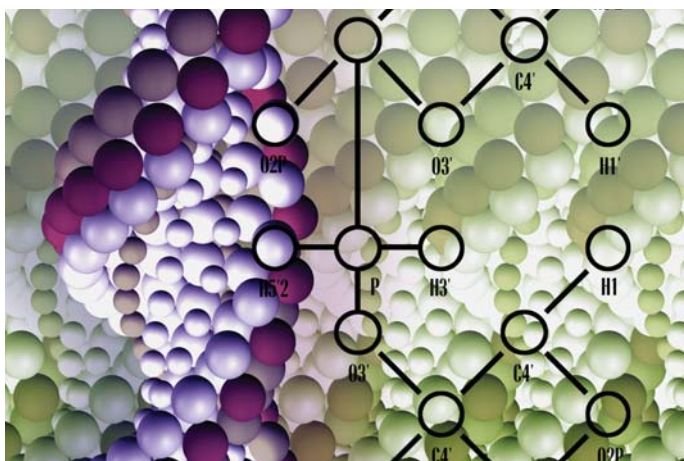


# THE NATIONAL ACADEMIES **IN FOCUS**

infocusmagazine.org



Direct-to-Consumer Genetic  
Testing

Adding Math to Preschool  
Learning

Improving Health Worldwide

Satellite Data May Hold  
Clues to Arctic Melt



Fall 2009  
vol. 9 number 2

# THE NATIONAL ACADEMIES

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- Page 20: Zhou Wenzhong, People's Republic of China ambassador to the U.S.; Wan Gang, China's minister of science and technology; John Holdren, assistant to the U.S. president for science and technology; Kerri-Ann Jones, assistant secretary of state for oceans and international environmental and scientific affairs at the U.S. Department of State; and NAS President Ralph Cicerone at the National Academy of Sciences on Oct. 15, 2009, photo by Patricia Pooladi/NAS

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## Globalization and Science

As this issue of *In Focus* went to press, world leaders gathered in Copenhagen for a summit on climate. Few issues demonstrate more dramatically than climate change both global interdependence and the central role of science in shaping geo-political decisions. Although we cannot know precisely what will emerge from the Copenhagen meeting, it is clear that scientific evidence about global warming and the impact of humans on climate — and public understanding of that scientific evidence — should be potent drivers of policy decisions.



A number of the studies and activities highlighted in this issue demonstrate the global reach of science and the place of science in policy that affects the globe. Closely connected to the issue of climate, for example, is our project on *America's Energy Future*, which shows how careful scientific assessment can illuminate our nation's policy options and how they will affect the world. Two other recent reports — one on the risks of emerging infections, the other on the international distribution of air pollution — amply illustrate how choices made in one country affect others and the need for global scientific understanding of these risks to health. Beyond an expression of shared risk, health also represents a shared aspiration for human progress. *The U.S. Commitment to Global Health*, another important report covered in this issue, outlines how the U.S. can take advantage of its biomedical and technological prowess to promote global health and project a positive influence in the world.

A critical component of the steps we choose to take as a nation is international cooperation and collaboration. This year the National Academies celebrated decades of scientific, engineering, and health collaboration with our counterparts in China (30 years) and Russia (50 years). In recent years, the U.S. National Academies have also been working in partnership with science academies in Africa to enable them to provide the kind of guidance in their countries that the National Research Council and the Institute of Medicine provide in the U.S. These milestones in international cooperation indicate the dual aspect of science as a driver of globalization and as an expression of globalization. Through our studies and cooperative activities, the National Academies provide a conduit for international partnerships and help to reinforce the place of science in policy decisions that affect everyone on the globe.

A stylized, handwritten signature in black ink that reads "Harvey V. Fineberg". The signature is fluid and cursive, with the first and last names being more prominent.

HARVEY V. FINEBERG  
President, Institute of Medicine



# ADDING MATH TO PRESCHOOL LEARNING

Math is often seen as a low priority in preschools, which typically devote their resources to language and reading skills and social development. But a new report from the National Research Council says that it's time for early childhood educators to stop giving math short shrift.

**S**tudies show that children start absorbing mathematical concepts far earlier than commonly recognized. Even as young as 10 months, babies can distinguish between a set of two items and a set of three. They expand on this awareness as they get older — for example, by noticing when another child has more or fewer toys than they do.

Adult support is crucial in helping young children see the mathematical aspects of everyday situations, the report says. It recommends that all public and private preschools increase the amount of time devoted to mathematics, and include lessons that have math education as their primary purpose. Currently, if preschools teach math at all, it's generally folded in as a secondary goal of other activities — a less-effective teaching strategy.

