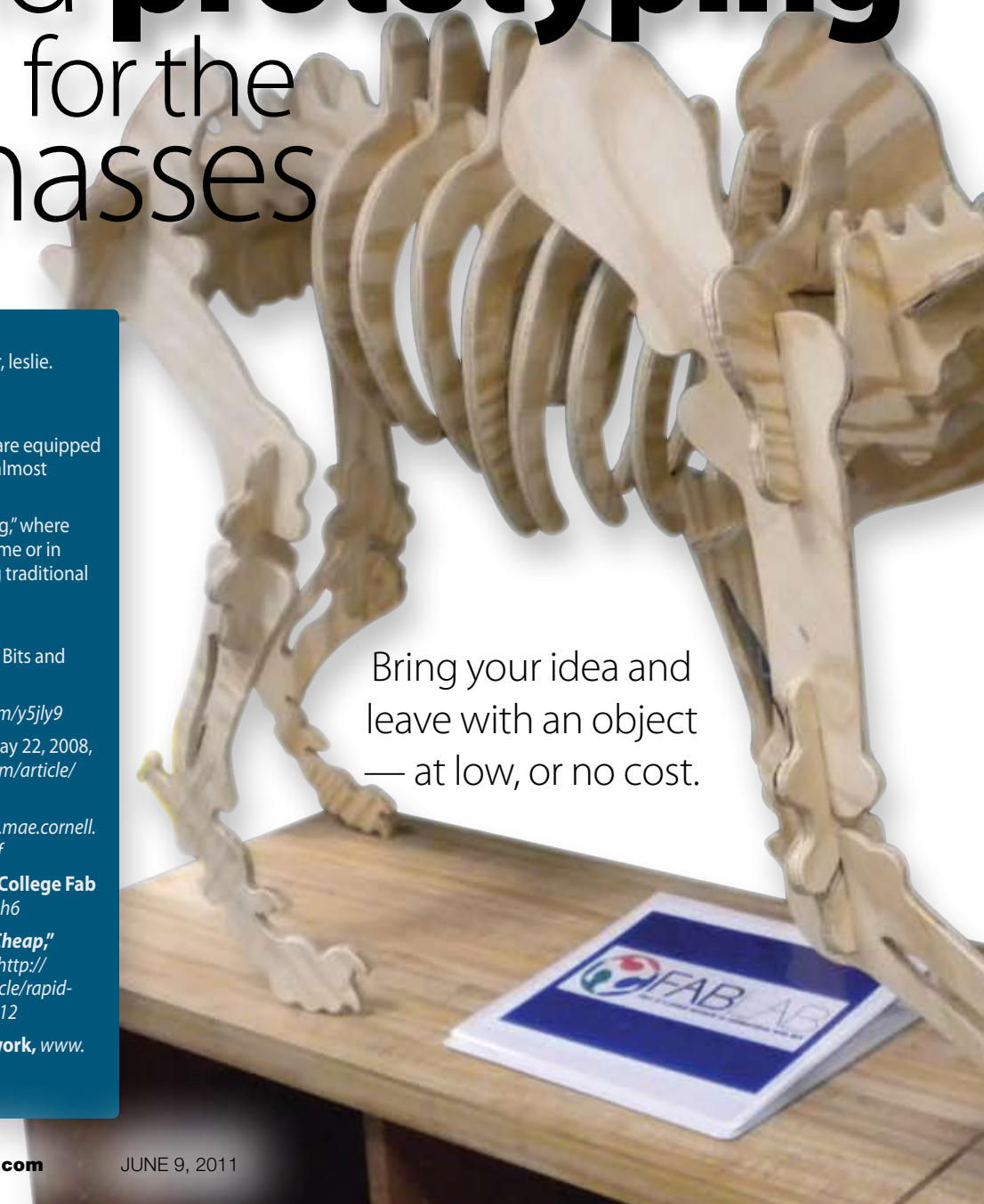
In many areas of the country and the world, you can now visit a local "Fab Lab" (short for fabrication laboratory), often housed at a nearby community college or in a mobile van to create just about anything at low cost or for free.

