

LEGACY

FALL 2016



Today's Lessons.

TOMORROW'S LEADERS.

There is a moment when learning occurs, when education sparks understanding and sets knowledge ablaze. For Noble Academy, this lightbulb moment is its mission.



Can you spot the eight differences in these two photos?



Now, how do you spot the ways to make a difference in your agricultural endeavors?

A keen eye, a lot of education and a desire to get better. That's where the Noble Foundation comes in. For 70 years, we've made a difference in the lives of thousands of farmers, ranchers and land stewards. We research. We share. You grow.

UPCOMING EVENTS



Sept. 29
Pecan 101
Workshop



Oct. 4
Fence
Construction
Workshop



Nov. 5
Basic Beekeeping
Part 1: The
Fundamentals



Nov. 11
Basic Beekeeping
Part 2: Honey
Bee Production



Dec. 2
Managing Taxes
for Agricultural
Producers

Learn about livestock, pecans, beekeeping and taxes. Attend an upcoming educational event and hone your skills. For more information or to sign up for an event, please visit www.noble.org/events

THE SAMUEL ROBERTS
NOBLE
FOUNDATION

Answer key: bar at top of greenhouse; red building in background; girl's shirt sleeve; leaf in front of girl's leg; label on girl's shirt; button on man's shirt; logo on man's hat; top of tomato cage on right

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A Little Blue Reminder

To our readers,

The first time I saw the blue cow, I remember thinking, "It's a toy?"

A few years back, Director of Communications Adam Calaway and I were discussing how to generate interest in our booth at the upcoming National Cattlemen's Beef Association (NCBA) conference. He placed a fist-sized, resin figurine on my desk and said, "This is how."

He explained that the blue cow (the deep navy color represents the Noble Foundation and the cow signifies the agriculture industry) would be hidden around the conference hall and people could return her to earn a prize.

I had my doubts, but I trust my people and their expertise. So, the blue cow was given the green light. Fast forward a few months, and I stood in the middle of our booth at NCBA watching an endless stream of people pour in, clutching their blue cows and praising the concept.

This year we marked our 70th anniversary, and again the blue cow served as a cornerstone of our online celebration. A herd of almost 1,000 cows moseyed around the world as employees and friends of the Noble Foundation carried their blue cows while traveling. (We only lost a few to those cattle-rustling TSA agents.)

Soon, hundreds of photos began pouring into our Facebook page (facebook.com/bluecow), including some celebrities, athletes and national politicians who took time out of their schedules to snap a photo with her.

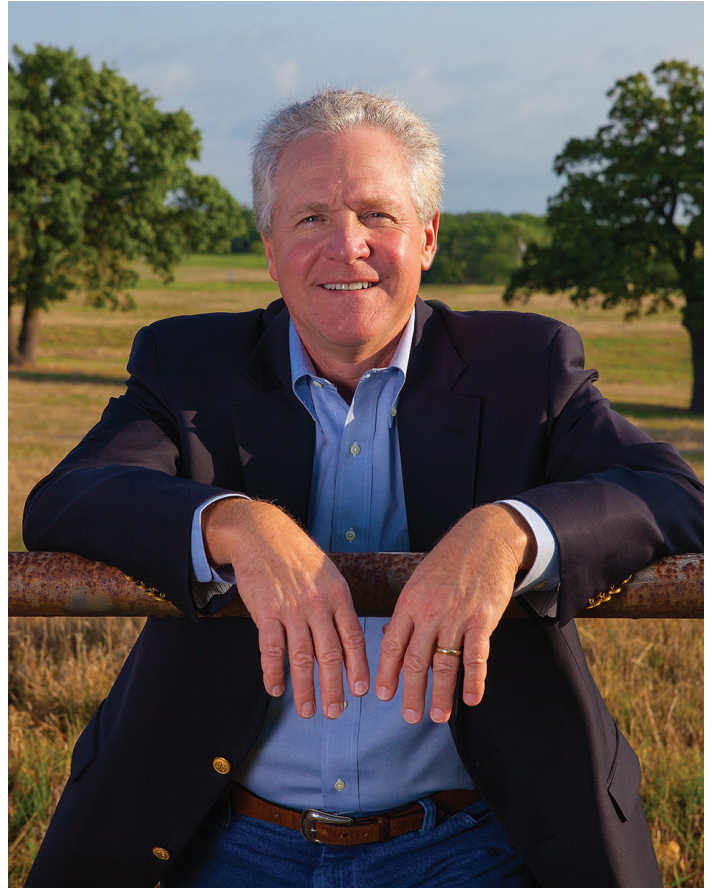
To date, the blue cow has traveled to 33 states in the United States, 13 countries and six of seven continents. She's gone scuba diving, had an MRI and attended multiple universities. She's stood on the corner in Winslow, Arizona (what a fine sight to see), moored with Mozart at the Sydney Opera House and evolved into something even greater at the Galapagos Islands.

In July, thanks to her creator Shane Porter (our web and new media manager), principal investigator Elison Blancaflor, Ph.D., and our friends at NASA, the blue cow made a historic trek to the International Space Station, where she circled the planet 631 times.

The overwhelming response to the blue cow is more than just a gimmicky social media phenomenon. The blue cow underscores people's participation in community, their connection to the Noble Foundation and - in a larger sense - their bond to agriculture. We are blessed to work in one of the few industries that impacts every single life on the planet. It's fundamental. It's commonality. It's life.

At its core, agriculture should be a rallying point from which we can all find agreement and unity. However, there are countless naysayers nibbling on the edges of our sector, attempting to cause discord by focusing on problems and not joining the search for solutions.

But founder Lloyd Noble addressed them in 1948: "I am convinced that these sirens who have been playing the dirge of despair have proved that their own minds are static, that the only degree to which we have reached the end of the road of opportunity is the degree to which we have exhausted the imaginative capacity of the human mind. If we can stir people's imagination as to the potentialities of the soil when conserved and built up, then the knowledge they would naturally acquire (would increase) confidence



in themselves. As it is only when people have confidence or faith that they fight their greatest battles."

Lloyd Noble set a course for the Noble Foundation, a grand vision dedicated to the singular cause of advancing agriculture. He knew that once this idea left his hands, the organization would change and grow, being shaped by each generation.

Today's employees understand our role. We serve as stewards of this great legacy for just a few moments in time. We did not see the beginning nor will we fully understand the fruits of our labors. But we know we are a part of something greater because we are a part of agriculture.

Sometimes we forget the profound nature of that calling and then something reminds us - something like a little blue cow that has traveled around the world and into the stars spreading a simple message that we are a part of agriculture.

Not bad for a toy.

Sincerely,

Bill Buckner
President and CEO

The Art of Agriculture

The Noble Foundation and Goddard Center collaborate on an art show as the 70th anniversary celebration nears its end.

by J. Adam Calaway



Community members enjoyed artwork submitted by more than 100 adults and youth at the Celebrating Farm Life opening reception, July 7, 2016.

Agriculture is beautiful. From morning sunrises and cowboys on horseback to cattle gently grazing emerald fields, images of agriculture are sown into the cultural tapestry of America.

As part of its 70th anniversary, the Noble Foundation honored the agricultural lifestyle with “Celebrating Farm Life,” a juried art exhibition at the Goddard Center in Ardmore, Oklahoma.

“Agriculture is more than just an industry that produces the fundamental goods that sustain our lives and fuel our society,” said Bill Buckner, president and CEO of the Noble Foundation. “For the men and women in agriculture, it is a way of life. This art exhibit provides a forum for farmers and ranchers to proudly display the beauty of

the agricultural life, as well as offers the public a glimpse into a world that many may never experience.”

More than 250 community members attended the art show’s opening reception on July 7, packing the Goddard Center’s four main galleries to view paintings, drawings, photography, sculpture, jewelry and fiber artworks.

The exhibit remained open until Sept. 16, just a few days before the end of the 70th anniversary.

The Noble Foundation launched its platinum anniversary celebration on Sept. 18, 2015, with a reception honoring its employees and founder, Lloyd Noble.

The year-long festivities included welcoming Canadian farmer Chris Koch as part of the *Profiles and Perspectives Com-*

munity Enrichment Series; publishing a year-long series that highlighted the organization’s seven decades of contributions to agriculture, research, education and philanthropy; and hosting a special social media campaign featuring the blue cow (see President’s Message, previous page, for more details).

“We have proudly honored the many people and accomplishments of the Noble Foundation throughout this last year,” Buckner said. “This anniversary has been a celebration of where the Noble Foundation has been but also where we are going. We will continue Mr. Noble’s charge to advance agriculture and strengthen communities long into the future, using proven practices as well as new approaches, discoveries and innovations. Our quest never ends.” ■

Where has your blue cow been?



Angel Fire, New Mexico



Wasilla, Alaska



Crete, Greece



Lubbe Farm in Uganda



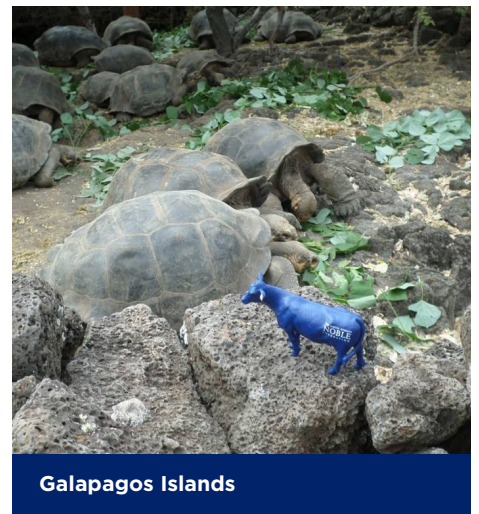
New York City Public Library



Maui, Hawaii



Winslow, Arizona



Galapagos Islands



Toronto, Canada



Tokyo, Japan



Kennedy Space Center in Titusville, Florida

Visit facebook.com/bluecow to see where the blue cow lands next, and read the messages from Noble Foundation friends.



ON THE COVER:

The fall 2016 issue of *Legacy* magazine represents the second in a three-part series dedicated to the Noble Foundation's 70th anniversary year.

Following a "then-now-next" theme, these three issues celebrate eras in the Noble Foundation's timeline, including its history (then - Winter 2015), the current activities (now - Fall 2016) and the future of the organization (next - Winter 2016).

This issue of *Legacy* focuses on "now" - the present activities that shape and define the Noble Foundation's endless pursuit to advance agriculture. Included within these pages are stories about collaborations with state (Oklahoma State University) and national partners (Soil Health Institute), as well as a look at our research in the plant growth and development cluster.

The cover story centers on Noble Academy, the youth education program, which provides invaluable support to teachers and inspires students to experience STEM and agriculture education through hands-on learning.

On the cover, Noble Foundation photographer Rob Mattson illustrates how Noble Academy sparks the imagination of today's youth, helping them have that lightbulb moment of learning as they grow into tomorrow's leaders.

For the designers in the audience, notice Noble Academy's logo - a leaf overlaid with six-carbon rings - serves as the lightbulb's filament. And the young woman who is the cover model is 9-year-old Laurel Davis, daughter of Creative Manager Rachael Davis.

Noble Spotlight



SCIENTISTS ANNOUNCE GENETIC ADVANCEMENTS IN ALFALFA RESEARCH

Researchers from the Noble Foundation, University of Minnesota and the National Center for Genome Resources have made significant strides in sequencing the alfalfa genome. The group announced their findings in July at the North American Alfalfa Improvement Conference.

