

Bulletin *of the*

CONNECTICUT ACADEMY OF SCIENCE AND ENGINEERING



1976

Volume 27,3 / Fall 2012

High-Tech Imaging Tools Let CT Scientists Unlock Secrets of Biological Molecules

You are likely somewhat familiar with medical imaging technology that allows doctors to visualize internal structures of the body and figure out what's wrong with us; MRI's (Magnetic Resonance Imaging) and CAT scans (Computerized Axial Tomography) are two common examples. But perhaps you didn't know that similar high-technology tools are employed by scientists in Connecticut—and worldwide—to study biological molecules at the atomic level in order to glean indispensable information for the design of more effective drugs. Leading-edge research being done in our state could very well ensure we'll have a safer and healthier tomorrow. A field of science called structural biology aims to understand the three-dimensional shapes of biological molecules that perform most of the functions of living cells. The shape of a biological molecule is of paramount importance because changes to its shape affect its function.

Patrick Loria, professor of chemistry, molecular biophysics and biochemistry at Yale University, offered an analogy. "If you want to know how to fix something, you have to know how it works, so knowing its shape

is crucial. Understanding how a car engine works requires knowing how the pistons, cylinders, rods and other parts fit together."

Loria's lab at Yale studies enzymes, which are proteins that catalyze or speed up chemical reactions. "Many enzymes are the target of drugs; the drug molecule is designed to bind or interact with the target enzyme. We believe that knowing not just the three-dimensional structure of the enzyme, but also something about its flexibility, will facilitate better drug design." Think about drug-protein interactions as that of a 'key' or drug fitting into a 'lock' or protein, he said. "We know that the lock and the key are flexible and change their shape, sometimes quite significantly. Knowing how the 'lock' changes its shape is important for making a drug or 'key' that better fits. Our goal is not to design better drugs, but to provide information that would benefit those who do."

Biomolecules are too small to see in detail with even the most advanced microscopes, so Loria relies heavily on Nuclear

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From the National Academies

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

◆ US Should Strengthen its World-Class Research Universities

American research universities are in danger of serious decline unless the federal government, states, and industry take action to ensure adequate, stable funding in the next decade, according to a new report by the National Research Council. Universities must also meet "bold goals" to contain costs, enhance productivity, and improve educational pathways to careers both within and beyond academia, the report says. Congress requested the report, which recommends 10 strategic actions that the nation should take in the next five to 10 years.

The report recommends that Congress fully fund the America COMPETES Act and maintain current levels of funding for basic research across other federal agencies. In addition, states are urged to try to restore and maintain per-student funding for higher education to levels equal to the period of

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At the Maritime Aquarium at Norwalk, the Focus is on Long Island Sound

The Maritime Aquarium at Norwalk differs from most aquariums because it focuses solely on one body of water: Long Island Sound, the "Estuary of National Significance" just outside its doors.

As an arm of the Atlantic Ocean, Long Island Sound is an environment rich in aquatic life, even within sight of heavily urbanized New York City. The Sound's marine population—and The Maritime Aquarium's exhibits—include sharks, seals, sea turtles, jellyfish and varieties of crabs, game fish and mollusks, like delicious and economically important oysters and clams.

A visit through the Aquarium is presented as a journey from the Sound's edge—at the shallow salt marsh—into deeper and deeper waters. Visitors also detour into the Sound's critical watershed, which is home to river otters and migrating salmon and sturgeon.

As the Aquarium prepares to celebrate its 25th anniversary next summer, it transformed earlier this year with a \$4.5 million "FINtastic RefurbFISHment." Additions include a popular new

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Seven-foot sand tiger sharks prowl the "Ocean Beyond the Sound" exhibit.

[Photo: Maritime Aquarium at Norwalk]

Magnetic Resonance (NMR) spectroscopy to determine the shapes of proteins in solution and says he couldn't do his work without it. "NMR is a high-resolution spectroscopic technique that allows us to characterize the structure of proteins, and it also provides information about nearly every atom in a protein over a timescale that ranges from billionths of seconds to tens of seconds. No other experimental technique comes close." While not an imaging technique, NMR provides important data on the physical and chemical properties of atoms or the molecules in which they are contained.

Anna Pyle, professor of molecular, cellular and developmental biology and professor of chemistry at Yale, thinks of structural biology tools as her eyes and essential for visualizing the biological processes she is investigating. "Structural biology is a key pathway to discovery in biomedicine," she said.

Pyle focuses on RNA, a close cousin of DNA. "Increasingly, we are finding that RNA is involved in nearly every aspect of metabolism, in ways we never even imagined a few years ago," she said. "It

assembles into complex structures we need to understand because they contribute to metabolic function." RNA also affects gene expression. "We have all these genes that make up our bodies, but they have to be turned on and off at the right time; RNA is not only an informational molecule, but also a regulating molecule that affects sequence and timing of gene expression."