Mathematics teaching in early childhood education settings should concentrate on two major content areas, said the committee that wrote the report. The first is “number,” the umbrella concept educators use to describe counting, determining less and more, and basic operations such as adding and subtracting. The second area is geometry, spatial thinking, and measurement.

Helping children reason about things mathematically is an important part of instruction, the report says. For example, children might practice measuring various objects using a wooden block and then discuss why it’s important to use a standard unit of measure in determining whether one object is longer or taller than another. Or a teacher might ask a child to count a set of toys from left to right and then from right to left, to help him or her understand that the order in which items are counted doesn’t change the number.

For each content area, the report describes “teaching-learning paths” — sequences of learning experiences in which each new step builds on earlier steps. Research has shown these pathways to be an effective way to help children’s learning in mathematics, the committee said. For example, a child might be shown many examples of shapes to learn what aspects are mathematically relevant to determining shape — such as how many sides each one has — and what factors are not, such as size or orientation. After a child learns basic shapes, he or she can learn to combine them to create new shapes.

These teaching-learning paths should help shape the early childhood education system from the ground up, the report says. Teachers should use them in their class-

rooms, curriculum developers should base their materials on them, and states should develop or revise their early childhood learning standards to reflect these paths. And professional development opportunities are needed to instruct preschool educators on the teaching-learning paths and how to implement a mathematics curriculum effectively. The education and training given to preschool teachers has historically focused more heavily on emotional and social development, an emphasis that may leave many ill-equipped to teach math effectively.

Opportunities to receive strong math instruction are especially important for children from low income groups, the report notes. On average these children demonstrate lower levels of competence in math prior to entering school, and these gaps persist or widen as schooling continues. Providing these kids with high-quality mathematics instruction early on can provide a foundation for future learning and help address long-term inequities in educational outcomes, the report says, urging Head Start and other publicly funded programs to implement the report’s recommendations. — *Sara Frueh*

■ **Mathematics Learning in Early Childhood: Paths Toward Excellence and Equity.** Committee on Early Childhood Mathematics, Center for Education, Division of Behavioral and Social Sciences and Education (2009, 398 pp.; ISBN 0-309-12806-4; available from the National Academies Press, tel. 1-800-624-6242; \$54.95 plus \$5.00 shipping for single copies; also on the Internet at <[www.nap.edu/catalog/12519.html](http://www.nap.edu/catalog/12519.html)>).

The committee was chaired by **Christopher T. Cross**, Cross & Joftus LLC, Danville, Calif. The study was funded by the U.S. Department of Health and Human Services, National Institute of Child Health and Human Development, Ewing Marion Kauffman Foundation, and the President’s Fund of the National Research Council.

## SYMPOSIUM EYES THE FUTURE OF DIRECT-TO-CONSUMER GENETIC TESTING



**A** woman concerned about her family history of breast cancer can now go to a clinic, have her blood drawn and sent off in the mail, and within weeks receive a call or letter telling her whether she has the genetic mutation that places her at higher risk of developing the disease. Similar tests on the market offer to help people understand their genetic risk of developing heart disease, Type 2 diabetes, and many other disorders.

Proponents of direct-to-consumer genetic tests say that if more people knew their disease risk, they would perhaps take steps to lower it. But these tests also raise difficult medical, ethical, and legal questions: Are they valid and accurate ways to understand people's level of risk? Are consumers getting good counseling, given that a patient's doctor doesn't interpret or deliver the results? In August the National Research Council and Institute of Medicine gathered dozens of researchers, health care workers, agency staffers, and others at a two-day workshop to explore issues surrounding direct-to-consumer genetic tests.

One key issue raised by participants is how well these tests shed light on risk, given the genetic complexity of many diseases. Researchers and doctors have gained the knowledge and experience to identify many

diseases linked to a single genetic mutation or duplication. But as research increasingly makes clear, uncovering the genetic triggers of many diseases is not so simple. "We're now dealing with a whole family of significant, chronic major diseases in humans where the information that's rapidly accumulating suggests very strongly that there may be no dominant gene that's going to be the clue to these diseases," said speaker David Korn, vice provost for research at Harvard University. Illnesses such as heart disease and emphysema may have hundreds of genetic factors involved, and the exact contribution of each is unclear. "There's a lot more going on in these diseases than simply finding one or two genes that are going to give us the magic bullet," Korn emphasized.

