The parts of NGSS

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NOTE: This is the second part of a weekly NATS series focusing on NGSS and implementation in the classroom.

NGSS is a new way of looking at how we teach students and has many new features that improve learning in the classroom. The goal is to move away from copying notes and rote memorization and focus instead on applying core skills to their world. A truly NGSS-aligned lesson will be engaging students to relate science concepts to the world around them through the use of **Phenomena**. The lessons will utilize **three-dimensional learning.** Those three dimensions are: **Science and Engineering Practices (SEP), Crosscutting Concepts (CCC), and Disciplinary Core Ideas (DCI).**

In this article we will briefly discuss these terms and how they relate to each other. In future articles we will explore these topics in depth with an example lesson.

Performance Expectation (PE) - NGSS standards are called “Performance Expectations”. Why does this matter? Because, they are trying to move students away from simply knowing information to working with the information. Most PE’s start with a science and engineering practice, something like: “Develop a model of…” or “Explain from evidence…”. Each PE also embeds a DCI and a CCC.

Phenomena - The “why” of the lesson - Much of science teaching in the past has focused on rote memorization and general knowledge. However, that learning has been divorced from real-life connections. Phenomena provides students with the answer to “why do I need to learn this?” Providing phenomena at the beginning of the lesson motivates students to find an answer to a problem or design a solution to a problem. Along the way, they learn basic science concepts. Students change from **learning about** a topic to **figuring out** how or why something happens. Phenomena are provided by the individual teachers.

Three-Dimensional Learning - Students must use all three dimensions of the PE together in order to understand phenomena and to design models or solutions to problems. “Classrooms incorporating three-dimensional learning will have students build models, design investigations, share ideas, develop explanations, and argue using evidence.” [http://static.nsta.org/files/tst1508_50.pdf]

Science and Engineering Practices (SEP) - The “how” part of the PE. SEP’s help “students understand how scientific knowledge develops..as well as the links between engineering and

science" (NGSS). SEP's provide students with the knowledge and skills needed to ask questions and design an engineering solution to problems. There are eight SEP's ask students to do things like: Develop Models, Analyze and Interpret Data, Use Math and Computational Thinking, and Engage in Argument from Evidence.

Crosscutting Concepts (CCC) - The "application" part of the PE. CCC's help students apply core scientific concepts to new areas. This isn't about using knowledge of how cells divide to understand wavelengths of light. CCC's focus on seven universal themes in science: 1) Patterns, 2) Cause and Effect, 3) Scale, Proportion, and Quantity, 4) Systems and System Models, 5) Energy and Matter in Systems, 6) Structure and Function, and 7) Stability and Change. For instance, can identifying patterns in the fluctuations of prey populations lead to an understanding of predator species or environmental damage?

Disciplinary Core Ideas (DCI) - The "what" of the PE. DCI's are the broad science ideas that focus the instruction of SEP's and CCC's around context.They are broken down into four domains you probably recognize: Life Science; Physical Science; Earth and Space Science, and Engineering, Technology, and Applications of Science. The DCIs come from the Framework and are specifically designed to" prepare students with sufficient core knowledge so that they can later acquire additional information on their own" (NGSS, pg XV). In order to be considered a core idea, at least two of these criteria are met; 1) broad importance across multiple sciences, 2) a key tool for understanding more complex ideas, 3) relate to student interest or life experiences, 4) be teachable over multiple grades.

It is easy to focus on the DCI and think this is the standard to be taught. However, to truly teach the Performance Expectation and have Three-Dimensional Learning, you cannot just teach the DCI's. You must have all three dimensions working together. One way to assess your lessons is to ask the kids what they are learning. Do they respond with: "We are learning about conservation of energy" or do they respond with: "We are figuring out how airbags protect you to see if we can design a better helmet".

This is the real power behind NGSS. Students learn to explain phenomena with evidence gathered using science and engineering practices and communicate their reasoning using cross cutting concepts. Early results show success and greater engagement of students in science. Concepts are not abstract and disconnected facts. Instead, they are embedded in real-life and show students that science not something just done in a laboratory. Science is alive and applicable to them.