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DeSimone has worked at UNC-Chapel Hill for 18 years. To retain him, the university got him a \$3 million research tool -- to be housed at N.C. State. That's how important this is.
Staff Photos by Shawn Rocco



Right: Philip DeSimone messes with his dad as they wait at a restaurant. 'Represent the family well,' the children are often told.



DeSimone samples the seafood dinner of Suzanne, his wife and high school sweetheart, at Betty's Waterfront restaurant in Holden Beach.



Left: DeSimone hugs his daughter, Emily, at a holiday party.



DeSimone lives by his Blackberry, even as winter commencement gets under way. With him is Ed Samulski, who recognized DeSimone's potential early on and hired the young chemist 18 years ago.



Joe DeSimone, center, discusses a polymer chemistry experiment on which grad student Kevin Herlihy, left, is working. A place on DeSimone's team can translate into corporate ownership.

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Joe DeSimone - 2008 Tar Heel of the Year

SARAH AVERY, Staff Writer

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It's perfect that Joe DeSimone is a chemist.

The science, founded on an ancient quest to turn rocks into gold, is fundamentally preoccupied with transformation.

So, too, is DeSimone, a chemist lauded with the highest honors and a potent force of change in North Carolina and beyond.

Since arriving at the University of North Carolina at Chapel Hill in 1990, a fresh-out-of-grad-school assistant professor, DeSimone has become one of the nation's premier scientists -- the youngest member named to the National Academy of Engineering and, last summer, winner of the \$500,000 Lemelson-MIT Prize, which many consider a step to the Nobel.

Along the way, he has founded companies, led the university into entrepreneurial ventures, received more than 100 U.S. and international patents, pulled in millions of dollars in federal grants and built a research empire poised to become a major player in the emerging field of nanotechnology.

At 44, DeSimone hasn't even hit midcareer.

"To say he is extraordinary would be an understatement," says Erskine Bowles, president of the University of North Carolina system.

DeSimone's current research in nanotechnology -- mass producing microscopic particles in any size or shape -- could be a blockbuster. Nanoparticles hold promise because, among other things, they can be loaded with chemotherapy drugs or completely composed of medicine, like tiny pills, and home in on disease sites in the body.

"The potential power is quite significant," said Dr. Anna Barker of the National Cancer Institute. On

the strength of DeSimone's breakthrough, Barker said, the government agency awarded UNC-CH one of eight national centers for nanotechnology research, providing \$5 million a year for five years.

It's the kind of attention that makes DeSimone highly sought after. Keeping him from leaving North Carolina, say Bowles and others, is the academic equivalent of retaining a Dean Smith. Twice DeSimone has been wooed by top universities, and twice he has been persuaded to stay, given salary raises, promotions and other inducements.

What has held DeSimone more than anything, however, is the university's willingness to consider change -- change in the way academic science is conducted, change in how discoveries are brought to the market.

Such an approach is crucial to curing cancer, curbing global warming, creating technologies that improve the world -- the things DeSimone says he wants to do.

"This is how we can solve the greatest problems of our time," he says.

DeSimone doesn't know his IQ, but his mental agility might rank in the freaks-of-nature category.

"He's in the upper 1 percent of people I've dealt with, in terms of brilliance and importance to an institution," said James Moeser, the former chancellor at UNC-CH who helped craft incentive packages to keep DeSimone from leaving.

Friends and colleagues say DeSimone's genius lies in applying complex science to solve everyday problems. It's what caught the attention of the Lemelson-MIT Prize committee, which cited DeSimone for the breadth of his innovations -- from green manufacturing to medical devices to nanomedicine -- and his "unique ability to transfer his novel solutions from the lab to the marketplace."

That ability was evident from the start, when he gained fame in the early 1990s for developing an environmentally friendly dry-cleaning process using carbon dioxide instead of a toxic petrochemical. The process, licensed by UNC-CH, became the foundation for Hangers Cleaners, a dry-cleaning franchise DeSimone founded in 1996.

