

Bulletin of the

CONNECTICUT ACADEMY OF SCIENCE AND ENGINEERING



Volume 20,2 / Summer 2005

News from the National Academies

The following is excerpted from press releases of the National Academies and from *Infocus Magazine*, a news resource of the National Academies, which can be found online at www.infocusmagazine.org.

◆ On Science and Its Crucial Role in Policy-Making and Education

In a recent speech, outgoing National Academies president Bruce Alberts noted the critical role of the Academies in providing advice and guidance to the US government. He also noted the importance of the Academies' role in ensuring that the nation is doing everything it can to maximize the effectiveness of the science and technology enterprise in the United States.

The following are excerpts from Dr. Alberts' speech:

On science and policy-making: "The benefits that are derived from science extend far beyond the obvious ones – such as improved medical care, labor-saving machinery, and our rapidly increasing ability to store and access knowledge and to communicate with each other. Modern science has also provided us with such a deep understanding of the natural world that we can often predict what is likely to happen in the future. This predictive ability is what makes science so important for policy-makers..."

"Why does our system for providing advice to policy-makers work as well as it does? First, unlike the situation in some other parts of the world, everyone in the US government, on both sides of any argument, believes in science. Second, the press pays close attention to our work. We're often front-page news..."

"In addition, our review processes remove all non-scientifically based conclusions and recommendations from our reports, so we can't be discredited for going beyond the science... We take pride in simply telling the truth – the scientific truth – to power. Finding a balance among the many competing needs in our complex society is the expertise of policy-makers, and not ours."

"It is irrational for a government anywhere to make decisions without sound scientific advice. This fact motivates our new 10-year effort, funded by the Gates Foundation, to strengthen academies of science in Africa as providers of national science policy advice. Initially, our effort will be focused on Uganda, Nigeria, and South Africa — with other nations to be added later."

"But what about the 50 states of our nation? Many of them would seem to be no better off than developing nations in their ability to harness science advice. From time to time, the National Academies have been commissioned by a particular state or city to provide needed science advice.... But many states will need their own organization to provide the local science advice that they need. For this reason, we have begun an experiment designed to help strengthen a state analogue to the National Academies, the California Council on Science and Technology. We also have been forging closer ties with the National Association of Academies of Science, representing the 43 state and regional academies in the United States."

"Whether here or elsewhere, it is not enough to produce timely reports with sound recommendations – it is also crucial that there be trusted public servants in the government who are sufficiently scientifically and technologically adept to interpret our advice for the political establishment. These individuals provide invaluable links between the government and the scientific community..."

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Changing the Way We Think About Science

The Connecticut Center for Science & Exploration

According to its president, Theodore Sergi, the future Connecticut Center for Science & Exploration (CTCSE), will carry a message far beyond its riverfront site at Adriaen's Landing in Hartford. The Center, currently under design by renowned architect Cesar Pelli, will communicate to teachers, scientists, business leaders and students in *all four corners of the state* that "science and technology have a much more important role in society than we've given them to date."

In fact, changing the way we think about science — connecting it to the excitement of inventing, building and fixing real things so more kids will want to become scientists — is the Center's critical mission. And Sergi adds, "there's an economic imperative that we do this." That's because tackling the difficult challenges ahead, such as curing diseases and saving the environment, will require more people in science and technology than ever before. Right now, there's some concern in the field because the United States is trailing behind other countries when it comes to the number of students they prepare for careers in science.

These percentages tell the story:

- Only 13% of graduate degrees in the United States in 2001 were in science, technology, mathematics and engineering, compared to Germany's 38.9%, Japan's 42.4%, Korea's 48.3% and Sweden's and Switzerland's 41%.*
- Connecticut institutions of higher learning awarded 32,499 certificates and degrees in 2003, of which only 5,000 were in sciences, mathematics, computer or health-related fields.

"We can't continue to recruit all of our science talent from Pakistan, China and India," said Sergi, "because the number of scientists coming to the United States from other countries is on the decline." Fewer students are coming here to study subjects like engineering and biochemistry. And those who do come are returning home sooner than before. In Connecticut, which is fast becoming one of the nation's leading biotechnol-

* Organization for Economic Cooperation and Development. August 2001.

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Science Center (continued from page one)

ogy centers, the need for highly skilled employees in technical fields is expected to multiply.

A Lot Depends On Families And Teachers

The CTCSE will help secure Connecticut's future by involving families and teachers with the science that's all around them. Conceived as part education and part entertainment, the Center expects to attract 400,000 local visitors and tourists each year to its interactive exhibits and galleries. The Center will also feature classrooms and laboratories and two theaters, one showing large format films and another multi-use space for live presentations

Our Thanks to Academy Sponsors

The Academy wishes to express its sincere thanks to all of its sponsors, whose support makes the important work of the Academy, including this publication, possible.

Special recognition and thanks for continuing support of the Academy's programs to the Connecticut Department of Economic and Community Development.

