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Helping Depleted Fisheries Recover  
Concussions and Young Athletes  
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Protecting the Nation's Children

# THE NATIONAL ACADEMIES

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## Academies Welcome New Institute of Medicine President

Victor J. Dzau, M.D., is an internationally recognized trailblazer in translational research, health innovation, and global health care strategy and delivery. On July 1, he takes on an entirely new role as he begins a six-year term as president of the Institute of Medicine.

Dzau takes the helm at IOM after serving nearly 10 years as chancellor for health affairs at Duke University and president and CEO for Duke University Health System. While at Duke, he was the guiding force in establishing several new initiatives, including the Duke Translational Medicine Institute, Duke Global Health Institute, Duke-NUS Medical School in Singapore, and the Duke Institute for Health Innovation. Before that, Dzau held influential posts with Harvard Medical School, Brigham and Women's Hospital, and Stanford University.

Dzau is also a highly regarded researcher. His work in the lab laid the foundation for the development of angiotensin-converting-enzyme (ACE) inhibitors, which are used globally for the treatment of high blood pressure and congestive heart failure. He pioneered gene therapy for vascular disease, being the first to introduce DNA decoy molecules to block transcriptions as gene therapy in humans. Dzau was elected to the IOM in 1998 and has served on several of its leadership committees.

“As a physician-scientist and leader in academic medicine,” said outgoing IOM president Harvey V. Fineberg, “Victor has consistently demonstrated inspirational leadership, innovative thinking, and multifaceted achievement. Now, all of us at the IOM, both members and staff, will benefit more fully from

his leadership.” Fineberg, who served 12 years as IOM's president, is joining the faculty of the University of California, San Francisco, for a one-year appointment as a presidential chair and will focus on global health policy and analysis.

“I am humbled and honored to be selected to lead the IOM at a time of unprecedented opportunities and challenges in health, health care, and biomedical sciences,” Dzau said. “Harvey Fineberg has been an exceptional leader of the IOM, and I am committed to building on his outstanding work and advancing the impact of the IOM on the nation and globally.”



(left to right) C.D. Mote Jr., Victor J. Dzau, and Ralph J. Cicerone



## ABRUPT CLIMATE CHANGE

### Early Warning System Could Help Predict Rapid Changes in Climate Before It's Too Late

With unprecedented levels of carbon dioxide in the atmosphere, scientists are certain that Earth's future climate will be warmer, sea levels will rise, global rainfall patterns will change, and ecosystems will be altered. But what remains uncertain is exactly how and when we will arrive at that future.

**M**any climate projections forecast steadily changing conditions that suggest society and ecosystems will have time to adapt. But the scientific community has been paying increasing attention to the possibility that at least some changes will happen abruptly — over the course of years to decades, rather than gradually over centuries — leaving little time to react.

Some abrupt changes are already underway, for example the rapid decline of Arctic sea ice due to warming temperatures and the increases in extinction rates of both marine and terrestrial species. Recent research has eliminated the possibility that other large and abrupt changes will happen this century, such as a shutdown of the Atlantic Ocean circulation patterns or a rapid release of methane from Arctic and sub-Arctic latitudes, although these processes are still worrisome over longer timelines. Still other scenarios, such as the destabilization of the West Antarctic ice sheet, are plausible but their probabilities of occurring this century are less certain and require more scientific research.

Abrupt changes in the physical climate system are not the only cause for concern, however. Even changes that occur gradually may cross a threshold and trigger sudden and permanent ecological or socio-economic impacts. An example of such a “tipping point” is a slight increase in ocean



acidity levels, which would affect many species' ability to survive. In addition, human infrastructures may be affected by rises in sea levels or thawing permafrost.

Although research has helped distinguish more imminent threats from those that are less likely to happen this century, there is still significant work to do to understand these tipping points in the climate, natural, and social systems.

The ability to anticipate what would otherwise be surprises requires both careful monitoring of climate conditions and improved models for projecting changes, according to a recent National Research Council report. It recommends an early warning system that would allow for the prediction of abrupt changes and facilitate more informed decisions on the balance between mitigation and adaptation.

Building upon existing land and satellite monitoring networks, the early warning system would also capture and analyze new information on the interconnectedness of climate and human systems. Among the critical needs for anticipating abrupt changes with a moderate-to-high likelihood of occurring this century are expanded and standardized monitoring of ocean oxygen content, pH levels, and temperature; enhanced observations of atmosphere, sea ice, and ocean characteristics in the Arctic;

and better understanding of how species interactions and interactions between climate-caused extinctions and other drivers intensify extinction rates.

New and existing information should be integrated into numerical models, which in turn should regularly alternate between data collection, model testing and improvement, and model predictions that suggest future data needs. An early warning system will need to be refined as understanding of abrupt climate changes, impacts, and social vulnerabilities evolves.

The system should be part of an overall risk management strategy, providing required information for hazard identification and risk assessment. Ultimately this could inform decisions to tailor preparedness efforts, ensuring that warnings result in appropriate protective actions and ultimately pre-empt catastrophes. — *Lauren Rugani*

■ ***Abrupt Impacts of Climate Change: Anticipating Surprises.*** Committee on Understanding and Monitoring Abrupt Climate Change and Its Impacts, Board on Atmospheric Studies and Climate, Division on Earth and Life Studies (2013, 250 pp.; ISBN 978-0-309-28773-9; available from National Academies Press, tel. 1-800-624-6242; \$59.95 plus \$5.00 shipping for single copies; also on the Internet at <[www.nap.edu/catalog/18373.html](http://www.nap.edu/catalog/18373.html)>).