The group announced the majority of the genome has been sequenced and genomicists are putting the final pieces into place. Researchers may now be able to study which genes are likely to affect disease resistance, digestibility and the ability to produce natural nitrogen fertilizer. This will allow us to breed plants for higher quality and production.

SCIENTISTS STUDY PLANT-MICROBE INTERACTIONS IN SWITCHGRASS

Researchers at The Samuel Roberts Noble Foundation (including co-principal investigators Kelly Craven, Ph.D.; Michael Udvardi, Ph.D.; Wolf Scheible, Ph.D.; and Malay Saha, Ph.D.); the Lawrence Livermore National Laboratory; the University of California, Berkeley; and the University of Oklahoma recently received a five-year, \$11 million grant from the U.S. Department of Energy to study soil microbial populations in and around switchgrass plants that grow well (or poorly) on nutritionally depleted soils.

Understanding how such microbes promote prairie grass growth in nutrient-deficient, marginal soils could help researchers understand how to grow healthier, hardier plants for livestock and people.

INSIDE THIS ISSUE

LOCATE THE BLUE COW. WIN A PRIZE.

Hidden within each issue of *Legacy* magazine (after page 7) will be a blue cow. Find the blue cow and send us a message on social media with #ifoundthebluecow. The first five people will win a prize.

SOCIAL MEDIA



www.noble.org



twitter.com/noblefoundation



facebook.com/noblefoundation



linkedin.com/company/noble-foundation



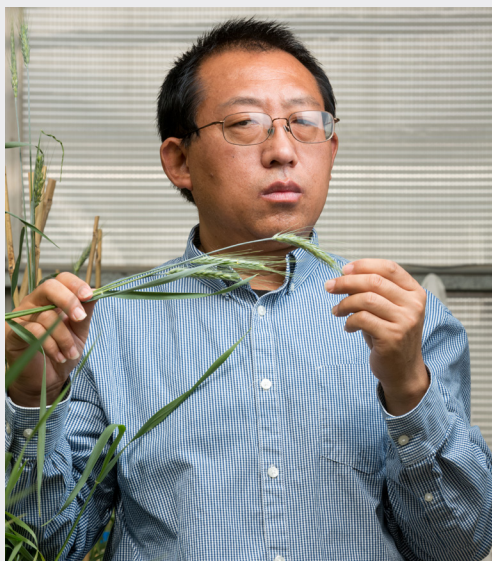
youtube.com/thenoblefoundation



pinterest.com/noblefoundation



instagram.com/noblefoundation



MA TAKES REINS OF NOBLE'S HISTORIC SMALL GRAINS BREEDING PROGRAM

Xuefeng Ma, Ph.D., joined the Noble Foundation as a new principal investigator and became only the sixth researcher in the last 60 years to lead the organization's small grains breeding program. Ma will focus on improving small grains (wheat, rye, triticale, etc.) varieties for early fall-winter forage production. The main goal of the Noble Foundation's small grains breeding program is to develop cultivars with high forage yield suitable for sustainable fall and winter grazing as well as good grain production in the case of dual-purpose wheat.



RESEARCHER STUDIES COVER CROP EFFECTS ON WINTER PASTURE

Noble Foundation researchers are studying how cover crops could be part of a year-round grazing system that provides economic and environmental benefits to farmers and ranchers.

Noble Foundation research agronomist James Rogers, Ph.D., received a three-year, \$155,975 conservation innovation grant from the U.S. Department of Agriculture Natural Resources Conservation Service to conduct the research. The grant will support Rogers in determining how much moisture is used and/or conserved by summer cover crops and how those crops impact production of grasses and legumes consumed by livestock (commonly called forages) during the winter months.

AGRICULTURAL SCIENCE EDUCATION INSTITUTE COMES TO OKLAHOMA

Noble Academy, Oklahoma State University Agricultural Education program and CareerTech Agricultural Education division offered the first Curriculum for Agricultural Science Education (CASE) Institute in Oklahoma. The CASE Institute Principles of Agricultural Science - Plant was held in June. CASE Principles of Agricultural Science - Plant is a foundation-level course for agricultural educators that teaches the form and function of plant systems. CASE Institute students are immersed in inquiry-based exercises filled with activities, projects and problems to teach them plant concepts through laboratory and practical experiences.



YOUNG SELECTED AS FIRST EDITOR OF NEW JOURNAL

Noble Foundation Associate Professor Carolyn Young, Ph.D., has been named editor-in-chief of the American Phytopathological Society (APS) *Phytobiomes* journal. *Phytobiomes* is the society's new open-access journal and will cover the many interrelated disciplines of research associated with the sustainable production of food, feed and fiber. Young was selected because of her active participation in the phytobiomes community, her high standing as a productive and widely recognized scientist, and her broad, interdisciplinary research interests.

NEW LAW AIMS AT BUILDING AGRICULTURAL RESEARCH CAPACITY

The Charitable Agricultural Research Act (S. 908) was included as part of the tax bill that passed on Dec. 18, 2015, Protecting Americans From Tax Hikes Act of 2015. Known as CARA, the federal measure created a new type of 501(c)(3) public charity called agricultural research organizations (AROs). AROs may serve as a nonprofit organizational vehicle for individuals or families who would like to commit their wealth for the conduct of agricultural research for the public good.

LEGACY

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Bill Buckner
PRESIDENT/CEO → *CSI in the Wheat Field*

J. Adam Calaway
EDITOR/WRITER → *Liquid Nitrogen Ice Cream, definitely!*

Rachael Davis
GRAPHIC DESIGNER → *Crayon Rock Cycle*

Rob Mattson
PHOTOGRAPHER → *Milk's Macromolecules*

Courtney Leeper
COPY EDITOR/WRITER → *Nails for Breakfast*

Robyn Peterson
WRITER → *Let's Talk About the Weather*

Laura Beil
WRITER → *Molecules Matter! Structure of Photosynthesis*

Sidney Reynolds
WRITER → *Chemistry's Rainbow: The Power of pH*

Shane Porter
WEB → *Strawberry DNA Extraction*

Legacy is published by the Department of Communications at The Samuel Roberts Noble Foundation. Headquartered in Ardmore, Oklahoma, the Noble Foundation is an independent, nonprofit institute conducting plant science research and programs to enhance agricultural productivity. *Legacy* offers insight into the outstanding scientists and agricultural consultants who pursue the vision of founder Lloyd Noble.

Reprints
Reprint requests may be made by contacting J. Adam Calaway, Director of Communications, at 580-224-6209 or by email at jalcalaway@noble.org.

No-cost subscription/address change
Legacy is provided at no cost to the general public as a courtesy of the Noble Foundation. To receive a copy of the magazine or to change your mailing address, please email jalcalaway@noble.org.

The Samuel Roberts Noble Foundation
2510 Sam Noble Parkway
Ardmore, Oklahoma 73401
580-223-5810 (general information)
580-224-6209 (media)

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ISSN: 1939-5035

Wayne Honeycutt, Ph.D., evaluated soilborne disease, nutrient availability and soil physical properties in a plot of barley interseeded with red clover as part of his Maine ARS cropping systems study. This photo originally appeared in the USDA ARS magazine.



“Our job is to identify the key soil processes that influence productivity, resilience and environmental quality; then we will work with others to highlight research gaps and coordinate national partnerships to address those gaps. This will help drive the transformational changes needed for the betterment of soil health and ultimately society.” —Wayne Honeycutt, Ph.D.



HOW DID THE SOIL HEALTH INSTITUTE BEGIN?

The Samuel Roberts Noble Foundation and Farm Foundation, NFP announced the formation of the Soil Health Institute on World Soil Day, Dec. 5, 2015. The timing was fitting: 2015 was the International Year of Soils.

The Institute is the action-arm evolution of the Soil Renaissance, an initiative established in 2013 by the Noble Foundation and Farm Foundation, NFP to advance soil health and make it the cornerstone of land-use management decisions.

WHAT IS ITS MISSION?

The Soil Health Institute's mission is to safeguard and enhance the vitality and productivity of the soil. It works directly with conventional and organic farmers and ranchers, public- and private-sector researchers, academia, policymakers, government agencies, industry, environmental groups, and consumers as the primary resource for soil health information. It also works to set soil health standards and measurement, build knowledge about the economics of soil health, offer educational programs, and coordinate research in all aspects of soil and soil health.

HOW IS IT FUNDED?

The Noble Foundation continues to provide start-up financial and administrative support for the new institute, including counsel on human resource processes, budgeting, contracts and organizational structure, nonprofit business stewardship, and public announcements. The Noble Foundation has committed to an initial \$20 million across 10 years. The goal: have like-minded organizations and individuals join this critical effort to ensure long-term, sustainable success.

Exploring the Global Frontier Under Our Feet

The Soil Health Institute brings new vision and energy to a cause that impacts the world.

by Sidney Reynolds

For Wayne Honeycutt, exploration into the critical role of soil began with one of soil's most common edible inhabitants – the potato.

During the 1990s, Honeycutt, Ph.D., convened a research workshop with Maine's potato growers, processors and county agricultural extension specialists. The cost of producing potatoes had been increasing more than the market could bear, squeezing profits so hard that anyone associated with potatoes – from the potatoes you cook for dinner to potato chips – was hurting.

As research leader of the New England Plant, Soil and Water Laboratory for the USDA Agricultural Research Service (ARS) in Orono, Maine, Honeycutt wanted to share the laboratory's soil, plant disease, agronomic and economic expertise to support potato growers.

"We knew that the right crop rotation strategies would increase growers' income," Honeycutt said. "Rotation can be an effective way to suppress plant diseases, enhance soil nutrient availability, increase crop yield and reduce chemical use."

After eight years of research with various crop rotations, the laboratory provided growers with state-of-the-art decision-support software. The tool showed probable yield expectations, level of nitrogen recycling, soil microorganism activity, disease incidence and economic feasibility, based on their rotation choices.

By the end of the journey, an interdisciplinary team of scientists had shown that they could double potato yield by either irrigating or improving soil health.

"My perspective on soil health took root during this time," Honeycutt said. "In that particular research, we found that improving soil health significantly improved water availability. This is just one data point, but it started me down a path of realizing how critical soil is to all aspects of the ecosystem and agriculture."

The potential to improve drought resilience and increase crop yields on a worldwide basis provided transformative inspiration. Honeycutt realized that improving soil management can make a fundamental impact in a world expected to feed 9 billion people by 2050, and, in order to do so, agricultural producers need strong, evidence-based research and coordination of projects across different climates and soils.

His path was set.

THE WORLD'S SOIL ASTRONAUTS

Today, as president and CEO of the Soil Health Institute, Honeycutt is a champion for soil health standards, measurement and best practices.

He assumed the position after spending more than 30 years serving the U.S. Department of Agriculture; first for the ARS and later as deputy chief for science and technology for the Natural Resources Conservation Service (NRCS), where he led its soil health



The Soil Health Institute held its annual meeting July 27-29, 2016, in Louisville, Kentucky.

campaign. This effort has achieved national and international recognition for its training materials, partnerships, scientific expertise, technology transfer, adoption rates, landowner benefits and environmental benefits.

Honeycutt brings this wealth of experience to a new institute created to drive strategic, coordinated and practical investments in soil health research.

“While it is clear that soil health management systems can build resilience to drought, as well as provide protection from other extreme weather events, significant research needs still exist to achieve our goals,” Honeycutt said. “Our job is to identify the key soil processes that influence productivity, resilience and environmental quality; then we will work with others to highlight research gaps and coordinate national partnerships to address those gaps. This will help drive the transformational changes needed for the betterment of soil health and ultimately society.”