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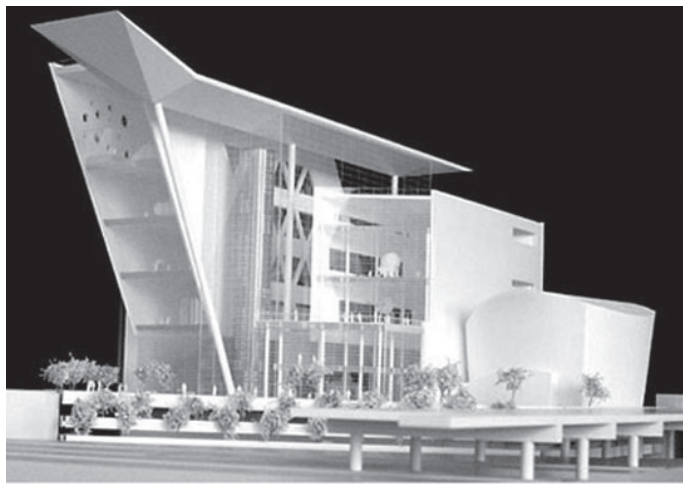
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Architect Cesar Pelli's winning design for the proposed center. (Photo: Connecticut Center for Science and Exploration)

and shows. The spotlight will be on all the sciences and their role in everyday life. The CTCSE will also showcase local inventors and industrialists, like Eli Whitney and Igor Sikorsky, who were highly creative thinkers. "At its core," said Sergi, "science is about creativity." Countries like Singapore, he explained, actually teach creativity in elementary school. They also have a tremendous interest in young women going into science. But in this country, "we exclude half our population from science," said Sergi, "and it's just a waste." The Center will encourage families to be open to both sons and daughters going into mathematics, science, and engineering and will help elementary teachers get comfortable with science so they give kids more experiences early on.

Starting this summer, as part of pre-opening programs, the Center will launch an Institute for Inquiry. Funded by a grant from the GE Foundation, the program trains teachers to make science more exciting to kids by showing them how to conduct experiments and reach conclusions based on their own observations. The CTCSE team was introduced to inquiry-based methods of teaching at the Exploratorium, a progressive hands-on science center in San Francisco that has served as a helpful model.

CTSCSE will begin sponsoring distance-learning programs that support an additional 100,000 teachers throughout the state. The Center will focus on the most impressionable ages, from 3rd to 8th grade, said Sergi, although they hope kids of all ages will come in — "those who have a passion for science and those who don't" — on the theory that "one great science experience or one great science teacher" might be all it takes to inspire a kid.

Judging from the reaction of the state's top scientists, educators, and corporate executives who are rallying around the Center and its mission, there's no shortage of inspiration. And it's been that way ever since the right group of people came together for a meeting at the governor's residence in 2002. Key to that meeting were Henry McKinnell, CEO of Pfizer, who now chairs the CTCSE Board of Trustees and Richard Levin, President of Yale, who now serves as vice-chair of the Board and head of its program committee. Sergi joined the group in 2003, after retiring from his position as Connecticut Commissioner of Education. Jeffrey Immelt, CEO of General Electric, has come on the Board more recently. Said Sergi, "I think there's a feeling in the corporate world that this is the right thing to do, it's no cure-all but it's one part of the package that says as a society, we value science."

Ahead of Schedule, Right On the Money

With all this support, Sergi and his team have been able to advance the schedule considerably. "Originally, people were talking about opening in 2009 or 2010; now the Center is going to break ground this fall and open in winter 2007/2008."

(See Science Center, page 8)

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Science and Engineering Notes from Around Connecticut



Business & Industry

PRATT IS JETTING AHEAD. Pratt Canada is leveraging its know-how to introduce a new engine, one that analysts say could revolutionize the market for light business jets as Pratt Canada becomes an increasingly important part of its East Hartford-based parent company, **Pratt & Whitney**. The new engine, called the PW600, is a cigar-shaped turbofan about the size of a household water heater. Though tiny when compared with the engines that lift commercial airliners, the PW600's narrow profile and lightweight design are tailor-made for a new generation of business jets about to hit the market. Already, two aircraft makers — start-up Eclipse Aviation and industry veteran Cessna Aircraft — have chosen the PW600 for their latest planes, commonly known as “microjets” or “very light jets.” Though sometimes referred to as “Little Pratt,” the Canadian division now accounts for about \$2 billion worth of Pratt’s \$8 billion in annual revenue.

NEW DRUG HOLDS PROMISE FOR SMOKERS. Researchers at **Pfizer, Inc.**, are racing to develop a potentially lucrative drug that would make smoking as treatable as erectile dysfunction, high cholesterol and acid reflux disease. Scientists identified a brain receptor to which nicotine binds, and designed a drug — varenicline — that binds to the same site. Varenicline is in Phase III testing, normally the last step before a company applies for approval from the Food and Drug Administration. Researchers hope that the drug will attach to nicotine receptors in the brain, preventing overpowering cravings from setting in when someone stops smoking. If varenicline’s claims hold up, the drug could generate more than \$500 million a year in sales.

