

By Carolyn Higgins

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## Carolyn Higgins: Improving R.I. students' grasp of science

When I attended high school in the 1980s, we were required to memorize the periodic table -- a rite of passage for my generation. At 14, I saw no value in being able to regurgitate the atomic mass of chlorine, yet I studied and passed the test my teacher gave me.

I can say now, as a veteran science teacher, the effort I expended was wasteful. Why memorize a resource that is accessible in any science classroom or on the Internet? I want my students to develop the skills to analyze information and construct explanations, which leads to conceptual understanding, not simply memorize facts.

These skills, and the science and engineering practices that go with them, are an explicit dimension in Rhode Island's standards for science education, known as the Next Generation Science Standards (NGSS). The need for high-quality science education -- beginning at the earliest grades -- is essential now more than ever.

As president of the Rhode Island Science Teachers Association, I have been deeply involved in the adoption and implementation of the NGSS and know they will provide students with preparation that supports learning and provides the skills and knowledge necessary to succeed in a rapidly and continuously changing world.

Regardless of career choice, whether they attend college or go directly into the workforce, students will need to learn how to formulate questions, think critically, and design solutions to problems. Rote memorization will no longer be the way to learn science. Instead, students will ask questions and seek evidence to develop explanations, giving them ownership of the ideas. It's my job to guide them to evaluate their ideas and help them to explore their questions.

For example, not many adults can clearly explain why a plant emits oxygen as photosynthesis occurs. Most likely, you memorized the chemical reaction in school: carbon dioxide and water react within a plant in sunlight to produce oxygen and sugar. Though many can recite the chemical equation, few can explain the concept it illustrates.

With NGSS, students will be expected to explore phenomena, not just memorize facts. Students might observe what happens to an aquatic plant in a test tube of water when exposed to sunlight. When they see bubbles forming on the leaves of the plants, their questions start: Where did the bubbles come from? What is the gas in the bubble? What happens if you take the plant away from the light?

By observing first, students will become curious about the phenomenon. They observe, question, model, and explain while investigating how plants use photosynthesis to grow and develop and ultimately how energy is transferred to other living things. Using science practices, students will observe and measure the oxygen created by the plants and then apply this knowledge to construct a deeper understanding of how this phenomenon relates to photosynthesis.

This is how real science is done -- figuring out phenomena. By having students in science classes from kindergarten through high school use the same practices that scientists and engineers use, we hope to inspire students to pursue careers in science, engineering and technology fields.

Implementation of NGSS is under way. Rhode Island school districts are in year three of a four-year process. Teachers are receiving professional development to support new approaches to teaching and learning. Parents can help, too, by providing opportunities that engage children with the natural world, as well as the designed world (engineering).

Take a hike and identify plants, birds, and insects. Visit a local observatory (Rhode Island has some great ones!) to view stars and planets and then research their size and distance from Earth. Design a variety of paper airplanes and test which one will fly the farthest. Let your children explore, question and wonder!

Doing science does not require expensive equipment or a college degree. Doing science does require curiosity. Children are full of curiosity and we need to make sure they use it.

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