

Changing the Course of Science Education

Resources

Research



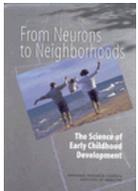
[Atlas of Science Literacy: Mapping K-12 Science Learning. Vol. I & II.](#) AAAS Press, 2001.

Atlas of Science Literacy is a two-volume collection of conceptual strand maps—and commentary on those maps—that show how students' understanding of the ideas and skills that lead to literacy in science, mathematics, and technology might develop from kindergarten through 12th grade.



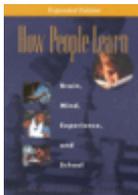
[Children's Ideas In Science.](#) Open University Press, 1985.

This book documents and explores the ideas of school students (aged 10-16) about a range of natural phenomena such as light, heat, force and motion, the structure of matter and electricity. It also examines how students' conceptions change and develop with teaching. The editors have brought together science educators who come from different parts of the work but whose work is focused on the same determination to bring insight into the conceptual world of children in science classrooms - insight which will be helpful in making science teaching and learning more rewarding for teachers and children alike.



[From Neurons to Neighborhoods: The Science of Early Childhood Development.](#) National Academies Press, 2000.

This book presents important conclusions about nature-versus-nurture, the impact of being born into a working family, the effect of politics on programs for children, the costs and benefits of intervention, and other issues. Authoritative yet accessible, this book presents the evidence about "brain wiring" and how kids learn to speak, think, and regulate their behavior. It examines the effect of the climate-family, child care, community-within which the child grows.



[How People Learn: Brain, Mind, Experience, and School.](#) National Academies Press, 1999 and 2000 (expanded edition).

This book offers exciting new research about the mind and the brain that provides answers to a number of compelling questions. When do infants begin to learn? How do experts learn and how is this different from non-experts? What can teachers and schools do—with curricula, classroom settings, and teaching methods—to help children learn most effectively? New evidence from many branches of science has significantly added to our understanding of what it means to know, from the neural processes that occur during learning to the influence of culture on what people see and absorb.



[How People Learn: Bridging Research and Practice](#). National Academies Press, 1999.

In synthesizing a broad body of research, *How People Learn* provides an opportunity to provide research-based messages that are clear and directly relevant to classroom practice. Three of the findings are highlighted in this report because they have both a solid research base to support them and strong implications for how the enterprise of education

is conducted:



[How Students Learn: Science in the Classroom](#). National Academies Press, 2005.

Organized for utility, the book explores how the principles of learning can be applied in science at three levels: elementary, middle, and high school. Leading educators explain in detail how they developed successful curricula and teaching approaches, presenting strategies that serve as models for curriculum development and classroom instruction. This book

discusses how to build straightforward science experiments into true understanding of scientific principles. It also features illustrated suggestions for classroom activities.



[On Evaluating Curricular Effectiveness: Judging the Quality of K-12 Mathematics Evaluations](#). National Academies Press, 2004.

This book reviews the evaluation research literature that has accumulated around 19 K 12 mathematics curricula and breaks new ground in framing an ambitious and rigorous approach to curriculum evaluation that has relevance beyond mathematics.



[Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future](#). National Academies Press, 2007.

In a world where advanced knowledge is widespread and low-cost labor is readily available, U.S. advantages in the marketplace and in science and technology have begun to erode. A comprehensive and coordinated federal effort is urgently needed to bolster U.S. competitiveness and pre-eminence in these areas. This congressionally requested report by a pre-eminent committee makes four recommendations along with 20 implementation actions that federal policy-makers should take to create high-quality jobs and focus new science and technology efforts on meeting the nation's needs, especially in the area of clean, affordable energy.



[Scientific Research in Education](#). National Academies Press, 2002.

