

# Monitoring Progress Toward Successful K-12 STEM Education

A NATION ADVANCING?



NATIONAL RESEARCH COUNCIL  
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# Monitoring Progress Toward Successful K 12 Stem Education A Nation Advancing

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## **Monitoring Progress Toward Successful K 12 Stem Education A Nation Advancing:**

*Monitoring Progress Toward Successful K-12 STEM Education* Committee on the Evaluation Framework for Successful K-12 STEM Education, Board on Science Education, Board on Testing and Assessment, Division of Behavioral and Social Sciences and Education, National Research Council, 2013-04-08 Following a 2011 report by the National Research Council NRC on successful K 12 education in science technology engineering and mathematics STEM Congress asked the National Science Foundation to identify methods for tracking progress toward the report's recommendations In response the NRC convened the Committee on an Evaluation Framework for Successful K 12 STEM Education to take on this assignment The committee developed 14 indicators linked to the 2011 report's recommendations By providing a focused set of key indicators related to students access to quality learning educator's capacity and policy and funding initiatives in STEM the committee addresses the need for research and data that can be used to monitor progress in K 12 STEM education and make informed decisions about improving it The recommended indicators provide a framework for Congress and relevant deferral agencies to create and implement a national level monitoring and reporting system that assesses progress toward key improvements recommended by a previous National Research Council 2011 committee measures student knowledge interest and participation in the STEM disciplines and STEM related activities tracks financial human capital and material investments in K 12 STEM education at the federal state and local levels provides information about the capabilities of the STEM education workforce including teachers and principals and facilitates strategic planning for federal investments in STEM education and workforce development when used with labor force projections All 14 indicators explained in this report are intended to form the core of this system *Monitoring Progress Toward Successful K 12 STEM Education A Nation Advancing* summarizes the 14 indicators and tracks progress towards the initial report's recommendations

### **Indicators for Monitoring**

**Undergraduate STEM Education** National Academies of Sciences, Engineering, and Medicine, Division of Behavioral and Social Sciences and Education, Board on Science Education, Committee on Developing Indicators for Undergraduate STEM Education, 2018-04-08 Science technology engineering and mathematics STEM professionals generate a stream of scientific discoveries and technological innovations that fuel job creation and national economic growth Ensuring a robust supply of these professionals is critical for sustaining growth and creating jobs growth at a time of intense global competition Undergraduate STEM education prepares the STEM professionals of today and those of tomorrow while also helping all students develop knowledge and skills they can draw on in a variety of occupations and as individual citizens However many capable students intending to major in STEM later switch to another field or drop out of higher education altogether partly because of documented weaknesses in STEM teaching learning and student supports Improving undergraduate STEM education to address these weaknesses is a national imperative Many initiatives are now underway to improve the quality of undergraduate STEM teaching and learning Some focus on the national level others involve multi institution collaborations

and others take place on individual campuses At present however policymakers and the public do not know whether these various initiatives are accomplishing their goals and leading to nationwide improvement in undergraduate STEM education Indicators for Monitoring Undergraduate STEM Education outlines a framework and a set of indicators that document the status and quality of undergraduate STEM education at the national level over multiple years It also indicates areas where additional research is needed in order to develop appropriate measures This publication will be valuable to government agencies that make investments in higher education institutions of higher education private funders of higher education programs and industry stakeholders It will also be of interest to researchers who study higher education Changing Expectations for the K-12 Teacher Workforce National Academies of Sciences, Engineering, and Medicine, Division of Behavioral and Social Sciences and Education, Board on Science Education, Policy and Global Affairs, Board on Higher Education and Workforce, Committee on Understanding the Changing Structure of the K-12 Teacher Workforce, 2020-07-10 Teachers play a critical role in the success of their students both academically and in regard to long term outcomes such as higher education participation and economic attainment Expectations for teachers are increasing due to changing learning standards and a rapidly diversifying student population At the same time there are perceptions that the teaching workforce may be shifting toward a younger and less experienced demographic These actual and perceived changes raise important questions about the ways teacher education may need to evolve in order to ensure that educators are able to meet the needs of students and provide them with classroom experiences that will put them on the path to future success Changing Expectations for the K 12 Teacher Workforce Policies Preservice Education Professional Development and the Workplace explores the impact of the changing landscape of K 12 education and the potential for expansion of effective models programs and practices for teacher education This report explores factors that contribute to understanding the current teacher workforce changing expectations for teaching and learning trends and developments in the teacher labor market preservice teacher education and opportunities for learning in the workplace and in service professional development

