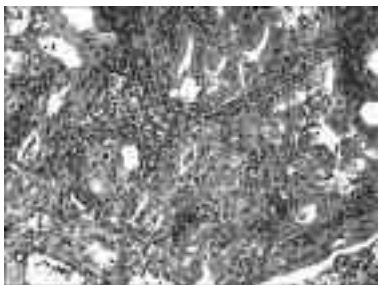


MIT Science News In Review

[Biology]

CCR Lab Develops Endometriosis and Ovarian Cancer Mouse Models

In the December 28 issue of *Nature Medicine*, researchers at the MIT Center for Cancer Research detailed their findings of the first mouse model for endometriosis and endometrioid ovarian cancer. Endometriosis, a common and painful disorder in the tissue lining the uterus, affects nearly 90 million women worldwide and can potentially lead to infertility. The significance of this discovery is widespread, as Tyler Jacks, a key researcher, explains, "Not only did we create new mouse models for two important gynecological diseases, but also this research provided evidence for a genetic link between endometriosis and ovarian cancer and may explain why some women who have endometriosis also develop ovarian cancer."



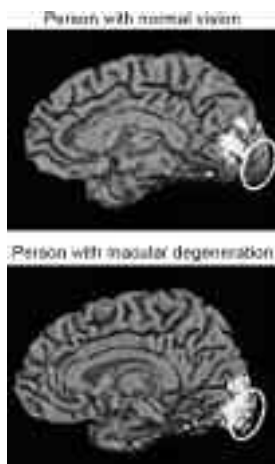
Postdoctoral fellow Daniela Dinulescu, first author of the *Nature* paper, discovered that a mutated K-ras oncogene or Pten tumor suppressor gene in the ovarian surface epithelium caused the development of a type of ovarian tumor. When the mutations are simultaneously induced in the mouse model, the characteristics of the subsequent ovarian cancer are very similar to those observed in the human strain of the disease. The mouse models that were developed provide evidence that genetics are partially responsible in the development of endometriosis and endometrioid cancer. These models will also help develop a treatment for endometriosis.

—M. Anahar

Source: "Endometriosis and Ovarian Cancer Modeled in Mice"
<http://web.mit.edu/newsoffice/2005/endometriosis.html>

Macular Degeneration Induces Reorganization in the Visual Cortex

Neuroscience researchers at MIT recently reported changes in the brains of patients suffering from macular degeneration. Professor Nancy Kanwisher and postdoctoral associate Chris Baker of the McGovern Institute for Brain Research used functional Magnetic Resonance Imaging (fMRI) to study this specific case of blindness. Macular degeneration, a major cause of blindness, is a condition in which central vision is lost, forcing patients to rely on their peripheral vision. This results in lower acuity, making it difficult for those suffering from macular degeneration to focus on objects and even read text. Both patients with macular degeneration and normal subjects viewed various images while in a fMRI scanner, providing information about how the brain responds to the visual stimuli. The results of the



Source: <http://web.mit.edu/newsoffice/2005/macular.html>

scans indicate that the area of the primary visual cortex associated with central vision in normal subjects is activated by images presented in the periphery for patients with macular degeneration. This suggests a change in the organization of the primary visual cortex after years of living with macular degeneration. Reported in the *Journal of Neuroscience*, this data is significant as it highlights the ability of the brain to change or adapt to new circumstances. This research may eventually lead to new rehabilitation strategies for patients with macular degeneration, in addition to research aimed at understanding the mechanisms by which the brain adapts to this condition.

—A. Tambini

Source: "Macular degeneration accompanied by significant brain reorganization"
<http://web.mit.edu/newsoffice/2005/macular.html>

[Biomedical Engineering]

Mending a Broken Heart

Engineers at MIT in collaboration with the Harvard-MIT Division of Health Sciences and Technology (HST) recently reported the fabrication of a small piece of heart tissue that possesses characteristics typical of mature cardiac tissue, including regular contractions.