Steve Shafer, Ph.D., joined Honeycutt this spring as chief scientific officer of the Soil Health Institute, heading up the organization’s research arm. The former associate administrator for national programs in the ARS once directed the Beltsville Agricultural Research Center in Beltsville, Maryland, the USDA’s largest research center.

Shafer’s immediate focus is to spearhead research that leads to an increase in soil organic carbon. A single percent increase can essentially improve the top 6 inches of soil’s water-holding capacity by 2,400 to 11,700 gallons an acre in many typical agricultural soils. Improving the soil’s water-holding capacity and increasing water infiltration would also reduce runoff.

“Imagine what enhanced resiliency and reduced soil and nutrient losses mean not only in economic terms to our farmers and ranchers,” Shafer said, “but also in environmental terms for the stream, river and Gulf water quality needs we have.”


Another early focal area will be quantifying the impacts of soil health-promoting practices on profitability across a range of soils, crops and climates. In addition, the Institute will coordinate intelligent grant spending to develop new technologies and practices while collaborating with other specialists from a range of disciplines.

Such activities will include discovering optimal cover crop species mixes to enhance beneficial soil microbial processes that increase soil organic carbon, control plant pathogens, increase yield and protect water quality. “This is exciting and critical work,” Honeycutt said. “We are drilling down into the soil’s DNA.”

Both leaders emphasize the need to quickly transfer new research findings to farmers and ranchers. Agricultural producers and land managers face projected increases in the frequency and intensity of extreme weather, which are expected to negatively impact crop and livestock production as well as numerous natural resources and related ecosystem services.

“Faster education and full transparency will be critical,” Shafer said. “The translation of findings from scientific research into decision-support tools to achieve positive outcomes for farmers, ranchers and land managers will always be in the forefront of everything we do.”

It’s a bold mission for an organization less than a year into its existence.



Steven Shafer, Ph.D., (far right) chief scientific officer of the Soil Health Institute, often reminds agricultural leaders of the long-term, projected implications of soil health. By 2050, scientists project, more than three-quarters of the 70 percent increase in global food production needs will come from sustainable intensification of existing farmland.

Photo courtesy of Mike Olliver and The Nature Conservancy

“During the early stages of the Soil Renaissance, one individual challenged us, saying ‘We’re not thinking big enough. We need an organization that is to soil what NASA is to space.’ So now we’re exploring the global frontier that is right under our feet.” —Bill Buckner

NOBLE FOUNDATION LAUNCH PAD

The Soil Health Institute, founded in December 2015, is the outcome of the Soil Renaissance, an initiative launched by the Noble Foundation and Farm Foundation, NFP to raise the national discussion about soil health with the hope of making it a cornerstone of land-use management decisions.

For two years, farmers, ranchers, soil scientists, agribusinesses, economists, environmental and nongovernmental organizations, and government agencies collaboratively examined the role of soil health in a profitable, sustainable natural ecosystem. The group identified the need for a national organization to serve as a hub for measurement standards, economic data and coordinated research.

“During the early stages of the Soil Renaissance, one individual challenged us, saying ‘We’re not thinking big enough. We need an organization that is to soil what NASA is to space,’” said Bill Buckner, Noble Foundation president and CEO, and chairman of the Soil Health Institute’s Board of Directors. “So now we’re exploring the global frontier that is right under our feet.”

For Honeycutt, the challenges awaiting the Soil Health Institute incite the same energy and passion that he felt all those years ago when a simple spud launched his career trajectory.

“Thanks to the tireless efforts and generosity exhibited by many individuals from the Noble Foundation and Farm Foundation, we are now setting the stage to conduct life-changing research, education and adoption,” Honeycutt said. “It is now incumbent on us to make the most of this once-in-a-lifetime opportunity, and I am extremely excited to see what we can accomplish in the coming months and years.” ■

Pistol Pete, the Oklahoma State University mascot, and the Noble Foundation blue cow represent a 70-year-old relationship.



A SHARED CAUSE

**Oklahoma State University and the Noble Foundation
build on a 70-year legacy of collaboration as they
serve their home state and beyond.**

by Courtney Leeper

Sarah Oliver's favorite part of science is seeing how it helps people.

That's part of why she chose Oklahoma State University (OSU) over the Ivy League schools that originally drew her interest. OSU offered her the opportunity to jump right into research as a freshman, and Stillwater's small-town atmosphere reminded her of home: Ardmore, Oklahoma, the place her interest in science was first sparked during school field trips to the Noble Foundation.

As a third-grader, Oliver's mind was captivated by the rows and rows of grasses growing in the greenhouse. Three years later, she pulled on a latex glove to touch warm, half-digested grasses pulled from a cow's rumen, the first of its four-chambered stomach. Today, Oliver still remembers her thought while the cow stood there obliviously chewing its cud: "Science is really cool."

Oliver's desire to explore the world through science and to be part of a career field that uses science to find solutions to some of life's most complicated problems,

led her from Ardmore to OSU. There she studies biochemistry and works in a laboratory focused on human health. This summer, she found her way back to the Noble Foundation as one of five Summer Research Scholars in Plant Science.

"I'm not just sitting here pipetting things," Oliver said. "I am sitting here pipetting things knowing that if I discover something interesting, it might help people."

This desire is a common thread shared among people at both OSU and the Noble Foundation. Throughout the last 70 years, they have collaborated many times to fulfill their shared objective of serving Oklahoma and advancing agriculture through research and education.

IN THE BEGINNING

OSU (originally named Oklahoma A&M University) was a healthy 55 years old when the Noble Foundation came into existence in 1945 with the main purpose of promoting soil conservation and land stewardship in the post-Dust Bowl era.

After founder Lloyd Noble, an oilman and philanthropist, died in 1950 and left much of his estate to the Noble Foundation, the trustees purchased a 198-acre farm 2 miles east of Ardmore. This tract of land became headquarters for a joint research program developed by the Noble Foundation and OSU in May 1951. Led by Horace Harper, Ph.D., an OSU professor of soils, the program called for the establishment of three research and demonstration farms on soils typical of south-central Oklahoma. The idea was simple: conduct research and demonstrate best practices so area farmers and ranchers could apply this knowledge to their land and operations. In essence, Harper became the Noble Foundation's first Agricultural Division director while maintaining his OSU position.

For the next seven years, OSU and the Noble Foundation expanded agricultural research in the region beyond soil to include beef and dairy cattle production; field and horticulture crops, including pecans; cropping systems; irrigation; and marketing. Each



Horace Harper, Ph.D., an OSU soils professor and the first Noble Foundation Agricultural Division director, in 1952.



Horace Harper, Ph.D., (second from left) at a field day, May 20, 1954.

year, more than 2,000 people attended field days at the farms to see the results of new technologies and practices.

In 1958, the Agricultural Division's focus shifted to directly funneling information to area agricultural producers through consultation. While the initial collaboration ended, the relationship with OSU did not.

BETTER TOGETHER

Wadell Altom joined the Noble Foundation as a soil fertility specialist for the consultation program in 1966. As an OSU graduate, he credits his time working in OSU's soil and water testing laboratory as an agronomy student with preparing him for his first job, which launched his career at the Noble Foundation that would span more than four decades.

While the consultation program sent out teams of specialists to work with producers and help them adopt new practices, research continued. "Only we didn't have research technicians to carry out the day-to-day work back then," said Altom, who retired as Agricultural Division director in 2009. The consultants were responsible for all aspects of a research project, from the initial idea to carrying it out. "If you believed in a project, you were going to do it," he continued.

This led to collaboration among specialists, including the team of Altom and Jerry Rogers on soil fertility projects from the 1970s to the 1990s. The team also pulled in Robert Morrison, an OSU statistician, to design the project and analyze the data so they could focus on communicating the results to farmers.

Altom also remembers working with William "Bill" Raun, Ph.D., an OSU agronomist. Raun's project led to the development of GreenSeeker technology, which detects nutrient needs in pasture and crop fields. The Noble Foundation provided a portion of the funding and testing for this technology, including supporting a postdoctoral fellow, Jagadeesh Mosali, Ph.D., who collaborated with OSU on using GreenSeeker in bermuda-grass fertility projects.

"It was nice to know that if you had a question, you could ask someone somewhere else," Altom said. Through the years, Altom served on various committees at OSU, from research review to agricultural leadership. "Ultimately it benefits producers if all organizations work together."

Many interactions among pecan specialists at OSU and the Noble Foundation have led to standard practices used by pecan growers in the state, which is ranked

third in the nation for number of pecan acres, and country.

Through the 1970s, OSU's R.D. Eikenbary, Ph.D., used data from the Noble Foundation's Red River Farm to learn more about the pecan weevil, which causes immature pecans to fall from trees early and destroys quality when their eggs hatch inside the nut. In the 1980s and 1990s, Phil Mulder, Ph.D., current department head of the OSU Entomology and Plant Pathology Department, built on Eikenbary's research and developed the circle trap, the use of which is now a standard practice in the pecan industry to control weevils.

In the late 1990s, Cecil Crabtree, a producer who grows pecans along the Red River and works with Noble Foundation consultants, noticed his pecan trees looked unhealthy.

The leaves were pale, and they weren't producing as many pecans as other orchards in the area. Crabtree mentioned the problem to Scott Landgraf, a Noble Foundation horticulturist and pecan specialist at the time, who pulled in Mike Smith, Ph.D., from OSU. Together, Landgraf and Smith determined Crabtree's orchard lacked manganese, a nutrient deficiency never before recorded, and found a treatment still used today.

Researchers also have worked together to determine why pecans seem to have a productive crop every other year and on best practices for watering and fertilizing orchards.

Now, the Noble Foundation's pecans are also being used in OSU research on pecan health benefits and food safety.

"While we are doing our own pecan research, we are also growing pecans like a producer might," said Charles Rohla, Ph.D., manager of the Noble Foundation's Center for Pecan and Specialty Agriculture. "We often become a laboratory for other researchers, including those at OSU, who have their own interests in different aspects of pecan growth, care and marketing. There is strength in numbers, and together we make a better program for the state of Oklahoma."

COMBINED EXPERTISE

Working together on research has become progressively more important in recent decades, according to Keith Owens, OSU Division of Agricultural Science and Natural Resources associate vice president who oversees OSU's statewide Oklahoma Agricultural Experiment Station system.

"Collaborative research enhances the credibility and viability of a project by including a wider array of expertise," Owens said. "A research project often covers a wide



Charles Rohla, Ph.D., continues working with OSU researchers to benefit the pecan industry through the Noble Foundation Center for Pecan and Specialty Agriculture.

range of methodology, technology and theory across a number of career disciplines and programs. The complexity of these projects is likely to be far beyond the research capabilities of a single individual, demanding multiple experts working as a team to accomplish a common goal."

One common goal in Oklahoma has been helping farmers and ranchers deal with cotton root rot, a debilitating fungal disease that can wipe out alfalfa and other crops like cotton, peanuts and pecans. Todd Baughman, Ph.D., a researcher at OSU's Institute for Agricultural Biosciences, has been studying different ways to control the disease with fungicides on trial plots at the Noble Foundation's Red River Farm since fall 2013. With the Noble Foundation just five minutes away, he works closely with Noble Foundation researchers James Rogers, Ph.D., a forage systems specialist, and more recently Carolyn Young, Ph.D., a mycologist.

