

At Princeton, every senior writes a thesis or undertakes a substantial independent project. Leah Bushin and Tova Bergsten are two Class of 2015 graduates who did their senior theses in chemistry. Both projects resulted in publications in prominent research journals.

## Listening in on bacterial communications

**BACTERIA SPEAK TO ONE ANOTHER** using a soundless language known as quorum sensing. In a step toward translating bacterial communications, researchers have revealed the structure and biosynthesis of streptide, a signaling molecule involved in the quorum-sensing system common to many disease-causing streptococci bacteria.

The research team included undergraduate Leah Bushin, who was the co-first author on an article published on April 20, 2015, in *Nature Chemistry*. Bushin helped determine the structure of streptide as part of her undergraduate senior thesis project.

To explore how bacteria communicate, first she had to grow them, a challenging process in which oxygen had to be rigorously excluded. Next, she isolated the streptide and analyzed it using two-dimensional nuclear magnetic resonance (NMR) spectroscopy, a technique that allows scientists to deduce the connections between atoms.

The experiments revealed that streptide contains an unprecedented crosslink between two unactivated carbons on the amino acids lysine and tryptophan. To figure out how this novel bond was being formed, the researchers took a closer look at the gene cluster that produces streptide. Within the gene cluster, they suspected that a radical S-adenosyl methionine (SAM) enzyme, which they dubbed StrB, could be responsible for this unusual modification.

“Radical SAM enzymes catalyze absolutely amazing chemistries,” said Kelsey Schramma, a graduate student and the other co-first author on the article. The team showed that one of the iron-sulfur clusters reductively activated one molecule of SAM, kicking off a chain of one-electron (radical) reactions that gave rise to the novel carbon-carbon bond.

“The synergy between Leah and Kelsey was great,” said Mohammad Seyedsayamdost, an assistant professor of chemistry who led the research, which was supported by the National Institutes of Health. “They expressed interest in complementary aspects of the project, and the whole ended up being greater than the sum of its parts,” he said.

Future work will target streptide’s biological function — its meaning in the bacterial language — as well as confirming its production by other streptococcal bacteria strains. —By Tien Nguyen

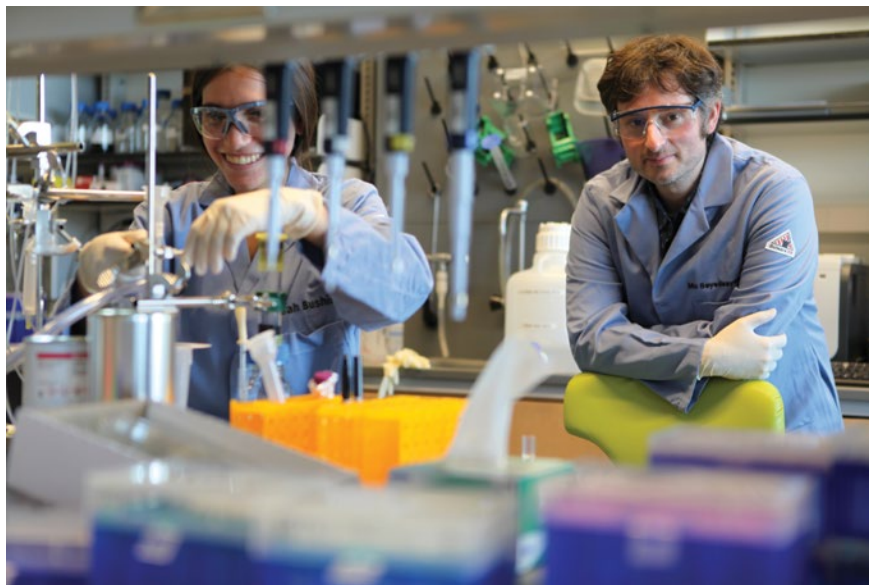
## New chemistry aids drug development

**DRUG DEVELOPMENT OFTEN INVOLVES** modifying the chemical structure to get the right combination of properties, such as stability and activity. Working in the laboratory of John Groves, the Hugh Stott Taylor Chair of Chemistry, undergraduate Tova Bergsten and graduate student Xiongyi Huang developed a practical and versatile method for altering molecules that could have wide application in drug synthesis and basic research. The method involves using a manganese catalyst to convert carbon-hydrogen bonds into chemical structures known as azides, which are useful for modifying the properties of drugs.

“Since this was my first long-term lab experience, I learned quite a bit,” Bergsten said. “It was eye-opening to be involved in the experimenting, writing and publishing side of a paper. I plan to continue with scientific research, and what I’ve learned through this experience will definitely be useful for my future work.”

The research, which was supported by the National Science Foundation, was published in the *Journal of the American Chemical Society* on April 14, 2015. —By Tien Nguyen

PHOTO BY C. TODD REICHART



While an undergraduate, Leah Bushin (left) co-authored an article on the structure of a signaling molecule involved in bacterial communication with co-first author Kelsey Schramma and adviser Mohammad Seyedsayamdost (right), assistant professor of chemistry.