The study was chaired by **James W.C. White**, professor of geological sciences at the University of Colorado, Boulder. The study was funded by the National Oceanic and Atmospheric Administration, National Science Foundation, U.S. intelligence community, and the National Academies.

# HELPING DEPLETED FISHERIES RECOVER

**F**ishing provides a source of food and a livelihood for millions of people in the United States. In 2011, for example, U.S. commercial fishermen brought in 4.5 million tons of fish and shellfish, much of which ended up on plates in restaurants and homes across America. In some places, however, overzealous pursuit of these lucrative catches has depleted fish populations. Of the U.S. fisheries that have been assessed, about 20 percent are overfished, according to estimates by the National Oceanic and Atmospheric Administration.

When a fish population drops to a level considered overfished, federal law requires that fishery managers implement a “rebuilding” plan to help the species recover, usually within a 10-year time frame. These plans restrict fishing, which can have a serious economic impact on certain communities. Concern about such consequences has led to heavy scrutiny of the plans and their effectiveness.

The National Research Council took a look at federal rebuilding plans and, in general, found them successful at reducing pressure on many overfished populations and increasing fish numbers. But outcomes have been mixed; fishing pressure is still too high in some places, and other populations have not rebounded as quickly as projected despite fishing restrictions.

Part of the reason why some fisheries don’t recover according to plan is that it’s difficult to make the complex ecosystems in which fish live follow a strict timetable. Fishing limits are part of the solution, but fishing is only one of the factors that affect population levels; environmental factors



also influence whether populations recover and the rate at which they do.

Currently, when fish populations do not rebound as expected, fishery managers respond by controlling what they can — fishing levels — even though other factors may be stalling the recovery. They impose even stricter fishing limits in an effort to meet the federal deadline, which leads to more severe economic effects for fishing communities. If instead managers could implement recovery plans to keep fishing at a reduced but consistent level until the fish populations recover, there would be fewer harmful economic impacts because the fisheries wouldn’t be subject to major, unanticipated dips in fishing limits.

Fishery managers could also take action earlier, imposing gradual limits when fish populations start to drop rather than waiting until they are overfished. Then they could avoid rebuilding plans — and the strict fishing limits that come with them — altogether. — *Sara Frueh*

■ **Evaluating the Effectiveness of Fish Stock Rebuilding Plans in the United States.** Committee on Evaluating the Effectiveness of Fish Stock Rebuilding Plans of the 2006 Fishery Conservation and Management Reauthorization Act, Ocean Studies Board, Division on Earth and Life Studies (2014, 154 pp.; ISBN 978-0-309-29230-6; available from National Academies Press, tel. 1-800-624-6242; \$50.00 plus \$5.00 shipping for single copies; also on the Internet at <[www.nap.edu/catalog/18488.html](http://www.nap.edu/catalog/18488.html)>).

The study committee was co-chaired by **Ana Parma**, research scientist, CONICET (Council for Science and Technology of Argentina), Buenos Aires, and **Patrick Sullivan**, associate professor of quantitative population and community dynamics, department of natural resources, Cornell University, Ithaca, N.Y. The study was funded by the National Oceanic and Atmospheric Administration.



# THE LAY OF THE LAND

## Satellite Data and Computer Models Provide an Invaluable Understanding of Earth's Surface

**F**or more than 40 years, the series of satellites known as Landsat has provided a continuous record of changes taking place on Earth's surface. As the record lengthens, researchers are able to document effects of climate variability, invasive species, and land use over time. The data and imagery have contributed substantially to the management of key national interests such as agriculture, forestry, hydrology, urbanization, homeland security, disaster mitigation, and climate change.

The future of Landsat data collection is at risk, however, according to a recent National Research Council report. The latest satellite, Landsat 8, was launched in February 2013 with only a five-year design life. Its predecessor, Landsat 7, was launched in 1999 and is operating in a degraded mode. At the time of the report's completion, Landsat 9 was under discus-

sion but its program missions remained unclear, management responsibilities had not been articulated, and no budget had been appropriated for the program.