At the time, Hangers was one of the state's fledgling entrepreneurial efforts to commercialize the fruits of academic innovation. Now technology transfer is a common practice at UNC-CH and N.C. State University, where DeSimone holds a joint professorship, but DeSimone's leap from laboratory to marketplace set a new pace.

The same year Hangers was formed, DeSimone and UNC-CH struck a licensing agreement with DuPont. The chemical giant agreed to build a plant in Fayetteville and use DeSimone's carbon dioxide process for making Teflon -- a ubiquitous coating that had become controversial for a hazardous chemical involved in manufacturing. DeSimone's process eliminated toxicity.

Both processes sprang from an idea DeSimone originally had as a graduate student at Virginia Tech, where he studied polymer chemistry -- the science behind plastics. He noodled with the idea of using supercritical carbon dioxide -- a form between gas and liquid -- in combination with other chemicals to create novel cleaning processes and plastics. The idea wasn't fully formed, but when DeSimone was set to graduate in 1990 and began applying for jobs, he tossed it out to a few prospective employers.

Of 13 job interviews, he had 17 offers from chemical companies such as DuPont and Dow, where he was certain to start at \$55,000 a year -- a princely sum to a 24-year-old Ph.D. But he also interviewed at three universities, even though DeSimone had not done postdoctoral research, which most require of beginning professors.

"My colleagues said no, we're not interested in this guy," says Ed Samulski, who started UNC-CH's polymer chemistry program and made DeSimone his first hire. "I pressured the committee a little, and they reluctantly agreed. They said, 'You can bring this guy in if you want, and we'll try not to embarrass him.'"

"When he came, he essentially blew everybody away."

Early sacrifices

The pay at UNC-CH was \$20,000 lower than DeSimone had been promised in industry. His office was in a dark basement of Venable Hall, a relic of a building famous for its dungeonlike, subfloor corridors. He had four students, no guarantee of tenure, and one colleague in polymer chemistry -- Samulski.

Liking his idea about supercritical carbon dioxide, the university gave him wide latitude to pursue the science.

"He was so happy, so excited," his wife, Suzanne, recalls. "When you're creative, the last thing you want to be told is what you have to do."

So the DeSimones moved to Carrboro from Blacksburg, Va. -- Joe and Suzanne and their young son, Philip. Daughter Emily was born in 1992. They moved into a cookie-cutter neighborhood of 1,700-square-foot houses, where Joe graded the front yard for grass seed by pulling Philip on an old gate. Suzanne went to work at a chemical company in the accounting department.

It was a life that would become far removed from anything they had known, but it began on familiar, unpretentious footing.

Both DeSimones rose from deep, blue-collar roots. High school sweethearts, they married a month after Joe graduated from Ursinus College, a small liberal arts school in their hometown of Collegeville, a Philadelphia suburb.

Joe lived at home, a "townie" who also served on the volunteer fire department and stocked grocery shelves at the ACME market on weekend nights. His father, an Italian immigrant, held two jobs as a tailor at competing department stores, and his mother was a part-time bookkeeper.

Despite winning top honors in high school, DeSimone never considered a place such as Harvard or Yale, and he instead chose to attend Ursinus because he didn't have to pay room and board.

"We were not worldly about what Ivy League meant," he says. "To us a big school was Penn State or Villanova."

Suzanne went into the work force right after high school, at an insurance company by day and the grocery store at night.

In choosing North Carolina, Suzanne was hesitant, because it was so much less money than Joe could have made in industry. But she loved his enthusiasm and shared his appreciation that the university took a chance on him when he didn't have the usual credentials, nor a fancy academic pedigree.

That appreciation runs deep in both of them. Friends cite the couple's loyalty -- to old friends, to the university, to their roots. DeSimone keeps test tubes of concoctions he made in college and grad school, still has a wooden shop stool he made in middle school, roots for the Tar Heels despite a huge tug on his heart when they play the Virginia Tech Hokies.

