



Fertile Ground for Learning

The Impact of Urban Farming Initiatives In Milwaukee and New York City

A Case Study for the NEA Foundation

The NEA Foundation supports student success in STEM fields by helping public school educators work with key partners to build strong systems that prepare students for college, work and life. With the generous support of AT&T, the Foundation has provided grants to and worked with two public school systems and their partners— Milwaukee Public Schools and New York City Public Schools—to strengthen STEM learning around an area of vital interest in both cities: urban farming.

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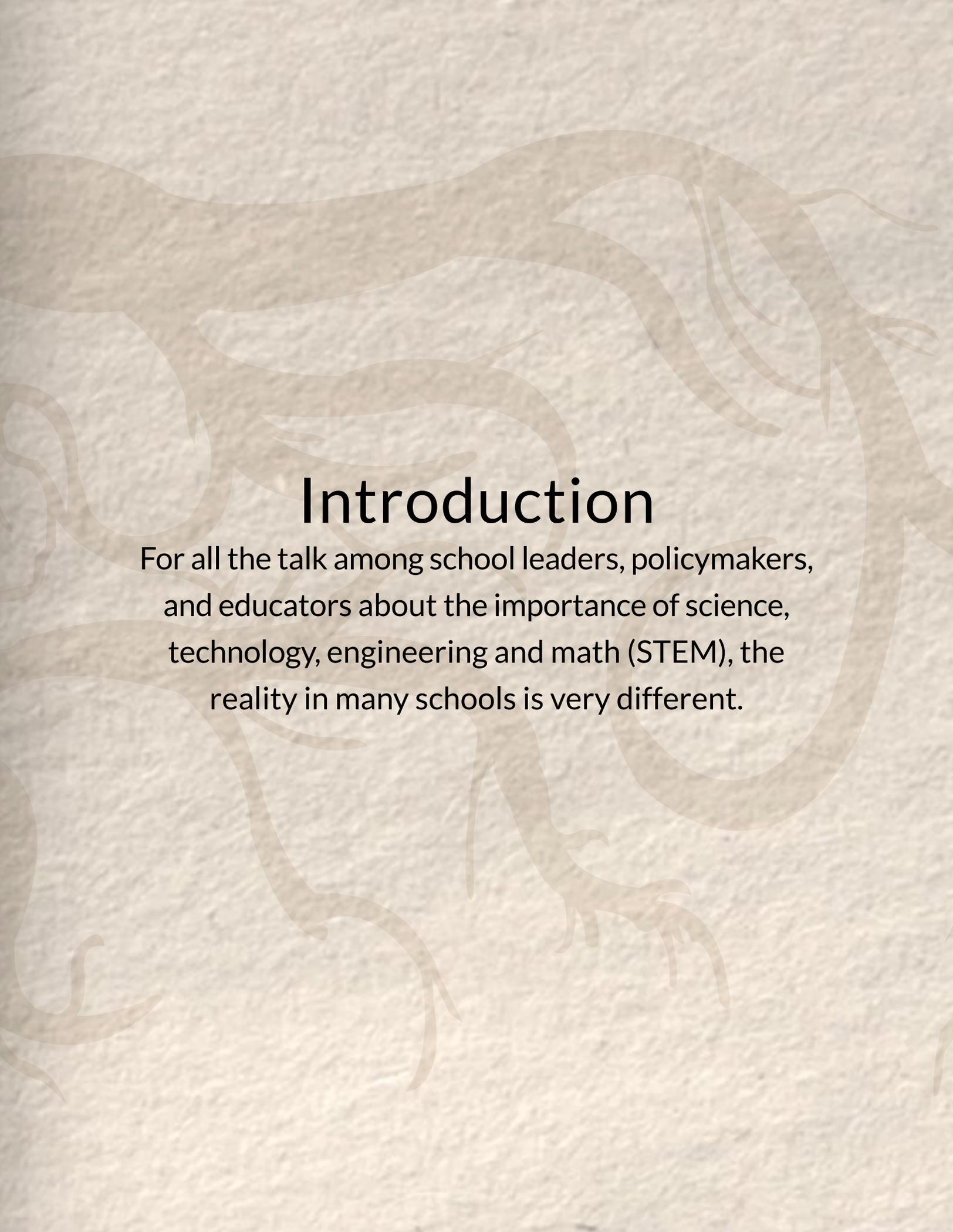
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Introduction

For all the talk among school leaders, policymakers, and educators about the importance of science, technology, engineering and math (STEM), the reality in many schools is very different.

While research stresses the importance of hands-on, experiential learning as the best way to spark interest in these critical fields, the reality is that little about science instruction in today's classrooms matches those aspirations. From shortages of trained science teachers to stretched budgets that have eliminated lab equipment, too many teachers—especially those in the urban school systems that serve disproportionate numbers of disadvantaged and minority students—are forced to resort to “paper labs” in the absence of the materials and training needed for real ones.

“The way labs are conducted now are by using one-page descriptions of what would happen if students experienced the lab,” says Linda Goode Bryant, founder of New York City-based Project EATS. Small wonder, then, that the former president of the National Academy of Sciences calls what happens in many of today's classrooms a “caricature of science.”

“The exploration of the wonderful world of living things should be a fascinating delight for students,” writes Bruce Alberts, a professor of biochemistry and biophysics at the University of California, San Francisco, and editor-in-chief of *Science* magazine. “But...most students gain no sense of the excitement and power of science. Instead, we adults have somehow let science education be reduced to the memorization of ‘science key terms.’”

A 2007 study by the National Academies of Science, Engineering, Medicine and the National Research Council argues that students must be able to know, use, and interpret scientific explanations of the natural world, generate evidence and explanations, understand the nature and development of scientific knowledge, and participate productively in scientific practices and discourse.

Experiential, hands-on activities promote all these critical skills, along with the collaboration and communication skills needed in all careers. Just as importantly, when they are connected to issues that matter to students and their communities, they make science meaningful and relevant—something students do instead of something they learn.



Urban Farming: Providing Food for Thought

The NEA Foundation supports student success in STEM fields by helping public school educators work with key partners to build strong systems that prepare students for college, work and life. With the generous support of AT&T, the Foundation has provided grants to and worked with two public school systems and their partners—Milwaukee Public Schools and New York City Public Schools—to strengthen STEM learning around an area of vital interest in both cities: urban farming.

“The urban farming movement is definitely coming in vogue,” says Michael Landers, a special education teacher at Bradley Tech in Milwaukee. “There are a lot of collectives, interest in food justice, and other organizations interested in moving this type of agenda forward and spreading it.”



In both cities, students in participating schools are getting hands-on experience planting, growing, cultivating, and, in many cases, selling produce. In New York, students are working with urban gardens of their own design on school grounds. In Milwaukee, plants and fish grow together in aquaponics systems, large tanks that support both in a symbiotic, sustainable environment.