Young remembers meeting Stephen Marek, Ph.D., another OSU researcher, in

2006. Young describes Marek as the "brilliant plant pathologist" who taught her about the fungus that causes cotton root rot, *Phymatotrichopsis omnivora*. When the two went out to alfalfa fields to observe the disease-ridden land and collect samples to study back in the laboratory, Marek climbed to the top of a grain bin to get a better view of the damaged field.

Now the team flies unmanned aerial vehicles, also known as drones, to capture aerial images that help them track the disease progression. This helps Baughman better see the results of his trials and gives him more information upon which to base the next round. It also helps Young as she tackles the problem in the laboratory, where she and her team study how the fungus reproduces and what makes it attack.

"Bringing in different areas of expertise helps us see things in a new light," Young said. "You bring in partners who together make the best team possible because, really, it's about working together to help farmers."

BY THE NUMBERS

195 OSU students have received Sam Noble Scholarships since 1999.

(That's **\$1,999,750** of financial aid.)

The Noble Foundation matched

\$4,177

donated to OSU by employees in 2016.

58

current Noble Foundation employees earned their degrees from OSU.

Noble Academy has helped send

6 OSU

master of international agriculture students to Watoto Child Care Ministries in Uganda to assist with agricultural development activities.

\$244,200

has been awarded to OSU for distribution as financial aid to agriculture students.

\$15,688,860

has been awarded to support capital projects, research projects and eight endowed chairs.

\$451,380

has supported the Oklahoma Agricultural Leadership Program (OALP) since 1984.

4 employees are OALP alumni, and two are part of the current class (Class XVIII). Billy Cook, Ph.D., Agricultural Division director, serves on the Advisory Council.

24 OSU students

have spent the summer working alongside Noble Foundation ag consultants and scientists as Lloyd Noble Scholars in Agriculture and Summer Research Scholars.

John Weir, OSU research associate (front), works with Noble Foundation consultants and researchers to promote prescribed burns.



BEYOND RESEARCH

John Weir, a research associate in the OSU Department of Natural Resource Ecology and Management, first met Russell Stevens, a wildlife and range consultant at the Noble Foundation, when they did research together on the Noble Foundation's Coffey Ranch in the late 1990s. They were studying the effects of fire, used strategically, on the health of open pastureland.

Fire is a natural part of the Great Plains ecosystem, but fear of fire has led to its suppression as more and more people have come to live closer and closer together. As a result, eastern red-cedar trees have spread; birds and other wildlife have lost their habitat; and when fire does occur naturally or by accident, the flames can blaze uncontrollably because of red-cedar's high flammability.

Research points toward the need for fire on the landscape, but fires must be carefully planned and conducted by people with experience. More than 90 percent of Oklahoma's 12 million acres of forestland is privately owned. The Noble Foundation began organizing workshops to help these land managers in the 1990s, and Weir began organizing groups of interested landowners into local associations that could work together to share equipment and knowledge while bringing fire back as a land management tool

In 2010, as the various prescribed fire

associations emerged, Weir and fellow wildlife conservation experts realized landowners needed more support to make controlled burns commonplace.

Ron Voth of the Oklahoma Wildlife and Prairie Heritage Alliance and Darrel Dominick of the Oklahoma Conservation Commission received a grant to meet with landowners and the various associations, conduct trainings, and administer a survey to find out why people weren't burning. Two years and 500 responses later, they found that liability – and the lack of insurance to cover any potential damages – was a major reason limiting landowners' use of prescribed burns. In 2010, the group started working toward making prescribed burn insurance a reality but soon realized the need was greater than just insurance.

"What we needed was a group that could support them," Weir said. "We needed a network of people that would connect all these groups. That's where the idea for the Oklahoma Prescribed Burn Association came in."

In November 2012, OPBA was in its infancy when Weir contacted Russell Stevens at the Noble Foundation. "Russell and I had a good working relationship, and I knew the Noble Foundation had a strong history with prescribed burning," Weir said. "They know how to work with landowners and groups. They know how to train. And they're just

good people to work with. I thought it would be right up their alley."

By April of the next year, the Noble Foundation and OPBA signed a two-year agreement that allocated 90 percent of Stevens' time to serve as the first OPBA executive director.

Soon after, OPBA was able to set up the organizational bylaws and legal documents to ensure the association could revitalize the local associations by providing them with equipment, training and more support. Stevens played a large role in conducting a study on the effectiveness of prescribed burn plans that was presented to the Oklahoma Senate.

"The Noble Foundation helped us get over a lot of the hurdles of forming an organization," Weir said. "Having Russell pretty much full time was a huge, huge help. OSU, the Noble Foundation, OPBA, it's all a great fit because we're all working for the same cause, the same reason. Together we can get a lot of good stuff done."

Including making prescribed burn insurance a reality for landowners in 2015.

"OPBA is a good demonstration of what can actually be done when you work together," Stevens said. "We don't care about whether it's from the Noble Foundation or OSU. If we see a problem that we can tackle together, we do. We roll up our sleeves and go to work side-by-side." ■

A student investigates the relationship between the amount of carbon dioxide dissolved in water and the pH of water as part of Noble Academy's *The Carbon Cycle* lesson.



Today's Lessons.

TOMORROW'S LEADERS.

Noble Academy supports teachers and the next generation of problem-solvers in local schools and beyond.

by Courtney Leeper

Micki Runyan remembers the day Frank Hardin, Ph.D., first stepped into the principal's office at Dickson High School. "He was so kind, and we were so excited," the biology teacher said. She chuckled as she continued, "It was like someone had thrown this sweet little rabbit to ravenous wolves."

It was 2012, and Hardin had sat down to talk with Runyan, principal Rex Trent and chemistry teacher Wanetta Thompson about how the Noble Foundation's newly formed youth educational outreach program, Noble Academy, could help ignite students' excitement about science and agricultural education.

Hardin, a scientist turned educator, had recently been selected to lead Noble Academy. He discovered his love for connecting students with science while teaching undergraduate laboratory courses as he pursued his graduate degrees in cellular biology at the University of Georgia.

"Agriculture is the original science," Hardin said. "And we want to show students the role agriculture plays in their everyday lives while introducing them to careers in agriculture. We want to help build strong leaders who can discern information by applying the basics of logic and science they learned in eighth grade."

But first, Hardin wanted to better understand teachers' needs so he could shape Noble Academy to meet them. Calls to schools turned into meetings, and meetings turned into collaborations. Soon Hardin started bringing hands-on science lessons to classrooms. A few years later, Jenn Scott joined him as educational outreach assistant after teaching high school agriculture for 10 years.

"We could tell he had a great love for bringing science and agriculture to students," Runyan said. "It was a great fit. We've been working with Noble Academy for four years now, and it has just bloomed."



What is
STEM
education?

STEM stands for science, technology, engineering and mathematics. The STEM education approach uses these subjects to equip students with the skills, knowledge and experiences to think and solve problems critically.

The Principal's Perspective

About 20 minutes away, Tim Parham knows it's not easy to keep 100 eighth-graders interested in an all-day activity. But the Plainview Middle School principal said Noble Academy's annual Science in Ag Day does it pretty well.

Each year, Plainview students load up on busses and head out to either Hardy Murphy Coliseum in Ardmore or the Noble Foundation's campus to spend a day exploring science through the lens of agriculture alongside other area eighth-graders.

"It was interesting to see all the microbes from the cow's stomach," said Jentri Rayburn, a Plainview student, after learning how ruminant animals convert grass to muscle at this spring's Science in Ag Day. "I'm around cows a lot, so it was cool to see what's inside them."

Rayburn and her classmates also planted their own strawberry plants and learned about plant propagation. They simulated plant breeders' work to produce higher-yielding, more disease- and pest-resistant plants. And they learned about wildlife habitat, soils, polymers and technologies that assist land management decisions.

"We have kids with a natural interest in agriculture; whose families are involved in agriculture, but we also have kids who aren't familiar with it," Parham said. "Science in Ag Day has something for all of them. We always have kids come back talking about it, and they wear their Science in Ag Day T-shirts throughout the year."

Hardin and Scott visit Plainview multiple times during the school year with a rolling rack full of student-size white laboratory coats and all the materials needed for the sixth- through eighth-graders to conduct an experiment. The students become scientists for 40 minutes as they pull DNA from a strawberry and iron from cereal. Each lesson is an opportunity to further explore concepts their teacher has explained.

On those days, after the lesson, Parham looks for the students who struggle academically.



Students from the Take Two Academy in Ardmore, Oklahoma, help build a hoop house on Oct. 22, 2015.

"Those kids light up," Parham said. "Our kids go berserk over the lessons. They especially reach those who are difficult to get plugged in. And it inspires the teachers to think outside the box in their own lesson planning."

Noble Academy's out-of-the box approach also has the middle school expanding agriculture in their own little circle. Public schools are being squeezed for funding, Parham said, but Hardin has shared advice on applying for grants. As a result, Plainview Middle School will soon have a hoop house where students will raise vegetables and herbs as an educational laboratory. Eventually the principal hopes their produce will be served in the school cafeteria.

"My brain wasn't even looking for that, but now we're jumping all in," Parham said. "To collaborate with these brilliant people, some of the best in the world, has been such a positive experience. I can count on Dr. Hardin and Noble Academy's support."



FRANK HARDIN, Ph.D.
Educational Outreach Manager

What drew you to education?

I always looked forward to teaching when I was in graduate school. I enjoyed the interaction with the students, and I didn't realize how much I missed it until I was working on a research project full time. I have a passion for science, and I love teaching the next generation. I couldn't ask for more.

What does Noble Academy strive to do?

We want to build strong youth leaders. It's not a new idea that strong youth are

surrounded by caring adults. That's part of what we do. We also provide them with information and set them up to explore further on their own.

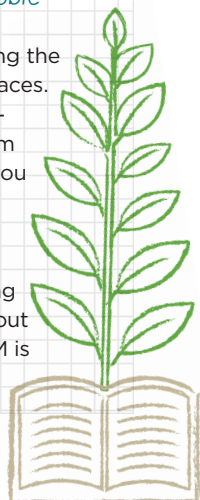
Why is Noble Academy important?

It's important to tie today's youth with agriculture and STEM, and that's what we do every day through Noble Academy. We get to open students' eyes to all the opportunities in agriculture. Farming and ranching is the bread and butter of agriculture, but there are so many additional

career paths that play a role in feeding and clothing the world.

What's your favorite part of working with Noble Academy?

The best part is seeing the smiles on students' faces. When you're explaining a concept to them and all of a sudden you see the light go on, and you realize they understand. That's a great moment. Seeing them get excited about agriculture and STEM is what motivates me.



Brian Williams, a small plot research associate, mentors a student at the soils rotation during the 2016 Oklahoma Envirothon held at the Noble Foundation.



A Competition Revived

Will Moseley was determined not to let the Oklahoma Envirothon competition for high schoolers completely fizzle out. But he needed a little help.

The Noble Foundation wildlife and fisheries consultant became involved in the competition as a judge in 2009. During the next couple of years, he tutored a team from Lawton. Moseley remembers pulling out his notes from college, including those from a graduate-level course on population dynamics. He began the study sessions by telling the students, “Now this is advanced material,” but they were eager to learn.

“To see them not only start to understand the concepts but enjoy learning was enjoyable for me,” Moseley said. “I saw how valuable that education was. Plus, traveling around the state, and beyond in the case of the North American competition, gave them the chance to see various real-world problems in our environment and have amazing experiences together. It’s an extracurricular activity I wish I’d had when I was their age.”