A major sports fan -- he longed to play quarterback on the high school football team, but even before he grew to his current 6'3" and 265 pounds, his coach had him pegged as a lineman -- he remains a fierce fan of all teams Philadelphia. At a Carolina Hurricanes game one night, he was picked up on the Jumbotron and proudly flashed his orange-and-black Flyers jersey.

Even as his career took off, he mixed a successful formula for maintaining balance. He's self-assured but not arrogant. He's constantly busy but not flustered. He regularly takes red-eye flights home so he can eat breakfast with his family -- an ethic he learned from his mom, who bundled up dinner and carted the children to his dad's second job so the family could eat together.

Among his best friends are college mentors and former students. The Samulskis are like family.

DeSimone's first grad student, Valerie Ashby, remembers meeting him in his basement office, just days after he arrived. Boxes were stacked on his desk, and the dingy quarters were lit by a single window at ground level.

"You could see the ankles of people walking by," Ashby says. He was 25, she was 23, but he became her mentor and remains so "until I take my last breath," she says. She credits him with mapping a path for her future, providing a vision of how to pursue her dream of a career in academia. When Ashby took a job on the faculty at Iowa State University, turning down a job at MIT, DeSimone was incredulous.

"We laugh about it," she says, noting that the move was perfect for her at the time. "I have always been clear about who I am, and he has been clear about what I could be."

Five years ago, DeSimone helped woo her back to Carolina, and this month, she delivered the commencement address to December graduates.

Success and setbacks

It wasn't long before people were referring to DeSimone as a science superstar. His record of creating new uses and processes for carbon dioxide fueled large federal grants to support more research -- so large, in fact, that his grants were quickly surpassing the startup money departments give new professors to establish their labs.

DeSimone was awarded tenure in five years and given a simultaneous appointment at NCSU in its chemical engineering department.

But it wasn't all rosy. By the early 2000s, DeSimone's two prominent successes at DuPont and Hangers were running into problems. Hangers wasn't catching on among mom-and-pop dry-cleaning owners, in part because the equipment was far more expensive than traditional machines, and the business eventually fizzled.

"It was immensely frustrating and disappointing," he says.

Then DuPont did not expand its investment in DeSimone's Teflon process beyond the Fayetteville plant, and because DeSimone and UNC-CH had granted the company exclusive licensing rights, they could not sell the technology.

From both experiences, DeSimone says, he learned valuable lessons. And there were always new opportunities. Just as the Hangers venture was winding down, DeSimone ran into an acquaintance at a party, UNC-CH alum and venture capitalist William Starling, who mentioned his work with a cardiologist at Duke. They were trying to develop a tiny coil called a vascular stent that could be implanted to deliver artery-opening drugs and then gradually dissolve as if it had never been there.

DeSimone joined the team, and soon helped make the absorbable stent act like metal to prop open a blocked artery.

"It was like a fresh, new ocean," he said. "It felt really rejuvenating to think about something other than carbon dioxide and polymers."

Within eight months, the Synecor group developed a prototype stent, tested it in animals and sold it for more than \$100 million. DeSimone, who had a single-digit percentage ownership for his role in the stent's development, stands to make millions.

But that wasn't all. He got his feet wet in the fast-moving current of medical technology. He was eager to dive in.

One idea, then another

Utility is a hallmark of DeSimone's science, and he tells his students that unless something can be put to use, it's not worth much. That credo fed his creativity and led him into polymer chemistry -- an area of science that had the bland veneer of practicality. Now, he was driven to figure out how his science might be applied to a whole new realm, manipulating polymers to help sick people.

One of his lab's discoveries was a Teflon-like material that was liquid. It could be pressed into different forms, then solidified with heat or light. Once cured, it was impervious to solvents.

"It turned out to be an excellent molding material," DeSimone says. He filed for patents, and in 2003, his group used it to make tiny diagnostic tools called Lab on a Chip to help detect cancer.

Previously, the tiny chips were made on expensive silicon wafers. Now they could be mass-produced on relatively cheaper plastic. That gave DeSimone other ideas.