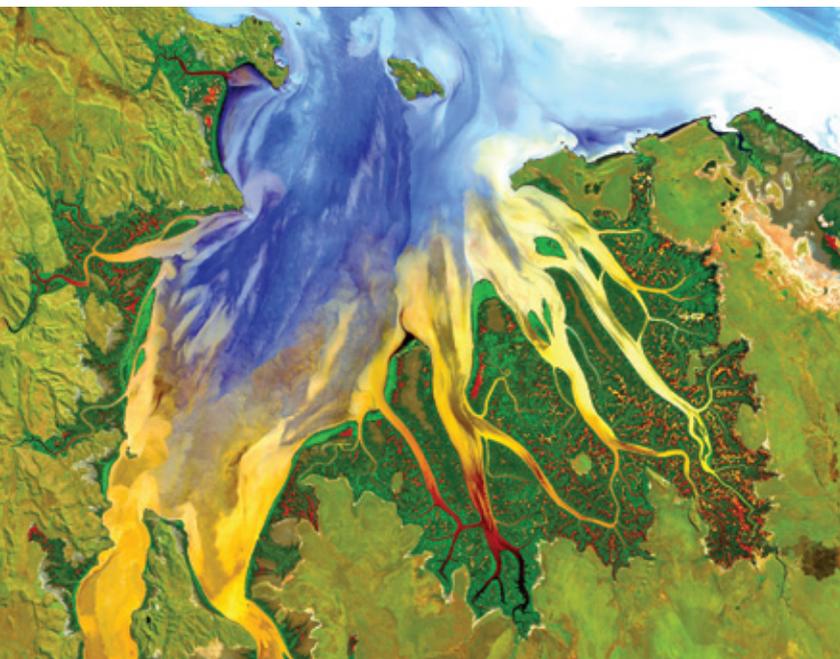
Through most of its history, Landsat has been fraught with inconsistent management, ad-hoc designs and implementation of the spacecraft, and reliance on sheer luck over careful planning. Typically, the satellites have been justified, planned, and executed individually or at most in pairs.

The report concludes that a continued program will not be viable under the current mission development and management practices. It recommends that the U.S. government establish a sustained and enhanced land imaging program with an overarching national strategy and long-term commitment, including clearly defined program requirements, management responsibilities, and consistent funding.

## Modeling Land Change

The record of data from Landsat has provided input into land-change models, a key means for understanding how humans are reshaping the Earth's surface through agriculture, construction, energy production, and other activities, for forecasting future landscape conditions, and for developing policies to manage the use of resources and the environment from the local scale to large expanses of forest around the world.

The varieties of land-change models have different strengths, weaknesses, and applications. Some approaches use land-cover information from satellite imagery and past



observed relationships to project changes a short period into the future. Others make use of social science information about land-change processes that can be used to evaluate a wider range of alternative futures.

A second Research Council report identifies opportunities to advance modeling approaches that would further our understanding of human interactions with the

environment and improve decision making about land-related management and policy. These advancements could be realized in the models themselves, in land observation strategies, in cyber infrastructure, and in developing best practices in model evaluation.

## A Path Forward

The Research Council's Landsat report does not recommend who should oversee the satellite program — currently managed jointly by the U.S. Geological Survey and NASA — but it does outline key elements of a successful program regardless of where the federal government decides it should reside. The core scientific and operation requirement for a future program is the capture and distribution of global data that is calibrated to allow the comparison of future land images with previous collections, easily accessible by all users, and free.

The report also describes top priorities for a future program that include technical capabilities, data systems, and opportunities for integration between government, private, and foreign-based entities. — *Lauren Rugani*

■ **Landsat and Beyond: Sustaining and Enhancing the Nation's Land Imaging Program.** Committee on Implementation of a Sustained Land Imaging Program, Space Studies Board, Division on Engineering and Physical Sciences (2013, 76 pp.; ISBN 978-0-309-29001-5). The study was chaired by **Jeff Dozier**, professor of environmental science and management at the University of California, Santa Barbara. The study was funded by the U.S. Geological Survey.

■ **Advancing Land Change Modeling: Opportunities and Research Requirements.** Committee on Needs and Research Requirements for Land Change Modeling, Board on Earth Sciences and Resources, Division on Earth and Life Studies (2014, 152 pp.; ISBN 978-0-309-28833-0). The study was chaired by **Daniel G. Brown**, professor of natural resources and environment at the University of Michigan. The study was funded by the U.S. Geological Survey and NASA.

Both reports are available from National Academies Press, tel. 1-800-624-6242 or on the Internet at <[www.nap.edu](http://www.nap.edu)>.



# THE NATION'S CYBERSECURITY WORKFORCE

**T**he daily lives of Americans are increasingly dependent on cyber infrastructure. Personal data, medical records, and banking information are a few examples of critical information that is stored electronically, and the security of that data depends on both the capacity and capability of the cybersecurity workforce.

There are indications that the need for cybersecurity workers will continue to rise, but the rapidly evolving nature of the field leaves open the question of what types of jobs those will be and what abilities will be necessary to do them. Cybersecurity encompasses a wide variety of occupations in both the public and private sectors, and the skills required for each job range from technical expertise to behavioral and management aspects.

Right now, there is an insufficient number of highly trained individuals across the broad spectrum of cybersecurity occupations. Professionalization of certain occupations could help enhance workforce quality, much as medical and law schools prepare students to become doctors and lawyers. It could even attract workers by creating formal pathways into the field. But professionalization measures come with tradeoffs that should be weighed carefully before being implemented.

For example, certification or formal education programs could provide a way for hiring managers to vet candidates and hire those with the necessary skills, but they could also prevent the hiring of candidates who have gained skills in less conventional ways yet possess the type of creative and innovative thinking needed at a time when technologies, threats, and defensive measures are constantly evolving.