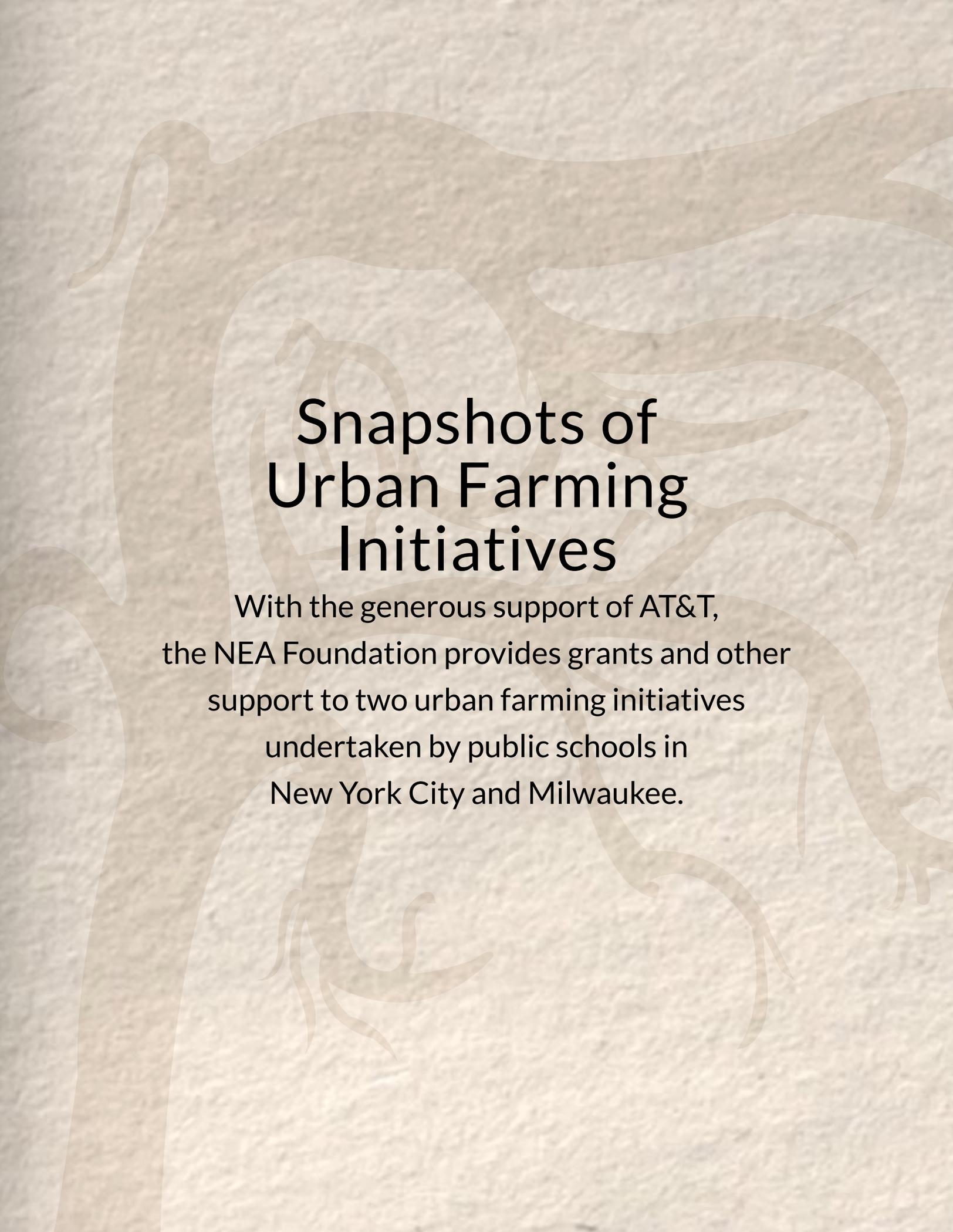
By measuring and observing these systems, students get hands-on experience in key scientific processes—and literally see the results of their work grow before their eyes. And what students learn goes beyond science. Teachers use urban farming and aquaponics as ways to illustrate social justice issues around food availability, and allow students to learn critical business skills by participating in microeconomies that grow from marketing and selling produce in their schools and communities.

The NEA Foundation grants support existing programs that have grown organically in both cities. These initiatives focus on underserved and minority students—in Milwaukee, minority students make up 85 percent of the school population and free and reduced eligibility is 83 percent, while in New York City, participating campuses are in high-need neighborhoods where 70 percent of all students qualify for free and reduced lunch. Grant support focuses in large part on developing curriculum that will allow more teachers—in many subjects and grade levels—to engage still more students in experiential, hands-on STEM learning.

“It’s a unique time when agriculture is being pushed back into the forefront,” says Kadeesha Williams, a trainer and farmer with Project EATS. “It’s really fun to hear students talking about the environment. Moving even deeper into that and talking about urban agriculture is really empowering.”



This case study features overviews of both programs, as well as examines key components of their success and lessons learned that can be used to replicate similar programs in schools across the country. For many districts, the time may be right.



Snapshots of Urban Farming Initiatives

With the generous support of AT&T,
the NEA Foundation provides grants and other
support to two urban farming initiatives
undertaken by public schools in
New York City and Milwaukee.

The two initiatives focus on different types of urban farming— in New York, activities largely center around farm gardens built outdoors on school grounds. In Milwaukee, educators build and maintain self-contained aquaponics systems that create a symbiotic environment for the plants and fish grown inside. They also represent two different models for STEM-based learning—in Milwaukee, teachers use their systems as the focus of classes and lessons focused on sustainability, as well as a broad range of cross-cutting activities across many subjects and grade levels. In New York, what began as an afterschool activity run by a community nonprofit is now making more deliberate inroads into classrooms and teachers’ own lesson plans. Both programs are explored in more detail in the pages that follow.

In Milwaukee, Connecting Schools to Urban Farming through Aquaponics

When Thomas Matthews became principal of Trowbridge Street Elementary School eight years ago, the struggling K-8 school lacked art, PE, or any other reason for families “to send their kids there,” he says.

A multidisciplinary freshwater studies program focused on nearby Lake Michigan breathed new life into school, increasing enrollment to near capacity. Now the renamed Trowbridge School of Discovery and Technology is looking inland for new ways to give students hands-on experiences.

In Milwaukee, Connecting Schools to
Urban Farming through Aquaponics

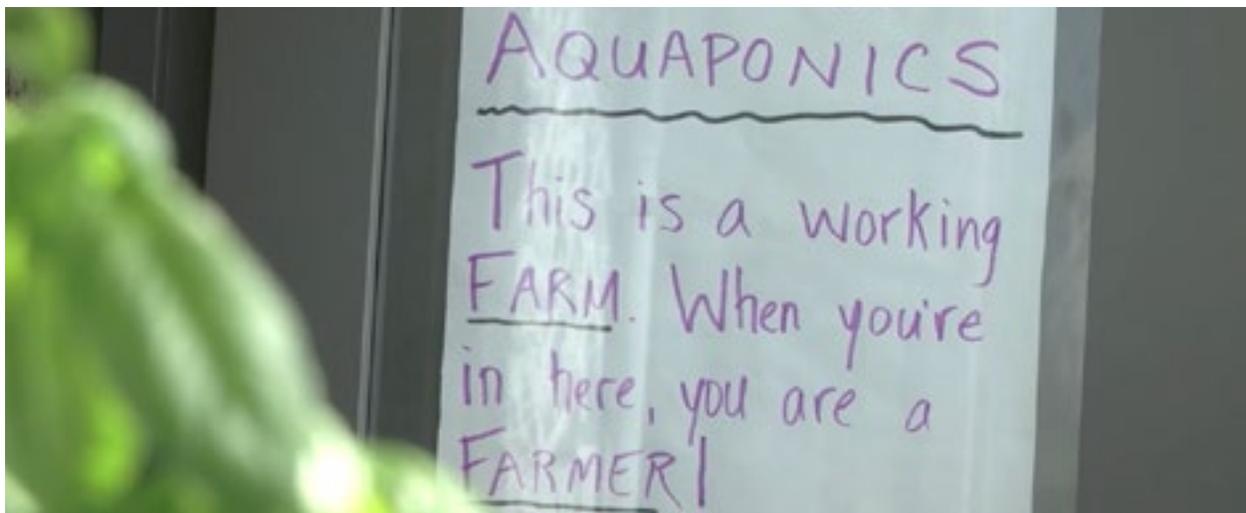
Over the past decade, the city of Milwaukee has emerged as a leader in the urban farming movement. Former professional basketball player Will Allen, one of the national faces of urban farming, founded a local company called Growing Power, which, along with another Milwaukee-based organization called the Sweet Water Foundation, has brought an emphasis on new employment opportunities in sustainable farming and fishing, food security, and social justice issues to the city.

