

**Governor's Commission
on College and Career Success
Commonwealth of Pennsylvania**

Final Report

December 22, 2006

Commission on College and Career Success

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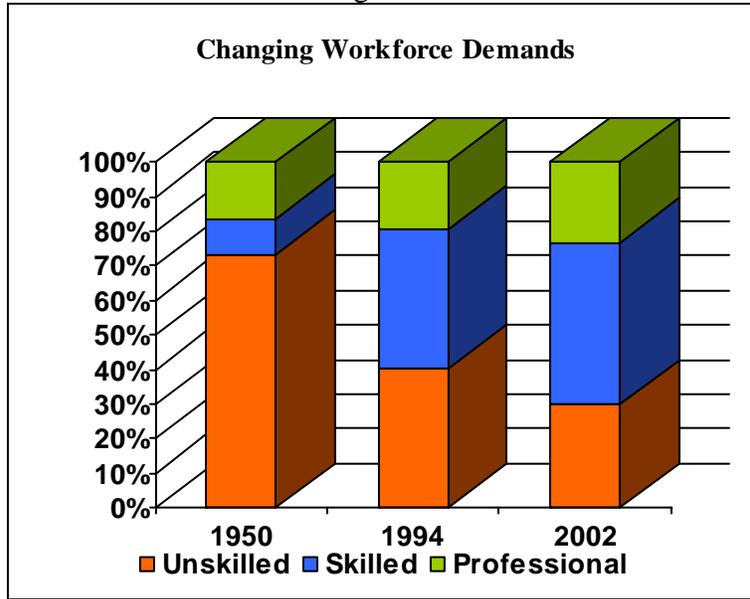
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Introduction

Globalization has arrived in Pennsylvania, with significant implications for business and education alike. Gone are the days when workers enjoyed a career in a single industry, perhaps even with a single employer, where the biggest competition they faced for jobs came from the town at the other end of the county. Instead, like never before in history, today's workers find themselves competing for jobs with other qualified applicants from around the world. Jobs once thought to be permanent bulwarks of the American economy have moved overseas, where tasks can be performed less expensively and with the same results. This means that not only are Pennsylvania students competing with those from Indiana and Ohio for jobs after graduation; they are also competing with students from Singapore and Hong Kong. In short, if Pennsylvania is to compete—and win—in the global economy, our students must be world-class. We have a long way to go to achieve this goal, both as a nation and as a commonwealth. Most research that compares U.S. students with their international peers shows us falling further and further behind. Even our highest performing students lag behind their international peers. Research conducted by the *Organization for Economic Cooperation and Development* (OECD) shows that the U.S. ranks 23rd out of 29 OECD countries in math achievement.

Not only have the competitors changed, but the rules of the game itself have changed as well. Many of the old unskilled jobs of mills, mines, and the field have been outsourced to other countries; and those that remain require a highly trained workforce, as can be seen in Figure 1 below. Whereas only 30% of jobs required skilled or professional labor in 1950, that proportion has risen to about 70% in 2002. In fact, we have moved beyond the “Information Age” to an era that can best be described as the “Conceptual Age.” It is no longer sufficient to train our citizens to merely absorb and adapt to new information; instead, we must develop and produce new knowledge ourselves if we are to maintain our position in the global economy.

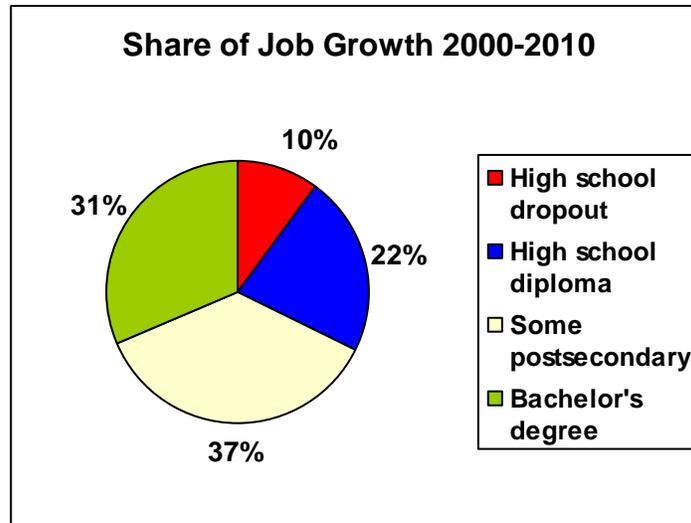
Figure 1.