Pyle's lab relies primarily on the high-resolution imaging technique called X-ray crystallography, which reveals the structure and function of many biological molecules, including vitamins, drugs, proteins and nucleic acids, such as RNA and DNA. When these biological molecules form crystals, they can be bombarded by a beam of X-rays. The angles and intensities of the diffracted beams permit development of a three-dimensional picture. "There are only a handful of RNA structures that have ever been deciphered. Understanding these structures is critical to the study of infectious disease. RNA viruses cause Hepatitis C, West Nile and Yellow Fever. We hope our research will identify new drug targets."

Pyle was principal investigator on a Yale research team that recently discovered how a key protein involved in detecting and fighting infection interacts with invading viral molecules and stimulates an immune response. This protein, called RIG-I, has been the subject of worldwide study and the Yale team's findings very well could assist those pursuing drugs for many serious diseases, including cancer. Their paper was published in October 2011 in the journal *Cell*, one of the most prestigious journals in biomedical research. The Howard Hughes Medical Institute (HHMI), for whom Pyle is an investigator, provided funding for the project.

[Editor's Note: CASE member Thomas Steitz, another Yale scientist and HHMI investigator, won a Nobel Prize in Chemistry in 2009 for determining the structure and function of ribosomes, also using X-ray crystallography. See Spring 2010 *CASE Bulletin*.]

Jane Withka, an associate research fellow at the Pfizer Global Research and Development Center in Groton, CT, also relies on structural biology tools and technology to perform her work. "Nineteen years ago, when I joined Pfizer, companies were just starting to embrace the idea of using high-resolution structural analysis to design better drugs. We needed to see how the compound was interacting with the target protein, which has a three-dimensional shape. Having structural information helps facilitate the design—without question."

Her focus is on protein and peptide structure and their interactions with drug molecules. A peptide is a piece of a protein and both are made up of many combinations of amino acids. While a peptide may have five to 20 amino acids, the larger protein could have thousands. Withka explained that she and her co-workers are especially interested in drug/protein binding affinity—how tightly a drug molecule binds to its target protein or enzyme. "We want it as tight and specific as possible because that potentially allows a lower drug dose and fewer off-target effects, which can present patient safety issues."

While she is an expert in NMR technology, the Structural Biology and Biophysics group at Pfizer also employs X-ray crystallography, mass spectrometry, biophysics and molecular biology expertise to "bring a lot of different techniques and disciplines to bear on solving a biomedicine problem."

Withka's research team works to develop drugs for diabetes and cardiovascular disease, among others. Pfizer underwent a major restructuring following its 2009 acquisition of Wyeth Pharmaceuticals and ahead of the patent expiration of its cholesterol drug Lipitor®. In February 2011, the company announced it would reduce its worldwide workforce by 25%, including about 1,100 people in Groton

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IN BRIEF

Science and Engineering Notes from Around Connecticut



Biomedical Research

GROUNDBREAKING FOR BIOSCIENCE CT. Governor Dannel Malloy and University of Connecticut (UConn) President Susan Herbst were joined by UConn officials and legislators at a groundbreaking ceremony on June 11 for Bioscience Connecticut, an initiative designed to “jumpstart” the state’s economy by revitalizing the **UConn Health Center** in Farmington. The groundbreaking marked the official kickoff for building projects which include \$864 million in funding for a new patient care tower, parking structures and ambulatory care center at the UConn Health Center campus, in addition to renovation of the **John Dempsey Hospital**. Improvements are tied to plans by **The Jackson Laboratory** to build a new lab for genomic medicine at the campus. The Jackson Laboratory is expected to partner with scientists and doctors from UConn and other Connecticut medical centers and hospitals, focusing on personalized medicine.

ION TORRENT LEADS SEQUENCING COMPETITION. The Archon Genomics X Prize will award \$10 million to the first team sequencing the complete genomes of 100 people at age 100 or older in 30 days or less, with an error rate of no more than 0.0001% and for a cost of no more than \$1,000 each. **Life Technologies Corp.’s Ion Torrent** is currently the sole entrant. In January, the company said its Ion Proton™ Sequencer was ready to sequence a complete human genome in a day at a cost of \$1,000. Many studies identify gene variants that increase the risk of disease, but according to Nir Barzilai of Albert Einstein College of Medicine in New York City, who proposed the centenarian-genome contest to the X Prize Foundation, sequencing centenarians’ genomes provides insight into mechanisms in which “longevity genes might counter the disease genes and the unhealthy lifestyle.”



Business & Industry

CT TO GET MILLIONS IN FRAUD SETTLEMENT. Connecticut is one of the states that, along with the federal government, reached agreement with GlaxoSmithKline (GSK) for the largest healthcare fraud settlement in US history. GSK will pay a \$3 billion settlement for illegal marketing and drug pricing practices for its products, including the depression-treatment drugs Paxil® and Wellbutrin® and the diabetes drug, Avandia®. The state will receive an estimated \$11.1 million with a net state share of \$5.7 million as part of a total \$2 billion in civil penalties and damages that GSK will pay to various federal healthcare programs, including Medicaid, for harm allegedly suffered as a result of illegal conduct. In addition to the civil penalties, the company will pay another \$1 billion in criminal fines.

