A Place for Wonder

School Gardens as Sites Ripe for Learning

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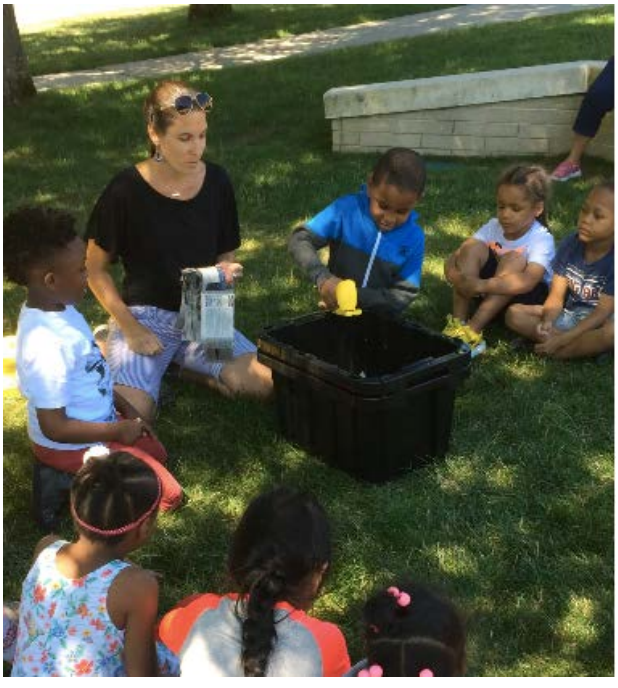
Ms. Russell and her class of 6- and 7-year-olds turn over the dirt in the Pioneer School garden and notice it shifting on its own. Ms. Russell asks everyone to pause and gather around. Do they see what she sees? The children lean in to get a closer look.

"Look, look, I see something!" Darnell shouts, excitedly pointing at dirt that seems to be moving by itself. Kayleigh eagerly reaches her fingers into the dirt and pulls out a squirming worm. She places it on her palm, giggling as everyone leans in to see.

The excitement and joy of this moment are contagious and are a regular part of learning in school and community gardens throughout Bridgeport, Connecticut. In 2016, Sacred Heart University partnered with Green Village Initiative to harness the power of school gardens to serve area children and communities—not only by providing fresh food, but also by creating learning spaces filled with wonder and discovery. Together, the two entities coauthor grants, create lesson plans, and provide supports to local educators who are using school gardens to enhance the learning and lives of their students and families. The Green Village Initiative oversees 25 school gardens, 12 community gardens, and one community farm. It serves more than 20,000 children, about 5,000 of whom are between the ages of 3 and 7.

In this article, we take an in-depth look at a yearlong investigation that emerged from a class visit to one of these school gardens. We also provide recommendations for how to implement and extend lessons from the garden across literacy, math, and science.



The Benefits of School Gardens

Garden-based learning is not new. Philosopher and educator John Dewey mentioned the pedagogical benefits of nature study and working school gardens as early as 1915 (Dewey & Dewey 1915). However, it was not until the past few decades that school gardening began to increase, with specific state departments of education (e.g., Texas and California) developing curricula and evaluating implementation (Dirks & Orvis 2005). The California Department of Education, for instance, launched its "Garden in Every School" initiative in 1995 to promote education across academic domains (CNPS, n.d.). That same year, California chef Alice Waters founded the nonprofit Edible Schoolyard Project to connect gardening to academics, nourishment, and the larger community (The Edible Schoolyard Project, n.d.). The US Department of

Agriculture reported that more than 12,300 schools operated edible gardens in 2019, reflecting the most recent statistics available (USDA 2019).

The learning that occurs in school gardens has the potential to improve health, academic, behavioral, and social and emotional outcomes for students (Blair 2009; Greer et al. 2019). For older children, school gardens can lead to increased academic engagement and achievement—specifically in the areas of science (Klemmer et al. 2005), mathematics, language arts, writing, and social studies (Williams & Dixon 2013). A study of school gardens in Washington, DC, found that their presence was associated with higher test scores; it also found that gardens helped address racial and economic inequities in academic achievement (Ray, Fisher, & Fisher-Maltese 2016). Research conducted in early childhood settings remains minimal, although emerging evidence suggests that the benefits for preschoolers are consistent with school-aged children (Davis & Brann 2017).