UConn FOSTERS CT BUSINESS GROWTH. Rita Zangari, executive program director for the **University of Connecticut (UConn)’s Technology Incubation Program (TIP)**, helps faculty turn scholastic research into viable products and businesses. TIP is a key component in the university’s effort to help create a high-tech economy that will bring investment and high-paying jobs to Connecticut. Designed to nurture the successful startup of high-tech companies, TIP offers fledgling faculty entrepreneurs lab and office space, ready access to UConn researchers, facilities, equipment, and a variety of business and university services. TIP oversees three facilities, including ones in Storrs, Farmington, and Avery Point. Started three years ago, TIP is nearly at full capacity, currently hosting four start-up companies in the Advanced Technology Lab in the new BioSciences Complex at Storrs and two in Farmington. **Ian Hart**, UConn’s Director of Industrial Initiatives and TIP founder, says “I think we have come a very long way in a short amount of time,” citing the establishment of TIP’s facilities, a core staff, and advisory committee.

UTC FIRE & SECURITY SEGMENT ACQUIRES KIDDE. **United Technologies Corporation (UTC)** has announced completion of its acquisition of Kidde global fire safety company and the renaming of the corporation’s Chubb operating segment as **UTC Fire & Security**. Kidde’s Industrial Fire Protection and Residential & Commercial fire safety segments join Chubb to create a business with 52,000 employees in approximately 30 countries and expected 2005 revenues exceeding \$4 billion. Kidde’s Aerospace & Specialist Equipment business, which generated approximately \$300 million in 2004 revenue, will become part of UTC’s Hamilton Sundstrand. UTC acquired Kidde for approximately \$3 billion, including debt, after announcing an agreement with Kidde’s board in December 2004.



Communication

FACE IT. An area of the brain that activates when looking at faces does not respond the same way when perceiving other very familiar objects, according to a study by **Yale** researchers. “We humans are all face experts,” said **Yaoda Xu**, associate research scientist in the Department of Psychology and first author of the study. “Face perception is crucial to social animals. We need to be able to recognize if another person is friendly or unfriendly, or recognize other emotions.” Prior research has described a face-specific neural response that occurs about 170 milliseconds after an observer sees a face. The magnetic field generated by this neural response can be detected at the rear part of the human brain and is termed the M170 response. Xu and her colleagues wanted to know if the M170 response could be elicited by any visual stimuli that the observer has become an expert at, like cars for car experts. The study found that, while the success and failure of face identification strongly correlated with the amplitude of the M170 response, the success and failure of car identification did not. “What this study showed is that the M170 sensor is face specific,” Xu said. “And this face specific response is not entirely due to our expertise with faces, but rather, it reflects a specialized neural mechanism in the brain dedicated to face processing.”



Education & Cognition

CHESHIRE TEACHER TAPS INTEREST IN FORENSICS. Students at **Cheshire High School** recently combed through one of the classrooms there, looking for clues to the cause of death of a man whose body had been found lying face down on the floor by the evening cleaning service. Well, almost. The students were taking part in a simulation, part of a semester-long course in forensics that **Tanya Sterba** has been teaching for the past two years. Masking tape outlines the location where a body was found. Time of death has already been established and the body transported to the medical examiner’s office. Now it’s up to student teams to examine the room for evidence and determine if the death was a homicide. During the semester, local experts from the Cheshire police and fire departments give guest lectures on topics as varied as explosives and the types of paperwork a working detective must file. Sterba decided to create the forensics course when she noted how interested her science students were in TV shows like “CSI” and “Forensic Files.” After securing approval from her board of education, she went for special training at a summer course sponsored by Court TV and the American Academy for Forensic Science. She also attended seminars at the **University of New Haven** and took part in a **Pfizer** program that sent local teachers to visit a crime laboratory.

CIVIL LIBERTIES AND FORENSICS. DNA dragnets and the use of fingerprint evidence are among the topics being examined in a new **University of Connecticut (UConn)** course in molecular and cell biology, “DNA Fingerprinting and Civil Liberties.” **Linda Strausbaugh**, a professor of molecular and cell biology who initi-

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ated the course, says it is designed to encourage people who use biological evidence in law enforcement to think about the civil liberties implications. In addition, she says, "cross training" is needed for members of the legal community and scientists to better understand one another's issues. The idea for the course was suggested by two of Strausbaugh's former students — **Carl Ladd**, now director of the DNA Unit for the state police laboratory, and **Michael Bourke**, director of CODIS (Combined DNA Index System) for the state lab.

MEDICAL STUDENTS GET REAL-WORLD EXPERIENCE. Every Thursday afternoon, medical student **Cullin Jumper** drives to Bristol to "practice medicine" in the offices of **Antonio Scappaticci**, **Charles Licata**, and **Richard Guerriere**. Ten years ago, Guerriere was doing the same thing. An alumnus of the **University of Connecticut School of Medicine**, Guerriere was the first medical student to be mentored at the Bristol practice, and the group has continued mentoring students ever since. "This is the first time one of our graduates has joined the medical practice where he also trained," says **Karen Harrington**, director of student continuity practice. Jumper's weekly excursions are part of a three-year training program in primary care, known as student continuity practice, that is a requirement for all medical students. Harrington says student continuity practice is a very important part of medical students' training. "It offers an experience that cannot be duplicated in the classroom — or in most schools, where only one or two years of continuity practice is offered," she says.