A National Research Council report identifies the tradeoffs that come with professionalization and lays out a set of criteria for decision makers to determine when and how to professionalize a given occupation within the workforce. It says that an occupation should have defined and stable characteristics, and should also have a clear deficiency that can be remedied directly through an appropriate professionalization measure. Cybersecurity is too broad and diverse to consider professionalizing the field's range of occupations in the same way at the same time. — *Lauren Rugani*

■ **Professionalizing the Nation's Cybersecurity Workforce: Criteria for Decision-Making.** Committee on Professionalizing the Nation's Cybersecurity Workforce: Criteria for Future Decision-Making, Computer Science and Telecommunications Board, Division on Engineering and Physical Sciences (2013, 66 pp.; ISBN 978-0-309-29104-6; available from National Academies Press, tel. 1-800-624-6242; \$34.00 plus \$5.00 shipping for single copies; also on the Internet at <[www.nap.edu/catalog/18446.html](http://www.nap.edu/catalog/18446.html)>).

The study was co-chaired by **Diana L. Burley**, associate professor of human and organizational learning at the George Washington University in Washington, D.C., and **Seymour E. Goodman**, professor of international affairs and computing at Georgia Institute of Technology in Atlanta. The study was funded by the U.S. Department of Homeland Security.



# Concussions and Young Athletes

**S**ports-related concussions have become a high-profile public health concern in recent years. With estimates of approximately 1.6 million to 3.8 million concussions and other traumatic brain injuries (TBIs) occurring in the U.S. each year during sports and recreational activities — likely a conservative approximation due to underreporting — parents worry about their children playing certain sports and whether the equipment being used adequately protects them.

Despite increased attention, confusion and debate persist about factors such as how to define a concussion, how multiple concussions affect an athlete's vulnerability to future injury, when it is safe for a player to return to sports, and the effectiveness of protective devices and other interventions in reducing the incidence and severity of concussive injuries. To offer some clarity, the Institute of Medicine and National Research Council conducted a review of

## THE GROWING CONCERN OVER SPORTS-RELATED HEAD INJURIES

the science relating to sports-related concussions in youths ages 5 to 21.

The committee that wrote the report found that football, ice hockey, lacrosse, wrestling, soccer, and women's basketball consistently are associated with the highest rates of concussion. In addition, young people with a history of prior concussions as well as female athletes in general display higher concussion rates. The report recommends that the Centers for Disease Control and Prevention establish and oversee a national surveillance system to accurately determine the incidence of sports-related concussions among youths.

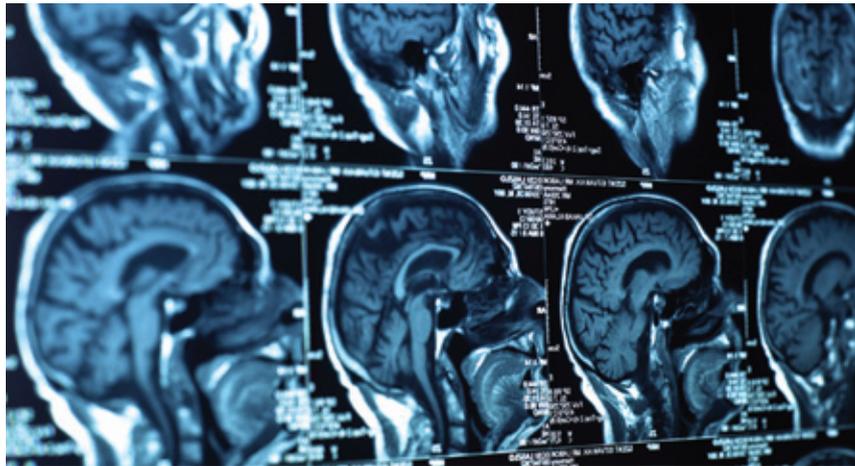
Concussions are reported more frequently among high school athletes than college athletes in several sports, the committee observed. Even so, young athletes confront a "culture of resistance" to reporting when they might have a concussion and to complying fully with treatment plans, which

could endanger their well-being. Once a concussion is recognized and diagnosed, its management is of vital importance. A potentially concussive injury requires removing the athlete from play, caring for the injury appropriately in both the acute stage and during the recovery process, and returning to play only when the athlete is fully recovered, the committee said. Athletes who return to play before their brain has healed entirely may place themselves at increased risk for prolonged recovery or more serious consequences if they sustain another head injury. However, there is no universal time frame for recovery, and the National Institutes of Health and the U.S. Department of Defense should support research to establish specific metrics and markers for concussion diagnosis, prognosis, and recovery in youth and to inform the creation of age-specific, evidence-based guidelines for managing short- and long-term consequences of concussions, the report recommends.

There is little evidence that current sports helmet designs reduce concussion risk, and no evidence that other devices, such as mouth guards and headbands for soccer, do so. Nevertheless, properly fitted helmets, face masks, and mouth guards should still be worn because they reduce the risk of other injuries, such as skull fractures and facial and dental injuries, the committee stressed.

Moreover, the National Collegiate Athletic Association should work with the National Federation of State High School Associations and other youth sports governing groups to conduct a rigorous scientific evaluation of the effectiveness of age-appropriate techniques, rules, and playing and practice standards in reducing sports-related

concussions and impacts, the report says. Several sports organizations have previously developed limits on the amount of head contact a particular player should



experience over a given period of time, and although this practice makes intuitive sense, it is currently without scientific basis.

