

Observations . . . by Larry NGSS: Ready or Not

By Larry Malone, FOSS Co-director

There's a new day dawning in science education. The blinding glare of the Next Generation Science Standards is rising above the horizon. The NGSS, intended to illuminate the science education universe, have dazzled and stunned many of us. Is this fast changing environment all flash and sparkle, or is there prospect for a clear vision guiding us in a meaningful direction?

The NGSS are a derivative effort that has grown out of the National Resource Council's (NRC) *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* (2012). The purest light shining across the science education landscape emanates from the Framework. **The energy of NGSS has evolved into a kind of radiant fog that ironically clouds vision and makes it more difficult to see the path forward.** How should we look at these NGSS? Is it safe to look directly at them, or do we need to cast our vision to one side so as to not be blinded by the glare?

NGSS come to us as “standards.” Traditionally we have recognized standards as comprehensive compilations of specific bits of knowledge we are expected to communicate to students. Standards historically provided specific guidance for instruction, thus, a nominal outline for curriculum. NGSS break out of that tradition. **NGSS do not describe**

what to teach; they describe performance criteria: descriptions of what students should know and be able to do to demonstrate proficiency in science and engineering. **NGSS are probably more fruitfully considered as an assessment blueprint or framework.** NGSS describe what we want our students be able to do. Is this a good thing or another barrier to effective science instruction? **It has the potential to operate for good or bad, depending on how educators relate to NGSS.**

At this time, it is unclear what kinds of accountability assessments will be implemented. Assessments of the kind suggested by NGSS have not yet been designed. Producing assessment of science proficiency in K–12 is challenging assessment designers to conceive of ways to efficiently and accurately examine students' abilities to perform in alignment with NGSS. A high-powered committee convened by the National Research Council's Board on Assessment and Testing is ruminating on this issue and recently announced that “the committee will review recent and current, ongoing work in science assessment to determine which aspects of the necessary assessment system for the Framework's vision can be assessed with available techniques and what additional research and development is required to create an overall assessment system for science education in K–12.” By the time you are reading this article, a report outlining a conceptual framework for the task and proposed steps to accomplish the goal will have been released by the NRC committee.

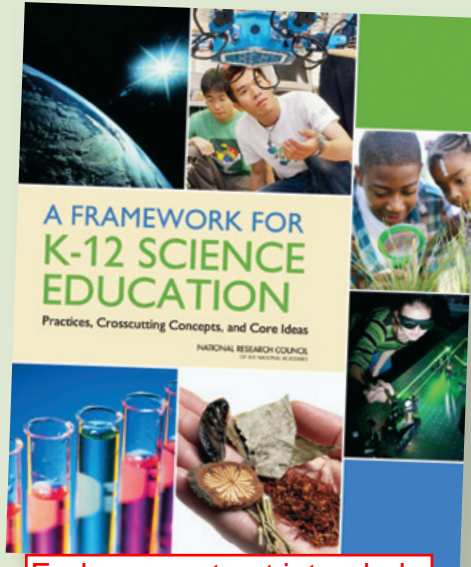
In the meantime, during this transition to NGSS, what should we do? **We will need to embrace the fact that we are confronted with a significant conceptual shift in our relationship with school science.** In an Education Week webinar (*Preparing for the New Science Standards*, June 2013), seven elements of this shift were identified.

1. K–12 science should reflect the interconnected nature of science as it is practiced and experienced in the real world.
2. The NGSS are student performance expectations—NOT curriculum.
3. Science concepts build coherently K–12.
4. The NGSS focus on deeper understanding of content as well as application of content.
5. Science and engineering are integrated in the NGSS, K–12.
6. NGSS content is focused on preparing students for the next generation workforce.
7. NGSS and Common Core State Standards (ELA and math) are aligned.

