ALLIANCE FOR EXCELLENT EDUCATION

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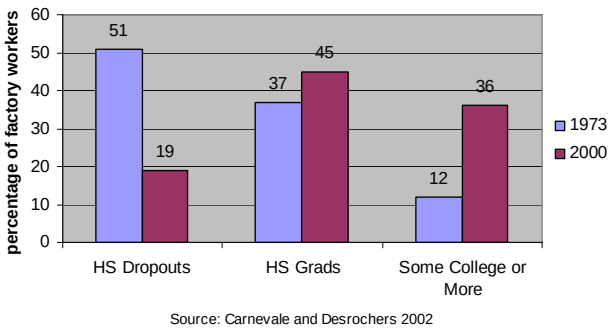
High School Teaching for the Twenty-First Century: Preparing Students for College

To prepare students for postsecondary education, educators and policymakers must perform two tasks at the same time: restructure high schools so they are aligned to the expectations of colleges and revamp instruction so that college readiness is the goal, measure, and substance of good teaching.[1] The research is clear: the key to preparing students for college is rigorous high school course work (Adelman 1999; ACT 2005). Therefore, high schools and teachers must set college-ready expectations for students, teach rigorous content so that students can apply knowledge in new situations, and use teaching methods that engage students in learning to reason, write, and use information in complex ways. The conditions of high school teaching must also change because teachers cannot solve all problems on their own. Teachers need the help of standards, assessments, curricula, pre-service preparation, and professional development aligned to college readiness if they are to succeed in the classroom.

In the twenty-first century, most students need at least some postsecondary education to earn a decent wage. An estimated 85 percent of current jobs and almost 90 percent of the fastest-growing and best-paying jobs now require some postsecondary education (Business-Higher Education Forum 2003; US Department of Labor 2006). Over the past three decades, options have quietly diminished for those who do not go to college (see chart 1). Most manufacturing jobs, long a good option for high school dropouts to earn a living wage, now require postsecondary training and skills (Barth 2003; American Diploma Project 2004). High school students know this. That is why 80 percent plan and expect to go to college (Ingels, et al. 2005; MetLife 2000). And that is why record numbers of students are preparing to go to college by taking advanced courses and college entrance exams; for instance, in 2007, a record-breaking 1.5 million students took the SAT (College Board 2007a).

Chart 1: Education Level of Factory Workers Increasing 1973—2000



Source: Carnevale and Desrochers 2002

[1] This brief focuses on policy-related issues concerning college readiness—meaning the course work and teaching needed to prepare students for most four-year and two-year programs that lead to a bachelor's degree. It is important to recognize that not all students will attend a four-year university and that rigorous career and technical education programs are important elements in reforming high schools. However, this paper focuses on college readiness, not because career preparation is unimportant or secondary, but because an in-depth exploration of one topic was preferable to covering many topics superficially—a mistake often ascribed to high school standards. Additionally, recent studies, though not undisputed, have shown that the skills needed to succeed in college are similar to skills needed for good-paying jobs (ACT 2006b; American Diploma Project 2004). An exploration of college readiness, therefore, may yield valuable data that can inform the work of all high school teachers, not just those who teach college preparatory courses.

Unfortunately, high schools are failing students by not preparing them for college. Nationally, only 70 percent of students graduate from high school on time, and a mere 34 percent graduate ready for college (*Education Week* 2007; Greene and Winters 2005). These rates are even lower for poor and minority students. Overall, only 18 percent of freshmen graduate in four years, go to college, and earn an associate's degree in three years or a bachelor's degree in six (National Center for Public Policy and Higher Education 2004). A third of those who make it to college must take remedial courses, costing the nation over $1.4 billion every year at community colleges alone (NCES 2004; Alliance for Excellent Education 2006a). Routinely, professors report that freshmen arrive unprepared for the rigors of college work (ACT 2007). Given that many high school standards, assessments, and curricula are not aligned to college, the blame for poor student performance does not lie only with teachers. However, the impact a teacher makes on student learning is tremendous, and high school teachers have much to offer in preparing more students for college.

The Disconnect Between High School and College

Policymakers should not assume that the biggest obstacle to preparing students for college is poor-quality teachers. Rather, the biggest problem may be the lack of alignment between the structure of high schools and what colleges expect.

Standards, assessments, and course requirements are not aligned to college.

Sixty-five percent of college professors do not believe high school ***standards*** prepare students for college, perhaps because they believe standards cover too many topics without targeting the essential knowledge and skills required for college readiness (ACT 2007a). High school ***assessments*** administered for state accountability purposes often measure ninth- or tenth-grade level knowledge and skills and rarely ask students to explain their reasoning or to apply knowledge to new situations, giving teachers and students little useful feedback about college readiness (Callan, et al. 2006; Conley 2003). Furthermore, high school ***course requirements*** are poorly aligned to college expectations, so that it is common for students to graduate from high school without taking the right courses to get into college (Wagner 2006; Barth 2003). This disconnect is particularly troubling because most students do not know what courses are required for college admission (Venezia, et al. 2003).

Furthermore, few teachers have formal ways to inform their teaching with college expectations such as up-to-date admission and placement information or access to systematic data on what college professors expect students to know and be able to do (Venezia, et al. 2003; Callan, et al. 2006). Plus, due to the large size of most high schools, a crowded and complex master schedule gives teachers scant time for updating their content knowledge to a college level or for collaboration with colleagues to discuss how students are progressing toward college readiness.

High school teaching is not aligned to college.

A recent report from ACT finds that a large majority of high school students took core math and science courses but did not gain college-ready skills (60 percent and 74 percent, respectively), suggesting that the course title may be right but the content and instruction are not (2007a). Similarly, the Illinois Education Research Council discovered that, course titles being equal, high school students with higher-quality teachers (as measured by a variety of factors) were more likely to be college ready (Presley and Gong 2005). Clearly, college-aligned *teaching*, in conjunction with aligned standards, assessments, and courses, is a major factor in preparing students for college.

High school ***teachers often value and teach different things than college instructors expect***, due in part to poorly aligned standards and curriculum. Community college and university professors expect students to know fewer but more targeted topics and to have mastered fundamental skills. High school teachers, on the other hand, rate the need to teach far more content and skills as important, and they focus students on topics that professors do not deem as critical (ACT 2007a). For example, high school teachers say their biggest goals are to expose students to advanced math topics like calculus, and increasing numbers of students are taking calculus courses (ACT 2007a; College Board 2007a). Yet college instructors prefer that students develop fundamental skills (like basic operations) and learn advanced content later (ACT 2007a).

Likewise, a significant gap exists with ***reading comprehension***, a key skill for college (ACT 2007a). In general, high school teachers rarely teach reading comprehension strategies in the upper grades, and high school teachers do not require reading-heavy assignments or expose students to complex texts as often as students need to prepare for college-level work (ACT 2007a; ACT 2006a; Education Trust 2005). The lack of focus on reading is not always the fault of individual teachers. Few preservice preparation programs require secondary teachers to complete adolescent literacy course work, and the longstanding culture of high schools is that teachers are responsible for teaching content, not for teaching reading (Heller and Greenleaf 2007). The lack of preparation and an impoverished culture of literacy must change if more students are to graduate with the literacy skills needed to succeed in college.

First Things First: Defining College Readiness

Making college readiness the goal of high school teaching begs the question of what college readiness means and how it can be integrated into teaching. A basic definition of college readiness is simply the knowledge and skills students need to succeed in entry-level college course work without remediation (Conley 2007). But what, exactly, constitutes that knowledge and those skills?

Three Ways to Define College Readiness

One of the first definitions used on a broad scale was developed by Jay Greene of the Manhattan Institute in 2003. His definition measured the minimum qualifications a student needed to meet to be considered for the least-selective four-year colleges—earning a regular high school diploma, mastering basic reading skills, and completing the least burdensome course requirements. Even using that low threshold, Greene's latest calculation finds that only 34 percent of US students had graduated college ready, with even lower rates for African American (23 percent) and Hispanic students (20 percent) (Greene and Winters 2005).

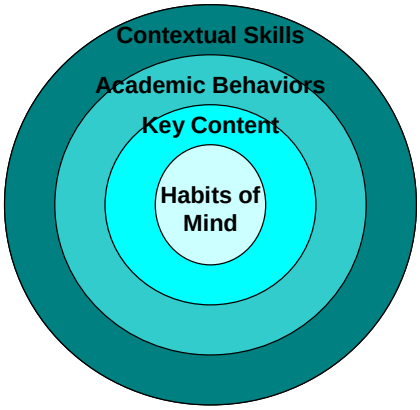
ACT has created a benchmark for college readiness by linking actual college performance to student scores on its high school assessment and by surveying instructors at community colleges and four-year institutions about what they expect college freshmen to know and be able to do (2006a). Combined with its national survey of high school curriculum, analysis of reading skills required for college readiness, and observation of college preparatory high school teaching, ACT has collected comprehensive data on what course work, content, reading skills, and teaching practices prepare students for college (2006a; 2006c; 2007a).

A third definition of college readiness also begins with college expectations and maps backwards. This four-part definition (see chart 2) was developed by David Conley at the University of Oregon.

- First, ***habits of mind*** are what professors consistently identify as the skills needed for learning college-level content, including critical thinking skills such as analysis, interpretation, problem solving, and reasoning (National Research Council 2000; Lundell, et al. 2004).

- Second, ***key content knowledge*** is the essential knowledge of each discipline that prepares students for advanced study, the "big ideas" of each content area. Numerous organizations and initiatives have carefully outlined those big ideas in core subjects (see below), and organizations like ACT and the Education Trust have identified thinking skills and teaching practices that lead students to develop college preparatory knowledge and skills (ACT 2006d, Education Trust 2005).

Chart 2: Facets of College Readiness



Source: Conley 2007

- The third facet, ***academic behaviors***, includes general skills, such as reading comprehension, time management, and note-taking, which students need to engage in college-level work. Metacognition, or self-awareness of how one is thinking and learning, is also a critical academic behavior for high school students to master, because they will no longer be able to count on teachers or on parents to keep track of their progress once they get to college.
- Finally, ***contextual skills*** are practical skills for getting into and succeeding in college ("college knowledge"). These include understanding the admissions process, placement testing, financial aid, and the academic norms and expectations of college life, such as how to communicate with professors and peers in an academic setting (see Lundell, et al. 2004). Contextual skills are not generally the responsibility of classroom teachers, but they are key to a successful college transition, and disadvantaged students are less likely to possess them (Venezia, et al. 2003; Conley 2005). That is why organizations like the College Board have created courses like CollegeEd, an academic and career advisory course for grades seven through twelve that informs students about careers and college majors and what knowledge and skills students need to prepare for them (College Board 2007b).

Teaching Aligned to College Readiness

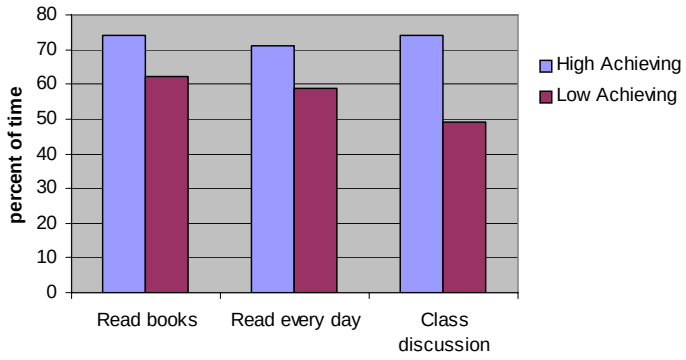
Policymakers and educators have a variety of sources from which to draw to develop a definition of college readiness. Once that task is accomplished, however, the primary responsibility of high school teachers and leaders is to integrate that definition into teaching.

Setting High Expectations

First, high school teachers must ***believe that all students can learn*** to high standards in order to help them master a college preparatory curriculum. Teachers working with students of color especially need high expectations; research shows that high school teachers tend to have lower expectations for students in high-minority schools unless they have strong preparation for teaching there (MetLife 2001; Ladson-Billings 1999). But beliefs are not enough. To maintain high expectations and deliver on them, teachers need teaching skills that include the ability to make content accessible to a wide range of learners (Darling-Hammond and Bransford 2005;Wenglinsky 2002).

Student work assignments must also set high expectations for students. In a 2005 study of higher-achieving and lower-achieving high schools, the Education Trust finds a gap in the rigor of assignments (see chart 3). Teachers in higher-achieving high schools were much more likely to ask students to engage in college-preparatory activities like reading books, reading every day, completing reading-heavy assignments, and participating in classroom discussion (Education Trust 2005). Learning to set high expectations for college and assigning rigorous work should begin in teacher preparation programs in which candidates get their first introduction to aligning curriculum with standards. However, high expectations are also absorbed from fellow teachers and school leaders, in addition to springing from a teacher's own attitudes (Chase 1991).

Chart 3: College Preparatory Assignments



Source: Education Trust 2005

Measuring High Expectations

Organizations such as Teach for America and the New Teacher Project, which help districts recruit top-flight talent into low-performing schools, rigorously screen for candidates that strongly believe in student potential, and they reinforce that core belief during training. The same is true for the National Board for Professional Teaching Standards (NBPTS), which credentials accomplished teachers. To earn certification, teachers must demonstrate that, among many other things, they believe all students can learn and that they are dedicated to making knowledge accessible to all students. A study of the NBPTS standards finds some knowledge and skills associated with greater teacher effectiveness in math and science, including preparation for teaching students with diverse learning needs and preparation for teaching higher-order thinking skills using hands-on methods like laboratory investigations (Wenglinsky 2002). All three models illustrate the importance of setting high expectations, communicating them constantly to students, and providing teachers with skills that engage all students in college preparatory work.

Sources: Kopp 2004, New Teacher Project 2007, NBPTS 2007

Delivering Rigorous College Preparatory Content

The key task for increasing the rigor of course work is for teachers to ***know their content at a college level*** and to ***update that knowledge regularly***. Research shows that secondary math and science teachers with strong content knowledge make a greater impact on student learning; training in how to teach that content knowledge is also beneficial (Walsh and Tracy 2004; Allen 2003; Monk 1994). Research in other disciplines is spotty, but it stands to reason that teachers need the capacity to impart the "big ideas" of each discipline to their students in a way that stretches students toward college readiness (Allen 2003; Presley and Gong 2005).

High school teachers also need to teach students ***thinking skills essential to each content area***. Each academic discipline has its own set of practices that define what good and bad thinking looks like for that

discipline (see Heller and Greenleaf 2007). For example, students in history class should not just memorize facts like the causes of the Civil War; instead, they learn that history is about interpretation of events and how to engage in that interpretation critically and responsibly. Research suggests that students learn more when teachers use teaching methods that require students to apply appropriate disciplinary processes to the subject matter they are learning (e.g., use of scientific inquiry) (Newman, et al. 1996; Lee, et al. 1995). High school students need to learn these ways of thinking in addition to the "big ideas" so they can analyze and synthesize new knowledge once they get to college (ACT 2006d).

Teachers should first develop content knowledge and the capacity to teach disciplinary thinking skills in their teacher preparation program. Ongoing professional development in the content area is also needed. A chemistry teacher, for example, must keep pace with changing views of atomic structure and how chemists practice their trade (Heller and Greenleaf 2007). To highlight the importance of content knowledge in pre-service preparation, the American Association of Colleges of Teacher Education developed profiles of preparation programs that prepare teachers with strong content knowledge in science, technology, engineering, and math (STEM) fields since policymakers have placed so much emphasis on STEM (AACTE 2007).

Numerous studies and organizations have developed ***college-ready content standards*** that can inform high school teachers once they are in the classroom. Each resource has its own merit and application, so teachers and administrators together should weigh them carefully. The American Diploma Project outlined high school math and English standards, reading lists, and typical assignments that are aligned to both college and work expectations (2004). The Standards for Success Project, sponsored by the Association of American Universities, has developed college readiness standards in six core subject areas that outline the knowledge, skills, and habits of mind required for success in research universities (Conley 2003b). Starting with data on student performance in college and mapping backward to what students need to learn, the College Board developed SpringBoard, a program for grades six through twelve. SpringBoard provides curriculum guides, diagnostic and formative assessments, and professional development for secondary teachers to prepare students for college (College Board 2007c). And in fall 2007, ACT will release QualityCore, a program designed to improve the rigor of fifteen high school courses. For each course, based on course work that has prepared students for college, the program will offer model instructional units, course blueprints, guidelines for creating benchmark assessments, and end-of-course exams that are tied to college-readiness standards (2007b).

Strengthening the Preparation of Future Teachers

The Teachers for a New Era initiative aims to strengthen K–12 teaching by developing state-of-the-art programs at schools of education. The eleven participating institutions are focused on three principles of redesign. First, a teacher education program should be guided by a respect for evidence, including attention to pupil learning gains. Second, to strengthen the content knowledge of future teachers, arts and sciences faculty must be fully engaged in the education of prospective teachers, especially in the areas of subject matter understanding. Finally, teacher education should be understood as an academically taught clinical practice profession, requiring close cooperation between colleges of education and actual schools, master teachers as faculty in the college, and residencies for beginning teachers during a two-year period of induction. Strengthening content knowledge and modeling good practice in the classroom are key to increasing the rigor of high school teaching (Darling-Hammond 2006).

For more information, visit http://www.teachersforanewera.org/.

Teaching Reading and Writing Skills for College

Most students enter high school struggling to learn the "big ideas," or content of each discipline, because they struggle to understand their textbooks or to communicate what they have learned (Biancarosa and Snow 2006; Snow and Biancarosa 2003). Seventy percent of eighth graders and 65 percent of twelfth graders do not read at proficient levels (NCES 2007, 2006). Moreover, almost all college freshmen discover, regardless of their performance in high school, that college courses demand a new level of reading and writing skill in all subject areas. High school teachers must prepare students to read and write for each major discipline, not just for English class, so that students are ready to take on college assignments. A chemistry teacher, for instance, needs both preservice training and professional development in the classroom to help students learn to read a text and to apply the material in a lab report as a chemist would—by engaging in precise analysis with exact answers (Heller and Greenleaf 2007).

A host of major reports have identified classroom and school-level strategies for improving adolescent literacy (Graham and Perin 2007; Center on Instruction 2007; IRA 2007; Biancarosa and Snow 2006; NASSP 2005). Numerous reports have also outlined recommendations on the topic for federal, state, and local policymakers (Alliance for Excellent Education 2006b; NSBA 2006; NGA 2005; NASBE 2005). A handful of states, notably Florida and Alabama, have launched statewide initiatives to train middle and high school teachers in all subject areas to support the literacy development of students. In addition, a number of teacher preparation programs have begun to incorporate literacy instruction into their content-area curricula and course work requirements for middle and high school teacher candidates (see below).

Preparing Content Teachers to Teach Reading and Writing

Teachers College at Columbia University, in collaboration with the National Academy for Excellent Teaching, has designed two courses for middle and high school teacher candidates in science and social studies. The courses combine existing student-teaching seminars in science and social studies with a focus on adolescent literacy that is specific to the content area. The adolescent literacy course is now required for all science education students and, beginning in fall 2007, will be required for all social studies education students. The courses are designed so that preservice teachers learn the literacy techniques in the fall and implement them when they student teach in the spring. To solidify what is learned in the fall, student teachers are supported by a mentor teacher in their subject area and a content-area supervisor from Teachers College. "When you fragment literacy and subject matter, it gets very confusing for the learner," said Dolores Perin, associate professor of psychology and education and coordinator of the Reading Specialist Program. "Combining the two offers a twofold benefit. One is the transfer of learning—I would expect that the literacy skills would transfer to the subject matter. The second is that the students see an authentic reason for literacy."

For more information, visit http://www.tc.columbia.edu/news/article.htm?id=6274.

Motivating and Engaging Students for College

Motivation is the key to learning in the upper grades, even more than in the earlier grades (National Research Council 2004). Motivation may be particularly important for disadvantaged students for whom college has not been presented as a real option (Irvine 1990). However, a focus on motivation should not be separated from teaching students rigorous content and higher-order thinking skills. Instead, these skills should be taught and modeled through the teaching of rigorous content (Center for Research on Learning 2001).

Decades of research in ***literacy and math*** reveal some motivation strategies that high school teachers can learn in their preservice preparation and hone once in the classroom (National Research Council 2004). In terms of literacy, researchers have found that giving older students some choice in reading materials is a helpful motivator, as is allowing adolescents to draw on their interests and abilities outside of school to complete reading and writing tasks (Guthrie and Humenick 2004; Moje 2006). In general, students are motivated when given ***tasks that are challenging but achievable*** and when given opportunities to ***apply knowledge*** in real-world situations (National Research Council 2000). Students, especially struggling students, need "scaffolded" support from teachers, such as having extensive opportunities to practice and revise their work in response to feedback, so that they learn how to reach high standards by applying purposeful effort over time (National Research Council 2000).

Teaching Conditions Aligned to College Readiness

In addition to knowledge and skills, teachers need support and conditions that set them up to succeed in preparing students for college (Center for Teaching Quality 2007). Yet if conditions like out-of-field teaching or the lack of college-ready assessments persist, teachers will find their ability to impact college readiness stymied.

Making Appropriate Teaching Assignments

It is fair to ask that students be taught by teachers who demonstrate subject matter competency and knowledge of how to teach their content (Darling-Hammond 2006). However, teaching a subject for which one is not trained (otherwise known as out-of-field teaching) is a significant problem in the upper grades, particularly in math (Jerald 2002). On top of that challenge, high school teachers are most likely not to be "highly qualified" as defined by NCLB[2] (Stullich, et al. 2006). Both problems compound in low-performing high schools, causing administrators difficulty in staffing classrooms with well-trained teachers. Only a comprehensive approach to recruitment and retention will allow administrators to make appropriate assignments so that students can learn college preparatory material from teachers trained in their discipline.

On the supply side, high schools need a large pool of candidates to select from, including getting an early jump in the hiring process to have the best shot at recruiting trained teachers. A 2003 study by the New Teacher Project finds that the lengthy, bureaucratic hiring process in most districts discourages higher-quality candidates, and they exit the process faster than lower-quality candidates (Levin and Quinn 2003). High schools also need smart incentives to attract candidates with the right content knowledge for the right classroom, and teaching struggling students must change from being a hazing period for rookies into a rewarding challenge for veteran stars. Routinely, new teachers are given the most difficult assignments, in the most struggling schools. If they are to use their knowledge and skills to prepare students for college, then they will need a better transition into teaching, like induction, than the current sink or swim model.

[2] According to NCLB, a secondary teacher is deemed "highly qualified" after meeting three requirements: 1) obtaining a bachelor's degree, 2) earning certification or licensure to teach in a state, and 3) demonstrating subject matter competency.

Finding the Right Incentives to Improve Teaching Assignments

Clark County, NV, the fastest growing school district in the country, includes seven hundred thousand students and eighteen thousand teachers in 327 schools. On average, the district opens one new school per month, and 75 percent of teachers are recruited from outside the state. To cope, Clark County has generated several recruitment and retention strategies so that administrators can make appropriate teaching assignments. Low-performing schools are given a two-month head start in hiring and receiving transfers. In partnership with the teachers' union, the district treats new highly qualified teachers as third-year teachers to attract them with higher salaries. Teachers who attend the district's Urban Teacher Academy are moved up the salary schedule, trained for five weeks before school starts, and offered the chance to work with master teachers and full-time mentors in professional learning communities. Clark County has also experimented with principals' salaries, awarding bonus salary points for challenges a principal may face in struggling schools (e.g., poverty-level schools or low-achievement schools). Thus, working in a challenging school is now at the top of the pay ladder, not at the bottom.

Source: Presentation by Dr. George Ann Rice, retired associate superintenden, Human Resources Division, Clark County School District, at the 7th Annual NCTAF Symposium, July 10, 2007.

Focusing Induction and Professional Development on College Readiness

If rigorous college preparatory teaching is the goal for high school teachers, then brand-new teachers will need help in delivering content in ways that engage students, especially since new teachers are more likely to work with poor and minority students (Peske and Haycock 2006). New teachers need ***comprehensive induction*** support in their early years to keep them in the profession and to improve their skills (Alliance for Excellent Education 2004). Unfortunately, high school teachers are less likely than teachers in lower grades to receive induction (Ingersoll 2007). Since many new teachers wrestle with what content to teach and how to teach it (Kauffman, et al. 2002), mentoring from an expert veteran in the novice's subject area is crucial to making induction work in a college-readiness setting (Alliance for Excellent Education 2004). Moreover, the focus of high school induction should be on curriculum and should include regularly scheduled common planning time with colleagues centering on students' academic growth toward college; otherwise, the induction may offer emotional support but is unlikely to improve teaching skills (Education Trust 2005).

For all the criticism of one-day disparate workshops that pass for ***professional development***, current practice remains largely incoherent and sporadic (NCES 2001). But professional development is more effective and better promotes college readiness when it is delivered at the school building and driven by clear goals, useful data, and teacher input.