**Commerce, Justice, Science, and Related Agencies Appropriations for 2014** United States. Congress. House. Committee on Appropriations. Subcommittee on Commerce, Justice, Science, and Related Agencies, 2013 The Case for STEM Education Rodger W. Bybee, 2013 If you are interested in STEM education policies programs or practices or you work on STEM in some capacity at any level The case for STEM education will prove to be valuable reading Author Rodger W Bybee has written this book to inspire individuals in leadership roles to better understand and take action on STEM initiatives The book's 10 chapters accomplish several tasks Put STEM in context by outlining the challenges facing STEM education drawing lessons from the Sputnik moment of the 1950s and 1960s and contrasting contemporary STEM with other education reforms Explore appropriate roles for the federal government as well as states districts and individual schools Offer several ideas and recommendations you can use to develop action plans for STEM With an emphasis on both thinking

and acting The case for STEM education is a must read for leaders at all levels national and state policy makers state level educators responsible for STEM initiatives college and university faculty who educate future STEM teachers local administrators who make decisions about district and school programs and teachers who represent STEM disciplines Back cover

Digital Tools and Solutions for Inquiry-Based STEM Learning Levin, Ilya, Tsybulsky, Dina, 2017-03-31 In the digital age the integration of technology has become a ubiquitous aspect of modern society These advancements have significantly enhanced the field of education allowing students to receive a better learning experience Digital Tools and Solutions for Inquiry Based STEM Learning is a comprehensive source of scholarly material on the transformation of science education classrooms through the application of technology Including numerous perspectives on topics such as instructional design social media and scientific argumentation this book is ideally designed for educators graduate students professionals academics and practitioners interested in the latest developments in the field of STEM education **STEM Education 2.0** Alpaslan Sahin, Margaret J. Mohr-Schroeder, 2019-08-12 STEM Education 2.0 discusses the most recent research on important selected K 12 STEM topics by synthesizing previous research and offering new research questions The contributions range from analysis of key STEM issues that have been studied for more than two decades to topics that have more recently become popular such as maker space and robotics In each chapter nationally and internationally known STEM experts review key literature in the field share findings of their own research with its implications for K 12 STEM education and finally offer future research areas and questions in the respected area they have been studying This volume provides diverse and leading voices in the future of STEM education and STEM education research STEM Learning Is Everywhere National Research Council, Division of Behavioral and Social Sciences and Education, Teacher Advisory Council, Planning Committee on STEM Learning Is Everywhere: Engaging Schools and Empowering Teachers to Integrate Formal, Informal, and Afterschool Education to Enhance Teaching and Learning in Grades K-8, 2014-09-03 Science technology engineering and mathematics STEM permeate the modern world The jobs people do the foods they eat the vehicles in which they travel the information they receive the medicines they take and many other facets of modern life are constantly changing as STEM knowledge steadily accumulates Yet STEM education in the United States despite the importance of these subjects is consistently falling short Many students are not graduating from high school with the knowledge and capacities they will need to pursue STEM careers or understand STEM related issues in the workforce or in their roles as citizens For decades efforts to improve STEM education have focused largely on the formal education system Learning standards for STEM subjects have been developed teachers have participated in STEM related professional development and assessments of various kinds have sought to measure STEM learning But students do not learn about STEM subjects just in school Much STEM learning occurs out of school in organized activities such as afterschool and summer programs in institutions such as museums and zoos from the things students watch or read on television and online and during interactions with peers

parents mentors and role models To explore how connections among the formal education system afterschool programs and the informal education sector could improve STEM learning a committee of experts from these communities and under the auspices of the Teacher Advisory Council of the National Research Council in association with the California Teacher Advisory Council organized a convocation that was held in February 2014 Entitled STEM Learning Is Everywhere Engaging Schools and Empowering Teachers to Integrate Formal Informal and Afterschool Education to Enhance Teaching and Learning in Grades K 8 the convocation brought together more than 100 representatives of all three sectors along with researchers policy makers advocates and others to explore a topic that could have far reaching implications for how students learn about STEM subjects and how educational activities are organized and interact This report is the summary of that meeting STEM Learning is Everywhere explores how engaging representatives from the formal afterschool and informal education sectors in California and from across the United States could foster more seamless learning of STEM subjects for students in the elementary and middle grades The report also discusses opportunities for STEM that may result from the new expectations of the Next Generation Science Standards and the Common Core Standards for Mathematics and Language Arts