SIKORSKY ANNOUNCES CHALLENGE WINNER. In July, Stratford-based Sikorsky announced that Pankl Aerospace of Cerritos, CA, was the winner of the Innovation Entrepreneurial Challenge for developing a Hollywood-inspired camouflage that coats the outside of a helicopter fuselage with light-emitting diode screens, using a camera feed to project the image of the surrounding area onto the aircraft. Contestants submitted solutions to five

questions for review by Sikorsky, which may invest in the winning idea.

FIRST FIVE PROGRAM NEWS. Through Governor Dannel Malloy’s First Five job creation initiative, loans and tax credits are being provided to support **Alexion Pharmaceuticals’** relocation from Cheshire to New Haven so the company can expand its “treatment of ultra-rare and life-threatening diseases.” The relocation project is estimated to cost \$100 million with a ten-year, \$20 million dollar loan at a 1% interest rate from the state. If Alexion creates 300 jobs, as much as the full \$20 million dollar loan can be forgiven. East Hartford’s **CareCentrix** is the fifth company to participate in the First Five program. The company is eligible to receive a total of \$24 million in state grants to support its relocation to Hartford and the creation of 290 jobs over five years—it will get a \$12 million grant if it retains its current 213 jobs for the five-year period, and another \$12 million if it adds close to 300 positions. CareCentrix helps people manage and optimize home-based care.

NEVADA FIRM MAKES MOVE TO OXFORD. In May, **Go Green Global Technologies**, a company dedicated to developing and marketing technologies focused on a cleaner planet, announced that it is moving its corporate headquarters from Nevada to **Oxford, CT**. Chief Executive Officer John D’Alessandro said that this move will allow the company to operate more cost effectively while taking advantage of Connecticut’s Angel Investor Tax Credit Program for companies focused on green technology.

NOVATRACT GETS CI FUNDING. Connecticut Innovations invested \$1 million in **NovaTract Surgical, LLC** this June for its development of medical devices that reduce incisions in minimally invasive surgery. **Kurt E. Roberts**, an assistant professor of gastrointestinal and general surgery at the **Yale School of Medicine** and NovaTract’s scientific founder, developed the technology and related techniques. The device is an internal organ retraction device useful for abdominal surgery such as gallbladder removals and appendectomies, resulting in less pain and scarring as well as shorter recovery times due to the lower risk of post-operative infection, adhesion and hernias.

IMPROVING JOB OPPORTUNITIES FOR VETS. To improve veteran’s job opportunities, this May, **Congressman John Larson** joined local veterans and businesses at the Middletown Armed Forces Reserve Center to kick off the Veterans Job Match Initiative Event. The event was held in conjunction with the **Connecticut Departments of Veterans Affairs and Labor** as well as the **Connecticut Center for Advanced Technology** and other organizations with the goal to match unemployed veterans with local businesses looking to hire in manufacturing and the trades.



Communication

‘MOST WIRED’ HOSPITALS. **Hartford Hospital, Middlesex Health System, MidState Medical Center, St. Francis Care, William W. Backus Hospital,** and the **Yale New Haven Health System** have been designated as the nation’s “Most Wired” according to *Health Care’s Most Wired 2012 Survey* released in July. These hospitals meet the criteria because of efforts to use informa-

Items that appear in the In Brief section are compiled from previously published sources including newspaper accounts and press releases.

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tion technology to protect patient data, and optimize patient flow and communications.



Education & Cognition

CYBER-CHALLENGE. On May 21, over 100 Connecticut high school students exhibited presentations at the **Connecticut Science Center** as part of Cyber-Challenge, a three-year program made possible by a \$1.2 million grant awarded by the National Science Foundation's Technology Experiences for Students and Teachers (ITEST) and administered by the **Connecticut Business and Industry Association's Education Foundation** in collaboration with **EASTCONN**. Students researched various issues, such as solving electricity blackouts and improving vaccination rates. Prizes included iPods, video cameras, and headphones.

CT TEACHERS HONORED WITH PRESIDENTIAL AWARDS. On June 11, the White House announced the winners of the 2011 Presidential Awards for Excellence in Mathematics and Science Teaching. Two Connecticut teachers were honored with the awards, considered the nation's highest honor for math and science teachers and given to those educators who serve as models to their peers and leaders in the improvement in math and science education.

- In Westport, **Karen Thomas** teaches geometry, algebra, and pre-calculus at **Staples High School**. Thomas, a graduate of Mount Holyoke College who has been an educator for 16 years, also serves on the **Task Force for Westport Education 2025: Meeting the Global Challenge**.
- **Tyler Hoxley**, a science and biology teacher at **East Hartford High School** for the past 19 years, is a graduate of **Central Connecticut State University**, where he earned his undergraduate and master's degrees. He recently served on the **Connecticut State Department of Education Next Generation Science Standards Review Committee**.