Growing food from seed is not only exciting, it enhances all children's understanding of where our food comes from. Children who have experienced growing and tasting vegetables in their school gardens, alongside lessons on nutrition, are more likely to taste new vegetables and consume more vegetables during school lunch (Greer et al. 2018; Greer et al. 2019; Parmer et al. 2009; Morgan et al. 2010.) In addition to these nutritional benefits, working in school gardens can be physically demanding: gardening is a full-body exercise, and children use both gross and fine motor skills while weeding, planting, digging, and raking. Garden-based learning has also been found to impact children's social and emotional skills, leading to improvements in working with others and an increase in self-satisfaction and pride, thanks to growing food from "seed to table" (Chawla 2015).

Creating Experiences that Build Knowledge

Developing and extending children's interests and funds of knowledge are particularly important in early childhood. As such, early childhood educators are uniquely positioned to build on ideas and experiences that have meaning in children's lives. A developmentally appropriate curriculum seeks to deepen children's existing knowledge and extend their learning across content areas. It also recognizes that children are active constructors of their own understanding and that they benefit from initiating and regulating their own learning activities (NAEYC 2020). School gardens offer meaningful contexts for learning and have the potential to build children's knowledge about the world in which they live. (See "Building Children's Schema" above.) As children work in and observe the life cycles of these gardens, their curiosity and ensuing questions can foster inquiry and learning across multiple domains.

Consider the opening vignette. During a routine visit to one of the school gardens supported by Sacred Heart and Green Village Initiative, the children from Pioneer School were captivated by their discovery of worms. Coming from an urban area, many had limited experiences with worms and wondered

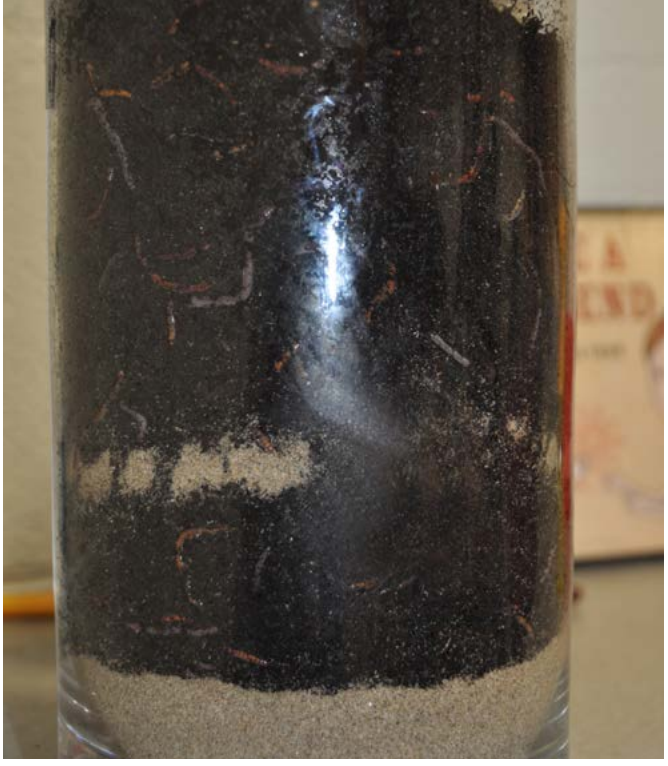
- Where do worms live?
- What do worms eat?
- Do they move forwards, backwards, and sideways?
- What is the biggest worm ever found?

Building Children's Schema

From the first unearthing, teachers at Pioneer School began building children's schema about worms. *Schema* is the map we have in our minds about a certain topic. It is made up of our background knowledge—everything we know and think we know—about a topic. We use our schema to put new information into a meaningful context to help us remember and understand it.

We develop schema through our experiences in the world: who we know, where we go, what we do. We also build it through reading, listening, and viewing a variety of media, among other activities.

All children deserve rich opportunities to build their schema, which in turn, helps their future educational success (Fisher & Frey 2009; Kempton 2014).



Drawing on this interest, teachers created a variety of activities to answer children's questions about worms and to build upon their emerging language and literacy, math, and science knowledge. A description of the yearlong study that ensued follows.

Using the Garden to Expand Children's Language

After bringing their garden worms into the classroom, the children and Ms. Russell build a *vivarium*, or an enclosure that keeps animals under semi-natural conditions for observation and study. They place soil and the worms in a cylindrical vase, which they nestle inside a larger glass hurricane vase. They cover the vivarium with dark paper for several days, then remove it so the children can witness what the worms have done.

"Wow! The worms dug holes and tunnels through the dirt!" Jayden exclaims as Ms. Russell pulls the paper from the vivarium.

"Oooh, I see them, I see them," cry several of the children.

