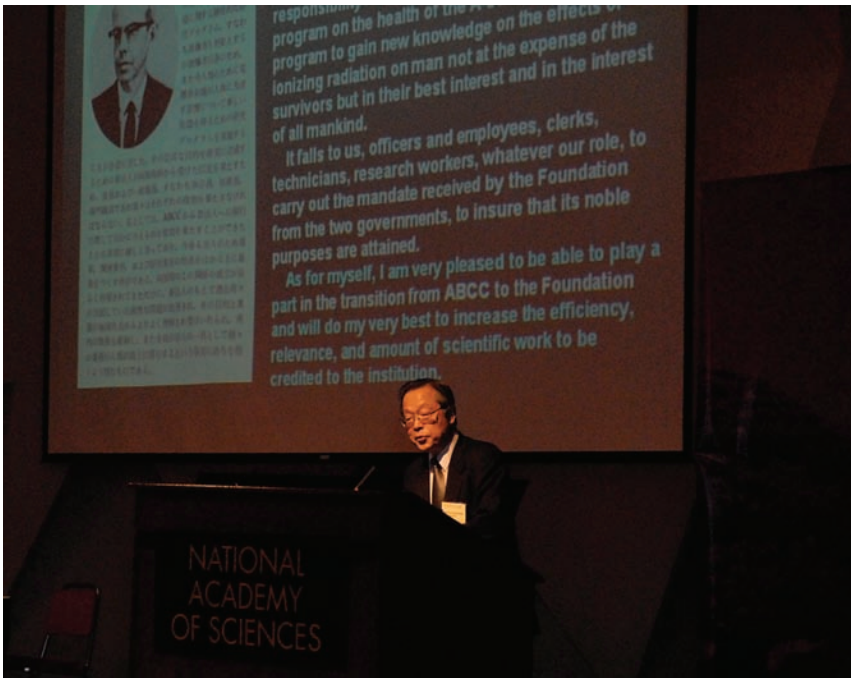
Knowing What Works in Health Care: A Roadmap for the Nation. Committee on Reviewing Evidence to Identify Highly Effective Clinical Services, Board on Health Care Services, Institute of Medicine (2008, approx. 280 pp.; ISBN 0-309-11356-3; available from the National Academies Press, tel. 1-800-624-6242; $39.95 plus $4.50 shipping for single copies; also on the Internet at <www.nap.edu/catalog/12038.html>).

The committee was chaired by **Barbara J. McNeil,** Ridley Watts Professor and head, department of health care policy, Harvard School of Medicine, and professor of radiology, Brigham and Women's Hospital, Boston. The study was funded by the Robert Wood Johnson Foundation.

After the FALLOUT

Study on Atomic Bomb Survivors Marks 60 Years

Following the atomic bombings of Hiroshima and Nagasaki in Japan, President Truman turned to the National Academy of Sciences to examine the health of the survivors and the possible genetic effects on their future children. Sixty years later, the study continues to uncover new information about how radiation affects the human body. This unprecedented success is due to the steadfast leadership, dedicated employees, and loyal study participants of the Radiation Effects Research Foundation (RERF) and its predecessor, the Atomic Bomb Casualty Commission (ABCC).



Today, approximately 40 percent of the blast survivors — and 80 percent of those who were younger than 20 at the time — are still alive. In fact, in one of the study cohorts, more than 70 percent of the survivors continue to participate in biennial health exams. To commemorate 60 years of this groundbreaking study, the National Academy of Sciences held a symposium at its headquarters last December.

"When the bomb was dropped on Hiroshima on August 6, I was outside on the street, at a distance of about 1.2 kilometers from the hypocenter, and I was badly burned all over my body," recalled Sunao Tsuboi while addressing symposium attendees. "Four days later, I lost consciousness and remained in a coma for about 40 days, unaware even of Japan's surrender. We survivors of the atomic bombs were the first people in human history to experience atomic bombs. [It is] my belief that RERF will continue to make the utmost in contribution. I'm now 80 years old, and I still feel young."

With the goal of maintaining the health and welfare of survivors, such as Tsuboi, the initial research at ABCC focused on determining early medical effects, such as acute radiation syndrome and cataracts. Follow-up studies looked at cancer and benign tumor risks, as well as the effects on the aging process and immune system. To develop accurate health risk assessments, scientists also estimated the radiation doses received by survivors. Researchers found that the number of leukemia and other cancer incidences and deaths increased in proportion to radiation dose and that the health effects varied depending on the amount of radiation received.