The ***clear goal*** is to focus teaching on college readiness. Setting goals is usually achieved by strong school leaders who set the tone and culture of a school and who ensure that professional development keeps its eye on the prize: improved student learning and college preparation (NASSP 2004). Research shows that school leaders must keep professional development focused on student learning so that meeting time does not degenerate to procedural matters like the bell schedule or complaining about pep rallies (Supovitz and Christman 2003). ***Helpful data*** comes not from a single test at the end of the year—however important that assessment may be for accountability purposes—but from ongoing benchmark assessments, aligned to college readiness standards and administered at regular intervals. The best leaders carve out time for teachers to collaborate, and they gather them regularly to ask, "What are we doing well, and how can we improve so that students learn more?" (NASSP 2004; Education Trust 2005). From that point on, ***teacher input*** is needed because teachers themselves have much of the expertise they need, and they can strategize

about ways to improve instruction (Education Trust 2005). Teachers may discover the need to update their content knowledge in certain areas or to home in on a certain teaching strategy. Regardless, that decision is made with strong teacher input, driven by classroom data on college readiness, rather than made by administrators isolated in the central office.

In this way, finding time in the master schedule and leveraging college readiness data become the means to target and strengthen professional development at the high school level, rather than coming up with money to send teachers to workshops.

Professional Development Driven by Data

In 1998, barely 70 percent of students at Norview High School in Norfolk, VA passed the state reading exam, and only 30 percent passed algebra or geometry. In every subject, African American students performed worse than their white peers. In response, Norview teachers mobilized to improve achievement. Teachers grouped into teams by subject area, adopted shared curriculum guides and common assessments, and met regularly as teams around assessment data in order to review student progress. To evaluate their effectiveness as teachers, teams focused on three central questions: "What am I teaching well?"; "What am I not teaching well?"; and even "Why do your students perform better than mine?" Struggling teachers then observed successful teachers in the classroom. Six years later, the results were clear: Norview raised achievement and narrowed gaps. In 2004, 93 percent of students passed the reading exam, 94 percent passed the algebra exam, and just under 90 percent passed in geometry. Remarkably, in reading and algebra, Norview no longer had a black-white achievement gap. Three years later, Norview continues to post high achievement, to narrow gaps, and to outpace the average performance of high schools across the state. In 2006, all subgroups of students made AYP, 90 percent of students passed the reading exam, and 87 percent of students passed the math exam.

For more information, go to www.all4ed.org/publications/ReadingNext/NorfolkReadingCaseStudy.pdf.

Leveraging Assessments and Data to Improve College Readiness

High school teachers need a range of assessments that measure and inform their students' preparation for college, not just one test score at the end of the year. But teachers must be willing to use those assessments; otherwise, data will remain in a report instead of informing classroom practice. In comparing high-achieving and low-achieving high schools, the Education Trust finds that teachers in the former embraced assessments and even created them if they did not exist, whereas teachers in the latter merely tolerated them (2005).

In terms of ***content knowledge***, high schools have long used Advanced Placement (AP) and International Baccalaureate (IB) exams to focus high school teaching on college preparation; over time, the College Board has created AP exams for thirty-five courses in twenty subject areas (College Board 2007d). A growing number of states are beginning to embed college-ready assessments into their statewide assessment systems. New York is the only state currently using end-of-course exams for college admission and placement decisions, but eighteen other states are pursuing this strategy (Achieve 2007). Another approach, taken by California and Texas for freshman course placement, is to create comprehensive high school assessments that are taken by students in eleventh grade; five additional states plan to create such assessments in the future (Achieve 2007). And six states (Colorado, Idaho, Illinois, Kentucky, Maine, and Michigan) have incorporated the ACT or SAT into their state assessments systems to inform high schools about how well students are prepared for college (Achieve 2007).

Thinking skills, or habits of mind, can also be measured. Oregon's Proficiency-Based Admission Standards System collects a variety of evidence from high school students to determine their readiness for college (Oregon University System 2007). Similar measurements have been developed by Washington state and New York City (Conley 2007). A growing number of schools, districts, and some states have developed portfolio assessments that require students to demonstrate mastery of skills they will need to apply in college and the workplace. Such portfolios include research papers, science investigations, mathematical models, or senior projects that call on students to analyze and present information in ways that are expected in college. Rhode Island and Pennsylvania now use such assessments as part of their high school graduation requirements (Darling-Hammond, et al. 2005).

Assessing ***academic behavior*** like motivation or study skills may be more difficult and subjective. As Conley has pointed out, however, if certain behaviors like "hard work" are clearly defined and measured through survey instruments, then some useful information can be gleaned (Conley 2007). The Center for Evaluation and Education Policy conducted extensive surveys of high school students and teachers and compared that data to survey data of first-year college students and professors. It measured, for example, the amount of time high school students spend preparing for class compared to college freshmen or how challenged both sets of students feel by course assignments and its correlation to grades earned (Center for Evaluation and Education Policy 2005). Such academic surveys could yield valuable comparisons between teacher efforts, student responses, and college-level outcomes, revealing what is influencing and improving academic behavior.

Recipe for Success: Improve Instruction and Improve Conditions

Setting the high goal of college readiness will require nothing less than an intensive, sustained effort to reform high school teaching. Many positive reforms in some states and districts have led to raising high school standards, aligning them with college expectations, and increasing course requirements for graduation; such reforms must happen everywhere. But what also remains is to systematically increase the rigor of *instruction* so that high school *teaching* is aligned with college expectations.

Policymakers must recognize the critical role teachers play in preparing students for college and must ensure that teachers get the assistance and resources they need. Teachers, after all, are the ones who make the greatest impact on students' learning for college by setting high expectations, teaching rigorous content and college preparatory skills, and motivating more students to set their sights on college. But they also deserve, and must receive, the supports and conditions necessary for success—their own and that of their students headed to college.

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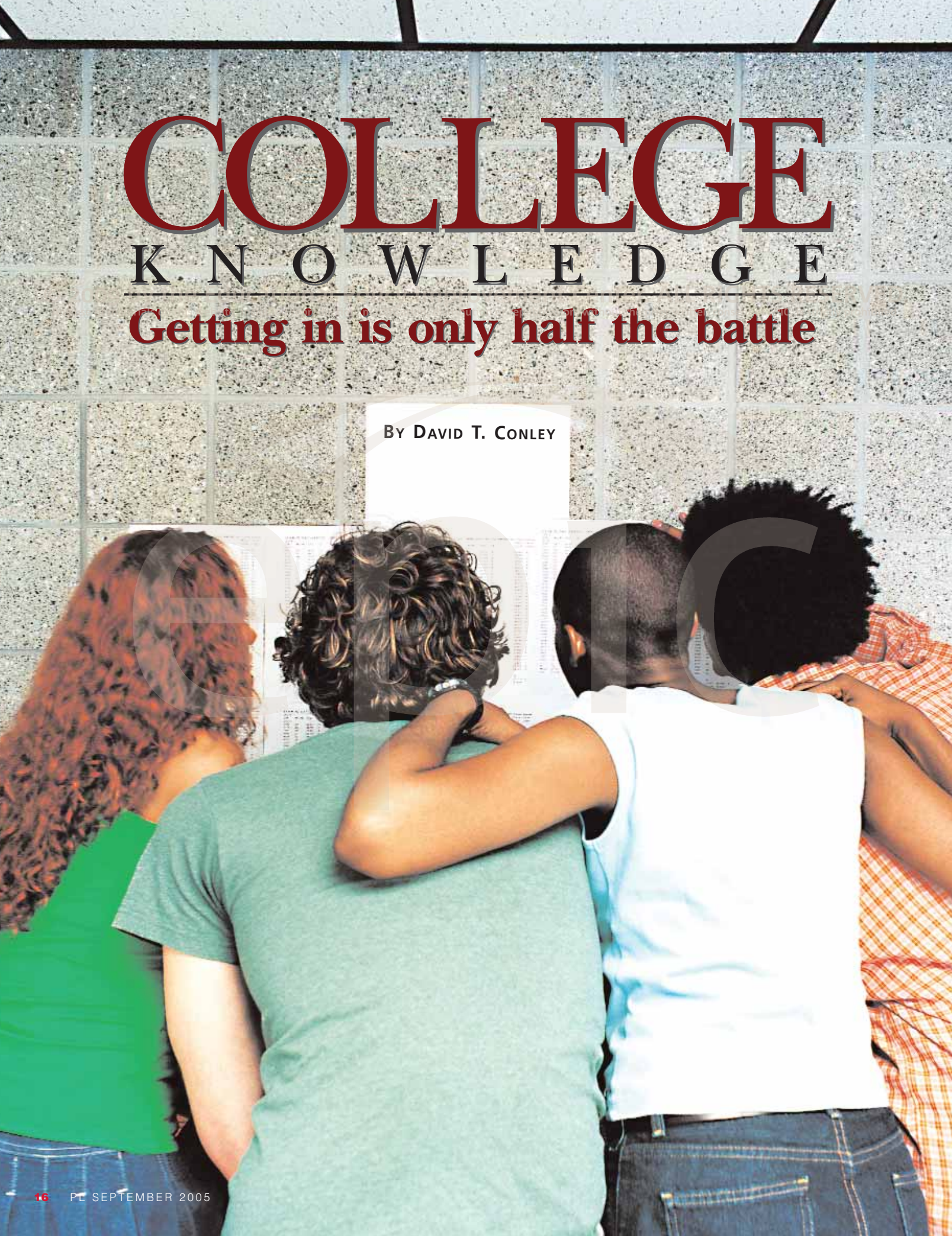
COLLEGE KNOWLEDGE

Getting in is only half the battle

By David T. Conley



PREVIEW

To help students meet the intellectual demands of college, secondary schools must create a sequenced curriculum that is aligned with college course work.

Such a curriculum can be developed jointly by postsecondary and secondary school faculty members.

A series of questions can help secondary schools ensure appropriate and challenging course sequencing.

It's time for high school and college educators alike to come to grips with the fact that high school and college are not nearly as well aligned as they need to be. As a result, many high school students who have set attending college as a goal never get there, and many who do make it struggle to succeed once they arrive. Merely taking college-prep courses in high school and achieving the GPA required for admission are not sufficient to ensure student success in college. The current system functions to get high school students into college, but there is much less concern on either side of the divide about whether what they are learning is what they need for postsecondary success. Further, high school teachers receive little guidance regarding the knowledge and skills that students should be developing to be ready for entry-level college courses.

Most parents and high school students believe, or at least hope, that the high school curriculum is carefully designed to ready students for success in postsecondary education. Parents would likely be shocked to learn that only a relatively small proportion of students who graduate from high school each year are truly college ready. Many students who are admitted to college require remediation or drop out during their first year; others struggle mightily in entry-level courses until they figure out what college really expects of them. Many transfer to another institution because they are not prepared for the challenge level they encounter. Almost all see their high school GPAs drop precipitously during their freshman year in college (Adelman, 1999).

Perhaps one-third of U.S. high school students end up meeting the not particularly challenging college readiness levels of four years of English; three years of math; two years each of natural science, social science, and foreign language; and a "basic" level of performance on the National Assessment of Educational Progress (NAEP). Far fewer meet the more rigorous standard of four years of English, math, science, social science, and a foreign language and a "proficient" level on NAEP (Greene & Forster, 2003).

Given the fact that approximately 80%–90% of entering high school freshmen profess the desire to go on to college (Kirst & Venezia, 2004), how must high schools change to enable more students to be college ready? What are some of the principles and practices that must be followed to ensure that students are not only admitted to college but are also prepared to succeed once they arrive?

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Factors That Limit Success

Although many teachers do strive to challenge students to engage at rigourous levels, the overall structure of the high school curriculum tends to emphasize completing required courses rather than mastering necessary skills and developing intellectually. As a result, students often enter college expecting all assignments and tests to have clear right or wrong answers. For example, when students are required to interpret material in high school, they may assume that any kind of interpretation is acceptable. When they reach college, they are surprised and even offended when they are told that they must apply certain disciplinary rules of thinking and analysis for their argument to be considered worthwhile or correct (Conley, 2003). In other words, they may have successfully completed the course in high school without developing the habits of mind necessary to engage fully in the study and understanding of that discipline in college.

Using an agreed-upon set of standards, cross-level teams can review materials and examples of actual student work taken from high school and college classes to determine how the expectations for students are complementary and how they are not.

In today's high schools, course sequences may do little more than teach new and often unconnected material to each succeeding grade level without consciously and deliberately increasing cognitive challenges or introducing new and higher expectations for students. Essential attributes of college success—such as critical and analytic thinking, inquiry, skilled writing, and high-quality work—are not necessarily nurtured with progressively more-challenging assignments that are scored consistently against uniform high standards. The vast majority of high schools provide learning in discrete units with little connection during the day or across the years.

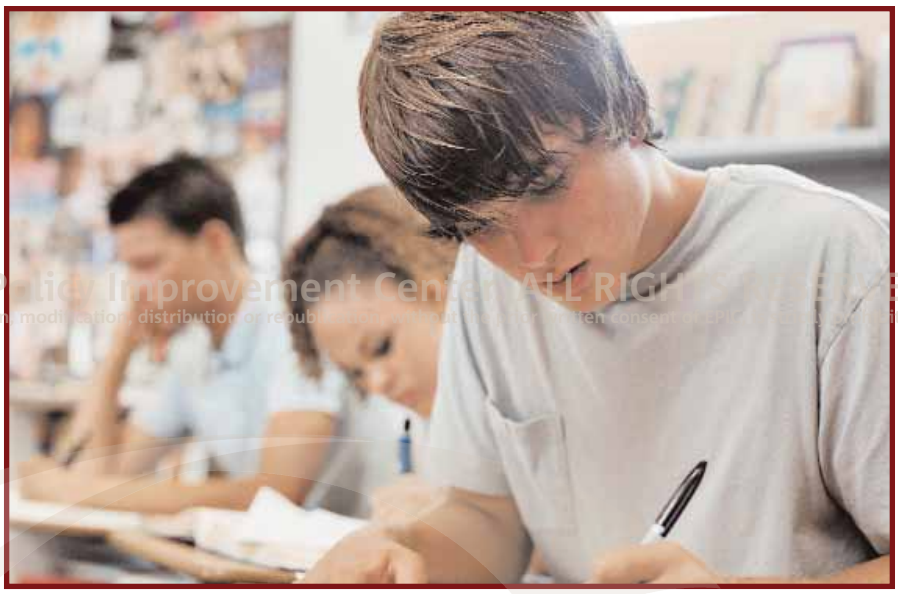
English courses. High school English, for example, tends to be four unrelated, consecutive courses in which students read a variety of pieces of literature that have no obvious connection among them. After reading this literature, students sometimes are required to write and sometimes are not. As a result, writing skills do not develop systematically during high school. In fact, the 1998 NAEP found that the percentage of 12th-grade students who reached the proficient level in writing, about 25%, was identical to the proportion of 8th-grade students who had reached this level (Donahue, Voelkl, Campbell, & Mazzeo, 1999).

Mathematics courses. At first glance, mathematics courses may seem to be better sequenced than English courses. In practice, such essential skills as mathematical reasoning and problem solving are not always developed consistently over the four years of high school. Instead, each course largely follows the same pattern of introducing new material, algorithms, or methods; having students practice them in homework; and then reviewing the homework in class. Examinations may be limited to ascertaining whether material has been understood and whether students can apply what they have just learned to a range of problems that were previously introduced and practiced (Third International Mathematics and Science Study [TIMMS], 1995). Although the material may be quite different, what senior math students are expected to do and how they are expected to think is little different than what was expected of them as freshmen.

TIMMS revealed that when U.S. math teaching is compared to mathematics instruction in other nations that excel in international comparisons, students in U.S. classes do not engage actively in problem solving or develop a deep understanding of mathematical concepts. U.S. mathematics courses also cover far more topics and spend less time on each topic (TIMMS, 1995). As a result, few students come away from high school with the basic realization that mathematics is a symbolic language that is used to understand the natural world. Students may emerge from four years of high school mathematics with the ability to factor equations and graph quadratics, but they may have little insight into the underlying processes and phenomena that these procedures can represent, why this knowledge is important to know, and how this knowledge might be put to use.

Science courses. The college-prep science curriculumconsists almost exclusively of biology, chemistry, and physics, often with a choice between regular and AP versions. The critique of these courses is that, once again, they tend to emphasize terms and vocabulary over the understanding of concepts (Rutherford & Ahlgren, 1990). Although basic nomenclature is certainly important to mastering the sciences, most of the terminology is reintroduced and re-explained in entry-level college courses. In addition, general education science requirements in college may be fulfilled by courses in a wide range of scientific fields beyond biology, chemistry, and physics. For example, general principles of scientific inquiry and scientific thinking are as important as or more important than specific content knowledge in these three subject areas because they prepare students for entry-level college science courses in geology, astronomy, and the environmental sciences.

In sum, the purpose of the high school science sequence is unclear. Is it to prepare students for additional study in biology, chemistry, or physics? Is it to introduce these disciplines as stepping-stones to other scientific disciplines? Is it simply to cover terminology and topics? How do the three science subjects most commonly taught in high school relate to one another or to parallel concepts taught in the mathematics curriculum? And where do students learn to think like scientists? Where do they develop the key understandings of the scientific method as a mode of inquiry, not as an algorithm to be followed in a mechanical, step-by-step fashion?



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High school courses must be sequenced to develop intellectual maturity, improve critical thinking skills, and increase rigor as students approach college entry.

Strategies for Aligned Instruction

To design a high school instructional program that systematically prepares students for success in postsecondary education requires clear agreement on the high school exit and college entrance standards that students are expected to meet. Once such agreement is achieved, the high school faculty can design an intellectually coherent, developmentally sequential program of study.

One strategy is to design or improve culminating activities during the senior year. Although many high schools have recently adopted the culminating project or senior-project model, many of these projects have unfortunately devolved into show-and-tell presentations that are not grounded in challenging academic standards and judged using rigorous, consistent scoring criteria.

One way for high schools to develop culminating activities that require student mastery of challenging content and higher order thinking skills is to develop a joint working group with local community college and university faculty members. Although this can be difficult to do for a variety of reasons, an increasing number of schools are connecting successfully across the high school–college boundary. Community colleges are often the most willing partners, but postsecondary institutions of all types have increased their connections to high schools and their interest in improving alignment.

Such groups can review academic content knowledge standards for high school exit and college entrance. For example, the American Diploma Project's *Ready or Not* report (available at www.achieve.org) outlines English and math standards that students should meet to graduate from high school. The Association of American Universities' *Understanding University Success* study (available at cepr.uoregon.edu) documents the knowledge and skills expected in entry-level university courses in six academic subject areas. Together, these two studies enumerate what students should have mastered by the end of high school and what will be expected of them in entry-level college courses. These highly complementary documents create a clear vision of the ultimate goal of a high school education that leads to postsecondary success.

Using an agreed-upon set of standards as a common point of departure, cross-level teams can then review course outlines, assignments, grading criteria, and examples of actual student work taken from high school and college classes to determine how the expectations for students are complementary and how they are not. After developing sequenced grading criteria that connect expectations across high school and college, members of a joint working group comprising high school and college faculty members can rate one another's papers to determine that the level of challenge is properly sequenced between high school and college. Although this type of joint calibration activity remains the exception rather than the norm, when it does occur, faculty members in both institutions then know what their colleagues are thinking and what they expect of their students. These commonly held definitions can then serve as cognitive frameworks for planning courses at each institution, which help lead to a more seamless transition from high school to college. Such articulated courses connect the exit level of high school with the entry level of college so students are able to continue to build more complex skills continuously throughout high school and into college.

The Culminating PROJECT

Many schools and even some states have instituted culminating projects that generally take place during the senior year and are also known as senior projects. Here are some resources to help schools interested in instituting such projects:

- The Senior Project Center bills itself as "the only comprehensive, nationally recognized" site for information on senior projects and provides "focused Senior Project research, technical assistance, and resources to high schools across the nation." Its detailed Web site can be found at www.seniorproject.net
- The State of Washington will require all students to prepare a culminating project beginning in 2008. A description of guidelines along with examples of culminating projects can be found at www.sbe.wa.gov/culminating%20projects/guidelines.htm
- The Mercer Island (WA) School District has prepared a detailed handbook outlining the procedures and components of a culminating project that can be downloaded from www.misd.k12.wa.us/schools/hs/sip/culm_proj_handbook.pdf

Improving Course Sequencing

After a basic agreement on exit and entrance expectations is in place, the high school curriculum can be better sequenced over four years. To create improved course sequencing, a series of important questions must be asked about each course:

- How does this course help students acquire the relevant knowledge and skills that are necessary to meet the exit standards?
- How does this course help develop the intellectual maturity of students?
- How does this course connect with the courses that came before and will come after it? How does it identify and reinforce key concepts and knowledge that were previously learned? How does it anticipate skills that have yet to be mastered?
- Is the challenge level of the material appropriate for developing the intellectual maturity of students at this age level?
- Is the pace of the work and the expected student production on a trajectory to have students ready for what will be expected of them in college?
- Does the course help students develop at least one of the foundational skills—such as writing, reasoning, problem solving, or analytic thinking—that are necessary for college success?

Aligning the High School English Curriculum

Let's look at an example of how a high school English program could be redesigned to prepare students for entry-level college courses. To accomplish this goal, a high school English department will need to agree on the types of texts taught at each grade level, the purpose of teaching each type of text, the analysis that students will do on these foundational texts, how the specific texts will connect with one another, how students will make links among them, what genres the texts represent, and what themes and archetypes the texts illustrate and develop.

In addition, the school's faculty members as a whole will have to come to agreement on expectations and standards for student writing, starting with examples of the type of work students are expected to produce by the time they graduate. These exemplary papers will be created for all the major writing genres that students will encounter in college and be accompanied by a common scoring guide with adaptations for specific genres. The scoring guide will span "freshman-to-freshman" performance levels from high school to college. Teachers will agree to use the appropriate version of the scoring guide as the baseline instrument for evaluating all student writing. Teachers will also agree on the number of pages of writing they will assign in each course and the quality of feedback on the writing they will provide. Students and parents should know the overall number of pages students will be expected to write during their four years in high school.

Schools should also adopt formal guidelines for proofreading and editing along with expectations for correct grammar and spelling. All teachers will agree to apply these guidelines to all student writing. In essence, the school will produce an explicit set of writing standards that results in all students having the same general expectations applied to their writing. These standards should be designed so students are expected to write in a progressively more complex and technically accurate fashion each year. This developmental progression simply serves to emphasize that expectations for writing proficiency are high in college and that such abilities take time to develop.

In a coherent program, research projects become a more central part of the curriculum in English and in other subject areas. Here again, a developmental sequence will lead students from relatively simple, straightforward research projects to more complex ones that allow them to develop the skills needed for college success. Although the resulting research papers need not become ever longer, they should become progressively more complex. According to data

collected by the National Survey of Student Engagement (2004), college research papers are most frequently in the five-page range. Providing students with extensive experience in writing many 5-page papers over four years is better than having them write one 20-page paper during their senior year.

The culmination of this program of study in English is a senior-level, seminar-type course specifically designed to emulate the demands of college classrooms. This concept is a radical departure from the current high school structure and, as a result, would be among the more difficult practices to implement. However, given the current critiques of the senior year and the need to try something different to keep students more engaged during their final year of high school, it may be time to consider this type of fundamental change.

The senior seminar in English might be team taught with a writer, a poet, or a faculty member from a local postsecondary institution. Its content would emphasize analytic thinking, student writing critiques, and the free exchange of ideas among students and instructors. The pace of reading and writing assignments would be consistent with what students would encounter in a typical college course, and students would be expected to write and rewrite pieces regularly and present them for discussion and debate. Papers would be three to five pages in length.

The senior seminar would yield information about a student's skill level and intellectual development and establish the work habits necessary for college success. The performance of students in this course during the first semester of their senior year could help students and their families assess the type of postsecondary institution that is the best fit for each student. For these reasons, the final course evaluation should contain a narrative component in addition to any letter grade assigned that would help students understand their strengths relative to college readiness in English and indicate areas where they need to add skills or change behaviors.

Ensuring Postsecondary Success

High schools that are designed to prepare large numbers of students for college success look dramatically different from those that prepare only a small proportion of their students for college success. The most important, and perhaps the most often overlooked, difference between these two types of schools is that the high-performing high school almost invariably has a more intellectually coherent program of study based on a curriculum that grows progressively more challenging from the freshman to the senior year. At high-performing schools, faculty members agree, either implicitly or explicitly, on the standards and expectations for students and on what constitutes a college-ready student.

A high school program that prepares students for college success requires intentionality and a commonality of purpose for students and staff members. The program must be geared toward a clear goal: to create a level of intellectual and skill development that connects seamlessly with what will be expected of students in college. Few high schools have attempted to create such an integrated, coherent, intellectually definable, and defensible program that is based on how a successful student would think, act, and learn after completing the school's program of instruction.