—Dana Korsen & Jennifer Walsh

■ **Sports-Related Concussions in Youth: Improving the Science, Changing the Culture.** Committee on Sports-Related Concussions in Youth; Board on Children, Youth, and Families; Institute of Medicine and National Research Council (2014, 356 pp.; ISBN 978-0-309-28800-2; available from National Academies Press, tel. 1-800-624-6242; \$64.00 plus \$5.00 shipping for single copies; also on the Internet at <[www.nap.edu/catalog/18377.html](http://www.nap.edu/catalog/18377.html)>).

The study committee was chaired by **Robert Graham**, director, National Program Office, Aligning Forces for Quality, and department of health policy, School of Public Health and Health Services, George Washington University, Washington, D.C. The study was funded by the Centers for Disease Control and Prevention; CDC Foundation with support from the National Football League; U.S. Department of Defense; U.S. Department of Education; Health Resources and Services Administration; National Athletic Trainers' Association Research and Education Foundation; and the National Institutes of Health.

# A CRISIS IN CANCER CARE



**T**he treatment of cancer has always been a profound medical challenge, and it is about to become an even greater one. By 2030, cancer incidence in the U.S. is expected to rise to 2.3 million new diagnoses a year — an almost 45 percent increase over the current annual rate of 1.6 million. This increase will be driven largely by the aging of the U.S. population: The number of adults older than 65 is growing rapidly, and this slice of the population accounts for the majority of cancer diagnoses and deaths, as well as the majority of cancer survivors. In addition, the oncology workforce is not expanding to accommodate this influx of patients, so the future number of patients is likely to exceed the system's capacity to care for them.

Meanwhile, the cost of cancer care is rising faster than many other sectors of medicine. Cancer treatment in the U.S. cost \$125 billion in 2010 and is expected to reach \$173 billion per year by 2020. Still another challenge is the complexity of cancer and its treatment. New knowledge and therapies are rapidly emerging — a positive development, except that it can be difficult for clinicians to assimilate this vast quantity of new knowledge effectively into the care they provide.

All of these developments are driving a crisis in cancer care, says a recent report from the Institute of Medicine, which recommends various steps to help the U.S. health care system rise to the challenge. Research shows that many patients need more accurate information than they are getting now. Patients with advanced cancer have additional communication and decision-making needs, including discussions with clinicians about implementing

advance care plans when they approach the end of life. Currently these discussions do not happen as often as they should. Cancer care teams should provide patients and their families with understandable information about the cancer prognosis and the benefits, harms, and costs of treatments. The federal government and other stakeholders should improve the development and dissemination of this information.

More information should be gathered on the benefits and harms of different therapies, especially for older patients who often have multiple chronic health conditions and are usually excluded from clinical studies. An information technology system should be created to collect this information and help clinicians quickly incorporate new medical knowledge into routine care. And using new models of team-based care could help meet workforce shortages and ensure that care is coordinated. — *Sara Frueh & Jennifer Walsh*

■ **Delivering High-Quality Cancer Care: Charting a New Course for a System in Crisis.** Committee on Improving the Quality of Cancer Care: Addressing the Challenges of an Aging Population, Board on Health Care Services, Institute of Medicine (2013, 412 pp.; ISBN 978-0-309-28660-2; available from National Academies Press, tel. 1-800-624-6242; \$65.95 plus \$5.00 shipping for single copies; also on the Internet at <[www.nap.edu/catalog/18359.html](http://www.nap.edu/catalog/18359.html)>).

The committee was chaired by **Patricia Ganz**, Distinguished University Professor in the Schools of Medicine and Public Health, University of California, Los Angeles, and director of cancer prevention and control research at the Jonsson Comprehensive Cancer Center, Los Angeles. The study was funded by the National Cancer Institute; Centers for Disease Control and Prevention; AARP; American Cancer Society; American College of Surgeons, Commission on Cancer; American Society of Clinical Oncology; American Society of Hematology; American Society for Radiation Oncology; California HealthCare Foundation; LIVESTRONG; National Coalition for Cancer Survivorship; Oncology Nursing Society; and Susan G. Komen for the Cure.



# Protecting Our Nation's Youth

## Reports Highlight Need for Stronger Efforts to Prevent Abuse & Sex Trafficking of Minors

Commercial sexual exploitation and sex trafficking of minors are grave problems in the U.S., though this may not be generally known because such crimes are apt to happen at the margins of society and behind closed doors. Crimes can range from prostituting a child, recruiting or transporting minors for the purpose of sexual exploitation, or exploitation through survival sex — the exchange of sexual acts for a necessity, such as shelter or food — among other offenses.

**A** recent report from the Institute of Medicine and National Research Council says minors who are prostituted or sexually exploited should be recognized and treated as victims rather than arrested and prosecuted as criminals, as they currently are in most states. National, state, local, tribal, and territorial jurisdictions should develop laws that redirect young victims and survivors of commercial sexual exploitation from the criminal justice or juvenile justice systems toward support services.

Current prevention efforts are scarce, and efforts that exist are generally insufficient and uncoordinated, according to the report. Professionals who interact with minors — such as teachers, health care providers, and members of law enforcement — often aren't aware that trafficking and exploitation are happening in their communities and lack the expertise to identify and respond to at-risk youth.