With this growing urban farming movement as a backdrop, starting in 2007 a handful of teachers in Milwaukee Public Schools (MPS) began introducing aquaponics programs in their schools. Now known as the Urban Schools Aquaponics (USA) initiative, the MPS program has received national attention as a model for STEM education. It also provides opportunities for students to discover careers in a growing field in their home city.

Trowbridge is one of two elementary schools in the city that is introducing aquaponics for the first time in fall 2015, part of a deliberate expansion of the program to 12 high schools and three K-8 schools. “It’s going to be a destination in the building, a focal point that physically brings to life what we’re trying to create awareness of,” says Matthews.



Before the NEA Foundation grant, aquaponics programs were largely dependent on individual teachers willing to put a system of their own in place in their schools. For example, at the [Lynde & Harry Bradley Technology & Trade School](#), science teacher Rochelle Sandrin won support from her principal and funding from a school oversight group to get the school's aquaponics system off the ground. Students did most of the construction during the 2012-13 school year. The next fall, the system was the centerpiece of a full-year life sciences course, during which students observed and learned about the large system while constructing smaller 10-gallon systems of their own.



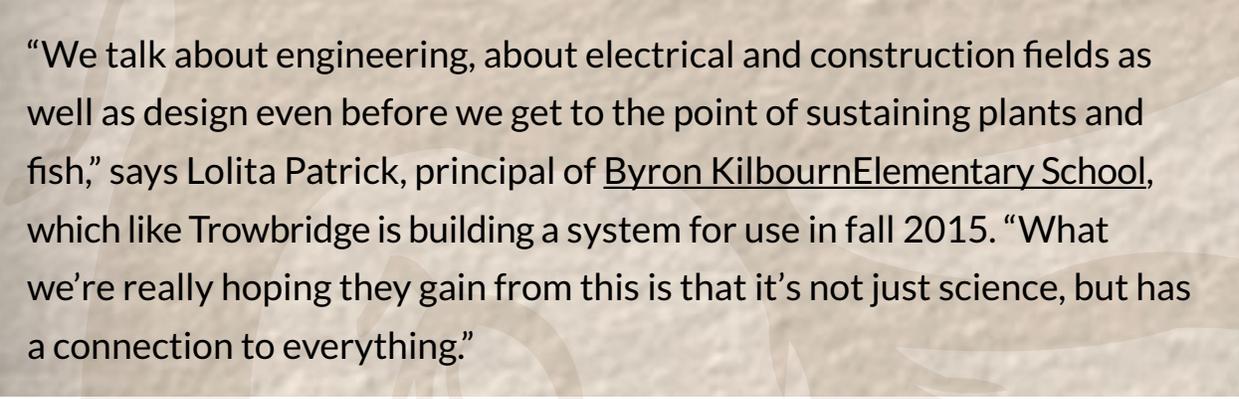
Grant funding from AT&T and the NEA Foundation, along with partnerships with both Growing Power and the Sweet Water Foundation, has helped the program expand to additional schools. The NEA Foundation grant has also supported the creation of a districtwide curriculum that will make it easier for additional schools to adopt the program.

At each Milwaukee school, the aquaponics system—and its purpose—is different. In some, the system is at the center of a microeconomy, with harvests yielding fish and produce that are sold at farmers markets and to restaurants. In others, aquaponics is primarily a way to give students hands-on experience with inquiry and observation. At another school with large amounts of outdoor space, it's part of a broader urban agriculture program that combines vocational

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education and science. Even in schools where systems are currently being constructed, they provide students opportunities to get a sense of their own futures.

Students in a broad range of subject areas are exposed to the aquaponics systems as opportunities for learning. Along with serving as a tool for inquiry and observation in science classes, students in social studies use the systems as a springboard to discuss access to healthy food and social justice issues. English teachers encourage students to write creatively about what they observe in the tanks. Vocational education students get hands-on experience building tank stands and other accessories for the systems. And all students get experience explaining what they know to peers, parents, and community members—a key skill needed for future jobs. “You can go in so many different directions with aquaponics,” says Matthew Ray, a sustainable living teacher at [Fernwood Montessori](#), the district’s first school to build an aquaponics lab (see callout on next page).



“We talk about engineering, about electrical and construction fields as well as design even before we get to the point of sustaining plants and fish,” says Lolita Patrick, principal of [Byron Kilbourn Elementary School](#), which like Trowbridge is building a system for use in fall 2015. “What we’re really hoping they gain from this is that it’s not just science, but has a connection to everything.”

Teachers often target students who haven’t been successful in science classes in the past, at times going through the roster by hand to identify students missing science credits needed for graduation. “When teachers look at the roster, they say you have all the challenging kids,” says Sandrin, now a science curriculum specialist for MPS. “But it’s the best part of the day. Once the kids showed up and saw what the class was about, they kept showing up.”

At Fernwood: Programs, Not Projects

With a giant 2,600-gallon tank located in a greenhouse adjacent to the playground, [Fernwood Montessori School's](#) massive aquaponics system is hard to miss. But Matthew Ray likens it to something much smaller—a bean, to be precise.

Fernwood's aquaponics system is at the center of Ray's sustainable living class, which goes beyond urban farming to cover housing, energy, waste management, career options, economics, marketing, cultural differences, and healthy food choices. "Aquaponics as an educational tool is the magic bean—everything can grow from it," Ray says.

More visibly, Fernwood's system grows fish and produce—perch, shad, lettuce, kale—which are marketed to local restaurants, used for staff lunches, and sold at farmer's markets. The resulting microeconomy gives students opportunities to manage budgets, develop marketing materials, and develop public speaking and presentation skills while giving tours to peers and community members.

Fernwood's aquaponics system was the first in the district. Discharged water from the system is absorbed by a 1,100-square-foot rain garden, which provides still more produce to students who willingly volunteer to work the system and the garden.

"Digging down, getting dirty and wet is just more engaging," Ray says. "The kids live it, the kids work it."

While the system is the centerpiece of Ray's sustainable living class, the veteran educator points to its value across everything the school teaches. "You can run a system just as a project," he says. "But if you look at it as a program, it can be seen on so many different levels. Anything you want, it's just there."

In New York City, Bringing Urban Farms into the Classroom



Like many young people, Kadeesha Williams grew up farming. What's different is that she did so while growing up in the Bronx in New York City.

"I grew up as part of a community garden, so I knew where tomatoes come from," Williams says. "I assumed other kids would know too, but later I realized a lot of adults don't, either."

Today, Williams is working to give students in some of New York City's most underserved communities the same opportunities she had growing up. As a farmer and trainer with [Project EATS](#), she leads afterschool urban farming programs on two public school campuses in New York City.

A program of the Active Citizens Project, Project EATS was founded in 2008, after food prices skyrocketed worldwide. Seeing stories of deprivation in places like Haiti that import much of their food, founder Linda Goode Bryant saw

similarities between Haiti and communities in New York City with limited or no access to fresh nutritious food. One of the ways to change that, Bryant argues, is to grow food and increase the skill and knowledge of youth and adults in those communities, enabling them to secure the food they need to live healthy lives. Educating residents about the importance of sustainability and food security is key to achieving that goal, she explains.

“We believe in integrated learning activities — that what I learn applies to our daily life,” Bryant says.



The Project EATS After School (PEAS) program conducts twice-weekly afterschool activities in its on-site gardens on two New York City campuses, the Thomas Jefferson Educational Campus, which four schools share, and at Teachers Prep High School, where two schools share a campus. “One of the big pluses of doing a program like this is that the kids come to you,” Williams says.