It would seem prudent to acknowledge the advice of the designers of the NGSS (specifically Stephen Pruitt): **take your time, don't rush to acquire new instructional materials, continue to teach what you are currently teaching, but endeavor to modify how you teach it—align instruction with the guidance provided in the Framework regarding implementation of the scientific and engineering practices.** And Peter

McLaren (Science and Technology Specialist at the Rhode Island Department of Education), who has made a thoughtful and thorough analysis of the NGSS terrain, says, “The Framework is a key document and absolutely necessary to understand NGSS implementation; design professional development around the Framework.” And he advises, “Go slow, build awareness and understanding; open communication and share successes; be patient.”

When you have taken time to wade into the NGSS, you will discover that **they are deep,** implying a need for **purposeful cognitive engagement** with **significant and provocative content.** Hard stuff. So the big question is, **what kind of instructional materials will be needed to guide students to a place where they will perform well on the yet unknown assessments?** The answer is simple: FOSS. Why FOSS? FOSS provides a comprehensive



science experience. The FOSS program is designed carefully to move students along a developmental path from kindergarten through middle school. Along that path, students are exposed to all of the key disciplinary core ideas (content) as well as the complete array of scientific and engineering practices.

Some will protest that the FOSS program is not perfectly aligned with NGSS grade by grade. There are a few places, particularly in grades K–3, where FOSS research on learning progressions leads to a slightly greater array of experiences for young students than would be suggested by NGSS. Grade-level alignment is unimportant when compared to the benefits of curriculum coherence. The Framework promotes the importance of providing science learning as a coherent progression. A progression places value on teaching concepts in a thorough, sequential manner, carefully teaching prerequisite concepts before advancing to progressively more complex related concepts.

As an example, let’s consider an individual fifth-grade NGSS performance expectation. *5–ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.* Whoa! This is a load for students to learn in fifth grade and for teachers to teach in fifth grade. It would necessitate guiding student

to understand the materials and functions of the geologic subsystem of Earth (the rocks and minerals); the distribution and activities of the water on Earth; the materials and activities of the envelope of gases surrounding Earth; and the properties and distribution of the diverse, squirming layer of living organisms that lives in the tenuous biosphere between Earth’s hard solid mineral crust and the middle reaches of the atmosphere. The primary Earth subsystems are complex and it takes a concentrated coordinated effort to systematically teach how each of these major subsystems acts. This suggests that students should come to know these subsystems in a carefully conceived learning progression that unfolds over a period of many years, starting in kindergarten, so that by the time students advance to fifth grade they have acquired a fundamental knowledge of Earth systems. Then in fifth grade, teachers can concentrate on helping students grapple with concepts of how the subsystems interact to produce the mega-effects of subsystem interactions (weather, climate, ecosystem, energy transfer, etc.).

Although the Framework communicates this learning-progression philosophy clearly, NGSS are lax in honoring learning progressions. The learning-progression failures are particularly obvious in the primary grades. Because it is unlikely that students will be assessed each year throughout their K–8 careers, it is more important that students be thoughtfully introduced to the ideas communicated in NGSS before their science knowledge is examined, rather than being exposed to those ideas on the arbitrary schedule promoted by the grade-level NGSS.

The challenge facing educators will be to muster the courage to teach science in a manner that honors a commitment to provide students with a meaningful, stimulating science learning experience. This will necessitate a commitment to professional development to ensure that teachers understand that achieving the vision of the Framework is much more than ticking off standards from an NGSS checklist. And educators will need to be aggressively vigilant when confronted by instructional materials that display comprehensive checklists that identify the page on which a given standard is taught.

Because of the nature of the NGSS performance expectations, it is virtually impossible to “teach the standard” in a succinct single lesson exposure. Trust FOSS to deliver a meaningful science experience for your students; it’s not a quick fix solution to NGSS, it is a commitment to good science instruction that unfolds throughout students’ entire academic careers.

Note: As the NGSS saga plays out, the FOSS staff will continue to reshape the FOSS program to ensure that students have access to the learning experiences they need in order to respond effectively to the NGSS. Check FOSSweb for the release of documents showing FOSS Connections to NGSS. We will continue to develop activities to establish an ever stronger grade-level connection between FOSS and the entire NGSS spectrum. 🌿