Source: U.S. Bureau of Census and Pennsylvania Department of Labor and Industry, Center for Workforce Information and Analysis (Pennsylvania statewide)

This trend promises to continue in the coming years. As Figure 2 illustrates, by 2010, two-thirds of all new jobs created will require at least some postsecondary education. For those entering the job force directly from high school, stronger math, reading and technical skills will be needed to succeed. The picture is clear: our economy demands that more students graduate from high school with the skills needed to directly enter the new economy; or ready to enter and succeed in college.

Figure 2.



Source: Carnevale, Anthony P. and Donna M. Desrochers, *Standards for What? The Economic Roots of K-16 Reform*, Educational Testing Service, 2003.

These trends mean that low-skilled employment is fast becoming a thing of the past. The academic distinctions that had once been made between students going to college and those planning to go directly into the labor market are no longer useful. ACT's latest research provides empirical evidence that high school graduates need to be educated to a comparable level of readiness whether they plan to enter college or workforce training programs." (Ready for College and Ready for Work, p 2). In essence, the commonwealth must prepare all students to go to college, whether they choose to attend or not, as they will need "college level" skills and knowledge no matter what their choice.

This will require a radical shift in how we teach our students and what we expect of them. Most high school students (94%) expect to attend college at some time during their lives (US Department of Education, 2003). However, we know that many of these students never make it. In all of our districts, too high a percentage of students drop out. Fewer still manage to complete college—only 28% of ninth graders are estimated to graduate from college. (National Center for Public Policy and Higher Education, 2004). We must build the educational pathways that will make college attendance possible for all high school graduates.

Bringing our Schools into the 21st Century

Over the course of the last century, our changing economy has placed increasing demands on the high school experience. The American high school transformed from an elite college-preparatory institution that served only 10% of the population in 1910 to a large, inclusive socializing and sorting mechanism that serves 92% of the population but still prepares only a small fraction of students for college-level work. This misalignment of expectations between a high school designed for the industrial age, and the skills and knowledge needed for the information age, is no place more evident than in the state of Pennsylvania. Employers tell us they are being forced to lower their standards just to fill their empty positions. In fact, 82% of the businesses surveyed by the *Business Calling Program* since 2003 say they are having difficulty recruiting the skilled workforce they need. These results mirror those found in national surveys as well. In the latest in a series of national reports on this issue, *Are They Really Ready to Work*, a survey of four hundred top employers in the US reveals that over 40% of employer respondents rate the overall preparation of high school graduates for the entry-level jobs they fill as "deficient." And one third of all companies provide remedial basic skills training to bring recent graduates up to workplace expectations.

The booming industrial economy of 20th century America allowed nearly everyone with a strong back and a willingness to work to find employment with an income that could comfortably sustain a family. But as our economy has changed, our schools have not kept pace. In fact, the high schools that served America during the industrial age so well are still substantially in place today; but they cannot deliver a workforce that capable of meeting the demands of the global economy of the 21st century.

Colleges and universities are in a similar situation. Approximately 30% of all high school graduates entering college require at least some remediation (National Center for Education Statistics, 2003). And the one hundred and forty college professors that we worked with told us

they are often forced to teach material that they consider pre-college level by everyone's standards. Remediation in college is expensive both for the commonwealth but also for students, since they are less likely to obtain a college degree than those who do not require remediation.

In short, about 30-40% of our high school graduates are not ready for their next steps in life. (Rising to the Challenge: Are High School Graduates Prepared for College and Work? 2005). This is not just a personal loss for those individual students; it also constitutes an unbearable and unnecessary burden for the state.

