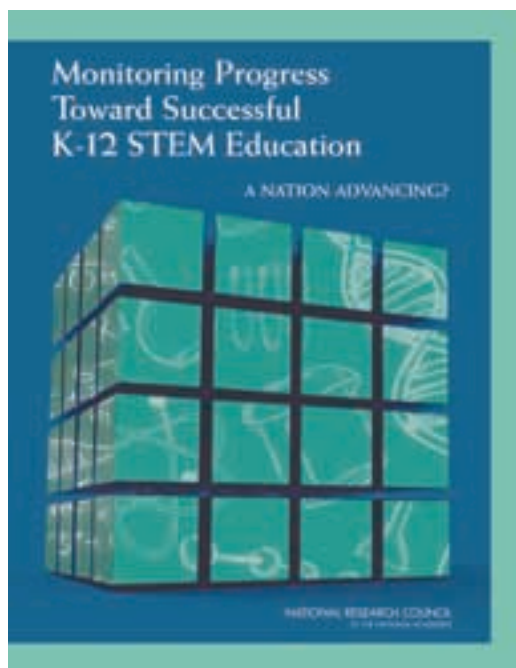


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BOARD ON SCIENCE EDUCATION • BOARD ON TESTING AND ASSESSMENT

MONITORING PROGRESS TOWARD SUCCESSFUL K-12 STEM EDUCATION: A NATION ADVANCING?



The United States faces well-documented challenges in the performance and persistence of K–12 students in science, technology, engineering, and mathematics—fields collectively referred to as STEM. But political will and momentum are gathering behind efforts to address these challenges and improve education in these disciplines. How will we know whether these efforts are making progress?

Following the release of the National Research Council's 2011 report *Successful K–12 STEM Education*, Congress asked the National Science Foundation (NSF) to identify ways to track progress toward the report's recommendations for strengthening education in the STEM fields. At NSF's request, the National Research Council convened a committee to take on this assignment.

The committee's report—*Monitoring Progress Toward Successful K–12 STEM Education: A Nation Advancing?*—identifies 14 indicators linked to the 2011 report's recommendations. By providing a focused set of key indicators related to students' access to quality learning, teaching, and policy and funding initiatives in STEM, the report identifies the data needed to monitor progress in K–12 STEM education and to make informed decisions about improving it. The recommendations and indicators are summarized in the table on the following page.

RECOMMENDATIONS FROM SUCCESSFUL K–12 STEM EDUCATION

INDICATORS

Districts should consider multiple models of STEM-focused schools.

1. Number of, and enrollment in, STEM-focused schools and programs in each district.

Districts should devote adequate instructional time and resources to science in grades K–5.

2. **Time allocated to teach science in grades K–5.**
3. Science-related learning opportunities in elementary schools.

Districts should ensure that their science and mathematics curricula are focused on the most important topics in each discipline, are rigorous, and are articulated as a sequence of topics and performances.

4. **Adoption of instructional materials in grades K–12 that embody Common Core State Standards in mathematics and A Framework for K–12 Science Education.**
5. **Classroom coverage of content and practices in Common Core and A Framework for K–12 Science Education.**

Districts need to enhance the capacity of K–12 teachers.

6. **Teachers' science and mathematics content knowledge for teaching.**
7. Teachers' participation in STEM-specific professional development activities.

Districts should provide instructional leaders with professional development that helps them to create the school conditions that appear to support student achievement.

8. Instructional leaders' participation in professional development on creating conditions that support STEM learning.

Policymakers at the national, state, and local levels should elevate science to the same level of importance as reading and mathematics.

9. **Inclusion of science in federal and state accountability systems.**
10. Proportion of major federal K–12 education initiatives that include science.
11. State and district staff dedicated to supporting science instruction.

States and national organizations should develop effective systems of assessment that are aligned with A Framework for K–12 Science Education and that emphasize science practices rather than mere factual recall.

12. States' use of assessments that measure the core concepts and practices of science and mathematics disciplines.

National and state policymakers should invest in a coherent, focused, and sustained set of supports for STEM teachers.

13. State and federal expenditures dedicated to improving the K–12 STEM teaching workforce.

Federal agencies should support research that disentangles the effects of school practice from student selection, recognizes the importance of contextual variables, and allows for longitudinal assessments of student outcomes.