URBAN EXCELLENCE. Researchers at the **University of Connecticut** (UConn), in partnership with the University of Central Florida and funded by a 5-year, \$3 million grant from the National Science Foundation, are beginning the School Organization and Science Achievement Project to investigate why some urban schools do better than others—and better than many of their suburban counterparts—when it comes to teaching science. According to the principal researcher, **John Settlage**, professor at UConn's **Neag School of Education**, the project grew out of a study of elementary science test scores.

ROBOTICS EXERCISE. This spring, fifteen members of the **New Britain's Boys & Girls Club** worked with **Ravindra Thamma** from **Central Connecticut State University's School of Engineering and Technology** to build a robot during a 3-week mechatronics program. During the first phase of the program, participants designed and built robots; this was followed by a large team effort to build a robot with a controller, sensors and linear gearbox. Work was completed at the club and the **CCSU Robotics Laboratory**. The School of Engineering and Technology announced two scholarships for club members—one for the School of Engineering and the second, a NASA scholarship for CCSU and the aerospace program.

NSF GRANT SUPPORTS SCIENCE LEADERS. **Connecticut College** received a \$438,990 grant from the National Science Foundation in support of the college's Science Leaders Program,

a largely federally funded program established by Connecticut College in 2007. The program is intended to attract students who qualify for need-based financial aid and provide them with research experience in chemistry, physics, environmental science, neuroscience and laboratory-based biological sciences.



Energy

FUEL CELL CFO PREDICTS PROFIT. **Michael Bishop**, CFO of Danbury-based **FuelCell Energy Inc.** (FCEL), expects the company to become the first fuel cell manufacturer to report a profit once annual production exceeds a total capacity of 80 megawatts. That production target is "in sight" this year as a nearly 80% drop in natural gas prices—due to a glut of US shale gas—drives increasing sales of fuel cells. The lower gas prices make it more competitive to generate electricity with the company's on-site stationary fuel cells, which are used to power large buildings or small campuses with half the carbon emissions of plants burning fossil fuels.

UTC WINS 'MOVE' GRANT. In July, **United Technologies Company** (UTC) of East Hartford was awarded a \$4.4 million federal grant for natural gas technology research. Only 13 recipients were awarded this grant from the US Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E) MOVE—or Methane Opportunities for Vehicular Energy—program. The MOVE program's objective is to aid development of next-generation natural gas vehicles.

KEEPING PACE. On June 12, Connecticut enacted the first commercial Property Assessed Clean Energy (PACE) program. The program enables commercial property owners to use loans with low fixed rates and longer repayment periods than traditional loans to pay for energy upgrades or onsite renewable energy. Businesses have 20 years to repay loans through an annual supplemental property tax assessment. The loan program will be managed by the state's **Clean Energy Finance and Investment Authority**.

PROTON ENERGY TO COLLECT DATA. The US Department of Energy will invest \$1.4 million in Wallingford's **Proton OnSite** (formerly **Proton Energy Systems**) to collect and analyze performance data for hydrogen fueling stations and advanced refueling components. The projects are part of a larger \$2.4 million investment in five nationwide projects with the goal to further fuel cell technologies and support technologies that diversify the transportation sector and reduce foreign oil dependence. Proton OnSite will put in place an advanced high-pressure electrolyzer at an existing hydrogen fueling station and use a research team to collect data on station operation, maintenance, repair, and energy consumption.



Environment

DESTRUCTIVE ASH BORER ARRIVES IN CT. The arrival in Connecticut of the emerald ash borer, a beetle responsible for killing millions of ash trees in the United States, was confirmed on July 16, 2012, when it was found in **Prospect** by staff of **The Connecticut Agricultural Experiment Station**. Subsequent infestations of this beetle were detected in **Naugatuck**, **Bethany**, and **Beacon Falls**. There are more than 22 million ash trees in Connecticut and the borer could cause great damage here as it has in 15 other states. On August 9, the Experiment Station issued a quarantine for hardwood firewood and wood chips and for ash nursery stock and green lumber in New Haven County. The

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Department of Energy and Environmental Protection suspended timber contracts and firewood permits for state land in that area. The quarantine is in effect until rescinded by the Station director.

MAPPING THE SOUND. This summer, a research vessel began mapping the bottom of Long Island Sound to guide future decisions about its uses. The project, funded by a 2004 settlement between Connecticut, New York, Long Island Power Authority, **Northeast Utilities**, and the Cross Sound Cable Company is a collaborative effort to collect high resolution geophysical data in order to make the best decisions about proposed future uses of the bottom of the Sound, including new pipelines or cables.

CT RIVER IS FIRST 'NATIONAL BLUEWAY.' US Interior Secretary Ken Salazar led a ceremony in Hartford in late May to designate the **Connecticut River Watershed** the first in the United States dedicated to conservation and recreation. The 410-mile **Connecticut River** was named the nation's first National Blueway as part of the America's Great Outdoors Rivers initiative created by President Obama to establish a community conservation and recreation program. The designation recognized the work of more than 40 organizations, including the **Connecticut River Watershed Council**.