The afterschool projects, which focus on hands-on activities such as building compost piles, draw students tired of sitting in classrooms—but maintain tight connections to what they are learning there, Williams says. “A lot of the lessons encourage more experiential learning opportunities but also encourage students to retain the language and vocabulary of what they learn in class,” she says.

“When they have to know the difference between anaerobic and aerobic bacteria because it’s a function of their compost pile, it’s easier to remember,” she says of the key scientific concept, which focuses on whether organisms need air to metabolize energy. Activities also reinforce skills needed in the classroom, such as using measuring tapes and graph paper to design the layout of the garden.



As with farming itself, the PEAS activities follow the changing seasons. In the fall, the focus is on harvesting, seed saving, and composting. During the winter, the focus shifts inside, where students discuss topics ranging from GMOs to access to different kinds of food and take field trips to supermarkets to see firsthand what’s available in their neighborhoods. Then, in spring, students help with planting and maintenance.

Students also man farm stands, packaging and selling vegetables and self-made products like lip balm. Project EATS also has seven larger production farm sites located in Brooklyn and Manhattan, where students support large composting and greenhouse operations. Their experience makes them eligible for seasonal farm work in New York City and with Project EATS.

Along with afterschool activities, Project EATS is focused on integrating urban farming activities into classrooms—a key emphasis of the NEA Foundation grant. Teachers were introduced to activities with “in-class field trips,” during which Project EATS coordinators help teachers with activities related to urban farming, such as having students create smaller compost bins. “Students are engaged when they have hands-on labs,” says Suzette George, a living environment and ecology teacher at FDNY high school in Brooklyn (see callout on next page).

Project EATS is now developing curriculum so teachers can weave activities related to the gardens and urban farming into their own lesson plans. “We try to keep it flexible so activities can be inserted into the curriculum,” Williams says. “Teachers can decide to use the entire thing, use a lesson, or insert an activity into something else. The idea is that students still get their hands in the soil with the worms.”

The idea, say coordinators, is to provide added learning opportunities for all students, particularly those who aren’t good fits for lecture-style classrooms.

“The way our education system is designed, there isn’t wiggle room for students who learn differently,” says Williams. “So students have benefitted from having a hands-on opportunity.”



Bringing It Inside at FDNY High

For Suzette George, teaching her high school students complex science vocabulary remains a constant challenge. But when Project EATS brings lessons—and worms—from the school’s garden plot into her classroom, they quickly see the relevance.

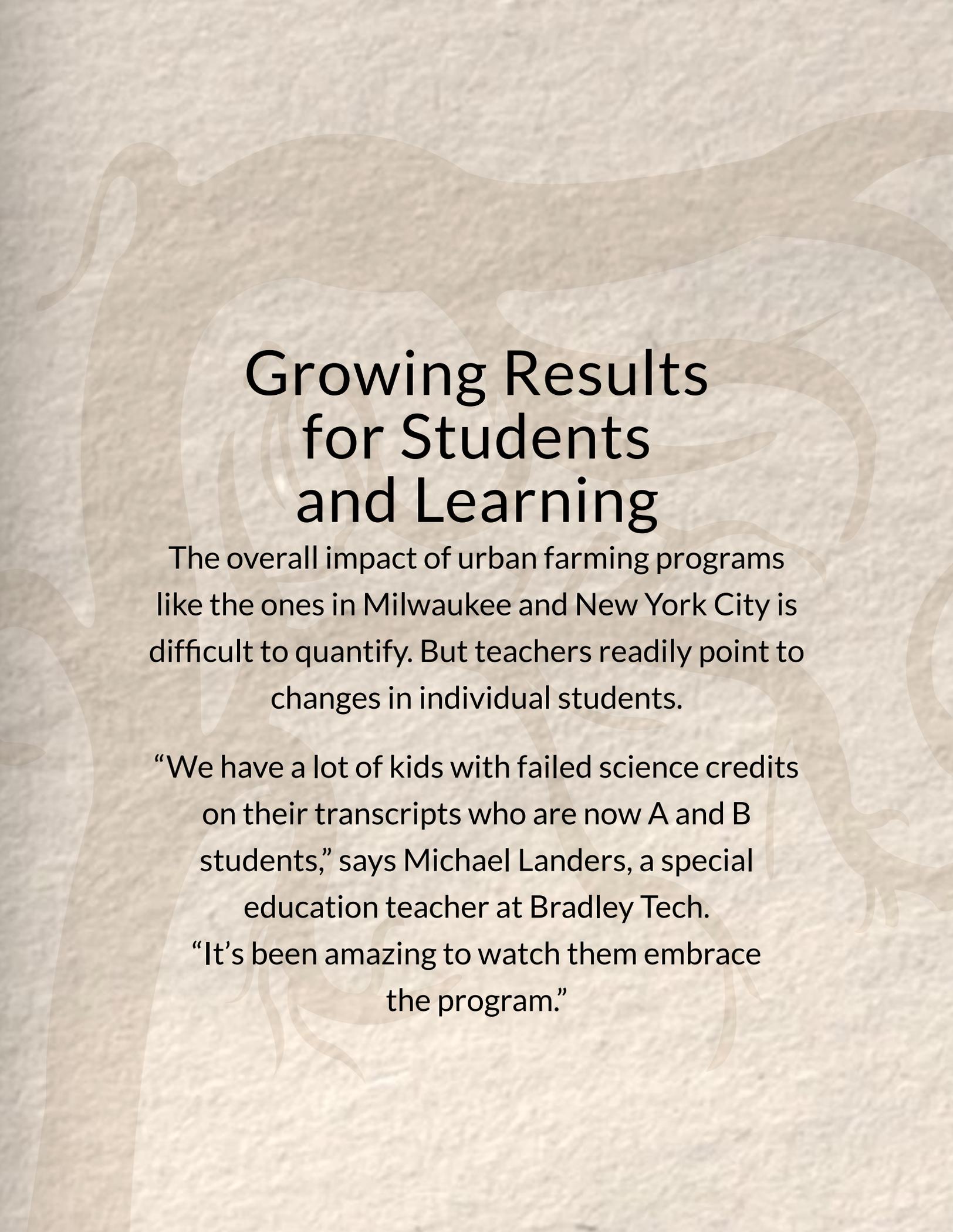
“We are limited in the lab materials and things we have, and they actually bring things students can work with,” says George, who teaches living environment and ecology to students at [FDNY High School for Fire and Life Safety](#), one of four high schools located on the Thomas Jefferson Educational Campus in Brooklyn.

Worm bins—complete with worms—make concepts like biotic and abiotic (living and non-living) factors in an ecosystem come to life.

“Vocabulary terms are major challenges,” George says. “But when they’re looking at the worms, they’re really assessing what the things these worms need to survive. Then they think about the non-living things that humans need to survive.”

Other in-class projects have included dissecting flowers from the garden located just outside to learn the essential structures of plants. The impact of that lesson extended beyond science classes, George says. “Students were able to go into their English class and talk about how flowers are different with the English teacher,” she says.

George says that hands-on learning not only helps students understand abstract concepts, it also makes a significant difference in engagement. “I could show them videos and Powerpoints, but Project EATS makes it applicable to the students’ lives,” George says. “They’re more curious and have more questions to ask. We need more of these types of programs where students are able to take ownership of their learning.”

The background of the page features a large, faint, light-brown silhouette of a cow, facing right. The cow's head is on the left, and its body extends towards the right. The silhouette is semi-transparent, allowing the underlying paper texture to be visible. The overall color palette is warm and earthy, with various shades of beige and light brown.

Growing Results for Students and Learning

The overall impact of urban farming programs like the ones in Milwaukee and New York City is difficult to quantify. But teachers readily point to changes in individual students.

“We have a lot of kids with failed science credits on their transcripts who are now A and B students,” says Michael Landers, a special education teacher at Bradley Tech.

“It’s been amazing to watch them embrace the program.”