WINNING ROBOTICS. A robot playing basketball? That's exactly what happened at the **ctnow.com Meadows Music Theater** on a Saturday in March. **Wolcott High School's Team Max** took first place in the New England Regional FIRST Robotics competition with its tall, gangly robot on wheels. FIRST — or For Inspiration and Recognition of Science and Technology — is a nationwide competition begun in 1989 to pump up students' excitement about science and engineering. More than 20,000 students take part annually from the United States and six other nations. Starting in early January with a standard kit of motors and electronic controls, each team has six weeks to design and build a working robot. **United Technologies Corporation** sponsors 11 Connecticut high school teams, and engineers from its divisions, such as **Pratt & Whitney**, **Sikorsky Aircraft** and **Hamilton Sundstrand**, serve as advisers.



Energy

POWER LINE FINALLY APPROVED. After nearly two years of controversy, the **Connecticut Siting Council** unanimously approved a 69-mile **Middletown-to-Norwalk** power line that would be the largest built in the state in 30 years. Approved by a 9-0 vote, the plan requires that 24 miles of the line between Norwalk and Milford be installed underground in order to minimize disruption to the environment through the more densely populated portions of Fairfield and New Haven counties. It also requires three local bypasses around residential areas and schools. **Connecticut Light & Power** and **United Illuminating** jointly proposed the line and must adopt principles that minimize electromagnetic fields. The order also grants towns along the route additional input when detailed construction plans are created. Before construction begins, the project will be reviewed by power grid operator **ISO New England**, and additional permits would be required from the state Department of Environmental Protection and the US Army Corps of Engineers.

The project is expected to cost nearly \$1 billion and be completed in 2009.

FUEL CELL TECHNOLOGY TOUTED. The bad news at the gas pumps is likely to get only worse this year, and that's yet another reason for Connecticut to work harder at promoting fuel cell technology, according to **US Rep John Larson** (D-1st). Larson, a longtime proponent of tax incentives for fuel cell development, encouraged the General Assembly and municipalities to support the industry. Pilot programs to power schools, buses and municipal buildings with fuel cell technology will pay enormous long-term rewards, he said. Fuel cells convert hydrogen into heat and electricity, leaving water as a byproduct, and advocates say they're the best alternative to dirty and increasingly costly fossil fuels. According to **Frank Wolack**, a marketing manager with Danbury-based Fuel Cell Energy Inc., a combination of public and private support of Connecticut's fuel cell industry could position the state to become a major manufacturer and exporter again.

AND IN FUEL CELL RESEARCH AT UCONN. In the late 1950s and early 1960s, when NASA needed a power source, the space agency turned to a Connecticut company: **Pratt & Whitney**, a division of **United Technologies Corporation**. When Pratt & Whitney developed reliable fuel cells, it set the stage for a Connecticut industry that quickly took root. Some 40 years later, the state provides more than a third of the nation's fuel cell-related jobs. The **University of Connecticut (UConn)** has positioned itself at the epicenter of the industry; in 2001, **UConn's School of Engineering** founded the **Connecticut Global Fuel Cell Center (CGFCC)**. The 16,000-square-foot facility is the nation's largest academic facility dedicated exclusively to fuel cell technology, and one of just a few such facilities in the world. Through external support, the CGFCC is equipped with nearly \$2 million worth of equipment specifically to serve industry research and testing needs and help companies develop products. **Trent Molter**, a research scientist and business development officer for the Center who is one of the founders of Proton Energy Systems in Wallingford, points to the Center's strong mix of both academic and industrial experience as one of its greatest strengths.



Environment

ENVIRONMENT AND CROHN'S DISEASE. In a study recently published in the journal *Inflammatory Bowel Disease*, **University of Connecticut (UConn)** pathologist **Herbert Van Kruiningen**, professor and head of the Pathobiology and Veterinary Science department, reports possible associations between environmental factors and Crohn's disease, a severe, chronic inflammatory bowel disease. He conducted the research in northern Belgium, where he says there is "an inordinate frequency" of the disease — as many as five cases per family. "Much of the literature indicates that Crohn's disease occurs more frequently in urban populations," he says. "I was surprised to find that of the villages we visited, nine out of 10 were located in agricultural communities. And the tilled land came right up to the edge of the houses. I was also struck by the fact that a good number of these Belgian families used human waste on their vegetable gardens. Also, many families ate a table spread made of uncooked pork." The study found that families that acquired Crohn's disease had a greater frequency of hand, foot, and mouth disease and of hepatitis A, suggesting that they may have had more exposure to enteroviruses, which are acquired by fecal contamination of water or uncooked foods. "We've made some associations," says Van Kruiningen, "and they warrant further study."

