The three freshmen were given the task that nearly all students in McCormick’s Engineering Design and Communication course sequence receive: create a device that betters the life of someone with a physical disability. In this case, how could they help a stroke survivor open bottles and jars using just one hand?

They started the way each group of students starts—by taking a sheet of paper and writing down every crazy idea they had. The ideas ranged from vague (some sort of device) to absurd (monkeys, aliens with laser beams). But when the team visited the Rehabilitation Institute of Chicago and observed a stroke survivor who had the use of only one hand to open bottles, they saw the significance of the problem. The man put the jar between his knees, under his arm, and tried to hold it with one part of his hand while twisting the top with his fingers. “We felt weird watching him
struggle,” says Ted Stein (computer science ’11). “We only went for one observation, but that was enough to know what we were doing was necessary.”

The lessons Stein and his colleagues learned as freshman back in 2008—that good design fulfills a need, that design is ultimately for the greater good—are taught to students from their very first year at McCormick. Over the past 15 years, from the development of the first-year EDC classes and introduction of the Segal Design Institute to the creation of several graduate programs, design has become an integral part of the curriculum and culture at McCormick.

“It has made a big difference in how students think about themselves as engineers,” says Bruce Ankenman, associate professor of industrial engineering and management sciences and director of undergraduate programs for the Segal Design Institute. “They think of themselves as designers, not as mathematicians. It’s a different mindset.”

Though design has always been an integral part of engineering, McCormick has pushed it to the forefront in the past decade. What was once the Institute for Design Engineering and Applications at Northwestern evolved into the Segal Design Institute in 2007 after Gordon Segal and Carole Browe Segal, founders of Crate & Barrel, made a significant donation to the school. Housed in the Ford Motor Company Engineering Design Center (built in 2005), the Segal Design Institute aimed to be a hub for design education and research across the University.

A key aspect of that effort was introducing students to design in their freshman year during the required two-quarter EDC course sequence. There, students get their first taste of McCormick’s human-centered design curriculum. “Our students learn not only how to solve problems but also how to frame them,” says J. Edward Colgate, the Allen K. and Johnnie Cordell Breed Senior Professor in Design and codirector of the Segal Design Institute. “It’s about understanding users and stakeholders, and how—through design and technology—you can impact lives and solve problems.”

The problems these students are asked to solve are not trivial. In 2003 McCormick began a collaboration with the Rehabilitation Institute of Chicago. Under the direction of Elliot Roth, the Paul B. Magnuson Professor and chair of physical medicine and rehabilitation in the Feinberg School of Medicine, RIC had received a grant from the US National Institute on Disability and Rehabilitation Research enabling it to partner with engineering students to design solutions for their patients.

“It’s been a tremendous experience,” Roth says. “We’ve been able to teach engineering students the importance of working with people with disabilities to improve their functionality. The students learn the importance of listening to clients, and they create products that have immediate impact. Together we’ve been able to create some great devices.”

“One idea had the jar upside down before we realized that when you got it open, all of the contents would fall out,” Peterson says.

Products that make a difference
Now, most McCormick students work on RIC projects in their first quarter of EDC. For many, it’s their first foray into product development, a process that involves its share of hits and misses—as the team charged with designing a jar-opening device learned.

“We had things that attached to a table with a clamp and screw, and then attached to a jar with a clamp and screw, and you pushed one around,” remembers team member Doug Peterson (industrial engineering ’11). “It was complicated.”

Another idea was a wedge that fit under a kitchen cabinet. A third idea involved a plunger. “Mechanically, that turned out to be a nightmare,” Stein says.

“One idea had the jar upside down before we realized that when you got it open, all of the contents would fall out,” Peterson says.
Encouraging innovation
McCormick is not alone in its push for entrepreneurship. The Innovation and New Ventures Office (formerly known as the Technology Transfer Program) guides professors through intellectual property and licensing issues. The office is headed by Alicia Löffler, associate vice president of research, who has a background as a faculty member at the Kellogg School and in the biotech field.

“Our goal is to inspire innovation and create a bridge between Northwestern’s research and public benefit,” Löffler says. “We are working across the University with both professors and students to create a new culture of innovation. McCormick is also working toward this goal, and we’re excited to have it as a great partner.”

Given McCormick’s emphasis on entrepreneurship and innovation, it is no surprise that it plays a significant role in the activities of INVO. From July to December 2010, INVO helped McCormick faculty—guiding them through intellectual property and licensing issues—with 55 new inventions. That’s more than half of all the projects overseen by the office during that time. INVO also helped McCormick faculty found five new startups in 2010—more than any other school at the University.

In addition to overseeing individual faculty projects, INVO works closely with the Farley Center: Farley Center director Mike Marasco sits on the INVO board, and the NUvention: Energy course draws on INVO’s expertise to determine which green technologies developed at Northwestern might be viable businesses. “The Farley Center is better positioned today because of INVO,” Marasco says.

Finally they came up with a utensil with two conical indents into which users could place different-sized jars while they opened the top with one hand. The students soon realized that one cone-shaped indent was enough, and they created a prototype that looked like a volcano. The “Jarcano” was born.

They built a prototype out of wood, but needed a material that prevented the jar from slipping once inside the cone. They found Dycem, a high-friction rubber, but even that proved troublesome: it wouldn’t stick with glue, it became useless when wet, it fell apart in layers when they tried to cut it. Eventually, they succeeding in making a prototype (using staples and cutting the Dycem with a laser) and brought it to RIC for testing.

They didn’t even need to show the patient how to use it. He set it on the table and immediately opened a jar. “He got wedged to it right away,” Peterson says. “We told him we had a different prototype for him to try, and he said no.”