In such a school, it is virtually impossible for students to make bad decisions about which courses to take because all courses have been designed and articulated in a framework of common goals and expectations. When a school has such a carefully designed and connected instructional program, students can plan their course of study with high confidence that it will prepare them for college. Students may find different paths through the program, but they will all be headed in the same overall direction—toward intellectual growth that is consistent with readiness for and success in postsecondary education. In a time when the notion of reinventing the high school is taking hold across the country, let us bear in mind what most students say they want from high school and create an education that helps them achieve that goal. PL

Editor's note: *This article is adapted from* College Knowledge: What It Really Takes for Students to Succeed and What We Can Do to Get Them Ready *(Jossey-Bass, 2005).*

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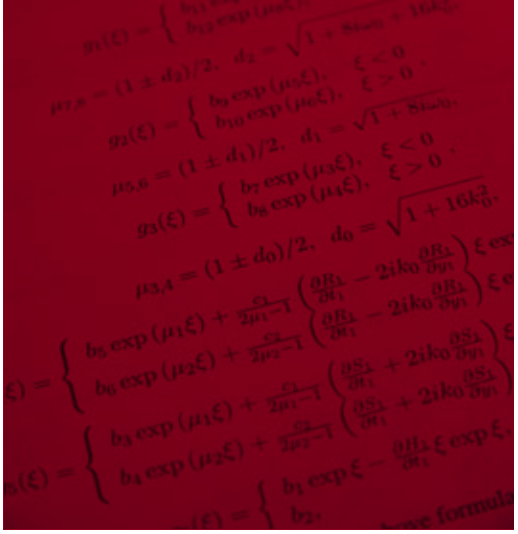
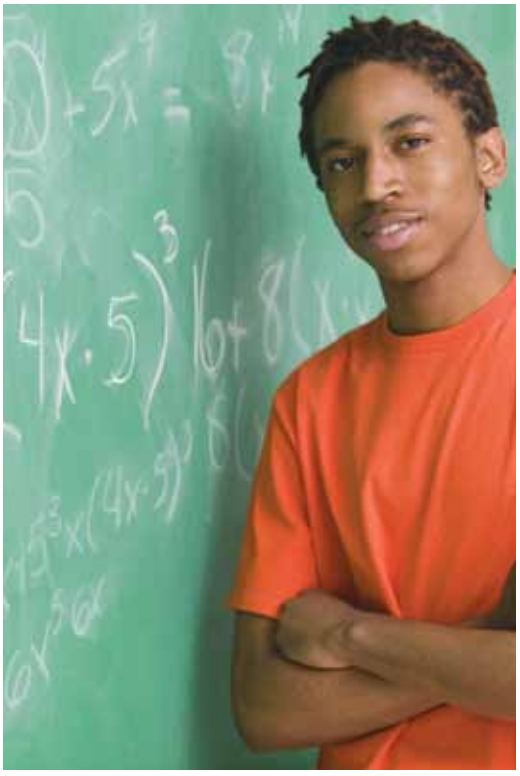
REALIZING THE POTENTIAL:

How Governors Can Lead Effective Implementation of the Common Core State Standards





National Governors Association

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Realizing the Potential: How Governors Can Lead Effective Implementation of the Common Core State Standards

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EXECUTIVE SUMMARY

In recent years, governors, chief state school officers, business leaders, and college faculty have grown increasingly concerned that American students are not adequately prepared either for college or for the workforce. Governors and chief state school officers understood that the changing economy and persistent achievement gaps required a dramatic shift in academic expectations. Further, they realized their states were no longer well served by a system in which each state had its own standards for what students should know and be able to do.

In 2008, to better prepare all students for college and the workforce, governors and chief state school officers embarked on an historic, state-led effort to create a common core of academic standards in English language arts and mathematics for grades kindergarten through 12 (K-12). They insisted that the standards be based on research and evidence, be internationally benchmarked, and be aligned with college and workforce expectations. The National Governors Association Center for Best Practices (NGA Center) and the Council of Chief State School Officers (CCSSO) led the effort and, in June 2010, the NGA Center and CCSSO released the newly developed Common Core State Standards (CCSS) in arts and mathematics for K-12.

As of September 2011, 44 states, the District of Columbia (D.C.), the U.S. Virgin Islands, and the Northern Mariana Islands,[1] serving more than 80 percent of the nation's K-12 student population, had adopted the new standards in both English language arts and mathematics. The development and widespread adoption by states of the CCSS are an historic milestone in American education. Effectively implementing the CCSS in schools and K-12 classrooms has the potential to transform education in the United States by narrowing achievement gaps and ensuring that every student graduates from high school ready for college and work. Implementing the CCSS will be challenging because it will require significant changes in instruction, assessment, educator preparation and development, curriculum and materials, and accountability measures. Much of the work pertaining to implementation of the CCSS will be done in schools and classrooms by teachers and principals and their districts.

Nevertheless, governors and other state policymakers can play a critical leadership role in supporting implementation of the CCSS. Governors' authority over education and the tools with which they can take action vary considerably from state to state, yet all governors should consider taking the following actions to support implementing the CCSS:

- Communicate a vision for reform;
- Identify performance goals and measure progress;
- Engage key leaders from education, business, and philanthropy;
- Build educator capacity;
- Lead transitions in state assessments and accountability policy;
- Support local development and acquisition of new curricula and materials; and
- Maximize resources and share costs.

Making the Case for the Common Core State Standards

The United States economy has undergone a dramatic shift in recent decades. The shift to a knowledge-based economy, coupled with rapid globalization has resulted in a greater demand for a more educated, skilled workforce. In the coming decade, the share of U.S. jobs requiring some level of postsecondary education is expected to grow to 63 percent.[2] By 2018, it is expected that the United States will need 22 million new college degrees and at least 4.7 million new workers with postsecondary certificates but will produce 3 million fewer degrees than needed.[3] Unfortunately, there is evidence to suggest that significant portions of the student population in the U.S. are insufficiently prepared for postsecondary education, at a great cost to states.[4]

Students' performance on the National Assessment of Educational Progress (NAEP), the only rigorous and consistent measure of student achievement nationwide, is an indication of the challenges that states face in trying to prepare students for postsecondary education. For example, 2009 NAEP data indicate that just 38 percent of U.S. 12th graders performed at or above proficiency in reading and only 26 percent performed at or above proficient in math.[5]

Data from international academic assessments further indicate that students in the United States are falling behind their peers in other developed nations. On the Programme for International Student Assessment (PISA), 15-year-olds in the United States ranked 17th in reading and 31st in mathematics. The United States' highest achieving students are falling behind the highest achievers in other developed countries.[6]

Additional data reveal U.S. students' lack of preparation for college coursework. ACT establishes college readiness benchmarks by examining performance of students in college and identifying the minimum score needed to indicate a 75 percent chance of obtaining a C or higher in the corresponding first-year, credit-bearing college course. In 2011, just 25 percent of high school graduates nationwide who took the ACT standardized test scored at a level that indicates readiness for entry-level, credit-bearing college coursework without remediation in all four core subject areas.[7] A higher percentage, about 28 percent of the U.S. students who took the ACT test met none of the readiness benchmarks.[8] Among U.S. students under the age of 25, 44 percent of those entering public two-year institutions and 27 percent of those entering public four-year institutions, enrolled in a remedial course.[9] Remedial courses are not an effective substitute for more rigorous high school preparation. Students taking remedial courses are only about half as likely to graduate with a postsecondary degree as their peers who do not need remediation.[10] The costs of remediation to prepare students for postsecondary education are significant for taxpayers, postsecondary institutions, and students. Nationally, the cost of remediation for students enrolled in public institutions in the 2007-2008 school year was $3.6 billion, a cost taxpayers effectively pay twice, first for the students to learn the material in high school and again for them to learn it in a postsecondary institution. Students bear the cost of additional tuition and fees, and taxpayers bear the cost of grants or tuition relief for low-income students. Finally, there are costs to states and the nation in lost revenues. It has been estimated that the nation could realize as much as $2 billion in additional earnings if students who did not complete college due to lack of readiness were able to graduate at the same rate as their peers not needing remediation.[11]

The Road to Developing the Common Core State Standards

In recent years, governors, chief state school officers, business leaders, and college faculty have grown increasingly concerned that American students are not adequately prepared for either college or the workforce. The shortfall of well-educated, highly-skilled workers was essentially an economic and public education problem. In states where governors were approaching economic problems through public education reform, one of the tactics frequently taken was an effort to improve the rigor of the standards for student learning. Over time, however, it has become apparent that having different sets of academic standards for what students should know and be able to do is not serving U.S. students well. As a result, governors decided to take action.

In 2008 the NGA Center, CCSSO, and Achieve, Inc. jointly released the report *Benchmarking for Success: Ensuring U.S. Students Receive a World-Class Education,* which called on states to "upgrade state standards by adopting a common core of internationally benchmarked standards in math and language arts for grades K through 12 to ensure that students are equipped with the necessary knowledge and skills to be globally competitive."[12]

Following the release of that report, the NGA Center and CCSSO convened governors' advisors and chief state school officers to gauge interest in developing a set of common, internationally benchmarked academic standards. Fifty-one states and U.S. territories signed a memorandum of understanding (MOU) committing them to participate in the development process. The stated goal was to develop academic standards that would be based on research and evidence, be internationally benchmarked, be aligned with college and work expectations, and include rigorous content and skills.

Governors and chief state school officers believed that common standards ultimately could better prepare all students with the knowledge and skills they need to succeed in college and work; ensure consistent expectations and outcomes regardless of where a student lives; provide educators, parents, and students with clear, focused guidelines; and offer school districts and states opportunities for more efficient use of fiscal resources through the shared development and use of common assessments and other instructional materials.

Once the MOU was signed, the NGA Center and CCSSO began developing the various workgroups and committees that would draft and refine the standards. The process was state led, voluntary, and broadly inclusive of many perspectives. The standards development process included multiple opportunities for feedback from teachers, researchers, higher education officials, business leaders, and members of the public.

On June 2, 2010, the NGA Center and CCSSO released the Common Core State Standards for K-12 English language arts and mathematics. By late-2011, 44 states, the District of Columbia, the U.S. Virgin Islands, and the Northern Mariana Islands, serving more than 80 percent of the nation's student population,[13] had formally adopted the CCSS in both English language arts and mathematics. Further, 45 states and the District of Columbia are participating in one or both of the state assessment consortia developing common assessment systems that will measure student mastery of the CCSS.

Challenges Ahead

The development and widespread adoption by states of the CCSS mark a significant milestone in American education, but implementing the CCSS is likely to be a long and potentially challenging process. Implementation will require significant changes in instruction, assessment, educator preparation and development, curriculum and materials, and accountability measures.

Implementing the CCSS will require support and leadership for schools and educators to both learn the standards and change their curricula as necessary. Training educators on the new standards will require state education agencies to think strategically about the resources they will need to create and how to disseminate those resources across the state. At the same time the CCSS were developed and adopted, many states also passed new laws governing the evaluation of educators. While the advances in state policy relative to educator evaluations were needed, consideration must be given to how the implementation of the CCSS will affect the new policies. For instance, in states where student performance is a component of an educator's evaluation, will the state use scores from the first administration of the new consortia-developed assessments in educator evaluations? Implementing the CCSS will also require states to determine how to reallocate funding to ensure that the implementation of the CCSS is well designed, executed, and evaluated. State education agencies will need to determine how funding could be reallocated to ensure that school districts have the capacity they will need to help schools successfully implement the CCSS. Governors can play a role in that process through their budget authority and their unique position as the state's leader of policy development and implementation.

Clearly, much of the CCSS implementation work will have to be done in schools and classrooms by teachers and principals and their districts. It is important to recognize, however, that governors and other state policymakers can play a critical leadership role. Their role will be particularly important given the current state fiscal concerns, which remain substantial and will continue through at least 2013.[14]

Communicating the Need for the Common Core State Standards

Public understanding of the CCSS, their origin, and their purpose remains uneven. Many myths about the standards still exist. Some incorrectly fear that they are an attempt to control what happens in the classroom or a product of the federal government that amounts to unwanted intrusion in state and local school reform efforts. Also, parents, students, educators, and others in the community may not understand the need for more rigorous standards because they believe their local schools are doing fine.

In a change process as significant as the development and implementation of the CCSS, confusion is to be expected. This means that stakeholders in every state, from the governor down to business leaders and educators, must constantly communicate the need for the CCSS. For instance, explaining to parents that standards set clear and realistic goals for success, and having common standards help ensure that students receive a high-quality education regardless of where they live. The standards do not tell teachers how to teach; rather, they define what students should know and be able to do, so that teachers can design appropriate lessons. The development of the CCSS was state led and implementation of the standards remains a state task. It is also important to note that adoption of the standards was voluntary. At no point, was the federal government involved in the development or adoption process. Without a clear and consistent message, states may find it increasingly difficult to move forward with their implementation plans.

Preparing and Supporting Teachers and Leaders

Implementing the Common Core State Standards will be a significant change for teachers, principals, and administrators in most states. Teachers will be required not only to teach students new, more rigorous content aligned to the standards, but also to engage students in more challenging work in the classroom. To help students acquire higher-level knowledge and skills, teachers may need to improve their own content knowledge. It is generally agreed that current methods of preparation and professional development of educators do not focus on improving knowledge of content in a way that improves students' learning. Given this situation, teachers and school principals may not be adequately prepared for the dramatic shift in instructional practice that the CCSS will require. Ultimately, K-12 and postsecondary education leaders will have to work cooperatively to identify strategies to improve preparation and professional development of educators.

Building and Aligning State Assessments

States will need new and improved tests[15] aligned to the CCSS that are more sophisticated measures of students' learning. Many current assessments are poorly aligned to existing standards and rely too much on low-level questions that do not measure students' acquisition of more sophisticated skills and concepts. Assessments aligned to the CCSS that measure the knowledge and skills necessary for success in college and work are being designed by the Partnership for Assessment of Readiness in College and Careers (PARCC) and the Smarter Balanced Assessment Consortium (SBAC) (For information about PARCC and SBAC, see text box on p. 21).

The new assessments are promising for a number of reasons. First and foremost, they have the potential to measure student mastery in a way that has previously been difficult to do, with a specific focus on college and career readiness. Whereas most current assessments are confined to limited item types (i.e., multiple choice) that assess a narrow amount of content, the new assessments will include multiple item types that can more fully capture the application of knowledge and skills across all achievement levels. Second, because multiple states will use common assessments, comparisons can be drawn about student performance across states. Currently, it is virtually impossible to make comparisons of student performance across states because each state has its own standards and accompanying assessments. To further complicate the issue of comparability, states have different benchmarks for what constitutes proficiency on an assessment (e.g., a proficient score on an Algebra I end-of-course assessment might be 60 percent in one state and 40 percent in another state).

While comparability of assessment scores was one of the goals in developing CCSS assessments, there will likely be tensions both within and across states relative to determining what constitutes proficiency. One of the goals of the assessments is to establish a proficiency standard for students' college and career readiness. The process for establishing this will involve many stakeholders, including postsecondary education leaders, across multiple states. These individuals will likely have differing opinions about where to set the target. To further complicate this process, a recent report from ACT estimated that only about one-third to one-half of 11th-grade students currently meet the new standards.[16] Thus, there may be interest within states to set lower proficiency targets to avoid dramatic drops in proficiency compared to student performance on current assessments. Additionally, there may be a difference between the score that means a student is proficient and the score that means a student is college and career ready.

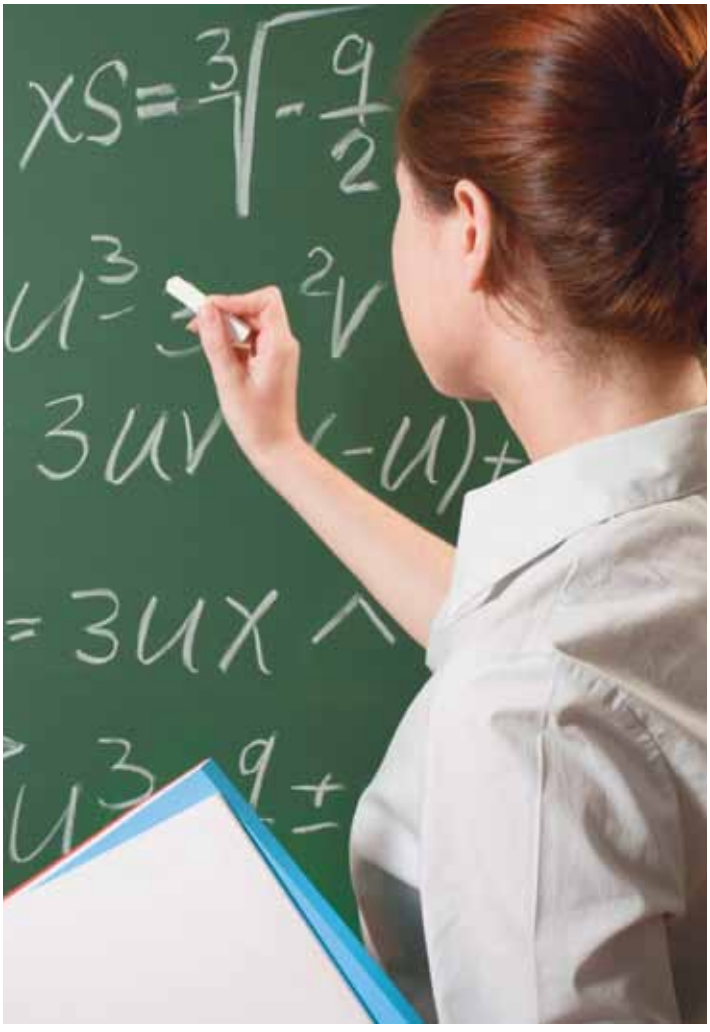
Adapting State Accountability Measures

Many state leaders see the implementation of new standards and assessments as an opportunity to examine how states currently hold school districts and schools accountable for student learning. Over the past few years, several states have experimented with changes to their systems for holding schools and districts accountable. For example, several states now measure the growth of students from one year to the next rather than solely base accountability decisions on the performance on a single test. Current federal accountability policy largely shapes state accountability models. Federal accountability requirements have in some cases created perverse incentives. For example, federal law creates incentives for schools and teachers to focus on the students on the verge of proficiency and less on students performing at lower levels who require the most assistance.[17] Recognizing these issues, the U.S. Department of Education recently invited states to apply for waivers from sections of the No Child Left Behind Act of 2001, including certain accountability provisions.[18] In exchange for waivers, states must agree to implement a host of reform measures.

States that have attached high stakes decisions to assessment results may need to consider the implications of making the transition from one set of standards, expectations, and performance measures to another. For example, retaining a student who performs poorly on the new high school assessments in the first year the assessments are given could be perceived as unfair because the student has had little opportunity to learn the new standards and may have already been behind as expectations rose. On the other hand, states and districts will not want to graduate students that have not met the new standards during the transition period. The implications of lower student performance during the transition for educators are another consideration—one that is of particular concern given the number of states that have recently passed legislation that ties teacher pay, employment, tenure, and licensure to student assessment scores.

Supporting the Development and Acquisition of Aligned Curriculum and Materials

The quality and depth of existing curriculum, textbooks, and other instructional tools and materials currently used in classrooms varies by state and district. The CCSS will require revisions, and in some cases, upgrades to these materials. States across the country play different roles with respect to the development or selection of curriculum, textbooks, and other instructional tools and materials. In the implementation of the CCSS, it will be necessary for each state to determine what role it will play in the development and acquisition of CCSS aligned curricula and materials. For example, should the state take the lead in developing new curricula or should districts take on that task with support from the state? It will also be important for a state to decide how, or if, it should evaluate the process that districts put in place to prepare teachers to use new curricula and instructional tools and materials necessary to meet the CCSS. Finally, and equally important, it will be critical for each state to consider how best to ensure that all districts, regardless of size, location, and affluence have the resources they need to successfully implement the CCSS.



Paying the Cost of Implementation

The state of the economy has caused revenues in most states to drop in recent years, and state leaders are making cuts in state budgets. For the first time in many years, these cuts include cuts to public education. For the near future, many states will not have new state money available to pay for educator training, new instructional materials, new assessments, and remedial supports for struggling students. Such states will have to adopt creative solutions for marshaling or reallocating existing public and private sector resources to support CCSS implementation. Fortunately, there are opportunities for reducing or controlling costs through policy change and by sharing costs across school districts and states through the joint development of new curricula, materials, professional development, and assessments.

What Governors Can Do to Support Effective Implementation of the CCSS

Governors and other state policymakers can play a critical leadership role in supporting implementation of the CCSS. Governors' authority over education and the tools with which they can take action to support the implementation of the CCSS vary considerably from state to state. Nevertheless, all governors should consider taking the following actions to support implementing the CCSS:

- Communicate a vision for reform;
- Identify performance goals and measure progress;
- Engage key leaders from education, business, and philanthropy;
- Build educator capacity;
- Lead transitions in state assessments and accountability policy;
- Support local development and acquisition of new curricula and materials; and,
- Maximize resources and share costs.

Ultimately, each governor will play a different role in the state they lead relative to implementation; however, in concert with other system actors, the success of the implementation effort will depend largely on three things:

1. Ability to articulate a vision for implementation;
2. Providing opportunities for innovation through state policy; and,
3. Willingness to support innovation relative to financing implementation.

The discussion that follows is intended to help governors and their key policy staff decide how best to lead CCSS implementation efforts in their states. The guide attempts to do that in two ways. First, it includes discussion questions for governors and their staff to consider as they make policy decisions to support the implementation of the CCSS. Second, in Appendix A, state policy makers can find a sample tool developed by the NGA Center to help structure conversations and decisions pertaining to implementation. Although CCSS implementation efforts are only just beginning in most states, some interesting approaches that governors should consider replicating in part or in full are already emerging. Such practices are highlighted in boxes in the discussion that follows.

Communicate a Vision for Reform

Governors should work with chief state school officers, postsecondary education leaders, business leaders, and national organizations, to develop a coordinated, strategic communications plan in support of the CCSS. The plan should include consistent messages about how the CCSS is a significant change and why it is important for the state's students and for the economic development of the state as a whole. Leaders will need to be clear about how the higher expectations set by the standards will ensure that all students are better prepared to succeed in college and the workforce. Governors and other state leaders can also prepare the public, educators, and other leaders for what could be disappointing initial assessment results by acknowledging the possibility ahead of time and discussing what the state will be prepared to do in response to support both students and educators. The CCSS website (http://www.corestandards.org/) includes materials that governors' and their staff may find helpful in communicating about CCSS.

GUBERNATORIAL ACTIONS

- *Develop a coordinated, strategic communications plan*
- *Be clear about the high expectations in the CCSS*
- *Prepare the public for changes in the number of students deemed "ready" for college and work*

Communicating a Vision for Reform: Tennessee and New York

A comprehensive communications strategy that includes educators, lawmakers, stakeholders, business leaders and parents is critical to building and maintaining support for the implementation of educational reforms. **Tennessee** and **New York** are among the states that have launched aggressive communications campaigns to raise awareness about the importance of rigorous academic standards and their implications for districts, schools, educators, students, and parents.

Tennessee

In 2008, policymakers in **Tennessee** worked to implement more rigorous academic standards while adopting a new set of aligned assessments. Former Governor Phil Bredesen and other state leaders understood the importance of preparing parents and communities for the expected drop in student assessment results after raising expectations and standards. In response, then-Governor Bredesen, former U.S. Senator Bill Frist, and then-Commissioner of Education Tim Webb partnered to launch an intensive communications campaign to raise awareness of the importance of high academic standards. That public/private partnership, called, the "First to the Top Coalition," grew to include 30 business, education, and community groups. The Coalition launched the "Expect More Achieve More" campaign in advance of the results from the first assessments aligned to the new standards. The statewide campaign included press conferences with the governor and other education leaders, community meetings, public service announcements, editorials, print resources, and a website (www.expectmoretn.org).

New York

In response to adoption of the Common Core State Standards, the New York Department of Education launched "Engage NY." The effort includes an online platform for educators to access information and share resources about the new standards, data-driven instruction, and teacher and leader effectiveness. The department maintains a website (http://engageny.org/) and has used it as a vehicle to disseminate the implementation timeline, video clips about the standards, links to exemplars, and additional tools and resources developed by outside organizations. The site also includes a blog, Facebook page, and Twitter account to further share information with the general public.

? *Questions for Discussion*

1. **What is the governor's education goal(s)? How do the CCSS help reach the goal(s)? To what extent is the goal(s) and message about the importance of the CCSS pervasive throughout the state?**
2. **To what extent has the governor framed the implementation of CCSS as a workforce, equity, and/or international competitiveness issue?**
3. **Where does the governor's office plan to target communication about the implementation of CCSS? What opportunities are available to deliver the message throughout implementation?**

Identify Performance Goals and Measure Progress

Governors are already leading efforts to collect and report better data on performance indicators, such as high school graduation rates. They are well positioned to lead the effort to identify additional performance indicators and set goals for improvement. Many states collect and report data on key indicators, such as assessment scores, graduation and dropout rates, attendance and chronic absenteeism, course enrollment and completion, and teacher qualifications.

Governors can work with other leaders to identify the most critical indicators to use for monitoring progress. A 2010 NGA Center Issue Brief entitled "Setting Statewide College- and Career-Ready Goals" suggested the following set of "Power Indicators" that can provide an accurate measure of a state's progress in preparing its students for college and careers.[19]

- Percentage of students completing, or on track to complete, a college-and career-ready course of study;
- Percentage of students demonstrating proficiency on "anchor assessments," such as a college admissions exam or state assessment designed to measure college readiness;
- Percentage of students obtaining college credit or a career certificate in high school;
- Four-year cohort graduation rate; and
- Percentage of traditional, first-year students enrolling in remedial coursework at a postsecondary institution.[20]

Delaware is an example of a state that has set college and career readiness targets. **Delaware's** core set of indicators and goals for improvement on each are as follows:

- 100 percent of students will meet the standard on the state math and reading exams by 2013-2014;
- 87 percent of students will graduate by 2013-2014;
- 92 percent of students will graduate by 2016-2017;
- 70 percent of students will enroll in college and 85 percent of them will be retained by 2013-2014;
- 60 percent of students will be rated proficient or advanced on the National Assessment of Educational Progress (NAEP) 4th-grade math exam by 2014-2015;
- 55 percent of students will be proficient or advanced on all other NAEP exams by 2014-2015; and,
- The black-white and Hispanic-white achievement gaps on NAEP exams will be reduced by half by 2014-2015.