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GE LAUNCHES ECOMAGINATION. A **General Electric** (GE) initiative called **Ecomagination**, recently introduced by Chairman and CEO **Jeff Immelt**, will aggressively bring to market new technologies that will help customers meet pressing environmental challenges. GE has initially identified 17 products that meet its Ecomagination criteria. These products must significantly and measurably improve customers' environmental and operating performance. Examples include products that are significantly more energy-efficient than existing technologies, renewable resource technology such as wind power and products that meet third-party efficiency or environmental standards. GreenOrder, an environmental consulting firm, provided independent, quantitative environmental analysis of GE's products and verification of the product claims.

WHAT'S BITING YOU? One of fully 49 species of mosquitoes inhabiting Connecticut could whine and then bite you. *Bulletin 966* of **The Connecticut Agricultural Experiment Station** can show which species bit you. Written by entomologists **Theodore G. Andreadis, John J. Shepard and Michael C. Thomas**, and illustrated by **Gale Ridge**, the *Bulletin* can be read at www.caes.state.ct.us/Bulletins/2005/b966b996.pdf. In addition to presenting full-page drawings and keys for identifying the species, the *Bulletin* graphs their seasonal abundance and identifies the counties where they were found. The *Bulletin* reports results from examination of over one million specimens and surveillance for pathogens during 1999–2004 in the state. It tallies the eight viruses found in the 49 species of Connecticut mosquitoes, including West Nile and eastern equine encephalitis.



Food & Agriculture

CLEAR PLASTICS FOR FOOD STORAGE CAN POSE THREAT.

Low doses of the environmental contaminant bisphenol-A (BPA), widely used to make many plastics found in food storage containers, including feeding bottles for infants, can impair brain function, leading to learning disabilities and age-related neurodegenerative diseases, according to Yale researchers and colleagues. "These data heighten concerns about the potential long-term consequences of human BPA exposure," said Neil J. MacLusky of Helen Hayes Hospital, who conducted the study with **Csaba Leranth**, professor in the Department of Obstetrics, Gynecology & Reproductive Sciences and in the Department of Neurobiology at **Yale School of Medicine**. Leranth's group found that low doses of BPA in female rats inhibit estrogen-induction of synaptic connections in the hippocampus, an area of the brain involved with expression of sexually differentiated behaviors, as well as with formation and retention of memory. About two billion pounds of BPA are produced annually in the United States. In addition to its use in plastics, BPA is found in dental sealants and prostheses; derivatives are used as flame-retardants in adhesives, paper and textiles.

VEGGIE SPECIAL. When the **Connecticut Department of Agriculture** queried shoppers at the state's network of farmers' markets in 1998, they found a preference for fully 73 specialty vegetables normally grown in Asia, Europe, and Central and South America. Growers requested information about varieties, yields, and culture for such specialty vegetables as okra, leeks, and sweet potatoes. **David Hill** and **Abigail Maynard** began growing the vegetables at **The Connecticut Agricultural Experiment Station** farms in Hamden and Windsor. They added Jilo, an African eggplant, to their experiments to provide cultural information

to growers near Waterbury and Danbury where many Brazilian families know and seek the crop. In the years since, Hill and Maynard have improved the production of these plants in the state. Jiló (*Solanum gilo*), a member of the Solanaceae family, resembles eggplant and was brought to Brazil from Africa, where Jilo is called "garden eggs."



Health

A SURGE OF DEFIBRILLATORS. **Nick Cross** of South Windsor and his friends were playing Ultimate Frisbee, with plenty of jostling and shoving. All of a sudden, Cross felt lightheaded and collapsed. He staggered to his feet and collapsed again. The seemingly healthy teenager was minutes from dying of sudden cardiac arrest triggered by an undiagnosed heart ailment. A police officer was soon at his side and revived him with CPR and an electrical jolt from an automated external defibrillator (AED). Recently, declining prices and improved technology has made them widely available. Efforts by government and private organizations have put AEDs in police cars, government buildings, schools, health clubs, senior centers, nursing homes, businesses, airports, churches and, in the latest development, apartment buildings and homes.

CREATING HUMAN EMBRYONIC CELLS IS WITHIN SIGHT.

Cloning expert **Xiangzhong "Jerry" Yang** says his laboratory at the **University of Connecticut** at Storrs is ready to move from studying stem cells in cows to creating human embryonic stem cells. Meanwhile, the **Yale University School of Medicine** says it is ready to create a new stem cell institute, but officials worry they will have trouble competing for researchers with states such as New Jersey and California that have earmarked billions for research. Academy member **Robert Alpern**, new dean of the Yale School of Medicine, has said that Yale is committed to creating a new stem cell center that would bring six or seven top-flight scientists together. Embryonic stem cells, which can give rise to any tissue type in the body, so far have been created only from cloned embryos in mice and in humans. "I think we can see therapeutic testing in less than 10 years," Yang said.

MENOPAUSE AND AFRICAN-AMERICAN WOMEN.

