

SCIENCE EDUCATION IN NEW YORK STATE: AVERTING THE CRISIS

A Position Paper of the New York State Science Education Consortium

(May, 2008)

In November 2006, the New York State Board of Regents proposed “P-16 Education: A Plan for Action”, a plan to “close the great divide in achievement along lines of income, race and ethnicity, language, and disability” and to “keep up with growing demands for still more knowledge and skill in the face of increasing competition in a changing global economy”. These ambitious goals frame the 13 actions described in the plan, including the intention to “raise the learning standards to exceed global standards so all students graduate ready for citizenship, work, and continued education”. The Regents noted in 2006 that, except for mathematics, New York’s learning standards have not been reviewed in 10 years while “other states and nations have renewed their standards and continue to do so”. With respect to New York’s science standards and their related core curricula and assessments, the Consortium has for several years identified persistent problems and made recommendations to the New York State Education Department. These problems can be summarized as follows:

- The current broad scope of the State’s core science curricula, particularly at the intermediate and commencement levels, constrains in-depth treatment and integration of major ideas, the development of scientific reasoning, and the implementation of research-based, learner-centered instructional strategies that can improve student understanding and achievement.
- Tied to the State’s core curricula, its assessments tend to evaluate breadth of understanding of lower-order science concepts over depth of understanding and effective use of higher-order science concepts. As a consequence, this structure encourages more superficial treatment of many topics often through teacher-centered instruction with the assessments failing to index the capabilities of the most gifted and accomplished science students.
- Lack of a coherent vision and sustained plan for science teacher professional development at the State level invites fragmented and episodic attempts to provide such services at the regional and local levels.

The approval of the New York State Learning Standards Review and Revision Process by the Board of Regents in October 2007 provides the opportunity for the State Education Department to address the foregoing problems beginning in 2011-2012 with standards implementation in schools scheduled for 2015-2016. Given the pivotal roles that science and technology play in the nation’s economic and social development, the stated timeline for MST standards review and revision is concerning. This said, the Consortium identifies below the:

- Essential attributes that must be present in all State science curriculum documents by 2015 to make them effective instruments for local curriculum development and instructional planning in all schools and for all students.
- Essential attributes that must be present in all State science assessments developed and administered by 2015 and thereafter to make them both instructionally sensitive and fully aligned and consistent with research-based science teaching strategies and practices.
- Necessary objectives for professional development of K-16 science teachers in 2013-2016 to ensure that teachers are able to use research-based science teaching strategies and practices to improve student learning in science for all students in all schools.

ESSENTIAL ATTRIBUTES OF NEW YORK STATE K-12 SCIENCE CURRICULUM DOCUMENTS IN 2015
New York State Science Education Consortium (5/08)

ESSENTIAL ATTRIBUTES	RATIONALE
Documents should organize concepts and skills in progressions that are both logical and developmental while retaining their separate identities (elementary, intermediate, earth science, living environment, chemistry, and physics) and overarching standards and key ideas.	Each document must recognize students' prior knowledge within topics being addressed, the hierarchy of scientific knowledge in those topics, and the cognitive capacity of children to learn the concepts and skills within the document to meaningful and proficient degrees.
Documents should include specifications of learner performance.	Each document must state clear and explicit expectations for the desired concepts, skills, and scientific attitudes. These expectations can then serve as measures against which to compare and gauge student performance.
Documents should emphasize inquiry-oriented learning.	Success in the work environment, higher education, and in life requires effective problem solving. Inquiry-oriented learning enables students to solve problems by demonstrating effective communication skills and the application of scientific processes, laboratory skills, and technology, including information and data gathering and analytical skills.
Documents should each include an independent science research component.	Extensive research has demonstrated the effectiveness of project-based learning in local environments to engage students in higher order thinking involving analysis, synthesis, and evaluation.
Documents should limit the breadth and increase the depth of content expected to be learned.	Both international and national studies have affirmed that, to foster deeper understanding and the ability to use knowledge, the curriculum must be limited in scope to enable the investigation of major ideas in science in greater depth.