GUBERNATORIAL ACTIONS

- *Identify critical indicators to monitor progress*
- *Set annual performance targets*
- *Link multiple data systems to track outcomes*

Delaware's leaders acknowledge the ambitious nature of the state's college and career readiness targets. It is important to note, however, that those targets represent a "mid-point" in the effort to achieve the goal of college and career readiness for all students in the state. The goals are the guiding force behind the state's Race to the Top grant activities, of which implementation of the CCSS is a critical component.

To set goals such as those established by **Delaware**, leaders in other states can collect baseline data; set specific, measurable, attainable, realistic, and timely goals for improvement; establish annual or biannual targets to monitor progress; and publicly report performance measures annually.[21] State leaders can then make adjustments in policy to better support progress. It is important to note that outcomes data should be part of the communications effort to help build public support and sustain momentum.

For many states, adding new performance measures means making changes to their existing data system, collecting additional data, and/or establishing and improving linkages between data systems, such as those between K-12 education and early childhood education, postsecondary education, and employment. The agencies involved could face significant challenges in creating the linkages (e.g., privacy concerns and legislation could limit what data can be shared across state agencies). Governors can encourage various agency leaders to collaborate by helping them understand the benefits to both the state and to their individual institutional missions.

? Questions for Discussion

1. **What measures will the state use to annually track student performance during the implementation of the CCSS? How will the implementation impact state performance targets?**

2. **What role can the governor play in establishing and improving linkages between data systems, from early childhood through workforce?**

Engage Key Leaders from Education, Business, and Philanthropy

For the CCSS to have a lasting and meaningful impact, key leaders from various sectors within and outside education will need to work together to help align policies and programs, build and sustain public support, and target resources to support implementation of the standards. To start, governors should ensure that an existing state-level group with broad stakeholder representation, such as a P-20 Council, is helping to oversee, monitor, and evaluate CCSS implementation. Governors in many states chair a P-20 council. In other states, they appoint many of the council's members and charge them with taking action on key priorities. If a P-20 Council does not exist, states may want to consider making use of another existing group that brings together key leaders from divergent parts of the education system, including early childhood and postsecondary education, as well as business and philanthropic leaders.

Whatever form the state-level group takes, the most important features are that it engages key leaders from various sectors, empowers them to take action and/or advise its member agencies and institutions, and makes the CCSS implementation a top statewide priority. State leaders need both the input from and support of such key leaders as the initiative moves forward. For higher standards to take hold, the CCSS must affect policies and programs throughout the education system, from early childhood through postsecondary education. For example, if postsecondary education leaders do not change policies around college course placement to align with the CCSS and the new assessments, their significance and impact could diminish. Similarly, representatives from the early childhood education community must be engaged to help ensure students arrive in kindergarten ready for the higher expectations laid out in the CCSS. Business and philanthropic leaders can play a critical part in building community support for CCSS implementation as well as in lending financial resources to the effort.

The state council or commission should start by developing a strategic state plan for making the transition to the new standards and assessments. The strategic plan should identify areas for policy action at the state level on issues such as developing a communications strategy, reallocating state resources, building educator capacity, supporting the development and acquisition of new curricula and materials, transitioning from old assessments and accountability measures, and setting goals and tracking progress. The council or commission could help identify the most important areas for state action but also help support efforts at the local level, including making recommendations about how existing funds can be reallocated to strategically support implementation. Equally important, members of the council or commission can contribute to the strategic communications effort to build and sustain support for the CCSS as challenges arise.

GUBERNATORIAL ACTIONS

- *Empower a multi-stakeholder state group to oversee, monitor, and evaluate implementation*
- *Develop an implementation plan with input from outside education on transitions to new policies*

Tennessee's implementation efforts are guided and supported by multiple stakeholder groups and outside entities. The First to the Top Leadership Team is the basis for the overall management structure for implementation . It is comprised of the First to the Top staff, who are housed at the Tennessee Department of Education (TDOE), and lead staff implementing the work of the grant at Tennessee Higher Education Commission (THEC), Tennessee Consortium on Research, Evaluation, and Development (TN CRED), the Educational Delivery Unit, and the Tennessee STEM Innovation Network. The First to the Top staff also meet regularly with staff from the Governor's office, and Finance and Administration as needed. The First to the Top staff have primary responsibility for oversight of implementation both at TDOE and across all external projects, overall grant management including budgets, monitoring and reporting, and external relations with education stakeholders across the state and nationally.

The team's objective is to work across agencies and sectors to implement and evaluate all aspects of the Race to the Top grant. The implementation work is also guided by an advisory council made up of a broader set of stakeholders, including mayors, foundation representatives, state legislators, and local superintendents.

The advisory council provides strategic guidance and communications support. In addition, the state's First to the Top Coalition, comprised of 30 business, community and education organizations, including local chambers of commerce, philanthropies, SCORE, the state department of education, the Tennessee Education Association, and many others is helping support grant implementation, primarily by helping communicate the vision and goals of the reform effort around raising expectations. The coalition provides support and helps communicate the importance of higher standards and college and career readiness for all students.

? *Questions for Discussion*

1. **How will the state engage a wide-reaching coalition of critical stakeholder groups to drive and support implementation of the CCSS in the short- and long-term? How will the state use external groups to support communications and implementation?**
2. **To what extent does your state plan to share information on its implementation plan and impact with the general public?**
3. **How will the state leverage existing reform efforts to coordinate the implementation of CCSS?**

The Importance of Strong Coalitions: Massachusetts

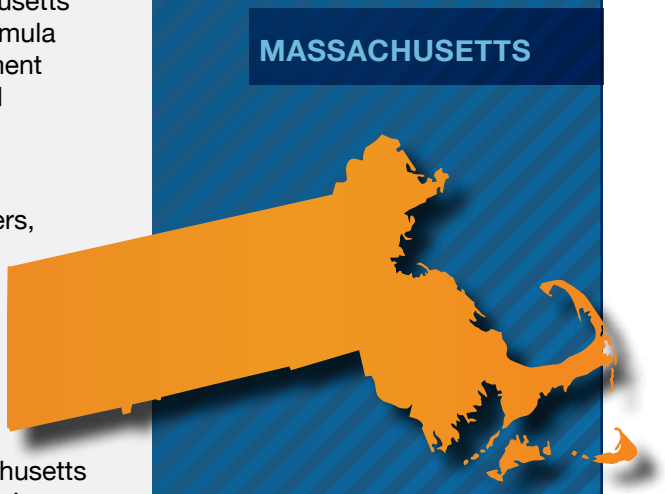
Strong leadership from governors, legislators, education commissioners, business leaders, and advocates has led to **Massachusetts'** tightly aligned system of high standards, rigorous assessments, and educator supports. Steady support of high academic expectations has enabled the state to maintain public support, overcome opposition, and effectively implement the sweeping changes that were necessary to make the commonwealth's schools among the nation's best.

The turnaround in **Massachusetts** education began in the early 1990s when the governor, lawmakers, educators, and business leaders worked together to build statewide support for systemic change, and in 1993 urged the state legislature to pass the landmark Massachusetts Education Reform Act. The act promised an improved funding formula to more equitably distribute state aid, and called for the development of a system built on high standards, demanding assessments and accountability for student progress.

Full implementation of the act took years, and was mobilized and strengthened by the continued support of coalitions of stakeholders, including business leaders and advocacy groups. With the new law in place, the state developed frameworks for curricula in all major content areas to inform the development of the Massachusetts Comprehensive Assessment System. Implementation of the frameworks was strongly encouraged but remained voluntary for schools and districts.

A coalition that came together to support adoption of the Massachusetts Education Reform Act played a critical role in maintaining the state's dedication to reform as the policy was implemented. Student proficiency rates dropped initially, as the result of higher standards and more rigorous assessments. Strong leadership from the governor's office, bipartisan coalitions and the ongoing support of advocacy organizations and business leaders kept the state from lowering expectations in the face of lowered test scores. Since then, the percentage of students testing proficient or higher has risen steadily. Dropout rates in **Massachusetts** decreased to the lowest in a decade and graduation rates inched steadily upwards.[a]

[a] Massachusetts Department of Elementary and Secondary Education, "Statewide Dropout Rate Falls Below 3 Percent." Available at: http://www.doe.mass.edu/news/news.aspx?id=5374. See also, Massachusetts Department of Elementary and Secondary Education, "For Fourth Consecutive Year, State's 4-Year Graduation Rate Rises." Available at: http://www.doe.mass.edu/news/news.aspx?id=6000.



Build Educator Capacity

The implementation of the CCSS affords an opportunity for governors to address a range of issues relative to human capital management. Chief among them, as discussed below, are the licensure of educators, professional development for educators, and the evaluation of educators. All of these issues will require attention as the CCSS are phased in.

Licensure of Educators

Each state has sole authority over the licensure of educators. That authority can be used by governors to drive important changes in the way educators are licensed to ensure that they are ready to teach new curricula aligned to the CCSS. Governors can ask the state board of education (or the entity responsible for overseeing educator licensure), to change licensure requirements to require educators seeking initial licensure to demonstrate their mastery of the standards. That could be done in a number of ways. As an

example, licensure regulations could be changed to require teacher and principal candidates to pass an assessment that measures their mastery of the standards before they receive an initial license. Another option would be to require programs that prepare educators to place an emphasis on the mastery of content of the CCSS in the prospective educator's clinical or internship experience and require the candidate to demonstrate their mastery through the submission of a professional portfolio.

State licensure policies also should be changed to require that any educator seeking licensure renewal be required to complete professional development that addresses CCSS specifically. The professional development requirements for educators should be focused on acquiring content knowledge and learning new instructional strategies that will help teachers teach the CCSS. States will have to decide how much professional development will be required to complete the requirements for re-licensure. The amount will likely vary depending on what subjects a teacher teaches; however, all educators, including principals should complete some professional development related to the CCSS for re-licensure.

GUBERNATORIAL ACTIONS

- *Direct state board of education to change licensure requirements to focus on CCSS for incoming and current educators*
- *Create a professional development strategy for supporting CCSS*
- *Evaluate the impact of professional development*
- *Reallocate resources to implement new educator evaluation systems*

Professional Development for Educators

Although it is important to tie educators' professional development to licensure, the state should play a greater role in ensuring that the professional development offered is of high quality. Governors can play an important role with respect to improving the quality of professional development for educators. As an example, governors can use their budget authority to reallocate funds towards professional development for educators that focuses on CCSS implementation (at least for the next two years), improves the performance of students, is of high-quality, meets national standards for professional learning, and is cost effective. To meet those criteria, states have to evaluate the professional development they invest in, which is something not done in most states. The evaluation could be facilitated by electronically linking educators and the professional development they participate in over the course of the school year. [22]

Governors also can ask their state superintendents of schools to work with school and district education leaders to ensure the state provides a strategy for professional development in support of the CCSS. In most instances veteran teachers and principals will need immediate, intensive professional development pertaining to what the CCSS requires of students and how the CCSS are different from current standards. Some veteran teachers may also need to improve their content knowledge specific to the content they teach. Professional development for veteran teachers should focus on building content knowledge and teaching content to diverse groups of students through instructional strategies that are innovative and engaging. Some veteran principals will need assistance developing and identifying ways to support teachers as they start to teach the new standards. Additional support will have to be provided to principals and other supervisors who are charged with evaluating teachers. Such support is of particular importance given the recent changes in educator evaluation policies across the country.

Evaluation of Educators

Governors should consider how they can advocate for changes in how educators are evaluated—a step necessary to ensure that all students have access to effective teachers and principals. While many states have taken action to improve the evaluation of educators, some have not. In states where policies relative to teacher evaluation have not been changed, governors could form a commission or task force to make recommendations for how to better evaluate educators and use the data from evaluations to improve the quality of teaching and school leadership. They can also work with legislators to draft bills that improve the rigor and the quality of the teacher evaluation process—an approach many governors have taken over the past eighteen months.

Implementation of new educator evaluation policies is challenging, especially with the implementation of CCSS. Many new state policies regarding educator evaluation tie high-stakes decisions, such as employment, tenure, compensation, and licensure to evaluation results. In many states, state law stipulates that some percentage of an educators' effectiveness is tied to student performance on assessments. Given the high-stakes attached to educator evaluations and the introduction of CCSS and their accompanying assessments, states should consider how they will make determinations about educator effectiveness (specifically, measures of student performance that are tied to assessments) during the transition from state standards and assessments to CCSS and assessments.

Delaware is addressing teacher and principal quality on all three fronts—improving professional development, preparation, and evaluation and linking evaluation results to decisions about professional development. **Delaware** has provided initial training on CCSS to 9,000 teachers. In addition, the state department of education has trained 350 instructors to provide additional professional development to teachers. The state has also adopted state standards for professional development and educator evaluation.

Starting in fall 2011, **Delaware** will use participant evaluation forms and student achievement data to evaluate the impact of professional development on educators' behavior and students' learning. Once available, it will also incorporate educator evaluation data. The state is also providing a development coaches program to help improve the consistency and rigor of educator performance evaluations at the same time it is working toward a new educator evaluation system for both teachers and principals. The new evaluations will incorporate measures of student achievement and tie directly to professional development. In addition, the state is providing separate data coaches to help teachers, principals and administrators develop their ability to analyze student data and use it to adjust instruction, monitor progress, and intervene with struggling students.[23] **Delaware** also has plans to begin assessing the effectiveness of teacher and principal preparation programs, including providing programs and the public with information about graduates' evaluation ratings and awarding annual expansion grants of $150,000 to successful preparation programs.[24]

? *Questions for Discussion*

1. **What course(s) or practical experience requirement(s) can the governor can ask the state board of education (or the accrediting body in the state) to add to or change in the preparation program approval standards to ensure that educators get the information they need to successfully teach or supervise teaching of CCSS?**

2. **What policies regarding licensure (both initial and renewal) can be added or changed to require educators to demonstrate mastery of CCSS for initial licensure as well as renewal of a license?**

3. **What funding does the state need to provide to support the transition to more rigorous educator evaluation systems that include the CCSS?**

4. **What flexibility can be provided for the transition to CCSS and assessments relative to educator evaluation?**

5. **Does the state have standards for professional development? Are they aligned to national standards? How are current professional development funds spent in the state? To what extant is the state evaluating the effectiveness of the professional development? If the state does not evaluate the effectiveness of professional development, what steps can be taken to begin to do this?**

6. **How can the governor push for placing a greater emphasis on measuring the effect of professional development on student learning and using that information to:**

   a. **improve the quality of professional development offered to educators;**
   b. **improve the overall return on the state's investment in professional development; and**
   c. **increase transparency and accountability for local education agency use of state funds to support professional development?**

Using Data to Produce Effective Educators: Louisiana

Ensuring that educators are prepared to teach the depth and rigor required by the Common Core State Standards is critical to achieving gains in student learning. **Louisiana** Governor Bobby Jindal and the state's Board of Regents have recognized the importance of high-quality teacher preparation and implemented a range of reforms to ensure that new teachers who enter the classroom have the knowledge and skills they will need to be effective.

For more than a decade **Louisiana** has supported a Blue Ribbon Commission for Educational Excellence, which is housed in the governor's office, and co-chaired by a member of the state's Board of Regents and the Board of Elementary and Secondary Education. This commission has been instrumental since its inception in 1999 in driving changes to the state's accreditation and licensure standards for both teachers and principals. For example, the commission recommended changes to the state's accreditation standards for teacher and principal preparation programs. The changes required all university and alternative providers of educator preparation to redesign their programs to meet the new requirements and maintain their accreditation.

Since the redesign, the Blue Ribbon Commission has made additional recommendations that include the creation of a system of accountability for teacher preparation programs. The value-added teacher preparation assessment model was developed as a response to the accountability recommendation and can be a model for other states. The process involves analyzing value-added results of first- and second-year teachers in the 4th – 9th grades who teach math, science, social studies, reading or language arts and then linking them to the preparation program each teacher attended. Using value-added data, the state examines and publicly reports the effectiveness of every preparation program in the state.

Louisiana uses value-added data to examine and publicly report on the effectiveness of every preparation program in the state. Providers that are unable to produce effective teachers lose their state accreditation. To address the growing number of online providers, the state recently passed legislation that requires out-of-state online providers to participate in the teacher preparation assessment model as well.

With a robust data system that links educators, their students, and their preparation programs, **Louisiana** was uniquely positioned to pass legislation to change educator evaluation policies in the state. With the governor's support, House Bill 1033 was signed into law in 2010.[25] The bill requires all teachers and principals to be evaluated annually and also requires educator evaluations to be linked to student growth measures.

Align State Assessments to the Common Core State Standards

The development and adoption of the CCSS have set the stage for the development of assessments that measure the skills students need in college and work, such as critical thinking, collaboration, and communication; accurately predict college and career readiness; and, provide results that are comparable from state to state. However, without clear gubernatorial leadership, the promise of new, aligned assessments may not be realized. Governors should focus their efforts on four key areas: comparability of assessment scores between the states and two consortia; determining the assessment score (commonly referred to as a "cut score") that indicates a student is ready for college and work;[26] postsecondary course placement decisions; and the transition to new assessment systems aligned to the CCSS.

Governors and other state leaders should keep pressure on the two assessment consortia to build assessment systems that will allow comparability across states regardless of which consortia a state has joined (additional information about the assessment consortia can be found in the text box on page 21). Governors offer two main reasons for wanting to ensure that new tests are comparable across states. First, states want to benchmark against one another and internationally, to both inform policy and improve performance. Governors want to be able to learn from states with high performance on CCSS assessments. Without comparable scores it is difficult to understand a particular state's deficiencies within a national and international context. Second, governors want to bring an end to varying definitions of proficiency from state to state. When a student moves from **Utah** (a member state of SBAC) to **Arizona** (a member state of PARCC), parents and teachers need to be confident that the understanding about a student's knowledge and skills gleaned from the state test means the same thing in both places.

Governors should work to engage postsecondary education leaders in the decisions being made by the two assessment consortia about the college- and career-ready cut score.

Building Educator Capacity: Maryland and North Carolina

Maryland
Governor Martin O'Malley has championed education reform in **Maryland**, including strategies to increase the rigor of standards and improve support for educator training and development. Looking ahead to the challenges of preparing **Maryland's** teachers to teach the CCSS, the Maryland Department of Education has developed a series of regional academies for teams of educators from each school in **Maryland**. The academies focus on building educators' understanding of the new standards; highlighting differences and similarities between the Common Core State Standards and **Maryland's** former state standards; and mapping out the state's timeline for implementation of the standards. The sessions at the regional academies for educators also include time for school teams to develop one-year implementation plans for their school. In addition to offering in-person sessions, **Maryland** also offers online sessions. The first series of sessions reached 6,000 educators. Additional sessions are planned for 2011 and 2012.

North Carolina
Governor Beverly Perdue began pushing the state board and the North Carolina Department of Public Instruction (NCDPI) to think about how the state could support implementation of the Common Core State Standards shortly after the state adopted the standards in June 2010. In response, local education agency (LEA) professional development leadership teams in **North Carolina** began training on the CCSS in the summer of 2011 through regional summer institutes. As a follow-up to the training, LEA professional development leadership teams will now begin to develop implementation plans and design local curricula resources. To assist them in that process, NCDPI has developed online modules and tools that help teachers understand the differences in the CCSS and the old standards. Additionally, the NCDPI have provided resources to districts to help guide the inclusion of the CCSS in the state's evaluation processes.

North Carolina has committed to providing professional development to educators on the Common Core State Standards for the next three years. Using the state's Education Regional Service Alliances (RESA), professional development will not only be provided to educators but will be evaluated and refined to improve its quality and delivery. For additional information about the **North Carolina's** professional development plans, see the Facilitator's Guide for Common Core State Standards and North Carolina Essential Standards.

Leaders in postsecondary education were involved in drafting the CCSS, and their involvement in the assessment conversation is equally critical. As the consortia work to develop the CCSS assessments, postsecondary leaders have a vested interest in the content of the assessments to ensure that it reflects the knowledge and skills that students need to succeed in college and work. The establishment of a college- and career-ready cut score is a decision the states that comprise each consortium will make. However, higher education leaders should be part of the decision, as ultimately, the college- and career-ready cut score will be used by institutions of higher education to determine whether a student is ready to enroll in a credit-bearing course in the particular subject area. For too long state assessments have not been effectively connected to whether a student was ready to enroll in college-level coursework; governors and their postsecondary leaders must work to ensure that is no longer the case.

GUBERNATORIAL ACTIONS

- *Convey the importance of comparable scores to both assessment consortia*
- *Insist on the inclusion of postsecondary leaders in the development of a single college- and career-ready cut score*
- *Persuade IHEs to adopt the college- and career- ready cut score for placement decisions*
- *Decide which assessments the state will no longer offer*
- *Communicate to the public the likelihood of fewer students deemed college and career ready early in the transition period*

Ultimately, the cut scores set collectively by the states comprising SBAC and PARCC will have to be approved in each state by the state board of education or other entity charged with the task of establishing policies relative to assessments. Ideally, every institution of higher education in every state will work with their respective consortium to develop and ultimately adopt the college- and career-ready cut score for placement decisions. However, governors will likely have to play a lead role in influencing in-state higher education officials, governing or coordinating board members, and other state education leaders to use the assessment scores for placement consistently across all institutions. In states with university systems, adoption of the assessment consortia cut scores might be easier given that university systems have governing responsibility over multiple institutions of higher education. In states without a university system, governors may have to work to convince each institution that for purposes of consistency and comparability, adoption of the assessment consortia cut score for college readiness is in the state's best interest. The work currently underway by the two assessment consortia and their state partners may be wasted if only a few institutions use the assessment scores.

The CCSS assessments offer states an opportunity to upgrade the quality of their assessments without increasing the assessment burden on students and teachers. In fact, many states will realize cost savings from the joint development of assessment items and technology. Gubernatorial leadership is necessary to ensure that the next-generation assessments are not merely an add-on to existing state tests. Failing to do so could result in over-testing—something that educators, parents and policymakers almost universally agree is already a problem in schools. Once the common assessments are developed, state leaders must decide which of their current assessments will continue to be used, and how all of the assessments fit into the state's accountability system.

Of even greater concern to governors and other state leaders is the stark reality that large numbers of students will not be deemed college and career ready in the first few years after the transition. On the basis of current student performance on assessments that estimate college and career readiness, states can expect fewer than half of their students—and in some states fewer than one-quarter of their students—to score at the college-and career-ready level on the 11th grade assessment. Governors and state leaders from in and outside government should begin communicating with the public about the expected changes immediately. Moreover, states should plan to provide additional supports in 12th grade, and potentially even earlier, for students who do not meet the college- and career-ready threshold.

? Questions for Discussion

1. **To what extent has the governor engaged with public postsecondary institutions to secure a commitment for using a common college- and career-readiness benchmark?**
2. **How will the state determine which assessments are duplicative and no longer necessary after the CCSS assessments are ready to use? How will the need to use student assessments scores to make determinations about educator effectiveness be part of the decision-making process?**
3. **How will the state address the potential of a large number of students not being deemed college-and career-ready? What is the communications strategy? What stakeholders will need to be involved in developing the communications strategy?**
4. **What role can the governor play in ensuring that school districts have funding to address the needs of 12th grade students who are not college-and career-ready? What role should higher education play in this effort?**
5. **What cost savings, if any, will be realized by using CCSS assessments? How can those savings be re-allocated to help struggling students become college-and career-ready?**

Updating Assessments: Rhode Island and North Carolina

Governors have an important role to play in leading the transition to new assessments aligned to the CCSS . Because the assessments being developed by SBAC and PARCC will not be fully available until the 2014-15 school year, governors and other stakeholders will have to decide on the extent to which the state will incorporate a transitional assessment. **Rhode Island** Governor Lincoln Chafee and **North Carolina** Governor Beverly Perdue are both closely monitoring the development of the common assessments. Each state has developed a transition plan for updating their assessments. Although both plans end with the state fully incorporating a new assessment in the 2014-15 school year, their paths to adoption differ substantially.

Rhode Island is a governing state for PARCC. Over the next several years the state will phase out assessment questions aligned with current standards and phase in new questions aligned with the CCSS. That phased-in transition will allow the state time to gradually ramp up expectations, identify challenges and provide the tools and supports that will be necessary to overcome them.

North Carolina, a governing state for SBAC, is on a faster implementation schedule. The state plans to implement and assess the CCSS in the 2012-13 school year, using current resources and testing contracts to develop an assessment based on the CCSS until the SBAC assessment is complete. The state believes that process will avoid confusion over what should be taught, provide students with a clear picture about what they should be learning and what will be assessed, and allow the state to accelerate its implementation of the CCSS.[a]

[a] August 17, 2011 interview with Angela Quick, Deputy Chief Academic Officer, North Carolina Department of Public Instruction.

SMARTER Balanced Assessment Consortium (SBAC)

The SBAC is comprised of 28 states with 19 governing states. **Washington** serves as the lead state. The major components of SBAC's planned assessment system include the following.

- Optional, computer adaptive, interim or benchmark assessments. These would provide almost instant results on student progress and provide teachers with possible formative strategies and professional development options tailored to the results. Decision making power on the scope, sequence, timing, and number of interim assessments is left to the states.
- Performance tasks or events in reading, writing, and mathematics that are completed each year during the consortium testing window. The tasks must involve "student initiated planning, management of information and ideas, interaction with other materials and/or people, and production of an extended response." Extended response options include an oral presentation, exhibit, product development, or extended written piece. Teachers and machines will be used to score the tasks.
- End of year comprehensive (summative) assessment with 40-65 questions in each content area. The assessment will be computer adaptive and include selected response, constructed response, and technology enhanced items. Teachers and machines will be used to score the assessment with a distributed, online scoring system.