The report calls for the U.S. departments of Justice, Health and Human Services, and Education to support nationwide efforts to raise awareness of these crimes by providing training for professionals who routinely interact with minors and through public awareness campaigns geared toward children and adolescents. And because those who sexually exploit minors by and large are not held accountable for their actions, all jurisdictions should review and strengthen laws against exploiters, traffickers, and solicitors.

Another recent report by the Institute of Medicine and National Research Council takes a look at child abuse more broadly, highlighting the need for research to fill gaps in understanding child abuse and neglect. According to the report, rates of physical and sexual abuse of children have declined during the past 20 years, although rates of neglect have not, for reasons not fully understood. Based on the National Child Abuse and Neglect Data System, about three-quarters of reported cases in 2011 were classified as neglect, about 15 percent as physical abuse, and about 10 percent as sexual abuse.

Ascertaining more accurate numbers has several challenges, including the existence of different definitions of abuse and neglect among the entities that collect information, various legal definitions across states, and diverse research standards for determining incidence and prevalence rates. All of these uncertainties impede understanding of the problem's causes and consequences, as well as effective prevention and treatment, the report concludes. The financial effects of this problem on society as a whole are evident, however: Each year, cases of child

abuse or neglect impose a cumulative cost to society of \$80.3 billion.

The report calls for a national strategy to advance research on child abuse and neglect in the following areas, among others: why children have different sensitivity to abuse of similar severity, why some child victims respond to treatment and others do not, and how different types of abuse impact a child's developmental trajectory. In addition, a national surveillance system should be created to improve accuracy in identifying cases of child abuse and neglect.

— *Dana Korsen & Jennifer Walsh*

■ ***Confronting Commercial Sexual Exploitation and Sex Trafficking of Minors in the United States.***

Committee on the Commercial Sexual Exploitation and Sex Trafficking of Minors in the United States; Board on Children, Youth, and Families; Institute of Medicine and National Research Council (2013, 478 pp.; ISBN 978-0-309-28655-8). The study committee was co-chaired by **Richard D. Krugman**, vice chancellor for health affairs, and dean, University of Colorado School of Medicine, Aurora; and **Ellen Wright Clayton**, Craig-Weaver Professor of Pediatrics, professor of law, and co-founder, Center for Biomedical Ethics and Society, Vanderbilt University, Nashville, Tenn. The study was funded by the Office of Juvenile Justice and Delinquency Prevention in the U.S. Department of Justice.

■ ***New Directions in Child Abuse and Neglect Research.***

Committee on Child Maltreatment Research, Policy, and Practice for the Next Decade: Phase Two; Board on Children, Youth, and Families; Institute of Medicine and National Research Council (2014, 442 pp.; ISBN 978-0-309-28512-4). The study committee was chaired by **Anne C. Peterson**, research professor, Center for Human Growth and Development, University of Michigan; and founder and president, Global Philanthropy Alliance, Kalamazoo, Mich. The study was funded by the U.S. Department of Health and Human Services.

Both reports are available from National Academies Press, tel. 1-800-624-6242 or on the Internet at <[www.nap.edu](http://www.nap.edu)>.

# How Are You, REALLY?

## Measuring Well-Being to Inform Policy

Interest in measuring how people feel about their experiences and how satisfied they are with their lives has grown in recent years among policymakers, researchers, the media, and the general public. This stems from concerns that traditional economic measures, such as gross domestic product, do not on their own reflect a population's or country's quality of life adequately.

The National Institute on Aging and the United Kingdom's Economic and Social Research Council asked the National Research Council to assess whether measuring "experienced well-being" — moment-to-moment, hour-to-hour, and day-to-day feelings of pleasure, contentment, anxiety, pain, etc. — has value for informing policy.

The resulting report says that well-informed policy decisions need to consider the "evaluative" and "eudaimonic" aspects of self-reported well-being. Evaluative well-being reflects a person's assessment of his or her overall life satisfaction. Eudaimonic well-being refers to a person's perceptions of purpose and the meaningfulness (or pointlessness) of the activities he or she is engaged in, and of life overall. An activity can rate highly in one area and low in another. For example, time spent caring for children is typically reported as being more meaningful than pleasurable, while the opposite is true for other activities, such as watching television.

Which aspects of subjective well-being are most relevant and important to measure depend on the specific policy matter to be addressed, the report says. Many targeted questions that concern governments and private organizations focus on improving quality of life and reducing daily suffering for various groups, such

as aging populations, people with chronic health conditions, or children in child care or custody arrangements. Data revealing relationships between self-reports of well-being and particular aspects of life — for example, accessibility to child care and commuting patterns — could be useful for informing employer policy decisions intended to improve workers' well-being.

Because some methodological issues still need to be resolved, such as how responses to questions are influenced by the context or order in which they are asked, questions that gauge experienced well-being should initially only be included in flagship surveys of federal statistical agencies on a pilot basis, the report says. Whatever the collection vehicle, data on experienced well-being must reflect multiple dimensions to be useful in policymaking. Specifically, both positive and negative emotions, as well as concepts of purposefulness and worthwhileness alongside feelings like pleasure and pain, are important dimensions to include.

