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Science education has evolved significantly over the past several years, as the introduction of STEM education has introduced a more systemic and integrated approach to teaching science, technology, engineering, and math. The Next Generation Science Standards (NGSS) illustrate this new approach to science through the incorporation of scientific and engineering practices, crosscutting concepts, and disciplinary core ideas.

“The NGSS are based on A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas (Framework) developed by the National Research Council (NRC)” (Bybee, 2013, p. xiii).

Administrators must use the framework and NGSS as they were designed and intended. The implementation must be structured and include specific core factors, including educator support, informed stakeholders, high-quality instructional materials, and effective systems (NGSS District Implementation Workbook, 2017).

This paper provides research, tips, and strategies that administrators can use to understand the NGSS, begin implementation of NGSS, and secure success in NGSS implementation.

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The practices defined by the NRC should be taught to students in process form. When a step-by-step procedure is defined for each practice, students can more easily apply the practice to any discipline. This enables coordination of knowledge and skill.

The crosscutting concepts defined by the NRC may be applied across all science domains. “The crosscutting concepts are the themes or concepts that bridge the engineering, physical, life, and Earth/space sciences” (Pratt & Rybee, 2013).

The disciplinary core ideas are designed “to prepare students with sufficient core knowledge so that they can later acquire additional information on their own” (Pratt & Rybee, 2013). Students develop their ability to find and use appropriate resources rather than being given the information in a direct instruction manner.

While it is preferable to incorporate the three-dimensional NGSS approach, it is acceptable to work toward this approach over time. However, teachers should understand up front that the goal is to incorporate all three dimensions for total integration.

“It’s important to help students develop scientific literacy through the use of phenomena ... to develop scientific literacy for students ... [and] bring the NGSS goals into the classroom while also following state standards” (Yan, 2017).

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**T**he K-12 Science Framework should guide the decisions necessary for implementing the NGSS into your current curriculum.

The National Research Council (2015) outlines seven principles that reflect this vision:

- 1) Ensure coherence across the state, district, and schools
- 2) Encourage teachers to emphasize the uniqueness of science
- 3) Develop and provide continuing professional development at all levels
- 4) Build relationships and partnerships
- 5) Take the time to implement the NGSS properly
- 6) Make equity a priority
- 7) Make communication a priority

These principles support the vision by arranging standards so elementary through high school students have many chances to build on prior knowledge. Scaffolding is an essential requirement for incorporating NGSS into the curriculum and classroom. Some scaffolding strategies include:

- 1) Offering a context clue to help students remember prior knowledge;
- 2) breaking a complex task into smaller tasks;
- 3) providing students with an example of the desired outcome or product;
- 4) using verbal clues to prompt answers;

- 5) facilitating student engagement and participation;
- 6) modeling an activity; and
- 7) guiding students through a task similar to one completed before (Lewis, n.d.).

Major elements to consider for implementation include recommendations in instruction; professional development; curriculum resources; assessment; collaboration, networks, and partnerships; and policies and communication (National Research Council, 2015). Successful implementation requires a systemic approach.

Communicate and support a vision consistent with implementation of the NGSS
Support teachers in making changes to their instructional techniques
Help principals and teachers create and develop a classroom culture that supports the new vision
Embed assessment into the instruction itself
Create implementation teams that include all levels of employees (e.g., paraprofessionals, teachers, administrators)
Create a multi-year plan for professional development and implementation
Create and deliver professional development that is content specific; related and modeled to the teacher's desired instructional practices; demonstrates reflective collaboration; and includes a support system
Leverage partnerships
Do not rush to replace all current materials. Rather revise these materials as possible
Plan a proper scope and sequence to incorporate implementation of NGSS
Use clear measures to evaluate possible new materials
Curriculum materials should be evaluated for scaffolding opportunities in future grade levels
Create a new system of assessment that incorporates multiple assessments including tests, classroom-embedded assessments and district/state-level assessments
Help teachers develop appropriate formative assessments
Create opportunities for collaboration
Identify, participate in, and build networks
Cultivate partnerships
Ensure existing policies are consistent with NGSS implementation
Create realistic timelines and monitor progress against determined performance measures
Use the K–12 Framework to drive teacher preparation at the college level
Communicate with local stakeholders

(National Research Council, 2015)



3. **I P P**

Who will be involved with planning and implementing NGSS within the district? A district-level administrator plays an integral role in implementing NGSS within a school district, but ownership of this plan lies at many different levels. As the number of stakeholders involved rises, so does the potential for problems. Therefore, the selection of members for the leadership team is critical. Ideally, you will select representatives from different areas of content area instruction, district administrators (e.g., special education, ELL, assessment, curriculum and instruction), legislature, parents, teachers, school administrators, and other community stakeholders (NGSS Adoption and Implementation Workbook, n.d.).

4. **P I I I P P I**

This system should support teachers as well as school-level administrators. Include district-level staff in developing the system, so you can utilize the resources you already have in place. Open the lines of communication to ensure that everyone is involved in the process to minimize future issues.

5. **P I I P**

Once the plan has been fully developed, it is time to bring in parents and stakeholders. Maintaining continual communication can help you garner the support needed once NGSS has reached the classroom. You can maximize the strengths of these groups to increase the level of support and potentially increase available resources.

6. **I IP I IP**

Determine which instructional materials will be needed to fully bring NGSS to the classrooms. Evaluate the current resources available and inventory those th-6.9 (tD)16 (r)8 (enin pali-10 (gin (e)-12 (le

**A**s administrators begin implementing NGSS within their schools, there are common pitfalls that should be avoided. Administrators should not expect instruction to change overnight. Teachers should not be expected to implement NGSS in their classrooms without support.

Furthermore, administrators should not be so focused on standards that they forget the broad focus of NGSS. For example, never walk into a classroom and ask, “Which standard are you teaching today?” Instead, the focus should be on the practices in the lesson plan.

Administrators must also communicate with parents and the community to garner support. This ongoing communication should include regular updates and efforts to educate all stakeholders on the implementation process itself (National Research Council, 2015).

As you work through the process of implementation, remember the general premise behind engineering design. Create a plan. Execute the plan. Evaluate the results and determine if optimal results w-15 (s s)-14.00 11.5 11.5 11nimal As yad,ogvai (ent)-8 (s aal )]T]0 -1.304 TDcinete -1.ulia-15 E2(