CT GETS FEDERAL FUNDS FOR ENVIRONMENTAL CLEANUP. Federal environmental officials are spending more than \$1.5 million to help Connecticut municipalities clean up and redevelop contaminated properties and boost local economies. **Meriden** and **Newtown** will each receive \$200,000 to clean up hazardous substances. The **Waterbury Development Corp.** will receive \$200,000 for hazardous substance clean up and another \$200,000 for site assessments. In addition, **Preston** received \$800,000 in grants to assess and clean up brownfield sites at the former **Norwich Hospital** property, including a \$200,000 grant to investigate hazardous substances in soils and building materials and develop cleanup plans and support community involvement, and a \$600,000 clean-up grant that will be used to remove hazardous substances from the 390-acre property.

OPEN SPACE ACT SIGNED. On July 19, **Governor Dannel Malloy** signed into law *An Act Concerning the State's Open Space Plan* requiring Connecticut to update the strategy for protecting open space every five years, instead of "as necessary." The **Connecticut Department of Energy and Environmental Protection**, along with the state **Department of Agriculture**, the state **Council on Environmental Quality**, municipalities and other environmental organizations, are required to protect open space by identifying and locating areas of highest priority including wildlife habitat and ecological resources. The act expands the required information to include an estimate of how much state land is preserved as open space and potential methods, costs, and benefits of establishing accurately tracked open space land.

REVEALING THE SECRETS OF LONG ISLAND SOUND. Oceanographer and CASE member **James O'Donnell** of the **University of Connecticut** is looking at physical processes that determine circulation in Long Island Sound. Variations in water surface temperature, timing and volume of freshwater river discharge, and predicted global climate changes are factors that affect bottom habitat for animals such as lobsters. Working with the **Department of Energy and Environmental Protection**, O'Donnell's Sea Grant research project is developing tools that will turn observations into model predictions that coastal managers can use to assess what areas are most vulnerable to habitat change and also invasive species. He and his colleagues are also developing better

visualizations of rising sea level and storm effects on coastal communities. O'Donnell is also involved in the new Long Island Sound Mapping Initiative, which will help estimate circulation, hydrography, and bed stress.



Food & Agriculture

RARE WHITE BISON BORN IN GOSHEN. The birth of a rare white bison on **Peter Fay's** farm in Goshen on June 16 attracted Native Americans from as far away as South Dakota because it is considered a sacred event. Since the 1800s, the bison population, once decimated due to over-hunting, has rebounded to several hundred thousand. The National Bison Legacy Act, introduced in May, is an effort to have Congress recognize the bison as America's "national mammal." A white bison occurs about one in 10 million births.

MIGRANT FARM WORKERS GET CARE. The **University of Connecticut's Mobile Migrant Farm Worker Clinic**, started in 1997 by **Bruce Gould**, associate dean for Primary Care at the **University of Connecticut School of Medicine**, is visiting Connecticut farms this summer to care for migrant farm workers who suffer high rates of work-related injuries and chronic conditions. Agriculture, one of the nation's most dangerous professions, had 24.7 work-related injury deaths per 100,000 workers in 2009, compared with 3.5 deaths per 100,000 for other laborers.

HOLISTIC FARMING. **Allyson Angelini**, owner and farmer of **Full Heart Farm** in Ledyard, CT, and **Cheryl Placido**, part-time farmer and teacher, were among twelve women graduating recently from Connecticut's Whole Farm Planning Program for Beginning Women Farmers. Through a series of ten seminars held by Holistic Whole Farm Planning and administered by Holistic Management International (HMI) and the Northeast Organic Farming Association of Connecticut (CT NOFA), participants studied some traditionally overlooked aspects of farming including owner health, community, leadership and communication. The program seeks to educate new farmers, and equip women to own and manage their own farms.



Health

HEALTHY EATING. In May, the state **Department of Public Health** launched a nutritious eating and exercise campaign funded through the Supplemental Nutrition Assistance Program (SNAP), which helps low-income individuals and families afford food sold at grocery stores and farmers' markets. The campaign promotes healthy habits for young children and their parents with an "Action Pack" initiative that encourages parents and children to "Take Action" and "Eat Healthy" by eating plenty of fruits, veggies and low-fat dairy, and staying physically active.

TELEPHARMACY INITIATIVES. Legislation was adopted by the state in 2012 that will allow all Connecticut hospitals to participate in telepharmacy initiatives to dispense sterile products. These products are defined as any drug that is compounded, manipulated or otherwise prepared under sterile conditions, such as an intravenous (IV) medication. During the 2011 legislative session, the General Assembly passed a law permitting the state **Department of Consumer Protection** (DCP) to form a telepharmacy pilot program at one Connecticut hospital and its satellite locations with consultation from the state Department of Public Health (DPH). The new legislation builds upon this pilot program.