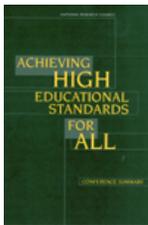
This book describes the similarities and differences between scientific inquiry in education and scientific inquiry in other fields and disciplines and provides a number of examples to illustrate these ideas. Its main argument is that all scientific endeavors share a common set of principles, and that each field including education research develops a specialization that accounts for the particulars of what is being studied. The book also provides suggestions for how the federal government can best support high-quality scientific research in education.



[Strategic Education Research Partnership](#). National Academies Press, 2003.

The *Strategic Education Research Partnership* (SERP) proposes a large-scale, coherent program of research and development that would put the problems of educational practice at its center, and focus on all stages necessary to influence practice. These include theory testing, the development and evaluation of instructional programs, the study of practice in context, and attention to taking innovations to scale.

Standards



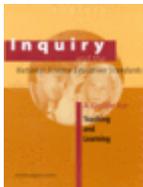
[Achieving High Educational Standards for All: Conference Summary](#). National Academies Press, 2002.

This volume summarizes a range of scientific perspectives on the important goal of achieving high educational standards for all students. Based on a conference held at the request of the U.S. Department of Education, it addresses three questions: What progress has been made in advancing the education of minority and disadvantaged students since the historic *Brown v. Board of Education* decision nearly 50 years ago? What does research say about the reasons of successes and failures? What are some of the strategies and practices that hold the promise of producing continued improvements?



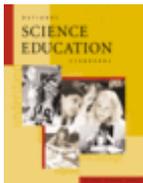
[Classroom Assessment and the National Science Education Standards](#). National Academies Press, 2001.

This accompanying volume to the *Standards* focuses on a key kind of assessment: the evaluation that occurs regularly in the classroom, by the teacher and his or her students as interacting participants. As students conduct experiments, for example, the teacher circulates around the room and asks individuals about their findings, using the feedback to adjust lessons plans and take other actions to boost learning.



[Inquiry and the National Science Education Standards: A Guide for Teaching and Learning](#). National Academies Press, 2000.

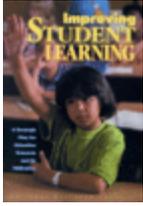
This book is a practical guide to teaching inquiry and teaching through inquiry, as recommended by the National Science Education Standards. It explores the dimensions of teaching and learning science as inquiry for K-12 students across a range of science topics. Detailed examples help clarify when teachers should use the inquiry-based approach and how much structure, guidance, and coaching they should provide.



[National Science Education Standards](#). National Academies Press, 1996.

Americans agree that our students urgently need better science education. The **Standards** offers a coherent vision of what it means to be scientifically literate, describing what all students should understand and be able to do in science. The volume reflects the principles that learning science is an inquiry-based process, that science in schools should reflect the intellectual traditions of contemporary science, and that all Americans have a role in science education reform.

Education Reform



[Improving Student Learning: A Strategic Plan for Education Research and Its Utilization](#)

National Academies Press, 1999.

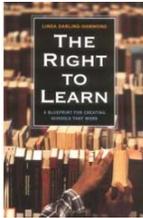
This book offers suggestions for designing, organizing, and managing an effective strategic education research program by building a structure of interrelated networks. The book highlights such issues as how teachers can help students overcome their conceptions about how the world works, the effect of expectations on school performance, and the particular challenges of teaching children from diverse and disadvantaged backgrounds.



[Planning for Two Transformations in Education and Learning Technology: Report of a Workshop](#)

National Academies Press, 2003.

In response to concerns about the continued unrealized potential of IT in K-12 education, the National Research Council's Division of Behavioral and Social Sciences and Education, Center for Education (CFE), Board on Behavioral, Cognitive, and Sensory Sciences (BBCSS), and Computer Science and Telecommunications Board (CSTB) undertook a collaborative project to help the IT, education research, and practitioner communities work together to find ways of improving the use of IT in K-12 education for the benefit of all students.



[The Right to Learn: A Blueprint for Creating Schools That Work](#)

Darling-Hammond, L. Jossey-Bass, 1997.

