



Sue Meggers leads her students through hands-on soil science activities near her Truro, Iowa, classroom.

teaching the SCIENCE of SOIL

By Joel Schettler

Curriculum changes perceptions about ag, one classroom at a time.

Fertilizer feeds the world. Without it, at least half of the world's crops wouldn't grow, according to data compiled by The International Fertilizer Industry Association, an organization promoting the importance of sustainable fertilizer use.

Ask Bill Gates. Writing in *Wired* magazine in November 2013, he outlined his manifesto for how to improve our world. And it all begins with fertilizer.

"Two out of every five people on Earth today owe their lives to the higher crop outputs that fertilizer has made possible," wrote Gates. The study of soil health can help poor farmers plan their harvests more efficiently, he said, benefiting the world's poorest 2 billion people.

An understanding of our planet and its ecosystem begins with

the science of soil. Yet with nearly 80 percent of Americans living in urban environments, many students have lost their connection to the soil. (Only 2 percent of Americans are employed in agriculture, according to The World Bank Group.) One organization is trying to change perceptions, one classroom at a time.

At the National Science Teachers Association annual conference held in March 2015 in Chicago, teachers were eager to get started. The line to enter the hall formed early.

More than 10,000 science teachers attended the four-day event with its full schedule of speakers, networking and breakout sessions. Yet a top priority for many was to meet with sales representatives and gather classroom materials from vendors filling the large hall of McCormick Place West.

On the trade show floor, in a booth in a center aisle just inside the entrance, representatives spoke about a soil science education program developed and funded by the Nutrients for Life Foundation (NFLF), the education and philanthropic arm of The Fertilizer Institute (TFI), which is supported by CHS and fertilizer manufacturers.

CHS is a long-time member of The Fertilizer Institute. Cheryl Schmura, vice president of CHS Crop Nutrients, is TFI's incoming board chair.

A Big Mission

When the NFLF was formed 11 years ago, "its purpose and mission was to educate people about fertilizer," says Harriet Wegmeyer, the foundation's executive director. "That includes responsible uses of fertilizer, why we have fertilizer, its role in society, and, ultimately, how



fertilizer affects people's daily lives. It's a big mission."

Education means hard facts and real data. And soil science is bigger than just the benefits of nutrients; it's an important part of understanding the greater ecosystem. To fulfill its mission, the NFLF began developing supplemental curriculum for earth science teachers.

"The fertilizer industry and nutrients are certainly a big part of soil science, and there is a need for teacher resources," says Wegmeyer. "Now we have the knowledge and expertise in this industry to put together good resources to tell the story about fertilizer and how it impacts lives around the globe."

In 2007, the foundation unveiled its work, launching "Nourishing the Planet in the 21st Century," a curricula set designed for middle school and high school students. The

STEM (science, technology, engineering, math) curriculum includes six lesson plans and activities on everything from periodic tables to subject matter regarding soil horizons, soil formation and diagnosing nutrient deficiencies. The

the curriculum, which met Next Generation Science Standards accreditation standards and was endorsed by the Smithsonian Institution. "Those credentials were important to me. I used many of the posters and curriculum materials. The

"I believe that to care for the environment means you have to understand the environment."

— Nancy Bridge

program was an immediate hit.

"One look and I was hooked," says Nancy Bridge, science department chair at Olympia High School in Orlando, Fla. A teacher for more than 20 years, Bridge was an early adopter of

background for teachers was so helpful."

In 2010, the NFLF released a version of the same curriculum for elementary school students, which includes many hands-on gardening activities.

"Making things tangible provides students the opportunity to improve visual and verbal skills, but they also get the tactile element," says Sue Meggers, a teacher who has used the curriculum for many years in her Truro, Iowa, classroom. "When people can feel things and actually know that they are real, it leaves them with longer impressions. This curriculum allows teachers — if they're willing to go there — the opportunity to get dirty and let students experience how soil traits affect fertility."

Students learn more than just the benefits of potassium, phosphorus or nitrogen. They begin to respect what the soil can give them, say teachers, and that only by acting as responsible stewards will they be able to reap what they sow for decades to come.

"It's amazing how many

To request classroom resources, visit nutrientsforlife.org/for-teachers. Watch a video at chsinc.com/c.

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At the National Science Teachers Association annual conference and tradeshow, teachers sample hands-on activities they can use to teach about soil science. The free curriculum was developed by the Nutrients for Life Foundation.

► eighth-grade kids walk through my door who have never grown a plant from a seed, even in rural Iowa in a school with only 900 kids,” says Meggers. “We take it for granted that everybody knows how to plant a plant.”

Like Meggers, Bridge finds that most of her Florida school’s 3,000 students have little connection with the land. “We do not have an agriculture program,” she says. “Even though we live in what used to be the heart of a citrus growing area, in a survey at the beginning of the year my students responded that food comes from the grocery store. If pushed, they will clarify that answer with an explanation that food is delivered to the back of the store in trucks and then put on shelves.”

To reach as many students as possible, the NFLF partnered with Discovery Education a year ago to create new digital content around soil science. Called “From the Ground Up: The Science of Soil,” the new digital curriculum includes its own website with videos,

interactive lesson plans and other content that can work alone or in tandem with other NFLF materials in middle school classrooms.

“Discovery has 2 million teachers in its network and its

5,000-acre corn and soybean operation, as well as the farm’s seasonal Christmas tree and pumpkin production businesses.

“Not everybody has the opportunity to visit a farm,” says

Fertilizer use efficiency in U.S. corn production is at an all-time high. In 2010, farmers nearly doubled production while using fewer nutrients for each bushel than in 1980.