These findings allowed the survivors to understand possible consequences of their exposures, because at the time, no one knew what the potential long-term effects would be. The research results also significantly contributed to establishing radiation dose limits for protection standards around the world. Moreover, what emerged was a broader understanding of how radiation interacts with the human body, and how radiation could be used for good, such as in medical diagnoses and treatment. Scientists from the around the world, including those involved with Chernobyl and other radiation incidents, have visited ABCC/RERF over the years to study radiation's effects.

"What we learned, and are still learning, helped pave the path for nuclear medicine, the use of radiation in oncology, and the ability for nuclear power to provide energy," said Evan Douple, associate chief of research at RERF. "The wealth of knowledge the survivors gave is truly a gift to all of mankind."

Just as remarkable throughout the years has been the cooperative effort between the

United States and Japan, even during the first decade when some survivors distrusted ABCC and its motives. However, ties eventually strengthened, and in 1975 ABCC reorganized to form RERF, a joint U.S.-Japan research organization.

The vast pool of knowledge, which continues to grow, provides a strong foundation for RERF's future. As technologies evolve and emerge, RERF will have the potential to yield new information for radiation biology, the interaction of radiation with living systems, and all uses of radiation for the public good. — *Jennifer Walsh*

The Radiation Effects Research Foundation is a project of the Division on Earth and Life Studies, administered through its Nuclear and Radiation Studies Board. RERF is managed by a binational board of directors consisting of resident and visiting directors. Scientific research activities are carried out on the basis of recommendations of a binational, 10-member scientific council. On the Internet at <www.rerf.or.jp/>.

Aging, Longevity, and 'HEALTHSPAN'

BY MEGAN CHAO

For many centuries, discovering the fountain of youth has been just a dream. Aging is an inevitable process in human life, the result of a highly variable biological cycle. As we grow through childhood, we learn fundamental skills to function as adults, but as we progress from adulthood to the end of our days, the possibility of slipping into functional decline becomes a risk. The independence we spent a great deal of our lives seeking could be gone in just a short period of time.

The elusive nature of the aging process and the need to find new ways of addressing the human healthspan — the period of one's life during which he or she is generally healthy and free from serious or chronic illness — brought more than 150 experts and researchers from public and private institutions around the globe to the Arnold and Mabel Beckman Center in Irvine, California, last November. For three days, it was a convergence of great minds for the fifth annual conference of the National Academies Keck *Futures Initiative* (NAKFI). Attendees from a wide range of fields, including public health, bioengineering, gerontology and neuroscience, challenged this year's topic, "The Future of Human Healthspan: Demography, Evolution, Medicine, and Bioengineering."

CHALLENGING AGING

In his opening remarks, the chair of the conference steering committee, Columbia University Professor Jack Rowe, said, "I'm sure I'm not the only one who's not sure what's going to happen," in reference to the cross-collaboration that would ensue for a greater part of the conference. Before splitting up into assigned task groups, participants participated in panel discussions, establishing an in-depth dialogue of topics early on. The relaxed atmosphere promoted intuitive, nonrestricted thinking, allowing the participants to consider serious issues in aging and healthspan.

The conference keynote address was given by Michael Merzenich, professor of otolaryngology at the University of California, San Francisco. He broke down the topic of healthy longevity, an idea involving a longer life in a body that still works well, and

divided the cycle of life and brain function into epochs, from childhood to old age.

Intentionally diverse task groups met for roughly nine hours in total, developing scientific plans to tackle the challenges presented to them. They explored topics such as the effects of exercise on human healthspan, the cellular and molecular mechanisms of biological aging, and changes in social context to enhance functional status of the elderly. Others were tasked with designing

new research paradigms to assess healthspan and developing technological interventions to overcome barriers to independence and community participation, for example.

Some of the groups initially had trouble getting started; others eased right into project design and discussion. Certain members butted heads on ideas, while others bounced their ideas off of one another to make progress. The dynamics of the task groups may have varied greatly, but all had their sights set on

the challenges before them, discussing solutions for the near future as well as allowing themselves to imagine far-future possibilities. Some even floated around science fiction-like ideas of new technologies for changing human behavior, limb and organ regeneration, and artificial intelligence.