In *The Right to Learn*, leading educational figure Linda Darling-Hammond weighs in with her own views on progressive education. Darling-Hammond is from the old school of liberal education theory--she emphasizes the process of learning rather than testing. She believes that what's wrong with public schools today can, in great measure, be attributed to excessive bureaucratization--administrative red tape--that leaves teachers with little time for teaching.



[Science for All Children: A Guide to Improving Elementary Science Education in Your School District](#)

National Academies Press, 1997.

This book provides guidelines for planning and implementing an inquiry-based elementary science program in any school district. It presents a rationale for inquiry-based science, describes how teaching through inquiry supports the way children naturally learn, explains the five building blocks of an elementary school science program, and profiles successful inquiry-based science programs in districts nationwide.

Elementary



[Adding it Up: Helping Children Learn Mathematics](#). National Academies Press, 2001.

This book explores how students in pre-K through 8th grade learn mathematics and recommends how teaching, curricula, and teacher education should change to improve mathematics learning during these critical years. The committee discusses what is known from research about teaching for mathematics proficiency, focusing on the interactions between teachers and students around educational materials and how teachers develop proficiency in teaching mathematics.



[Linking Literacy & Science in the K-8 Classroom](#). NSTA Press, 2006.

Based on conferences in Seattle and Dallas, sponsored by NSTA and funded by NSF, this book is just right for K–8 teachers, science and literacy supervisors, school administrators, and professional development providers. Separate sections cover reading, writing, special instruction for English language learners, and the administrators' role in the process of blending science and literacy to the benefit of all.



[Primary Science: Taking the Plunge](#). Harlen, W. Heinemann, 2001.

This book is written for preservice and inservice classroom teachers in primary, elementary, and middle schools. It is particularly aimed at generalist teachers, who may not see themselves as "science teachers," yet have to teach science. But is also for science specialists and curriculum directors or leaders who are attempting to ensure that students' science activities offer genuine learning experiences. To that end, the book provides direct and detailed advice on what kinds of questions teachers should ask, how teachers can respond to children's "difficult" questions, how to develop and assess children's process skills, and how to support children's understandings through inquiry.



[Resources for Teaching Elementary School Science](#). National Academies Press, 1996.

This book is an annotated reference guide to hands-on, inquiry-centered curriculum materials and sources of help for teaching science from kindergarten through sixth grade. Selecting resources to teach elementary school science can be confusing and difficult, but few decisions have greater impact on the effectiveness of science teaching. Educators will find a wealth of information and expert guidance to meet this need in this book, developed by the NSRC.



[Taking Science to School: Learning and Teaching Science in Grades K-8](#). National Academies Press, 2007.

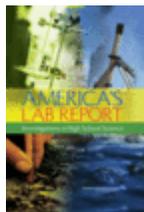
Drawing on a vast array of work from neuroscience to classroom observation, *Taking Science to School* provides a comprehensive picture of what we know about teaching and learning science from kindergarten through eighth grade. By looking at a broad range of questions, this book provides a basic foundation for guiding science teaching and supporting students in their learning.

Secondary



[Adding it Up: Helping Children Learn Mathematics](#). National Academies Press, 2001.

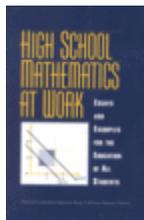
This book explores how students in pre-K through 8th grade learn mathematics and recommends how teaching, curricula, and teacher education should change to improve mathematics learning during these critical years. The committee discusses what is known from research about teaching for mathematics proficiency, focusing on the interactions between teachers and students around educational materials and how teachers develop proficiency in teaching mathematics.



[America's Lab Report: Investigations in High School Science](#).

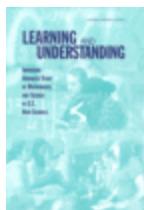
National Academies Press, 2005.

This timely book investigates factors that influence a high school laboratory experience, looking closely at what currently takes place and what the goals of those experiences are and should be. Science educators, school administrators, policy makers, and parents will all benefit from a better understanding of the need for laboratory experiences to be an integral part of the science curriculum and how that can be accomplished.



