New Jersey Student Learning Standards SCIENCE

Primer on Teaching and Learning in Science

Students are figuring it out, rather than learning about a topic. The performance expectations in the NJSLS-S are targets for assessment. Student work is driven by questions arising from phenomena or by an engineering design problem. Students are supported in connecting their learning across units and courses to build a coherent understanding of science ideas and of the crosscutting concepts. They have opportunities to apply their developing science knowledge to explain phenomena or design solutions to real-world problems. Finally, they interact with each other as they conduct investigations; represent data; interpret evidence; gather additional information; and develop explanations, models, and arguments. Students are doing the cognitive work rather than passively receiving information.

All Standards, All Students: Curriculum and Instruction 6A:8-3.1 requires that all students receive instruction in all of the NJSLS-S. Students in grades K-5 need sufficient instructional time so that they can demonstrate proficiency with grade specific Performance Expectation. In high school, regardless of course titles and/or organization, students need instruction in all of the life science, physical science, and Earth and space sciences standards prior to graduation.

Courses are substantially based on the NJSLS-S: Graduation Requirement 6A:8-5.1 requires students to earn at least 15 credits in science, including at least five credits in laboratory biology/life science or the content equivalent; one additional laboratory/inquiry-based science course, which shall include chemistry, environmental science, or physics; and one additional laboratory/inquiry-based science course. As a point of clarification, the third course can be chemistry, environmental science, physics, or an Earth and space science course. Regardless of the course title, the course must be substantially based on the NJSLS-S.

What is Effective Science Curriculum? An effective curriculum includes Big Ideas, Dialog and Discourse, Content Coherence, Student Sense-Making, and organized by the school's Teaching and Learning Framework. See this 3 minute NSF video.

- ✓ The learning is based on phenomenon. The teacher engages students in authentic and meaningful scenarios that reflect the practice of science and engineering as experienced in the real world and that provide students with a purpose (e.g., making sense of phenomena and/or designing solutions to problems).
- ✓ The teacher develops lessons that build on prior knowledge. Teacher encourages students to develop deeper understandings of the practices, disciplinary core ideas, and crosscutting concepts by identifying and building on students' prior knowledge.
- ✓ Students are figuring it out, rather than learning about a topic. Instruction is set of activities and experiences that teachers organize in their classroom in order for students to demonstrate proficiency with grade appropriate Performance Expectations.
- ✓ Learning experiences are three-dimensional and lead to proficiency with grade appropriate elements of the practices, disciplinary core ideas, and crosscutting concepts.
- ✓ The students' questions, claims, evidence and reasoning result in scientifically valid evidence-based explanation for how or why the phenomenon occurs or the designed solution will work.
- ✓ Teacher uses inclusive instructional strategies that encompass a range of techniques and approaches that build on students' interests and background so as to engage students more meaningfully and support them in sustained learning. (See NGSS Appendix D: *All Standards, All Students*/*Case Studies* for descriptions, explanations, and vignettes that illustrate what the strategies look like in a classroom.)
- ✓ The teacher makes the Crosscutting Concepts explicit in order to provide an organizational structure for the students to combine knowledge from various disciplines into a coherent and scientifically-based view of the world.
- ✓ Teacher leverages the connections to the New Jersey Student Learning Standards for English language arts. The NJSLS- literacy standards work in tandem with the specific demands of the NJSLS-S.
- ✓ Teacher leverages the connections to the New Jersey Student Learning Standards for Mathematics. Science is a quantitative discipline, so it is important for educators to ensure that students' science learning coheres well with their learning in mathematics.
- ✓ The climate of the classroom supports both individual and collaborative sense-making efforts. Students take responsibility for their learning rather than waiting for answers.
- ✓ Students are collaborating, critiquing, argue with, and learn from their peers.
- ✓ Teacher facilitates productive discourse in a way that enables all students to participate and learn.
- ✓ Formative assessments of three-dimensional learning are embedded in the instruction. The tasks or prompts elicit direct, observable evidence of three-dimensional learning. The goals, objectives, and assessments should begin with an element of a Science and Engineering Practice rather than Bloom verbs.

Instructional Models that are Consistent with the NJSLS-S: Table 1 identifies some of the instructional models that are consistent with the letter, spirit, and intent of the NJSLS-S. The common characteristics of these models are that students are actively engaged in scientific and engineering practices and applying crosscutting concepts to deepen their understanding of the core ideas. The learning experiences engage students with fundamental questions about the world and with how people have investigated and found answers to those questions. It is the students who carry out scientific investigations and engineering design projects related to questions or phenomena rather than teachers disseminating information (pp. 8-9, NRC, 2012).

Table 1: NJSLS-S Consistent Instructional Models (Institute for Science + Mathematics Education, University of Washington, 2014)

Inquiry Kit Instruction (modified)	Challenge Based Instruction	5E Instructional Model (BSCS)
Culturally Relevant Instruction	Project-Based Instruction	Tinkering Pedagogy
Learning Progressions	Knowledge Integration	Meaningful Expertise Instruction
Model-based Reasoning	Place-based Instruction	Emergent Investigations (RSS)

Table 2 shows the Implications of the Vision of the *Framework for K-12 Science Education* and the New Jersey Student Learning Standards for Science. There are some instances when direct instruction is appropriate, however, it should not be the norm.

Table 2: Implications of the NJSLS-S

Should observe less…	Should observe more…
Rote memorization of facts and vocabulary	Facts and vocabulary learned as needed while developing explanations and designing solutions supported by evidence-based arguments and reasoning
Leaning of ideas because they are what is next in a textbook or curriculum	Systems thinking and modeling to explain phenomena and to give a context for the ideas to be learned
Teachers providing information to the whole class	Students conducting investigations, solving problems, and engaging in discussions with teachers' guidance
Teachers posing questions with only one right answer	Students discussing open-ended questions that focus on the strength of the evidence used the generate claims.
Students reading textbooks and answering questions at the end of the chapter	Students reading multiple sources, including science-related magazine and journal articles and web-based resources
Pre-planned outcome for "cook-book" laboratories or hands-on activities	Multiple investigations driven by students' questions with a range of possible outcomes that collectively lead to a deep understanding of established core scientific ideas
Worksheets	Students writing of journals, reports, posters, media presentations that explain and argue
Oversimplification of activities for students who are perceived to be less able to do science and engineering	Providing supports so that all students can engage in sophisticated science and engineering practices

For detailed support, the Guide to Implementing the Next Generation Science Standards provides guidance to district and school leaders and teachers charged with developing a plan and implementing the NGSS as they change their curriculum, instruction, professional learning, policies, and assessment to align with the new standards. For each of these elements, this report lays out recommendations for action around key issues and cautions about potential pitfalls. Coordinating changes in these aspects of the education system is challenging. As a foundation for that process, *Guide to Implementing the Next Generation Science Standards* identifies some overarching principles that should guide the planning and implementation process.