— Dana Korsen & Sara Frueh

■ **Subjective Well-Being: Measuring Happiness, Suffering, and Other Dimensions of Experience.** Panel on Measuring Subjective Well-Being in a Policy-Relevant Framework, Committee on National Statistics, Division of Behavioral and Social Sciences and Education (2013, 204 pp.; ISBN 978-0-309-29446-1; available from National Academies Press, tel. 1-800-624-6242; \$44.00 plus \$5.00 shipping for single copies; also on the Internet at <[www.nap.edu/catalog/18548.html](http://www.nap.edu/catalog/18548.html)>).

The study committee was chaired by **Arthur A. Stone**, senior behavioral scientist and professor of psychology, Center for Economic and Social Research, University of Southern California, Los Angeles. The study was funded by the U.S. National Institute on Aging and the U.K. Economic and Social Research Council.



# Science *Communication* Initiatives



Communicating science effectively can be a challenge, but luckily new research is emerging that can help. To give researchers, communicators, and others a chance to hear about some of the latest findings on the subject, the National Academy of Sciences held its second Sackler Colloquium on the Science of Science Communication last fall — a gathering that once again filled the NAS auditorium to capacity. A live video webcast made the colloquium accessible to thousands who could not attend in person, and there were 13,000 tweets about the meeting around the world, with a potential reach of 5 million people.

Among the themes that surfaced was that expertise alone is not enough to establish a communicator's credibility; trust is needed as well. Two qualities that make a communicator trusted are competence and warmth, explained NAS member Susan T. Fiske, a professor of psychology and public affairs at Princeton University who presented research on how the public perceives different groups and professions in terms of those two characteristics. Scientists

typically do well on half of this equation: The public tends to view scientists as competent, but it also finds them cold. Fortunately, many scientists are also teachers, a profession that, according to Fiske's research, tends to be perceived as warmer, which points to the approach and skill set they should draw upon when communicating with the public. Focusing on informing and educating rather than persuading builds trust.

Two people at the Academies make it their job to investigate and support efforts to communicate about two thorny science issues: evolution and climate change. While not controversial scientifically, these subjects often become contentious when they enter the realms of politics and public opinion.

Jay Labov, senior adviser for education and communication at the National Research Council, works to confront challenges to teaching evolution in the nation's science classrooms — a task that can seem never-ending. "Someone once said this topic is like trying to sink a rubber duck: Just when you think you've got the problem solved, it pops up somewhere else,"

quips Labov. Still, he predicts that progress may be made as the Next Generation Science Standards, which include evolution, are implemented in many states. Also likely to drive progress are the recently restructured Advanced Placement biology courses, which are based on recommendations from a 2002 National Research Council report and which emphasize evolution as a fundamental concept of modern biology to a much greater extent than the courses did previously. When challenges do arise, Labov works directly with state and local organizations that are trying to keep evolution in science classes and helps mobilize Academy members to write letters and engage with such organizations as well.

Is it possible to convince someone who is skeptical about evolution? When Labov discusses the subject with college students, he explains the difference between belief systems and scientific approaches — a distinction many students have never heard before. “Science is the search for natural explanations to natural phenomena, and therefore the supernatural is beyond the reach of science. Science has nothing to say about whether a supernatural being exists,” says Labov. Many religions have been able to separate or reconcile faith and science, and some scientists are deeply religious. While it may not be possible to change the mind of a biblical literalist, many people who are uncertain may be convinced if the topic is discussed this way, according to Labov.

The other Academies staffer is Martin Storksdieck, who until this year directed the Climate Change Education Roundtable. The roundtable was established in 2009 to discuss the challenges

to educating students and the public about climate science and climate change, and ways to overcome those difficulties. Knowing where your audience is coming from is important, according to Storksdieck, who points out the Six Americas study by the Yale Project on Climate Change Communications, which found that Americans’ views of climate change fall into six main categories, ranging from alarmed to dismissive. “People in the middle say, ‘I’m open to listening to you. Tell me why I should believe this is really a problem. Show me the evidence.’” More skeptical people, he says, come at it with the question, “Why should I trust you?” “It’s really important to know what questions people have. Otherwise what we do is shower people with information that they’re not receptive to taking in or that doesn’t answer any questions they have in the first place.”

Research also suggests that it’s effective to explain the evidence for climate change separately from discussions of policy solutions, says Storksdieck. Some who are skeptical “believe that if they were to acknowledge the scientific foundation, they would automatically buy into a set of policy prescriptions they may not like, such as measures to limit emissions.” This belief makes them reluctant to accept the evidence. It’s important to make clear that whether and how to address climate change is a separate issue from whether climate change is happening. “You need to dissociate those two,” Storksdieck says. “You need to let people know that there are many ways in which you can address or not address it, that there are many choices once you see what the problem is.” — *Sara Frueh*

# ***National Convocation***

## *Focuses on Strengthening*

# ***U.S. Research Universities***

In 2012 the National Research Council released a report that red-flagged a major crisis facing U.S. research universities, warning that these institutions, which have been so essential for the nation's prosperity and security, are in danger of serious decline. The release of the report was the starting point of an initiative to make the health of U.S. research universities a national priority. Members of the committee that wrote the report — which included industry CEOs, university presidents, a former U.S. senator, and a Nobel laureate — took part in a series of nine regional meetings to discuss how to implement the congressionally mandated report's 10 breakthrough actions for strengthening these vital institutions.