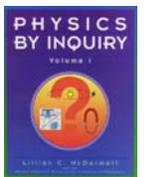
[High School Mathematics at Work: Essays and Examples for the Education of All Students](#). National Academies Press, 1998.

This book is a collection of thought-provoking essays that frame basic issues, provide background, and suggest ways to strengthen the mathematical education of all students. The essays present ideas for making mathematical education meaningful for all students--how to meet the practical needs of students entering the work force after high school as well as the needs of those going on to postsecondary education.



[Learning and Understanding: Improving Advanced Study of Mathematics and Science in U.S. High Schools](#). National Academies Press, 2002.

This book takes a fresh look at programs for advanced studies for high school students in the United States, with a particular focus on the Advanced Placement and the International Baccalaureate programs, and asks how advanced studies can be significantly improved in general. It also examines two of the core issues surrounding these programs: they can have a profound impact on other components of the education system and participation in the programs has become key to admission at selective institutions of higher education.



[Physics by Inquiry, Vol. I & II](#) McDermott, L.C. John Wiley & Sons, Inc., 1996.

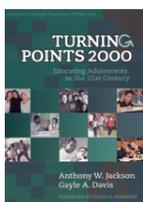
Physics by Inquiry is a set of laboratory-based modules that provide a step-by-step introduction to physics and the physical sciences. Through in-depth study of simple physical systems and their interactions, students gain direct experience with the process of science. Starting from their own observations, students develop basic physical concepts, use and interpret different forms of scientific representations, and construct explanatory models with predictive capability. All the modules have been explicitly designed to develop scientific

reasoning skills and to provide practice in relating scientific concepts, representations, and models to real world phenomena.



[Resources for Teaching Middle School Science.](#) National Academies Press, 1998.

This book is a valuable tool for selecting effective science curriculum materials that will engage students in grades 6 through 8. The volume describes more than 400 curriculum titles, including textbooks, that are aligned with the *National Science Education Standards*. The curriculum materials are grouped in five chapters by scientific area and by type--core materials, supplementary units, and science activity books. Each annotation of curriculum material includes a recommended grade level, a description of the activities involved and of what students can be expected to learn, a list of accompanying materials, and ordering information.



[Turning Points 2000: Educating Adolescents in the 21st Century.](#) Jackson, A.W. et al. Teachers College Press, 2000.

This volume calls for a rigorous curriculum, instructional methods that will prepare all students to achieve higher standards, targeted professional development opportunities for teachers and involved parents and communities, amount other items. "*Turning Points 2000* provides a perfect blend of practical guidance and grand vision, looking with hope toward a day when the developmental needs of all children are met," said Dr. James Comer, Maurice Falk Professor of Child Psychiatry, Yale Child Study Center. "The authors skillfully bridge the gap between research and practice as they share strategies for families, communities and institutions to collaboratively prepare adolescents for life."

University



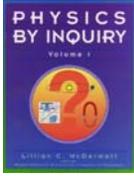
[BIO2010: Transforming Undergraduate Education for Future Research Biologists.](#) National Academies Press, 2003.

The report discusses incorporating more math, physics, chemistry, engineering and computer science into classes and laboratory work and emphasizing independent research will help undergraduate education reflect real-world science. Schools, professional societies and funding agencies should develop new teaching materials and facilitate faculty collaboration.



[Evaluating and Improving Undergraduate Teaching in Science, Technology, Engineering, and Mathematics.](#) National Academies Press, 2003.

This book offers a vision for systematic evaluation of teaching practices and academic programs, with recommendations to the various stakeholders in higher education about how to achieve change. What is good undergraduate teaching? This book discusses how to evaluate undergraduate teaching of science, mathematics, engineering, and technology and what characterizes effective teaching in these fields.



[Physics by Inquiry, Vol. I & II](#). McDermott, L.C. John Wiley & Sons, Inc., 1996.