Step Into STEAM, Grades PreK-5 Sarah B. Bush, Kristin L. Cook, 2024-10-18 Create innovative and equitable experiences that prepare your learners for the future STEAM education is crucial for preparing learners to meet the demands of a rapidly evolving world Not every learner is going to pursue a STEAM related career but each and every learner needs to be challenged with opportunities to transfer what they are learning in mathematics and science instruction to seek solutions to the complex problems of today and to meet our future world head on In this Second Edition of Step Into STEAM authors Sarah Bush and Kristin Cook guide and inspire PreK 5 educators through a seamless process of designing and implementing STEAM inquiries that align precisely to key mathematics and science content and practices all while meeting the demands of guiding assessments Going far beyond a collection of STEAM activities this book shows educators as well as school and district leaders how to build a STEAM ecosystem that can measurably improve every learner s mathematics and science achievement as well as engagement belonging and interest What truly sets this book apart is its masterful integration of problem based inquiry as the foundation for STEAM instruction This updated edition Expands on the latest research in STEAM education across PreK 5 in various educational settings Incorporates strategies grounded in Universal Design for Learning to engage all learners Provides updated STEAM resources aligned to the Integrated STEM Practices Embeds actionable tips throughout each chapter that educators can implement immediately in addition to suggestions for ongoing learning and growth for all Offers an updated companion website with additional templates for brainstorming sessions or book studies action plans and checklists to help educators put their ideas into practice This is an essential guide for educators looking to implement STEAM education in their classrooms and beyond Step Into STEAM provides a comprehensive roadmap for cultivating the creativity problem solving abilities resilience and empathy that will empower the

next generation of innovators entrepreneurs and global citizens Make the most of your limited instructional time and become part of the Step Into STEAM journey      **Future of STEM education: Multiple perspectives from researchers**  
Subramaniam Ramanathan, Ida Ah Chee Mok, 2023-03-28      **Step Into STEAM, Grades K-5** Sarah B. Bush, Kristin L. Cook, 2019-03-14 How do you create an innovative and equitable classroom experience that prepares elementary students for jobs that don't yet exist while placing a critical focus on mathematics and science content and practice standards all while meeting the demands of high stakes testing The answer to this question is Step into STEAM which provides a practical and accessible approach for educators to create meaningful and transformative learning experiences for each and every student This book guides and inspires K 5 educators through a seamless process of designing and implementing STEAM inquiries that align carefully to key mathematics and science content and practices Taking an opposite approach to existing resources that provide collections of disjointed STEAM activities this book empowers teachers and schools to build cohesive and sustainable STEAM infrastructures grounded in grade level standards and purposeful assessment to deepen the mathematics and science learning of each and every student STEAM instruction is for each and every student STEAM instruction is about mathematics and STEAM instruction can and should be implemented for student success and to engage students in making their community and our world a better place Loaded with resources to help K 5 teachers and instructional leaders develop implement and assess meaningful STEAM inquiries this research based book Provides practical on the go resources to help busy teachers get started in creating purpose driven STEAM instruction Allows educators to interact deeply with the content and create equitable STEAM experiences that blend community and societal interests Includes online companion printable resources to help educators jumpstart or deepen STEAM learning throughout a school or district supporting STEAM professional development professional learning communities and book studies Checklists pictures graphic organizers reflection questions Try it Out sections and example STEAM inquiries help teachers seamlessly connect multiple subject areas create transformative learning experiences engage elementary students in developing creativity and empathy and enable students to solve meaningful and authentic problems for others all to prepare students for their bright futures Make the most of your limited instructional time and become part of the Step into STEAM movement Through carefully crafted research based frameworks inspirational authentic and approachable practical strategies rooted in the reform efforts of student centered STEAM learning and opportunities for professional self reflection Step into STEAM rightfully re elevates educators to their proper places as innovation experts and agents of change in their own classrooms schools districts and communities An inspirational step in a needed direction this book from Drs Bush and Cook is what educators have been craving a guide to transforming ourselves our learning spaces and our profession Richard Cox Jr Expert STEAM Teacher Instructional Coach Bullitt County Public Schools Step into STEAM offers a rare opportunity for anyone concerned with education to consider what learning would be like with equity empathy and experience By providing examples from teachers