The SBAC will also produce a digital library of formative assessments, publicly released items and tasks, model instructional units, tools and resources for training educators and providing professional development, training modules for scoring, and tools to support teacher collaboration. An online reporting and tracking system will allow users to access key information on student progress. For more information, visit: http://www.k12.wa.us/smarter/.

Partnership for the Assessment of Readiness for College and Careers (PARCC)

The PARCC consortium is comprised of 24 states and the District of Columbia with 15 governing states. **Florida** serves as the lead state. The major components of PARCC's planned assessment system include the following.

- Optional diagnostic and formative assessments that range from tasks to be completed in a single class periods to deeper assessments that range across several classes. The diagnostic assessments will be accessible to teachers at any time during the school year and will generate data that can be used to identify student strengths and weaknesses and modify classroom instruction as necessary. The optional mid-year assessment will be largely performance based, and provide data that can be used to improve instruction and inform professional development for teachers as they score student work.
- Performance-based assessments in English language arts/literacy and mathematics that may span multiple sessions/class periods and include computer-enhanced items and tasks that focus, among other things, on critical thinking, reasoning, writing, and extended problem solving, and result in a product.
- End of year comprehensive (summative) assessment in each content area with 40-65 questions. The assessment will be computer based and will likely include selected response, constructed response, and technology enhanced items. Automated scoring will be utilized as much as possible to ensure timely results and drive down costs.
- Required assessment of Speaking and Listening that will not be used in the determination of the summative score.

All of the PARCC assessments will incorporate constructed response items, performance tasks, and computer enhanced and scored items. PARCC will also produce a digital library of publicly released test items, formative assessments, model curriculum frameworks, additional curriculum resources, tutorials and practices tests for students and teachers, training modules for scoring, and professional development materials. For more information, visit: http://www.parcconline.org/about-parcc.

Rethink State Accountability

Governors should be aware of potential implications that changes in assessment system will have for their state's accountability system. The transition to new standards and assessments will affect districts, schools, and students to the extent that student test scores on the new assessments could be lower in the first few years of implementation. Lower student assessment scores will impact the ratings (sometimes referred to as "accreditation status" or "grades") districts and schools are assigned in state accountability systems.

To prepare for the potential decline in student tests scores and school ratings, governors can lead efforts to make temporary changes in state accountability policy to govern the transition to the CCSS and assessments. In particular, governors should consider if the high-stakes measures within the state's accountability system are fair during the transition to CCSS and assessments. In the past few years, many states have created temporary flexibility or relief from aspects of their accountability system when new state standards are adopted and new assessments are introduced. For example, a state may weight student test scores on a newly introduced assessment lower than normal to phase in the new assessment design and test items. Moreover, flexibility regarding student graduation requirements and promotion and retention policies may be necessary during the transition.

Governors may also consider if there are permanent changes that should be made to the state accountability systems. For example, as an alternative to sanctions for low-performing districts and schools, governors may want to explore the option of incentivizing districts and schools that help struggling students, recover students who have dropped out, and close achievement gaps. Incentives could be effective considering that some students will initially struggle with meeting more rigorous standards and will require additional support. Higher standards will create challenges for students with disabilities and the growing number of students who do not speak English as a first language as well.

Given the intent of the CCSS is to ensure that students are college-and career-ready, once implementation begins, states may want to consider incorporating measures into the state accountability system that addresses college and career readiness specifically. For example, the number of students that earn dual enrollment credits or the number of students that take Advanced Placement (AP) courses. Some states, like **Florida** have already made changes to their accountability systems to incorporate measures of individual student achievement of academic standards and progress towards college and career readiness. In 2009, **Florida** modified its school accountability system with new measures.

GUBERNATORIAL ACTIONS

- *Design a new state accountability system that places greater emphasis on college and career readiness and creates incentives for schools to help struggling students*
- *Make changes to state accountability systems to incorporate CCSS and assessments and provide temporary relief, where appropriate to districts and schools during the transition to CCSS and assessments*

Under the new system, schools earn a letter grade "A" to "F" based on:

- Performance on Florida's Comprehensive Assessment Test (FCAT);
- Participation and performance in accelerated courses (Advanced Placement, International Baccalaureate, Dual Enrollment, Advanced International Certificate of Education, and industry certification);
- Performance on the SAT, ACT, or college-placement test;
- Graduation rate of students who performed at or below a "level 2" on the eighth grade math assessment; and
- School level growth or decline in the components listed.[27]

Overall, measures within an accountability system should be measures over which schools and educators have some ability to influence and improve through direct action at the school-level, with the appropriate support from local education agency (LEA) and state education agency (SEA.). This concept of tiered assistance will require governors to re-think two important things. First, the extent to which the SEA provides support to the LEA and second, the extent to which the LEA provides support to the schools within the district. While monitoring and oversight are important, both the SEA and LEA will have to provide more direct assistance to ensure that educators have the resources and support they need to ensure that students learn the CCSS and are successful.

? Questions for Discussion

1. **On what timeline will the state incorporate new assessments into its accountability system? Does the state plan to incorporate other measures of college and career readiness beyond assessments into its system? How does the state plan to identify and communicate the transition?**
2. **How can incentives be used to encourage districts and schools to help struggling students and recover high school dropouts?**
3. **What role can the governor play in encouraging the SEA and LEA to provide more direct support to schools?**
4. **What role, if any will higher education play in providing supports to struggling students while in high school?**
5. **How can the governor allocate (or reallocate) resources to support the assessment and accountability transition and provide additional supports to struggling students?**
6. **To what extent will accountability policies that govern student promotion and retention, graduation requirements, students with disabilities, students who are English language learners need to change to incorporate CCSS and assessments? How does the state plan to identify and communicate the transition?**

Support Local Development and Acquisition of New Curricula and Materials

Although the development and acquisition of new curricula and materials is often seen as a local issue, state leaders have a critical role to play in ensuring that districts develop and acquire rigorous curricula and materials aligned to the CCSS. State leaders will need to decide how much and what kind of role they will play in the development of new curriculum and materials. Regardless of the nature and extent of the role the state ultimately plays, governors and chief state school officers can encourage districts within the state and across states to reduce costs by working together voluntarily to acquire or develop new curricula and instructional tools and materials, including instructional tools, course syllabi, and model lessons. State leaders also should consider the role that technology can play in providing teachers and students with access to additional sources of information and materials beyond traditional textbooks. Significant cost savings could be achieved in this area if districts and states were willing to share technological resources. For example, states could work together to create a common electronic test item bank to store old test items that teachers can use on formative assessments administered throughout the year. Another example might be a group of states working together to videotape model lessons that would be posted on a website for teachers across states to view and use to improve their instruction.

State leaders may also help by developing criteria for ensuring that locally developed or selected curricula and materials are aligned to the CCSS. For example, state leaders might consider developing model curricula that could be used by districts voluntarily, or by making textbook selections at the state level. States could also provide a list of options or criteria for districts to help guide their selection of textbooks. Statewide committees of teachers, principals, and other administrators could be used to develop new curriculum frameworks, pacing guides, scope and sequence guides or sample lesson plans. Engaging teachers in the effort would also provide a strong professional development opportunity while also generating needed new materials and resources.

For example, **North Dakota** is working with content and curriculum specialists from around the state to develop a common curriculum template and additional instructional guides that will be made available free of charge to all local school districts for their voluntary use. State leaders hope that by providing such a framework at the state level, they can shorten development timelines, increase cost effectiveness, improve collaboration among districts, and produce better products than any one district could do alone.[28]

In addition, **California** has published curriculum guides for Kindergarten to grade six that are organized by grade and describe what a student should know upon entering each grade. The curriculum guides also include notes about the shift in topics between grade levels, new expectations for English language learners, and charts that highlight the difference between the previous state standards and CCSS.

The model curricula include grade-level breakdowns of standards, expectations for learning, instructional strategies and resources, and connections to related standards in other grades.[29]

GUBERNATORIAL ACTIONS

- *Define state role in supporting the development of new curriculum and materials*
- *Encourage costs savings through cross-district partnerships*
- *Direct education agency to develop selection criteria to measure the alignment of new curriculum and materials to the CCSS*

A Multistate Collaboration to Develop Quality Curricular and Instructional Materials

The adoption and implementation of the Common Core State Standards presents a challenge for all states to develop and identify curricular and instructional materials aligned with the CCSS. That common need also presents an unprecedented opportunity for states to collaborate on high quality materials, and to take advantage of recent advances in electronic and open source technology.

New York, Illinois, Massachusetts, North Carolina, and **Colorado** are currently collaborating to design and pilot an open-source "platform" that enables teachers to access, download, and create resources aligned to the new standards. The Shared Learning Collaborative platform will provide educators with no-cost supports aligned to the standards, including lesson plans, diagnostic tools, and curricular units, as well as an opportunity to network, collaborate, problem-solve and share their own resources. Once complete, the platform will also include "apps" that teachers and students can download to help track student progress against the heightened expectations. Similar to online recipe web sites like Epicurious, the platform will also allow teachers to rate and comment on the materials to identify the most useful and effective items.

Funded by the Bill & Melinda Gates Foundation and the Carnegie Corporation of New York, the Shared Learning Collaborative platform will be open to all states at no cost in 2014.

? *Questions for Discussion*

1. **How can the governor use his/her budget authority to direct the development or adoption of high quality, aligned, curricular and instructional materials?**
2. **What policies regarding open educational resources can be added or changed to support scalable resources aligned to the CCSS?**
3. **What policies address opportunities for cross-district and/or cross-state collaboration on the development and/or purchase of curricular and instructional materials, and the building of technology infrastructure?**

Maximize Resources and Share Costs

Governors are already leading efforts to reexamine the current allocation of state resources and to strategically reallocate funds that are not effectively spent. Governors might also consider temporarily focusing existing funding on activities that more directly support implementation of the CCSS, such as professional development funds or funds used to create instructional tools and curricular resources for teachers. To the extent that it is possible, such decisions should be grounded in data about which programs and policies are more or less effective relative to improving student achievement. For example, a state could decide that all professional development efforts funded with state dollars need to be focused only on the CCSS for some specified period of time and should meet standards for what constitutes effective professional development.

Governors and other policy makers must focus on how schools organize personnel and time to ensure that the right conditions exist to improve efficiency at the local level. More than 80 percent of a school district's expenses are for educator and support personnel compensation. Often that compensation is based on longevity and degree attainment. Research indicates both have little correlation with student performance.[30] States can improve students' achievement and realize efficiencies by tying compensation to factors that more directly impact achievement such as teacher effectiveness. Similarly state policies that limit class sizes in all grades hinder district efforts to achieve cost savings and do not produce the gains in student achievement thought to be associated with smaller class sizes. Research indicates that improvements in students' achievement as a result of class size reduction have only occurred in elementary schools where classes were reduced to fewer than 17 students. Class size reduction policies are costly and should be applied only to the grades in which research indicates they are beneficial.

States can also enable districts to direct resources to CCSS implementation efforts through the creation of policies and funding strategies that offer flexibility for course completion. For example, states should consider eliminating seat time requirements for credit accumulation. New policies should focus on whether or not a student achieves proficiency in both the course and on a corresponding assessment. Such policies should also allow students to gain credit through a demonstration of mastery in all courses, including core courses. Significant cost savings could occur by allowing students to earn credits at their own pace with greater consideration given to students that are able to master course content in less than one school year. Doing so would allow schools to focus their resources on students that require additional support to meet the increased expectations of the CCSS.

Further, governors can promote the opportunity for states and districts to share costs in new ways. Rather than having each of the 50 states developing their own assessments, states have already come together in two consortia (PARCC and SBAC) and secured federal funds to support the development of new assessment systems aligned to the CCSS. States and districts can also share the costs of developing new curricula and instructional tools and not each develop their own at greater expense for each.

Finally, governors can lead efforts to secure additional resources from other sources, such as the philanthropic and business communities. Business leaders were actively involved in the development of the CCSS, and many are eager to sustain the effort. Major foundations have helped support the CCSS to date; regional and state-based foundations may be interested in supporting local implementation efforts. Governors are able to bring these groups together to think differently about how to make use of existing resources within the state to better support ramped up teaching and learning of the new standards.

GUBERNATORIAL ACTIONS

- *Focus existing funding on activities to support CCSS implementation*
- *Create policy conditions that enable improvements in efficiency*
- *Create incentives for cross-district or -state cost sharing*
- *Secure additional resources from philanthropy and business to support implementation*

? *Questions for Discussion*

1. **What services can be consolidated by the state (e.g., purchasing) to free up resources for implementation?**
2. **How can the governor, through policy or budget authority, create incentives for districts to share or consolidate services?**
3. **What policies around time (e.g., seat time, school day) and class size can be changed to free up additional resources, provide flexibility for students, and target additional resources to struggling students?**
4. **What policies can create flexibility at the school or district levels that can enable administrators to reallocate resources to support the implementation of the CCSS?**
5. **To what extent does the state monitor the relationship between student achievement data and where resources are spent in districts for benchmarking purposes?**

CONCLUSION

The advent of the Common Core State Standards is an historic event in American education. The CCSS is not solely an attempt to teach students more; rather, it is an attempt to teach students content and higher-order skills in a new and more rigorous manner. The effort is intended to ensure that students are better prepared for postsecondary education and the workforce. The CCSS set a higher expectation for all students, not just the more advantaged or easily taught.

Without effective implementation of the CCSS—including significant attention to communications, resources, educator capacity, curriculum and materials, assessments and accountability, engagement of key stakeholders, and efforts to set goals and measure progress—the potential of the CCSS may never be fully realized. The implementation challenges are significant but not insurmountable. Governors can lead the effort to confront the challenges and embrace the opportunities and begin a transformation in American education that could start to close achievement gaps, improve graduation rates, and improve the productivity of our economy.

The CCSS offer states an opportunity to rethink how the education system is structured and supported from kindergarten through high school and postsecondary education. Some of the changes, such as assessments and professional development, need to be immediate, and others, such as more effective educator recruitment and retention strategies, can take shape over the longer term. Some, such as changes in resource allocation, may require action in the state legislature. Others, such as assessment and accountability policies, may require action by the state board of education. Still others, such as changes in instruction, will require action in the classroom.

Working together, and with support from national organizations, governors and state leaders can support effective implementation and fully realize the potential of the Common Core State Standards to help ensure that American students are adequately prepared for the future.

APPENDIX A.

A Sample Tool to Organize State Policy Decisions Pertaining to the Implementation of the Common Core State Standards.

Guiding Questions on Education Capacity:

1. What course(s) or practical experience requirement(s) can the governor can ask the state board of education (or the accrediting body in the state) to add to or change in the preparation program approval standards to ensure that educators get the information they need to successfully teach or supervise teaching of CCSS?
2. What policies regarding licensure (both initial and renewal) can be added or changed to require educators to demonstrate mastery of CCSS for initial licensure as well as renewal of a license?
3. What funding does the state need to provide to support the transition to more rigorous educator evaluation systems that include the Common Core State Standards?
4. What flexibility can be provided for the transition to CCSS and assessments relative to educator evaluation?
5. Does the state have standards for professional development? Are they aligned to national standards? How are current professional development funds spent in the state? To what extant is the state evaluating the effectiveness of the professional development? If the state does not evaluate the effectiveness of professional development, what steps can be taken to begin to do this?
6. How can the governor push for placing a greater emphasis on measuring the effect of professional development on student learning and using that information to:

    a. improve the quality of professional development offered to educators;

    b. improve the overall return on the state's investment in professional development; and

    c. increase transparency and accountability for local education agency use of state funds to support professional development?

APPENDIX A. EDUCATOR CAPACITY WORKSHEET

ISSUE	GOALS & OBJECTIVES	POLICY CHANGE /ACTION	RELATED PROJECTS	RESPONSIBLE ENTITY	BUDGET & FUNDING SOURCES	TIMELINE	STATUS
LICENSURE	Ensure that all educators in the state have knowledge of the CCSS	• Require teacher and principal candidates to pass an assessment that measures their mastery of the standards before they receive an initial license • Require that any educator seeking licensure renewal be required to complete professional development that addresses CCSS specifically	Educator preparation program approval standards that incorporate CCSS	State board of education			○
EDUCATOR PREPARATION							○
EDUCATOR EVALUATION							○
PROFESSIONAL DEVELOPMENT							○

WORKSHEET: Status Key

- No Progress
- Some Progress (or Just Started)
- A Lot of Progress (Some Work Remains)
- Complete

NOTES

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7 ACT, Inc., The Condition of College and Career Readiness 2011, (Iowa City, Ia.: ACT). Available at: http://www.act.org/research/policymakers/cccr11/pdf/ConditionofCollegeandCareerReadiness2011.pdf. The ACT determines its college readiness benchmarks by examining the performance of students in college and identifying the minimum score needed on ACT subject area tests in English, mathematics, reading, and science to indicate a 50 percent chance of obtaining a B or higher or about 75 percent chance of obtaining a C or higher in the corresponding first-year, credit-bearing college course. These college courses include English Composition, College Algebra, an introductory social science course (e.g., History, Political Science, Economics, Sociology, and Psychology), and Biology.
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NGA CENTER DIVISIONS

The NGA Center is organized into five divisions with some collaborative projects across all divisions.

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BUILDING A SCIENCE, TECHNOLOGY, ENGINEERING, and MATH EDUCATION AGENDA

An Update of State Actions

National Governors Association


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An Update of State Actions

John Thomasian, Black Point Policy Solutions, LLC

NGA Center for Best Practices

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CONTENTS

Some STEM Facts

- At all levels of educational attainment, STEM job holders earn 11 percent higher wages compared with their same-degree counterparts in other jobs.
- The top 10 bachelor-degree majors with the highest median earnings are all in STEM fields.
- The average annual wage for all STEM occupations was $77,880 in May 2009, significantly above the U.S. average of $43,460 for non-STEM occupations.
- Over the past 10 years, STEM jobs grew three times faster than non-STEM jobs. STEM jobs are expected to grow by 17 percent during the 2008–2018 period versus 9.8 percent growth for non-STEM jobs.
- In 2010, the unemployment rate for STEM workers was 5.3 percent; for all other occupations, it was 10 percent.

EXECUTIVE SUMMARY

For several years, governors and education policy leaders have been working to strengthen science, technology, engineering, and mathematics (STEM) education throughout the states. The immediate goals are twofold: increase the proficiency of all students in STEM and grow the number of students who pursue STEM careers and advanced studies. The reasons are straightforward: STEM occupations are among the highest paying, fastest growing, and most influential in driving economic growth and innovation. Individuals employed in STEM fields enjoy low unemployment, prosperity, and career flexibility. In short, STEM education is a powerful foundation for individual and societal economic success.

Unfortunately, the United States has fallen behind in fully realizing the benefits of STEM education. Results from the National Assessment of Educational Progress over roughly the past 10 years show little improvement in high school seniors' knowledge of math and science. Moreover, the Program for International Student Assessment, which provides cross-country comparisons, shows that U.S. students currently rank behind 25 countries in math scores and behind 12 countries in science scores. These factors may have contributed to another problem: the slow growth in postsecondary degrees awarded in STEM fields over approximately the past decade. This lack of strong degree growth is causing the United States to fall behind other countries that are surging ahead to create a STEM talent pool. For example, U.S. STEM degrees represent only about one-third of bachelor's degrees, but they represent more than half of the first degrees awarded in Japan, China, and Singapore.

The reasons the United States lags behind its competitors in producing STEM graduates have been well documented. They include:

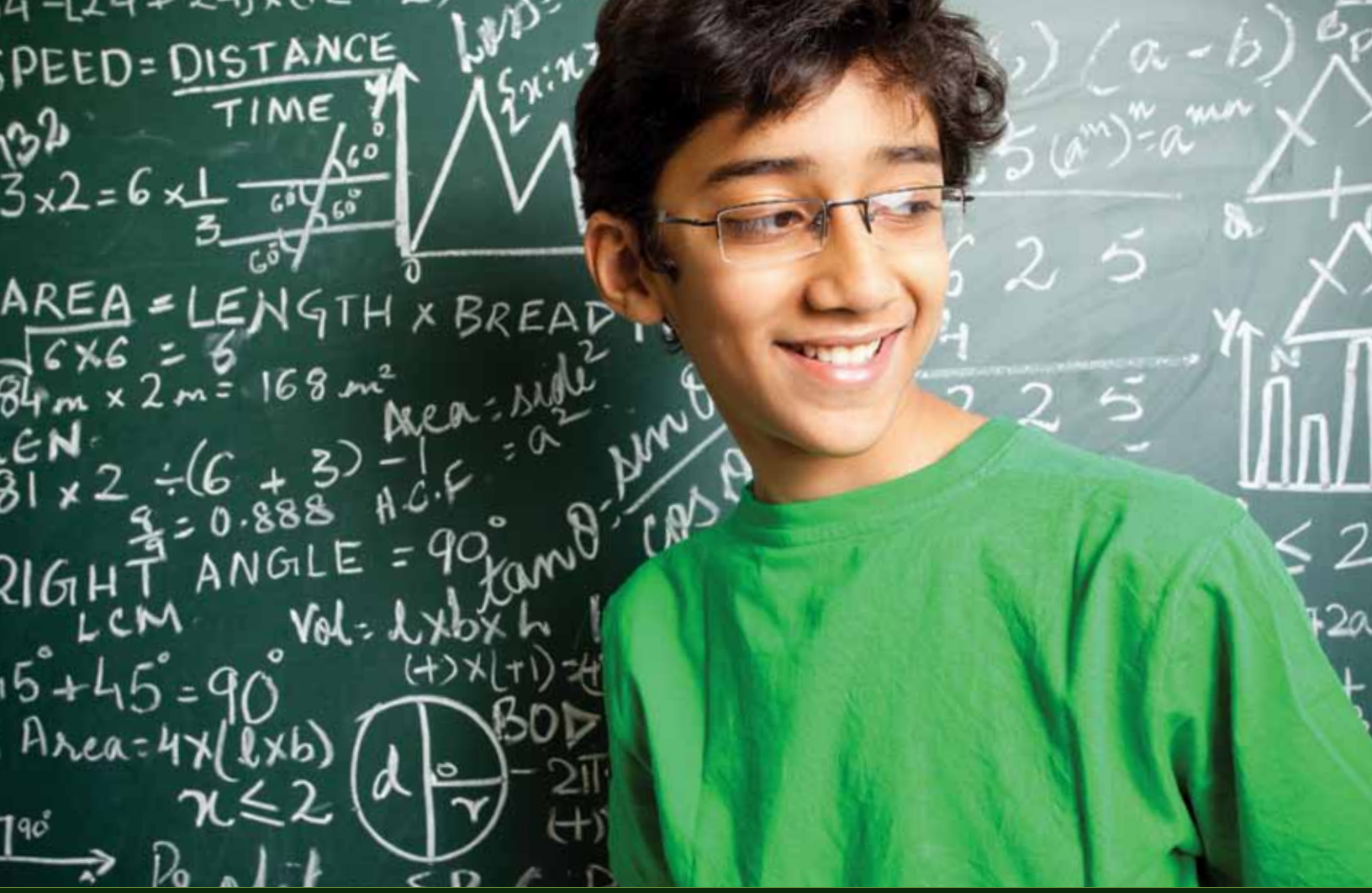
- **Lack of rigorous K–12 math and science standards.** Standards in math and science have varied greatly across states and, in many cases, do not test students' abilities to utilize concepts and solve problems.
- **Lack of qualified instructors.** A shortfall in the numbers of qualified math and science teachers in the classroom is a chronic problem in the K–12 system; many classrooms are staffed by teachers with neither a certificate nor a degree in their assigned subject area.
- **Lack of preparation for postsecondary STEM study.** A student's ability to enter and complete a STEM postsecondary degree or credential is often jeopardized because the pupil did not take sufficiently challenging courses in high school or spend enough time practicing STEM skills in hands-on activities.
- **Failure to motivate student interest in math and science.** In most K–12 systems, math and science subjects are disconnected from other subject matters and the real world, and students often fail to see the connections between what they are studying and STEM career options.
- **Failure of the postsecondary system to meet STEM job demands.** Although STEM jobs are expected to grow by 17 percent between 2008 and 2018, many higher education institutions—including community colleges, four-year colleges, and research universities—have not made an effort to increase their output of STEM degrees or certificates.

States and their educational institutions have taken the following actions to address these challenges:

- **Adopted rigorous math and science standards and improved assessments.** Through the Common Core State Standards Initiative, led by governors and chief state school officers, states are implementing more rigorous, internationally benchmarked math standards. A separate state-led effort soon will produce improved science standards.
- **Recruited and retained more qualified classroom teachers.** Several states and districts are using financial incentives, support systems, professional development, and improved institutional conditions to recruit, retain, and reward high-performing math and science teachers.
- **Provided more rigorous preparation for STEM students.** Through new school and instructional designs—STEM-specialty schools and academies, early college programs, linked learning, and online courses—states and schools are providing students with more focused and rigorous STEM curricula with real-world applications.
- **Used informal learning to expand math and science beyond the classroom.** Many public and private institutions, such as museums, science centers, and after-school programs, provide valuable out-of-class experiences that demonstrate how math and science connect to everyday life and careers and allow students and teachers to expand their skills. These programs are proving to have a positive effect on STEM interest and achievement.
- **Enhanced the quality and supply of STEM teachers.** A number of higher education institutions have established goals to improve teacher preparation programs, provide support systems and professional development, and generate more qualified math and science teachers.
- **Established goals for postsecondary institutions to meet STEM job needs.** A number of states have worked with postsecondary institutions to boost the number of certificates and degrees in STEM fields.