Source: National Agriculture Statistics Service, USDA

credibility is off the charts,” says Wegmeyer. “Our partnership is reaching more urban teachers than our Nutrient for Life resources had been reaching. We are suburban and rural; we have some urban reach, but not nearly to the extent that Discovery does.”

Year two of the Discovery partnership will include a spring virtual field trip to Bomke’s Patch, a farm near Springfield, Ill., where students will learn about the

Wegmeyer. “But because it’s a virtual field trip, anybody can go. The kids can sit in a classroom and go to the farm.” Three new videos will be produced for the program, along with three new family activities.

A Fight for the Future

In a world with a growing population, food production and food security will become increasingly important economic

and political issues in coming decades. The NFLF’s mission is to “foster an understanding and appreciation of fertilizer’s vital role in raising healthy crops to feed a hungry world.”

With its newest segment just released, “Feeding the World and Protecting the Environment,” the NFLF worked with teachers across the country to develop a complex, rigorous curriculum to be used in high school advanced placement (AP) environmental science classrooms. As with its other NFLF curriculum, it went through a review to meet high standards, including review from an AP College Board educator.

Like previous NFLF offerings, the curriculum is free to teachers, helping to fill a need in schools. It makes no apologies for fertilizer, and it’s helping to shape attitudes and open minds about what fertilizer is and what it isn’t.

“In AP environmental science, fertilizer is a huge component of biogeochemical cycles,” says Wegmeyer. “In the educational environment, we need to discuss fertilizer based on facts and science. In this piece, we’re talking about the 4R Nutrient Stewardship framework — the importance of the right product at the right time in the right place at the right rate. Students need to understand that, too.”

Such a message isn’t always easily received. In March 2011, Nancy Bridge was invited to speak about earlier curriculum to teachers at a San Francisco conference. The atmosphere became tense when the subject of fertilizer came up. “It was like a giant tornado sucked the air out of the room,” she recalls. “My job then was to recover and bring them back.”

Bridge began to discuss nutrition and healthy soils for healthy plants and healthy

people. The NFLF has nothing against organic products either, she explained to teachers in the room, they just aren’t sustainable for a planet with 7 billion inhabitants.

“I had phosphate rock,” she says. “I really think it was the rock that made the difference. Fertilizer looks sort of unnatural, but phosphate rock looks very organic. It’s very hard to dispute the science behind fertilizers. That was my road out, the rainbow after the storm, so to speak. It worked well and the reviews from the teachers were wonderful; for many it was an ‘aha’ moment. I loved it. I think I made a difference for the entire agriculture industry that day.”

Leading with Science

Many in the room came with a preconceived idea about fertilizer, says Wegmeyer of Bridge’s San Francisco presentation, but because she stuck to the facts she was able to turn people’s opinions.

“Science. Always science,” says Bridge. “No emotion, no hearsay. That is what I love about the NFLF curriculum. It gives teachers enough background information so they have the science base to teach from. I deal with skeptics on a daily basis. The nature of environmental science is emotionally charged. I conquer it one subject at a time with science.”

When Norman Borlaug sparked the Green Revolution with the creation of dwarf wheat, he was credited with saving more than a billion people from starvation as his practices were adopted in Pakistan, Mexico and India. Fertilizer fueled the crop development. Many believe

the same revolution awaits agriculture as work continues on creating healthy soils around the world. That work begins in the classroom.

“If people want to continue to have the wealth of food that they have, they need to focus on soil science,” says Meggers. “This is why we have to teach it. This is why our eighth-graders need to know it. And you have to get to this before high school, because that’s when students start to develop their sense of community. Until you give them that ownership, they’re not going to care. You help them understand what farmers have had to learn — that the land is not an infinite resource. Our job is enormous.”

Bridge agrees. “I’m fighting in an urban setting for the future of the agriculture

industry. I’m not sure if many ag people understand how important that fight is. The agriculture industry thinks that supporting FFA programs will do it. Sadly, that’s playing to the orchestra; the entire symphony is in the urban areas, and they do not understand agriculture. What you don’t understand, you fear; what you understand, you regulate against.”

Agriculture is making progress in measuring and maintaining its precious environmental resources, says Meggers, including GIS mapping and precision farming. “But with all the new technology available, if you don’t understand the basics of soil and the way it functions as a physical and chemical entity, along with biotic factors in air and water, what’s the point? It’s all a package deal.” ■

Students in Sue Meggers’ Truro, Iowa, classroom learn about soil composition with help from curriculum provided by the Nutrients for Life Foundation.



Are You as Smart as an 8th-grader?

To find out how much you know about nourishing the planet, answer the first few questions from a quiz created by the Nutrients for Life Foundation to gauge the knowledge of middle school students before and after studying curriculum about the value of fertilizer.

1. **Plants require ___ different elements to be healthy.**
 - a. 2
 - b. 17
2. **Plants and humans require ___ essential elements.**
 - a. similar
 - b. different
3. **Plants obtain their essential elements from ___.**
 - a. air, water and soil.
 - b. air, water and pollen.
 - c. air, pollen and soil.
4. **Soils ____.**
 - a. serve as a nutrient bank for plants.
 - b. contain both organic and inorganic material.
 - c. differ in their abilities to hold and transmit water.
 - d. All of the above.
 - e. None of the above.
5. **Plants transport water from the roots through ___ and food from the leaves through ___.**
 - a. the xylem; the phloem.
 - b. the phloem; photosynthesis.
 - c. diffusion; photosynthesis.
6. **Plants require nutrients to be present in certain amounts to be healthy. The essential components of most fertilizers are ___.**
 - a. nitrogen, zinc and boron.
 - b. nitrogen, iron and manganese.
 - c. nitrogen, phosphorus and potassium.

Answers: 1. b; 2. a; 3. a; 4. d; 5. a; 6. c.