Other speakers explored privacy issues, such as the ethical quandaries that arise when an individual's test reveals health risks that may run in the family, but which relatives don't want to know about. A report summarizing these and other presentations and discussions at the symposium will be published next year. Audio and PDF files of the presentations are available online at [sites.nationalacademies.org/PGA/stl/PGA\\_053096](http://sites.nationalacademies.org/PGA/stl/PGA_053096). — *Sara Frueh*





# ON THIN ICE

## Clues to Arctic Melt May Be Found in Declassified Data

The worlds of James Bond and climatology rarely cross paths. But as climate around the globe continues to shift, many are beginning to view climate change as also a national security issue.

This is particularly relevant in the Arctic basin where the loss of sea ice in recent years and the possibility of the basin becoming ice-free during the summer months have raised a number of security, environmental, and economic concerns. Could the intelligence community hold pertinent information to help climatologists and other scientists better understand global climate change and the shrinking Arctic sea ice?

In July, approximately 600 images from intelligence sources showing detailed elements of the melting and freezing cycles of Arctic sea ice were made public by the U.S. Geological Survey, hours after a National Research Council report urged their release. “It was a pleasant surprise to learn that the USGS acted so quickly,” said chair of the committee that wrote the Research Council report Stephanie Pfirman, and chair of the department of environmental science at Barnard College. “Having these images is critical for projecting how Arctic sea ice



will change over the next several decades, because they show information at scales, locations, and time periods that is not available elsewhere.”

With the possibility of an open water basin, trans-Arctic shipping between the Atlantic and Pacific is likely to increase, which will impact laws governing oceans and territorial waters, as well as the monitoring and policing of international agreements and search and rescue. Other consequences of diminished ice cover include easier access to potential fossil fuel deposits and other mineral resources, requiring the development of appropriate policies and infrastructures, and strain on wildlife habitats and shifts in ecosystems.

“Better forecasts of sea-ice conditions can help officials and leaders prepare for and adapt to the impacts of climate change and minimize environmental risks associated with increased development,” Pfirman added.

The committee called for release of the images because few observations are available at times and scales necessary to understand processes involved in the melting and freezing of the ice. Collecting ground-based observations via manned-drifting stations is challenging due to changing environmental conditions, and observational aircraft flights in that region are difficult and expensive. Moreover, the only previ-

ous satellite images of Arctic sea ice that were readily available to the public were 15 to 30 meters resolution, making them too coarse to capture details. The newly released images are at 1-meter resolution, allowing scientists to see processes unavailable in other data.

Scientists can now learn more about the rapid loss and transformation of Arctic sea ice by examining the distribution of ice thickness and how stress and strain lead to the pattern of cracks and other features in the ice. In addition, the new images could help show how pools of water, called meltwater ponds, begin to form in ice floes and expand in the ice over summer. Because meltwater ponds are darker than Arctic sea ice, they absorb more light and enhance floes’ rate of melting.

Collection of the images started in the 1990s as part of a program in which scientists recommended gathering and archiving high-resolution classified imagery from intelligence sources at environmentally sensitive locations around the globe. The goal was to ultimately declassify and distribute the images to the broader scientific community. However, these images remained unavailable until July when the USGS released them. The images are available at [gfl.usgs.gov](http://gfl.usgs.gov) — *Jennifer Walsh*

■ **Scientific Value of Arctic Sea Ice Imagery Derived Products.** Committee on the Scientific Value of Arctic Sea Ice Imagery Derived Products and Committee on Climate, Energy, and National Security; Polar Research Board; Division on Earth and Life Studies (2009, 48 pp.; ISBN 0-309-13763-2; available from the National Academies Press, tel. 1-800-624-6242; \$15.00 plus \$5.00 shipping for single copies; also on the Internet at [www.nap.edu/catalog/12631.html](http://www.nap.edu/catalog/12631.html)).

The committee was chaired by **Stephanie Pfirman**, a professor in environmental and applied sciences and chair of the department of environmental science at Barnard College, New York City.



## NO BORDERS FOR

## AIR POLLUTANTS

**T**ake a deep breath. Now take another. Did you know that the air you are inhaling could contain pollution that traveled here all the way from Asia? Or that air particles from the United States can drift across the Atlantic Ocean to Europe?

A recent report from the National Research Council finds that air pollutants can be transported aloft across the Northern Hemisphere to continents that lie downwind. Although air quality is nearly always dominated by local or regional emissions, air pollutants from abroad are becoming a growing concern as emissions from developing countries increase and environmental protection standards tighten in industrialized nations.

“Air pollution does not stop at national borders,” said Charles Kolb, chair of the committee that wrote the report and president and chief executive officer of Aerodyne Research Inc. “It travels through the atmosphere to distant regions of our planet and can affect the health of people and ecosystems.”

