NEWS in Science and Technology
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The following is an Executive Summary of the Academy's quarterly Bulletin (Vol. 25,4) that includes topics and issues in science and technology deemed by the Academy to be both timely and relevant to Connecticut's interests. Each item is briefly summarized from press releases and reports of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. Hyperlinks are included to the original online source, where more detailed information is available.

NOTE: Online versions of this newsletter and the Bulletin are available on the Academy website at www.ctcase.org.

FEATURE ARTICLE

➢ A Delicate Balance: How to Capitalize on Data Storage Capacity While Maximizing Effectiveness and Ease of Use

As computers become more powerful and efficient, researchers can design scientific activities that generate increasingly large data sets and exploit this computer power to analyze the data, leading to an amount of high-quality information never before thought possible. However, massive quantities of data being generated present complex data storage and stewardship issues for universities, libraries, industrial giants and governments worldwide.

Among the challenges:

- How can essential, sometimes irreplaceable, data be best preserved and organized for future use?
- Who owns the data?
- Who pays for the computing hardware necessary to store and analyze large data files?
- Who may access the files?
- How can researchers ensure that their work will be accessible in the future when computing technology becomes obsolete so quickly?

The data keep coming…

- An August 28, 2009 Wall Street Journal article notes that "computer users world-wide generate enough digital data every 15 minutes to fill the US Library of Congress."
- Yale invested $1 million to purchase a petabyte (a million gigabytes) of digital storage for Yale's Genomic Sequence Center. The school says it is already feeling the pinch for more storage space.
- Yale's partnerships with large telescopes in Chile, Arizona and Hawaii generate a terabyte (about 1,000 gigabytes) of data each night.
- The UConn Health Center (UCHC) developed a modeling and simulation system called "Virtual Cell," which is hosted on UConn hardware and used by people all over the world via the Internet. Simulations can generate huge amounts of data, according to CASE Member Leslie M. Loew, professor of cell biology and computer science and engineering at UCHC.

Challenges:

- Andrew Sherman, research scientist and high performance computing specialist at Yale, says there is no one size fits all data storage solution. It is key to consider the ultimate application of the data and what the end user values. "Speed, reliability, protection/security, capacity and ease of access are all valid needs that currently require different storage solutions."
- The increasingly collaborative nature of science and research puts additional stress on the current infrastructure.
- Medical records used in research must be deidentified for privacy reasons, and access to them is highly restricted. However, they can hold extremely valuable information in terms of research. Access to that data could enable groundbreaking research and bioinformatics centers at UConn and throughout the country are exploring that issue.

Working toward future solutions

- The research community is exploring the use of cloud computing in which storage is distributed among multiple servers connected by networks. "This approach can make searches much faster, since it's like splitting a book into multiple sections … It also offers the advantage of being able to selectively replicate some of the data on more than one machine," Sherman said adding that this may be important for data that are used frequently or are impossible or costly to replace.
- CASE member Steven M. Girvin, deputy provost for science & technology at Yale University, says the school is considering subsidizing the price of storage so that people don't buy their own storage potentially preventing access to data. "It's a delicate balance—making data storage cheap enough that researchers aren't tempted to use their own storage media, but charging enough to prevent people from keeping every scrap of information—such as data taken when a machine was broken," he said.
- Yale established the Office of Digital Assets and Infrastructure (ODAI) to assess data stewardship issues and develop recommendations. ODAI is committed to creating a coherent data stewardship infrastructure that focuses on digital content (data, including images, audio, video and metadata—data describing the data—from various domains).
- ODAI has published guidelines for researchers to generate data management plans in response to the new National Science Foundation (NSF) requirement. According to ODAI Director Meg Bellinger, several funding organizations now require researchers to submit data management plans.

Why data management plans are important

- Researchers rely on notes about where to find the conditions present at the time of an experiment. Loew says that granting agencies and professional journals need to enforce annotation requirements to keep data as useful and reusable as possible.
- "Federal agency requirements for researchers to provide access to their data and describe how they will deal with data curation will provide an archival record of what the provenance was at the time of data collection," Girvin said.

[http://www.ctcase.org/bulletin/25_4/25_4.pdf]

NEWS FROM THE NATIONAL ACADEMIES

The following is excerpted from press releases and other news reports from the National Academies (www.national-academies.org).