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HEALTHYCT WINS FEDERAL APPROVAL, FINANCING. This June, the federal Centers for Medicare & Medicaid Services granted federal approval, along with a \$75.8 million federal loan, to **HealthyCT**, the state's largest group of physicians, to launch a new non-profit, consumer-driven health insurance company known as a Consumer Operated and Oriented Plan, or CO-OP. Because HealthyCT is a non-profit, any profit will be invested back into the plan, keeping premiums affordable and ensuring access to quality, affordable health care for people across Connecticut. HealthyCT was created by two physician associations: the **Connecticut State Medical Society** and **CSMS-IPA**. The CO-OP has yet to be approved by state regulators as a health insurer. If the doctors win approval, it could start selling health plans by October 2013.

CT LEGALIZES MARIJUANA FOR MEDICAL USE. On June 1, **Governor Dannel Malloy** signed into law legislation legalizing marijuana for medical purposes. Tight restrictions accompany the law to avoid the type of abuses that the other 16 states and the District of Columbia have experienced with implementation. Under the law, patients and their caregivers must register with the **Department of Consumer Protection**. Doctors must certify that the marijuana is needed for such debilitating conditions as Parkinson's Disease, cancer, HIV, AIDS, multiple sclerosis or epilepsy.

PATENT PENDING. In May, graduate students from the **University of Connecticut's Center for Entrepreneurship and Innovation** met with 13-year-old **Mallory Kievman** to plan a strategy for manufacturing and marketing her "Hiccupop." Working with sugar, water and apple cider vinegar Mallory created a lollipop that delivered relief to 80% of a small group of friends and family with whom she tested it. **John Birk** of the **UConn Health Center** believes the lollipop could work well to break the reflex arc pathway of the hiccup.

WHOOPIING COUGH ON THE RISE. Cases of pertussis, or whooping cough, in Connecticut have more than doubled since last year, causing health officials to urge all residents to receive a booster vaccine. According to the Centers for Disease Control and Prevention in 2011, Connecticut reported 30 cases of whooping cough, with current reports listing 76 cases so far this year. Though not fatal to adults or older children, whooping cough can be very serious for young children, particularly infants.



High Technology

ENTREPRENEUR GRANTS AWARDED. In July, the **Hartford Business Development Grant for Innovative Entrepreneurs**, funded by the city and the **Connecticut Science Center**, announced awards of \$15,000 to **Aztech Engineers** for their Convection Enhanced Closed Loop Geothermal Heat Pump and \$6,730 to **Open Wire Lab** for its effort to produce electronic kits used to integrate digital interactive components into projects, including changes in light and sound generated by motion, temperature change, sound or luminosity. The grants are awarded to entrepreneurs whose projects are in applied science, technology and innovation and benefit the city of Hartford.

COUNTERFEIT PARTS PLAGUE INDUSTRIES. Chinese counterfeit microchips are turning up in US aerospace and defense industries, potentially wreaking havoc by compromising quality and enhancing opportunities for "cyber-snooping." The chips, copies of US-designed chips, are made in China and sold for commercial purposes. Because US aerospace and defense industries' demands

are small compared to commercial applications, they rely on economical commercial chips to provide computing power. A Senate Armed Services Committee investigation found over one million suspect parts. Lockheed Martin and Boeing products as well as the **Sikorsky SH-60B** helicopter and Alenia's C-27J airlifter have all been affected. The committee seeks to ensure companies buy parts from trusted suppliers, requiring written notification of counterfeit parts.

HORIZON FINANCES 3-D DENTAL TECHNOLOGY. Farmington-based **Horizon Technology Finance Corp.** is providing a \$3 million revolving credit line to Texas firm OraMetrix Inc. in an effort to support the growth and expansion of SureSmile, its 3D technology for applying oral braces. SureSmile uses 3D-imaging software and a robotic arm to bend orthodontic wire around patients' teeth. Horizon's portfolio consists of venture capital- and equity-backed development-stage companies in the technology, life sciences, healthcare information and services, and clean-tech industries.



Transportation

'MERRITT' IN THE PLAN? The **Connecticut Department of Transportation** (ConnDOT) is conducting a series of discussions with residents of communities that border the Merritt Parkway as part of the first phase a \$1.3 million study to investigate the feasibility of building a trail in the right-of-way to the south of the parkway. The trail, which would form part of the East Coast Greenway, was first conceived nearly 20 years ago by founders of the Merritt Parkway Trail Alliance, and is intended to improve the environment and enhance quality of life.

EQUIPMENT GRANT TO IMPROVE BUS EFFICIENCY. **New London County's** public bus company, SEAT (Southeast Area Transit District), will share a \$10 million equipment replacement grant with eight Connecticut Transit Divisions. Funds from the grant, which was awarded to the Connecticut Department of Transportation by the Federal Transit Administration, will be used to replace fare boxes and associated equipment.

