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A Teacher's Perspective on Citizen Science

by Ed Lindsey

In 2008, I started working with Acadia Learning for Participatory Science. Bill Zoellick, Sarah Nelson, Hannah Webber, and other scientists had started a project to get high school students outside, measuring environmental mercury. Measurement of mercury concentrations in things like fish, insects, and leaves had become affordable with the acquisition of a new mercury-analyzing instrument at the University of Maine. Mercury sampling had always been the province of professional science because the analysis cost was so high. Now, students could pose subtle, local questions about how mercury accumulates in organisms and get some numbers back from the lab. The professional scientists were on board to provide the expertise needed to make the citizen science as tight as it could be, but they were also there to experiment with citizen science. What would happen if you gave teenage citizens some background knowledge, the means to produce real data from a system of inherent interest to them, and the opportunity to use the data to poke at various hypotheses? The professional scientists were exploring the intersection of citizen science and pedagogy, and I was lucky enough to be there.

ENGAGEMENT

For me, the timing was perfect. I had been assigned a course with the word chemistry in the title. My students were seniors and juniors who needed one more science credit to graduate. Many of them entered the course in a position of desperation. They had a low estimation of their agency and were wearied by a lack of real-life purpose in schoolwork. To survive, we needed to do something authentic and useful. I am using *authentic* in the sense of the Greek root meaning perpetrator, author. *Useful*, here, means it helps someone else do a job. To establish their agency, the students needed to make something for somebody else.

PLACE

Citizenship requires a place. Some places are socially agreed-upon definitions, such as *Maine* and *America*. Other places are real, for example, a watershed. Most of these students lived within the Sunkhaze Stream watershed, which feeds its water into the Penobscot River in Milford, Maine. As a group, they knew the roads, streams, bogs, gravel pits, ATV trails of this watershed. They knew about the pretty waterfall that makes a nice background for a graduation photo. They knew where to fish. Their intimacy with the place spanned the conscious and the unconscious.

We taped together enough topographic maps to show the whole watershed and planned to capture aquatic insects from four different streams. The mercury questions would evolve over time as we became more familiar with the characteristics of the streams and as we came to know the organisms that resided there.

Their citizenship of place created opportunities for getting work done. If I bought a student some gas for his truck, he would bring some other students to meet me somewhere in the watershed. And their citizenship of place diminished scientific fear. Students ignored bad weather and undertook daunting challenges to get data on the physical characteristics of the streams and to capture the aquatic insects we needed.

Photo: Ed Lindsey

In the spring, these students took a bus to Hancock County Technical Center, part of the Ellsworth, Maine, school system. Students from different schools across the state gathered there to present their mercury findings. Students stood up and shared their simple hypotheses about how mercury accumulates in organisms, showed the graphs they had made, and made various claims about how the data informed, or failed to inform, their ideas. These were young people not typically trotted out on the academic stage, yet they presented their findings, or lack of findings, without fear.

In the data, University of Maine scientist Sarah Nelson noticed a pattern. Certain aquatic insects from different places seemed to have accumulated different burdens of mercury in their tissues. Insects in streams occupy all trophic levels, from algae scrapers to top predators, and you can catch them easily. Could high-trophic-level insects such as dragonfly nymphs be used to directly assess mercury bioaccumulation in different places?

Nelson and her colleagues have worked this concept into a multiagency project involving more than 77 national park units and over 3,500 citizen scientists, using protocols and educational materials born out of this early partnership with teachers and students at Old Town High School and across the Northeast (see Flanagan-Pritz and Nelson this issue).

ROLE IN THE ENTERPRISE OF SCIENCE

So, this is the thing. The students' work on how mercury moves through local food webs was not being plugged into a pre-existing template to address pre-formed questions. Their work was happening on the edge of what was known, which is where one needs to stand to get a view of what might be known. The students were also occupying the edges of how learning science and teaching science can happen in a school. The organizers of the Acadia Learning project were also working two edges: the edges of scientific investigation and the edges of science pedagogy.

So, the citizen can perform different functions within the complex system of scientific research. One function is to multiply effort—to get data collectors on the ground to feed more data into established-question frameworks. Another function of the citizen is to assume some of the risk in the messy phase of question formation and methods development.

In June of this year, I had a conversation with Sean Birkel, Maine's state climatologist and creator of the University of Maine's Climate Reanalyzer. Birkel conceded that he is susceptible to distraction—the distraction of ideas, new questions, and possibilities for scientific exploration. He used the metaphor *tangent*. Others may observe Birkel being "off on tangents," but as he pointed out, the tangents are where some of the best science originates. He was implying that intentional occupation of these edgy, tangential spaces in the enterprise of science is necessary.

Both of these functions (data multiplier and edge scout) can intersect with public schooling. It is easier to organize students to collect data according to established protocols that feed existing databases. This work has its edge, though. Student citizens who work at multiplying data become more aware of the particular species, ecosystem processes, and threats to the natural world that well-established citizen science programs often address. Their work strengthens the established science, and their new awareness may cultivate activism. An increasingly perceptive citizenry makes citizen science politically edgy. This is good.

It is more difficult to activate students' existing citizenship of place in an effort to scout new scientific territory. Their citizenship of place, though, is the root of their empowerment to do so. And when students understand that their role is to assume the risks of exploration in a larger, worthy effort, they can let go of their fear. In this model, professional researchers get company in sharing the risks out in the tangential territory. Teachers and students get the cover needed to work the scholastic edges within the conservative institution of school, and place-conscious young citizens experience the power of civic agency. This is even better.

REFERENCES

Flanagan Pritz, Colleen, and Sarah J. Nelson. 2017. "Collecting Data on Charismatic Mini-Fauna: Public Participation and the Dragonfly Mercury Project." Maine Policy Review 26(2): 50–54.

Ed Lindsey teaches earth systems science and organizes the collaborative research program at Old Town High School. For his work with Acadia Learning for Participatory Science, Lindsey earned the Presidential Innovation Award for Environmental Educators in 2011–12 for Region 1 of the United States.