◆ US Competitive Edge in Science, Engineering Depends on Minority Participation

A new report from the three national academies says efforts to strengthen US science and engineering must include all Americans, especially minorities, who are the fastest growing groups of the US population but the most underrepresented in science and technology careers. The US labor market is projected to grow faster in science and engineering than in any other sector in the coming years. However, non-US citizens, particularly those from India and China, have accounted for almost all growth in STEM doctorates awarded. Underrepresented minorities—including African Americans, Hispanics, and Native Americans—comprised just over 9% of minority college-educated Americans in science and engineering occupations in 2006, the report notes. To reach a national target that 10% of all 24-year-olds hold an undergraduate degree in science or engineering disciplines, the number of underrepresented minorities with such degrees would need to quadruple or quintuple. Higher education institutions should create programs providing underrepresented minority students in STEM with strong financial, academic, and social support. The report also recommends stronger programs to develop reading, mathematics skills, and creativity in pre-K through third grade, and improved K-12 mathematics and science education for underrepresented minorities. The challenge of increasing underrepresented minority participation and success in STEM requires commitment from every type and size of learning institution, the report says.

[http://www.nap.edu/catalog.php?record_id=12984]

◆ New Report Urges Sustained US Investment in Education, Research

A new rule announced by the government in July makes it easier for veterans with post-traumatic stress disorder to receive disability benefits. This change could affect hundreds of thousands of veterans who served in Iraq, Afghanistan, and Vietnam. Under the new regulation, the VA will grant disability benefits to all veterans who can prove they served in a war zone, performing a job consistent with the traumatic events that allegedly triggered the PTSD. Veterans are no longer required to corroborate traumatic events related to hostile military activity, such as coming under fire or watching a friend die. According to the US Department of Veterans Affairs, the new regulations on PTSD claims will apply to claims received by the VA on or after July 13, 2010, as well as to claims received or appealed before this date, which have not yet been resolved by the Board or by VA regional offices. The rule applies to veterans who served in any US war.

[http://www.nap.edu/catalog.php?record_id=12999]

◆ Long-Term Effect of Ocean Acidification Unknown

The ocean has absorbed a significant portion of all human-made carbon dioxide emissions. This benefits human society by moderating the rate of climate change, but also causes unprecedented changes to ocean chemistry. Absorption of carbon dioxide decreases the pH of ocean water and leads to a suite of chemical changes collectively known as ocean acidification. Long-term consequences of ocean acidification are not known, but are expected to result in changes to many ecosystems. *Ocean Acidification: A National Strategy to Meet the Challenges of a Changing Ocean* reviews the current state of knowledge, explores gaps in understanding, and identifies key findings. Ocean acidification is a global problem that will intensify with continued CO_2 emissions and has the potential to change marine ecosystems. The US government has taken positive initial steps by developing a national ocean acidification program, but more information is needed to fully understand and address the threat that ocean acidification may pose to marine ecosystems.

[http://www.nap.edu/catalog.php?record_id=12904]

◆ Engineering a Quieter America

A new report from the National Academy of Engineering entitled Technology for a Quieter America, finds that exposure to environmental noise is a widespread problem in the United States and calls on the federal government to strengthen the regulatory framework for occupational noise, encourage the development and deployment of technologies for noise control, foster demand for low-noise products, and improve environmental noise metrics. The report assesses major sources of noise (transportation, machinery and equipment, consumer products, etc.), how they are characterized, efforts to reduce noise emissions, and efforts to reduce noise in workplaces, schools, recreational environments, and residences. The report reviews regulations that govern noise levels and the roles of federal, state, and local agencies in noise regulation. It also examines cost-benefit trade-offs between different approaches to noise abatement, the availability of public information on noise mitigation, and noise-control education in US schools of engineering.

[http://www.nap.edu/catalog.php?record_id=12928]

The following Connecticut scientists were elected to the National Academies in 2010:

NATIONAL ACADEMY OF SCIENCES

Ruslan Medzhitov, PhD
David W. Wallace Professor of Immunobiology and investigator, Howard Hughes Medical Institute, Yale University School of Medicine

INSTITUTE OF MEDICINE

Peter Cresswell, PhD
Eugene Higgins Professor of Immunobiology and investigator, Howard Hughes Medical Institute, Yale School of Medicine

Jack A. Elias, MD
Waldemar Von Zedtwitz Professor of Medicine, professor of immunobiology, and chair, Department of Internal Medicine, Yale School of Medicine

Robert S. Galvin, MD
Chief Executive Officer, Equity Healthcare; and adjunct professor of medicine and health policy, Yale School of Medicine

John H. Krystal, MD
Robert L. McNeil Jr. Professor of Translational Research and chair, Department of Psychiatry, Yale School of Medicine; Chief of Psychiatry, Yale-New Haven Hospital, and director, Clinical Neurosciences Division, VA National Center for PTSD

Charles J. Lockwood, MD
Anita O'Keefe Young Professor of Obstetrics, Gynecology, and Reproductive Sciences, and chair, Department of Obstetrics, Gynecology, and Reproductive Sciences, Yale School of Medicine

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