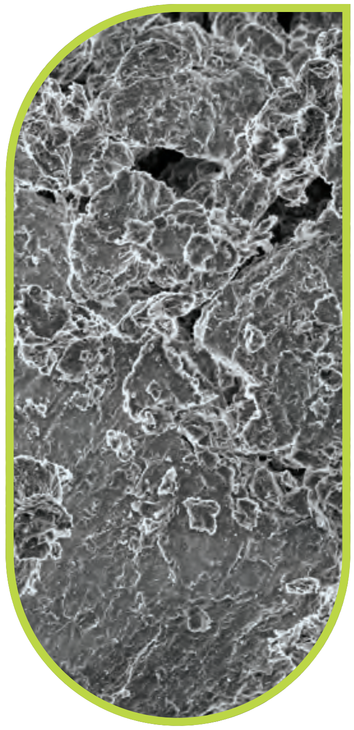

SOIL SECRETS

PROFESSOR LUDMILLA ARISTILDE COLLABORATES WORLDWIDE TO GAIN A BETTER UNDERSTANDING OF THE SOIL THAT SUSTAINS LIFE ON EARTH.

Combining experimental techniques with computational simulations, Professor Ludmilla Aristilde and her lab work to understand the environmental behavior of organic materials with implications for nutrient cycling, ecosystem health, agricultural productivity, and environmental biotechnology. "We cannot have food security without soil," Aristilde says. "That's literally what sustains us."

"I have collaborators all over the world, and these colleagues have really enriched my research. I get to work with a mosaic of researchers with different expertise and we can put our knowledge together to create a picture with a better understanding of soil processes."

Ludmilla Aristilde Associate Professor of Civil and Environmental Engineering

Growing up in Haiti, Northwestern Engineering's Ludmilla Aristilde looked critically at the land and thought about how soil sustains plants. This came naturally; her father was both an educator and farmer, and her mother was also an educator, instilling in Aristilde intellectual curiosity and a respect for the environment.

"Now I study soil microbes and soil minerals," Aristilde says. "It all stemmed from my childhood."

Aristilde, associate professor of civil and environmental engineering at the McCormick School of Engineering, works to understand the environmental behavior of organic materials with implications for nutrient cycling, ecosystem health, agricultural productivity, and environmental biotechnology.

Her driving motivation is simple but crucial. "We cannot have food security without soil," she says. "That's literally what sustains us. We need soil for agricultural productivity and for food security."

Understanding soil pathways and cycles

It's one thing to respect the soil and its importance. It's another to understand how the many different systems within the soil work. "We need to understand what's happening and why it's happening, and then by what mechanism," Aristilde says.

Phosphorus, a critical nutrient for plant growth, is a nonnegotiable component of fertilizers. Without it, farmers cannot ensure plant health and boost crop yields. Understanding Earth's phosphorus cycle, therefore, is important for protecting the global food supply.

Aristilde and her team have discovered a new way that nature cycles phosphorus, a finding that uncovers a missing piece of Earth's phosphorus cycle, which continues to puzzle scientists. Her study showed that iron oxide, a naturally occurring mineral in soils and sediments, can perform the reaction that transforms organic phosphorus to generate the inorganic form.

In another study earlier this year, Aristilde tracked the pathways of a plant waste mixture as it moves through bacteria's metabolism and contributes to atmospheric CO_2. These findings help disentangle the role of microbes in soil carbon cycling—information that could help improve predictions of how carbon in soil will affect climate change.

In a separate study, she found the factors that could determine whether plant-based organic matter gets trapped in the soil or feeds microbes that then respire CO_2 into the environment. That breakthrough could help researchers predict which soil chemistries are most favorable for trapping carbon—potentially leading to soil-based solutions for slowing human-caused climate change.

"The majority of carbon storage is in soil, and we want to mitigate or limit the amount of greenhouse gases that go into the environment," Aristilde says. "Since the majority of our carbon reservoir is in soil, any perturbation in that reservoir has a huge impact."

Better understanding of soil, Aristilde says, helps scientists predict how it will react to atmospheric changes. "Understanding environmental resilience requires prediction," she says. "It's important to be able to forecast how nature is going to respond. It's through this forecasting that we know to what extent the soil is resilient."

Collaborating across disciplines worldwide

A core faculty member of Northwestern's Center for Synthetic Biology and a faculty affiliate of both the Paula M. Trienens Institute for Sustainability and Energy and the International Institute for Nanotechnology, Aristilde's expertise is in both molecular environmental chemistry and molecular biochemistry. Therefore, the bedrock of her research is collaborating across disciplines.

"I tell the members of my group that the beauty of academia is that you have colleagues with different levels of expertise," she says. "I don't want to reinvent the wheel. If I know colleagues with a specific expertise in something I am interested in, I just want to collaborate with them."

By working with others, Aristilde hopes to move the world closer to a full understanding of the biology and chemistry of soils. In addition to her collaborations across the US with colleagues in Georgia, Indiana, Delaware, New York, and California, Aristide has fostered research exchanges across the globe with collaborators in Czechia, Denmark, France, Germany, and Thailand. Closer to home, Aristilde has found Northwestern collaborators at luncheons, taking notes on their specialties and circling back if there's an opportunity to conduct research together.

"I have collaborators all over the world, and these colleagues have really enriched my research," Aristilde says. "I get to work with a mosaic of researchers with different expertise and we can put our knowledge together to create a picture with a better understanding of soil processes."

BRIAN SANDALOW

Photos by Jason Brown