The above actions should begin to increase the number of students and professionals engaged in STEM fields and occupations, but it will take time to see results. Data through 2008 show only slight growth in STEM degree enrollment. And the percentage of STEM degrees awarded out of all degrees fell from 12.4 percent in 2000–2001 to 10.7 percent in 2008–2009. Because more individuals are attending college each year, the absolute number of STEM degree holders in the United States is expected to grow but not nearly at the rate of some international competitors.

For these reasons, states must push ahead with their STEM initiatives. Fortunately, most elements of the STEM agenda—improved standards, more qualified teachers, and access to advanced coursework—directly align with the larger education reform efforts underway. Where unique actions are needed to boost STEM education, such as the creation of STEM-focused schools and support systems for teachers and students, states at times are combining their own resources with those of the private sector, philanthropic community, and federal government. By more efficiently allocating resources in the K–12 system and improving the productivity of postsecondary institutions, states can find ways to advance STEM education without additional expense.

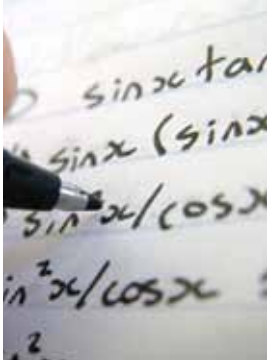


"One of my favorite quotes is from Carl Sagan, who said it's suicidal to create a society that depends on science and technology in which no one knows anything about science and technology—and that's the road that we are headed down. . . . You need to generate the scientists and engineers, starting in school—elementary school, middle school, you have to fund the research that those scientists go on to do—the fundamental research. You have to generate the engineers that can turn those scientific breakthroughs into products and services."

—Sally Ride

A Note on STEM Definitions

No standard definition exists of what constitutes a STEM job, and different studies often use slightly different groupings. Science, technology, engineering, and math positions appear consistently, but some studies include management and sales in STEM fields, while other research does not. Additional workers not consistently represented are STEM education employees, social scientists, certain health care professionals, and economists. In general, most studies tend to *under-represent* the total number of positions that involve STEM knowledge, such as understanding quantitative analysis.



1 INTRODUCTION

STEM—science, technology, engineering, and mathematics—is critical to and supportive of many education reforms being undertaken today, from adoption of common internationally benchmarked standards to better teacher preparation to enhanced coordination across the entire K–20 education system. In fact, STEM is not a separate reform movement at all; rather, it is an emphasis. It stresses a multidisciplinary approach for better preparing all students in STEM subjects and growing the number of postsecondary graduates who are prepared for STEM occupations.

The motivation behind this new emphasis on STEM is simple. Increasing the number of students versed in STEM and growing the number of graduates pursuing STEM careers or advanced studies are critical to the economic prosperity of every state and the nation. A labor force without a rich supply of STEM-skilled individuals will face stagnant or even declining wealth by failing to compete in the global economy, where discovery, innovation, and rapid adaption are necessary elements for success. To ensure that the United States does not follow that path, governors, education leaders, and policymakers at all levels have called for a new emphasis on STEM education in our nation's schools, from K–12 through postsecondary education. How states are working to achieve these goals is the subject of this report.

The National Governors Association (NGA) first addressed STEM in its 2007 report, *Building a Science, Technology, Engineering and Math Agenda*. That report provided an overview of the STEM-related challenges, opportunities, and actions from the state perspective. This report updates those recommendations in light of recent state progress to improve education standards and other efforts to advance STEM education. In addition, this report incorporates recent data from studies that make the economic case for pursuing a STEM agenda even more compelling than before.

The report's six brief chapters cover the following issues:

- **Chapter 2** defines the goals of the STEM agenda, focusing on specific measures.
- **Chapter 3** examines why STEM is important in terms of jobs, prosperity, and future economic success.
- **Chapter 4** reviews where the current system is preventing the graduation of more high school and college students with STEM skills.
- **Chapter 5** examines what is being done and can be done to counter these trends.
- **Chapter 6** concludes with a look at the work ahead.

Governors, state education policy staff, and state education leaders can use this guide to further the implementation of STEM agendas. Fortunately, as current state actions demonstrate, emphasizing STEM does not shift the direction of education reforms already underway. The majority of actions called for in this report complement changes initiated in both the K–12 and postsecondary systems over the past several years. A STEM focus merely provides coherence to many of these reforms, uniting them under a common set of goals.

Finally, this report also is designed to inform the public. Public commitment and public will are necessary to mobilize the efforts needed for change and to set higher expectations for the nation's youth. Without it, we will simply run in place while others pass us by.

"Because the major pathway to a STEM career is through postsecondary study, boosting the number of individuals in STEM jobs means more individuals graduating from college with STEM degrees or certificates."

2

GOALS OF THE STEM AGENDA

The STEM agenda has two basic goals. The first goal is to expand the number of students prepared to enter postsecondary study and pursue careers in the areas of science, technology, engineering, and mathematics. This goal is designed to bolster the innovative capacity of the U.S. workforce, which is falling behind other nations that are creating higher numbers of STEM-trained individuals each year compared to the United States.

The second goal is to boost the proficiency of all students in basic STEM knowledge. This goal is designed to improve the ability of students and workers to assess problems, employ STEM concepts, and apply creative solutions in their daily lives. This second goal requires that all high school graduates be ready with the basic skills to pursue work or study in both STEM and non-STEM fields and meet the demands of most jobs today.

Together, both goals are intended to enhance the global competitiveness of the U.S. economy and help individuals achieve economic security in their careers.

Increasing the Number of Students and Professionals in STEM

A major goal of the STEM agenda is to increase the number of individuals pursuing STEM careers. Because the major pathway to a STEM career is through postsecondary study, boosting the number of individuals in STEM jobs means more individuals graduating from college with STEM degrees or certificates.

Unfortunately, the growth in postsecondary STEM degrees awarded in the United States over the past decade has been anemic (Figure 2–1).[2] In the 2000–2001 academic year, postsecondary institutions awarded approximately 386,000 STEM degrees out of nearly 3 million degrees in all fields. By 2008–2009, the total number of STEM degrees awarded rose to about 435,000 out of more than 4.1 million. Thus, although the number of degrees awarded in all disciplines grew by 35.5 percent, the number of STEM degrees edged up by just 12.4 percent. Moreover, the percentage of all degrees that represent STEM fields fell from 12.9 percent in 2000–2001 to 10.7 percent in 2008–2009.

When these figures are compared internationally, the numbers look worse (Figure 2–2).[3] Between 1998 and 2006—the years of available data to compare the countries listed—the total number of U.S. undergraduate degrees awarded in all fields grew by 25 percent, while those awarded in STEM grew by 23 percent. In contrast, over the same period, STEM degrees in Poland grew by 144 percent; in Taiwan, by 178 percent; and in China, by more than 200 percent. Moreover, the data show that by 2006, China was already awarding almost twice as many first university degrees in STEM (911,846) compared to the United States (478,858), even though

Figure 2-1: Awards Conferred in Stem and All Subjects

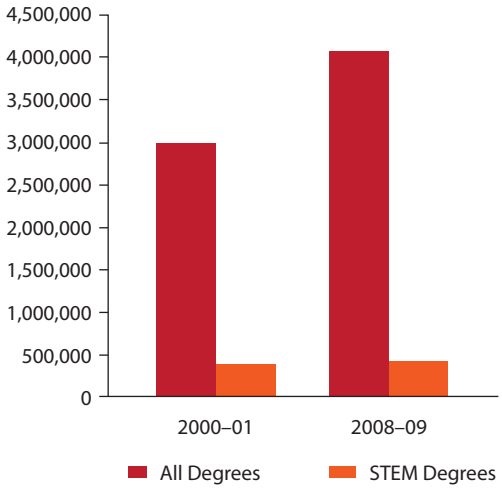
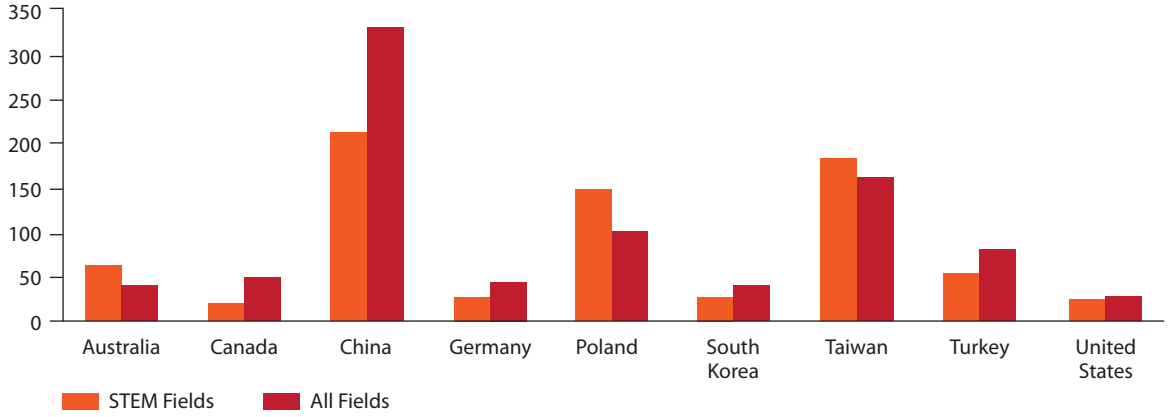


Figure 2-2: Percent Growth in Degrees Awarded, 1998–2006



the quality and number of some of the Chinese degrees has been questioned. Nevertheless, given this trend, the degree gap has surely grown.

When comparing U.S. postsecondary STEM-degree attainment with that of rising competitors, other troubling developments come to the fore:[4]

- In China, the number of first university degrees awarded in natural sciences and engineering has risen sharply since 2002, while the number awarded in Germany, Japan, the United Kingdom, and the United States has remained relatively flat.
- In the United States, STEM degrees have for a long time represented about one-third of bachelor's degrees. Countries where more than half of first degrees are now awarded in STEM fields include Japan (63 percent), China (53 percent), and Singapore (51 percent).
- In the United States, about 5 percent of all bachelor's degrees are in engineering. In Asia, about 20 percent are in engineering; specifically, in China, about one-third of bachelor's degrees are in engineering (although the percentage has declined in recent years).

Despite these statistics, the United States continues to be a significant producer of STEM degrees. In fact, when the Organisation for Economic Cooperation and Development (OECD) looks at the top 10 countries with the largest shares of *advanced* science and engineering degrees, the United States is the largest single contributor of new doctorates, with more than one-quarter of the nearly 89,000 total in 2009 (followed by Germany, the United Kingdom, and France).[5] However, other nations are quickly catching up by awarding STEM advanced degrees at a much higher rate than the United States (Figure 2–3). This is partly why a few corporations have moved some research and development activities overseas.

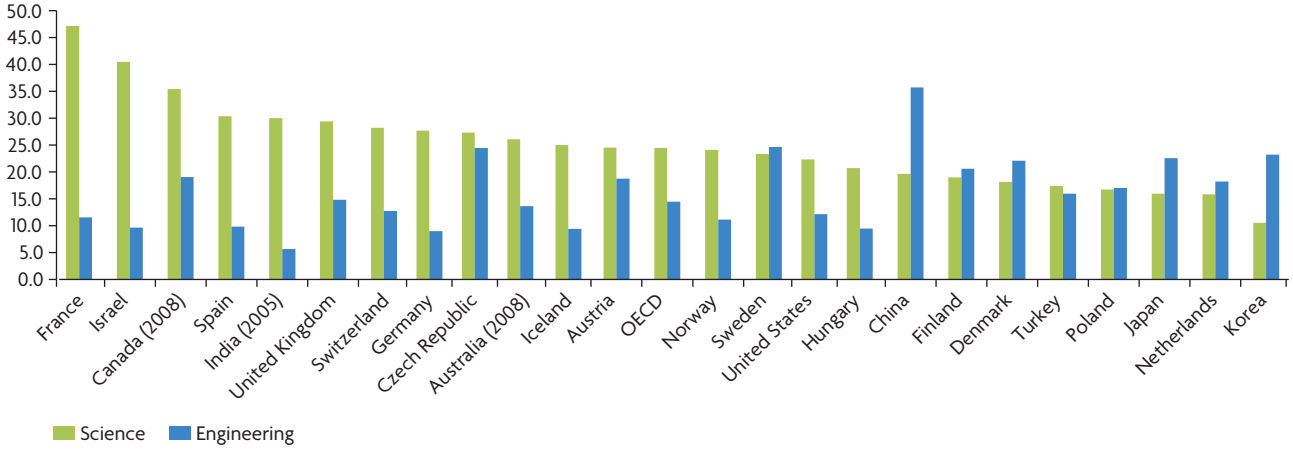
Increasing STEM Proficiency for All Students

Another goal of the STEM agenda is to improve the proficiency of all students in STEM, even if they choose not to pursue STEM careers or postsecondary studies. The ability to understand and use STEM facts, principles, and techniques are highly transferable skills that enhance an individual's ability to succeed in school and beyond across a wide array of disciplines. These skills include:

- Using critical thinking to recognize a problem;
- Using math, science, technology, and engineering concepts to evaluate a problem; and
- Correctly identifying the steps needed to solve a problem (even if not all the knowledge to complete all steps is present).

Achieving greater STEM proficiency begins in the K–12 system, where U.S. students have not demonstrated significant gains in math and science knowledge for almost 15 years, according to the National

Figure 2-3: Science and Engineering Graduates at Doctorate Level (2009)
(as percentage of all new degrees awarded at doctorate level)



Assessment of Educational Progress (NAEP). (Note: Currently, the NAEP measures math and science knowledge but does not measure technology and engineering knowledge. Testing of the latter two subjects will begin in 2014 [*see sidebar*].)[6]

Since 1990, the NAEP has reported performance in terms of three educational levels: basic, proficient, and advanced. At least among 12th-grade students, the results are decidedly mixed.

In math, the percentage of students achieving proficiency or greater more than doubled from 1990 to 2009—from 12 percent to 26 percent. However, over the same period, the proportion of students at or above basic dipped from a peak of 69 percent in 1996 to 64 percent in 2009; only 3 percent of all students scored at advanced in the latest test (Figure 2–4).[7]

Even less promising trends can be found in the 1996–2009 science assessment figures. Although students judged at or below basic fell slightly, those scoring at or above proficient stayed the same (21 percent). Over the same period, the percentage of students at the advanced level fell from 3 percent to 1 percent (Figure 2–5).

Taken together, the numbers suggest that student achievement in math and science has not changed much for almost 15 years—the percentage of 12th-grade students scoring at or above proficiency in math has shown only modest progress, while science skills have remained static over the NAEP testing years. More importantly, the nation has made almost no headway in increasing the number of students that reach the advanced level.

Within the data is another troubling aspect—a persistent achievement gap in the math and science scores between white students and African-American and Hispanic youth. Since 1990, the gap in mean scores between African-American stu-

TECHNOLOGY AND ENGINEERING LITERACY

According to the framework guiding the development of the first NAEP Technology and Engineering Literacy Assessment, students will be evaluated in these three major areas:

- **Technology and Society** involves the effects that technology has on society and on the natural world and the resulting ethical questions that arise.
- **Design and Systems** covers the nature of technology, the engineering design process used to develop technologies, and the basic principles of dealing with everyday technologies, including maintenance and troubleshooting.
- **Information and Communication Technology** includes computers and software learning tools; networking systems and protocols; handheld digital devices; and other technologies for accessing, creating, and communicating information and for facilitating creative expression.

Figure 2-4: NAEP Math Scores, 12th Grade

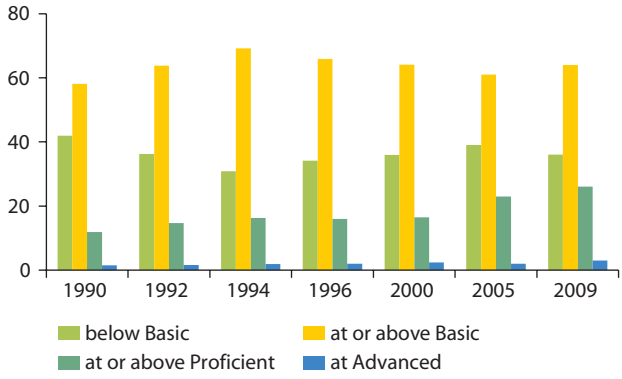
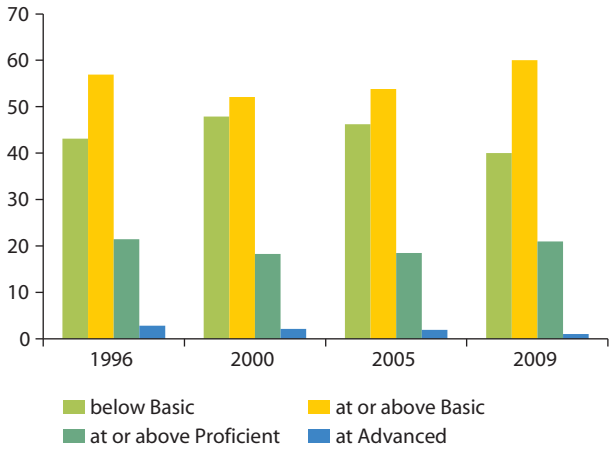


Figure 2-5: NAEP Science Scores, 12th Grade



dents and their white counterparts has averaged 27 for math and 34 for science; for Hispanic youth, the average difference has been 22 for math and 26 for science. Because these minority youth represent an increasing share of the nation's student population, the need to close this gap and the challenge it presents to raising overall math and science scores will only grow.

International Comparisons

Cross-national comparisons shed additional light on the math and science proficiency of U.S. students. The Program for International Student Assessment is an OECD test that measures math and science literacy among students 15 years of age. The results of the most recent tests are shown in Figure 2–6.[8] The tests show that in math, the United States ranked below 25 other countries that participated. The U.S. average math score of 487 also was lower than the OECD average of 496.

For science, the U.S. average score of 502 was not measurably different than the OECD average of 501, but 12 OECD countries had higher scores. At the very least, the numbers suggest that the United States is not dominating its competitors.

Two important measures are the numbers of students at both the bottom and top of the spectrum. In terms of math proficiency, the OECD considers scores *below* level 2 to indicate that students may not be able to consistently employ basic algorithms or make literal interpretation of the results of mathematical operations in real-life settings. Scores *above* level 4 indicate that students can complete higher order tasks, such as solving problems that involve visual or spatial reasoning in unfamiliar contexts. Twenty-three percent of U.S. students scored below level 2 in 2009, which was similar to other OECD countries. However, only 27 percent of U.S. students scored at or above level 4, which is below the OECD average of 32 percent.

The 2007 Trends in International Mathematics and Science Study (TIMSS) found similar results in its international comparisons.[9] At eighth-grade, the average U.S. math score for students taking the test was lower than the average score of students in five countries, higher than 37 countries, and essentially the same as five countries. Similarly, the U.S. average science score for eighth-graders was lower than the average score of students in nine countries, higher than 35 countries, and about equal to three countries.

Perhaps the most striking result is the difference among countries in the percentage of students scoring at or above the advanced benchmark. Figure 2–7 depicts the percentage of eighth-grade students that scored at or above advanced in math. Nine countries had higher percentages of students with advanced scores than the United States, and some of the differences in percentages were dramatic (e.g., the Chinese Taipei percentage was more than seven times that of the United States' percentage).

Figure 2-6: PISA 2009 Results (Age 15)
(*ranked by Math Scores)*

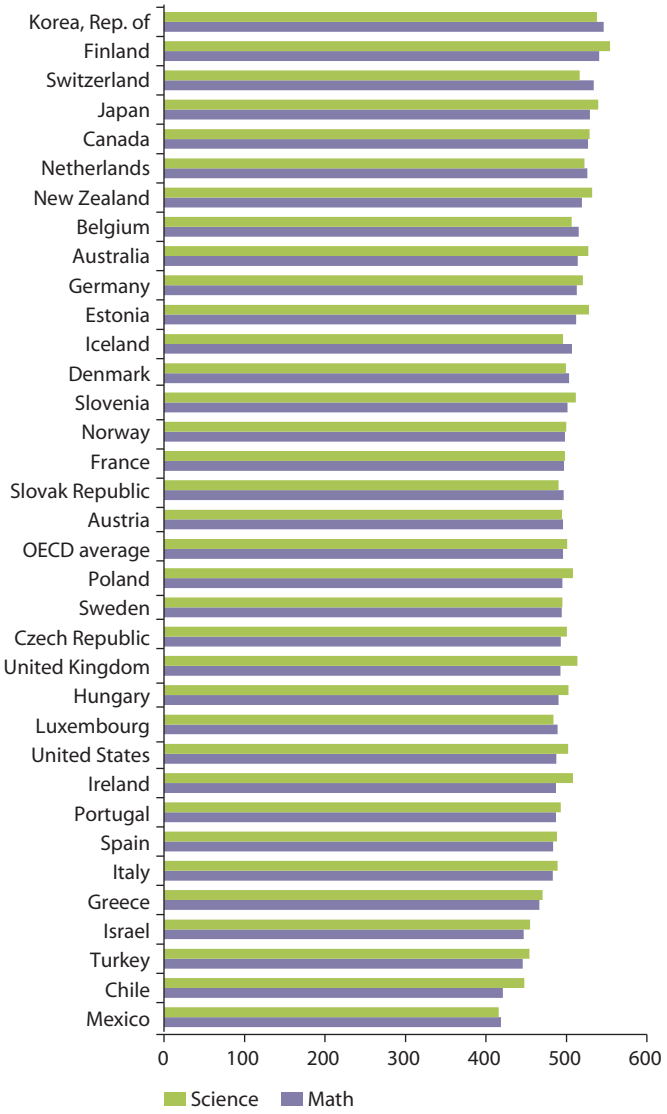
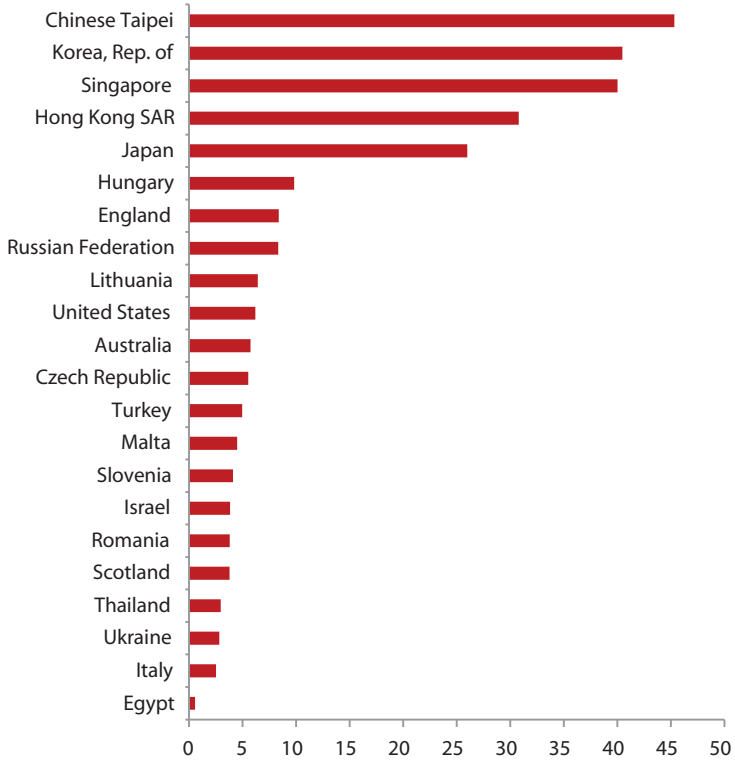


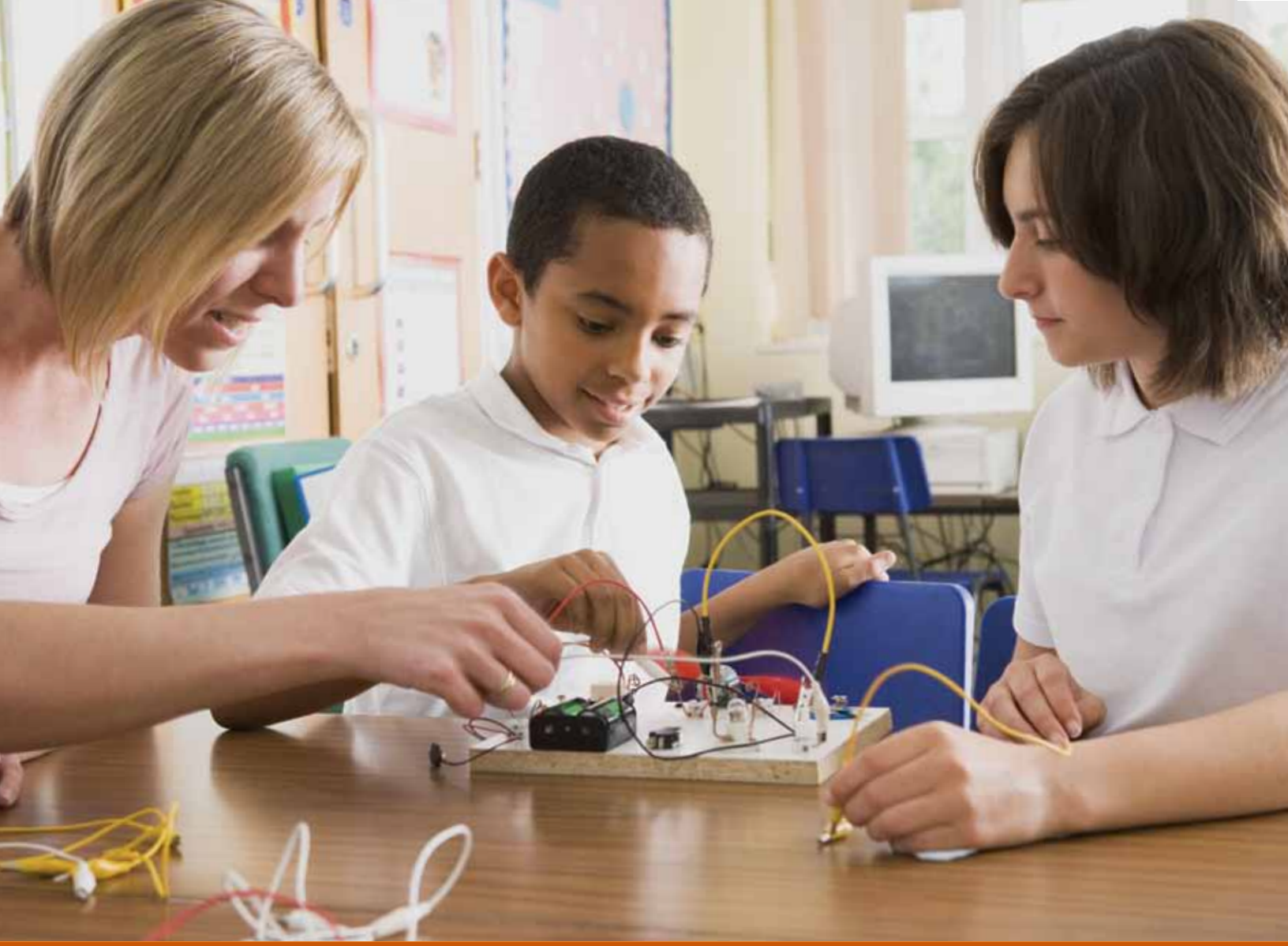
Figure 2-7: Percent of 8th Grade Students Scoring at or Above Advanced on 2007 TIMSS
Math for Selected Countries



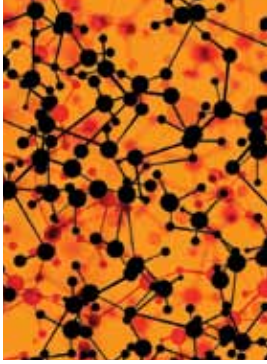
Eighth-grade results for advanced science scores in the 2007 TIMSS were similar: six countries—Singapore, Chinese Taipei, Japan, England, Korea, and Hungary—had higher percentages of students performing at or above the advanced science benchmark than the United States.