Program evaluations conducted for the NEA Foundation indicate that students find urban farming activities interesting and engaging. The largest impact was seen in increasing students' knowledge of agriculture and the science of growing food, as well as interest in learning how science can be used outside of the classroom, participating in other science-related activities, and running their own businesses.

For Project EATS, the voluntary nature of afterschool programs to date signals strong student engagement—as well as more significant shifts. “I realized there was an effect on students—otherwise they wouldn’t come back,” says farmer and trainer Kadeesha Williams. “But they were saying things like ‘I think college is something I can do.’ They feel smarter, and they had a skill set they didn’t have before.”



Teachers involved with the programs say they have seen increased enthusiasm and attendance among their students — especially for difficult to reach students. “I’ve had students who didn’t think they’d graduate high school or go to college, and they found something they love and they feel like they can learn again,” Williams says.

In Milwaukee’s Bradley Tech, an aquaponics program team taught by a special education and science teacher has helped engage students with special needs in mainstream science classes. “It increases their chances for success,” says Landers (see callout on next page).



Such programs also connect students with potential careers in growing fields, like Milwaukee’s burgeoning urban farming sector. One Bradley Tech student received a scholarship to study freshwater science in college. “Kids definitely are aware of the opportunity that this could be a career,” Landers says.

On a less academic level, programs like these are “about introducing students to getting their hands back in the dirt,” says Williams. But they’re about more than dirty hands—they also help build healthy skills for life. Both programs include a focus on food security and food justice, with students—and, at times, their parents—learning about the availability of healthy foods in their neighborhoods, and ways to improve their diets and lifestyles.

At Bradley Tech, Helping Special Populations Grow

As befits a science teacher, Michael Landers made a hypothesis about the potential impact of aquaponics on his students at the [Lynde & Harry Bradley Technology & Trade School](#). But Landers is no ordinary science teacher—he teaches special education students with significant cognitive and behavioral issues.

“They historically don’t do well in regular classes, but our hypothesis was that if we did aquaponics as more of a project-based class, we’d get better results,” he says. “That was definitely the case.”

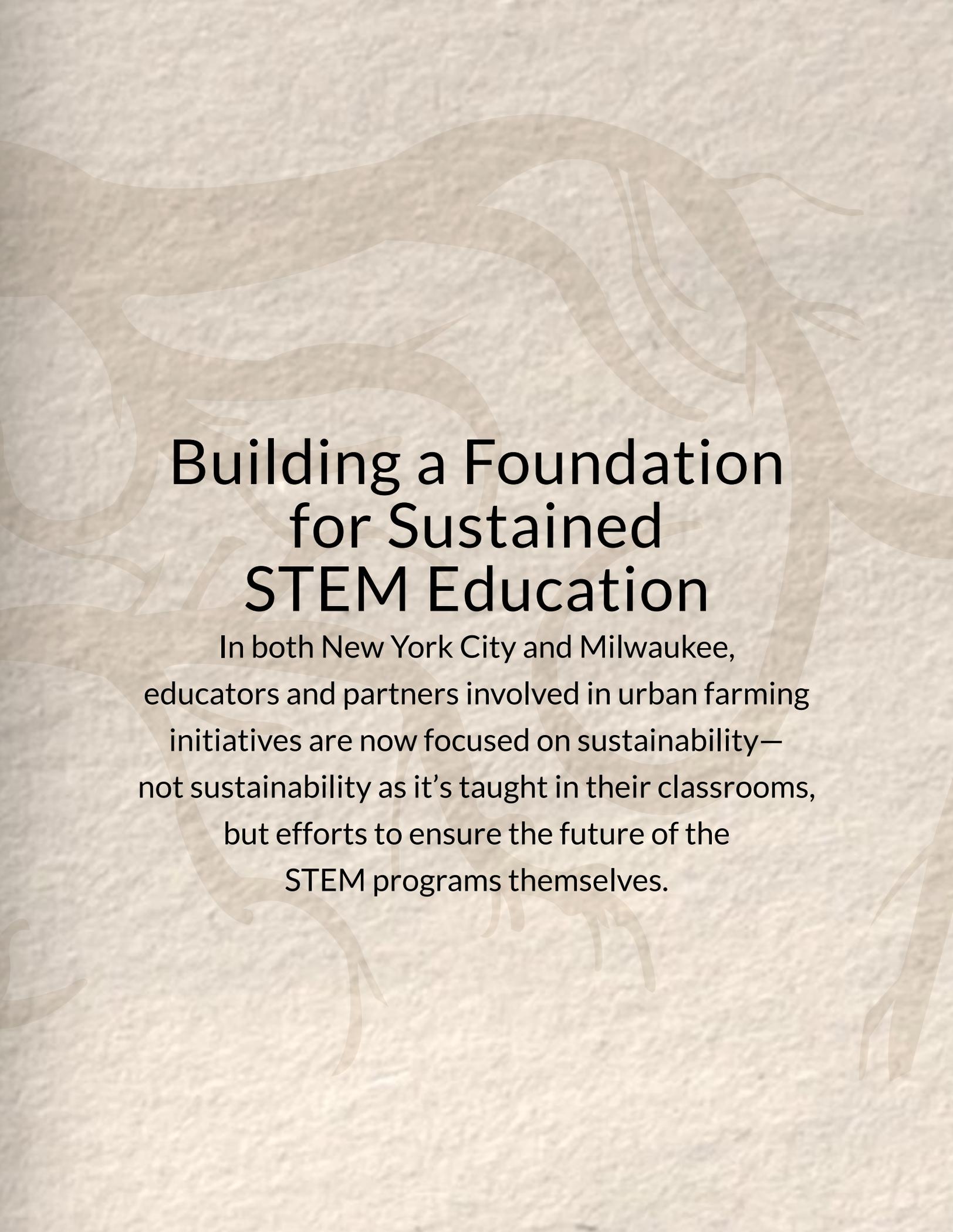
Landers helped build Bradley Tech’s aquaponics and sustainability program around projects, group work, and social justice issues focused on the “food deserts” in many Milwaukee neighborhoods. “There’s very little looking in a book—in fact, there isn’t a book,” he says.

To address the challenges of keeping a class of 30 students of varying abilities engaged, Bradley added two smaller systems to support its 180-gallon system. Groups of two to five students were also given their own small 10-gallon tanks and tasked with building their own systems.

“They were totally responsible for setting it up, choosing the design, selecting the plants, harvesting the produce, maintaining the health of the fish,” Landers says. “It was a platform for us to work on a lot of science skills,” including data collection, with each group maintaining a journal where they measured water temperature and other key data.

The program has impact beyond the students in the aquaponics and sustainability classes, which grew to two sections during the 2014-15 school year. Self-contained classes for students with more severe disabilities have also used produce from the system to run a sandwich shop for students and staff.

“My kids say we actually get to do stuff in class—as a teacher, that’s awesome,” Landers says. “The kids are engaged, and they are really learning.”



Building a Foundation for Sustained STEM Education

In both New York City and Milwaukee, educators and partners involved in urban farming initiatives are now focused on sustainability— not sustainability as it's taught in their classrooms, but efforts to ensure the future of the STEM programs themselves.

In Milwaukee, initial aquaponics training focused on intensive workshops in which interested teachers were trained on how to set up their systems and develop lessons using them. Given the staff turnaround found in most urban schools, this model proved unsustainable. Instead, a cohort of aquaponics teachers is meeting regularly to share what’s working and what isn’t, as well as to support new teachers with an interest in building systems of their own as the initiative expands to new schools.

Because of the institutional knowledge developed by the cohort, “we now have a solid idea of how much money it takes to keep a system running over a year, and how to handle pitfalls like keeping it going over spring and winter breaks,” says Rochelle Sandrin, a district science curriculum specialist. Structural engineers have also drawn up a general plan for a generic aquaponics system, which will serve as a template for new schools in the future.



