



The NGSS Science and Engineering Practices—An “8-point booster shot” for Inquiry!

Jo Anne Vasquez

Recently in a workshop I was presenting, Susan, a third grade teacher, lamented, “I just learned to teach in an inquiry-oriented way and now you’re telling me it is gone?” Visibly upset, she tried to explain how hard she has worked to become an inquiry-oriented teacher, using hands-on, inquiry-based materials. She thought she was all set, and now with the roll-out of the Next Generation Science Standards (NGSS) Susan cannot find inquiry anywhere. So, where did it go?

When the National Science Education Standards (NSES) were developed in 1996, they used the term *inquiry* to describe the activities students engaged in to develop knowledge and understanding of scientific ideas. This description led to various interpretations of what inquiry should and shouldn’t be in the classroom. Since there were different interpretations of the term, a companion book, *Inquiry and the National Science Education Standards* was written to clarify its meaning and to give guidance to inquiry teaching and learning. Then in 2011 the National Research Council (NRC) committee that developed *A Framework for K–12 Science Education* decided not to use the term *inquiry* since its meaning was still unclear. What we have all come to call inquiry is in the NGSS, but it is more precisely defined in terms of practices.

We know that students learn science best by engaging in the practices of science. The term *practices* may be confused with the colloquial sense of “a practice” or “to practice,” which is a repetitive performance of activities or skills. We need to now consider “practices” as what scientists and engineers do as they work, through a coordination of both knowledge and skills. As teachers, we can engage students in these practices and help them learn how scientific knowledge is developed and applied.

McGraw-Hill Education author Jo Anne Vasquez has been a classroom teacher, district science specialist for Mesa Public Schools, and adjunct professor of science education at Arizona State University. She is now VP & Programs Director for STEM Initiatives at Helios Education Foundation. Jo Anne is the Past President of the National Science Teachers Association and the National Science Leadership Association. She has won numerous awards including, the 2013 National Science Board’s Public Service Award, NSTA’s “Robert H. Carlton Award” for Leadership in Science Education. She has also received the 2007 New York Academy of Science’s “Willard Jacobson Award” for major contribution to the field of science education and was the 2004 NALEO (National Association of Latino Elected and Appointed Officials) honoree for her contributions to improving education.



For us to better understand the shift required from just thinking of inquiry as defined in the NSES, let's take a look at the similarities between inquiry abilities, as they were called in 1996, and the newer conception of practices in the NGSS.

Inquiry Abilities from the NSES (Grades K–5)	Science and Engineering Practices from the NGSS
Identify questions that can be answered through investigations	Asking questions and defining problems
Develop descriptions, explanations, predictions, and models using evidence	Developing and using models
Plan and conduct a simple investigation	Planning and carrying out investigations
Use data to construct a reasonable explanation	Analyzing and interpreting data
Use mathematics in all aspects of inquiry	Using mathematics and computational thinking
Recognize and analyze alternative explanations and predictions	Constructing explanations and designing solutions
Think critically and logically to make relationships between explanations and evidence	Engaging in arguments from evidence
Communicate investigations and explanations	Obtaining, evaluating, and communicating information

In the NSES, inquiry abilities were specified in grade spans, K–4, 5–8, and 9–12. They have been adapted and some combined here to give you a clearer overview of how, as you are making the shift to the NGSS, you can consider the similarities between the inquiry abilities and the science and engineering practices.

By now you are probably thinking this is all very difficult to understand, but let's take a look at a performance expectation from the NGSS that second grade students should be able to accomplish.

2-PS1 Matter and Its Interactions

Students who demonstrate understanding can:

2-PS1-4. Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.

Here is how you might prepare your students to be able to do this. Each group of students is given a paper plate that has a piece of chocolate bar and an ice cube on it. They discuss and record the properties of each. They are asked to find a way to change the shape of the ice cube and the chocolate. Once the groups have agreed upon the way and changed the shape of the ice cube and the chocolate, they will then share their findings by responding to some guiding questions from the teacher:

- What did you do to change the shape of the ice cube and chocolate?
- What was left afterward?
- What could you do to restore it to its former shape?

Seems easy enough don't you think? And probably not terribly different from any inquiry lesson that you've taught before.

For a while we will have to find ourselves changing the way we talk about inquiry, for some educators will insist it has gone away. On the contrary, inquiry is the heart of science. To inquire is to ask questions and our students have many questions. They then can investigate their questions. This is still the foundation of scientific investigation. Our role now is to think of inquiry in a new way, reflecting on the actual experiences that students encounter during the course of their learning. It might be considered that inquiry has received an "8-point booster shot" with the science and engineering practices and is inoculated against lecture-based approaches to teaching science.

So Susan, with all your great inquiry teaching, your classroom can move easily to being considered a "scientific community" that uses a full set of coordinated practices as outlined in the NGSS.