The team of researchers, led by Gordana Vunjak-Novakovic of HST, planted cardiac cells from a rat onto a 3D polymer scaffold that degenerated as the cells matured into full tissue. The cell-scaffolding setup, slightly smaller than a dime but roughly the same thickness, was bathed in a nutrient-rich medium. The researchers then applied electrical signals mimicking those of a heart by connecting the cells and scaffolding to a pacemaker. The electrical stimulation turned out to play a vital role in the rapid assembly of functional tissue—after only eight days of cultivation, the team was able to produce single cells that grew into tissue with a significant level of structural and functional organization. "The real advance here is we mimicked what the body does itself and got it to work," said Professor Robert Langer, another member of the team.

The patent-pending technique by the researchers was published and can be found in the online edition of the *Proceedings of the National Academy of Sciences*. Authors of the article include Milica Radisic (Ph.D. 2004), Hyounghsin Park, an HST research engineer, Helen Shing and Frederick Schoen of Harvard Medical School, Thomas Consi, a faculty member at the University of Wisconsin, and Lisa Freed, an HST principal research scientist. The next challenge for the researchers will be to incorporate this research with human cells and to see if it works in the body. Says Vunjak-Novakovic, "Think of it as a patch for a broken heart."

—T. Shen

Source: "Engineers aim to mend broken hearts"
<http://web.mit.edu/newsoffice/2004/heart.html>

[Materials Science and Engineering]

Plastics Pick Up Chemicals

Professor Phil Gschwend, from MIT's Department of Civil and Environmental Engineering, believes plastics can be used to more accurately measure the levels of organic pollutants in the Boston Harbor.



Traditionally, the only way to measure organic pollutants was by analyzing the chemical levels in animals; however, these values did not correspond to those predicted from models. This discrepancy was partially attributed to black carbons, solids like diesel soot and cinders that can attach themselves to many organic pollutants and keep them buried in the mud and out of animal systems.

To correct this inaccuracy, Gschwend and his colleagues tested triglyceride triolein, a material

found in plastic bags, that Gschwend compares to "little bags of fat." Rather than absorbing the chemicals of interest, the bags often ruptured, releasing the triolein. After several trials, they discovered that the plastic itself could be used to gather the pollutant levels in water. Just like plastic milk cartons absorb sour milk and its smell long remains despite constant rinsing, plastics could be placed in mud or water to measure the amount of chemicals.

Gschwend and his colleagues measured pollutant levels in the Quincy and Dorchester Bays by placing plastic strips in their water and mud for one to two days. The results the team gathered were indeed lower than previous measurements had been, which agreed with the calculated values from the models. They also found a constant diffusion between the water and the mud, with different chemicals moving back and forth between them. —P. Mulligan

Source: "Plastic Packaging Helps Monitor Ocean Pollutants"
<http://web.mit.edu/newsoffice/2005/plastics-0112.html>

[Astronomy]

MIT Undergrad IDs Supersized Stars

Research carried out by Emily Levesque, a junior in physics at MIT, has finally resolved the inconsistency between observed and predicted data of red supergiants. Physicists have always calculated these stars to be much larger than what astronomers have observed, creating doubts over whether the theory or the observations should be revised.

This project, led by Levesque's advisor Philip Massey of the Lowell Observatory, involved researchers from Cerro Tololo, the Universite de Montpellier II, and the Geneva Observatory. The international group confirmed that the theoretical predictions were correct by collecting and analyzing data from the supergiants. As the temperature and the radii of the stars are not directly observed but calculated from their brightness and spectra, the group also concluded that inaccuracies in converting between these parameters had resulted in the discrepancies between what had been observed and what had been predicted.

As these stars near the ends of their lifetimes, they become extremely large, cool and massive. The new conversion calculations determined by the group has allowed them to measure the size and temperature of seventy-four red supergiants in the Milky Way. Three of these stars are the largest ever discovered, with radii of approximately seven astronomical units, which is 1,500 times that of the sun.