Between 2009 and 2013, fewer and fewer teams participated, and the outlook for the Oklahoma Envirothon seemed bleak. So, Moseley took it upon himself to bring the competition to the Noble Foundation and keep it going.

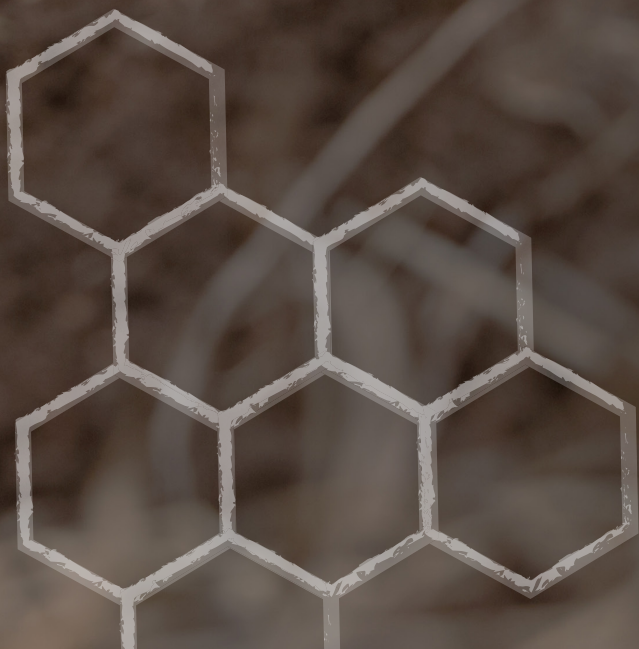
The full-time consultant quickly realized he didn’t have the time to consult, run such a large event and do what he loved at Envirothon – mentor students. By 2014, Noble Academy had stretched its reach beyond the traditional classroom setting, and Moseley knew Hardin was just the help he needed. After a year of observing, Noble Academy was ready to host in 2015.

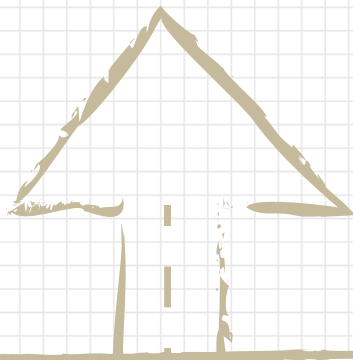
“Envirothon is a great example of how Noble Academy is truly an organizational effort,” Hardin said. “Noble Academy pulls together people passionate about their work. Will is passionate about Envirothon, and together we use the competition to show students the importance of properly managing natural resources and environmental issues facing current and future generations.”

The program drew in eight teams from across the state in 2016. The Edmond North High School team won the state championship title, and Noble Academy flew them to the North American Envirothon competition, which took place at the end of July in Ontario, Canada, to compete against 52 teams from across North America.

“It’s night and day different now,” Moseley said. “Noble Academy engages the students and gets them excited. They build connections with the teachers, and I focus on writing tests and finding judges. That two-way interaction between the judges and students is what makes Envirothon great, but it wouldn’t happen without Noble Academy.”

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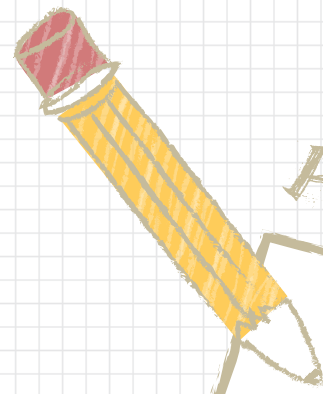
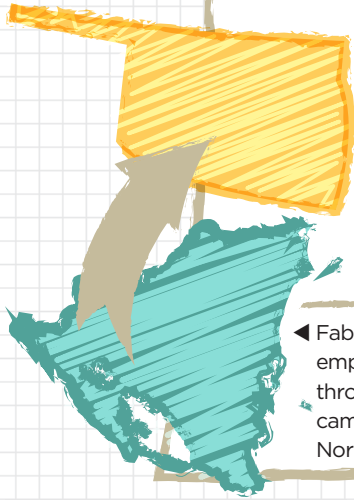


Noble Academy either hosted on campus or visited directly a total of

146

schools/educational organizations.

◀ Fabretto, a nonprofit that empowers underserved children through education and nutrition, came all the way from Dupla Norte, Managua, Nicaragua.



A + B = C

Noble Academy have traveled as

8,340

miles to Field of Hope in Uganda.



√58



The *Grown for You* trailer (collaboration of Noble Academy, Oklahoma Farm Bureau and Oklahoma Farming and Ranching Foundation) traveled to

21

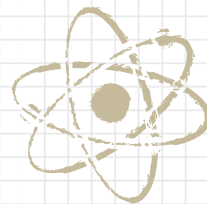
locations in Oklahoma in 2015.



Noble Academy provided training to teachers from

34

schools in Kansas, Oklahoma, Missouri and Washington.

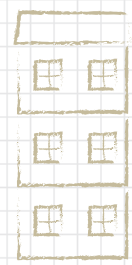
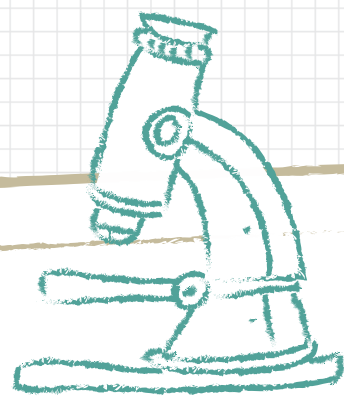


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lessons
far as

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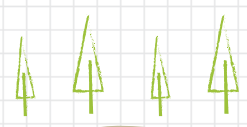
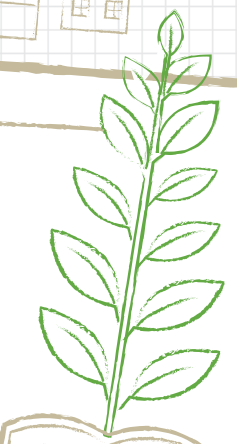
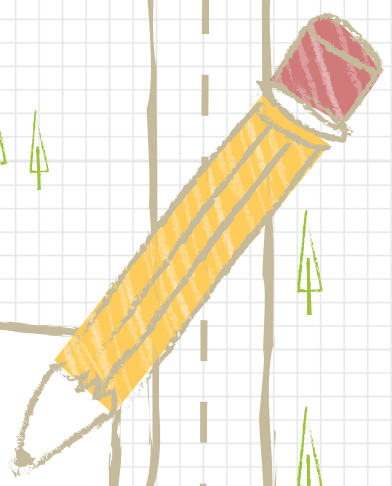
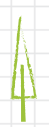
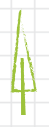
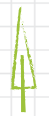
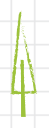
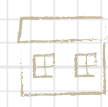
be



In 2016 alone,

539

students attended four
all-day Noble Academy
events.



Noble Academy has hosted

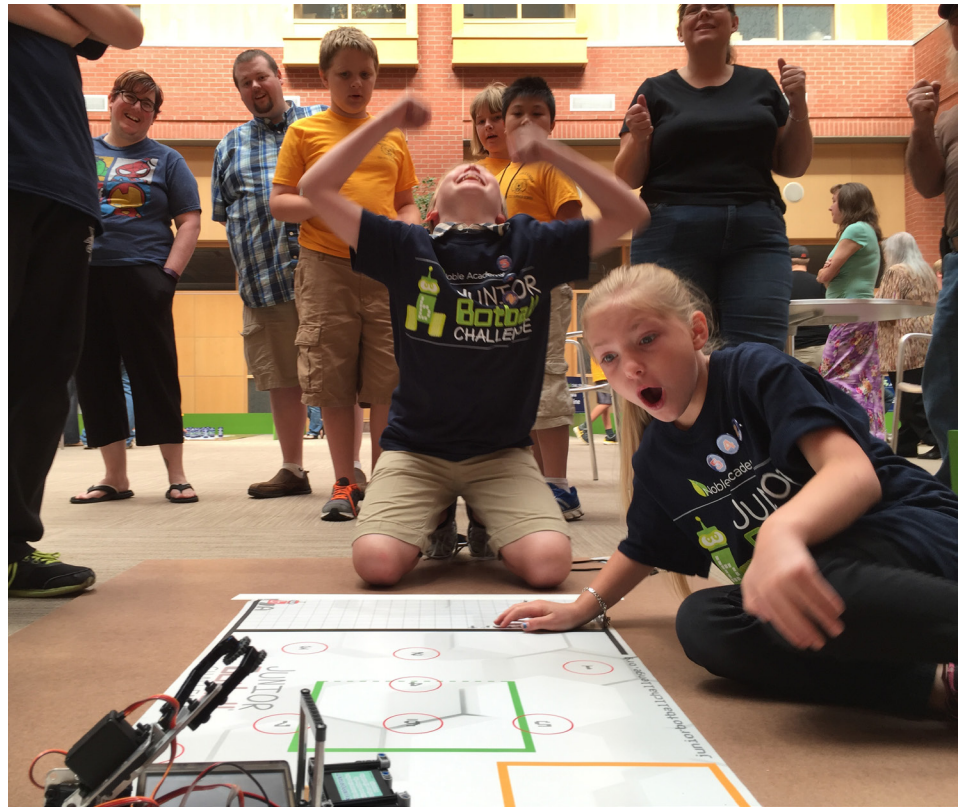
37

Lloyd Noble Scholars in
Agriculture and Summer
Research Scholars in
Plant Science.

They come from more than 22
universities across the nation. ▶



Noble Academy offers teachers lesson plans, classroom visits and much more. The youth educational outreach program teaches students of all ages through hands-on activities; hosts events that promote science and agriculture; travels across the state to engage teachers in professional development; and works with organizations to promote agricultural literacy in Oklahoma and beyond.



Jonathan Harris (left and center) and Amber Presley (far right) learned computer programming, critical thinking and perseverance skills through the Junior Botball program hosted by Noble Academy.

Robots in Agriculture

Noble Academy's first three years focused on building collaborations with local teachers and educators as far away as the Dallas Arboretum and Field of Hope in Uganda. In 2015, Hardin began searching for a way to round out Noble Academy's STEM approach with a technology and engineering component.

When Hardin met Steve Goodgame, he knew he had found a winner: Botball, a program that teaches elementary through high school students how to program mobile computers with sensors (aka robots) to accomplish tasks.

"When I saw elementary students using computer language to program these robots, it was amazing," Hardin said. "You see these students having a blast. What they don't know is there's an incredible amount of learning going on simultaneously. We knew this would be a great fit."

Goodgame serves as the executive director of the KISS Institute for Practical Robotics, which created Botball in 1994 and now reaches students throughout the world. He laughs lightheartedly at his and Hardin's first meeting. Hardin drove up to Norman for what they planned to be an hour-long session in September 2015. Four hours later, the two were still talking about their ideas on how to bring science and agriculture to the forefront of more students' minds and the many applications of robotics in agriculture.

"We were like birds of a feather," Goodgame said. Before coming to the KISS Institute, Goodgame worked on his family's agricultural operation in New Mexico, served as his local Farm Bureau president and taught high school science.

Agriculture is one of the biggest and most untapped areas for robotics, Goodgame said. Precision technologies like GPS-guided tractors, automatic milkers and unmanned aerial vehicles require computer programming. The possibilities are endless, and the future of agriculture needs computer programmers.