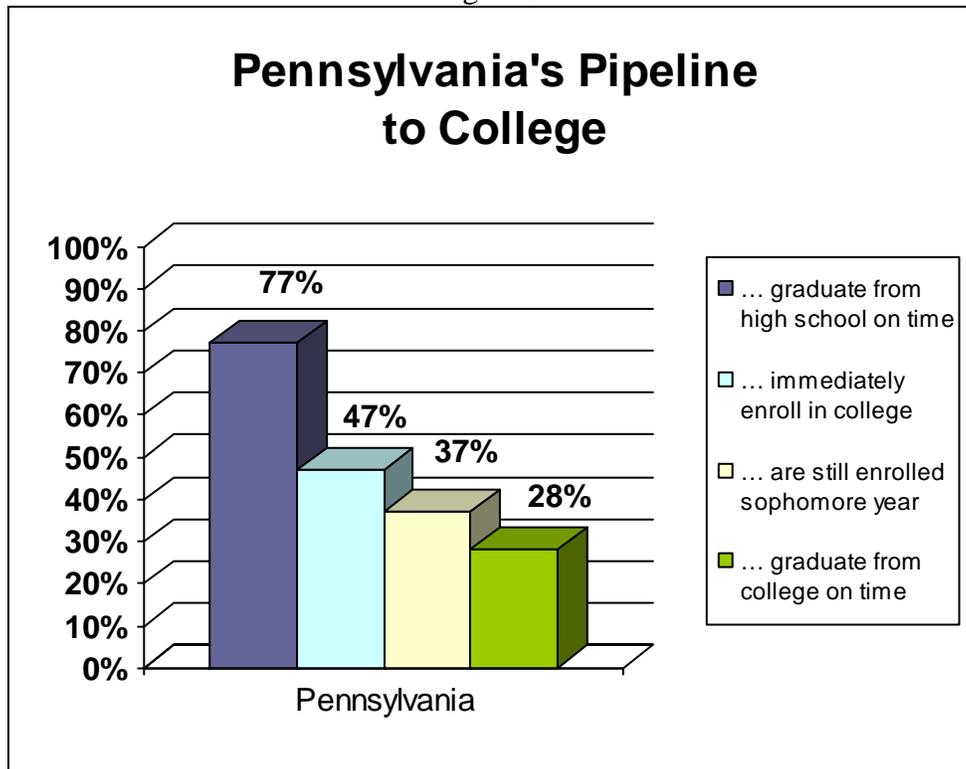
The Good News

Pennsylvania has a strong foundation on which to build. First, it is an educational pioneer among states, leading the charge to develop a standards-based system of instruction. This step has meant abandoning the all-too-familiar bell curve of relative achievement, and replacing it with uniformly high expectations for all students. Pennsylvania's standards are rigorous, comparable to the best in the world, and, if achieved by high school students, set graduates on pace to be extremely qualified to compete in today's international job market. The test currently used to measure the achievement of these standards at the high school level, the 11th grade Pennsylvania System of School Assessment (PSSA) exam, is a valid predictor of a student's readiness to succeed in current college-level work or entry-level jobs (Human Resources Research Organization, 2005). In fact, if a student performs at proficient or above on the 11th grade PSSA, they have a 90% chance of placing directly into college-level courses with no need for remediation. This system of standards-based education seems to be yielding fine results for our students through middle grades.

The Bad News

But in Pennsylvania, as in other states, increased standards have not yet yielded consistent results at the high school level. Student achievement has clearly improved at the elementary and middle-school level; but these improvements have not translated into across-the-board increases in high school performance. As can be seen in Figure 3, approximately one quarter of our students do not graduate from high school on time; and of those that do, less than half enroll in college upon graduation. Only 37% make it to their sophomore year, and less than one-third graduate from college on time. In short, Pennsylvania's educational pipeline is leaking with no low skill jobs paying reasonable wages to catch those students who do not make it through.

