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In the Lab Early

As Beckman Scholars, undergraduates experience responsibility and research life.

The typical undergraduate life isn't filled with lost sleep over curing cancer. But for Joseph J. Crivelli, participation in research has done just that. For Tesniem Fathi Shinawi, her undergraduate life has featured the learning experience of juggling classes, homework and research.

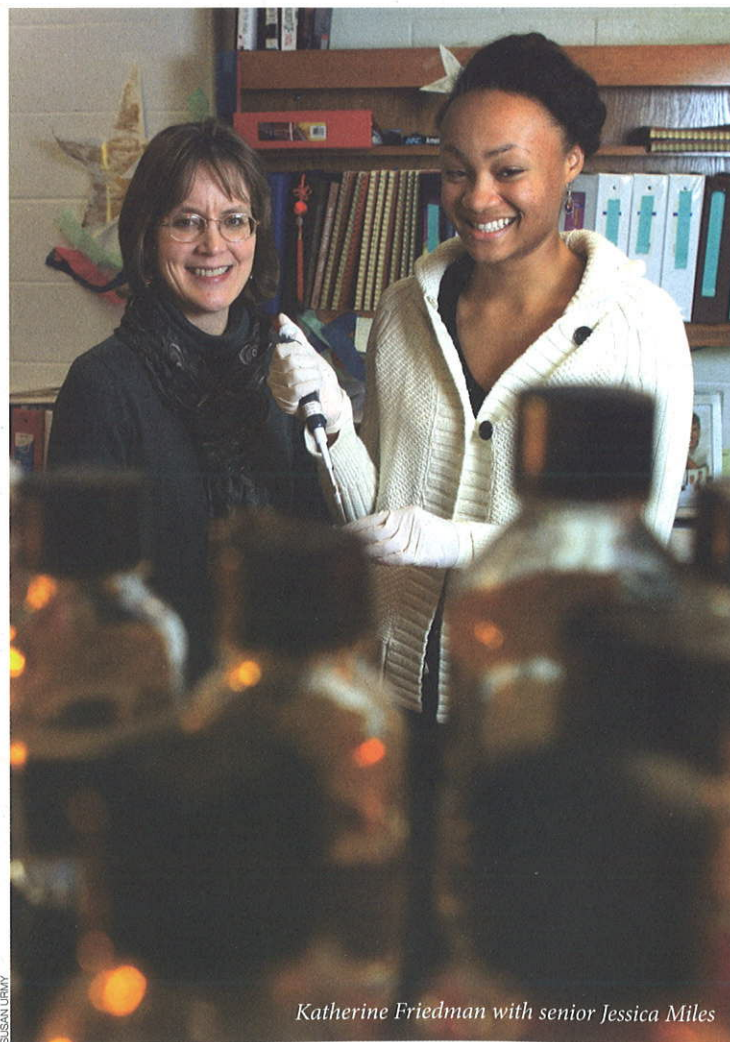
Crivelli and Shinawi are Beckman Scholars, participants in a by-invitation-only national program that funds scientific research for undergraduates. The prestigious Beckman Scholars program selects universities to participate, which in turn identify student applicants. Applicants must seek out a mentor and together they complete a research proposal. Key to the program are the close mentoring by a top researcher and the ongoing, in-depth research required of the student.

Being a Beckman Scholar provides an opportunity to see how research is done in an environment where you're not guided by courses, says Jeffrey Johnston, professor of chemistry, and one of the directors of the Beckman Scholars program in the College of Arts and Science. "It really comes down to, 'There's a problem in front of me and there's not really a script.' That's very different than going into an undergrad lab and being taught the techniques."

Scholars are chosen for a 15-month period; they receive a significant stipend and commit to working a set number of hours on their research, including summers. Johnston believes the investment reaches far. "There's a sobering moment, where you need to accomplish something because you're really the legacy of this program," he says. "We look for students who show some signs of being good peer leaders."

The Beckman Scholars program was founded by Arnold Beckman—regarded as one of the top inventors of scientific equipment—and his wife, Mabel, through their Beckman Foundation. Its purpose is to support the education, research training and personal development of students in chemistry, biochemistry and the biological and medical sciences.

Vanderbilt was accepted into the Beckman Scholars program in 2008. In addition to the scholars funded by the Beckman Foundation, the College of Arts and Science also names an additional Dean's Beckman Scholar, bringing the total of Beckman Scholars to seven since the program began. Here are a few of their stories.