“He had this look on his face,” says team member Jonathan Stockton (mechanical engineering ’11). “He just stared and pointed.”

As they developed the Jarcano, the team worked with Edna Babbitt, a therapist at RIC who introduced them to the patients who would test their designs. “They presented themselves professionally,” she says. “They took it very seriously. I thought their final design was great. It seemed like it could be functional for everyone from stroke survivors and amputees to people with arthritis. It’s something I’d like in my kitchen.”

As EDC found success with RIC projects, McCormick wanted to expand the undergraduate curriculum to include design courses beyond the freshman year. Today the school offers courses on industrial design, computer-aided design and intellectual property as well as those involving interdisciplinary design projects. “We have a nice suite of courses at the undergraduate level,” Ankenman says. “They provide opportunities for design and give students the tools to make better design projects.”

Students have brought design into their extracurricular activities, as well. The Design for America student group uses design for social good and has received accolades for its work on improving hand hygiene and reducing water consumption. Other student groups, including Engineers for a Sustainable World and Global Architecture Brigades, have designed projects for communities in developing countries. “There are a huge number of students who are very excited to design for local and international social impact,” Ankenman says. “They haven’t even graduated, and already they want to use their design skills to make a difference.”

To further extend its commitment to design, McCormick has also created a master’s program in engineering design and innovation (MS-EDI). “We wanted a cohort of graduate students who were committed to design and could be here full-time to flesh out our design culture,” says Colgate, who directs the program. The 15-month curriculum, which includes a summer internship, is largely project based. Students have worked with companies locally and nationally to design products ranging from a solar-powered rechargeable battery to a new type of bottle cap.

“We want to promote design across the University,” he says. “Design—understanding problems, creating solutions—is what drives innovation in society, and we hope to cultivate that way of thinking so our graduates can be successful in this global economy.”

Creating innovation for industry
McCormick has also expanded its design education to meet industry needs. Six years ago the MMM program—which combines the master’s in engineering management with a master of business administration degree—began to include courses on product design and development. Don Norman, a well-known figure in the design field, joined as codirector shortly thereafter. His design thinking, coupled with the systems expertise of Sudhakar Deshmukh, the Morrison Professor of Managerial Economics and Decision Sciences in the Kellogg School and MMM codirector, led the program to be refocused on design and operations. More recently, another graduate program, focusing on product development for midcareer designers and featuring both business and design courses, was renamed the Master of Product Design and Development (MPD) program to highlight the role of design in the curriculum.

In 2010 both the MMM and MPD programs got a new codirector in Greg Holderfield, who was
previously vice president of design and strategy at ARC Worldwide–Leo Burnett. Holderfield, an MPD\textsuperscript{2} alumnus whose design work has been recognized globally with more than 25 industry awards, said he returned to help influence the next generation of designers. “I sought out the program as a student because I knew the industry need was shifting into strategic thinking,” he says. “I wanted the skill sets that would allow me to hold my own at the table of business. When I graduated, I felt significantly empowered because I had a set of tools that enabled me to succeed and branch out in my career. I saw returning as a director as a great opportunity to help other students find the way.”

Holderfield’s approach to teaching builds off his successful 20-year career in industry; he is tuned into the needs of consumers, organizations, and students. In his graduate courses he pushes students to be creative through what he calls “process-plus-possibility-based thinking,” which, he says, fosters interdisciplinary development and in turn produces meaningful innovation. “It’s a truly collaborative way of problem solving that considers all aspects of the innovation process,” he says. “My undergraduate education in industrial design took place in a school of fine art, which I always believed shortchanged the perception and role of design in innovation. Teaching process-plus-possibility-based thinking provides a unique skill set in a school of engineering that elevates the traditional practice of design beyond object-based development. It’s about creating real meaning. It took me 15 years and a master’s degree to cement that idea; students today don’t have that time.”

One of the ways Holderfield and Colgate hope to push design at Segal is to recruit PhD students to facilitate more design research. Elizabeth Gerber, assistant professor of mechanical engineering, was hired two years ago to begin that process. Her own research looks at how people innovate individually and in teams. “We need PhD students to elevate design at the University,” Holderfield says. “We want to bring in graduate students who can study this process and help support this thinking. Northwestern has the great fortune to be a leader in engineering, and design has endless opportunities for growth. The industry is extremely interested in what’s going on here.”

**From the classroom to the community**

The Jarcano has continued to evolve over the past two years. Several more students refined the design, changed the materials, and fabricated 10 new versions for RIC to give out to those who need them. Segal administrators would like to create many more using mass-manufacturing techniques, but that’s not realistic. “We can’t make thousands of the products we develop,” Ankenman says.

To get around this stumbling block, McCormick has partnered with University of Illinois at Chicago’s RecTech program, a clearinghouse for information on recreational opportunities for people with disabilities. McCormick students can post their RIC-related innovations on the RecTech website with assembly instructions (wiki.rectech.org). “That way users can build one of our devices or find someone to build it for them,” Ankenman says. “It’s an outlet for us to bring our designs to the public.”

The idea that their designs can become products that are really used by people is a major motivator for McCormick students. “It’s discouraging when you work on something for hours and hours, and then it ends up in a file cabinet,” says Peterson. “The greatest success of a project is when it’s used after the project is over.”

That real-world application is precisely what the Segal Design Institute aims to achieve. “Design is what engineers do to make a difference in the world. It’s what has solved many problems of humanity,” Ankenman says. “Design is continually evolving. We hope that our curriculum and research continue to evolve along with it.”