Distinguishing between domestic and foreign components of air pollution and quantifying how global sources actually affect air quality and ecosystems is currently constrained by modeling and observational capabilities. Yet, some air pollution plumes observed in the U.S. can be attributed unambiguously to sources in Asia based on meteorological and chemical analyses. For example, one study found that a polluted air-mass detected at Mt. Bachelor Observatory

in Oregon took approximately eight days to travel from East Asia.

In the coming decades the concern over pollutants will grow, particularly as man-made emissions are expected to rise in East Asia. However, these increases could potentially be mitigated by progressively more stringent pollution control efforts and international cooperation in developing and deploying pollution control technology.

Projected climate change will also likely affect the emissions and travel of pollutants, but predicting the net impacts of these potential changes is extremely difficult with present knowledge.

To improve understanding of long-range transport of pollution, the report recommends a variety of research initiatives, such as “fingerprinting” techniques to better identify source-specific pollutant characteristics, atmospheric modeling, ground-based and remote sensing observations, and focused field studies. — *Jennifer Walsh*

■ **Global Sources of Local Pollution: An Assessment of Long-Range Transport of Key Air Pollutants to and from the United States.** Committee on the Significance of International Transport of Air Pollution, Board on Atmospheric Sciences and Climate, Division on Earth and Life Studies (2009, approx. 250 pp.; ISBN 0-309-0-309-14401-9; available from the National Academies Press, tel. 1-800-624-6242; \$35.00 plus \$5.00 shipping for single copies; also on the Internet at <[www.nap.edu/catalog/12743.html](http://www.nap.edu/catalog/12743.html)>).

The committee was chaired by **Charles Kolb**, president and chief executive officer of Aerodyne Research Inc., Billerica, Mass. The study was funded by the Environmental Protection Agency, NASA, National Oceanic and Atmospheric Administration, and National Science Foundation.





## MAKING GOOD ON **GLOBAL HEALTH**

Reports Detail How U.S. Leadership  
Can Help Make a Healthier World

**T**he H1N1 influenza sweeping the globe serves as a potent reminder that what happens to the health of people in one country can affect the well-being of people hundreds or thousands of miles away. For decades, American agencies, industries, and nonprofits have laudably dedicated resources to combating disease and promoting health internationally. But the evidence shows that a wide gap remains between the improvements that are possible given the scientific knowledge and resources available today and the actual progress that has been made on the ground.

That's the message of two recent reports from the Institute of Medicine and National Research Council. The good news is that with the appropriate political will, leadership, and resource commitments, the United States and its international partners could

close that gap and fulfill the promise of a healthy global population.

In May the Institute of Medicine laid out a fresh, bold vision for future U.S. investments in improving health worldwide. The report, *The U.S. Commitment to Global Health*, framed its recommendations within the philosophy that America has a moral obligation to share its medical expertise and resources to promote health worldwide; doing so would accrue subsequent economic, diplomatic, and security benefits.

The report identifies key areas in which U.S.-based groups could have a real impact. Existing interventions are making a difference and should be enhanced to achieve even more. At the same time, stepped-up research on health problems prevalent in developing nations would yield new preventions, diagnostics, and treatments. In addition,



American groups should contribute to building the infrastructure and capacity of global partners so they can play a more active role.

All this requires the United States to increase its financial commitment to \$15 billion per year by 2012, the report concludes. The current economic crisis only makes this funding boost all the more essential given that developing nations have been affected worst and many of their people blame America for the crisis. U.S. groups can facilitate more effective results by approaching people and institutions in recipient nations as partners to act with rather than act for.

Although the report emphasizes the need for action on health problems of all kinds, new infectious diseases sound the loudest alarms because they can spread worldwide with such ease. The majority of infectious diseases that have recently emerged have been caused by zoonotic pathogens that jump from animals to people.

For too long, the global community has reacted to zoonotic disease outbreaks like firefighters mobilizing to tackle one wildfire at a time. *Sustaining Global Surveillance and Response to Emerging Zoonotic Diseases*, a report from the IOM and Research Council, lays out the case for a better coordinated and sustained system of monitoring for the earliest hints of new zoonotic disease threats and responding more effectively to contain their spread.

The report emphasizes the urgent need for human health and animal health professionals to work more closely together. It is hardly practical to treat human and animal health as separate spheres when infectious agents ignore species distinctions; the result is missed opportunities to contain new threats.

Zoonotic disease surveillance also requires sustained funding. Current funding is largely sporadic, targeting resources to the “disease du jour” and fluctuating with changes in donors’ priorities. The report calls on the United States and its international partners to make a concerted effort to identify sources of dedicated support.