A key part of the NEA Foundation’s support in both cities involves efforts to create curriculum that will make urban farming and aquaponics accessible to more teachers and schools.

In Milwaukee, work continues on developing a full-fledged aquaponics curriculum. “For the first time this year, aquaponics is on student transcripts,” Sandrin says, prompting recognition from the University of Wisconsin-Milwaukee (UWM).

Aligned with both the Next Generation Science Standards and the district’s own math and science standards, the curriculum for aquaponics continues to be built out, with cohort members working closely with field experts from the University of Wisconsin-Madison Water Institute in the university’s school of freshwater sciences and the Sweet Water Foundation. (See an excerpt of one aquaponics unit in callout on page 25)



Planning has focused heavily on cross-categorical standards, integrating lessons in multiple science subjects as well as social studies elements such as identifying food deserts and sustainability issues. “We have been teaching science in U.S. schools as silos—with chemistry as separate from biology—which isn’t true,” Sandrin says. The new curriculum, she says, “makes connections for physics and chemistry teachers so they can come in and do measurements and data from the system.”

In New York City, Project EATS continues developing a curriculum that allows teachers to take activities similar to the ones used during “in-class field trips” conducted by its own staff and weave them into their own lesson plans.

“We work with schools to increase their capacity for providing hands-on activities rather than relying on other organizations to provide activities for them,” says Linda Goode Bryant, Project EATS’ founder. “I believe this way is more sustainable,” she adds.

Aligned with Regents standards, the Project EATS Curriculum (PEC) is built around standalone units and modules to facilitate their use by teachers (see example on the next page). “We’re designing a curriculum that we felt goes around some of the barriers to introducing curriculum into the classroom,” Goode Bryant says.

A small cohort of science teachers began testing units and activities this spring, and their feedback is helping shape the curriculum. For example, FDNY High School science teacher Suzette George found one suggested activity too extensive for a 45-minute lesson. “I was able to work with them to show them how to break it down into different units,” she says.



Sample Milwaukee Public Schools Aquaponics Unit

This culminating assessment for a Milwaukee Public Schools aquaponics unit demonstrates a hands-on approach to integrating key science concepts (carrying volume, thermodynamics, and unit design) with the design and construction of an aquaponics system—all while making connections to real-world issues.

WHAT?

Investigate and design an aquaponics system that maximizes output, while conserving energy and addressing at least one major global issue.

WHY?

In order to understand how the engineering design process and aquaponics can be used to address issues of energy conservation, social impact, and food security around the world.

HOW?

Students will select a major global issue that can be changed in a positive way through the use of aquaponics. Student will research the issue, and what has been done to address the issue to this point. Students will then use the engineering design process to design an aquaponics system that addresses the global issue keeping in mind cost, energy conservation, maximization of food production, water usage, land usage, and societal impact. Students will use evidence from their research to support their design decisions, and to explain how their system design addresses the global issue they selected. Students will be required to construct a model of their design.

Sample Project EATS

The following activity is part of a larger unit on the food web produced by Project EATS. The full unit includes lesson-based learning, as well as four interrelated activities culminating in the creation of a compost bin.

OVERVIEW (Estimated Time: 45 Minutes)

Students will examine the role waste and human consumption within the food web, by investigating the amount of waste produced daily at lunch. For one to two days students survey the packaging materials and food waste left over from their lunches. Students will determine what can be composted, reused, recycled or landfilled. This lab can go beyond the given time frame to measure three days of waste, a week, or even a month. Teachers should choose the length best suited for their classroom needs.

MATERIALS

Lunch discards from cafeteria or home lunches; four bags or buckets labeled: compost, recycle, reuse, and landfill; paper; pencils; gallon sized or bigger, zip lock bags.

Before the day of the lab, give students a rundown of the next few days, depending on how many days you choose to do the activity. Set up the buckets, or bags with signs reading reuse, recycle, compost, and landfill. Create a lunch log sheet for students to fill out while sorting their waste. Make sure to include sections for: description of the item; whether it can be reused, recycled, composted, or landfilled; what students could potentially replace the item with.

INTRODUCTION (15 Minutes)

Open the floor with a food web, emphasizing its differences from a food chain. Discuss as a class where food webs energy source comes from and explain the different trophic levels, involved in the food web defining each key term: autotrophs, heterotrophs, and decomposers. Give examples of each term, from organisms present in everyday life. Once completed, shift the conversation to decomposers, and how waste is recycled naturally in an ecosystem.

Once the basics of the food web have been covered, open the floor for a brief conversation on how humans have impacted the food web, specifically looking at human consumption and waste. Discuss how much of the material we throw away can be reused, composted, or recycled, even though that is not always practiced today. Emphasize how what people buy and how it is packaged can have a big impact on waste, and thus the way energy flows through a system.

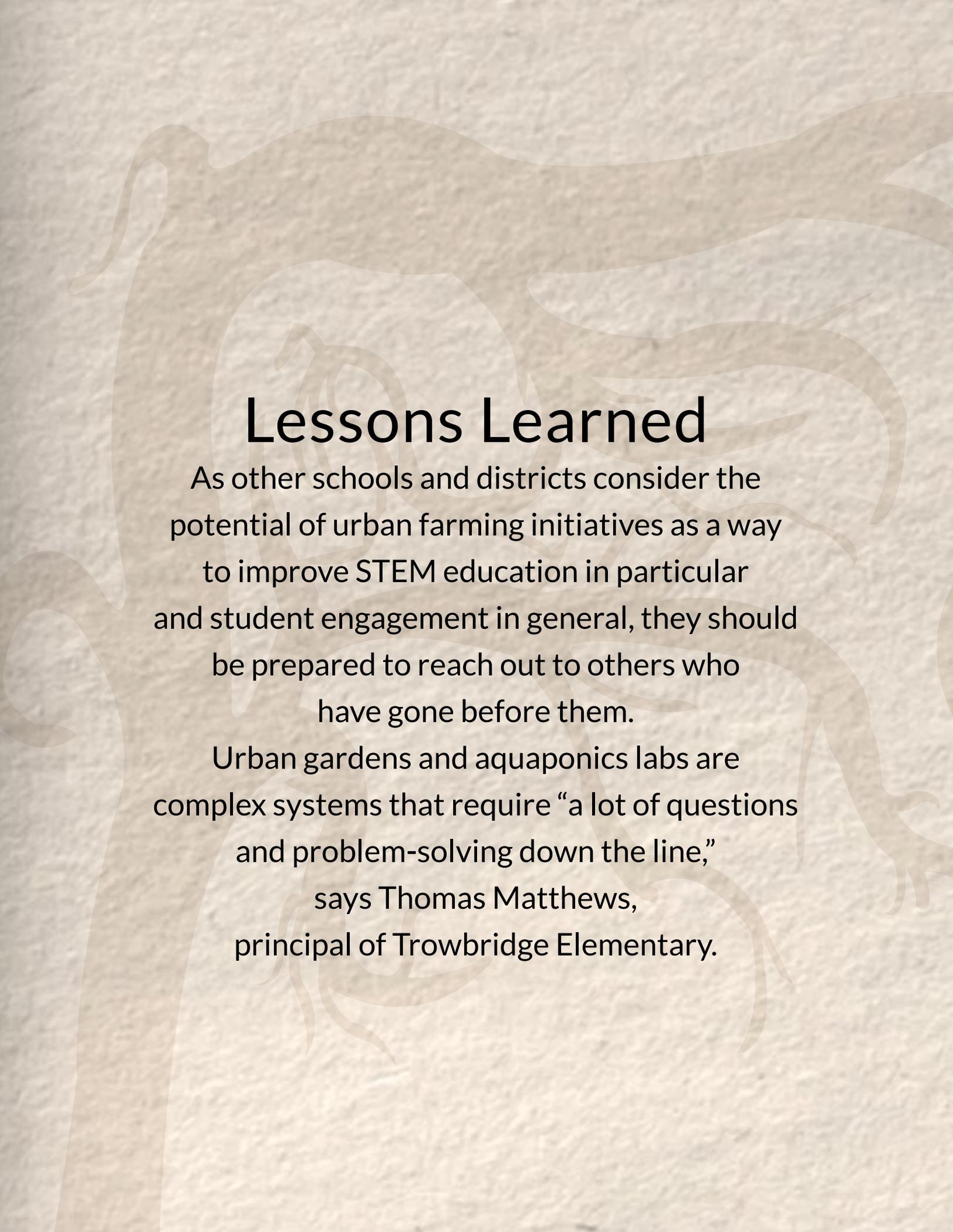
CLASS ACTIVITY (25 Minutes)