"The robots are a cool way to promote agriculture because they excite kids," Goodgame said. "It sparks their interest and teaches them something rigorous that has value. Even if they don't become program coders, they learn to look at and solve problems in a different way. We're filling up the toolboxes of our future problem-solvers."

Hardin adopted the junior program, designed to teach elementary students the basics of computer language through team-based challenges, for a Noble Academy workshop. He and Scott then contacted six area schools, which each selected two fourth- or fifth-graders to participate in the workshop taught by members of the Noble Foundation's Department of Computing Services.

Jonathan Harris, known as "Jono" to his friends, is a fifth-grader at Plainview who participated in the workshop alongside teammate Amber Presley, a fifth-grader from Dickson.

"Botball is about being able to build something," Jonathan said. "For me, that's enough. I like having a challenge and having to go back and fix things. I really got into everything about it. I'd like to get into the field of robots helping people."

After seven two-hour sessions, the students demonstrated their skills at a challenge day that Noble Academy made open to all schools. It brought in additional students from three schools, including one from Moore, Oklahoma, two hours north.

Jonathan and Amber stood side-by-side ready to tackle the challenges they had practiced in the workshop and try new ones. Amber's parents and grandmother watched from the sidelines.

"The first time I asked Amber about how Botball went, she said, 'It was awesome!'" said Tammy Presley, her mother. "I'm impressed with all they've learned. I think it will be very beneficial for their future, and Amber is so interested in it."

The students were given five minutes to complete each challenge, although they could try as many times as necessary. Amber and Jonathan worked to "park" their robot in a "garage"

on a challenge mat at one of the stations. They punched in their code and watched as the robot headed straight. Then the robot spun, and the teammates laughed.

"That's not supposed to happen!" Amber said, and the two brought the robot back to the starting line. Laughter turned to seriousness, and they didn't give up until they succeeded.

The junior program prepares the budding programmers for the tournament-style Botball competition for middle and high schoolers. This advanced program features a "game" in which students go head-to-head to complete challenges as part of a mission.

This year, the young programmers had to keep the stranded "BotNaut" alive on Mars until a rescue mission could save it. Next year, thanks in part to the conversation between Hardin and Goodgame that day in September, the students' challenges will all be related to agriculture.

For Students and Teachers

Hardin and Scott continue to seek new ways to make science and agriculture exciting to students while supporting teachers in the classroom.

Micki Runyan recognizes a shift in her students' attention level when she invites Noble Academy into her biology class at Dickson High School. Scott visited four or five times at the end of last year to reinforce lessons Runyan taught throughout the year.

"The students look at the lessons differently when they are wearing those Noble Academy lab coats," Runyan said. "I can say something over and over, and they look at me like a calf at a new gate. Frank and Jenn can come in and say the same thing, and they're like 'I've never heard that before!'"

Days with Noble Academy are fun, she said, but that's not only what they're about. Noble Academy provides handouts that include questions and follow-up activities for students to learn more on their own. Runyan's students keep their finished handouts in their class folders.

"Sometimes those follow-up activities turn into even more lightbulb moments for them," she said.

Throughout her 32 years of teaching science, five at Dickson, Runyan has encouraged her students to compete in science fairs. Her students have presented science projects all over the country, including her daughter, Taylor Runyan, who won the National FFA Star in Agriscience in 2012.

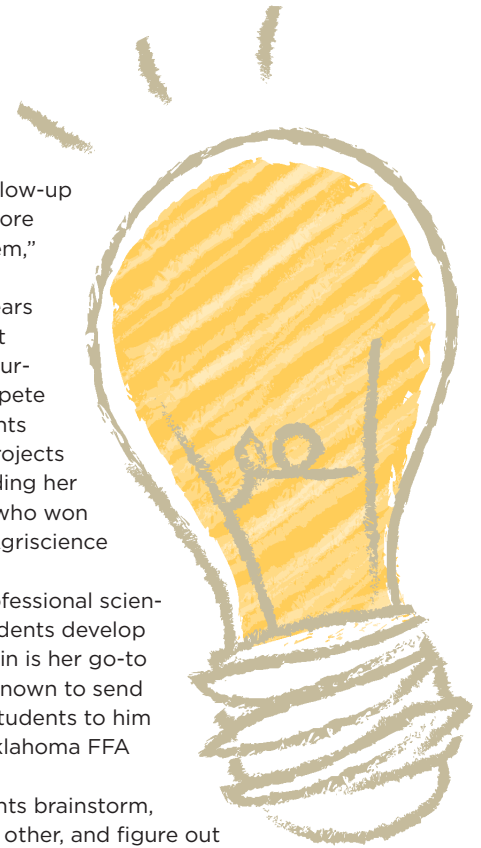
Runyan seeks out professional scientists who can help her students develop their projects. Often, Hardin is her go-to mentor. She's even been known to send other teachers and their students to him as they prepare for the Oklahoma FFA Agriscience Fair.

Hardin and the students brainstorm, bounce thoughts off each other, and figure out what is testable.

"For my kids, that's a huge role," she said. "He's always so kind and generous. He has a great ability to relate to the kids. It's way above his call of duty, but that's his love of science, his love of agriculture. And who knows, one of these kids might be on to the next big research that finds a cure for cancer or something to help hunger."

Runyan goes on to explain that her students are the future, and Noble Academy helps engage and excite them while unlocking their potential.

"We're blessed to work with Noble Academy," Runyan said. "I don't think they could have done anything more needed at such a crucial time in education. It helps open a whole new world for students." ■



JENN SCOTT
Educational Outreach Assistant

Hometown: Crystal Lake, Illinois

Education: Bachelor's degree in agricultural science at Truman State University in Kirksville, Missouri; master's degree in agricultural education at Oklahoma State University

Prior Work: Worked in the equine industry in Connecticut and Wisconsin before becoming an agricultural education instructor and FFA advisor in Illinois then Arizona for 10 years.

What's your favorite part of working with Noble Academy?

When we go into schools, we bring lab coats, safety glasses and gloves so the students get the full researcher experience. Many times as the students get ready, I'll hear comments like, "I feel like a scientist." This is why we do what we do. We want the students to have a positive experience with science and connect them with agriculture and the many career paths they can pursue.

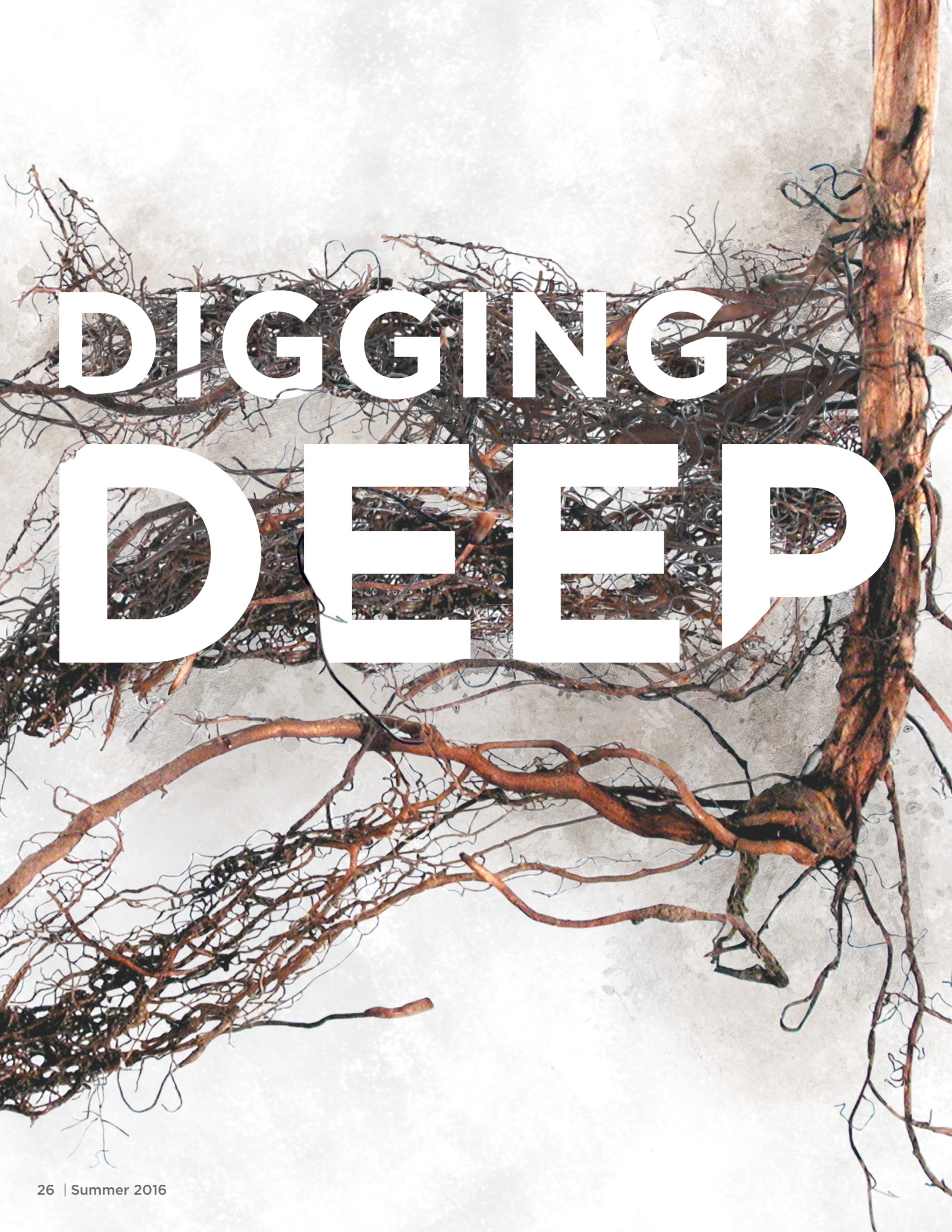
Is there a specific experience that has stood out to you?

This spring I visited several schools to teach *The Key to Leaf ID* to help teachers prepare their students for state tests. When I visited Ardmore Middle School after the tests, a student saw me in the hall and told me he'd been able to understand and answer all the questions on the dichotomous key portion of the test because of what I'd taught him. It feels good when students

recognize the value of what we bring to the classroom.

What is your favorite lesson to teach?

My favorite lesson to teach is *CSI in the Wheat Field* because students are engaged in a crime solving scenario, and it gives me the opportunity to advocate the importance of soil and how it impacts our daily lives.



DIGGING DEEP

Roots aren't glamorous, but they are essential to pulling life from the soil. Answering pivotal questions surrounding roots (and the countless processes in which they are involved) represents part of a new research cluster aimed at understanding plant growth and development.

by Laura Beil

Other than the marshmallow-smothered sweet potatoes served up at Thanksgiving every year, roots don't get much public adoration. They do their jobs with little fanfare, huddled out of sight, while leaves and flowers get the glory. So in the interest of root respect, a few facts:

- The deepest root ever documented (on a wild fig tree in Africa) burrowed 400 feet into the ground.
- Prairie grass has more bulk underground in the roots than above ground in the leaves.
- More than half the surface area of a root is practically invisible, made up of tiny hairs.