CTFASTRACK BREAKS GROUND. On May 22, ground was broken in New Britain for the **Connecticut Department of Transportation's** (ConnDOT) CTfastrack project to create a 9.4-mile busway from Hartford to New Britain. The project is scheduled to be completed by September 30, 2014, and will provide eleven stops in New Britain, Newington, West Hartford, and **Hartford**. According to ConnDOT, the project—previously known as the New Britain-Hartford Busway—will reduce congestion along the I-84 corridor while cutting carbon emissions by 12,800 tons annually. The project is also predicted to create 4,000 construction jobs and 100 additional long-term jobs.

NEW PEARL HARBOR BRIDGE OPENS. On June 22, three northbound lanes were opened on the new **Pearl Harbor Memorial**—or "Q"—Bridge in New Haven; eventually, there will be a total of five lanes in each direction. The state is replacing the existing six-lane "Q Bridge," built in the late 1950s, with a 10-lane replacement as the central piece of a \$2 billion project to redo a seven-mile stretch of highway that crosses **New Haven Harbor**. The new bridge will reduce recurrent congestion and improve mobility through the New Haven area, and is expected to greatly expand opportunities in the area, as it will allow for economic expansion and job creation.

—Compiled and edited by Wendy Millstein Swift

1987-2002. Federal programs to stimulate innovation and workforce development at the state level should be accompanied by strong incentives to sustain state support for public universities. In addition, the report calls on the nation's research universities to significantly increase cost-effectiveness and productivity in both operations and academic programs, and urges that federal and state regulatory burdens on them be reduced to help reduce costs. The federal government should also invest in infrastructure—particularly cyber-infrastructure—that has the potential for improving productivity.

Additional recommendations include making doctoral programs more effective by reducing attrition and the time it takes to obtain degrees and aligning doctoral programs with the careers inside and outside of academia. The government should support a faculty chairs program to open opportunities for early- and mid-career faculty, and federal and state policies should encourage collaboration between US national laboratories, businesses, and universities in order to enable large-scale, sustained research projects.

http://www.nap.edu/catalog.php?record_id=13396

◆ Report Calls for 'National Photonics Initiative'

A report from the National Research Council urges the federal government to develop a "National Photonics Initiative" to bring together academia, industry, and government to steer federal research and development funding and activities in the field of optics and photonics—a field that has the potential to help fuel the nation's economy and provide opportunities for future technology applications.

The committee named five major challenges facing the nation that can be addressed with advances in optics and photonics technology. The first is to keep up the pace of technological achievement established in previous decades. Others include improved military surveillance and missile defense, achieving cost parity for solar power versus fossil fuel across the country's electrical grid, reaching seamless integration of photonics and electronics at the chip level, and developing optical sources and imaging tools to support increased resolution in manufacturing.

Eight particular areas of technological application are discussed in separate chapters of the report: communications, information processing, and data storage; defense and national security; energy; health and medicine; advanced manufacturing; advanced photonic measurements and applications; strategic materials for optics; and displays. The report recommends actions for the development and maintenance of global leadership in photonics-driven industries, including both near-term and long-range goals, likely participants, and responsible agents of change.

http://www.nap.edu/catalog.php?record_id=13491

◆ Managing Radioactive Waste: Blue Ribbon Report

Few public policy issues are as challenging as the management of high-level radioactive waste in terms of demands on scientific research and engineering practice. After decades of dedicated work in more than a dozen nations, evidence is beginning to increase confidence that "solutions" can be found to this pressing environmental issue.

The summer issue of *The Bridge*, from the National Academy of Engineering, explores the subject of "Managing Nuclear Waste," including a summary of the recommendations of the Blue Ribbon Commission on America's Nuclear Future. The commission was appointed by Secretary of Energy Steven Chu at President Obama's direction in January 2010, and by January 2012, had fulfilled its mission and delivered its final report, *Report to the Secretary of Energy*. In it, the Commission concluded that the nation urgently needs a new strategy to deal with spent nuclear fuel and high-level waste.

The strategy recommended by the Commission has eight key elements: (1) a new, consent-based approach to siting future nuclear waste management facilities; (2) a new organization dedicated solely to implementing the waste-management program and empowered with the authority and resources to succeed; (3) access to the funds nuclear utility ratepayers are providing for the purpose of nuclear waste management; (4) prompt efforts to develop one or more geologic disposal facilities; (5) prompt efforts to develop one or more consolidated storage facilities; (6) prompt efforts to prepare for the eventual large-scale transport of spent nuclear fuel and high-level waste to consolidated storage and disposal facilities when such facilities become available; (7) support for continued US innovation in nuclear energy technology and for workforce development; (8) active US leadership in international efforts to address safety, waste management, non-proliferation, and security concerns. [See

<http://www.nae.edu/Publications/Bridge/59220/59224.aspx>

◆ National Weather Service Must Continue to Evolve

The National Weather Service (NWS) successfully completed a multibillion-dollar modernization program in 2000, but should continue to evolve as it faces new challenges, says a new report from the National Research Council.