Professor Neil Gershenfeld of the **Massachusetts Institute of Technology** (MIT), Cambridge, Mass., helped develop the Fab Lab concept in the 1990s after an MIT course called "How to Make (Almost) Anything." The Fab Lab program came about at MIT's Center for Bits and Atoms, which, according to the Fab Central Web site, "broadly explores how the content of information relates to its physical representation."

Gershenfeld thought Fab Labs would bring digital fabrication to everyone from hobbyists to inventors, entrepreneurs, displaced workers, small-business owners, and individuals in workforce-development programs. The goal: letting ordinary people turn an idea into a product

Rapid **prototyping** for the masses



Bring your idea and leave with an object — at low, or no cost.

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Key points:

- Fab Labs around the globe are equipped to let almost anyone make almost anything.
- "Personalized manufacturing," where individuals make stuff at home or in small labs, is supplementing traditional methods.

Resources:

Fab Central, MIT's Center for Bits and Atoms, *http://fab.cba.mit.edu*

Fab@Home, *http://tinyurl.com/y5jly9*

Fab it Now, Machine Design, May 22, 2008, *http://beta.machinedesign.com/article/fab-it-now-0522*

Factory@Home, *http://www.mae.cornell.edu/lipson/factoryathome.pdf*

Lorain County Community College Fab Lab, *http://tinyurl.com/3vgpoh6*

Rapid Prototyping "On the Cheap," Machine Design, Jan. 12, 2010, *http://beta.machinedesign.com/article/rapid-prototyping-on-the-cheap-0112*

United States Fab Lab Network, *www.usfln.org*

for personal or commercial use by giving them access to design and manufacturing tools previously available only to engineers at large companies.

On a given day, users might include kids laser-cutting their names on pieces of foam, off-the-clock engineers making a Sterling engine, and local businesses testing concepts and improving designs with the Fab Lab's high-tech prototyping and digital-fabrication tools. Students in Ghana designed and manufactured fluorescent key chains, a preteen in Boston built a flight simulator, and a group in San Diego crafted an acrylic part to hold a cell phone on a wheelchair armrest.

Other users are laying the foundation for an approach called "distributed mass manufacturing," where individuals use personal-scale manufacturing machines at home to produce everything from simple objects like toothbrushes to complex parts such as machine components. It is said that the approach could help "democratize" technology, although it would probably augment, not replace, traditional manufacturing methods.

Gershenfeld also wanted to create what he called a "personal fabricator" that would let individuals 3D print objects at home on-demand from computer-generated designs. Researchers and students at **Cornell University**, Ithaca, N. Y., later brought this idea down to earth. In a project called Fab@Home (after Gershenfeld's Fab Lab idea), researchers build a microwave-oven-sized 3D printer they called a "fabber." Anyone can put a fabber together for a few hundred dollars.

The **United States Fab Lab Network** (USFLN), shepherded by Gershenfeld, began as the Midwest Fab Lab Network in December 2006 and was renamed in November 2009 by several community and technical colleges throughout the U. S. to help integrate Fab Labs with technology classes at schools. In addition, Gershenfeld is pushing Congress to establish a **National Fab Lab Network** (NFLN) to provide an umbrella organization for the support of what some also call "personalized digital fabrication."

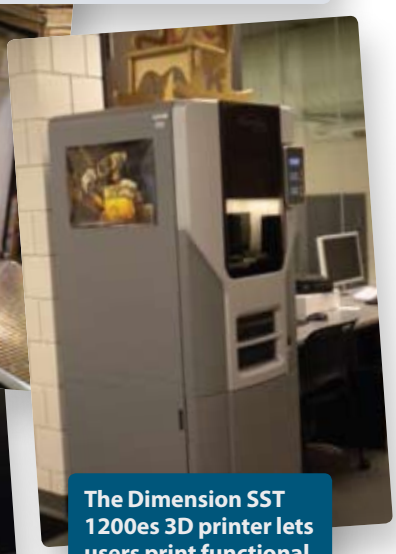
A Fab Lab user cut the wooden bones comprising this dinosaur skeleton with the ShopBot.

