Students Apply NGSS Science Practices in Environmental Stewardship

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Regardless of the grade level(s) you teach and the ability levels of your students, if you are looking for collaborative projects that get your students excited about learning while applying the NGSS science practices, read on! We surveyed California teachers who participated in a 4-month Environmental Education (EE) Professional Development (PD) institute in Spring 2015 and found they were re-energized and truly inspired as they facilitated student-driven environmental stewardship projects that encouraged student use of NGSS science practices. Based on participating teacher feedback, your passion for teaching may also be renewed and your students will be proud that they made a difference for the environment!

EE Professional Development Institute

Science practices can be taught at all grade levels in a variety of environment-based projects, as evidenced by 28 teachers (K-12) from the Los Angeles area with an average of 13.5 years of teaching experience. The teachers participated in a 4-month environmental education professional development institute and received in-depth content instruction from experts provided by the Los Angeles Department of Water and Power and the California Environmental Education Foundation (CEEF) in partnership with the CA Department of Water Resources, Sandia National Laboratories, and the Los Angeles Metropolitan Water District. The institute also focused on effective pedagogy (including the 5Es), required teacher facilitation of a student-driven environmental stewardship project, and provided follow-up support from both the local California Regional Environmental Education Community (CREEC) Network Coordinator and a Regional Director with the K-12 Alliance. The teachers were asked to incorporate two NGSS science practices (#6 explaining and #8 communicating) into the student work.

The students determined the topic and conducted the research. Projects ranged from water conservation and water quality testing to energy audits, school gardens, and campus beautification. Most projects contained a communication component, for example, a local campaign to "pick up your trash," a parent "Eco" night, or a digital storybook.

Figure 1: Students create a collaborative Google Slide presentation of their research on solving the need to add woodland plants around water-stressed redwood trees.

All stewardship projects can be viewed on the CEEF website at www.caeefoundation.org which includes descriptions of the environmental benefits of the stewardship projects, as well as the teachers' observations of their students engagement in the stewardship projects.

Research Conducted on the Institute

The teachers' shifts in instructional practices while engaged in the institute were the subject of a research study. Pre/post quantitative data analyses demonstrated that teachers made statistically significant instructional shifts in their integration of stewardship, their use of reasoning, explanation, and argument (Science and Engineering Practices 6 and 7), and data collection and analysis (Science and Engineering Practice 3 and 4). Teachers were able to incorporate grade-appropriate science practices into their instruction. (See Appendix C: Progression of the Science and Engineering Practices in Grades K–12 of the draft California Science Framework; see: http://www.cde.ca.gov/ci/sc/cf/scifw1st60daypubreview.asp) successfully aligning them with several of California's Common Core (CCSS) anchor standards (e.g., Reading 1, 2, 8; Writing 1, 2, 7, and 8).

Qualitative data analyses of teacher interviews and reflections also demonstrate increase in the use of the NGSS practices and shifts in integrating EE activities and stewardship into instruction. The research indicated the following three key findings:

1) Environmental stewardship is an effective vehicle for science practices, with the inclusion of science practices "legitimizing" EE in schools. From a high school science teacher, "The advantages of integrating the NGSS practices and CCSS into the environment stewardship projects is that you will be teaching the students what needs to be taught at their grade level and at the same time you are helping them learn the importance of taking care of the environment and how they can become advocates…" A high school teacher wrote how essential it is to bring the practices to life. "I think that **integrating environmental stewardship strategies into your teaching practice will bring life into the NGSS practices** (emphasis added). So when you have standards like that, they tend to be abstract. But there are things like energy flows [integrating the cross-cutting concepts of Energy and Matter: Flow, cycles and conservation], … if you use the framework of environmental stewardship and figure out how to teach the standards…then you can make the NGSS practices come alive for the kids. You've got to have something real at the core."