- Before lunch distribute zip lock bags to each student. Ask class to bring back everything left over from lunch to the classroom, placing all of the items in their zip lock bags. Students should include all uneaten food and packaging material. Nothing should be thrown away or recycled until it is recorded.
- For the next one to two days, ask students to bring their lunch waste back to the classroom and fill out their log sheets. Students must include: the type of material it is, whether it's reusable, recyclable, compostable, or material for a landfill. Then students must place the item in the appropriate bucket.
- Introduce the Three R's: reduce, reuse, and recycle.
- Have students total their log sheets

- At the end of the collection period, graph class totals for each Recycled, Reused, Composted, and landfilled materials.

RECAP (5 Minutes)

Once the activity is complete, ask students to now reflect on how humans impact the food web and waste. As a class brainstorm ways to collectively reduce their waste.



Lessons Learned

As other schools and districts consider the potential of urban farming initiatives as a way to improve STEM education in particular and student engagement in general, they should be prepared to reach out to others who have gone before them.

Urban gardens and aquaponics labs are complex systems that require “a lot of questions and problem-solving down the line,” says Thomas Matthews, principal of Trowbridge Elementary.

What follows are some key lessons learned about factors to consider while planning, building, and running urban farming ventures from the NEA Foundation’s partners in Milwaukee and New York.

SITE SELECTION

While it’s somewhat evident that a school garden depends on available space, even aquaponics systems, which are typically located indoors, require careful planning. The systems are heavy and, even with care, they can and do leak, meaning that placing them on an upper floor can lead to structural problems as well as floods in the classrooms below. Electrical systems must also be evaluated to ensure they meet capacity and safety needs—a potentially significant and often unanticipated expense.

In Milwaukee, building engineers are now required to evaluate proposed locations for aquaponics systems. “You can’t just do whatever you want in a school building,” says Rochelle Sandrin, a district science curriculum specialist.

STAFF SELECTION

It’s critical to determine who will oversee an urban farm or aquaponics system. In New York, Project EATS staff and youth participants oversee the garden as part of its afterschool and and summer fellowship programs. In Milwaukee, aquaponics programs have tended to be more principal-driven at the K-8 level and more the focus of individual teachers and classes at the high school level.

Even so, teachers overseeing aquaponics are not always science teachers—in Milwaukee, an English teacher and special education teacher were instrumental in getting programs off the ground in their respective schools. Other skill sets matter, too: Many teachers who get involved in aquaponics projects have a background in contracting or construction—helpful given the need to construct systems with many large components.

Building leadership has also proven critical in ensuring the sustainability of urban farming ventures. Support for the program “is very dependent on who is running the building at the time,” says Sandrin.

COMMUNITY PARTNERS

Programs rely on the expertise and support of community partners. Along with its school gardens, Project EATS operates its own large urban farm in New York and draws from a staff of experienced farmers, teachers, and community partners, including community health centers, homeless and housing organizations, and local colleges. Milwaukee Public Schools benefitted from the presence of two urban farming ventures in the city, Growing Power and the Sweet Water Foundation, as well as the freshwater studies program at the University of Wisconsin-Madison.

“If you run into snags, it’s really important to have that additional expert to draw from for feedback,” says Michael Sanders, a special education who teaches science at Bradley Tech in Milwaukee.

FUNDING SOURCES

Grants from multiple sources help get programs off the ground, but it’s critical to plan for ongoing operational costs—which can be considerable. Even in places where produce or fish are sold in farmers markets or to restaurants, don’t expect revenue to cover all expenses. An aquaponics lab or urban farm isn’t something typically found in an individual school’s budget—in fact, not every school has a line item to cover expenses for any science activities.

DESIGN CONSIDERATIONS

Gardens and aquaponics systems alike must be constructed with educational goals in mind. Aquaponics systems are often set up in aquarium tubs, but because the goal is for students to observe all parts of the system, many schools in Milwaukee opted to build glass tanks instead.

STUDENT INVOLVEMENT IN DECISIONS

In many schools, students have a say in the design of their school farm or aquaponics system. In New York City and in some schools with older students in Milwaukee, including Bradley Tech, students help build the systems and farms from the ground up.

Students can also help make decisions about what plants or fish they want to grow, although teachers should think through the implications. For example, Trowbridge is starting its aquaponics system with tilapia, a fish with greater tolerance to water temperature changes than trout.

OPPORTUNITIES ACROSS ALL ACADEMIC SUBJECTS

Urban farms or aquaponics systems shouldn't be the sole provenance of science courses. "While they have a STEM focus, once these systems are in school, they become something a lot of different people try to figure out how to use," Sandrin says. Along with inquiry-based science activities, they can be used to support marketing, business, creative writing, and communication activities in a variety of subjects. Where possible, curriculum should emphasize these cross-cutting connections, as well as encourage teachers in different subjects to work together using the systems.

In similar fashion, students of all ages can learn from the systems. In a K-8 school, for example, the older students are likely to be the ones in charge of maintaining the system, but even kindergarteners can learn to make observations based on what they see growing (or swimming). "We were able to hit so many targets with our students," Sandrin says.

Two key cross-cutting requirements are the ability to communicate with others and service learning requirements. Students involved in urban farming often become ambassadors, explaining the system to their peers, parents, and community members—fulfilling both requirements in an effective and personally rewarding way.

RECRUITING STUDENTS

Filling afterschool programs and elective science courses requires proactive efforts to identify students interested in participating in urban farming. In New York, Project EATS worked with counselors at participating schools to identify students who have struggled with science or who need volunteer hours. At the same time, project coordinators also visit classrooms and the cafeteria to talk up the program. “There’s a lot of feet on the ground,” says Kadeesha Williams, a farmer and trainer with Project EATS. Recruitment becomes much easier once a highly visible garden or system starts drawing attention from students. “It’s really easy when the garden is up and growing—it’s beautiful,” Williams says. In Milwaukee, teachers at times went through student transcripts by hand to identify students in danger of not graduating because of failed or missing science credits. Given their multiple uses and learning opportunities, remember that these programs attract students for different reasons, and target the pitches to individual students accordingly. “Some kids like the possibility of having a summer job in the field of urban farming,” Williams says. “Others are into science. Others are bored and want the opportunity to learn hands-on. They get excited for different reasons.”

MICROECONOMICS

Giving students the opportunity to market and sell the fruits of their labors provides valuable cross-cutting skills—and attracts interest. At Project EATS students on each campus develop their own business and marketing plans for selling handmade, food-based health and body products they make. “We’ve found no more effective incentive for kids than the opportunity to see money come in,” Landers says.

BUT MICROECONOMICS CAN BE CHALLENGING

They require identifying retail opportunities like farm stands or farmer's markets, cafeterias, and food pantries, where fresh produce can supplement canned staples. Schools need to determine whether local requirements allow them to sell produce and fish (which are classified as livestock and regulated in some places). And running a business requires teachers and students alike to hold to a key expectation: "You need to deliver," says Matthew Ray, a science teacher at Fernwood Montessori in Milwaukee.