Katherine Friedman with senior Jessica Miles

Jessica Miles, *senior, Louisville, Kentucky*

Katherine Friedman, *associate professor of biological sciences*

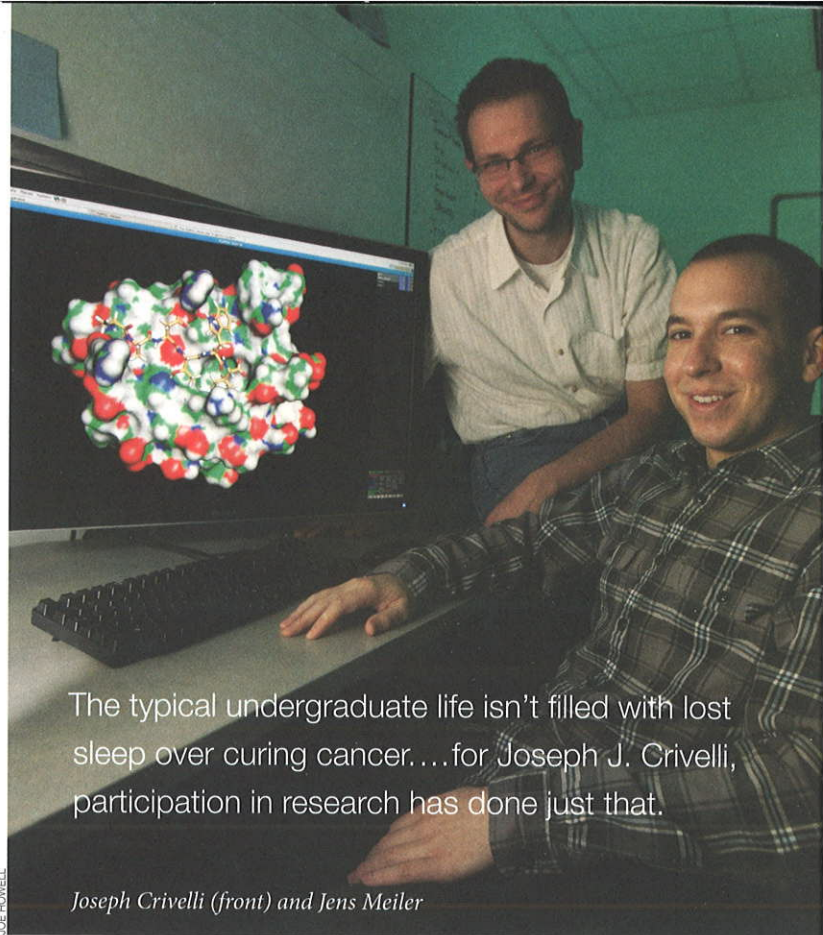
DOUBLE MAJORING IN BIOLOGICAL SCIENCES AND COMMUNICATION OF SCIENCE AND TECHNOLOGY,

Miles became one of the first undergraduates to participate in the program, though she only heard about it a week before the application deadline. “It was difficult to finish my application on time, but the challenge was definitely worth it,” Miles says. That weeklong race to complete the application set the tone for her entire Beckman experience—challenging, interesting and intense.

“The long-term commitment within the Beckman program is really quite unique,” Friedman says. “The summer, in particular, provides the student an uninterrupted time in which to pursue their research question and allows them to contribute to the mentor’s research program at a depth that is difficult to achieve during the academic year alone.”

Miles’ work in Friedman’s lab has been devoted to exploring telomeres, sequences of DNA at the ends of cell chromosomes, and telomerase, the enzyme that maintains the telomeres. “Telomeres and telomerase have significant medical implications,” Miles says, explaining that telomeres prevent the ends of the chromosomes from deteriorating. “The length of the telomere limits a cell’s life span, controlling the aging process. Moreover, inappropriate telomerase activity is a hallmark of an estimated 85 percent of cancers.”

Miles has learned another significant skill from Friedman: mentoring. After her Beckman Scholars experience, she and a friend created the Vanderbilt Association of Biology Students to mentor other students. “Our goal is to improve the academic experience of our members and to serve the needs of biology students who are not pursuing careers in medicine—a group that had no formal support before the formation of this organization,” Miles says.



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Joseph Crivelli (front) and Jens Meiler

Joseph J. Crivelli, *senior, Cortlandt Manor, New York*

Jens Meiler, *assistant professor of chemistry and pharmacology*

CRIVELLI AND MEILER HAD ALREADY BEEN WORKING TOGETHER FOR A FEW MONTHS WHEN CRIVELLI WAS ACCEPTED AS A BECKMAN SCHOLAR. Crivelli had pursued the relationship early in his sophomore year.