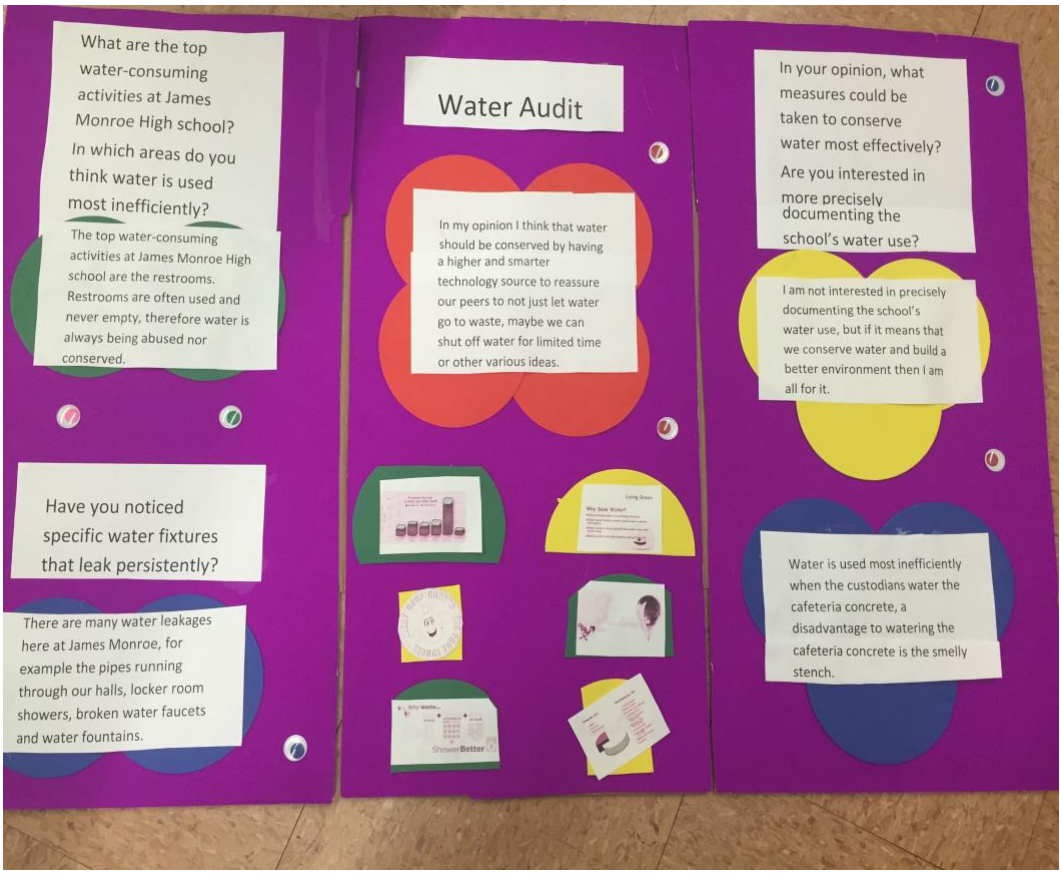

Figure 2: Student poster, which is intended to raise awareness of fellow students about water use and waste at their school; communicates student thinking.

2) Students were engaged in and excited about learning and exhibited positive perspectives. As another teacher stated, "Students have become more aware of their personal responsibilities as stewards of the environment."

3) Teachers noticed the integration of NGSS science practices was seamlessly applied in the stewardship projects. One grade 5 teacher whose class worked on campus beautification wrote of her students, "Then they actually started tallying, going to different areas of the school to see if they could notice any different trends when there was more litter, to kind of get an idea of what's happening. Like are the students walking out to the yard and just throwing their trash anywhere?...So they were walking around and tallying and taking notes. Then we brought it back together, talked about the data and why they think the results were the way they were."

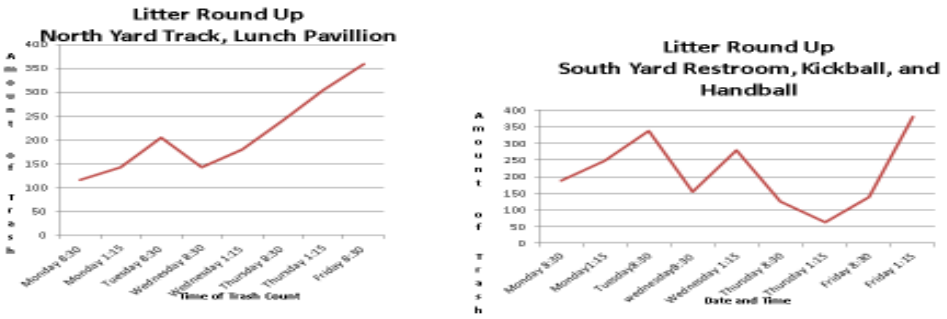

Figure 2: Graphs of student-generated data on campus litter collection; amount of trash (y-axis) and the day and time of the litter collection (x-axis) at an elementary school

In the context of this stewardship project, the teacher combined practice 8 (communication) with both practice 3 (Planning and Carrying Out Investigations) and practice 4 (Analyzing and Interpreting Data).

What does this mean for California's teachers?

Whether you're teaching science, math, or environmental science, you can incorporate the NGSS science practices into your instruction. Make the science practices an integral part of your curriculum, integrating them into every activity your students do, and consider using environmental stewardship as a means to powerfully motivate your students and recharge your enthusiasm for teaching.

References

Bybee, R. W. 1997. Achieving scientific literacy: From purposes to practices. Portsmouth, NH: Heinemann.

CA draft CA science framework (http://www.cde.ca.gov/ci/sc/cf/scifw1st60daypubreview.asp)

California Common Core Standards

Loucks-Horsley, S., K. Stiles, S. Mundry, N. Love, and P. Hewson. 2009. Designing professional development for teachers of science and mathematics. 3rd ed. Thousand Oaks, CA: Corwin Press.

National Research Council. 2012. A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. Washington, DC: The National Academies Press.

National Research Council. 2013. Next Generation Science Standards: For States, By States. Washington, DC: The National Academies Press.