Susan Montgomery of the University of Michigan

Scott Fogler and Lara Zielin
The University of Michigan • Ann Arbor, MI 48109

Undergraduate program advisor Susan Montgomery was three years into a tenure track position at the University of Michigan (UM) in education research when she realized that teaching and advising were her true passions. Driven by those passions, Susan did the unconventional thing and became a lecturer in 1999. Since then, she has been a "mom" for over 1,000 ChE students, who appreciate the warm and supportive community she helps create within a big university atmosphere.

"Susan Montgomery literally holds together the undergraduate curriculum at UM," says Ron Larson, chair of UM's chemical engineering department. "She is the most appreciated faculty member among the undergrads. The key element that makes her successful is her singular focus on the students and their needs. While other faculty members also care deeply about students, their research and administrative portfolios limit the extent to which they can involve themselves in the concerns of the students. There is simply no substitute for having a member of the faculty who is devoted exclusively to the students."

This is no small feat in a ChE program as large as UM's. Total enrollment hovers around 350 students. "UM can be daunting," explains Larson. "Even within the 'community' of a department, students can get lost." Susan works hard to combat this by maintaining a connection with each chemical engineering class. "Not only does she know every undergraduate that comes up through the program, she keeps track of them as they move on to their future careers," says Larson.

While she loves the classroom and has taught a wide range of undergraduate classes—from introduction to engineering to process design—Susan has a hard time choosing a favorite topic. "The real fun is seeing students transition from one phase of their careers to the next," she says. "The thrill is watching students blossom."

Susan works tirelessly to make students' growth and advancement a reality. In addition to her advising and lecturing, Susan is the principal author of the *Visual Encyclopedia of Chemical Engineering Equipment*, a CD-ROM designed to help beginning ChE students understand how chemical engineering equipment works.

The CD-ROM stemmed from her research in the Multimedia Educational Laboratory (MEL) at UM, which focused on studying the diverse learning styles of chemical engineering students, and developing multimedia educational software to address those learning styles. Susan then analyzed student use of this software to discern what types of interactions were preferred by what students. The goal was to help future educational software developers better understand the role that different interactions could play in addressing the needs of a variety of learners.

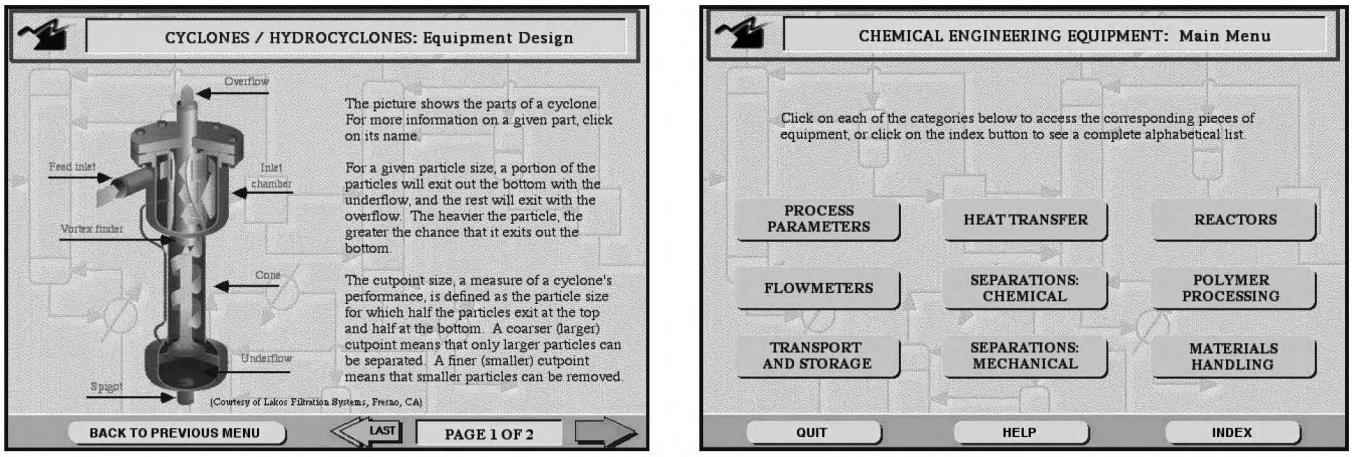


Figure 1. *A screenshot from Susan's encyclopedia CD-ROM showing an oversize view of equipment, left, and the main navigation page, right.*

The CD-ROM includes animations and pictures of real equipment as well as examples of applications of the equipment. From the main menu, the user can branch into a variety of different topics and operations, such as the corresponding pieces of equipment for processes including heat transfer, reactors, materials handling, and more.