THE SCOPE OF ACTIVITIES

A single system or garden plot may not offer enough opportunities to get a classroom's worth of students involved in its maintenance. As a result, even in schools with classes focused on aquaponics, the care and running of the system is often managed by a smaller group of students in an afterschool club setting, according to Sandrin. In order to keep all students engaged, consider opportunities for hands-on activities for individual or small groups of students, such as miniature compost bins or smaller 10-gallon aquaponics tanks that small groups of students manage together.

ENGAGING PARENTS AND THE COMMUNITY

If urban farming is intended to help students and their families address a lack of healthy food in their neighborhoods, then parents must also be introduced to the potential of gardening. At Byron Kilbourn Elementary in Milwaukee, one of two new elementary schools launching an aquaponics program through the NEA Foundation grant, school leaders have already held a parent night to introduce families to the program. Kilbourn also plans to offer parents further opportunities to see their students cultivating produce once the system is up and running in the fall. "We want to bring them in and see that these same skills can be replicated at home with their own gardens," Principal Lolita Patrick says.

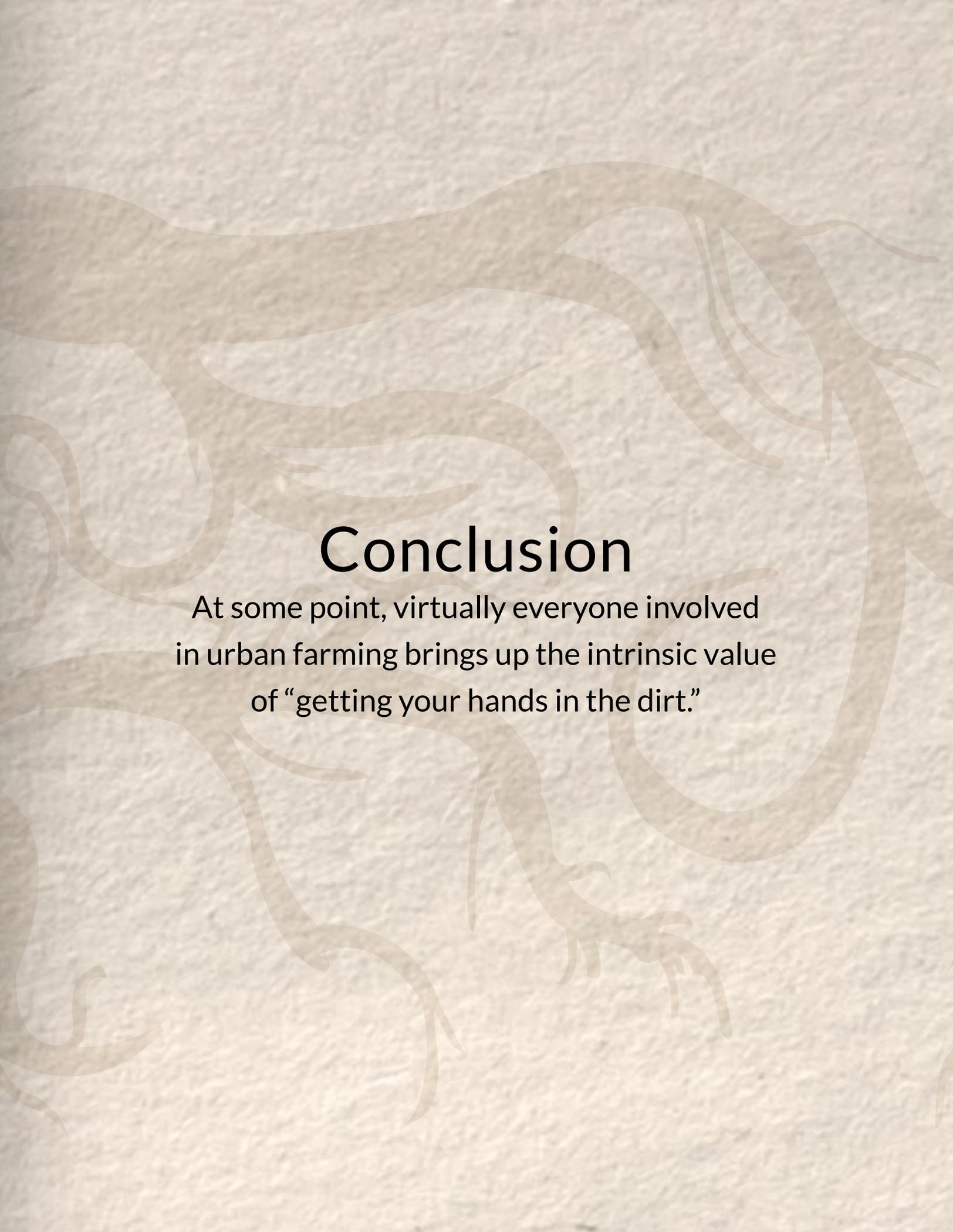
A highly visible urban garden also draws interest from the broader community. In the New York schools where Project EATS has built school gardens, community members often drop in to ask questions or volunteer to help.

Support structures for teachers running urban farming programs. In New York, Project EATS has provided the primary support for afterschool and in-class urban farming activities to date, and is currently developing a curriculum teachers can use to introduce similar activities themselves. This academic year, Project EATS is piloting an accredited academic course on sustainable agriculture with a science-focused public high school. In Milwaukee, the point teachers in each school are part of an aquaponics professional learning community. This PLC meets regularly, allowing teachers to discuss the systems at their schools, exchange ideas, brainstorm, and learn from outside experts. The cohort has also taken the lead in developing the district's aquaponics curriculum. While curriculum is being developed in both New York and Milwaukee to support teachers, focus groups of educators also stressed the importance of a coordinator to support teachers and oversee the program as a whole.

OTHER STRATEGIES TO ENSURE SUSTAINABILITY

Programs run by individual teachers run the risk of lasting no longer than their tenure in a school. "Making sure more than one person knows how to do it is huge," Sandrin says, pointing to team teaching structures in place at some schools.

Building interest and support for such programs among the greater faculty is also critical to ensure long-term support. "Have a salad staff day," Ray advises. "As soon as some people taste a salad, it's hook, line, and sinker."



Conclusion

At some point, virtually everyone involved in urban farming brings up the intrinsic value of “getting your hands in the dirt.”

Conclusion

As seen in this case study, giving students opportunities to experience science through hands-on activities makes what they are learning real in a way that “paper labs” and rote memorization can’t. Research into how young people learn and STEM best practices both confirm the value of experiential, project-based learning. Through our efforts in Milwaukee and New York City, we want to make sure that more young people have access to hands-on opportunities to learn and grow—not just in STEM, but in a wide range of subjects and disciplines that can help them find a passion that can fuel lifelong careers.



In today’s difficult fiscal climate, many schools struggle to find the resources needed to give their students these kinds of rich, real-world opportunities. But they don’t have to go it alone. Much of our work at the NEA Foundation focuses on helping teachers and their schools build strong partnerships that lead to lasting improvements in education. In both of the districts profiled here, schools didn’t go it alone. They had support from committed, community-based organizations with the expertise and the passion to support teaching and learning.

Conclusion

The value of these partnerships can be seen in another word that gets used a lot in urban farming—“sustainability.” In our schools, we see budgets fluctuate and initiatives come and go, resulting in limited opportunities to bring about lasting change. For our efforts to improve education to bear fruit, we need to build lasting coalitions committed to supporting—and improving— public education. At the NEA Foundation, we believe that the combination of teachers, district leaders, and community and business partners working together to improve teaching and learning is the fertile ground that will yield improved outcomes for our children, our schools, and our communities.



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