Together, Ms. Russell and the children discuss what the worms are doing. The children break into pairs and talk about what they observe and how the worms might have created the tunnels. Several children use their hands to show each other how the worms move; some even twist and turn their bodies. As Ms. Russell gathers her class back for a whole-group discussion, she introduces new vocabulary words like *burrow* and *bristles*. The children act out the movement of the worms as they *wriggled* and *squirmed* through the soil, burrowing down deeper. Then the class reads *It's a Good Thing There Are Earthworms*, by Jodie Shepard, and adds several new words to the growing "Worm Word Wall."

Strong vocabulary instruction takes place in language- and word-rich environments and includes intentional teaching of selected words and repeated exposure to them (Blachowicz et al. 2006). This rich instruction is magnified when children's active engagement in experiential learning is supplemented by read alouds and the conversations that ensue. Gardens provide a brilliant space to build on the knowledge children bring with them to grow their vocabulary and oral language.

Turning Garden Observations into Writing Skills

Each day that her children come together, Ms. Russell offers time for them to observe and record what the worms are doing in the vivarium. They also spend time during whole-group meetings creating informational texts and other written material. As they gather one morning on

the classroom rug, they start to wonder about the food worms eat. What food is good for them? What can't they eat?

Angel: Pizza is not good for worms.

Myles: Neither are doughnuts!

Ms. Russell: We've read several books that have given us hints about what foods are good for worms, and what foods are not so good. Can anyone remember what we learned about in the books?

(The children begin sharing information with their partners. Ms. Russell listens and sets up two large pieces of chart paper. After a few minutes, she brings the children's attention back to the whole group.)

Ms. Russell: Wow, you have become quite the worm experts! Let's create a poster of foods worms can eat. Let's see . . . what should I title it? Kendra, what do you think?"

Kendra: Worms Love to Eat.

Ms. Russell: What a great title. What do you all think? *(Heads nod vigorously.)* Kendra, why don't you come up and write the word "worms." *(Kendra begins writing on the chart paper.)* W-O-R-M-S. *(Ms. Russell slowly spells the word with the children, showing her hands stretching.)* What letter does "worms" start with? Can you all write it in the air?

(This process repeats as children work through the title.)

After titling the poster, Ms. Russell tells the children to return to their seats and draw and label one food that worms love to eat and one food that is not good for them. When they finish, they cut out what they have drawn and labeled, then glue it to the posters. These are displayed near the vivarium where visitors can see what worms can and cannot eat.

Identifying and labeling, first with drawings and then with words, can be the entry point into reading and writing for many children (Byington & Kim 2017). This functional writing shows children an immediate, clear purpose for writing and teaches them that there are times when writing should be short and concise. School gardens give children a chance to make observational notes and drawings on a regular basis. They can draw maps of the garden, identify and label plants, and document their daily observations. Gardens also provide rich material for writing pieces involving different genres, such as "All About" books, opinion pieces, and how-to books.

The children in Ms. Russell's class kept worm journals throughout the year. They used these to record observations, questions, and reflections on their learning. Eventually, they used the journals to create an informational book to teach other classes about worms.

Extending Scientific Inquiry Indoors

To extend their worm study throughout the cold months, Ms. Russell's class decides to create a *vermicomposting* bin to keep indoors. Vermicomposting is the process of worms eating food scraps and creating an enriching source of nutrients called *castings*. Castings are full of microbes and nutrients that can be used as

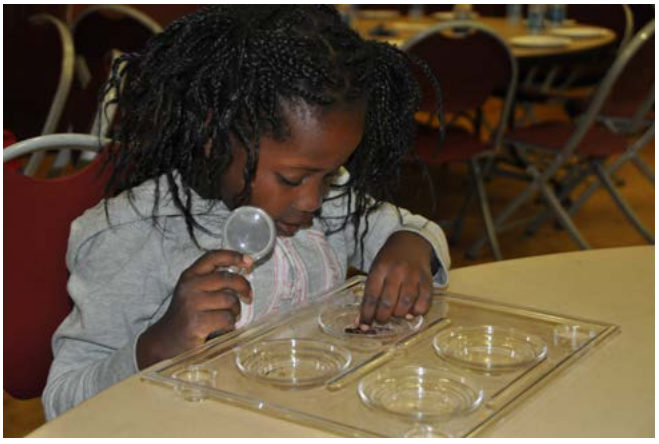
a beneficial additive to gardens or potted plants. The children just love the idea of this new soil actually being worm poop!

The most common worms used for composting are red wigglers, so Green Village Initiative supplies Ms. Russell with 1 pound (about 1,000) of them. After researching the different types of compost bins and watching online videos about vermicomposting, the class decides to use plastic bins for their project. Together, they carefully layer damp newspaper, organic soil, and food for the worms (vegetable scraps, oats, and coffee grounds). They add the worms to the bin, then wait and watch. It will take a minimum of three months for the worms to create castings. The children will then move this nutrient-rich soil back to the school garden in the spring.

