thinkpoint

How might we achieve balance through a comprehensive system of science assessment

by Edward Roeber, Ph.D.

Building a comprehensive and balanced approach to science assessment would take a set of resources created by a state for state-required assessment and voluntary local use, along with learning about assessment on the part of science educators. The model described here would provide opportunities for students to study science at every grade level K-12 in a manner respectful of local instructional decisions. Such work would help assure a deeper understanding about science and ensure that the joy of learning is infused in the study of science at all grades.

In this system, assessment *for* learning – used by educators to improve instruction and student learning while it is occurring—is teamed with assessments *of* learning, to verify that learning has occurred. By providing resources for local educator use at all grades, a state could assure that local assessment balances the considerable influence of statewide assessment, and equips teachers for success. This model of a comprehensive assessment system is built from the classroom level upward and comprises the following elements.

Assessment *for* learning

Formative assessment practice — used daily during instruction by teachers and students to monitor student understanding as instruction occurs. Formative assessment practices allow teachers to adjust instruction as needed and allow students to adjust their learning tactics as necessary, in a collaborative manner. The Council of Chief State School Officers (CCSSO) has defined formative assessment in this way:

"Formative assessment is a planned, ongoing process used by all students and teachers during learning and teaching to elicit and use evidence of student learning to improve student understanding of intended disciplinary learning outcomes and support students to become more self-directed learners.

"Effective use of the formative assessment process requires students and teachers to integrate and embed the following practices in a

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collaborative and respectful classroom environment:

- Clarifying learning goals within a broader progression of learning;
- Eliciting and analyzing evidence of student thinking;
- Engaging in self-assessment and peer feedback;
- Providing actionable feedback; and
- Using evidence and feedback to move learning forward by adjusting learning strategies, goals or next instructional steps." (CCSSO SCASS FAST, 2017)

All K-12 science educators should participate in activities to learn about formative assessment and learn to use formative assessment practices daily in their classrooms.

Project-based performance assessments — assessments that actively engage students deeply and yield products (presentations, demonstrations, written work) that can be assessed. Local educators could be assisted with a set of model performance events and performance tasks created by the state from which teachers (or their students) could select for use throughout the school year in support of in-classroom learning activities. The pool of model assessments should be large enough to provide choices to all science teachers and students, permitting them to reinforce planned instruction rather than force teachers to implement a small, required set of learning activities (and corresponding assessments). The performance assessments would be available at all grades K-12.

A testlet is a pre-determined set of items designed to measure the breadth and depth of a standard and its components. The set of items has been field tested and a final set of items should have been selected. They are to be used as an intact set of items - none deleted/none added. They have been validated to indicate students' level of achievement, a property that a set of items selected from an item bank can't demonstrate unless validated together.

Assessment *of* learning

Standards-based interim assessments — testlets constructed to measure student achievement of science standards. This pool of standards-based testlets could be used periodically throughout the school year — at the end of instructional units, marking periods, semesters or other times, after instruction occurs. The intent is to create a flexible pool of testlets for all standards that teachers can combine into mini-summative assessments so that teachers can determine which standards to address either individually or in combination with others, without the assessment dictating what teachers teach or when they teach it. These could be available at all grades K-12 for use on a voluntary basis.

Summative assessments — the annual ESSA-required statewide assessments of science, used in most states at three required grade levels, as well as comparable assessments for voluntary use in other grades K-12. The development of a K-12 summative assessment system is based on the observation that "what gets tested is what gets taught." When these assessments are limited to just three grades, instruction in science tends to be limited to just those three (or adjacent) grades. The goal of the K-12 science summative assessments is to provide quality needs-assessment data at all grades for instructional improvement purposes. Useful assessment information, helpful to local districts, could be obtained if the state would create summative assessments at all grades, a few for required use and the remainder for local educator use on a voluntary basis.

Other necessary resources

Blueprint of a high-quality science education program — a state-developed document that describes the characteristics of a high-quality K-12 science education program. This would include indicators of opportunities to learn in science classrooms; it would also include quality indicators for those who provide instruction, the courses offered to students (along with the enrollments in these courses), and instructional facilities. This blueprint (and supporting research) should serve as a significant resource in school improvement activities.

Research support for the blueprint of a high-quality science education program — the research that supports each of the elements of the blueprint, serving to answer the question of "who says that each Blueprint element is related to high-quality instruction and student achievement?"

Science program review tool — an online tool that could help schools and districts to collect information related to each element in the blueprint, serving to organize this information for ready use in local school and district improvement activities related to science education.

Blueprint of a High Quality Science Program

Indicators of high-quality opportunities to learn science

Student access to quality instruction
- Course offerings
- Course Enrollments
- Certified instructors

Facilities and resources in which such instruction occurs
- Dedicated classroom and special resources
- Per-student expenditures

Local district policies and accountability
- High school graduation requirements
- College and career readiness

Connections
- Availability and use of community resources

Professional learning and instructional support

Program planning, review, and improvement
- State and local assessment and instructional plans

The blueprint could be a significant school improvement resource to improve science instruction and student achievement

Figure 1. Example annual comprehensive assessment schedule for science

SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
Assessment *for* learning									
Formative Assessment									
Daily →									
Project-Based Performance Assessments									
A few times/year	x		x	x		x	x	x	
Assessment *of* learning									
Benchmark Assessments									
End of instructional units	x x	x	x x	x	x x	x x	x	x	
Summative Assessment									
Once a year							x		

Professional learning program for educators — a planned set of resources (e.g., webinars, print and video materials) as well as learning activities related to the various topics such as:

- Providing high-quality instruction in science
- Helping students to become effective self-learners and self-assessors
- Using formative assessment practices, project-based performance assessments, and interim assessment to improve teaching and learning
- Developing assessment literacy more broadly
- Using the Program Review Tool to enhance the science education program
- Helping science educators to demonstrate their effectiveness

Author

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Reflection Points

Design of a Comprehensive Science Assessment System

We invite you to join our ongoing dialogue. Use these questions to reflect alone or with colleagues. We also invite you to share your thoughts at surveymonkey.com/r/D8SMDHF.

1. Do you agree with the vision of a comprehensive assessment system as presented? Why or why not?
2. What challenges do you see in implementing such an approach to science assessment?
3. How could the state and districts address these challenges?
4. What will it take to implement the science assessment system you envision?
5. Other comments or suggestions.

To learn more

Examples of resources currently developed to support the professional learning of science educators as they seek to meet Next General Science Standards and MI Science Standards
www.nextgenscience.org and stemteachingtools.org/tools

ALN Learning Point on Formative Assessment
aln.michiganassessmentconsortium.org/sites/aln.michiganassessmentconsortium.org/files/resources/Sept2017_LearningPoint_Formative-Assessment.pdf

Resources that support the development of high-quality science assessments
stemteachingtools.org/pd/sessionb

Developing Assessments for the Next Generation Science Standards,
by James Pellegrino et al (2014)
www.nap.edu/catalog/18409/developing-assessments-for-the-next-generation-science-standards