Summing Up

The goals of the STEM agenda are straightforward: increase the number of individuals in the United States in STEM occupations, and increase the STEM proficiency of all individuals, even if they choose non-STEM careers. Unfortunately, the data show that the United States is not producing enough college graduates to boost the STEM labor force. Our ability to graduate high school students with good math and science skills has only modestly improved at best. In addition, of growing concern is the trend that, compared with key international competitors, the United States is falling behind in producing the *best* students in math and science who are prepared for college or careers.



"**. . . individuals with STEM degrees who enter STEM careers experience lower unemployment rates compared with workers who enter other fields, which means STEM workers enjoy greater job security.**"



3

WHY THE STEM AGENDA IS IMPORTANT

Increasing the number of high school, college, and postgraduate students majoring in STEM subjects is critical for economic prosperity. Most STEM graduates go into STEM jobs, occupations that are among the highest paying and fastest growing. Moreover, individuals with STEM degrees who enter STEM careers experience lower unemployment rates compared with workers who enter other fields, which means STEM workers enjoy greater job security. Students who study STEM also are able to enter a variety of fields and earn a salary premium even when they pursue non-STEM occupations. Finally, STEM education boosts the competitive edge and innovative capacity of states and regions, which sustain economic growth.

STEM Salaries Are Above the National Average

A sure way to raise the per capita earnings of a state or region is to increase the number of STEM graduates who reside there. STEM occupations are high paying, with wages significantly above the U.S. average.[10]

According to a recent analysis by the Bureau of Labor Statistics (BLS), the average annual wage for all STEM occupations was $77,880 in May 2009, and only four of 97 STEM occupations had mean wages below the U.S. average of $43,460. Moreover, the top 10 bachelor-degree majors with the highest payoff are all in STEM fields, according to the Georgetown University Center on Education and the Workforce (Figure 3–1).[11]

A STEM wage premium seems to hold even when comparing STEM and non-STEM workers at different levels of educational attainment. At each level, STEM job holders enjoy 11 percent higher wages than their same-degree counterparts in other occupations (Figure 3–2).[12] For example, STEM workers with some college or an associate's degree earn $7.61 more per hour than their non-STEM counterparts. STEM workers with graduate degrees earn $4.50 more per hour than those in non-STEM jobs.

Similarly, an individual with a STEM education seems to experience a wage advantage even when working in a non-STEM field. According to a recent

Figure 3-1: Top 10 Majors with the Highest Median Earnings *(full time students)*

Major	Median	Earnings at 25th Percentile	Earnings at 75th Percentile
Petroleum Engineering	$120,000	$82,000	$189,000
Pharmaceutical Sciences and Administration	$105,000	$83,000	$120,000
Mathematics and Computer Science	$98,000	$75,000	$134,000
Aerospace Engineering	$87,000	$60,000	$115,000
Chemical Engineering	$86,000	$60,000	$120,000
Electrical Engineering	$85,000	$60,000	$110,000
Naval Architecture and Marine Engineering	$82,000	$44,000	$120,000
Mechanical Engineering	$80,000	$59,000	$105,000
Metallurgical Engineering	$80,000	$50,000	$106,000
Mining and Mineral Engineering	$80,000	$52,000	$125,000

Figure 3-2: Average Hourly Earnings, Private Full-Time Workers
(BLS Report)

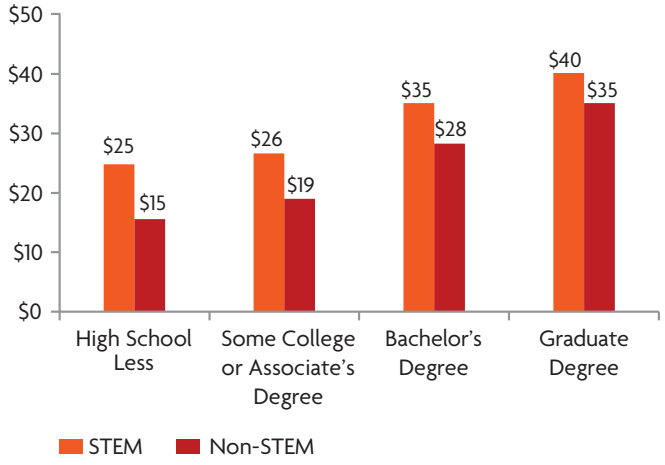
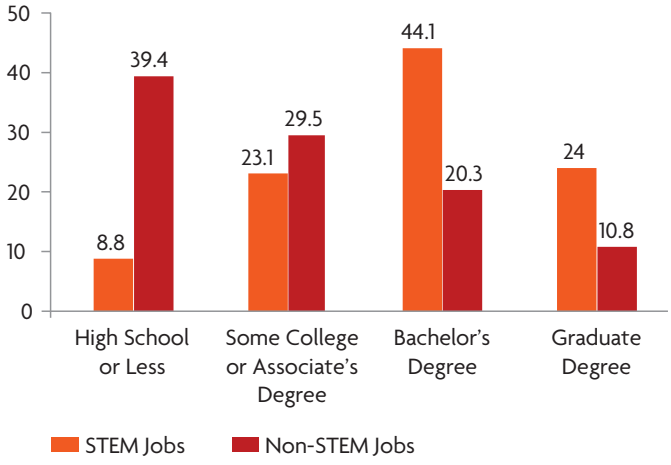


Figure 3-3: Percent Distribution of Degree Attainment
(STEM vs. Non-STEM)



study that examined Census data over time, the adjusted earnings premium of college-educated workers with a STEM degree was 11 percent higher relative to other college graduates, whether or not they ended up in a STEM job. That premium, however, rose to 20 percent when a STEM degree-holder ended up in a STEM job.[13] Although a STEM degree is the typical path to a STEM job, it is not the only path. Although more than two-thirds of the 4.7 million STEM workers with a college degree have an undergraduate STEM degree, the rest do not. Nevertheless, some level of postsecondary study is critical for landing a STEM job: 91.2 percent of all STEM job holders have some college training or an associate's degree, and more than 68 percent have a bachelor's or graduate degree (Figure 3–3). Thus, the ability to successfully complete postsecondary work is key for pursuing a STEM career.

STEM Knowledge Bolsters Employment Security

Although they make up only 6 percent of U.S. employment, STEM jobs are growing much faster than other job categories. This means the supply of STEM workers is unlikely to outstrip demand. Over the past 10 years, STEM jobs grew three times faster than non-STEM jobs. From 2008 to 2018, STEM jobs are expected to grow by 17 percent compared to just 9.8 percent for non-STEM jobs.

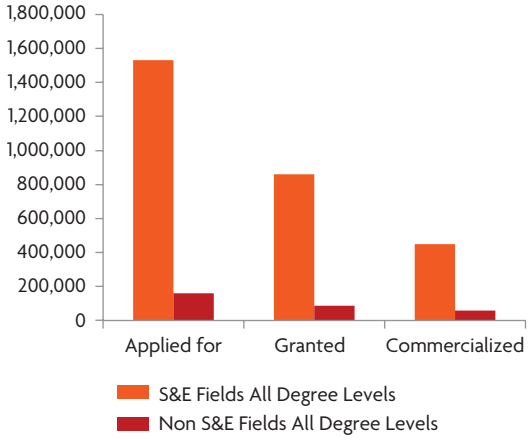
Equally important, workers in STEM jobs tend to experience lower unemployment rates than workers in other fields. For example, the unemployment rate for STEM workers rose from 1.8 percent in 2007 to 5.5 percent in 2009 before falling to 5.3 percent in 2010. In contrast, the unemployment rate for non-STEM workers jumped from 4.8 percent in 2007 to 9.5 percent in 2009 and 10 percent in 2009.[14]

Some of this premium can be attributed to the fact that the STEM workforce tends to possess higher educational attainment on average (Figure 3–3) than the non-STEM workforce, and this higher educational attainment usually leads to lower unemployment. This fact alone helps lead to lower unemployment levels for STEM workers; for example, the unemployment rate for college-educated workers in both STEM and non-STEM fields hovered around 4.7 percent in 2010. As most business leaders would attest, individuals who can fill STEM jobs remain in high demand and face excellent employment prospects throughout their careers.

Finally, it is important to note that STEM skills are highly transferable and provide individuals with many career options. A 2011 report[15] on STEM from the Georgetown University Center on Education and the Workforce describes STEM knowledge, skills, and abilities and how those assets add value to a wide variety of vocations:

[STEM] knowledge tends to be highly specialized, [and] it is both transferable and useful in contexts outside the traditional STEM disciplines and occupations. Ultimately, this dynamic gives rise to careers that mix essentially different academic preparation and occupations. A mix of technical preparation and preparation in other disciplines is increasingly advantageous across a wide array of occupations. In addition, the transferability of knowledge allows STEM professionals to shift into other careers, especially into managerial roles midcareer in which their technical competencies are an advantage.

Figure 3-4: Patenting Indicators for Scientists and Engineers and Other Degrees, 1998–2003



STEM and Innovation

Linkages between innovation and economic growth are fairly well established. Economists broadly agree that more than half of economic growth since World War II has come from technological innovation.[16] According to the Milken Institute's *Best-Performing Cities 2010,* "A rich innovation pipeline plays a pivotal role in a region's industrial development, commercialization, competitiveness, and ability to sustain long-term growth." [17]

The STEM workforce is a powerful component of this innovation pipeline. STEM occupations employ individuals who create ideas and applications that become commercialized and yield additional jobs. STEM fields overwhelmingly dominate other fields in generating new patents, including those that enter the marketplace. For example, during 1998–2003, scientists and engineers (S&E) applied for nearly 10 times more patents and commercialized almost eight times more patents than applicants from all other fields (Figure 3–4).[18]

STEM workers also contribute to the creation of innovation hubs—areas that usually include technology centers and research parks—that are important sources of economic activity. STEM workers are often found in high concentrations in these areas. In addition, research universities and other postsecondary institutions typically are nearby, providing new supplies of STEM graduates and opportunities for collaboration. Innovation hubs can spawn clusters of associated businesses and suppliers in both STEM and non-STEM fields while also rapidly growing jobs.[19]

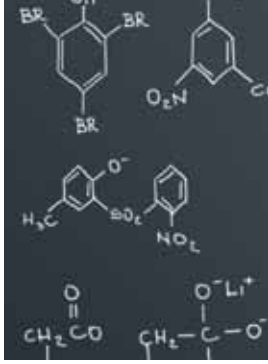
The Payoff

Growing a STEM workforce is a sound economic development strategy. The STEM workforce is a key component of an innovation economy and a key ingredient for creating new business clusters and jobs. STEM jobs also are fast growing and pay significantly above the national average. In addition, a STEM education provides individuals with a wage advantage and higher employment security throughout their careers, even if they pursue non-STEM occupations. As a recent U.S. Department of Commerce report concluded, "Although still relatively small in number, the STEM workforce has an outsized impact on a nation's competitiveness, economic growth, and overall standard of living." [20]

Seeing Connections

"When students discussed their career ambitions, many did not connect their aspirations with required high school math and science coursework, suggesting a need to help students see the relevance of upper-level math and science coursework in secondary school and beyond."

—From *The Opportunity Equation* (2007), Carnegie Corporation of New York



4

WEAK LINKS IN THE SYSTEM

A number of studies and blue-ribbon commissions over the past decade have identified problems in the current system that hinder states and the nation from meeting STEM education goals. Many gaps exist, but this report briefly highlights five that states are addressing:

- Inconsistent state standards in math and science;
- Shortfall of qualified math and science classroom teachers;
- Lack of preparation for postsecondary stem study;
- Failure to motivate student interest in math and sciences; and
- Failure of the postsecondary system to meet STEM job needs.

Inconsistent State Standards in Math and Science

For many years, policymakers have called on states to adopt more academically rigorous common math and science standards, which vary greatly. In many cases, they are too numerous and too broad to correctly define what students need to know. Moreover, many current standards lack the clarity and rigor of standards in other countries, which contributes to the lack of U.S. student gains in international testing.

As discussed in Chapter 5, a national, state-led effort is underway to correct these concerns; therefore, this report does not discuss in great detail the current problems surrounding standards. Nevertheless, because the new standards will take several years to implement, interim steps are needed to make certain that students are properly prepared for postsecondary STEM study. Meanwhile, states must forge ahead with the adoption of the more rigorous math and science standards and assessments to ensure that progress is not delayed.

Shortfall of Qualified Math and Science Classroom Teachers

A shortfall in the numbers of qualified math and science classroom teachers has been a chronic challenge in the K–12 system.[21] For example, only 63.1 percent of high school math teachers in 2007–2008

Figure 4-1: Percent of High School Math and Science Teachers Certified or Not Certified in their Assignment

	Major in main assignment			No major in main assignment		
Selected Main Assignment	**Total**	**Certified**	**Not Certified**	**Total**	**Certified**	**Not Certified**
Mathematics	72.5	63.1	9.4	27.5	16.4	11.1
Science	84.0	73.6	10.4	16.0	12.0	4.0
Biology/life science	76.1	60.2	16.0	23.9	17.2	6.7
Physical science	48.5	39.5	9.0	51.5	29.9	21.6
Chemistry	48.5	36.8	11.4	51.8	34.6	17.3
Earth sciences	33.2	27.2	6.0	66.8	23.3	43.5
Physics	57.7	42.7	15.0	42.3	28.1	14.1

both majored in math and were certified to teach math (Figure 4–1).[22] For science high school teachers, the statistics are better: 73.2 percent both majored in science and were certified. (In comparison, the percentage of teachers that *neither* majored in the subject *nor* were certified was 11 percent and 4 percent, respectively.)

The lack of teacher qualification becomes more acute in some of the physical sciences. In chemistry, only 36.8 percent of teachers held a major and certification in the subject. In earth sciences, only 27.4 percent of teachers majored and held a certificate in the subject. Of more concern, 21.6 percent of teachers in the physical sciences and 43.5 percent of the teachers in the earth sciences held neither a degree nor a certificate in the subject.

To increase the number of qualified STEM teachers in the classroom, states will need to focus on policies that recruit, retain, and grow the supply of qualified math and science teachers. In addition, they will need to promote policies that help retain teachers who are most effective in raising math and science achievement.

Lack of Preparation for Postsecondary STEM Study

New, improved math and science standards will go a long way in preparing students for college and ca-

reers, but more is needed to prepare students for postsecondary STEM study and STEM careers. For these students, stronger academic preparation raises their chances for success but is frequently not available.

Research has shown that strong academic preparation in high school improves STEM degree completion rates. For example, students who took trigonometry, pre-calculus, or calculus in high school; earned a high school grade-point average of B or higher; obtained college entrance exam scores in the highest quarter; and expected to attain a graduate degree in the future experienced higher rates of STEM degree completion (including STEM bachelor's degrees) and lower rates of leaving college without earning any credential than did their peers without these characteristics.[23]

In addition, research suggests—at least with regard to science—that certain instructional practices appear to be more effective than others in raising achievement.[24] These include:

- Doing hands-on activities in science;
- Writing long answers to science tests and assignments;
- Talking about measurements and results from hands-on activities; and
- Working with others on a science activity.

Unfortunately, many students who wish to study STEM leave high school without taking sufficiently challenging courses, participating in hands-on and group projects, or practicing concepts learned in math and science by applying them to real-world problems.

Failure to Motivate Student Interest in Math and Sciences

In most K–12 systems, science and math are taught as discrete subjects unconnected to other coursework. Students are not often exposed to the connections between the work they are doing currently in math and science and postsecondary fields of study and STEM occupations. Most of what students learn about the real-world connections to math and science is relegated to the once-a-year field trip to a museum or planetarium. Yet these students rely on technology every day in smart phones, computers, and televisions without understanding the underlying connections to math and science.

Helping students see the connections between math and science and future career opportunities is a critical aim of the STEM pipeline. Students typically form notions of their career path in secondary school. Without the right information, fully capable students may bypass STEM study because they could not foresee the applications of STEM knowledge.

Motivating interest in math and science requires improved teaching strategies in the classroom and opportunities outside the classroom to demonstrate linkages between math and science, real-world applications, and future careers. Teachers and other school staff will need help in making students see these linkages.

Failure of Postsecondary System to Meet STEM Job Needs

As mentioned in Chapter 3, between 2008 and 2018, STEM jobs are projected to grow by 17 percent, almost twice as fast as non-STEM jobs. Although it represents only 5 percent of the total workforce, STEM employment will expand by more than 1.5 million workers in 2018. More than 90 percent of these jobs will require postsecondary study, with 68 percent requiring a bachelor's degree or more.

However, in many cases, the higher education system—community colleges, four-year colleges, and research universities—fails to see the connection between academic outputs and the needs of the marketplace. Policymakers, including governors and state legislators, contend that more attention must be paid to the job demands of the regional economy. Programs and degree outputs must be better matched to the job market to sustain economic growth. This is particularly important with regard to STEM education, where supplies of STEM teachers are tight and global competition is strong.

"To realize the goals of a STEM agenda, states will need to adopt improved K–12 math and science standards and the assessments that test student knowledge and problem solving. Fortunately, states have made marked progress in this area over the past five years."

5

IMPLEMENTING A STATE STEM AGENDA

Despite the financial downturn and tight fiscal situation, states are continuing their efforts to advance a STEM agenda. In addition to state and local government resources, many of these efforts are leveraging support from the philanthropic community, businesses, and, in some cases, the federal government.

Although many simultaneous actions are needed to grow participation and outcomes in STEM education, this report focuses on six key steps that states are or should be taking across the entire K–postsecondary education continuum:

- Adopt rigorous math and science standards and improved assessments;
- Place and retain more qualified teachers in the classroom;
- Provide more rigorous preparation for STEM students;
- Use informal learning to expand math and science beyond the classroom;
- Enhance the quality and supply of STEM teachers; and
- Establish goals for postsecondary institutions to meet STEM job needs

Adopt Rigorous Math and Science Standards and Improved Assessments

To realize the goals of a STEM agenda, states will need to adopt improved K–12 math and science standards and the assessments that test student knowledge and problem solving. Fortunately, states have made marked progress in this area over the past five years.

Common Core Math Standards

In 2009, a coalition led by governors and chief state school officers released new, rigorous, and internationally benchmarked math and English language arts standards to widespread praise. Called the Common Core State Standards Initiative, the effort was coordinated by the National Governors Association Center for Best Practices and the Council of Chief State School Officers.[25] The standards were developed in collaboration with teachers, school administrators, and nationally recognized experts. As of late 2011, 46 states and territories had adopted the Common Core Standards and were in the midst of a two- to four-year process of bringing them into the classroom.

The standards define the knowledge and skills students should have along their K–12 education progression so that they will graduate high school able to succeed in entry-level, credit-bearing academic college courses and in workforce training programs. The standards:

- Are aligned with college and work expectations;
- Are clear, understandable, and consistent;
- Include rigorous content and application of knowledge through high-order skills;
- Build on strengths and lessons of current state standards;
- Are informed by other top-performing countries so that all students are prepared to succeed in the global economy and society; and
- Are evidence-based.

With regard to the math standards, the Common Core includes a number of improvements that will raise student STEM proficiency:

- The K–5 standards provide students with a *solid foundation in whole numbers, addition, subtraction, multiplication, division, fractions, and decimals.* They are designed to help young students build the foundation to successfully apply more demanding math concepts and procedures and to move into applications.
- The standards stress not only procedural skill but also conceptual understanding. They aim to ensure that students are learning and absorbing the critical information they need to succeed at higher levels.
- The high school standards call on students to *practice applying mathematical ways of thinking to real-world issues and challenges;* in short, they prepare students to think and reason mathematically.
- The high school standards set a *rigorous definition of college and career readiness* by helping students develop a depth of understanding and ability to apply mathematics to novel situations, as college students and employees regularly do.

Assessments

States also need to adopt and implement new and improved assessments that are aligned to the Common Core. Many current assessments do not fully reflect state standards, do not test problem-solving abilities, and rely too much on questions that test the acquisition of specific information and not more sophisticated skills and concepts. The new assessments will test deeper levels of knowledge and application of concepts. In addition, they will:

- Provide a common and consistent measure of student performance across states, which will allow states to compare performance on a common metric; and
- Offer an opportunity for states to pool financial and intellectual resources to develop better assessments while reducing the cost to each state.

The new assessments, scheduled to be released in 2014–2015, are being designed by two state coalitions: the Partnership for Assessment of Readiness in College and Careers and the SMARTER Balanced Assessment Consortium.

Science Standards

Developing and adopting new, rigorous, and internationally benchmarked science standards is the next crucial step in improving STEM education. A joint effort led by NGA and the Council of Chief State School Officers, with support from the National Science Teachers Association and the American Association for the Advancement of Science, has led to the development of a consensus report from the National Research Council that is a blueprint for the development of new K–12 science standards. The report, *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas,* proposes a stronger role for technology and engineering in science education. It also places a greater emphasis on teaching students not only the content and practice

of science but also how to apply science to real-world problems.[26] The framework's introduction states:

> *We anticipate that the insights gained and interests provoked from studying and engaging in the practices of science and engineering during their K–12 schooling should help students see how science and engineering are instrumental in addressing major challenges that confront society today, such as generating sufficient energy, preventing and treating diseases, maintaining supplies of clean water and food, and solving the problems of global environmental change. In addition, although not all students will choose to pursue careers in science, engineering, or technology, we hope that a science education based on the framework will motivate and inspire a greater number of people—and a better representation of the broad diversity of the American population—to follow these paths than is the case today.*

The next step is for the states to translate the framework into a set of educational standards that can guide the work of curriculum development, assessment, and teaching. This work is being carried out by Achieve in collaboration with teams from 20 states. The goal is to complete the development of what are being called the Next Generation Science Standards by the end of 2012.[27]

Recruit and Retain More Qualified and Effective Teachers

To improve K–12 STEM instruction, states will need to recruit more qualified math and science teachers to the classroom. In addition, states will need to focus on policies that retain their most effective instructors. Although more qualified math and teachers are needed, a major problem affecting the supply-and-demand balance today is the high number of skilled teachers who depart for non-retirement reasons.

To reduce departures and fill these hard-to-place jobs, states can utilize financial incentives, provide support systems, and improve institutional conditions. In particular, once placed, polices must focus on retaining the teachers who prove most effective in raising achievement.