Levesque's research has been presented at an American Astronomical Society meeting; she is currently the lead author of an article publishing these findings. Levesque plans to continue her work in astronomy at a research institute or a university after completing her Ph.D. —H. Chung

Source: "MIT Undergrad IDs Supersized Stars"
<http://web.mit.edu/newsoffice/2005/bigstar.html>

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[Nanotechnology]

R&D Conference Features the Future of Nano

Professor Edwin L. Thomas of the MIT Institute for Soldier Nanotechnologies (ISN) presented “The Challenges and Promises of Nanotechnology” at the 2004 MIT Research and Development Conference. Nanotechnology has already created stronger car bumpers, corrosion resistant paint, glare-reducing eyeglass coating, and stain-free clothing, but these products may be only the beginning of the benefits of nanotechnology. Thomas says that “nano is huge, with pervasive benefits for society, the economy and national security.”

The ISN was established two years ago and fosters research to improve the survival of soldiers. The Institute is comprised of seven research teams that focus on energy-absorbing materials, sensing, biomaterials, modeling and simulation, and systems design. These projects combine to protect, treat, and enhance the performance of soldiers in the field. In particular, Thomas discussed a project led by Robert Langer, the Germeshausen Professor of Chemical and Biomedical Engineering, to reduce the weight that soldiers must carry. The average soldier carries around about eighteen pounds of water, but Langer’s project aims to lighten this load by capturing and recycling personal water using a surface that can switch from hydrophilic to hydrophobic using an electric field. Water can be captured using the hydrophilic setting and released with the press of a button. This project is representative of the innovation occurring at the ISN.

Although the applications of nanotechnology seem endless, there are many barriers that have yet to be overcome. The National Nanotechnology Initiative (NNI) has outlined “grand challenges” for nanotechnology, including health and environmental safety concerns. To address these concerns, the NNI has provided \$100 million of funding to study the impact of nanoscale materials on the environment. Though the modus operandi of the nano world is still a mystery, it holds the potential to make materials “stronger, lighter, more water-soluble, more heat-resistant, or better conductors of electricity.”

The R&D conference also featured sessions by MIT professors on medical imaging, sensors and control, mechatronics, unmanned vehicles, and portable power.

—M. Anahtar

Source: “Tiny Technology Carries Big Promise”
<http://web.mit.edu/newsoffice/2005/nanotalk.html>

[Management]

Study Reviews Supply Chain Prophecies

A review of the future of the supply chain suggests that predictions made about the level of cooperation between different organizations may have been overly optimistic. Mahender Singh, from MIT’s Center for Transportation and Logistics, carried out the study as a member of Supply Chain 2020, a project which is attempting to pinpoint factors which will help the future of these businesses.

He has shown that, although many predictions about the future of supply chains were made under the assumption that cooperation and sharing of information would increase between different organizations, current trends indicate that trade has become more restricted.

Due to the threat of terrorism, communication between countries has decreased, particularly with the United States. The tendency of other countries to resist the economic dominance of America by forming alliances

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between themselves has added to this effect, making the dream of 'frictionless trade' virtually impossible. Businesses have also become more reluctant to share information, in order to maintain an advantage in a competitive market.

Despite these factors, Singh believes that economic forecasts for supply chains can provide them with valuable information in creating strategies for future growth and change. He searched through a variety of sources in order to select 46 publications which he believes will prove to be of the greatest use to supply chains. Known as Scenario Planning, this will allow companies to prepare for multiple probable outcomes in the future.

—H. Chung

Source: "Study Reviews Supply Chain Prophecies"
<http://web.mit.edu/newsoffice/2005/supplychain.html>

[Nuclear Engineering]

Fusion Experiment Joins MIT and Columbia

Researchers at MIT and Columbia University have begun collaboration on a pioneering experiment called the Levitated Dipole Experiment (LDX), focused on exploring the possibilities of fusion energy as a new energy source. They have chosen to emphasize fusion energy since its hydrogen fuel is virtually inexhaustible while the resultant energy is clean and non-pollutant.



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The LDX experiment involves generating strong magnetic fields from a half-ton semiconducting ring inside a large container, which confines high-temperature ionized gas known as plasma. Powerful magnets such as the huge semiconducting ring are used to generate the magnetic fields necessary to initiate, sustain, and control the plasma in which fusion takes place.

Scientists involved with LDX will carry out basic studies of confined high-temperature matter and determine whether plasma may someday be used to feasibly produce fusion energy on Earth.