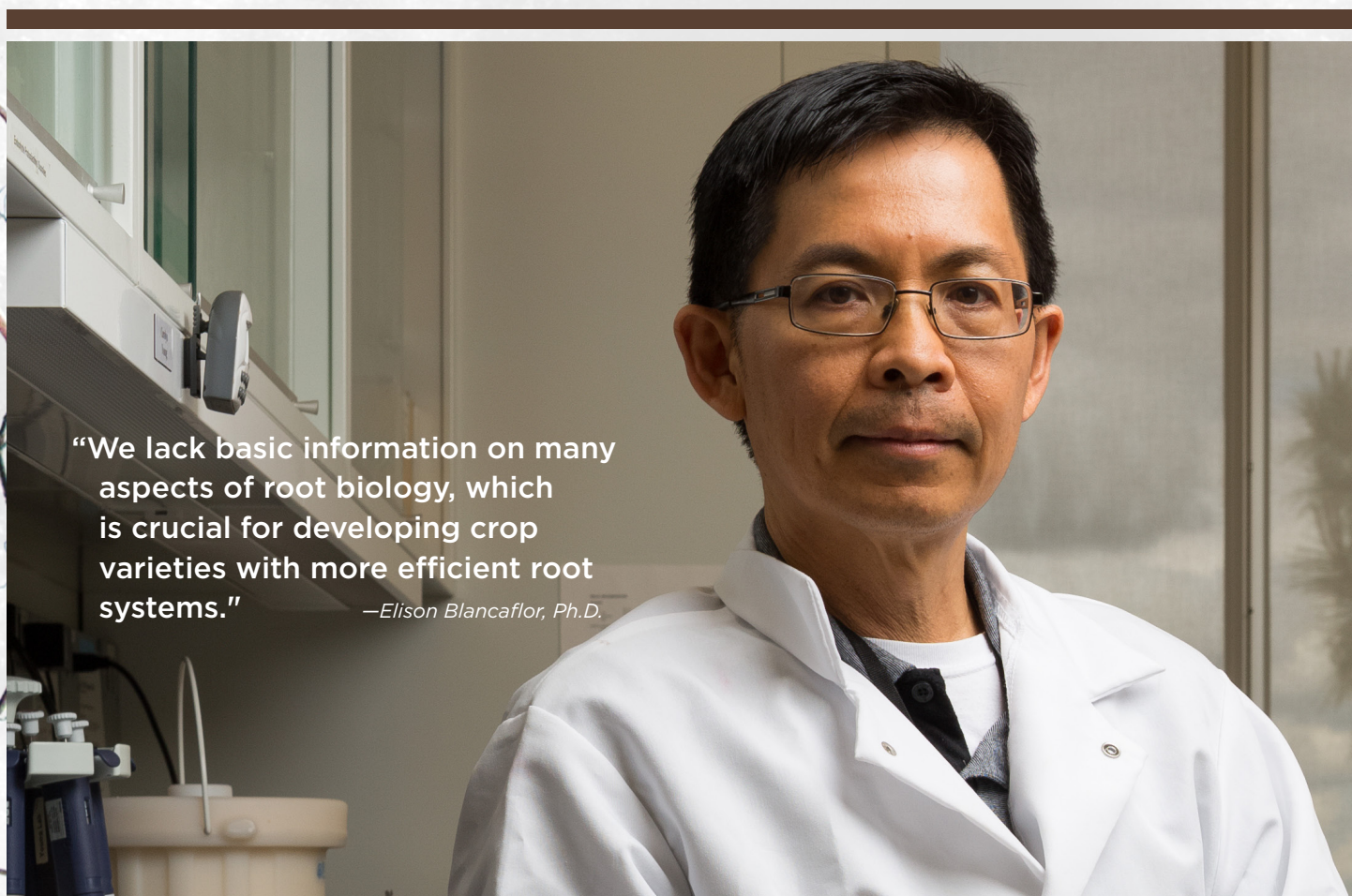
As they snake down into the soil, roots

anchor the plant and – largely through those root hairs – soak up water and nutrients to send upward. But much about roots remains a mystery: Scientists don't know, for example, exactly why some roots can weather a drought, or survive for months buried in frozen ground, or even manage the hydraulics of channeling, sometimes thousands of gallons of water each day, against the force of gravity. For that matter, scientists still can't fully explain why roots grow down and not up. "There are still many unanswered questions," said Elison Blancaflor, Ph.D., of the Plant Biology Division at the Noble Foundation.

That's why Blancaflor is heading up the Plant Growth and Development Research Cluster, which aims to dig deeper

into root science. Formed in 2014, the cluster is one of five research clusters that unite the scientific muscle of the Noble Foundation behind a single purpose. (The other research clusters are Low-Input Agriculture, Plant-Microbe Interactions, Breeder's Toolbox and Plant-Animal Interactions.) In addition to Blancaflor, Xuefeng Ma, Ph.D., of the Forage Improvement Division's small grains breeding laboratory, helps steer the cluster. But members of all three operating divisions are involved, including James Rogers, Ph.D., an agronomist in the Agricultural Division's Center for Advanced Agricultural Systems and Technology.

While each division has pursued its own projects throughout the decades, the



"We lack basic information on many aspects of root biology, which is crucial for developing crop varieties with more efficient root systems."

—Elison Blancaflor, Ph.D.



“Hopefully we can find some useful genes that would lead to development of better root architecture - deeper roots, better root mass.”

—Xuefeng Ma, Ph.D.



“... I’m interested in what goes on above the ground, like the levels of moisture, fertilizer and how animals respond to forage quality. But sometimes to understand what’s going on above the ground, you need to know what’s happening below.”

—James Rogers, Ph.D.

clusters create research teams that are greater than the sum of their parts. All of the groups are tackling the most formidable agricultural problems facing farmers and ranchers of the Southern Great Plains and beyond.

The Plant Growth and Development Research Cluster identified roots as one early focus because so much knowledge is still lacking. The growth of roots in soils, the shape of the individual root cells, the powers of resilience – all these properties involve thousands of intricate, overlapping biological processes that must be tightly regulated throughout the life of the plant, Blancaflor said. Yet, he added, “We lack basic information on many aspects of root biology, which is crucial for developing crop varieties with more efficient root systems.”

The project will study root development in vital forage crops, such as tall fescue, alfalfa and winter wheat.

“Hopefully we can find some useful genes that would lead to development of better root architecture – deeper roots, better root mass,” Ma said. By finding key genes, scientists can then turn to breeding crops that are more resilient.

The job of taking the research findings

outside the laboratory will fall to Rogers, who specializes in pasture and range management. In addition to surviving harsh conditions, plants with stronger roots may be better able to withstand grazing pressure. Animals can shear too much off the top of a plant, which weakens its ability to revive.

Better knowledge of roots may also be useful in the effort to enable farmers to move away from tilling their fields, Rogers said. Mechanical plowing exposes the soil, leaving it vulnerable to erosion, especially on the wind-whipped plains. Plowing can also create a compact layer of soil below the surface. To break this up, farmers use subsoiler plows to rip through that hard layer. Certain plants can provide the same purpose without leaving a field exposed.

“Roots themselves can till the soil,” Rogers said.

One plant, the Nitro radish, produces a large taproot that punches deep holes into the ground.

“It’s like a natural subsoiler,” Rogers said.

As research uncovers more secrets about roots, farmers and ranchers may eventually have more choices for plants that act as natural tillers.

For his part, Rogers welcomes the

attention to root biology and concedes that he, too, would not have thought as much about roots were it not for the new research cluster.

“I do applied research, so I’m interested in what goes on above the ground, like the levels of moisture, fertilizer and how animals respond to forage quality,” he said. “But sometimes to understand what’s going on above the ground, you need to know what’s happening below.”

Even though the cluster is less than two years old, Blancaflor and his team have discovered a handful of genes and proteins that play pivotal roles in root architecture, such as the length and shape of the root hair, and zone of growth.

He says one big challenge will be translating those findings to tangible benefits: “Can increasing the length, density or longevity of root hairs by changing the expression of specific genes really lead to more efficient roots for water and nutrient acquisition? What root types are better for the Southern Great Plains – shallow ones so they can better scavenge for immobile nutrients like phosphorus or deeper ones so they can access limited water better? These are some of the questions we are going to answer.” ■

Amber Christensen (left) decorates her second set of paper eyeglasses with help from Alex Hartdegen at the Sunshine Industries Adult Day Services.





More Space for Sunshine and Smiles

A new building enables the Sunshine Industries Adult Day Services program to grow, thanks in part to the Noble Foundation.

by Courtney Leeper

A crafter's dream lay strewn across a long table with four people on either side.

Red, blue, green, yellow. Feathers, foam letters, pom-pom balls. The eight artists selected the perfect pieces to cover their blank canvases – paper cut-out eyeglasses.

Some worked studiously, carefully balancing an Elmer's glue stick in one hand while sticking shiny plastic pieces onto the paper with the other. Others flaunted finished masterpieces. Their excited laughter brought joy to the faces of the Sunshine Industries Adult Day Services (ADS) staff members who helped and joked with them.

Amber Christensen's eyes lit up as Alex Hartdegen, the ADS intern, tied around his head the pair of colorful glasses he made. Christensen wore hers like a headband and placed a final feather on her second set after laughing at Hartdegen holding his artwork to his face.

"So pretty, Amber!" called out Meredith Howard, program manager, from the other side of the room.

The room makes up the majority of the 5,000-square-foot metal building. Program director Tammie Long's office is around the corner in a storage room that triples as a conference room. A final, narrow space on the opposite side doubles as an office for the remaining five staff members and a quiet space for clients to rest in recliners after lunch.

"It's a nice building," Long said. "It works well for us now, but we just don't have the space to accommodate all the need."

Their client waiting list is growing, but soon their wait will be over. With the community's support, including a \$200,000 gift from the Noble Foundation, ADS is building a new facility.

THE NEED

Tammie Long was a music therapy major at the University of Iowa when she and a friend, who studied special education, spent a summer working at a camp for people with cerebral palsy. Thirty years later, she still remembers it as the time of her life.

Long moved to southern Oklahoma in 1990. She began looking for a job where she could continue working with people with developmental disabilities and soon found Sunshine Industries. The Ardmore-based nonprofit agency was established

"Sunshine Industries is a respected and worthy organization, as evidenced by the long-term support of the Board of Trustees. They are one of our most impactful grant recipients, in terms of their service to people with developmental disabilities, and a great asset to our community."

—Mary Kate Wilson



Construction continues on the new Sunshine Adult Day Services facility.

in 1969 by parents who wanted a place that could assist their adult children with developmental disabilities live as independently as possible.

Sunshine Industries works with community businesses to provide jobs for those with disabilities. Some earn their own income by inflating blow-up balls for Dollar General, packaging gloves and making pens in a sheltered workshop environment. The workshop is where Long, like most Sunshine employees, started working in August 1990. Other clients work in Sunshine-owned thrift stores or at local restaurants and other businesses. Sunshine also offers residential services, but it did not offer adult day services at the time Long joined the agency.

Long and her supervisor, Lorene Johnson, who is celebrating 37 years of working at Sunshine this year, saw the need. "We kept thinking, there's got to be something for the people who have reached retirement age or are unable to work," Long said.

The Sunshine Board of Directors saw the need, too. Other area agencies offer day services for the aging, but Sunshine has a unique ability to provide specialized care for those with developmental disabilities as they become older or experience severe problems.

In 1999, Long drafted a business plan for a day services program while pursuing her bachelor's degree from East Central University. In 2008, the idea became reality. Long and one other staff member opened the doors of what used to be the VFW Bingo Hall to eight individuals.

"The program has been very successful," said Melissa Walker, Sunshine Industries executive director.

And then, in 2012, the announcement came that a residential care facility for adults with severe developmental disabilities in Pauls Valley, Oklahoma, would close. The facility completely shut its doors in the summer of 2015.