Use Financial Incentives to Recruit and Retain

Salary certainly plays a role in teacher recruitment. A number of states have used signing bonuses in addition to a teacher's salary to attract teachers to hard-to-serve areas or to hard-to-place positions, such as math and science. The Mission Possible initiative in Guilford County, **North Carolina,** is one such program that provides recruitment bonuses. A math teacher can earn a recruitment bonus of $5,000 per year for working in a hard to staff school and a performance bonus of up to $12,000 each year (see sidebar, *Mission Possible*).[28]

These financial incentives can play an even greater role in retaining teachers and targeting those who are most effective in raising achievement. A 2010 review of math and science teacher turnover found that 46.3 percent of science teachers and 59.9 percent of math teachers reportedly left their school because of salary reasons.[29] A further analysis found that low salaries were the primary determinant for science teacher departures, although salary did not play as significant a role for math teacher departures.

In 2005, Denver, **Colorado,** implemented ProComp, a compensation system that links teacher pay to the school district's instructional mission.[30] Under the ProComp program, teachers can receive salary increases and/or bonuses by meeting measures such as:

- Working at a hard-to-serve school or in a hard-to-staff position (e.g., math);

MISSION POSSIBLE

The *Mission Possible* program in Guilford County, North Carolina, awards both recruitment and retention as well as performance bonuses to qualifying teachers. A math teacher can earn a recruitment bonus of $5,000 per year for working in a hard to staff school and a performance bonus of up to $12,000 each year. One month after the program was approved in 2006, the district had 174 applicants to teach math, compared with just seven the year before. Moreover, 87 percent of the teachers from the 2006–2007 school year returned the next year.

- Obtaining advanced degrees and certifications or completing specialized professional development;
- Exceeding student achievement expectations on the state assessment; and
- Working in a school with a significant growth rate in achievement.

A 2010 evaluation of the program found:

- Mathematics and reading achievement has increased substantially from 2002–2003 to 2002–2009;
- Schools with greater rates of ProComp participation experienced higher rates of retention (11 percent since the program started);
- Schools designated "hard to serve" with greater rates of ProComp participation experienced a sharp increase in retention rates in 2006–2007, the first full year ProComp was implemented; and
- In 2009, annual combined salary incentives per teacher averaged $7,000.

Other incentive pay models similar to the above examples are in use throughout the country, and many have shown positive results in terms of placement, retention, and—most notably—teacher performance.

Improve Institutional Conditions to Promote Retention

Institutional conditions also can be a major factor in retaining math and science teachers. Institutional conditions include student behavioral problems, the effectiveness of the school leadership and administrative support, the availability of classroom resources, the degree of faculty input into schoolwide decisions, the degree of classroom autonomy held by teachers, and the usefulness of professional development in subject-content areas. Many of these conditions are statistically related to math and science teacher turnover.[31]

For math teachers, studies show that strong determinants for leaving include the amount of autonomy a teacher is given in the classroom, degree of student discipline problems in the school, and the extent to which there is useful professional development. Surprisingly, math teachers also preferred larger schools and were more likely to depart small schools.

As mentioned before for science teachers, the strongest factor in leaving is the potential salary offered by school districts. Other factors affecting science teacher turnover are the degree of student discipline problems in the school and the usefulness of professional development.[32]

The findings suggest that, beyond salary, states, schools, and districts can take several actions to help retain more math and science teachers that may not involve increased investments. These include maintaining discipline, providing strong leadership, giving teachers input regarding schoolwide decisions, providing some classroom autonomy, and—most importantly—providing relevant and useful professional development opportunities.

Some states have created special support systems for math and science teachers. For example, the Dayton Regional STEM Center coordinates an established network of regional institutions and professionals that provides STEM teachers with training and curriculum support.[33] Similarly, the Arizona Center for STEM Teachers provides K–12 teachers with professional development courses to improve STEM instruction and online forums for teachers to share experiences. Centers like these often are created with the help of federal and private grants.[34]

Provide Rigorous Preparation for STEM Students

Students pursuing STEM postsecondary study need strong preparation in high school to succeed in their studies and obtain a STEM degree. Data show that 54.9 percent of students entering STEM postsecondary fields obtain a degree within six years, but only 41 percent complete their degree in that field within six years.

Strong academic preparation in high school leads to higher STEM completion rates. Thus, students

who take more rigorous courses like trigonometry, pre-calculus, or calculus have higher rates of STEM degree completion. In addition, new studies are beginning to show that students who had research experience in high school, who were mentored as an apprentice or intern, and whose teachers connected content across different STEM courses were more likely to complete a STEM major than their peers who did not have these experiences.[35]

States have taken a number of actions to promote programs that can give students access to strong preparation, rigorous courses, and opportunities to apply STEM in hands-on projects. These new approaches to teaching STEM include:

- STEM-themed specialty schools;
- Opportunities for earning early college credit;
- Studies linked to future certificate and degree paths in key industrial sectors; and
- Access to online courses in STEM.

Many of these programs work together. For example, a STEM school may offer both online STEM courses and access to early college credit.

STEM Schools

STEM specialty schools provide students with a rigorous, college-ready, STEM-focused curriculum while also preparing pupils for higher level study and professional futures in STEM.

Although the STEM school model varies across the country, most focus on high school. The schools place a heavy emphasis on science, technology, engineering, and math and the teaching environment goes beyond the classroom. Students usually spend significant time working on group projects, and they often receive help from practicing engineers, inventors, and scientists. Many schools also place students in study-related jobs after school.

High Tech High (HtH) in **California** is an example of a specialty STEM school. HtH began in 2000 as a charter high school launched by a coalition of San Diego business leaders and educators. It is now an integrated network of schools spanning grades K–12. It houses a comprehensive teacher certification program and a new, innovative Graduate School of Education.

Students pursue personal interests through projects and compile their work in personal digital portfolios. Facilities are tailored to individual and small-group learning, including networked wireless laptops, project rooms for hands-on activities, and exhibition spaces for individual work. Students go outside the classroom to learn. Juniors complete a semester-long academic internship in a local business or agency, and seniors develop substantial projects that address problems of interest and concern in the community. In earlier grades—ninth and 10th grade as well as middle school—students may "shadow" an adult through a workday, perform community service in a group project, or engage in "power lunches" with outside adults on issues of interest.

Since 2008, HtH has partnered with the National Student Clearinghouse to examine the college completion rates for each of its students. In 2011, National Student Clearinghouse data indicated that 77 percent of HtH alumni are still enrolled or have graduated from a postsecondary institution, with 25 percent of these college graduates earning STEM degrees. In comparison, fewer than 30 percent of California adults in their twenties have a college degree, according to data from the U.S Census Bureau, and only 17 percent of the state's college students earn degrees in the STEM fields.[36]

There are many examples of STEM schools throughout the country and a variety of ways to design the schools and curricula (e.g., *see the Linked Learning sidebar*).[37] They can be created as charters, as magnet schools, or as academies within or separate from existing schools. The vast majority are in the public school system. An excellent overview of the different types of STEM specialty schools can be found in the report, *Successful K–12 STEM Education: Identifying Effective Approaches in Science, Technology, Engineering, and Mathematics.*[38]

Early College

Early college high schools blend high school and college in a rigorous and supportive program that compresses the time it takes to complete a high

LINKED LEARNING

ConnectEd: The California Center for College and Career uses a "linked learning" model for STEM. Linked learning students follow industry-themed pathways in a wide range of fields, such as engineering, arts and media, biomedicine, and health. These pathways prepare high school students for careers through a range of postsecondary options, including attending a two- or four-year college or university, an apprenticeship, the military, and formal employment training. As described on the ConnectEd website, the four core components of linked learning are:

- An academic component that includes English, mathematics, science, history, and foreign language courses that prepare students to transition, without remediation, to the state's community colleges and universities as well as to apprenticeships and formal employment training programs.
- A technical component of three or more courses that help students gain the knowledge and skills that can give them a head start on a successful career.
- A series of work-based learning opportunities that begin with mentoring and job shadowing and evolve into intensive internships, school-based enterprises, or virtual apprenticeships.
- Support services such as counseling and supplemental instruction in reading, writing, and mathematics that help students master the advanced academic and technical content necessary for success in college and career.

A number of school districts in California are implementing linked learning pathways in their high schools. To implement a certified pathway, the schools must show adherence to several criteria, including providing professional development and growth opportunities for pathway teachers.

school diploma by providing the opportunity to earn college credits, often tuition-free.

A newly opened example is the Wake NC State STEM Early College High School, a joint project of the Wake County (**North Carolina**) Public School System, North Carolina State University, and the North Carolina New Schools Project. STEM is the theme of the school's program. The early college high school lets Wake County students earn a high school diploma and up to two years of college credit at the same time. Students must be interested in science, technology, engineering, and/or math. Students who will be the first in their family to earn a college degree are encouraged to apply. The program is free to students, even when they are taking college classes.

Another example is the Metro Early College High School in **Ohio,** initially funded by a $560,000 operating grant from Battelle and supported by a $1.2 million infrastructure gift from the Ohio State University.[39] The school is operated by the Educational Council, a partnership of Franklin County's 16 school districts.

The learning experience is divided into two different phases: preparation and exploration (called Core Prep) and internships and access to college (called College Access). During the Core Prep phase, ninth- and 10th-grade students focus on learning that promotes performance. To exit the preparatory phase, students must demonstrate performance in mathematics, science, social studies, and language arts. This performance demonstration includes successfully passing the Ohio Graduation Tests and completing tasks that showcase a student's ability to work independently and in groups to investigate solutions to real-world problems.

After demonstrating mastery of the Core Prep phase, 11th- and 12th-grade students participate in a curriculum that is focused on "learning outside of the school walls." For example, students may choose a math- or science-focused curriculum where they work with field engineers and take corresponding engineering courses at the Ohio State University or Columbus State Community College.

Student experiences go beyond traditional internships by including demonstrations of problem solving and critical thinking in partnership with the learning lab. The result is a holistic program: Core Prep focuses on capacity building, and College Access focuses on practical experiences, skill development, social maturity, critical thinking, and responsibility.

STEM schools and early college programs often are not overly selective and have been shown to significantly boost high school and college achievement for both minority and disadvantaged students who participate.

Online STEM Learning

Online learning gives students access to STEM courses they may not have in their current school. These courses can supplement the current learning environment by allowing students to practice skills they studied in the classroom. Online learning often is combined with on-site study in STEM high schools and early college environments, although some states have entirely virtualized high schools and STEM curricula.

The **North Carolina** Virtual Public School is a recent example.[40] The new school will offer North Carolina students access to online Advanced Placement and honors courses as well as online services such as test preparation, career planning services, credit recovery, and Occupational Courses of Study to North Carolina students. Students also can take STEM-related courses at the virtual school. The online school allows all the state's students to access high-level courses taught by qualified teachers in subjects that may not be offered at local schools.

Apex Learning, a program that has existed for more than a decade, provides digital curricula for secondary education to school districts across the country.[41] The comprehensive and standards-based online courses cover a wide variety of subject areas, including core and advanced math and science subjects. Through Apex, for example, students in small or disadvantaged school districts can access a large suite of Advanced Placement courses to help them prepare for the rigors of postsecondary STEM study.

Use Informal Learning to Expand Math and Science Beyond the Classroom

It is important to help students understand the connections of math and science to life and career opportunities. Part of this can be addressed by expanding classroom teaching strategies with hands-on math and science activities. This is the approach taken at STEM schools and early college programs, which focus on real-world problem solving in the classroom and through collaborative projects. These programs also let students participate in projects outside the classroom where they can observe how STEM professionals address issues in fields such as biology, architecture, and physics.

Also important are organized educational opportunities outside the classroom, which include after-school programs, activities at museums and science centers, and virtual learning experiences. Evidence shows that these designed yet informal settings can and do promote science learning.[42]

For example, the 21st Century Community Learning Centers program is a federally funded initiative

that provides academic enrichment opportunities during non-school hours for children, particularly students who attend high-poverty and low-performing schools. Some states have leveraged these funds to further STEM learning goals. For example, the California Department of Education, in partnership with corporations and private foundations, is undertaking a major project to connect after-school program providers with STEM learning opportunities at nine regional support centers. The goal of the project is to reach 1 million youth with high-quality STEM programs annually through after-school programs.[43]

Museums and science centers also offer programs, resources, and classes that help students and teachers expand their knowledge and skills. For example, in **Illinois,** Chicago's Museum of Science and Industry offers courses for teachers to increase their knowledge of science, improve teaching skills, and demonstrate how to use museum programs and exhibits to enhance science curricula.[44] Similarly, the Exploratorium in San Francisco serves both children and adults, offering hundreds of self-guided exhibits, a website with more than 25,000 pages of content, film screenings, and day camps for kids and family science investigations. These exhibits and expertise are shared with museums worldwide.[45]

Other high-quality virtual learning experiences are available. A notable example is the JASON Project, founded by Dr. Robert Ballard, the scientist and oceanographer who discovered the RMS Titanic and who continues to conduct numerous deep-sea scientific and archaeological expeditions.[46] The JASON Project connects students with scientists and researchers—virtually and physically—to provide enriching science-learning experiences. It offers science classroom curriculum, professional development for teachers, digital labs and games, after-school and out-of-school activities, and chances to observe live-action exploration of marine archeological sites.

The value of the JASON Project and similar programs is best described by Dr. Ballard who, in an interview[47] with the Smithsonian Institution, discussed how children responded after seeing the video of the Titanic discovery:

> *They saw it and were mesmerized by this scientific adventure. . . . The kids from Nintendo, from television saw this and said 'That's what I want to do.' They reached out by writing me letters. All of these letters came in and it was a rather impressive number of letters. They all said 'I want to do what you do. How can I do what you do?' And the answer was 'Go to college and take physics for ten years'. And obviously they weren't making that connection between rigorous scientific and technical education and the fun I was having. They wanted to play but didn't know what the price was. And it turns out that they're willing to pay it.*

Governors and state educators can amplify the effectiveness of in-school programs by fully utilizing the vast network of informal learning opportunities that already exist within their state. Doing so does not necessarily require additional financial investments. Much can be gained by encouraging coordination between the formal and informal STEM providers and by building on the complementary strengths of these different institutions.

Enhance the Quality and Supply of STEM Teachers

More and better-prepared math and science teachers are needed to support the STEM learning pipeline. States can work with their postsecondary systems to establish goals to produce more teachers, enhance preparation programs, and create alternative pathways to allow math and science professional to enter the teaching profession. In particular, upgrading the training of teachers before they enter service is particularly important: this helps them acquire the hands-on skills to ensure that students learn and apply math and science knowledge.

The University of North Carolina (UNC) is both enhancing teacher training and increasing STEM teacher production. In 2004, the university set a 10-year target to increase the number of teachers it produces.[48] For math and science teachers, the goal was to increase the number of math teachers by 236

percent and science teachers by 200 percent between 2002 and 2010. To meet these targets, the university uses both traditional and innovative approaches, such as incentives to students, lateral entry programs, mid-career opportunities, e-learning, and collaborative programs with the state's community colleges.

The university also is conducting research to assess the impact of teacher preparation routes and programs on K–12 student performance (test scores). The analysis incorporates almost 500,000 high school end-of-course test scores in mathematics, science, and language arts as well as middle school reading and mathematics test scores. It also takes into account a variety of other factors that affect student performance. This research will allow UNC to more accurately assess the quality of the public school teachers educated through its teacher preparation programs and identify areas for improvement. The ultimate aims are to not only produce more teachers but also better-prepared teachers.[49]

Texas's UTeach program is another successful math and science teacher preparation program.[50] Created in 1997 by the College of Natural Sciences and the College of Education at the University of Texas at Austin (UT Austin), it sought to address the shortage and quality of secondary mathematics, science, and computer science teachers. The program is designed for undergraduates, graduates who wish to obtain certification, and experienced teachers who want advanced degrees. Since its inception, UTeach has more than doubled the number of mathematics majors and increased by six the number of science majors certified to teach.

UTeach is being replicated across the country. Nationally, as of spring 2011, 21 universities joined UT Austin to implement UTeach programs, which collectively enrolled 4,767 students. By 2018, UTeach expects to graduate more than 8,000 teachers.

Establish Goals for Postsecondary Institutions to Meet STEM Job Needs

In these times of tight budgets and a slow economic recovery, states are beginning to ask that their postsecondary systems be more responsive to the workforce needs of the region. Given the high rate of STEM job growth and the difficulty businesses experience in filling STEM positions, many states are urging their colleges and universities to increase the number of degree and certificate holders who can enter STEM fields.

This issue was examined in NGA's 2011 report, *Complete to Compete: Revamping Higher Education Accountability Systems*.[51] The report recommended that governors include efficiency and effectiveness metrics in their postsecondary accountability systems so they can begin to answer questions such as how well the system is meeting the need for an educated workforce. The report pointed out that performance funding could be used with such metrics to spur and reward action.

Several states are working with their postsecondary systems to establish measures and set goals for degree and certificate production in STEM fields. Several, including **Indiana, Ohio,** and **Arkansas**

have been or are in the process of linking a portion of the higher education budget to whether individual institutions meet performance goals, such as degree completion. The funding formula in **Ohio** goes a step further:[52] the Ohio State Share of Instruction program rewards course completion, success in attracting and graduating at-risk students, degree attainment, and meeting participation and completion targets in STEM courses. It also gives more money to campuses that keep costs below the national average.

Career pathways are other approaches many states use to fill high-demand STEM jobs.[53] These typically involve a partnership among community colleges, primary and secondary schools, workforce and economic development agencies, employers, labor groups, and social service providers. Career pathways connect education and training programs to help adults quickly gain a postsecondary credential in a high-demand job field, including STEM. The programs are "mapped"—starting from the postsecondary system through degree or certificate completion—enabling students to easily understand what courses they need to obtain a specific credential degree and what degrees are necessary to advance within specific industries (*see sidebar on Oregon Career Pathways*).[54] Their multiple access points provide a particular benefit to working adults by allowing them to enter postsecondary education programs at the level most appropriate to their experience. Students also receive support services (e.g., academic and career counseling) to help them overcome common barriers to education attainment and employment. Many programs also link students to employment opportunities, where they gain valuable on-the-job experience while working toward a degree or credential.

OREGON CAREER PATHWAYS

The Oregon Career Pathways initiative—launched in 2004—mirrors programs in other states to connect education and training to careers. Here is how the program is described on the Pathways website:

"Career Pathways is a series of connected education and training programs and student support services that enable individuals to secure a job or advance in a demand industry or occupation. Career Pathways focus on easing and facilitating student transition from high school to community college; from pre-college courses to credit postsecondary programs; and from community college to university or employment.

Career Pathways Initiative Goals:

- *To increase the number of Oregonians with certificates, credentials, and degrees in demand occupations.*
- *To articulate and ease student transitions across the education continuum from high school to community college; from pre-college (ABE/GED/ESL) to credit postsecondary; and from community college to university or a job."*

The student support services available through Pathways include career counseling and planning; internships; placement test preparation; summer institutes in reading, writing, and math to reduce remediation needs; and credits for prior experience and learning. STEM pathways include civil engineering technology, geographic information systems, and health information technology, to name a few.

"Governors have supported the creation of new STEM schools, enhanced the supply and quality of STEM teachers, improved teacher professional development and support, partnered with institutions that expand STEM learning, and asked for more from their postsecondary institutions to grow the STEM labor force."

6
MOVING FORWARD

States have done much over the past several years to advance the STEM agenda. Governors understand the value to the economy of growing the number of STEM workers and graduates. On many occasions, they have worked with businesses, the philanthropic community, and the federal government to pool the resources needed for change. They have supported the creation of new STEM schools, enhanced the supply and quality of STEM teachers, improved teacher professional development and support, partnered with institutions that expand STEM learning, and asked for more from their postsecondary institutions to grow the STEM labor force. Most importantly, governors led the effort that will significantly improve math standards throughout the states and the assessments aligned with those standards. Improved science standards soon will follow.

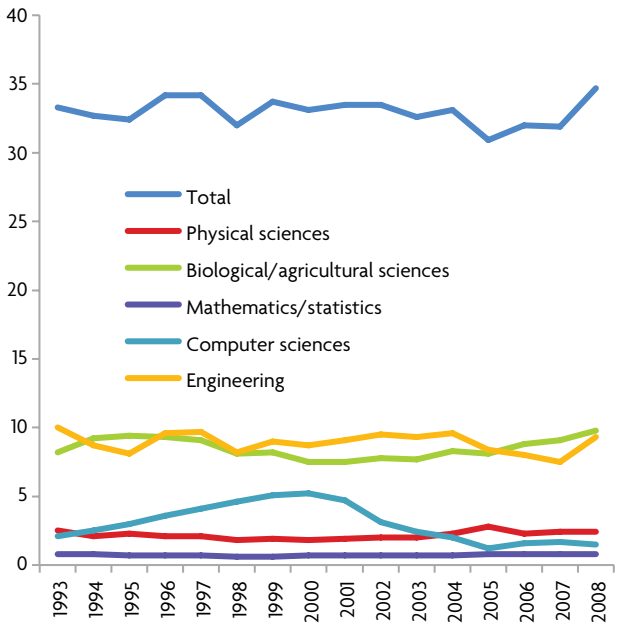
Progress is not immediate, however. For example, data from 1993–2008 show that freshman enrollment in STEM fields has gained only slightly, with an uncertain number moving to degree completion (Figure 6–1).[55] This suggests states cannot afford to relax their efforts.

The current fiscal situation also has made it difficult for states to make new investments or launch new programs. With regard to STEM, however, perhaps the greatest negative outcome of the economic contraction is the drop in state support for STEM-related research and development (R&D). STEM R&D helps drive the discovery of new ideas and products, and it fuels economic growth. Many governors recognize this and, in a number of states, have begun to increase R&D funding as their economies recover. However, it will take time for the levels of state R&D support to be where they were before the 2008 recession.

Still, with regard to STEM classroom investment, much can be done by more efficiently allocating resources already devoted to core educational services. The United States spends more than any other country to educate its students. The current fiscal situation presents an opportunity to bring greater efficiency to the K–12 classroom and to realign some goals (Figure 6–2).[56]

In a recent paper, *Restructuring Resources for High-Performing Schools,* Karen Hawley Miles and others argue that several strategies can be used to allocate more funds to quality instruction and less to activities that do not improve outcomes in K–12 education.[57] The authors suggest these and other strategies to improve the situation:

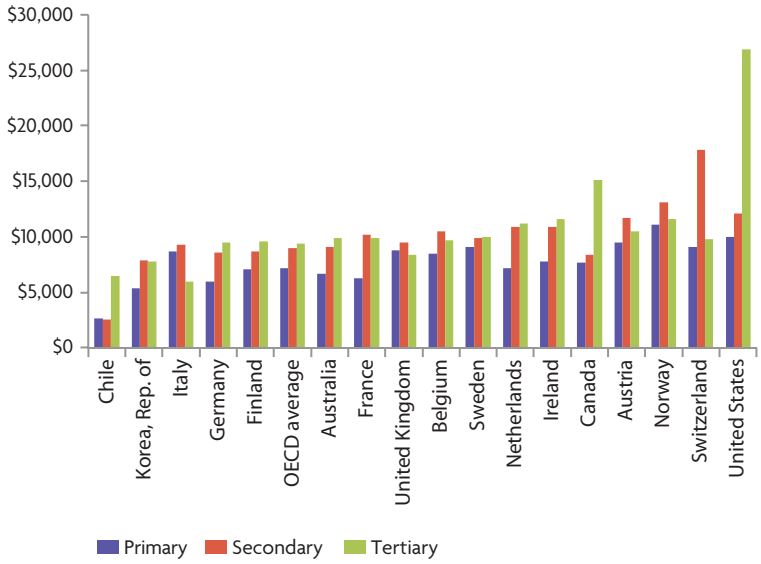
Figure 6-1: Trends in Freshman STEM Enrollment, 1993–2008
(thousands)



- Policies that dictate class size and staffing ratios should be eliminated and replaced with policies that reward and retain high-performing teachers. Although small class size can be beneficial, it is not as powerful as having a high-quality teacher in the classroom.
- States should eliminate mandated pay for longevity and education and instead tie compensation to factors such as effectiveness, student performance, and job responsibilities. Financial incentives that are designed to recruit, retain, and reward high-performing STEM teachers fall under this strategy.
- States and districts should leverage outside partners and technology. Strategies that create charter STEM schools with outside funds and build institutions to support STEM teachers reflect this approach.

A number of states also are pursuing separate initiatives to rein in postsecondary costs and provide more cost-effective options to students. These include articulation agreements among institutions, early college credit opportunities, and shifting resources to institutions that meet certain degree and efficiency targets (see Chapter 5). More will be needed to raise postsecondary productivity, however.

Figure 6-2: Per Capita Education Spending, 2008
(selected countries)



Taking Stock

This is an opportune time for governors to take stock of their STEM initiatives. As state economies begin to recover from the recent recession, it is important to harmonize the STEM education agenda with the state's economic agenda. Governors should ask the following questions:

- Are we producing the correct number of degrees and certificates to meet the job demands of specific industries in the region?
- Is our educational system providing a seamless trajectory from K–12 through all postsecondary institutions to allow students to efficiently and cost-effectively build the skills they need for STEM careers?
- Are we taking advantage of all the opportunities and resources available from the various public, private, and philanthropic institutions providing support to the STEM agenda?

Answering these questions requires working closely with the private sector, P–20 councils, the philanthropic community, and all components of the state's educational system. By coordinating resources, leveraging public and private dollars, achieving greater system efficiencies, and creating partnerships, states can drive a strong STEM agenda, often without new investments. With a strategic plan to create a more STEM-capable workforce, the path to economic growth grows clearer.

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