A study of African-American women in menopause shows that while they experience many of the same symptoms as white women, they report more vasomotor symptoms such as dizziness and bloating, according to a study by **Yale School of Nursing** researcher **Ivy Alexander**. The women reported symptoms common among white women in menopause: hot flashes, irregular menstruation, heavy bleeding, sleep changes, night sweats, vaginal dryness, decreased libido and urinary urgency. Other common symptoms were forgetfulness, depression, irritability, fatigue, headache, and skin and hair changes. Less common menopausal symptoms reported by the African-American women were related to vasomotor functions, which involve constriction of blood vessels. These symptoms included dizziness, vaginal discharge, vaginal and body odor, hot feet, swollen hands, body rashes, bloating and joint stiffness.

NEW TWISTS IN BRAIN PROTEIN PRODUCTION.

University of Connecticut Health Center scientist, **Robert Reenan**, has uncovered new rules of RNA recoding, a genetic editing method that cells use to expand the number of proteins assembled from a single DNA code. According to his work, the shape a particular RNA molecule adopts solely determines how editing enzymes modify the information molecule inside cells. The study may help

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explain the remarkable adaptability and evolution of animal nervous systems, including the human brain. DNA sequences spell out the instructions for making protein but they aren't always followed to the letter. Sometimes, the genetic recipe gets edited after cells copy DNA to RNA. Think of DNA as a "read only" copy of the genetic code and the RNA as a "writable" working copy that cells can edit extensively. Researchers still don't know why editing occurs, but posit that organisms use it to increase protein variety. Producing different proteins in a cell at once could let organisms fine tune biological processes with extreme precision.

TREATING ALCOHOLISM. Victor Hesselbrock, scientific director of the **University of Connecticut Health Center's Alcohol Research Center**, has spent years researching the nature of alcohol addiction and mechanisms to ameliorate its ruinous side effects. One of Hesselbrock's projects, the Collaborative Study on the Genetics of Alcoholism, led to the discovery of a gene that is related to alcohol susceptibility. The multi-site, NIH-funded research project studied 14,000 individuals in 2,500 families with a history of alcoholism. The discovery provides a good starting point for looking at the functional nature of the disorder and for finding other genes involved in alcoholism susceptibility, he says. The center was also involved in the study of Naltrexone, the first drug approved by the FDA for alcohol treatment in over 50 years, and, more recently, in studies that led to the FDA approval last year of another drug, acamprostate.

NEW GLAUCOMA GENE. A gene that causes a type of late-onset glaucoma has been discovered by two researchers at the **University of Connecticut Health Center**, Mansoor Sarfarazi and his graduate assistant, Sharareh Monemi. The discovery will enhance screening for late-onset primary open-angle glaucoma. It will improve early diagnosis, facilitating earlier and better treatment, and will also advance the likelihood of gene-targeted therapies. Sarfarazi and Monemi investigated more than 34,000 base pairs of DNA before finding the mutation they were searching for.

YALE SCIENTISTS "SEE" BASIS OF ANTIBIOTIC RESISTANCE. Using x-ray crystallography, researchers at Yale have "seen" the structural basis for antibiotic resistance to common pathogenic bacteria, facilitating design of a new class of antibiotic drugs. Studies led by Academy members **Thomas A. Steitz** and **Peter B. Moore** in the departments of molecular biophysics and biochemistry, and chemistry at Yale illuminate one of the ways that bacteria can become resistant to macrolide antibiotics. Some of the clinically important bacteria are resistant because of mutation of a single nucleotide base in the site where macrolide antibiotics bind to the ribosome. The Yale group was able to "see" structural alterations when antibiotics were bound to ribosomes with different sensitivity to the drugs because of mutation. Steitz and Moore are among the co-founders of **Rib-X**, a New Haven-based start-up company that has exclusive license to the high-resolution crystal structure of the ribosome they revealed.



High Technology

YALE-IBM PARALLEL COMPUTING FACILITY DEDICATED. A ribbon-cutting ceremony for a collaborative **Yale-IBM Parallel Computing Facility** was held on April 27 in **Becton Laboratories** at Yale. The ceremony represented the culmination of conversations begun in October of 2001 between IBM and Yale Engineering to foster an enhanced research relationship between the two institutions. While the contribution of this equipment under the IBM Shared University Research grant program was

announced in March of 2004, and the equipment delivered in the fall, this dedication marked the official opening of the computing cluster. This powerful cluster of interconnected computing systems provides Yale a cost-effective platform for high performance computing. Application of this computing cluster may lead to future experiments with IBM's Blue Gene technology, the basis for the world's most powerful supercomputer.

WINNING SWING. A Yale professor of Applied Physics and Physics, **Robert D. Grober**, has combined his passion for golf and his professional expertise to produce a unique and effective real-time audio biofeedback device for teaching and training golf. Grober developed a golf club that has motion-detecting sensors, similar to those used for safety air-bag deployment in cars, embedded in the shaft. Sonic Golf's unique feature is the use of real-time audio feedback. "We were able to identify a signal from the sensors related to the speed of the club," Grober said. "We convert this signal into an audio soundscape that is universally intuitive to golfers and instantly interpretable, providing real-time audio feedback on the tempo, timing and rhythm of the golf swing." A patent was filed through the Yale Office of Cooperative Research and the technology is licensed to his company, **Sonic Golf, LLC**. "This is a great example of the joy in practical application of basic science and engineering," said Academy member **Paul Fleury**, dean of the **Yale School of Engineering**.