who have dared to put children first this book offers more than just new way to teach it offers hope for youth today By considering what youth will need to be successful in jobs that are not yet created Cook and Bush provide a platform for educators to create authentic real world problem solving in classrooms with attention on the often forgotten about component of STEAM the M As a proponent of STEAM education my recommendation is to grab this book and watch your students love learning again Cassie Quigley Associate Professor of Science Education at University of Pittsburgh Author of An Educator s Guide to STEAM Engaging Students Using Real World Problems *Science and Service Learning* Jane L. Newman, Dennis W. Sunal, Cynthia S Sunal, 2016-12-01 The goal of Volume VII of Research in Science Education is to examine the relationship between science inquiry and service learning Its primary intent is to bridge the gaps between research and practice The volume is meant to be useful to science and service learning researchers and practitioners such as teachers and administrators because it provides information about strategies to integrate service learning into the science curriculum and instruction The main themes relate to such topics as Student science academic engagement and academic achievement Teacher instructional strategies in science and service learning Science curricula adaptation or development Civic responsibility of students and community partners Resiliency of students at risk Effect of standards based service learning and science on student outcomes such as academic engagement civic engagement and resiliency to adversity Specific case studies and strategies focus on how to Make learning more engaging Encourage collaboration among students teachers and community partners Improve academic competence Create social civic responsibility Stimulate resiliency in students at risk Improve student interest in STEM subjects and majors Develop STEM career interests Improve the quality of science and service learning instruction through addressing standards Students can learn in teacher centered classrooms however a learner centered class that focuses on science inquiry and service learning is more authentic and engaging to learners This type of learning may not be the only way to teach however many educators believe that it is the best way for students to learn Jordan 2005

**Transforming Insitutions** Gabriela C. Weaver, Wilella D. Burgess, Amy L. Childress, Linda Slakey, 2016 Higher education is coming under increasing scrutiny both publically and within academia with respect to its ability to appropriately prepare students for the careers that will make them competitive in the 21st century workplace At the same time there is a growing awareness that many global issues will require creative and critical thinking deeply rooted in the technical STEM science technology engineering and mathematics disciplines Transforming Institutions brings together chapters from the scholars and leaders who were part of the 2011 and 2014 conferences It provides an overview of the context and challenges in STEM higher education contributed chapters describing programs and research in this area and a reflection and summary of the lessons from the many authors viewpoints leading to suggested next steps in the path toward transformation

**Guide to Implementing the Next Generation Science Standards** National Research Council, Division of Behavioral and Social Sciences and Education, Board on Science Education, Committee on Guidance on Implementing the



Next Generation Science Standards,2015-03-27 A Framework for K 12 Science Education and Next Generation Science Standards NGSS describe a new vision for science learning and teaching that is catalyzing improvements in science classrooms across the United States Achieving this new vision will require time resources and ongoing commitment from state district and school leaders as well as classroom teachers Successful implementation of the NGSS will ensure that all K 12 students have high quality opportunities to learn science Guide to Implementing the Next Generation Science Standards provides guidance to district and school leaders and teachers charged with developing a plan and implementing the NGSS as they change their curriculum instruction professional learning policies and assessment to align with the new standards For each of these elements this report lays out recommendations for action around key issues and cautions about potential pitfalls Coordinating changes in these aspects of the education system is challenging As a foundation for that process Guide to Implementing the Next Generation Science Standards identifies some overarching principles that should guide the planning and implementation process The new standards present a vision of science and engineering learning designed to bring these subjects alive for all students emphasizing the satisfaction of pursuing compelling questions and the joy of discovery and invention Achieving this vision in all science classrooms will be a major undertaking and will require changes to many aspects of science education Guide to Implementing the Next Generation Science Standards will be a valuable resource for states districts and schools charged with planning and implementing changes to help them achieve the goal of teaching science for the 21st century

STEM Education ,2024-05-29 This book examines Science Technology Engineering and Mathematics STEM education in different countries with a focus on recent developments and emerging trends STEM education has become a gateway for socio economic and technological development of nation states In light of this many countries have prioritized STEM education and made it an integral part of their education at all levels Moreover many approaches have been used to develop STEM education and teach students to compete with the fast developing world However despite its infinite benefits it is also important to note that there is inequality in the access and delivery of STEM education within and across countries which requires new approaches to improve STEM education and its teaching and learning Therefore this book consists of chapters on the development teaching and access of STEM education from different education levels countries and perspectives The chapters discuss the concept of STEM education in general or on a particular level of education g PreK 12 education vocational education and higher education or subjects such as mathematics computer science and architecture Moreover the book includes chapters based on the nexus of STEM education and other subjects including arts and culture to teaching STEM education The book contributes to understanding and improving STEM education and instruction globally