GETTING IT ACROSS

Communicating the complexities of science topics takes skill and practice — an investment that science journalists must make to get the facts straight. Thirteen journalism students from graduate science writing programs around the country were invited to cover this year's conference, each participating in a different task group.

NAKFI stresses the importance of communication in its mission, which is why it recognizes talent and excellent work each year in the reporting and communicating of science, engineering, and medicine to the general public. A selection committee, after an almost yearlong deliberation over a wide range of media, decided on the winners for the 2007 Communication Awards, which were presented during the conference at a dinner held on Nov. 14. Eric Kandel was presented an award in the book category for his memoir, *In Search of Memory: The Emergence of a New Science of Mind*. Freelance writer Carl Zimmer won in the newspaper, magazine, and Internet category for his coverage of evolution and biology, and Jad Abumrad, Robert Krulwich, and Ellen Horne won in the television and radio category for their work on Radio Lab's "Where Am I?"

AT THE END OF IT ALL

The time spent together was short, but participants came out with a newfound excitement for their research. Task group challenges provided a foundation for establishing working relationships, fostering future collaborations between members. While the conference itself has passed, many researchers are well on their way to developing new ways to address aging. You never know, you might soon see robots as care takers for humans, or more elderly citizens participating in outdoor community activities.

Megan Chao is a graduate student in broadcast journalism at the Annenberg School for Communication at the University of Southern California. With a background in biology and creative writing, she plans to produce long-form science and health documentaries for television after graduation.

For more information on the Futures Initiative and this conference, visit <www.keckfutures.org>.

A Call for African Scientists to Speak Up

Narcisco Matos, executive director of the Foundation for Community Development in Mozambique, delivered the keynote speech at the third annual conference of the African Science Academy Development Initiative (ASADI) in Dakar, Senegal. ASADI, administered by the U.S. National Academies and sponsored by the Bill & Melinda Gates Foundation, aims to boost the ability of African academies to inform policymaking and public discourse with evidence-based advice. Following are edited excerpts from an interview with Matos by Bill Kearney.

What role should African academies have in getting science more accepted and utilized?

One of the key challenges for African scientists is to translate science to a language that can be utilized by the general public and policymakers. It also is a matter of identifying the issues that are a priority for a country; sometimes there is a disconnect between what the scientists are working on and what is perceived to be more useful to the country.

So academies addressing everyday problems would be helpful?

Yes, let me give you an example. In any city in Africa today you will see they are overcrowded with minibuses, which results in thousands of fatal accidents. But I would be surprised if you could find any study published in Africa on this phenomenon, although we live with it every day.

Why is it so important, as you said in your speech, for African scientists to be a bridge between "Western" science and indigenous practices for the treatment of disease?

Because we Africans still believe very much in — and use — practices that have not been interrogated by science. Most Africans go to a traditional doctor to treat disease, or go to church, or pray to their ancestors. We cannot ignore the reality of who we are, and it is important to recognize how the average African deals with daily life. There are [traditional] medicines that we know work, but they may have side effects that we don't know about because there are no studies.

You noted how CNN has on experts whenever there is a disaster, but that you do not see this in the African media. Is there a disconnect in Africa between the media and scientists?

That may be part of it, but it's also because, frankly, there is no high regard here for science, and the media are no different from society in general, so thus don't think about interviewing scientists. Also, when there is a problem, governments don't turn to their own scientists for help but hire consultants from abroad instead. Ironically, the first thing these consultants do is turn to local experts for help.

Do you think members of African national academies will become more receptive to the idea of public service as advisers to their governments?

Yes, ASADI is prompting scientists to begin to think about this. Our academies have been mostly honorific. You got in because of what you did in the past, not what you are expected to do in the future. Now I'm hearing the call for academies to be more active and produce evidence-based opinions that would reach those who make decisions.

For more information on ASADI and other interviews from the conference, go to <national-academies.org/asadi>.

NAE Launches New Web Site for Girls

"Engineer Your Life," a new Web site to encourage girls to enroll in undergraduate engineering programs, was unveiled by the National Academy of Engineering in February. The site is the centerpiece of a national campaign targeting high school girls and the adults in their lives — parents, counselors, teachers, and other educators — who want to learn more about the life and work of engineers.

At <www.engineeryourlife.org>, visitors can "virtually" meet 12 young women engineers and read inspiring stories about working with their communities, solving real problems, and how they came to choose engineering as a profession. Other young engineers also talk about their careers in their own words.