14. **Federal funding for the three broad kinds of research identified in Successful K–12 STEM Education.**

The report notes that Congress and relevant federal agencies could use these indicators as the core of a national-level monitoring and reporting system to:

- assess progress toward the key improvements recommended in the National Research Council's 2011 report;
- measure student knowledge, interest, and participation in the STEM disciplines and STEM-related activities;
- track financial, human capital, and material investments in K–12 education in STEM at the federal, state, and local levels;
- provide information about the capabilities of the STEM-education workforce, including teachers and principals; and
- facilitate strategic planning for federal investments in education and workforce development in STEM, when used with labor force projections.

Although the committee's intent is for all 14 indicators to form the core of such a system, the indicators highlighted in bold in the table—2, 4, 5, 6, 9, and 14—reflect the committee's highest priorities. With the exception of indicator 14, the priority indicators provide the most important information about student learning. As such, they represent the points of greatest leverage to improve STEM education and build progress toward the goals of increasing the number of underrepresented students who pursue science and engineering degrees and careers, expanding the STEM-capable workforce, and increasing science literacy. The committee also deemed Indicator 14 as high priority because it assesses progress in filling critical gaps in knowledge about programs and practices that contribute to those goals.

Data for most of these 14 indicators are, or could be, available through existing surveys administered by the National Center for Education Statistics, although those data sources have limitations that should be considered in light of the goals of the proposed monitoring system. Several of the indicators require new kinds of data collection, changes in the frequency of data collection, or additional research.

A monitoring and reporting system designed around these indicators would enable education leaders, researchers, and policymakers to better understand and improve national, state, and local STEM education for all students. Congress, NSF, and the Department of Education could take several steps to create such a system:

- Determine whether to create a dedicated survey or use existing federal surveys to collect data on the indicators.
- More fully develop the indicators—for example, by defining more precisely what they include, identifying what constitutes quality (in other words, what predicts downstream impact) for each indicator, and identifying the most appropriate sources of data.
- Compile, analyze, and report on data that already exist.
- Modify existing surveys or create new data collection mechanisms to yield the remaining needed information.
- Produce regular reports on K–12 STEM education that present data on the nation's progress with respect to the indicators and the goals for education in STEM.
- Engage stakeholders in discussions of the development of indicators, their results, and their ongoing utility.

Assuming these steps are undertaken simultaneously, much of the monitoring and reporting system could be developed within 5 years, and the fully developed system could be in place within 10 years. The time to put such a monitoring and reporting system in place could not be more opportune. In this era of heightened accountability, the availability of and capacity to collect high-quality data is greater than ever before. And with the advent of new state standards in mathematics and science, the demand for data that can measure the key elements of those reforms is increasing. The indicators identified by the committee are designed to capitalize on these current opportunities and make a meaningful contribution to ongoing efforts to improve K–12 STEM education.

COMMITTEE ON THE EVALUATION FRAMEWORK FOR SUCCESSFUL K–12 STEM EDUCATION

ADAM GAMORAN (*Chair*), Department of Sociology and Wisconsin Center for Education Research, University of Wisconsin–Madison; **RENA DORPH**, The Research Group, The Lawrence Hall of Science, University of California, Berkeley; **MARK DYNARSKI**, Pemberton Research, LLC, East Windsor, NJ; **DAVID FRANCIS**, Department of Psychology, University of Houston; **SHARON LEWIS**, Council of the Great City Schools, Detroit, Michigan; **BARBARA MEANS**, Center for Technology in Learning, SRI International; **MEREDITH PHILLIPS**, School of Public Affairs, University of California, Los Angeles; **WILLIAM SCHMIDT**, Departments of Statistics and Education, and the Education Policy Center, Michigan State University; **THOMAS SMITH**, Peabody College of Education and Human Development, Vanderbilt University; **RUTH LÓPEZ TURLEY**, Department of Sociology, Rice University; **SUZANNE WILSON**, Department of Teacher Education, Michigan State University; **NATALIE NIELSEN**, *Study Director*

FOR MORE INFORMATION . . . This brief was prepared by the Board on Science Education and the Board on Testing and Assessment based on the report *Monitoring Progress Toward Successful K–12 STEM Education: A Nation Advancing?* The study was sponsored by the National Science Foundation. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the authors and do not reflect those of NSF. Copies of the report are available from the National Academies Press, 500 Fifth Street, N.W., Washington, DC 20001; (800) 624-6242; <http://www.nap.edu>.

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