**Global Perspectives on STEM Education** Isha DeCoito,Xavier Fazio,Jane Gichuru,2024-06-05 This book focuses on STEM education as it applies to global competencies innovative curriculum and accompanying pedagogy Through a thematic approach the authors explore cross cutting perspectives with a focus on social

equitable environmental and scientific issues as they relate to STEM literacy The research outlined in the book adopts an integrated STEM framework that assesses analyzes and explicitly links all STEM disciplines The book prepares and inspires both educators and students to participate in STEM on a global level The research presented in the book highlights innovative and unique classroom practices in STEM education e g STEM environmental projects digital video games The book links research on and in practice and the intended audience include STEM educators researchers curriculum developers and policymakers interested in innovative STEM education

**Social Media in Education: Breakthroughs in Research and Practice** Management Association, Information Resources,2018-06-04 In the digital age numerous technological tools are available to enhance educational practices When used effectively student engagement and mobile learning are significantly increased Social Media in Education Breakthroughs in Research and Practice contains a compendium of the latest academic material on the usage strategies and applications of social media in education today Including innovative studies on online networks social constructivism and collaborative learning this publication is an ideal source for educators professionals school administrators researchers and practitioners in the field of education

**Reforming Science Teacher Education Programs in the STEM Era** Sulaiman M. Al-Balushi,Lisa Martin-Hansen,Youngjin Song,2023-06-07 This edited book explores different international practices in reforming science teacher education programs for STEM education Incorporating case studies in Asia the Middle East Africa Europe North America and South America the contributors emphasise the large variety in STEM teacher preparation Including science centric versions of STEM programs as well as more integrated models of STEM this contextual diversity will help readers learn about the design opportunities and challenges of STEM teacher preparation in a variety of circumstances in order to innovate and improve STEM education more broadly

Building Capacity for Teaching Engineering in K-12 Education National Academies of Sciences, Engineering, and Medicine,National Academy of Engineering,Division of Behavioral and Social Sciences and Education,Board on Science Education,Committee on Educator Capacity Building in K-12 Engineering Education,2020-03-13 Engineering education is emerging as an important component of US K 12 education Across the country students in classrooms and after and out of school programs are participating in hands on problem focused learning activities using the engineering design process These experiences can be engaging support learning in other areas such as science and mathematics and provide a window into the important role of engineering in society As the landscape of K 12 engineering education continues to grow and evolve educators administrators and policy makers should consider the capacity of the US education system to meet current and anticipated needs for K 12 teachers of engineering Building Capacity for Teaching Engineering in K 12 Education reviews existing curricula and programs as well as related research to understand current and anticipated future needs for engineering literate K 12 educators in the United States and determine how these needs might be addressed Key topics in this report include the preparation of K 12 engineering educators

professional pathways for K 12 engineering educators and the role of higher education in preparing engineering educators This report proposes steps that stakeholders including professional development providers postsecondary preservice education programs postsecondary engineering and engineering technology programs formal and informal educator credentialing organizations and the education and learning sciences research communities might take to increase the number skill level and confidence of K 12 teachers of engineering in the United States Handbook of Research on STEM Education Carla C. Johnson, Margaret J. Mohr-Schroeder, Tamara J. Moore, Lyn D. English, 2020-04-27 The Handbook of Research on STEM Education represents a groundbreaking and comprehensive synthesis of research and presentation of policy within the realm of science technology engineering and mathematics STEM education What distinguishes this Handbook from others is the nature of integration of the disciplines that is the founding premise for the work all chapters in this book speak directly to the integration of STEM rather than discussion of research within the individual content areas The Handbook of Research on STEM Education explores the most pressing areas of STEM within an international context Divided into six sections the authors cover topics including the nature of STEM STEM learning STEM pedagogy curriculum and assessment critical issues in STEM STEM teacher education and STEM policy and reform The Handbook utilizes the lens of equity and access by focusing on STEM literacy early childhood STEM learners with disabilities informal STEM socio scientific issues race related factors gender equity cultural relevancy and parental involvement Additionally discussion of STEM education policy in a variety of countries is included as well as a focus on engaging business industry and teachers in advocacy for STEM education The Handbook s 37 chapters provide a deep and meaningful landscape of the implementation of STEM over the past two decades As such the findings that are presented within provide the reader with clear directions for future research into effective practice and supports for integrated STEM which are grounded in the literature to date

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