The site provides details about nearly a dozen engineering fields, including possible projects, starting salaries, and other resources, as well as information on how to prepare for and choose college engineering programs.

It expands on the success of the EngineerGirl! site, which was designed to reach middle school girls.

— *Maureen O'Leary*

Grand Challenges for Engineering

A year ago the National Academy of Engineering announced a project to identify the challenges and opportunities that lay ahead for engineering in the 21st century.

Culled from about 1,600 suggestions from engineers, scientists, medical experts, policymakers, and ordinary people around the world, 14 challenges were selected by a panel of some of the most accomplished individuals of their generation, experts in science, engineering, and medicine convened to identify advances that could improve quality of life around the world. The committee included William Perry (chair), Sir Alec Broers, Farouk El-Baz, Wesley Harris, Bernadine Healy, W. Daniel Hillis, Calestous Juma, Dean Kamen, Raymond Kurzweil, Robert Langer, Jaime Lerner, Bindu Lohani, Jane Lubchenco, Mario Molína, Larry Page, Robert Socolow, J. Craig Venter, and Jackie Ying.

The challenges fall into four areas essential for humanity to flourish — sustainability, health, reducing vulnerability, and joy of living. The panel decided not to make any predictions or focus on gee-whiz gadgets. It felt that it was more important to outline broad objectives that might inspire action.

And here they are (drum roll) … Get to work, engineers!

- Make solar energy economical
- Provide energy from fusion
- Develop carbon sequestration methods
- Manage the nitrogen cycle
- Provide access to clean water
- Restore and improve urban infrastructure
- Advance health informatics
- Engineer better medicines
- Reverse-engineer the brain
- Prevent nuclear terror
- Secure cyberspace
- Enhance virtual reality
- Advance personalized learning
- Engineer the tools of scientific discovery

NAE is offering the public an opportunity to vote on which one they think is most important and to provide comments at the project Web site at <www.engineeringchallenges.org>.
— *Maureen O'Leary*

NAS to Post Hundreds of Memoirs Online

The National Academy of Sciences is placing its complete collection of biographical memoirs on the Internet. These brief biographies of deceased Academy members are written by people who knew them or their work. Although memoirs published since 1995 have been available online, more than 900 memoirs published in earlier volumes were available in print only. "This is a 'historic' event that will have substantial scholarly value and be of general interest to the public. This personal and scholarly view of the lives and work of such prominent scientists will be a wonderful resource," said John Brauman, home secretary of the Academy.

Among the recently added memoirs are those of famed naturalist Louis Agassiz; Joseph Henry, the first secretary of the Smithsonian Institution; Thomas Edison; Alexander Graham Bell; noted anthropologist Margaret Mead; and psychologist and philosopher John Dewey. More memoirs will be published regularly until the entire collection is available online. PDF files of each are available online at <www.nasonline.org/memoirs>.
— *Maureen O'Leary*

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.

Depression, Parenting Practices, and the Healthy Development of Children.
Board on Children, Youth, and Families, Division of Behavioral and Social Sciences and Education and the Institute of Medicine. Project director: Leslie Sim. Chair: Mary Jane England, president, Regis College, Weston, Mass. Sponsors: The California Endowment, Annie E. Casey Foundation, Robert Wood Johnson Foundation, and the Substance Abuse and Mental Health Services Administration.

Effectiveness of International and National Measures to Prevent and Reduce Marine Debris and Its Impacts.
Ocean Studies Board, Division on Earth and Life Studies; and Marine Board, Transportation Research Board. Project director: Susan Park. Chair: Keith R. Criddle, Ted Stevens Distinguished Professor of Marine Policy, University of Alaska, Fairbanks. Sponsor: U.S. Coast Guard.

Health Risks of Phthalates.
Board on Environmental Studies and Toxicology, Division on Earth and Life Studies. Project director: Ellen Mantus. Chair: Deborah A. Cory-Slechta, professor of environmental medicine, University of Rochester School of Medicine and Dentistry, Rochester, N.Y. Sponsor: U.S. Environmental Protection Agency.

Opportunities in Neuroscience for Future Army Applications.
Board on Army Science and Technology, Division on Engineering and Physical Sciences. Project director: Robert Love. Chair: Floyd E. Bloom, professor emeritus, department of molecular and integrative neuroscience, Scripps Research Institute, La Jolla, Calif. Sponsor: U.S. Department of the Army.