Using an advanced printing press technique used to make computer chips, the liquid Teflon-like substance could churn out perfect molds on a tiny scale -- essentially a long series of minute ice cube trays. The particles that sprang from the trays were even smaller -- nanosized, one billionth of a meter. He now has 80 patents pending in the technology.

This work created an immediate stir. By mass-producing the particles in unique sizes and shapes, scientists could for the first time take advantage of geometry -- an evolutionary step that had previously been nature's edge.

Now drugs could be built to mimic pollen particles, which are uniquely capable of infiltrating the lungs. Drugs could also mimic bacteria, which are savagely good at busting into cells.

DeSimone formed a company called Liquidia to make the particles and market the technology for other uses. UNC-CH has an equity stake, and many of his former students are principals and owners.

Jason Rolland, a co-owner of Liquidia who helped develop the production technology for the nanoparticles as a Ph.D. student in DeSimone's lab, said his main goal in studying under DeSimone was to get his doctorate and go to work in industry. Founding a company was not on his mind.

"Joe believes in you so much it's scary," Rolland says. "He makes you realize an ability in yourself you didn't know you had."

The company now employs nearly 40 people at its offices in Research Triangle Park and has advanced from the startup stage. After a national search, a chief executive officer, Neal Fowler, was hired from a subsidiary of Johnson & Johnson.

Everything was going along smoothly when, last fall, MIT called DeSimone. Two weeks later, Stanford was on the phone. For the scientist who had crashed UNC-CH's doors with no Ivy League pedigree, the prospect of being wooed by the toniest of suitors was tempting.

"I felt like I had to listen," he says.

UNC, NCSU join forces

He had received other calls from prestigious ZIP codes. In 2002, Georgia Tech and the University of Florida both tendered offers. DeSimone and his wife even went house-hunting in Atlanta, but the counteroffer from UNC-CH gave him most of what he needed and some of what he wanted -- primarily a \$3 million photolithography tool that was crucial to his research. It's housed at N.C. State. He was also made director of UNC-CH's Institute for Advanced Materials, Nanoscience and Technology and given a \$27,000 raise. He now earns \$263,000 a year.

Suzanne DeSimone says the prospect of leaving North Carolina was wrenching. They had built a 3,000-square-foot house on a huge lot in the Orange County countryside and had redone an old cottage at Holden Beach. Although Joe traveled constantly for academic seminars and other work -- he had been tapped as a science adviser to the Department of Defense and holds a security clearance -- Chapel Hill was home.

For a move, she says, she wanted to see the spark in her husband that had been there when they originally settled on UNC-CH.

"There was not the excitement," she says.

The family was on vacation in New York when DeSimone decided to stay in North Carolina.

"Looking back on the first retention, I view that as an investment. And it truly paid off," says Moeser, the former chancellor. "UNC is one of the top 10 universities in material sciences, and we don't even have an engineering program. All the others we compete with have that."

Moeser says losing DeSimone would mean more than losing the millions of dollars he wins in grants and the massive lab complex he has built.

"When you're talking about Joe, it's not just an individual, but a whole team," he says. "In many ways, Joe DeSimone is a franchise."

No one was prepared to lose that franchise last fall. In short order, a second retention package was put together, including another salary boost. And being named Chancellor's Eminent Professor gives DeSimone a direct line to the chancellor on issues involving the university's science mission.

That is of utmost importance to DeSimone. He wants the university to be more nimble in turning innovations into marketable products. And he wants to break down barriers between the different sciences. That's been his top goal in recent months, promoting a new approach to scientific research that would basically allow science students of any discipline to conduct research across all fields.

"The idea is to have a community of scholars so we can do what can't be done at other places," he says.

Many embrace his approach. Others don't. DeSimone wants to loosen scientific divisions that are as old as the university itself. In a meeting of science department heads, DeSimone makes his pitch. The head of the physics department, Laurie McNeil, expresses her department's concerns. As it is, she says, there are fears that research decisions will be dictated by DeSimone.

"Planning has not been done with other departments," McNeil said of the advanced materials institute DeSimone has run that would fold into the new curriculum he is advocating. "The decision-making process is 'What Joe wants.' "

DeSimone is undeterred.