The CD-ROM encyclopedia has been extremely well received both in academia and industry. Figure 1 shows a screen capture from the CD illustrating a sample introductory overview of an item of equipment—cyclones and hydrocyclones in this instance. The possibilities for illustrating chemical engineering practice are almost endless, and many of the screens in the CD show dynamic operation of the equipment, as in the case of bubble-cap distillation columns, screw extruders, filters, and cyclones, to mention just a few. When a visit to a chemical plant or refinery cannot be made, the *Visual Encyclopedia* is an excellent substitute for illustrating various operations that might otherwise have to be described more passively. It has been used for numerous industrial training courses. The CD is also included in two of the most popular textbooks in the field: Rich Felder's *Elementary Principles of Chemical Processes*; and Scott Fogler's *Elements of Chemical Reaction Engineering*.

In addition to the Encyclopedia CD-ROM, Susan and her colleagues have developed two other CDs. The first, titled *Engineering Fundamentals in Biological Systems*, provides real-world applications in fundamental processes, such as material balances on an artificial kidney. The second CD, *Material and Energy Balances*, provides interactive problem solving in real-world environments including the car prepainting system in Ford Motor Company's Wixom Assembly Plant, and Ann Arbor's wastewater treatment plant. The CD also includes tutorials on Pxy-Txy diagrams, psychrometric charts, and enthalpy-concentration diagrams. The CDs are distributed through the CACHE Corporation.

FAMILY TIES

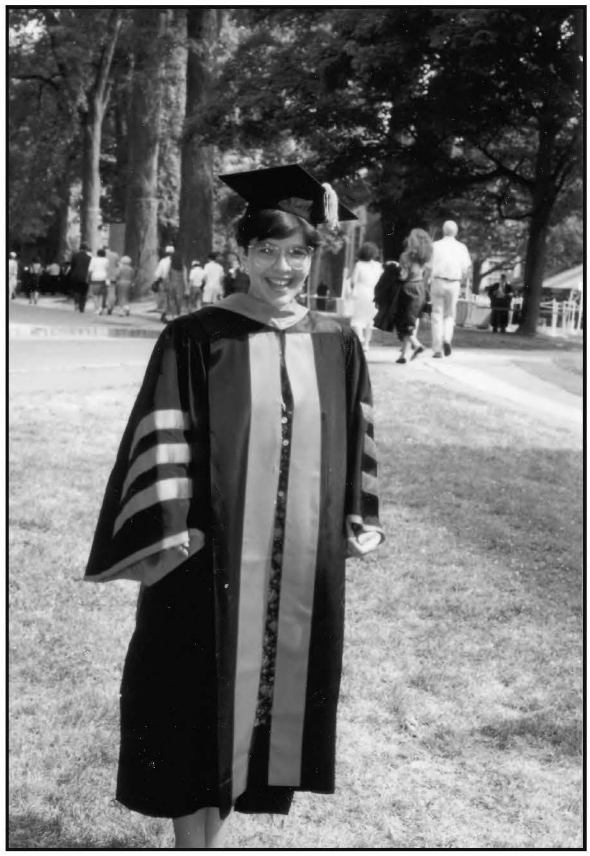
Susan's background and upbringing have much to do with her success in the field. She was born in Peru, of a Peruvian father and an American mother. Her father is a civil engineer who shared his passion for engineering with his daughters. He used to take Susan and her sister to job sites, showing them how things worked. Susan recalls going for a walk with her dad when they chanced upon a street replacement project. Her dad showed her all the layers that made up a street, and they met the construction workers.

Susan and her family lived for a year and a half in Nicaragua, where her father was an Agency for International Development consultant with their ministry of public works. Forced to leave suddenly in 1978 when a civil war broke out, Susan, her sister, and her mother moved to Ann Arbor, Mich., where her American grandmother lived.

The summer after her junior year in high school, Susan attended a Women in Science and Engineering program at Carnegie Mellon University and came home announcing that she intended to be a chemist. Her father corrected her, "reminding" her that she would be an engineer.

Susan graduated from high school at age 15, a feat she attributes to an excellent kindergarten that allowed her to complete first, second, and third grades in one year. She completed her undergraduate work at UM, then went on to Princeton University for her graduate work. Susan's advisor at Princeton was Professor Ludwig Rebenfeld, of the Textile Research Institute, where her research focused on flow through porous media. But her passion was in teaching, and her goal was a faculty position.

