

CAUGHT IN THE ACT

USU Biochemists Catch Life-Critical Enzyme in Action

More than 80 percent of the air we breathe is nitrogen, yet it's in a form neither humans, animals nor plants can access directly.

"It's an incredible irony," says Utah State University biochemistry professor Lance Seefeldt. "All living things need nitrogen to survive and we're swimming in a sea of it, but we can't get to it."

Seefeldt and colleague Brett Barney, USU research assistant professor, have solved a long-sought piece of the puzzle of how enzymes known as nitrogenases convert nitrogen into life-sustaining compounds that are subsequently transferred to the soil and food sources on which all plants and animals depend.

The two led an interdisciplinary team including scientists from Northwestern University and Virginia Tech that succeeded in capturing three steps of nitrogen fixation; that is, the process by which nitrogen is converted to ammonia.

Their findings were recently published in the *Journal of the American Chemistry Society*, the *Proceedings of the National Academy of Sciences*, *Chemical & Engineering News* and *Biochemistry*.

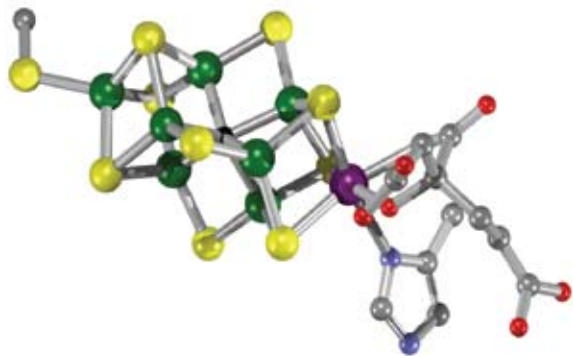


USU biochemists Lance Seefeldt, left, and Brett Barney are investigating how enzymes known as nitrogenases convert nitrogen into life-critical sustenance on which all living things depend.

"The structure of nitrogenase and the general site at which nitrogen gets bound and reduced has been known for more than a decade," Seefeldt says. "But until now, we didn't know anything about how that process works."

The researchers developed a chemical methodology to trap and detect intermediates in nitrogenase-catalyzed reductions and flash-freeze samples. Using spectroscopy, they confirmed that the samples were indeed enzyme-bound intermediates.

Trying to capture nitrogenase in action is similar to trying to catch a single frame of



The fixation of nitrogen from air is critical to all living systems. This reaction occurs in microbes where it is catalyzed by the enzyme nitrogenase (pictured). Illustration by USU alum Michael Yurth.

movie film on a moving reel, Barney says. “You have to catch it in the act and freeze the frame so you can actually look at it and understand it.”

Using the same metaphor, Seefeldt explains that “once we collect all the frames we can watch the whole movie.”

“We will be able to understand how the enzyme functions,” he says. “This will drive a lot of

research around the world and eventually could enable an alternative, clean method of producing nitrogen.”

Currently, science and industry rely on the nearly century-old Haber-Bosch process to produce nitrogen for fertilizer, paper, pharmaceuticals, mining and explosives. Developed by German Nobel prize winners Fritz Haber and Carl Bosch in the early 20th century, the process, Seefeldt says, is costly, energy-intensive and a source of pollution.

Seefeldt and Barney hope their current research will lead to methods that “fix nitrogen in a much more ecologically friendly process that requires less fossil fuel.”

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