Optimizing Graduate Medical Trainee (Resident) Hours and Work Schedules to Improve Patient Safety.
Board on Health Care Services, Institute of Medicine. Project co-directors: Dianne Wolman and Cheryl Ulmer. Chair: Michael M.E. Johns, chancellor, Emory University, Atlanta. Sponsor: Agency for Healthcare Research and Quality, U.S. Department of Health and Human Services.

Public Health Decision Making Under Uncertainty.
Board on Population Health and Public Health Practice, Institute of Medicine. Project director: Kathleen Stratton. Chair: Frank A. Sloan, J. Alexander McMahon Professor of Health Policy and Management and Professor of Economics; and director, Center for Health Policy, Law and Management, Duke University, Durham, N.C. Sponsor: U.S. Environmental Protection Agency.

Review of NASA's Exploration Technology Development Program.
Aeronautics and Space Engineering Board, Division on Engineering and Physical Sciences. Project co-directors: Brian Dewhurst and John Wendt. Co-chairs: Edward Crawley, Ford Professor of Engineering, and professor of aeronautics and astronautics and of engineering systems, Massachusetts Institute of Technology, Cambridge; and Bonnie J. Dunbar, president and chief executive officer, Museum of Flight, Seattle. 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.

Acute Exposure Guideline Levels for Selected Airborne Chemicals, Vol. 6
Board on Environmental Studies and Toxicology, Division on Earth and Life Studies (2007, approx. 296 pp.; ISBN 0-309-11213-3; available from NAP).

Agriculture, Forestry, and Fishing Research at NIOSH
Board on Agriculture and Natural Resources, National Research Council, and Institute of Medicine (2008, approx. 413 pp.; ISBN 0-309-11579-5; available from NAP).

Approaches for Evaluating the NRC Resident Research Associateship Program at NIST
Board on Higher Education and Workforce, Division on Policy and Global Affairs (2007, 170 pp.; ISBN 0-309-11218-4; available from NAP).

Assessment of the NASA Astrobiology Institute
Space Studies Board, Division on Engineering and Physical Sciences (2007, approx. 80 pp.; 0-309-11497-7; available from NAP).

An Assessment of the Small Business Innovation Research Program at the Department of Defense
Division on Policy and Global Affairs (2007, approx. 634 pp.; ISBN 0-309-10947-7; available from NAP).

An Assessment of the Small Business Innovation Research Program at the National Institutes of Health
Division on Policy and Global Affairs (2007, approx. 604 pp.; ISBN 0-309-10951-5; available from NAP).

An Assessment of the Small Business Innovation Research Program at the National Science Foundation
Division on Policy and Global Affairs (2007, approx. 300 pp.; ISBN 0-309-10487-4; available from NAP).

Autism and the Environment: Challenges and Opportunities for Research — Workshop Proceedings
Board on Health Sciences Policy, Institute of Medicine (2008, 358 pp.; ISBN 0-309-10881-0; available from NAP).

Benchmarking the Competitiveness of the United States in Mechanical Engineering Basic Research
Board on Chemical Sciences and Technology, Division on Earth and Life Studies (2007, approx. 144 pp.; ISBN 0-309-11426-8; available from NAP).

Bioinspired Chemistry for Energy — A Workshop Summary to the Chemical Sciences Roundtable
Board on Chemical Sciences and Technology, Division on Earth and Life Studies (2008, approx. 100 pp.; ISBN 0-309-11487-X; available from NAP).

Challenges in Adolescent Health Care — Workshop Report
Board on Children, Youth, and Families, Division of Behavioral and Social Sciences and Education (2007, 90 pp.; ISBN 0-309-11269-9; available from NAP).

Condensed-Matter and Materials Physics: The Science of the World Around Us
Board on Physics and Astronomy, Division on Engineering and Physical Sciences (2007, 284 pp.; ISBN 0-309-10969-8; available from NAP).

Core Competencies for Federal Facilities Asset Management Through 2020: Transformational Strategies
Board on Infrastructure and the Constructed Environment, Division on Engineering and Physical Sciences (2008, 136 pp.; ISBN 0-309-11400-4; available from NAP).

