

# Citizen science at St. Vrain

**Engaging upper elementary students in authentic science work**



BY **KATE GOSS**

It's 9:30 on a Friday morning, and the Willow World Lab at St. Vrain Community Montessori School (SVCMS), a public Montessori charter in Longmont, Colorado, serving over 260 students ages three through 8th grade, buzzes with purposeful work. Groups of upper elementary students prepare and pack equipment to collect data in the watershed in the coming afternoon. Others practice skills—pouring water in precipitation gauges and adding up the millimeters, slotting pebbles through gravelometers to analyze the range of habitats in a stream bed, or spinning a sling psychrometer to determine relative humidity. Off to the side, students introduce a new peer team to the purpose of a transparency tube and how to use it. All these students are engaged and empowered to study their world through a Citizen Science program that connects students with NASA and the local environment.

The Citizen Science program at SVCMS integrates a triad of resources. Montessori philosophy and a strong science curriculum form the foundation. NASA's international science and education program, Global Learning to Observe and Benefit the Environment (GLOBE), compliments that foundation by enabling students to participate in real, hands-on citizen science work. Through GLOBE, citizen scientists from around the world collect and share data, providing granular local



*Purposeful work*

data that helps NASA refine satellite imagery as well as performing original experiments that aid understanding of the local environment. The standardized science protocols from GLOBE extend the SVCMS science curriculum by providing context and real-world meaning for student work. Finally, collaboration with a local watershed group practicing adaptive management gives students critical access to the local biome, providing both place and purpose.

## Curriculum and Connections

At SVCMS, upper elementary students engage in a robust three-year cycle of scaffolded Montessori science curriculum. Fourth years follow the Coming of the Universe into studies of matter and energy, and then explore the foundations and organization of

life. Fifth years begin to integrate information into understanding processes, such as studying the atmosphere to understand weather and layers of the earth to understand changing formations. As sixth years, they synthesize these processes into integrated systems, beginning with the hydrologic cycle, adding in constructive and destructive forces of a dynamic earth, and taking chemistry through energy flow in ecosystems. Throughout this path, the lithosphere, atmosphere, hydrosphere and biosphere frame student learning, just as the data collection protocols from GLOBE are centered around these spheres—providing a strikingly aligned series of real-world connections to the school's Montessori scope and sequence.

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These connections between Montessori and GLOBE become deeper by employing familiar Montessori materials to analyze and understand citizen science data. Hundred boards, with tiles flipped over to their painted white backs, become the perfect material to introduce and practice percentage of cloud cover, and then to internalize their perception of the ranges of cloud cover. Water and air quality analysis, involving amounts as small as parts per million, become crystal clear when students compare the million cube with the astonishingly small unit cubes. Even measuring, a perennial activity, takes on new meaning when turned upright and used to capture rainfall.

### Willow World Lab

Student empowerment is an essential element of Citizen Science, and it begins in the Willow World Lab. The lab is a small space that was converted from an underutilized kitchen. The walls and shelves feature science equipment and Montessori materials to support their use. There's a cork board to highlight the latest field data as well as the new equipment to learn. Students can sign up for lessons, practice, and even master skills well enough to become trainers themselves. One such student trainer, compelled by the real equipment and math involved in measuring precipitation, reported practicing 53 times.

Freedom to practice independently in the Willow World Lab also supports students who may not be comfortable in science by providing a low-stakes, time-independent environment to reach a level of mastery that builds confidence. By removing emotional barriers, the result is higher engagement and a more inclusive body of citizen scientists both during practice and out in the watershed. One student who had not yet engaged deeply in science began self-identifying as a citizen scientist, even signing her name as "Dr."

in her journal.

The Willow World Lab also empowers students' intellectual and functional independence. Practice leads to deeper understanding of data, with students being able to identify outliers and problem solve solutions. Student competency flourishes to the point that they feel empowered to assist peers. Having a difficulty with dissolved oxygen? See Susan or Zach. Students also plan their field outings, identifying the overall purpose and their roles in the team, determining, packing, and loading appropriate science equipment, and being responsible for returning it to the lab in good condition. A compelling driver for this engagement is the opportunity to be out in nature in the local watershed.

### Place and purpose

Like many charter schools, SVCMS struggles with not being able to offer a prepared outdoor environment. Fortunately, collaboration with the Left Hand Watershed Center gives the school access to four unique sites along the Left Hand creek to center both the students and their work. Students follow the creek through a canyon, an alluvial plain, a high plain, and an urban setting—observing and collecting data through the seasons. They measure and map the banks, determine the slope and features, locate riffles and pools, observe the sky, and note the changing life surrounding it all. Their sincere joy in being out in nature with a purpose is evident in their first moments in the field, in their smiles and excited chatter, and in the earnest care they take in collecting data. They embody both being citizens of these beautiful places and scientists measuring and caring for them.

### Authentic citizen-science and service

Guides at SVCMS have observed that this deep engagement and connection

fosters curiosity, which is the grounds for authentic scientific questioning. Students are internalizing science as a process of observing, wondering, and finding out how to fulfill their desire to understand. They have begun to prepare and take an additional Curiosity Box on their field study outings, filled with additional equipment and resources to answer things they just might wonder about while out in nature.

This spring the fifth-year students will present original work at a Science Symposium centered on the watershed. As the program continues to develop, there is great potential and opportunity for sixth-year students to engage in service in adaptive management and care for their watershed. A deep knowledge of place and long-term data will support their developing understanding of ways to slow erosion and foster biodiversity. Then, like Montessori citizen-scientists, they will roll up their sleeves and make it happen.

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