Physics by Inquiry is a set of laboratory-based modules that provide a step-by-step introduction to physics and the physical sciences. Through in-depth study of simple physical systems and their interactions, students gain direct experience with the process of science. Starting from their own observations, students develop basic physical concepts, use and interpret different forms of scientific representations, and construct explanatory models with predictive capability. All the modules have been explicitly designed to develop scientific reasoning skills and to provide practice in relating scientific concepts, representations, and models to real world phenomena.



[Transforming Undergraduate Education in Science, Mathematics, Engineering, and Technology](#). National Academies Press, 1999.

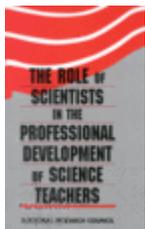
The book addresses pre-college preparation for students in SME&T and the joint roles and responsibilities of faculty and administrators in arts and sciences and in schools of education to better educate teachers of K-12 mathematics, science, and technology. It suggests how colleges can improve and evaluate lower-division undergraduate courses for all students, strengthen institutional infrastructures to encourage quality teaching, and better prepare graduate students who will become future SME&T faculty.

Professional Development



[Educating Teachers of Science, Mathematics, and Technology: New Practices for the New Millennium](#). National Academies Press, 2000.

This book synthesizes what we know about the quality of math and science teaching, draws conclusions about why teacher preparation needs reform, and then outlines recommendations for accomplishing the most important goals before us. Professional Development Schools are reviewed and vignettes presented that describe exemplary teacher development practices.



[The Role of Scientists in the Professional Development of Science Teacher](#). National Academies Press, 1996.

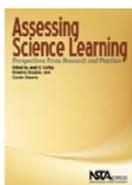
This highly readable book serves as a guide for those scientists interested in working on the professional development of K-12 science teachers. Based on information from over 180 professional development programs for science teachers, the volume addresses what kinds of activities work and why. Included are useful examples of programs focusing on issues of content and process in science teaching.

Assessment



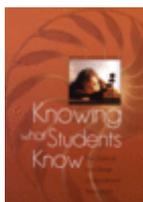
[Active Assessment for Active Science: A Guide for Elementary School Teachers.](#) Price, S.L. Heinemann, 1994.

This book combines practical discussion with theoretical information on the rationale for active assessments. It enables classroom teachers to develop and score their own assessments. The book's numerous classroom examples of assessments and student work provide teachers and staff developers with materials for workshops as well as individual reflection. Teachers will gain ideas that they can immediately use in their classrooms, as well as an appreciation for the careful, methodical work that is required to develop an assessment system.



[Assessing Science Learning: Perspectives from Research and Practice.](#) NSTA Press, 2008.

The National Science Foundation-funded research projects described here show the strong link between assessment and improved student learning; the essays invite science teachers to reflect on their practices and priorities and to consider a variety of productive assessment strategies and frameworks. The central ideas around which the chapters are based and which provide compelling data to fuel conversations about assessment purposes and opportunities include the: Roles of assessment in teaching and learning Characteristics of meaningful assessment items Need for research to validate assessment practices Significance of assessing both student knowledge and their misconceptions Value of assessing students ability to apply their knowledge Importance of assessment-focused professional development In addressing assessment as a central element of teaching practice, *Assessing Science Learning* explores the various forms assessment can take, including student journal entries, feedback on lab reports, observations of students engaged in activities, whole-class discussion, and large annual tests.



[Knowing What Students Know: The Science and Design of Educational Assessment.](#) National Academies Press, 2001.

This book essentially explains how expanding knowledge in the scientific fields of human learning and educational measurement can form the foundations of an improved approach to assessment. These advances suggest ways that the targets of assessment-what students know and how well they know it-as well as the methods used to make inferences about student learning can be made more valid and instructionally useful. Principles for designing and using these new kinds of assessments are presented, and examples are used to illustrate the principles. Implications for policy, practice, and research are also explored.