ESSENTIAL ATTRIBUTES OF NEW YORK STATE K-12 SCIENCE ASSESSMENTS IN 2015
New York State Science Education Consortium (5/08)

ESSENTIAL ATTRIBUTES	RATIONALE
Assessments should continue to be administered for Elementary Science, Intermediate Level Science, Regents Earth Science, Regents Living Environment, Regents Chemistry, and Regents Physics.	Each science discipline has its unique set of core ideas, implicit structure, and set of methodologies. Students need to become proficient in all science disciplines to become educated and successful citizens.
Each assessment should be organized around the major ideas of its particular discipline.	To help ensure the instructional sensitivity of State assessments, there must be a sufficient number and type of test questions on each statewide test to assess student understanding of each major idea in the associated State curriculum document.
Each secondary level assessment should include Problem Based Learning (PBL) components and scenario-based problem solving/designs in exam questions.	Test items should be developed that assess skills in writing, mathematical computation and scientific analysis of data based on real-world problems. Such items will encourage teachers to engage their students in authentic problem solving that supports their growing scientific literacy.
Each assessment should include performance tests based on Science, Technology, Engineering and Mathematics (STEM) concepts for P-16.	There are process skills and laboratory techniques that are inherent in each science discipline and student attainment of these skills and techniques can be best assessed through actual performance.
The State Education Department should disseminate disaggregated state test data to inform instruction and provide support for classroom-based formative and summative data desegregations.	Science teachers need to know the difficulties, discriminations, and response patterns of items on the State assessments to use this data to inform and improve their teaching.

NECESSARY OBJECTIVES FOR NYS SCIENCE TEACHER PROFESSIONAL DEVELOPMENT IN 2013-2016
New York State Science Education Consortium (5/08)

NECESSARY OBJECTIVES	RATIONALE
A New York State Science Professional Development Institute should be established to coordinate professional development for the State's K-16 science educators.	Professional development in New York State is presently fragmented, lacking coordination and coherence. The Institute could focus primarily on preparing current and future professional developers.
The State Education Department should involve the professional science educator organizations in the statewide planning and delivery of professional development.	Currently, much of the science teacher professional development being provided in the State is through the professional science educator organizations which have the subject matter and pedagogical expertise to offer high quality professional development experiences for science educators.
New York State should require that specified portions of the 175-hour continuous professional development requirement for newly certified teachers be designated for pedagogical content knowledge, science learning theory, and content updates.	Greater specificity in the topics to be addressed in the 175-hour requirement will help ensure that research-based professional development is received as opposed to, for example, using attendance at general faculty meetings as part of the required hours.
The State Education Department's Office of Higher Education should take further actions to improve the State's pre-service science education programs to better reflect the knowledge and skills teachers need in today's classrooms.	As never before, new science teachers need to develop instructional strategies that are learner-centered and address diverse populations of students. Neophyte teachers also require a firmer grounding in preparing, administering, and evaluating both formative and summative assessments. Common Branch elementary teachers should all take at least two science content courses, one in life science and one in physical science, and an elementary science methods course to be prepared to build the necessary foundation in science concepts and process skills to support students' later success in secondary science coursework.

Summary

Owing to recent State reforms, more students than ever before are completing Regents level science courses and passing Regents science examinations. However, are these students learning science concepts and methods at a deeper and more functional level than they had prior to the implementation of the reforms? Critical analysis of the current State science core curricula and related assessments reveals discrepancies in scope, emphasis, and rigor when compared to national science education recommendations and international curricula and assessments. The projected standards review and revision process offers the opportunity to better align standards, curriculum, and assessments with best professional practice. Hopefully, this effort will not be too late to avert what many see as a looming crisis.

The New York State Science Education Consortium is composed of 19 professional science educator organizations and networks existing in New York State and was founded in 2000. Constituents of the Consortium include the Science Teachers Association of New York State, Inc.; the State Professional Development Networks in Biology, Chemistry, Earth Science, and Physics; the New York State Science Education Leadership Association, the Long Island Science Education Leadership Association, the Catholic Science Council, and the Science Council of New York City, an umbrella organization that includes several regional and state science educator associations. Thus the Consortium gives voice to the several thousand members of its constituent organizations and networks and to many more unaffiliated science educators. The mission of the Consortium is to help ensure that the State's reforms in science curriculum, assessment, and professional development are appropriate, mutually supportive, and consequential. This position paper was developed at the Consortium's Eighth Science Education Summit held in Albany on April 25-27, 2008.

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