School gardens lend themselves to rich investigations to help children discover, create hypotheses and working theories, analyze results, draw conclusions, and present their findings. For instance, during their first indoor lab experience, the children in Ms. Russell's class placed red wigglers on damp paper towels (worms breathe through their skin, so it is important to keep them moist) and began observing. Soon, they began to talk excitedly about their discoveries—the color of the worms, which sides were the top and the bottom, the shape of the worms, how the worms felt, which end was the front, and which end was the back. They used their growing vocabulary about worms to describe what they observed, and they began to draw their observations in their worm journals. Living and learning from such an inquiry stance affords children the opportunity to ask questions and research their answers. It also teaches students that their questions can guide their learning, a skill that supports lifelong learning (Chappell et al. 2008).

Engaging in Mathematical Investigations

When the worms first arrive in Ms. Russell's classroom, they are delivered in a one-pound bag, about the size of a bag of coffee beans. The children are amazed that 1,000 worms can fit in such a small space. Ms. Russell takes out a handful and places them in cups for small groups of students



to observe. She asks each group to estimate the number of worms in their cup. The children write their estimates down, then compare them to the actual number.

Several weeks later, Michelle says, "Are our worms growing? I wonder how big they are." Amaya nods and responds, "They must be growing!" The two girls ask Ms. Russell if they can measure the worms. This launches a multi-day exploration of measurement and comparison.

Working in pairs, the children first estimate the length of their worms and cut a piece of blue yarn the size of their estimate. Next, they measure the actual length of their worms using a piece of red yarn. As they compare the two colors, Ms. Russell hears statements like Angel's: "My estimate was longer than the actual length of the worm." Another day, the children use rulers to measure their worms. Ms. Russell helps them graph their findings, then guides them as they compare and contrast.

School gardens hold tremendous opportunities for children to explore and use mathematical concepts and reasoning, as well as to develop their understanding of mathematical practices. Concepts that may be abstract and difficult to master in a classroom or by reading about others' experiences become more authentic and concrete when applied in the garden setting. (See "Math Explorations in the Garden" on page 75 for ideas on how to incorporate math lessons into a school garden.)

Math Explorations in the Garden

Teachers can use school gardens as a springboard for a variety of math activities, including

- classifying objects and counting the number of objects (plants, flowers, seeds, leaves) in each category
- charting findings and comparing and contrasting the data collected
- estimating the number of fruits/vegetables that may grow from the flowers observed and counted earlier
- measuring the growth of plants over time, using both standard and nonstandard units
- measuring, recording, and charting air and soil temperature changes

When focused on building academic language in mathematics, teachers should support children in expressing their developing mathematical ideas, even encouraging imperfect and emerging language as they learn new vocabulary (Blachowicz et al. 2006; Moschkovich 2015). For instance, as Ms. Russell moved about the classroom and listened to her students, she modeled the language and discourse of mathematics through her questions. She asked one pair of children to *estimate* how many red wiggler worms they would discover in a cup; she asked others to *compare* the lengths of their worms and to describe which red wiggler was *longer* and which was *shorter*.

Starting Your Own Garden Journey

School gardens have the potential to transform the lives of children, families, and communities. Early childhood classrooms and schools are natural places to foster the discoveries and wonder of learning in this ever-changing environment. Even if you do not have the space or community support for an outdoor garden, you can harness its possibilities by growing a few plants inside. Raised garden tables or even window gardens are also a great way to start.

Whatever shape your school garden takes, the following considerations can help ensure success:

- **Reflect on your garden's purpose.** What is your rationale for starting a garden? What goals would you like to achieve?
- **Garner support within the school and community.** Is the administration supportive of your goal? Can you identify other teachers to help create a garden and move toward a shared vision? Would a food services representative or a member of the building and maintenance team like to be involved? What family and community members want to participate?
- **Plan and design the garden.** Consider access to water, sunlight, and drainage as well as your proposed garden's accessibility, security, and visibility. Also decide if you will start your garden from seed or transplant small established plants.
- **Research the plants you envision.** Are your choices safe for young children? Will the care and feeding of your plants fit with your overall vision and goals for the garden and the experience level of your team?

About the Authors

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References for this article as well as a list of books teachers used for their worm study can be found online at **NAEYC.org/yc/winter2021**.

Photographs: courtesy of Kristin N. Rainville and the Green Village Initiative