The Development of DRIs 1994-2004: Lessons Learned and New Challenges — Workshop Summary
Food and Nutrition Board, Institute of Medicine (2008, approx. 198 pp.; ISBN 0-309-11562-0; available from NAP).

Environmental Data Management at NOAA: Archiving, Stewardship, and Access
Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies (2007, 130 pp.; ISBN 0-309-11209-5; available from NAP).

Experimentation and Evaluation Plans for the 2010 Census — Interim Report
Committee on National Statistics, Division of Behavioral and Social Sciences and Education (2008, 108 pp.; ISBN 0-309-11545-0; available from NAP).

Fusion of Security System Data to Improve Airport Security
National Materials Advisory Board, Division on Engineering and Physical Sciences (2007, 82 pp.; ISBN 0-309-10748-2; available from NAP).

Global Infectious Disease Surveillance and Detection: Assessing the Challenges, Finding Solutions — Workshop Summary
Board on Global Health, Institute of Medicine (2007, 284 pp.; ISBN 0-309-11114-5; available from NAP)

Grading NASA's Solar System Exploration Program: A Midterm Review
Space Studies Board, Division on Engineering and Physical Sciences (2007, approx. 80 pp.; ISBN 0-309-11492-6; available from NAP).

Gulf War and Health, Vol. 6: Physiologic, Psychologic, and Psychosocial Effects of Deployment-Related Stress
Board on Population Health and Public Health Practice, Institute of Medicine (2008, 360 pp.; ISBN 0-309-10177-8; available from NAP).

Hydrology, Ecology, and Fishes of the Klamath River Basin
Board on Environmental Studies and Toxicology and Water Science and Technology Board, Division on Earth and Life Studies (2008, 272 pp.; ISBN 0-309-11506-X; available from NAP).

Identification of Research Needs Relating to Potential Biological or Adverse Health Effects of Wireless Communication Devices
Nuclear and Radiation Studies Board, Division on Earth and Life Studies (2008, 78 pp.; ISBN 0-309-11294-X; available from NAP).

Increasing Capacity for Stewardship of Oceans and Coasts: A Priority for the 21st Century
Ocean Studies Board, Division on Earth and Life Studies (2008, 156 pp.; ISBN 0-309-11376-8; available from NAP).

Integrating Multiscale Observations of U.S. Waters
Water Science and Technology Board, Division on Earth and Life Studies (2007, approx. 230 pp.; ISBN 0-309-11457-8; available from NAP).

International Collaborations in Behavioral and Social Sciences — Report of a Workshop
Board on International Scientific Organizations, Division on Policy and Global Affairs (2008, 102 pp.; ISBN 0-309-11415-2; available from NAP).

Lost Crops of Africa, Vol. 3: Fruits
Development, Security, and Cooperation, Division on Policy and Global Affairs (2008, 380 pp.; ISBN 0-309-10596-X; available from NAP).

Manpower and Personnel Needs for a Transformed Naval Force
Naval Studies Board, Division on Engineering and Physical Sciences (2008, 170 pp.; ISBN 0-309-11265-6; available from NAP).

Mobilizing Science-Based Enterprises for Energy, Water, and Medicines in Nigeria
Development, Security, and Cooperation, Division on Policy and Global Affairs (2007, 144 pp.; ISBN 0-309-11118-8; available from NAP).

NASA's Elementary and Secondary Education Program: Review and Critique
Board on Science Education, Division of Behavioral and Social Sciences and Education (2007, approx. 208 pp.; ISBN 0-309-11551-5; available from NAP).

Neuroscience Biomarkers and Biosignatures: Converging Technologies, Emerging Partnerships — Workshop Summary
Board on Health Sciences Policy, Institute of Medicine (2008, 128 pp.; ISBN 0-309-10889-6; available from NAP).

New Directions for Understanding Systemic Risk: A Report on a Conference Cosponsored by the Federal Reserve Bank of New York and the National Academy of Sciences
National Research Council (2007, 120 pp.; ISBN 0-309-10752-0; available from NAP).

Nutritional Risk Assessment: Perspectives, Methods, and Data Challenges — Workshop Summary
Food and Nutrition Board, Institute of Medicine (2007, 146 pp.; ISBN 0-309-10871-3; available from NAP).

Opportunities for Coordination and Clarity to Advance the National Health Information Agenda: A Brief Assessment of the Office of the National Coordinator for Health Information Technology — A Letter Report
Board on Health Care Services, Institute of Medicine; and Computer Science and Telecommunications Board, Division on Engineering and Physical Sciences (2007, 30 pp.; available only online from NAP).