BIG BROTHER IS WATCHING. A **New Haven** resident recently heard a commotion outside his house, but by the time he got to the window, his Ford Explorer was gone. City marshals, armed with a new tool that photographs auto license plates and instantly matches them against a tax scofflaw database, had towed the offender's car right out of his driveway. Cash-strapped New Haven is a pioneer in using the so-called BootFinder system. The objective: snare people who haven't paid car taxes. New Haven officials are overjoyed at the results. They've towed about 1,800 cars and recovered more than \$1 million in delinquent taxes since the program began in September. The system is composed of an infrared camera that rapidly scans license plates and, connected to a laptop computer in the New Haven city system, scours a list of car tax delinquents. The car tax collection rate, at 80% before BootFinder, has now risen to 95%, said New Haven tax collector **C.J. Cuticello**.



Transportation

SUBMARINE JIMMY CARTER JOINS FLEET. The *USS Jimmy Carter* officially joined the Navy's submarine fleet as the former president, a graduate of the US Naval Academy and the only president to serve on a submarine, watched its crew charge across two gangplanks to man the sophisticated attack vessel on a cold day in February. Built by **Electric Boat**, the \$3.2 billion vessel is the third and final of the Seawolf class of submarines, stealthy, heavily armed ships originally designed to confront Soviet submarines. The *Jimmy Carter* is the most heavily armed and technologically advanced submarine ever built. In addition to the standard armament of Tomahawk missiles, mines and torpedoes it carries, the nuclear-powered ship can also operate in shallow water near shore in support of special operations forces. The ship also has a unique hull extension that makes it 100 feet longer than other submarines in its class, enabling it to accommodate new weapons, sensors and undersea vehicles.

— *Compiled and edited by Robert Vieth*

From the National Academies (from page 1)

“But none of this is enough to ensure that science — and scientific judgments — will create a more prosperous and rational world. Because the pace of scientific discovery continues to accelerate, the scientific and technological advances in this century will almost certainly exceed those of the past 100 years. Already, there are clear signs that our societies are ill-prepared for such changes...”

“Urgently needed are hundreds of thousands of “citizen scientists” who devote at least part of each week to spreading an understanding of science, its methods, and its values to non-scientists. And, if we are to have any chance of success, our university science departments must change their mission: Rather than focusing solely on training future research scientists, they must also openly encourage — and design programs for — science students at all levels who want to pursue a variety of other careers ...”

On science education: “Science education can be exciting and empowering for everyone.... The type of science teaching called for in the [National Science Education] Standards emphasizes logical, hands-on problem solving, and it insists on having evidence for claims that can be confirmed by others. It requires work in cooperative groups, where those with different types of talents can discover them — developing self-confidence and an ability to communicate effectively with others. But this teaching of “science as inquiry” demands a revolution in science teaching at all levels. An education that aims to fill the heads of students with correct answers is a disaster for many reasons.... Instead, all students must learn how to learn, so that they can solve new problems and overcome the many challenges that they will encounter in their adult lives.

“The good news is that a science education of the type just demonstrated meets major practical needs of modern societies. First, properly delivered, it can provide a nation with the type of work force that business and industry say they need: that is, workers with inquisitive, “can do” attitudes; the ability to use logic and experimental manipulations to solve problems; and the ability to function in collaborative work-groups. Second, by giving all young people the chance to function like a scientist, this type of education should enable a nation to do a much better job of encouraging and creating its next generation of scientists and engineers....”

“Science education can also help build a safer world.... Unless we can greatly reduce the dogmatism that infects our world, the eventual spread of knowledge will inevitably put nuclear technology into the hands of people who are eager to blow themselves up, along with hundreds of thousands of innocent civilians.

“This is why our Academy has put such a high priority on working closely with our colleagues in the Russian Academy of Sciences to prevent the proliferation of nuclear materials. And it is also why scientists all around the world must now band together to help create more rational, scientifically based societies that find dogmatism intolerable. More than 50 years ago, Prime Minister Nehru emphasized the importance of what he called a “scientific temper” for his new nation, India. By this he meant a society that exhibits the creativity, openness, and tolerance that are inherent to science — a requirement for his diverse nation.”

Science, a noble adventure: “Science is a great, noble adventure — an unending frontier in the long struggle of human beings to understand the world that surrounds us.... science is a marvelous community endeavor that enables new knowledge to be built upon old knowledge in unpredictable ways — ways that have enabled us to understand and manipulate this world to produce great benefits for humanity....”

[<http://www4.nationalacademies.org/nas/nashome.nsf/urllinks/NAS-6BVQF3?OpenDocument>]

◆ High-Quality Grad Students Critical to US

To maintain America’s leadership in science and engineering research, a comprehensive effort is needed to improve the recruitment, education, and training of a cross section of US students for careers in these fields, while continuing to attract the most talented scholars worldwide, according to a new report from the National Academies. The report calls for a study to explore which policies and programs would help the United States attract the best international and domestic graduate students and postdoctoral scholars. Providing the highest-quality training and career-development opportunities for these individuals, particularly women and underrepresented minorities, should be the overarching goal of US universities and research institutions.