"Suddenly, all those people needed services," Walker continued. "We knew we were going to have to grow."

THE NEED TIMES THREE

The Sunshine Industries Board of Directors approved plans for the construction of a \$4 million facility in 2012. Up to half of the funds could come from the agency's endowment, and the rest would depend on the community.

The staff held a golf fundraiser. Parents raised money. And community foundations, including the Noble Foundation, contributed. The Noble Foundation's 2014 grant is part of its long history of support for Sunshine that dates back to the agency's beginnings: 16 grants totaling \$788,560.

"Sunshine Industries is a respected and worthy organization, as evidenced by the long-term support of our Board of Trustees," said Mary Kate Wilson, director of philanthropy, engagement and project management. "They are one of our most impactful grant recipients, in terms of their service to people with developmental disabilities, and a great asset to our community."

The concrete foundation was poured in December 2015. Walls went up this February, and the stonework was completed in July. In late August, Long walked into the building after chatting with local architect Bill Lumpkin. The floor was dusty and the duct work still exposed, but Long could envision where everything would be, from the "dancing room" to the "wheelchair parking lot."

"I almost need a Segway to get around here," Long joked, moving from room to room.

The new 17,000-square-foot Sunshine Adult Day Services building will nearly triple the number of people the program can serve.



The new building adds 12,000 square feet of space and almost triples the number of people they can serve from 36 to 96. They already have 20 people expressing interest in services, including one woman whose hospital bed will be delivered to the site soon. At the current facility, Long can only accept two clients who need a hospital bed because of space constraints. Now that won't be a worry.

Instead of one large room, there are multiple activity rooms. Two have 12-inch concrete walls and reinforced hallways so that clients can easily watch movies or play games during a storm. There's a large commercial kitchen and cafeteria, where their annual Halloween and Valentine's Day dances will take place. A back porch for clients provides space to sit and enjoy the sunshine or walk on a trail within the fenced backyard. There are also offices, a conference room, a staff break room, and a feature Long gets excited about: windows, 21 to be exact.

"But it would only take one to be more than what we have now," Long laughed.

If all goes as planned, the building will be finished later this fall.

"We are all so excited," Long said. "There are so many things about this new building that will help us better serve our clients, and we'll do anything for them. We're also going to be able to take in more people. The need has grown, and this is the only way we could meet it." ■

Jin Nakashima, Ph.D., photographs planes, space shuttles and, through his work at the Noble Foundation, plant cells.



Jin Nakashima: Life Through the Lens

by Robyn Peterson

Before he was even in kindergarten, Jin Nakashima, Ph.D., was mesmerized by the constant circles of airplanes arriving and departing the airport near his home in Nagoya, Japan.

The planes slicing the sky sparked his imagination, as did his father's and grandfather's love affair with photography.

Soon his own love for photography took hold. It wasn't long before aviation and photography merged into a unified interest as he found great delight capturing the Boeing and Douglas planes as they navigated through the sky.

Today, Nakashima's hobbies have transformed into a career where he looks through a different type of lens, a microscope lens. This career advances agriculture while still sparking his boyhood imagination.

HOW DID YOU GET TO THE NOBLE FOUNDATION?

I came to the Noble Foundation in September 2005. Previously, I was a postdoctoral fellow at the University of Texas in Austin and was searching for a new job.

I saw a flier about (former Plant Biology Division Director) Richard Dixon, Ph.D., speaking at a seminar. I knew who he was, so I approached him about needing a new job and wanting to work at the Noble Foundation. He immediately gave me a job on his way back to the Foundation.

WHAT IS YOUR CURRENT JOB AT THE NOBLE FOUNDATION?

I am the cellular imaging facility manager.

WHAT IS THE CELLULAR IMAGING FACILITY?

It is an 11-room suite that contains equipment for modern light microscopy and biological imaging. The goal is to use light microscopy to address a range of plant biological questions.

WHAT DOES YOUR JOB ENTAIL?

I provide training to researchers who want to use the microscopes and related instruments. The microscopes we work with allow us to see living cells and the individual elements within the cell, such as mitochondria and chloroplasts. I also collaborate with internal and external researchers on their projects related to plant cell walls.

WHAT IS YOUR FAVORITE PART OF BEING A FACILITY MANAGER?

I'm able to see the full picture of the research projects I'm working on. Scientists are usually focused on their specific area of a project, but my job allows me to see the bigger picture while helping work toward the same goal. I like helping people get motivated and excited about science.

DIDN'T YOU HELP SEND PLANTS INTO SPACE?

Yes, I am part of Principal Investigator Alison Blancaflor's research team. Our research project with NASA began in 2010. We used *Arabidopsis thaliana* (thale cress) seedlings to study vital plant functions in near-zero gravity. The seedlings were exposed to near weightlessness for almost two weeks on the space shuttle Discovery. We continued the research in 2013 (using the same seedling type) to analyze gene expression and cell wall changes in the plants.

WHY SEND PLANTS INTO SPACE?

There are a few reasons. Studying vital plant functions in near-zero gravity shows how gravity impacts cell development and growth. Gravity not only helps anchor plants here on Earth but also orients plant growth and development for nutrient and water uptake. Uncovering genes associated with these traits will help researchers improve agricultural crops. For NASA, this research could lead to understanding how plants behave and develop in space. Plants are a vital component of regenerative life

support systems as they would provide oxygen and food sources if humans were to embark on a long-term space mission to Mars. It is important to better understand their biology in the microgravity environment of space.

BUT ISN'T THERE MORE TO YOUR NASA CONNECTION?

Outside of the Noble Foundation, I am a professional aviation photojournalist. I work with a Japanese aviation magazine providing articles and photos about various aspects of aviation. In 2003, the magazine editor contacted me to get information about human space flight in the U.S. I am the only Japanese photojournalist to continually cover space shuttle flights from 2005 to 2013, when the NASA space shuttles were retired. Now commercial rockets provide all transportation to the International Space Station.

DID YOU WRITE ABOUT THE NOBLE FOUNDATION PLANTS MISSION?

Yes, I am currently working to provide an article and photos to the web-based *Science Window* magazine from Japan Science and Technology Agency (JST). Being part of the research team allowed me to have a more in-depth look at NASA and human space flight. I also write about our adventures for the Noble Foundation *Plants in Space* blog.

HOW DO MICROSCOPY AND PHOTOGRAPHY RELATE?

Microscopy is basically taking pictures of plant cells. Microscopes and lights allow us to see even the smallest detail within the cell when it is happening, much like a camera lens.

WHAT MOTIVATES YOU?

Seeing other perspectives and views through writing and photography. ■

Dinner With a Side of Adventure

by J. Adam Calaway

The waitress at Cafe Alley had just slid the appetizer of fried green beans onto the table when Brady Barr launched into his first story.

“During my Ph.D. work at the University of Miami, I studied alligators. As part of the research, we had to examine the contents of their stomachs,” said Barr, crunching on a bean. “I’d go out into the Everglades at night and catch alligators. You have to be careful because when you make an alligator regurgitate, you never know what’s going to come out. I’ve had everything from trash to live snakes. One time I had an otter pop out. He must have just been eaten. He landed in the boat, blinked a couple times and jumped back into the water. Luckiest otter ever.”

I’m sorry – wait, what? Everglades at night? Alligator vomit? What is happening?

I pushed my plate of green beans forward. Two minutes in and I could tell this was not going to be a typical dinner conversation.

See, every year the Noble Foundation invites a handful of national presenters to headline our *Profiles and Perspectives Community Enrichment Series*. For almost two decades, we have hosted speakers from every imaginable walk of life – astronauts to zoologists. They come to southern Oklahoma for an evening and share their insights with a delighted audience who might not otherwise have the opportunity to see such renowned lecturers.

Following tradition, a few Noble employees take the speakers out to dinner beforehand. Each guest brings their own flavor to the conversation and usually offers up a sneak preview of the evening’s talk.

Barr was no exception. As a herpetologist (reptile and amphibian expert) who has traveled to more than 80 countries and hosted more than 100 wildlife documentaries for National Geographic, he indulged his dinner audience’s appetite for adventure, sparing no detail despite its potentially nauseating repercussions.

Barr pivoted from one amazing exploit to the next cringe-inducing scenario – all while I dealt with my own harrowing event (navigating around the tomatoes on my salad). He regaled us with tales of trekking through the African wilderness, crash landing in the Amazon rainforest, and crawling into an armadillo hole only to come face-to-face with a cranky cobra.

“That was a close one,” said Barr, casually chuckling as though he’d almost bumped into a stranger.

By the main course, I was feeling a little bit like the otter. But Barr – the living embodiment of a Jules Verne character – pressed deeper into his catalogue of stories.

He recapped near misses with hippos (“Meanest animals on the planet,” he said.), actually being bitten on the face by a snake (No worries, it wasn’t poisonous!), and taking a few rounds of chemo to kill a brain parasite he contracted while filming (I can’t make this stuff up.).

At some point, you understand that danger doesn’t register in Barr’s brain like the rest of us. He’s the guy that extreme-sports enthusiasts look at and say, “Whoa, dude, that’s a little too far.”



National Geographic host Brady Barr spoke to a packed crowd as part of the *Profiles and Perspective Community Enrichment Series*.

But his quest for adventure comes from a place of genuine love for educating his audiences about the importance of these often misunderstood creatures. Later that evening, Barr retold many of the stories to a packed audience, always returning to his messages of conservation and compassion.

But before he took the stage, Barr told his final story to a mesmerized table, hanging on every word while nibbling carrot cake. He had trekked weeks into the Burmese jungle to visit a cave known as the home for giant snakes. His team had been searching for a world record, 30-foot-long python (for reasons that defy logic). After wading through hip-deep bat guano, they found one a wee bit smaller (only about 20 feet) and tried to remove said snake. The python wrapped around two men, flexing its 4,000 muscles, then gnawed on Barr’s rump. He survived, but the repercussions were lasting.

“For months after that, I kept pulling python teeth out of my backside,” he said. “My kids saved them up so they could make a necklace or something.”

A statement which can elicit only one response: Check, please!

The Noble Foundation campus before 1988, when the Plant Biology Division was formed. Today's Agricultural, Plant Biology and Forage Improvement divisions work together to advance agriculture.

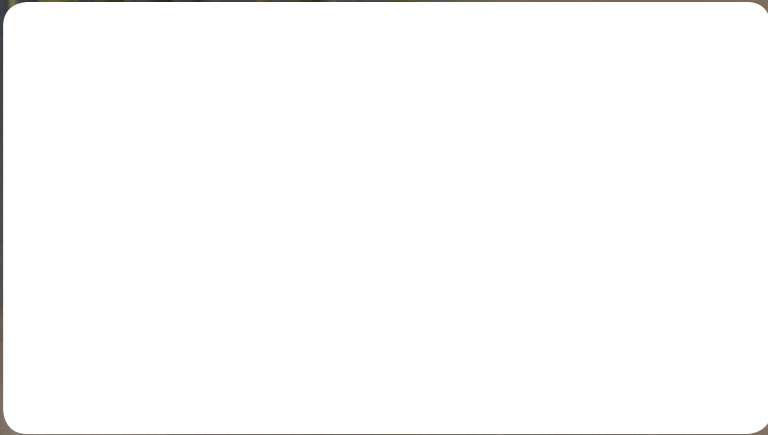


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Chance Tynes, agricultural research assistant, sorts cattle received at the Noble Foundation Oswalt Road Ranch.