Susan had doubts, however, about her ability to complete the Ph.D. Thrice during her time at Princeton, she announced to Prof. Rebenfeld that she was quitting the program. Prof. Rebenfeld offered unwavering support, but two other factors



Right, Susan celebrating her fourth birthday. Far right, a beaming Susan on her graduation day at Princeton. Below, Susan and her older sister Betsy proudly display a snowman they "engineered."

made her tough it out and complete the program. The first factor was knowing that without a Ph.D., she would not be able to fulfill her goal of becoming a faculty member. The second was the scolding of her grandmother, Margaret Hampshire, an independent woman with whom she lived while an undergraduate at UM. Where others, upon hearing that she was considering dropping out, offered condolences, her grandmother replied with comments such as, "We didn't work this hard for you to drop it all now. You get back there and get that Ph.D.!"

Perhaps this is why Susan can now speak so well to the number of women students who are struggling to find their place in the ChE program. "After a month, they may come to me feeling like maybe they're not good enough," she says. "I encourage them not to focus on whether or not they're 'good enough' but on whether or not this path is taking them where they want to go." The approach seems to work. Susan says a number of alumni have thanked her for the advice she offered early on in their academic careers. "They're out there doing what they love now, so they can look back and be glad they stuck with the program," she says.

Susan has the strength to help many, but when she needs someone at her side she calls on her sister, Betsy Vera. Susan says Betsy has stood by her continuously. They remain best friends and stay close, even though Betsy now lives in Chicago.

"I have learned so much from my family," says Susan. For example, she recalls watching her mother complete her undergraduate studies in her 40s, and then go on to earn a master's degree in Latin American Studies from Georgetown University. "Now that I am in my 40s, too, I appreciate having my mother as a role model for living the life you are meant to live," she says. Susan also says her mother's death at the young age of 52 solidified the importance of living your life now, versus waiting until retirement to do things you've always dreamed of.

ENTERING THE FIELD

Susan got her first job on a fluke. Like many undergraduate students, she was struggling to find funding for spring semester of her third year. She was just leaving the dean's office, disappointed, when she ran into Scott Fogler, a UM professor of engineering, whose class she had just finished taking, and acing—she had been the top student. He inquired about how things were going and, upon learning of her situation, he immediately offered her a summer job working in his laboratory and helping him with his textbook. This marked the beginning of more than 20 years of collaboration in various educational projects.

Susan's first teaching position was as a TA for the junior-level laboratory course at Princeton, where she caught the bug for education. "I could see the light bulb go off in students' minds," she says. An internship at a local community college teaching pre-algebra at night made her intrigued about learning styles, and the de-

Left, Susan poses with her sons and her father at the Plaza de Armas in Lima, Peru. Above, Susan (middle) and her sister, Betsy Vera, flank Prof. Dale Briggs at a 1984 undergraduate graduation reception; to her left are her grandmother and mother.

velopment of learners through their college careers. She was quite intimidated when asked to be responsible for the whole laboratory course at Princeton the following year, but that experience only cemented her decision to become a faculty member.

During this time, Susan also recalls going to the engineering library at Princeton to search for a research article in *Chemical Engineering Science*. Instead, she discovered *Chemical Engineering Education*, stacked right next to the journals she was supposed to be reading. All plans for the afternoon were scrapped as she spent long hours browsing through *CEE* instead.

Also during her time at Princeton, Prof. Rebenfeld supported her attendance at the 1990 ASEE National Conference in Toronto, back in the days when few graduate students attended the conference. Participants at that time stayed in college dorms, which really helped colleagues get to know one another better. "I always speak of this conference as the time in which I 'found my people'," she says. "Their dedication and passion for teaching matched my own."

After graduate school at Princeton, Susan returned to UM to complete a two-year postdoctoral appointment developing educational software for chemical reaction engineering and problem solving. Once again, she collaborated with her former professor, Scott Fogler, along with two dozen outstanding chemical engineering students. It was these students who taught her how energizing it can be to supervise teams of undergrads.

Again, Susan experienced a sea change. "At the time, my plans were to teach at a small undergraduate institution, or community college," she says. "But my love of UM and Ann Arbor meant I eventually accepted a tenure-track faculty position focusing on academic research, the first in a chemical engineering department." Susan's research focused on the use of multimedia to address diverse learning styles, and once again she supervised teams of undergraduate students in developing educational software.