Some aspects of the graduate education and training process in science and engineering appear to have an impact on the recruitment of domestic talent, the report notes, citing as major considerations: the amount of time it takes to earn a degree; the availability of fellowships and research assistantships, or funding for teaching assistantships; and whether lengthy postdoctoral appointments are required. American universities should continue to offer fellowships and assistantships that encourage the enrollment of international students, the report says.

[<http://www.nap.edu/books/0309096138/html/>]

◆ Ohio’s Third Frontier Project

The state of Ohio has announced seven research proposals to receive grants that will help the state’s universities and private companies collaborate to commercialize innovations in areas such as information technology, power and propulsion, advanced materials, electronics, and biotechnology. The grants are a key component of the “Third Frontier Project,” a 10-year, \$1.1 billion plan introduced in 2002 by Ohio Governor Bob Taft to create high-wage jobs and support the expansion of high-growth industries.

The National Academies evaluated how well the proposals met the criteria established for the competition. Two committees of experts convened by the National Academies conducted independent reviews of the proposals and recommended those that best met Ohio’s grant criteria. “More and more states are making important investments in technology research and commercialization. We are happy to help in that effort,” said Bruce Alberts, president of the National Academy of Sciences.

[<http://www4.nationalacademies.org/news.nsf/isbn/05102005b?OpenDocument>]

◆ What’s Driving Climate Change?

Scientists know from temperatures observed at the Earth’s surface that the planet is warming. There are factors that drive this warming, as well as others that cause cooling. In addition to pollution and volcanoes, other “forcings” of the climate include changes in land use and variation in the amount of energy received each year from the sun. But how do scientists quantify the effect of a particular forcing on temperatures? Historically, they have relied upon “radiative forcing,” a disturbance in the energy balance at the top of the atmosphere resulting from an external driver, such as industrial activity. For solar variability and many greenhouse gases, there is a direct relationship between top-of-the-atmosphere radiative forcing and fluctuations in surface temperature.

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

An expanded version of this article is available on the Academy's website at www.ctcase.org/bulletin/ctcse.html

The toughest part so far, according to Sergi, has been finishing the master plan, on which the team has worked alongside professional museum planners. "It's a road map," he said, "of everything we have to do between now and opening day to be successful, everything from philosophy to operations to fundraising to exhibits." Once the plan was done, the Center selected a construction manager and exhibit designer. The design team of Thinc Design/Jeff Kennedy Associates will spend the next six months developing a "master plan" of their own, creating concepts, schematics and construction schedules and working with the architect.

On the financial side, the original budget of \$150 million is still holding, of which about \$100 million is for the building. The other \$50 million is for exhibits and programming, staff salaries between 2003 and 2007, post-opening needs when revenues are just starting to build and an endowment fund. And of the \$150 million, they've raised \$128 million and are confident about the rest.

Next steps will be refining the architecture, beginning the construction and stepping up fundraising efforts. Sergi calls it "the hard work stage," a lot less glamorous than the architect competition but just as important.

Outreach to Partners and Organizations

In the meantime, Sergi and his staff are not waiting to get out in front of people. They've visited all the science museums in the state and enlisted them as partners, including the Discovery Museum in Bridgeport, the Norwalk and Mystic Aquariums, New England Air Museum in Windsor Locks, the Peabody Museum at Yale, the DNA Epicenter in New London, Eli Whitney Museum in Hamden and the Science Center of Connecticut in West Hartford. So far, their reaction is positive. They see the Center as a way to raise the interest in science and technology and possibly get funding that they couldn't have gotten on their own.

The Center also has a close working relationship with the Connecticut Academy of Science and Engineering. Together they collaborated on a very successful pilot program this spring in the Hartford Public Schools that presents live science shows to small clusters of first graders as a way to stimulate interest in science. The Center is also relying on the Academy for continued identification of the state's premier scientists, so they can serve as role models for kids and teach them about the many paths people take to reach success in science.

Academy members will also serve as advisers to the exhibit areas. One such adviser is Robert Ballard, "America's underwater frontiersman" who's now at the Mystic Aquarium and the Institute for Exploration at the University of Rhode Island. Another is the famous Henry Lee who was the state's chief forensic scientist and later its Police Commissioner, still works out of the forensics office in Meriden, and leads the University of New Haven's forensics program for policeman and firemen. According to Lee, "kids love forensic science" because "it's science with a purpose."

This spring, the Center helped support three statewide organizations that cater to kids: the Connecticut Science Fair, held at Quinnipiac College for students in grades 7-12; the Connecticut Invention Convention, held at the University of Connecticut in Storrs for students from kindergarten-grade 8; and the CPTV Family Science Expo, held at the Connecticut Expo Center in Hartford.

Sergi hopes together, the CTCSE and all its partners can convince kids that being a scientist would be the most exciting career of all, that it's "not too hard" for them to do, and that it's "one of the best ways to improve our quality of life." — **Barbara Standke is a freelance writer based in Chester, CT.**

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