The United States has the resources to lead international efforts to improve the health of people worldwide and the systems to monitor for new disease threats, the reports conclude. But health is both a universal good and shared responsibility, and it will take all nations acting in partnership to achieve a healthier world. — *Christine Stencel*

■ **The U.S. Commitment to Global Health: Recommendations for the Public and Private Sectors.**

Committee on the U.S. Commitment to Global Health, Board on Global Health, Institute of Medicine (2009, 298 pp.; ISBN 0-309-13821-3; available from the National Academies Press, tel. 1-800-624-6242 or on the Internet at <[www.nap.edu/catalog/12642.html](http://www.nap.edu/catalog/12642.html)>). The committee was co-chaired by **Thomas R. Pickering**, vice chairman, Hills & Co., Washington, D.C., and **Harold Varmus**, president, Memorial Sloan-Kettering Cancer Center, New York City. The study was funded by the Bill & Melinda Gates Foundation, Burroughs Wellcome Fund, Google.org, Merck Company Foundation, Rockefeller Foundation, U.S. Department of Health and Human Services, U.S. Department of Homeland Security, and U.S. Department of State.

■ **Sustaining Global Surveillance and Response to Emerging Zoonotic Diseases.** Committee on Achieving Sustainable Global Capacity for Surveillance and Response to Emerging Diseases of Zoonotic Origin, Board on Global Health, Institute of Medicine; and Board on Agriculture and Natural Resources, Division on Earth and Life Studies (2009, approx. 340 pp.; ISBN 0-309-13734-9; available from the National Academies Press, tel. 1-800-624-6242 or on the Internet at <[www.nap.edu/catalog/12625.html](http://www.nap.edu/catalog/12625.html)>). The committee was co-chaired by **Gerald T. Keusch**, associate provost for global health and associate dean for global health, School of Public Health, Boston University, Boston, and **Marguerite Pappaioanou**, executive director, Association of American Veterinary Medical Colleges, Washington, D.C. The study was funded by the U.S. Agency for International Development.

# CAMP LEJEUNE'S Contaminated Drinking Water

**F**rom the 1950s through the mid-1980s two water-supply facilities at Camp Lejeune Marine Base in North Carolina were contaminated with various toxic industrial solvents. Among the pollutants were perchloroethylene (PCE) — which entered the groundwater as a result of spills and improper disposal practices by an off-base dry cleaner — and trichloroethylene (TCE) from on-base spills and leaks from underground storage equipment.

After the contamination was discovered in the 1980s, considerable public controversy grew over the potential health consequences, which included various cancers and diseases. To date, few studies on the population have been performed. In order to supplement those studies and help better inform officials addressing health claims, Congress asked the National Research Council to examine whether there was a link between the past contamination and adverse health effects experienced by members of the Camp Lejeune community.

The Research Council found that evidence does exist that people at Camp Lejeune during that time frame were exposed to TCE and PCE in their water supplies, but strong scientific evidence is not available to determine whether health problems among those exposed are due to the contaminants.

Because additional research will unlikely provide definitive information on whether exposure resulted in health problems, the committee that wrote the report recommended that whatever actions officials need to take concerning the exposure should not wait until new health studies are completed. They should undertake appropriate action in light of the limited information that indicates exposure to toxic contaminants occurred and may have affected the health of the population.

“Even with the latest scientific advances, the complex nature of the Camp Lejeune



contamination, which happened decades ago, and the limited data on the concentrations in water supplies allow for only crude estimates of exposure,” said committee chair David Savitz, professor in the department of community and preventive medicine at Mount Sinai School of Medicine. “Therefore, the committee could not determine reliably whether diseases and disorders experienced by former residents and workers are associated with their exposure to the contaminated water.”

The ability to determine the levels of exposure at Camp Lejeune is complex because people could have been exposed at home, school, daycare, or work. Studies specifically on the population have addressed only reproductive health outcomes, and the quality of exposure information restricts their value, the report states. The inability to study exposure and health outcomes accurately would be a serious limitation in any future research. — *Jennifer Walsh*

■ **Contaminated Water Supplies at Camp Lejeune: Assessing Potential Health Effects.** Committee on Contaminated Drinking Water at Camp Lejeune, Board on Environmental Sciences and Technology, Division of Earth and Life Studies (2009, 338 pp.; ISBN 0-309-13699-7; available from the National Academies Press, tel. 1-800-624-6242; \$68.00 plus \$5.00 shipping for single copies; also on the Internet at <[www.nap.edu/catalog/12618.html](http://www.nap.edu/catalog/12618.html)>).

The study was chaired by **David A. Savitz**, Charles W. Bluhdorn Professor, department of community and preventive medicine, Mount Sinai School of Medicine, New York City. The study was funded by the U.S. Navy.