Susan has a long list of accomplishments to her name. In addition to those already mentioned, in 1994 she started a student chapter of ASEE at UM, the third such chapter and one of the few long-standing active chapters. The chapter has remained strong through the years, creating real change in the culture and appreciation of teaching through activities such as workshops and panels on engineering education issues.

"I strongly feel that the ASEE student chapter changed the culture of teaching and graduate student training at the College of Engineering," she says. "Many of the activities we organized, which centered around preparing students for faculty positions, have been adopted by the college." These activities include academic job-search workshops and panel discussions on working toward tenure.

To further prepare students, Susan regularly teaches a graduate course, "Teaching Engineering," that draws 50 graduate students and trains them for academic positions. The students learn to develop syllabi and course materials, practice presentation and teaching skills, and are introduced to different learning styles. They also learn to deal with student issues that may arise. "This has become

an invaluable class for would-be future faculty members," says Sharon Glotzer, UM professor of chemical engineering. "It attracts students from around the College of Engineering, including postdoctoral students."

Susan's concern for the well-being of graduate students and staff extends beyond the academic arena. Susan works to assist students with both academic disabilities and psychological issues. "Many times these issues manifest themselves during college years," she explains, "and bad grades are some of the early warning signs." To aid students, Susan says she tries to remove any stigmas around the topic of mental illness by sending out e-mail messages to students about depression, educating faculty about the issue, and encouraging those who need assistance to seek professional help. Her important work has not gone unnoticed: Recently she was asked to take part in a video titled "Depression on College Campuses."

Susan, right, with sons Ian, 12, and Nicky, 7, on a vacation to the Canadian Rockies.

In this sense, many faculty think of Susan as a pioneer. "She forges new ideas and utilizes new resources to make the curriculum more effective," says chemical engineering lecturer Barry Barkel. And it's not just students who benefit from her tireless work—so, too, do alumni. "Susan occupies the unique position of being the primary focal point of the department for both undergraduate students and alumni," says Barkel. "She is the face of the department for many people."

BEYOND RESEARCH AND TEACHING

Susan's family members likely think of her as a pioneer, too. She and ex-husband Sean Montgomery, whom she met when they were both undergraduates at UM, have two boys—Ian, 12, and Nicky, 7,—whom she has taken on summer excursions to places such as the Grand Canyon and the Canadian Rockies, in keeping with her philosophy to take adventures now and not wait until retirement. This summer, they will embark on a trip to Peru with Susan's sister, Betsy, where they will visit family members as well as journey to Machu Picchu.

Even when not traveling, life with two boys—and two cats, Smokey and Aten—is understandably very active. Both boys are involved with karate and Ian plays on various team sports. "We also enjoy going for walks and bike rides, and going canoeing down the Huron River," Susan says.

For Ian, watching his mom forge her own path in engineering may have inspired him. He has aspirations to one day be a robotics engineer. Nicky thinks that might suit him as well—if he doesn't make it as an NBA player first.

Susan has not forgotten her Hispanic heritage, and has instilled this pride in her sons. Ian and Nicky's friends have come to look forward to her *alfajores*—Peruvian treats she prepares for any and all occasions. She also serves as faculty advisor to the Society of Hispanic Professional Engineers, participates in numerous sessions organized by the Minority Engineering Program Office (MEPO), and recently started "Ingenieros," an informal Spanish conversation group.

"Dr. Montgomery has been an integral part of the diversity effort here in the College of Engineering," says MEPO program director Derrick Scott. "She rarely turns down a request to participate in our initiatives to attract and retain underrepresented minority engineering students."

Susan is careful, however, not to get too busy. "My boys are the loves of my life and I want to share in every aspect of their growing up," she says. After missing Ian's first soccer goal while out of town to be an ABET observer, Susan was determined that she would forgo traveling for business for a few years. "Ron Larson, the department chair, supported my efforts to create a balance between my academic position and my family life," she says. Despite this, Ian loves to point out that Susan missed his second soccer goal, which he scored while she was videotaping Nicky and his friends playing on the sidelines.

She did bend her own rules and take one business trip in 2002 to the ChE division Summer School for ChE faculty in Boulder, Colo. As Susan told the participants at the welcoming session: "It doesn't matter what city you are in, if you are surrounded by your friends and colleagues of the ASEE ChE division, you'll always feel at home."

It's hard not to feel at home around Susan, whether in Colorado, Michigan, or Peru. Her excellence, determination, and love for people translates into every activity she performs. "In short, every department needs a Susan Montgomery on its faculty," says Ron Larson. "But they can't have ours." ❐