Science Societies

Backyard STEM: Leveraging state-wide reach of 4-H to teach environmental and soil science

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4-H Youth Development Agents test drive the activity "Flipping Stones," a lesson on fish feeding adaptions where they are mimicking darter fish. Photo by Andrea Ludwig.

Backyard STEM is a curriculum development and educator training program focused on bringing environmental science to Tennessee youth through 4-H

programs. Read about how it equips 4-H educators with hands-on, low-cost, and adaptable STEM lessons that reach thousands of young people across the state.

“Ready, set…… DART!” Eighteen adults frantically run around a bunch of cardboard boxes, bent over double, using their noses to flip the boxes to find candy. They are 4-H Youth Development Agents who have come together for a Backyard STEM in-service training. In this lesson, educators are learning about the unique feeding adaptations of some of Tennessee’s native fish, the darters, who will flip stones on the riverbed to find food. This is just one of many interactive activities we’ve developed for Backyard STEM, a curriculum development and educator training program focused on bringing environmental science to Tennessee youth through 4-H programs.

4-H Youth Development Agents use a USB microscope to examine soil biota during a lesson on "Life Beneath Our Feet." Photo by

Jennifer DeBruyn.

State 4-H programs are administered by the Cooperative Extension Service at land grant institutions. Nearly six million youth are engaged through 4-H at the 100+ land grant Institutions nationwide. In Tennessee, we have University of Tennessee and Tennessee State University 4-H Youth Development Agents in all 95 counties, conducting programing at schools, summer camps, and other special events.

We focus on getting new content to these 4-H educators, which multiplies our impact. Each year, approximately 40 to 60 educators attend our in-service training days where we deliver new environmental science content. We use these in-service days as test beds for our activities, soliciting feedback from the educators and improving the lessons before they are published. In turn, these educators take the activities back to their county programs, reaching thousands of young people across the state.

Educators in nonformal settings such as 4-H and other youth development programs have unique challenges and opportunities compared with formal K-12 teachers in the classroom. Nonformal educators teach in a wide variety of indoor and outdoor settings and often teach a wider range of ages. In Tennessee, many 4-H clubs are still conducted during the school day, making it imperative that 4-H programming addresses state educational standards. For us, this means that in addition to thinking of creative ways to teach core educational concepts in fun and interactive ways, we also consider the needs of nonformal educators.

To that end, we try to develop, curate, or adapt activities that require minimal resources and affordable (or free) materials and think about the portability of the materials for agents that make multiple school visits in a day. During our training in-service days, we discuss variations and extensions of each activity to simplify the activity for younger students or add more complexity and challenge for older students.

The unique settings and delivery modes of nonformal education programs such as 4-H provide opportunities to capture the attention of youth and connect with them in ways that aren't available in a traditional classroom setting.

Andrea Ludwig guides 4-H Youth Development Agents in a game of "Wetland Hopscotch," illustrating the consequences of reducing wetlands for wildlife and ecosystem services. Photo by Jennifer DeBruyn.

Because environmental and soil science is an applied science, it is an excellent way to reinforce core STEM (science, technology, engineering, and math) concepts in a manner that is accessible and interesting for many students. For example, "Decomposer Tag" is a simple, active game that emphasizes the important role of decomposers in food webs. "Bug on the Run" is a design challenge using hexbug mini-robots with an underlying lesson in habits and adaptations that has students practice using the engineering design process. The broad environmental science focus of our program also helps support other aspects of 4-H programming. For example, our lessons can be related to forestry, wildlife, fisheries, plant sciences, horticulture, engineering, and outdoor recreation.

4-H programs offer a unique opportunity for us as higher education professionals to reach youth in innovative and engaging ways and encourage them to consider environmental and soil science or engineering as meaningful career. After 13 years of running the Backyard STEM program, we have amassed a catalog of 70+ environmental science lessons. Many of them are published through University of Tennessee Extension. The lessons focusing on concepts in soil science can also be found in the soils4teachers.com activity database.

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