# Energizing Times

## The Changing Face of U.S. Energy Options

The America's Energy Future project — a National Academies-wide initiative — brought together 65 experts to provide detailed, technical assessments of energy technologies available to the U.S. Panels were convened to study such issues as potential new energy supplies from coal and biomass, renewable resources, nuclear energy, and the potential for energy efficiency savings.

**B**eginning with a summit held in March 2008 and culminating with a 650-page report released this past summer, the initiative illuminated the urgency of addressing the role of energy in national security, economic concerns, and climate change.

Concerns over energy supply and use have been mounting for decades, particularly with regard to our growing reliance on imported petroleum and the environmental impacts of fossil fuel combustion. The U.S. now gets about 56 percent of its oil from foreign suppliers, up from 40 percent in 1990, and greenhouse gas emissions play a large role in global climate change. Changing the way that the U.S. uses energy is a broad issue. It will involve energy efficiency measures, such as those adopted in the 1970s, formulation of consistent government policies to drive these changes, and new technologies that





can improve the way energy is produced, distributed, and consumed.

Before changes to U.S. energy usage can occur, however, decision makers first need a realistic picture of the options that exist. The America's Energy Future project was launched to provide all the technical information needed to have an informed debate on the issue of energy in the U.S. In 2009 the project released *Liquid Transportation Fuels From Coal and Biomass*; *Electricity From Renewable Resources*; and *Realistic Prospects for Energy Efficiency in the U.S.* The final report, *America's Energy Future: Technology and Transformation*, brings together the findings from all of the panels and also includes information on fossil fuels, nuclear energy, and the nation's electric grid.

One of the main messages in the final report is that with a sustained national commitment, the United States could make substantial improvements to the way it produces and uses energy. Actions need to

be made soon, however, to achieve these improvements; the report states that actions taken between now and 2020 will determine our options for decades to come. Rather than make specific policy recommendations, the report provides timelines of potential technology development, and, in some cases, estimates relative costs and potential effects on greenhouse gas emissions and energy usage.

The report states that energy efficiency is a near-term and low-cost option to reduce energy demand while new technologies, such as carbon capture and storage, could substantially impact our ability to develop more environmentally friendly sources of electricity. The report notes that there is no single "silver bullet" technology that will address our energy challenges. Instead, a portfolio approach should be used, investing in several different technologies with the expectation that some will succeed, some will fail, but all will push research and development further so that the energy decisions that must be made in the next decade will be made wisely. — *Rebecca Alvania*

■ **America's Energy Future** was funded by the U.S. Department of Energy, BP America, Dow Chemical Company Foundation, Fred Kavli and the Kavli Foundation, GE Energy, General Motors Corp., Intel Corp., and the W.M. Keck Foundation. Support was also provided by the National Academies through the following endowed funds created to perpetually support the work of the National Research Council: Thomas Lincoln Casey Fund, Arthur L. Day Fund, W.K. Kellogg Foundation Fund, George and Cynthia Mitchell Endowment for Sustainability Science, and Frank Press Fund for Dissemination and Outreach. Additional information is available online at <[sites.national-academies.org/Energy/index.htm](http://sites.nationalacademies.org/Energy/index.htm)>.



# NO RISK, NO REWARD

**T**he NASA Institute for Advanced Concepts (NIAC) was created in 1998 to fund visionary ideas for space research. Sometimes risky and often far-out ideas proposed by NIAC researchers included the “space elevator,” a cable to ferry equipment from Earth into orbit, and a “solar shield” to be unfurled in space to deflect sunlight and counter global warming. NIAC funded 168 grant proposals before closing its doors in 2007 due to budget constraints. The National Research Council reviewed the institute to see whether it had fulfilled its mission — to produce revolutionary concepts that could dramatically impact NASA missions — and whether a successor is needed.

NIAC was terminated in a period when NASA was struggling to align itself with President George W. Bush’s Vision for Space Exploration, which focused on human exploration of space, particularly the moon and Mars. With limited funds, NASA cut NIAC, despite the fact that nothing comparable existed. Over NIAC’s nine-year tenure, annual costs were roughly \$4 million, about 0.02 percent of NASA’s budget. One element the National Research Council committee looked at to evaluate the program’s success was the degree to which NIAC projects impacted NASA. The committee found that roughly 7 percent of funded Phase-II projects impacted NASA’s long-term planning, a success given the high-risk quality of the research. In fact, two studies are being considered as possible future NASA missions. Most NIAC projects had long timelines — typically 10 to 40 years — and the committee stated that the number that find their way into NASA missions would likely increase over time.

