New system of assessments needed when next generation science standards are implemented, report says

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New types of assessments will be needed to measure student learning once the Next Generation Science Standards (NGSS) are implemented, says a new report from the National Research Council. The tests that states currently use emphasize factual knowledge and were not designed to assess the type of understanding envisioned by the standards, which emphasize depth of knowledge based on the ability to integrate core content with science and engineering practices.

The report describes a new system of assessments that should be developed, and it offers examples of the types of tasks and questions that could assess student knowledge as detailed in the standards. To monitor progress in meeting the standards, states should use information both from state-administered tests and from classroom-based assessments, as well as information about students' opportunity to learn in the ways laid out in the science standards, said the committee that wrote the report.

"The Next Generation Science Standards present challenges for assessment, but they are also an opportunity to address longstanding limitations with current approaches," said committee co-chair James Pellegrino, Liberal Arts and Sciences Distinguished Professor and Distinguished Professor of Education at the University of Illinois at Chicago. "Current assessments tend to ask students to define the scientific method absent specific content; assessments under NGSS should ask students to demonstrate that they understand aspects of

scientific reasoning by applying particular science practices, such as designing a study or interpreting the meaning of a data set, to questions about genetic inheritance, for example."

The Next Generation Science Standards, which have been adopted by eight states so far, describe "performance expectations" that articulate what students should know and be able to do at each grade level. The standards support science learning structured around three dimensions: scientific and engineering practices; core ideas of the science and engineering disciplines; and crosscutting concepts, such as "cause and effect" and "energy and matter." In classroom teaching and learning, these three dimensions should be integrated: for example, the students should always learn by engaging in one or more scientific practices in the context of core ideas, and their advancement should be mapped out in terms of a learning progression.

To assess students' mastery and integration of these three dimensions, a variety of question formats will be needed, the report says. Questions may require students to supply an answer, produce a product, or perform an activity. "Formative" assessments would help teachers see how students are progressing and make instructional decisions; and "monitoring assessments" would measure science learning on a broader scale.

For the monitoring tests, the full breadth and depth of NGSS expectations for a given grade level cannot be covered with a single large-scale test, the report says. The committee recommended that the information from external "on-demand" assessments (that is, assessments that are administered at a time mandated by the state) should be supplemented with information gathered from classroom-embedded assessments (that is, assessments that are administered at a time determined by the district or school that fits the instructional sequence in the classroom) to fully assess whether performance

expectations have been met.

These classroom-embedded assessments could take various forms. For example, they might be self-contained curricular units that include both instructional materials and assessments, provided by the state or district to be administered in classrooms. Or the state or district could develop banks of tasks that schools and teachers would use at the appropriate time in classrooms.

Assessments should be developed using a "bottom up" rather than a "top down" approach, the report says. The learning progression should begin with designing instruction and assessments for the classroom, perhaps integrated into instructional units, and then move toward assessment that meets the needs for monitoring purposes, including accountability.

In addition to using assessments to monitor students' progress, states should monitor indicators of "opportunity to learn" – the extent to which students have the opportunity to learn science in the way called for in the standards and the extent to which schools have the resources they need to support learning (e.g., teacher subject-area knowledge, adequate time, and appropriate materials to devote to science instruction).

"It will take time to implement the new system of assessments, just as it will take time to implement the teaching approaches needed for students to learn science in the way NGSS envisions," said committee co-chair Mark Wilson, professor of policy, organization, measurement, and evaluation and of cognition and development in the Graduate School of Education at the University of California, Berkeley. "States should develop and implement the new assessments gradually, starting with what is necessary and possible in the short term while establishing long-term goals for reaching a fully integrated system of curriculum, instruction, and assessment."

In 2011 the National Research Council released A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas, which served as the foundation for the Next Generation Science Standards.

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