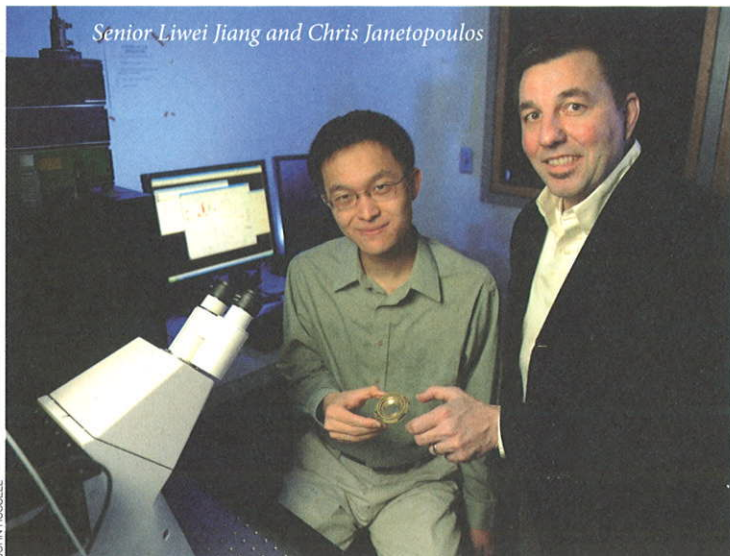
“If you would like to become involved in research at Vanderbilt but are unsure of where to start, I’d recommend that you browse lab web pages, get an idea of which research area you’re interested in, and most important, send some emails,” Crivelli says. “Don’t be shy. There are so many amazing researchers like Jens who are eager to work with undergraduates.”

Small wonder: Meiler says that he has gained “fresh and original ideas; thinking out of the box,” from his work with undergraduates like Joseph.

Crivelli, a mathematics major, used a molecular modeling program to study how proteins interact with peptides. “If we’re able to accurately model the signaling interactions that occur between proteins and peptides in living cells, we can design molecules to block these interactions, potentially leading to new classes of therapeutics to combat cancer and other diseases,” Crivelli says. “Another exciting application of my work is the design of protein antibiotics which bind bacterial peptides. With such technology, we can target the multidrug resistant microbes that have invaded our hospitals.”

That fits with the larger work at Meiler’s lab, which focuses broadly on protein research.

As for the future, “While the theory behind my current work intrigues me, the long-term medical implications are what keep me up at night,” Crivelli says. “I’m now most interested in using ground-breaking research for the benefit of the patient.”



“It really comes down to, ‘There’s a problem in front of me and there’s not really a script.’”

—Jeff Johnston, Beckman Scholars program co-director

Tesniem Fathi Shinawi, *junior, Murfreesboro, Tennessee*
David Cliffler, *associate professor of chemistry*

THOUGH CLIFFEL SAYS THE TYPICAL UNDERGRADUATE EXPERIENCE IS “NOT GEARED TO MAKING A MAJOR MARK IN RESEARCH,” Shinawi may just be another exception to that rule. She began working with Cliffler at the end of her freshman year; she was named a Beckman Scholar a year later.

During her time in Cliffler’s lab, she has been exploring whether optical dyes used to stain cells have an impact on the physiology of the cell.

“Because fluorescent dyes are so common in the scientific community, it is important to determine whether they are causing any unwanted or significant effects to cellular function and metabolism,” Shinawi explains. She is currently completing a paper on her findings.

The junior chemistry major also received valuable mentoring for her career path; when she joined the lab, she was unsure of her career goals or even her major. She has since decided to pursue medicine and is considering a combined MD/PhD program. “I have learned how to manage my time, to investigate and solve problems, and to learn and present research information. It has helped me realize that I could incorporate research into my future career goals,” she says.

Liwei Jiang, *senior, Durham, North Carolina*
Chris Janetopoulos, *assistant professor of biological sciences*

FOR JIANG AND JANETOPOULOS, THE BECKMAN SCHOLARS PROGRAM ONLY ENHANCED AN ALREADY FRUITFUL WORKING RELATIONSHIP. Jiang, a physics major, had sought out Janetopoulos a year earlier because he learned the professor “had some innovative ideas that were just waiting for people to develop into full-fledged, meaningful projects.”

And develop they have. Working with Janetopoulos, Jiang has created a number of microfluidic platforms to integrate into the Commodore Compressor, a microscope-compatible mechanical device that gently squeezes a living cell or organism to hold it still for study. During his time as a Beckman Scholar, Jiang added a perfusion system to provide nutrients to the specimen, allowing it to be kept alive for several hours and enabling scientists to study the effect of chemicals on the specimen.

“Scientists around the world prefer studying live cells and organisms because one cannot observe dynamic, living processes in dead specimens. However, many live specimens move around greatly under the microscope, making studying them difficult or impossible,” Jiang explains.

The Commodore Compressor is a unique tool, Janetopoulos explains, and it may have a significant impact in many areas of research. “We realized early on that there were many applications for this device without perfusion. However, adding perfusion to the device as Liwei has done makes the device extremely attractive for other fields as well,” he says.

Jiang’s progress and well-written description of his project led to him being chosen as one of a select few scholars to present his findings at the annual Beckman Symposium. “A few scholars gave suggestions on how I can further my project,” Jiang says. “I have valued their suggestions to this day.”

Jiang’s suggestions are also valuable to Janetopoulos and his lab. “For a laboratory such as mine that averages four or five undergraduates, having a Beckman scholar in the lab sets the bar pretty high for the other students,” Janetopoulos says.

Jiang plans to become a physician with a specialization in research. “Through my undergraduate research experience, I have become convinced that future developments in medicine lie in investigating the human body and disease in a scientific yet creative manner.”