The modernization upgraded weather observing and forecast systems and reorganized the agency's field office structure, but accelerating improvements in technology and scientific fields require continued modernization, according to the report, which found that NWS's current structure primarily reflects the state of technology and the weather, water, and climate services in the 1990s. NWS faces challenges such as keeping pace with advances in science and technology; meeting expanding user needs; and partnering with other weather-, water-, and climate-related institutions. NWS needs to prioritize core capabilities, evaluating its structure and broadening collaboration and cooperation with other institutions. To meet the challenges posed by uncertain and constrained budget resources and increasingly high operational performance standards, NWS should prioritize the capabilities that only it can provide, such as collecting and integrating observations, using numerical weather prediction, issuing watches and warnings, and incorporating its research results into operations.

The report recommends that the agency evaluate its function and structure, including an examination of individual field offices, regional and national headquarters, and the national centers and weather-related parts of the National Oceanic and Atmospheric Administration. The report recommends that NWS strengthen its collaboration and cooperation with other public and private weather, water, and climate organizations, as well as its engineering and procurement processes for major systems.

http://www.nap.edu/catalog.php?record_id=13429

Norwalk (from page 1)

Shark and Ray Touch Pool, as well as an all-new seal show, new exhibits and a new orientation space called Newman's Own Hall.

The Maritime Aquarium also boasts Connecticut's largest IMAX movie theater, with a screen that's six stories high and eight stories wide. The theater's "refurbFISHment" debuts Oct. 18, 2012, with such fall titles as "To the Arctic" and the teacher-favorite "Born to Be Wild."

A wealth of state standards-based programs are available. For presentations in the Aquarium, at schools, on local beaches and out on the Sound, browse all the offerings at www.maritimeaquarium.org.

Visit our web site at www.ctcase.org

Biological *(from page 2)*

and New London, over an 18-month period. Some of the research work formerly conducted in Connecticut has moved to other states, including Massachusetts. Still, Groton remains the company's largest R&D site and is critical to advancing Pfizer's portfolio.

"While we've been downsized, the expectations haven't changed. We have to be efficient, pick the best areas to work on and produce results that are useful," she said.

At the University of Connecticut Health Center in Farmington, CASE member Peter Setlow, professor of molecular, microbial and structural biology, studies spores of bacteria that can cause food poisoning, life-threatening infections, and deadly anthrax. Anthrax spores are particularly concerning as they have been used in terrorism incidents and are considered a potential—and powerful—biological weapon.

Think of spores as bacteria in a state of suspended animation. Hardy little buggers, spore-forming bacteria can survive pasteurization and "sleep" for hundreds or thousands of years in a dormant state, even enduring drought, extreme temperatures, radiation and toxins. But when they get the right signal, Setlow said, they come back to life in 30 minutes or more in a process called germination. "I want to understand the mechanism of spore germination and why some spores germinate quickly and

others don't, which is a big problem in eradicating them. We are using structural biology in collaboration with other faculty here to try to figure out how proteins are important to the process and where we might be able to interfere or manipulate processes for benefit."

Being able to see what's happening at the molecular level makes all the difference, he said. "If you have a molecule that you know does something really important and may be involved in disease, having the ability to look at its structure and say 'aha,' what if I change this amino acid to that one, maybe I'll understand why that mutation causes disease," he said.

The UConn Health Center uses X-ray crystallography and NMR to investigate biomolecular structure. "While these are not new tools," he said, "they've been refined tremendously over the years and the instruments, particularly for NMR, are much more powerful."

The food industry, medical and food sterilization industries, the National Institutes of Health and the Army Research Office have been very interested in Setlow's research for more than 30 years and have funded much of it. Recent new projects and facilities in Connecticut are addressing the global restructuring of the pharmaceutical industry. Yale University's capabilities were greatly

enhanced with the 2007 purchase of the Bayer Healthcare Pharmaceuticals site in West Haven; Bayer's research arm came with state-of-the-art, high-performance—and costly—equipment. And the Jackson Laboratory for Genomic Medicine will be constructed on the Farmington campus of UConn Health Center, supported by state incentives. The Jackson Lab-UConn initiative is part of an \$864 million state investment called Bioscience Connecticut, which seeks to bolster the biomedical industry in the state.

Commenting on these Connecticut developments in a May 31, 2012, report, the scientific journal *Nature* said, "The 800 or so research positions created by the two initiatives do not replace the several thousand pharmaceutical research positions that have been lost across the state. But ... the two projects are already spawning partnerships with Connecticut's remaining drug-makers and biotechnology firms, as well as with regional universities and institutions. These could lead to start-ups and spin-offs with the potential to produce new industrial research posts in drug and therapy development."

We'll have to wait and see, but as structural biology tools have demonstrated in helping some of our state's top scientists solve potentially life-saving puzzles at the molecular level, seeing means everything. —**Peg Hashem is a freelance science writer.**