Pre-Milestone A and Early-Phase Systems Engineering: A Retrospective Review and Benefits for Future Air Force Systems Acquisition
Air Force Studies Board, Division on Engineering and Physical Sciences (2008, 150 pp.; ISBN 0-309-11475-6; available from NAP).

Proceedings of a Workshop on Statistics on Networks
Board on Mathematical Sciences and Their Applications, Division on Engineering and Physical Sciences (2007, 470 pp.; CD-ROM; ISBN 0-309-10105-0; available from NAP).

Prospects for Managed Underground Storage of Recoverable Water
Water Science and Technology Board, Division on Earth and Life Studies (2008, 350 pp.; ISBN 0-309-11438-1; available from NAP).

Research Priorities in Emergency Preparedness and Response for Public Health Systems — A Letter Report
Board on Health Sciences Policy, Institute of Medicine (2008, 52 pp.; available only online from NAP).

Review of CCSP Draft Synthesis and Assessment Product 5.3: Decision-Support Experiments and Evaluations Using Seasonal to Interannual Forecasts and Observational Data
Center for Economic, Governance, and International Studies, Division of Behavioral and Social Sciences and Education (2008, 56 pp.; ISBN 0-309-11568-X; available from NAP).

Review of DOE's Nuclear Energy Research and Development Program
Board on Energy and Environmental Systems, Division on Engineering and Physical Sciences (2007, approx. 144 pp.; ISBN 0-309-11124-2; available from NAP).

Review of Toxicologic and Radiologic Risks to Military Personnel From Exposure to Depleted Uranium During and After Combat
Board on Environmental Studies and Toxicology, Division on Earth and Life Studies (2008, approx. 158 pp.; ISBN 0-309-11036-X; available from NAP).

Review of the U.S. Climate Change Science Program's Draft Synthesis and Assessment Product 2.4, "Trends in Emissions of Ozone Depleting Substances, Ozone Layer Recovery, and Implications for Ultraviolet Radiation Exposure"
Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies (2007, 76 pp.; ISBN 0-309-11525-6; available from NAP).

Review of the U.S. Climate Change Science Program's Synthesis and Assessment Product 1.3, "Reanalyses of Historical Climate Data for Key Atmospheric Features — Implications for Attribution of Causes of Observed Change"
Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies (2008, 68 pp.; available only online from NAP).

Review of the U.S. Climate Change Science Program's Synthesis and Assessment Product 3.2, "Climate Projections Based on Emission Scenarios for Long-lived and Short-lived Radiatively Active Gases and Aerosols"
Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies (2007, 54 pp.; available only online from NAP).

Science, Evolution, and Creationism
National Academy of Sciences and Institute of Medicine (2008, 88 pp.; ISBN 0-309-10586-2; available from NAP).

Soldier Protective Clothing and Equipment: Feasibility of Chemical Testing Using a Fully Articulated Robotic Mannequin
Board on Chemical Sciences and Technology, Division on Earth and Life Studies (2007, approx. 178 pp.; ISBN 0-309-10933-7; available from NAP).

Surveying Victims: Options for Conducting the National Crime Victimization Survey
Committee on National Statistics and Committee on Law and Justice, Division of Behavioral and Social Sciences and Education (2008, approx. 270 pp.; ISBN 0-309-11598-1; available from NAP).

Treatment of Posttraumatic Stress Disorder: An Assessment of the Evidence
Board on Population Health and Public Health Practice, Institute of Medicine (2008, 224 pp.; ISBN 0-309-10926-4; available from NAP).

Understanding American Agriculture: Challenges for the Agricultural Resource Management Survey
Committee on National Statistics, Division of Behavioral and Social Sciences and Education (2007, 214 pp.; ISBN 0-309-11092-0; available from NAP).

Violence Prevention in Low-and Middle-Income Countries: Finding a Place on the Global Agenda — Workshop Summary
Board on Global Health, Institute of Medicine (2008, 280 pp.; ISBN 0-309-11205-2; available from NAP).

IN FOCUS
P.O. Box 665
Holmes, PA 19043

PRE-SORT STANDARD
U.S. POSTAGE PAID
PERMIT NO. 6426
WASHINGTON, DC

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine