Combining Practices with Core Ideas in the NGSS

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Over his career, Cary has directed more than 20 state and federal grant projects, including several that involved the development and testing of new curricula and methods of assessment.

The Next Generation Science Standards (NGSS) is an assessment framework. That is, the performance expectations that make up the heart of the NGSS are intended to be endpoints in instruction. They illustrate what students are expected to be able to do to demonstrate their understanding at the end of a lesson or unit.

What does that mean? First of all the set of performance expectations does not include everything that could, or perhaps should be taught. For example, there are no performance expectations for series and parallel circuits. But that does not mean series and parallel circuits should not be taught, particularly if it makes sense within the context of a unit on electricity. It only means that if and when high stakes tests are developed around the NGSS there will be no items on series and parallel circuits.

By the way, my personal opinion about why the idea of series and parallel circuits has been left out of the NGSS is that this topic tends to be taught as a set of simple rules for solving a certain type of problem, but does not contribute to students' deep understanding of the forces and energy transfers in electric circuits. However, if you think it is important (in this case, for its practical value), then by all means teach your students about series and parallel circuits—provided you give priority to the performance expectations at your students' grade level.

Perhaps the most important distinction between the NGSS and prior standards is the way practices and core ideas are combined in the form of performance expectations. Consider, for example, what a fifth grader should be expected to know and be able to do about the sun, according to the *Next Generation Science Standards* (NGSS Lead States, 2013) and the *National Science Education Standards* (NRC 1996), the most recent comparable document.

These two statements both include the idea that the sun is a star. However, they are vastly different from an assessment point of view. To assess the older statement all that is needed is two multiple-choice questions, to find out if students know about the sun's

position in the solar system, and how big it is compared with the planets. To assess whether or not a student meets the performance expectation from the NGSS, the student needs to have an opportunity to construct and articulate an argument (verbally or in writing) about why he or she believes the sun to be a star, even though it is much, much, brighter than the stars that can be seen in the sky.

National Science Education Standards (1996, p. 43)	*Next Generation Science Standards* (2013, p. 160)
"The sun, an average size star, is the central and largest body in the solar system."	"Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth."

What I especially like about performance expectations is that they suggest ideas for instruction. For example, I can imagine starting by asking my fifth grade students what they thought of the idea that the sun is a star, and that stars are suns. Does it seem logical? What evidence could they suggest that was so? What evidence would suggest the sun is not a star? Then I could have them look at an image of a long road with streetlights, where the closest looks very large and bright and the most distant looks tiny and dim—although we know the lights are all the same size and brightness.

To illustrate how the distances to the nearest stars are measured, I could have the students use a graphical method to measure how far it is to a distant object on the playground by measuring angles to the object from two ends of a baseline (which connects with Common Core State Standards for 5th grade geometry). When measuring the distance to a star the baseline is the diameter of Earth's orbit around the sun.

To show the evidence that the sun and stars are made from the same elements, I could have the students use a diffraction grating to see that the spectrum of a light source is like a fingerprint, and share the nineteenth century discovery by William and Margaret Huggins that the sun's spectrum is very much like the spectrum of the stars.

How would you assess your students' abilities to "Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth?" You could just ask them! Their achievement of the performance expectation would be measured by the extent to which their responses showed they understood the three lines of evidence from the lesson: 1) A large, bright object can appear small and dim if it is far away. 2) It is possible to measure the distance to stars using the baseline of Earth's orbit, so we can envision how the sun would look if it were at the same great distance as the nearest stars; and 3) The sun and stars are composed of the same elements. Although you could construct a few multiple choice questions to see if they understood key ideas from the lesson, simply asking them to construct a response to the open-ended question would provide a much deeper look into how their thinking about the sun and stars has changed.