## NASA’s High-Tech Revolutionaries

These successes, and evidence that NIAC promoted scientific innovation and public interest in space, led the committee to recommend that NASA create a successor to NIAC, termed “NIAC2.” Several changes were suggested, however, as the committee found a few shortcomings in the original NIAC that may have contributed to its early demise.

The committee suggested that the new program’s activities be separate from NASA mission directorates and institutional constraints, although NASA missions should provide general themes for funded projects to ensure relevance. The committee also recommended that NIAC2 have a shorter time-frame for its vision; new projects should be scientifically and/or technically innovative and have the potential to benefit NASA in 10 years or soon beyond. The committee also recommended that NIAC2 proposal opportunities be open to teams both internal and external to NASA, and that a better system should exist for transitioning successful projects to NASA. One approach is to increase participation of NASA personnel in earlier stages of development. — *Rebecca Alvania*

■ **Fostering Visions for the Future: A Review of the NASA Institute for Advanced Concepts.** Committee to Review the NASA Institute for Advanced Concepts, Aeronautics and Space Engineering Board, Division on Engineering and Physical Sciences (2009, 90 pp.; ISBN 0-309-14051-X; available from the National Academies Press, tel. 1-800-624-6242; \$21.00 plus \$5.00 shipping for single copies; also on the Internet at <[www.nap.edu/catalog/12702.html](http://www.nap.edu/catalog/12702.html)>).

The committee was co-chaired by **Dianne S. Wiley**, technical fellow at the Boeing Phantom Works, and **Robert D. Braun**, David and Andrew Lewis Associate Professor of Space Technology in the Daniel Guggenheim School of Aerospace Engineering at the Georgia Institute of Technology, Atlanta. The study was funded by NASA.

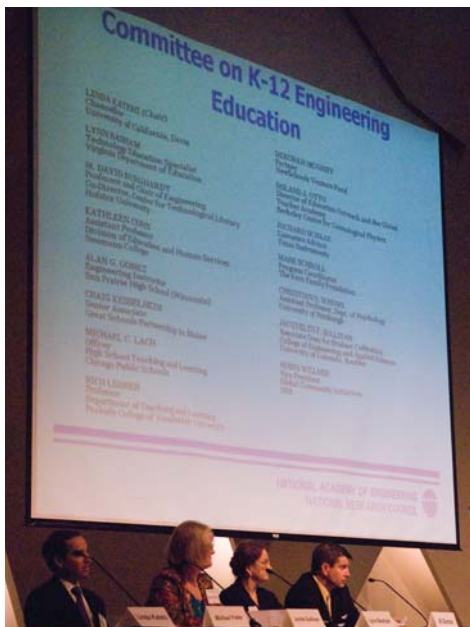


# Teaching Engineering in the K-12 Classroom

**M**ost Americans agree that educating students in the sciences, technology, engineering, and math — known as STEM education — is very important to U.S. competitiveness and economic prosperity. STEM lessons are required in public K-12 schools, but STEM subjects are taught as separate disciplines, usually focusing on math or science. The engineering component of STEM is often absent in policy discussions and in the classroom, says a new report from National Academy of Engineering and National Research Council. “Engineering might be called the missing letter in STEM,” according to *Engineering in K-12 Education: Understanding the Status and Improving the Prospects*.

“STEM education in the U.S. is woefully inadequate for the future of our nation, and it is insufficient to produce a robust field of opportunity for our children,” said Charles Vest, president of the National Academy of Engineering, during a symposium at which the report’s findings were presented.

The report evaluated dozens of K-12 engineering curricula and data on their effectiveness. It found that the engineering approach to problem solving has the potential to improve math and science learning, raise technological literacy among students, and increase interest in engineering as a potential career. Moreover, said the committee that wrote the report, inclusion of engineering can promote interconnections among the STEM subjects, such as when engineering design supports science inquiry



and mathematical reasoning. In short, engineering has the potential to act as a catalyst for more effective K-12 STEM education.

Connecting the four STEM subjects will require significant rethinking of what STEM education can and should be. Among the study committee's recommendations are to research the impacts of engineering education; research ways to connect scientific inquiry and mathematical reasoning to engineering design; and start a dialogue on how best to prepare K-12 engineering teachers.

Steve Meyer, a high school teacher from Wisconsin who spoke at the symposium where the report was released, said, "Engineering topics allow students to solve problems across a variety of fields, and as a result, they appeal to teenagers with a range of abilities and interests."

