By Erik Sofge Oct 30, 2009

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Injection-Mold Custom Organs

Fab@Home machine.

Medical researchers are already growing human tissues, and even organs, in the lab. Then there's Lawrence Bonassar. The assistant professor of biomedical engineering at Cornell University is producing custom body parts using Fab@Home, a 3D lithography platform developed at Cornell. (Its inventors won a 2007 Popular Mechanics Breakthrough Award.) Bonassar's "ink" is a culture of living cells suspended in gel. For homogeneous organs, he can skip the printer, squirting biogel right into an injection mold. And since the cells originate with the patient, organ rejection is not an issue. Prognosis: Human trials are years away, but rats can schedule back surgery right now--Bonassar's team has already replaced spinal discs in rodents.

Breed Super-Rice to Feed the World

Genetic engineer Pamela Ronald, photographed for *Popular Mechanics* on April 14, 2009. The flood-tolerant rice she helped develop has been grown successfully in Bangladesh.

Pamela Ronald is a genetic engineer with little patience for debates over "frankenfoods." If swapping some DNA base pairs around will fight hunger, she's all for it. Besides, she says, people have been meddling with genes for more than 10,000 years. "Everything on your table, everything you eat, has been genetically improved," Ronald says. "With the exception, maybe, of some wild blueberries, none of it occurs in nature." Nevertheless, Ronald finds herself sidestepping the genetic modification controversy by helping develop the new field of "precision breeding." Her lab at the University of California-Davis

isolated a gene that imparts impressive flood tolerance to a rice variety found in eastern India. A collaborator then incorporated that Sub1 gene into a strain valued by Indian and Bangladeshi farmers. The new crops retained their best characteristics--but now the rice could survive for two weeks underwater, while conventional plants would have died within days. Since all the genetic material came from the same species, few observers--even in purity-obsessed Europe--can raise objections.

Researchers now plan to develop rice strains that need less moisture and fertilizer, can fight off destructive microbes and can thrive in saltier conditions. Roughly half of the world's population relies on rice, so the development of more resilient strains can aid hundreds of millions around the globe. And that's just the beginning. "Rice is like the fruit fly of cereal studies," Ronald says. "What we discover in rice, we can apply to wheat and maize."

Replace Suture Kits With Lasers

Katzir's laser bonding is similar to Star Trek's dermal regenerator.

Lasers could replace old-fashioned needles and thread for suturing wounds and surgical incisions. A method devised by Abraham Katzir, head of Applied Medical Physics at Israel's Tel Aviv University, involves slathering the target area with a protein, then tracing the wound with a carbon-dioxide laser. According to Katzir, the procedure reduces surgical scars, healing time and the chance of infection. Prognosis: Katzir is preparing to use laser-bonding on hernia patients, and he hopes that the technology will soon be applied in eye and cosmetic surgery. His lab is also developing equipment that uses a smaller, diode laser--similar to the ones in DVD players. He envisions a flashlight-size system for emergency rooms and ambulances.

Mind-Meld With Machines

Idoya the monkey controls the robotic arm only using her brain.

Who needs a joystick when that famously complex CPU between your ears can exert direct control over a machine? Miguel Nicolelis, co-director of Duke University's Center for Neuroengineering, has shown that monkeys can make robots walk simply by thinking. Next, he is focusing on sensory feedback. Sure, touch and vision would be nice, but Nicolelis hopes that human brains eventually can learn to interpret data from such diverse sources as magnetic sensors and infrared imaging systems, essentially developing new, machine-based senses. (Hey, the Borg can do it.) Real-World Potential: Within five years, Nicolelis plans to introduce a brain-controlled, full-body exoskeleton to restore mobility to severely disabled patients. Potential applications are wide-ranging--imagine surgeries being performed by a specialist from across the country. There's an issue with user-friendliness, though--little of this cybernetic wizardry will come to pass until someone invents an interface that doesn't require a cable to be implanted in the user's brain.

Stop Blood Loss With Ultrasound

DBAC cuff and how it works. (Illustration courtesy of DARPA)

The Deep Bleeder Acoustic Coagulation (DBAC) program may sound like tech from some cyberpunk novel, but it's real engineering being developed with funding from DARPA, the Pentagon's research wing. DBAC will locate severed arteries deep below the skin, then use ultrasonic waves to cauterize the rupture without affecting surrounding tissues. Prognosis: DBAC's imaging step relies on proven technology, but

the coagulation function would require extensive testing. DARPA hopes to unveil a prototype DBAC, designed as a cuff that can fit over an injured limb, by 2011.

Deploy Tiny Robo-Docs

Smart pill.

"Smart pills" designed to carry miniature cameras or doses of medicine have been kicking around laboratories for years. Now researchers are homing in on a Lilliputian robot doctor that could do it all, combining diagnostic imaging with targeted drug delivery, while precisely navigating a patient's digestive track. A model from Pittsburgh's Carnegie Mellon University anchors itself within the body using adhesives, while another device (invented in Germany) is guided by magnets outside the body. When such bots hit clinics, they should make biopsies easier, and colonoscopies mercifully obsolete.

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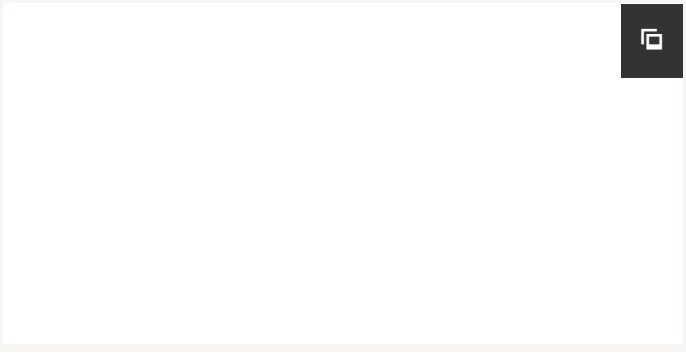

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