This effort culminated in a national convocation to examine what was learned at the regional events and identify top priorities for implementing the report's

recommended actions. Despite a government shutdown, hundreds of people gathered for the October event at the National Academy of Sciences building — and hundreds more attended virtually via video webcast.

The convocation's plenary session featured several high-level speakers who pinpointed challenges facing research universities on many levels. Jim Duderstadt, a member of the study committee and president emeritus and university professor of science and engineering at the University of Michigan, noted that a major reason why U.S. research universities became world-renowned is because of the longstanding partnership between federal and state governments, businesses, and research universities. That partnership must be revived, he urged. "Federal policies no longer place a priority on university research and graduate education," Duderstadt said. "Today

the states are no longer capable or perhaps willing to support their public research universities at world-class levels. Business and industry, in large part because of pressures of profit and loss from Wall Street, have largely ceded their basic research to universities, but not with the necessary level of support or engagement. And research universities themselves have failed to achieve the cost efficiency and productivity enhancement that is expected of them in an increasingly competitive world.”

Congressman Rush Holt, along with other speakers, noted the success of another Academy report, *Rising Above the Gathering Storm*, which resulted in Congress passing the America COMPETES Act and increasing funding for basic research. These results came out of a sustained effort to focus the attention of Congress and other key policymakers on the issues, and that same sustained effort is needed within the research community. “The problem, in short, is that Congress is acting only in response to immediate crises. This derives from a short-term mentality and exacerbates a short-term mentality. Things need to change. The members of Congress need to think like scientists,” he said.

Norman Augustine, who chaired the Gathering Storm report and is retired chairman and CEO of Lockheed Martin Corp., pointed out that research universities are essential for American competitiveness, citing studies that found 50 percent to 85 percent of the growth in America’s GDP per capita could be attributed to advancements in science and technology. In turn, those advancements stem from the creation of new knowledge, the availability of an

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*“If our universities do not prosper, it’s not likely that Americans will prosper. And I speak not just for Americans who attend those universities, but all Americans.”*

— Norman Augustine

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educated population, and the maintenance of an “innovation-friendly ecosystem” — all provided by research universities. “If our universities do not prosper, it’s not likely that Americans will prosper. And I speak not just for Americans who attend those universities, but all Americans,” he said.

Following the plenary session, attendees participated in several breakout sessions that looked at revitalizing the government-industry-university partnership, strengthening universities through greater productivity and stable funding, and building talent in science, engineering, and other research areas. — *Molly Galvin*

For more information, visit [sites.nationalacademies.org/pga/bhew/researchuniversities](http://sites.nationalacademies.org/pga/bhew/researchuniversities).

## Publications

*For documents shown as available from the National Academies Press (NAP), write to 500 Fifth St., N.W., Room 360, Washington, D.C. 20001; call 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.*

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Committee on Toxicology, Board on Environmental Studies and Toxicology, Division on Earth and Life Studies (2013, 294 pp.; ISBN 978-0-309-29122-4; available from NAP).

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Computer Science and Telecommunications Board,

Division on Engineering and Physical Sciences; Board on Life Sciences, Division on Earth and Life Studies; Committee on Science, Technology, and Law, Division on Policy and Global Affairs; Center for Engineering, Ethics, and Society Advisory Group, National Academy of Engineering (2014, 348 pp.; ISBN 978-0-309-29334-1; available from NAP).

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Committee on Science, Engineering, and Public Policy, National Academy of Sciences, National Academy of Engineering, and Institute of Medicine (2013, 66 pp.; ISBN 978-0-309-29304-4; available from NAP).

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National Materials and Manufacturing Board, Division on Engineering and Physical Sciences (2013, 186 pp.; ISBN 978-0-309-26922-3; available from NAP).

**Understanding the Connections Between Coastal Waters and Ocean Ecosystem Services and Human Health — Workshop Summary**  
Board on Population Health and Public Health Practice, Institute of Medicine (2014, 148 pp.; ISBN 978-0-309-29468-3; available from NAP).

**An Update on Research Issues in the Assessment of Birth Settings — Workshop Summary**  
Board on Children, Youth, and Families, Institute of Medicine and National Research Council (2013, 202 pp.; ISBN 978-0-309-28739-5; available from NAP).

**Veterans and Agent Orange: Update 2012**  
Board on the Health of Select Populations, Institute of Medicine (2014, 1,006 pp.; ISBN 978-0-309-28886-6; available from NAP).

**Views of the U.S. NAS and NAE on Agenda Items at the World Radiocommunications Conference 2015**  
Board on Physics and Astronomy, Division on Engineering and Physical Sciences (2013, 50 pp.; ISBN 978-0-309-29112-5; available from NAP).

**Views of the U.S. National Academy of Sciences and National Academy of Engineering on Agenda Items at Issue at the World Radiocommunication Conference 2012**  
Board on Physics and Astronomy, Division on Engineering and Physical Sciences (2013, 56 pp.; ISBN 978-0-309-16105-3; available from NAP).

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