LDX mimics nature in its approach to tackling fusion. The force field generated by two superconducting magnets resembles the fields characteristic of magnetized planets, such as Earth and Jupiter. A powerful superconducting ring roughly the size of a truck tire that weighs more than half a ton is levitated within a large vacuum chamber to create the primary confining fields. A second superconducting magnet placed above the vacuum chamber provides the force necessary to support the weight of the floating coil.

Several different fusion research experiments are underway, including the Alcator C-Mod at MIT, and the HBT-EP experiment at Columbia University. The research team working on LDX is led by senior scientist Jay Kesner at MIT's Plasma Science and Fusion Center (Ph.D. 1970, Columbia University), and Michael Mauel, a professor of applied physics at Columbia University (S.B. 1978 S.M.; Sc.D.; MIT). Their work is being sponsored by the Department of Energy's Office of Fusion Energy Sciences.

—T. Shen

Source: "MIT, Columbia begin new 'hot' fusion experiment"
<http://web.mit.edu/newsoffice/2004/dx.html>

Engine Efficiency Increased

MIT researchers have developed efficiency improvements for a common type of gas-fired engine. The engines, which typically run at all times to generate electricity for a building such as an apartment complex, can now benefit from lower friction levels amongst their components. Not only will less fuel be consumed, but that which is will produce fewer emissions.

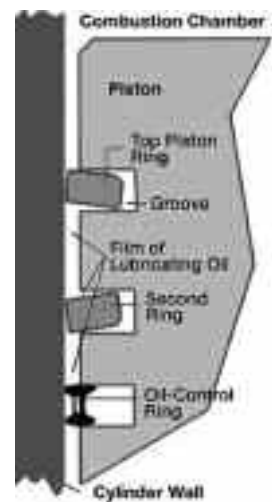
Prior to the research team's breakthrough, natural gas-fired reciprocating engines operated at under 40 percent efficiency—less than half their fuel's energy was actually translated into electric power. Much energy was lost through pistons' lateral interactions with the cylindrical wall in the combustion chamber.

The MIT team, led in part by principal research scientist Victor Wong, sought to mitigate the effects of these interactions to avert friction. They conducted a deep investigation of "the detailed characteristics of the surfaces, including submicron peaks and valleys on the piston and rings," according to Wong. Armed with this data, the team built a computer model to identify potential inefficiencies.

Results indicated three main weaknesses with the existing engine's design of the rings encircling the pistons. Prototypes constructed at a Colorado State University facility confirmed the model. In all, the team's changes improved base engine efficiency to about 45 percent.

—D. Barclay

Source: "Subtle changes will make a workhorse engine cleaner, more efficient"
<http://web.mit.edu/newsoffice/2005/gasengine.html>



[Education]

Technology Emphasizes Value of Human Problem-solving

A look at how technology produces rippling changes in the job market led Professor Frank Levy of MIT Department of Urban Studies, and Richard Murnane of Harvard University to gain new perspectives on how to meet the need for problem-solving approaches in jobs demanding advanced skill sets.

Workers once received training in repetitive tasks which are now easily replaced by computers. To compete with this shift in industry demand, available jobs require high-level thinking and entirely new skill sets that cannot otherwise be replaced. While computers are capable of following discrete tasks, humans still maintain the capacity to apply knowledge and abstract thoughts in solving complex problems.

To gain a further understanding, Levy and Murnane analyzed in what ways workers are trained, and researched teaching practices through observation at a public elementary school in Boston, MA. There they achieved success in reorganizing the educational program, which focused on improving curriculum and stressing subject areas typically troublesome for young students. Levy and Murnane believe future problems will not be solved without also altering education stigmas held by society.

The work of Levy and Murnane suggests strategies for developing problem-solving in preparation for employment as technology increasingly divides low- and high-level jobs. Their work culminated in a book titled, "The New Division of Labor: How Computers Are Changing the Job Market".

—S. Frank

Source: "Computers won't replace human capacity for problem-solving in workplace, authors write" <http://web.mit.edu/newsoffice/2005/work.html>