"He doesn't give a darn that we have these departments and various structures in the university," Chancellor Holden Thorp says, laughing. "He doesn't allow any of that to influence what can be accomplished.

"Yeah," he says, "that ruffles feathers."

Extraordinary goals

DeSimone sits next to a potential Ph.D. student visiting his office in the bright, new Caudill Labs science building at UNC-CH.

There is no finer space on campus, with two massive, arched windows that look out over the main quad. Through a third window behind his desk rises another science building in a hole once occupied by the decrepit Venable building. Down the hall are bright labs, including a clean room where his students don paper gowns and latex gloves and use custom-made tools to produce the tiny particles for testing in cancer tumors.

It's a long way from the tiny, dark basement where he unpacked his boxes 18 years ago.

At the entrance to his new quarters are 39 of his patents arranged on wooden plaques behind plexiglass -- a storyboard of innovation from a dry-cleaning process to nanoparticles. Framed newspaper and magazine articles about DeSimone line the walls above the bookshelves. Hefty glass and bronze awards fill another set of shelves.

DeSimone flips open his laptop for a slide show that demonstrates to the student, who will graduate in May with an Ivy League degree in applied mathematics, why she should consider joining his team in the chemistry department at UNC-CH.

In the world of Joe DeSimone, it's no leap of logic for a math student to become a part of one of the nation's top academic chemistry programs. A math Ph.D. could do work in his chemistry lab calculating how many tiny particles are necessary to inflict death in cancer cells.

Her candidacy, in fact, is exactly what DeSimone wants to promote at UNC-CH, where he envisions an army of mathematicians, biologists, engineers, physiologists, physicists and others collaborating "to solve the biggest problems of our time."

It's a phrase he uses over and over again. From DeSimone, a master chemist who practices an alchemy that succeeds, it's no false promise. He has discovered how to turn ideas into solutions, and

that's as good as gold.

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Joseph M. DeSimone

PRONOUNCED: Dee-sa-MOAN

BORN: May 16, 1964, in Norristown, Pa.

FAMILY: Wife, Suzanne; son Philip, 19; daughter Emily, 16

EDUCATION: Bachelor of science in chemistry, Ursinus College, May 1986; Ph.D. in chemistry, Virginia Polytechnic Institute and State University, May 1990

OCCUPATION: Chancellor's Eminent Professor of Chemistry at UNC-Chapel Hill; William R. Kenan Jr. Distinguished Professor of Chemical Engineering, N.C. State University; director of the Institute for Nanomedicine at UNC-CH; co-principal investigator of the Carolina Center for Cancer Nanotechnology Excellence; director of the Institute for Advanced Materials, Nanoscience and Technology at UNC-CH

SALARY: \$263,000 a year, plus varying amounts from research grants and endowments

FAITH: Catholic

HOBBIES: Going to Holden Beach with his family and beating all comers in boccie; ogling classic cars that will never replace his first, a 1966 blue Dodge Dart with 340 cubic-inch small block V-8, four-speed Hurst shifter, four-barrel 750 cfm Holley carburetor and 4.11 gears in the rear. "It was fast," he says.

THRILLING MOMENTS: Flying in a Navy plane off an aircraft carrier and being aboard for a midair refueling of F-16 fighter jets -- opportunities afforded during his participation in the Defense Science Study Group

INDULGENCE: A Cadillac XLR, which he bought to replace a red Corvette. He's big on American car models, since his brother, an electrician, is in a union.

FAVORITE SAYING: "Represent the family well," which he says to his children as they leave the house.

INSPIRATION: His younger sister, who battled cancer a few years ago, serves as a motivation to find a cure for the disease.

HONORS: 2008 Lemelson-MIT Prize for Invention and Innovation; 2008 inductee into the Order of the Golden Fleece, an honor society at UNC-CH; fellow in the American Association for the Advancement of Science, 2006; member, National Academy of Engineering, 2005; member, National Academy of Arts and Sciences, 2005

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