Teaching students via integrated STEM lessons may have great potential for sparking discovery in the future. — *Maureen O'Leary*

For links to the report and photos and audio from the symposium, visit [national-academies.org/morenews/20090908.html](http://national-academies.org/morenews/20090908.html).

## Longstanding Partnership Gets New Energy



The National Academy of Engineering's successful workshop series "News and Terrorism: Communicating in a Crisis" held its 17th workshop in September in Baltimore. U.S. Secretary of Homeland Security Janet Napolitano set the stage for discussion, calling the workshop series — which began in 2004 — "an important investment" with the potential to develop more effective ways to collaborate during a crisis.

**T**he workshop, moderated by Aaron Brown, former ABC News and CNN anchor, was designed to analyze communication of information among local leaders, journalists, scientists and engineers, and the public during an emergency. Using a terrorism scenario exercise, panelists had to respond to information that was presented to them.

The scenario in this workshop was a coordinated terrorist attack involving massive explosions in Baltimore's Inner Harbor and at City Hall from ammonium nitrate fertilizer bombs, as well as gunmen who fired on people at the scenes. Terrorists utilized live information and images broadcast by the media to target first responders



and onlookers. The scenario also involved speculation that the terrorists had anthrax or biological weapons, calling HAZMAT responders to the scene. Social media was used by the terrorists as well as the public to share information.

Several reporters who participated in the three-hour exchange spoke about the lessons they learned. In particular, they expressed the importance of knowing the chain of command at federal agencies as well as having trust among agency staff, media, and experts, and that preparation for emergencies in advance is necessary. They added that social media could be useful or misused during a crisis.

NAE President Charles Vest said, “This project gives the National Academies and NAE an opportunity to engage with real-world people — journalists, first responders, government officials — to show the importance of accurate information flow; some of that is technical, scientific, and medical in its origin. We have an opportunity to play a positive role to help the nation better prepare for potential catastrophes.”

The project is a joint effort of the National Academies, U.S. Department of Homeland Security, and the Radio Television Digital News Foundation. For audio recordings of Napolitano’s and Vest’s remarks, photos, and fact sheets, visit [national-academies.org/newsroom/nalerts/20090924c.html](http://national-academies.org/newsroom/nalerts/20090924c.html).

— *Maureen O’Leary*



## 2009 Marks Anniversaries of Cooperation Between U.S. and Chinese, Russian Scientists

In October the National Academy of Sciences hosted representatives from the U.S. and Chinese scientific and policy communities as the nations celebrated 30 years of science and technology cooperation and collaboration. Officials from more than a dozen U.S. government science agencies and research institutions attended.

At an opening ceremony, welcoming remarks were given by NAS President Ralph Cicerone, followed by addresses by Assistant to the President for Science and Technology John Holdren, U.S. Assistant Secretary of State Kerri-Ann Jones, Minister Wan Gang of the Chinese Ministry of Science and Technology, and Chinese Ambassador Zhou Wenzhong.

The ceremony commemorated the 1979 signing of an agreement between President Jimmy Carter and Chinese leader Deng Xiaoping that became a foundation for ongoing cooperation among scientists from both nations. Collaborations in the three decades that followed have spanned efforts as diverse as combating birth defects, countering invasive species, and supporting research in high-energy physics.

In addition, the ceremony opened the 13th biannual meeting of the Joint Commission on Science and Technology Cooperation, a joint governmental body that facilitates scientific collaborations between the two countries. Delegates explored ongoing and possible future areas of collaboration, including nuclear safety, biomedical



research, and clean energy development. During an evening reception at the Chinese embassy, Holdren read a greeting from President Obama, who noted the importance of the collaborative foundation the agreement established “given the challenges we all face in areas of energy, climate, agriculture, health, nutrition, and education.”

This year also marked 50 years of cooperation between the U.S. National Academy of Sciences and the Russian Academy of Sciences. In June U.S. President Barack Obama and Russian President Dmitry Medvedev sent letters of congratulation to the academies’ leadership, and officials from the academies met in Moscow the same month to celebrate the anniversary and discuss future cooperation on energy and climate change, biomedicine, and international security.

Collaboration between the U.S. National Academy of Sciences and the Chinese and Russian academies has been extensive and wide-ranging, including ongoing discussions about nuclear security and nonproliferation and the release of collaborative reports. For example, in 2007 the U.S. and Chinese academies released a joint report on energy and urban air pollution, and the following year the U.S. and Russian academies published a collaborative report on how to prevent weapons proliferation as more nations seek nuclear energy. — *Sara Frueh*

## 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. 8**

Board on Environmental Studies and Toxicology, Division on Earth and Life Studies (2009, approx. 434 pp.; ISBN 0-309-14515-5; available from NAP).

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