A winning design

LCCC student and Fab Lab technician Noah Rasor won the Grand Prize for his fabricated vessel "Noah's Ark" at a recent Fab contest in Amsterdam. He says different teams came up with other interesting designs. In one, an inflated garbage bag was used as a mold for a fiberglass hull. When the bag was deflated, the fiberglass retained the shape. The operator sat inside.

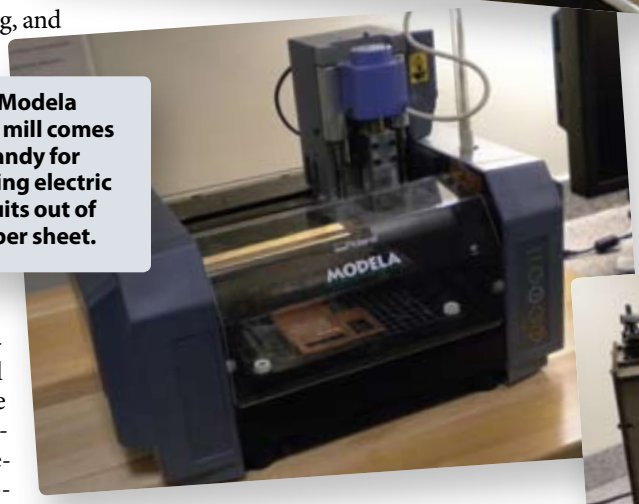
Rasor used the LCCC Fab Lab's ShopBot to make the boat skeleton. Here, he is operating the boat in an Amsterdam canal.

The Cleveland Metropolitan School District's new Fab Lab trailer is labeled "MC2 STEM" for the em-cee squared STEM high school sponsored by the Cleveland and White Foundations and GE's Nela Park Lighting Division in Cleveland.



The Dimension SST 1200es 3D printer lets users print functional models.

Currently, there are Fab Labs in more than 22 countries around the world, ranging from Afghanistan, England, India, Kenya, Norway, South Africa, and Spain to Elyria, Ohio. The Fab Lab at **Lorain County Community College** (LCCC) in Elyria, Ohio, was the second to open in the U. S. and the 10th to open in the world. Over about the last five years, the lab has quadrupled in size. All Fab Labs practice what are called the ABC's of Fab: Academics (science, technology, engineering, and mathematics (STEM) as well as fine arts); Business (entrepreneurship and rapid prototyping), and Community outreach (especially to non-traditional and underserved communities).



The Modela CNC mill comes in handy for cutting electric circuits out of copper sheet.

The lab at LCCC sports several tools for prototyping and low-volume production, including 24 late-model PCs equipped with easy-to-use design software such as CorelDraw and Google SketchUp. Because Fab Labs support collaboration as well as design, the computers are networked with those in other labs around the globe. Users anywhere can show each other what they are designing in real time.

The MakerBot is a tabletop 3D printer. The orange area is the build platform.

All the equipment in the lab runs on designs created in the software. Two Roland vinyl cutters cut cloth, cardboard, and copper sheet in addition to vinyl. Many users cut electric circuits out of copper sheets. A ShopBot router makes complex cuts in wood, and can, for example, carve intricate designs for furniture or elaborate lettering for signs.

An LCCC Fab Lab technician converses via digital technology with other Fab Labs around the globe.

The lab also contains a MakerBot, a machine similar to Cornell's fabbers. It can 3D print everything from cake frosting to small functioning batteries. An industrial-quality Dimension SST 1200es 3D printer lets users build durable models up to 10 ×10 × 12 in. out of production-grade thermoplastic for real-world testing. Users need only click "print" to prep the CAD file and print the model, then remove support material to reveal the physical model.

A table-top Modela milling machine lets users drill small holes and mill small parts as well as circuit boards. A NextEngine 3D scanner digitizes physical objects for CAD. Additionally, two Epilog lasers can each cut through plastic and other materials as thick as three quarters of an inch. The machines can also engrave text, graphics, and photos on materials such as glass, marble, and leather. **MD**