Figure 3.



Source: National Center for Public Policy and Higher Education, Policy Alert, April 2004. Data are estimates of pipeline progress rather than actual cohort.

Addressing the Problem

What follows are 12 policy recommendations designed to move Pennsylvania towards increasing the educational achievement of all of its students to meet the challenges of a 21st century economy and the requirements for productive citizenship.

The Commission recognizes that these 12 recommendations require that Pennsylvania not only increase the academic proficiency of its graduates, *but also do so while graduating more of its students*. This dual agenda is the only responsible route to take, given the lack of good jobs for those who do not have a diploma, and the needs for a robust 21st century Pennsylvania economy that includes a future tax base sufficient to support the needs of an increasingly aging population.

The Commission wishes to make one fact abundantly clear – there are currently tremendous inequities in our educational system. The data shows inequity by ethnicity, socio-economic status, and location at both the secondary and post-secondary levels (Education Trust, 2006). These persistent gaps are ensured by inequity of funding and resources which results in less credentialed teachers in front of our poorest children, larger class sizes and less college counseling for our children of color and less access to higher education for our rural students. (Graphs 15,16) A deep statewide commitment to the systemic implementation of this report's recommendations will lessen these inequities over time better than any single program could.

Lastly, the Commission recognizes that properly implementing these 12 recommendations will require new strategic educational investments. These new investments, however, will likely yield enormous returns. Governor Rendell's administration, together with the Pennsylvania Legislature, have already demonstrated their commitment to improving high schools as evidenced by their support of Project 720, Dual Enrollment, Classrooms for the Future, and improvements in college and career counseling. These are important first steps—steps that Pennsylvania can now build upon.

Recommendations

In August 2005, Governor Rendell asked a group of educators, business representatives, and educational advocates to come together as the Governor's Commission of College and Career Success. Much as the name suggests, the task before the Commission was to review research and make recommendations to ensure that today's high school graduates are prepared to be the citizens and workers that the commonwealth's economy demands. The Commission's specific charge was to:

- Create clear and consistent signals and policies for Pennsylvania's expectations for high school success.
- Conduct qualitative and quantitative research, which includes Pennsylvania, national and international studies.
- Create incentives for school districts to increase academic achievement in high school and higher education to increase retention through the first two years of postsecondary education.

For the last 18 months the Commission has heard from national experts, examined state data and spoken with hundreds of Pennsylvanians in order to determine what specific steps high schools, employers and postsecondary institutions needed to take to assure that Pennsylvania was preparing all students to meet with postsecondary and career success. While Pennsylvania was a national leader in some areas, in others, it was clear that all stakeholders needed to dramatically rethink both what our high schools ask of students and what sort of supports are provided to them. The demands placed on today's students are greater than ever before, and Pennsylvania needs an education system that understands today's changing economy and is nimble enough to meet students where they are and ensure that they graduate from high school college- and career-ready.

The Commission believes that raising graduation standards is imperative to ensuring a bright economic future for our commonwealth and its citizens. It is the Commission's belief that the following 12 recommendations provide a roadmap that will enable policymakers, high schools, postsecondary institutions, employers, parents, and students to confront the challenge of redesigning the Pennsylvania high school experience head on and emerge with the high quality workforce that our economy demands.

Recommendation 1

Require all Pennsylvania high school students to demonstrate proficiency on Pennsylvania's academic standards to graduate. Students can demonstrate proficiency by scoring proficient or advanced on the 11th grade PSSA or by passing a series of state-developed Graduation Competency Assessments.

The Commission recommends that the state require all students to take a progressive series of Graduation Competency Assessments (GCAs) within each of four major content areas: math (including but not limited to content traditionally instructed through Algebra II); English/Language Arts (demonstrating reading comprehension and written communication skills); laboratory science; and American History, Economics and Government. By linking these assessments more closely to the content covered in a rigorous college and work-ready curriculum, Graduation Competency Assessments allow in-depth assessment in each major subject area, and provide feedback to both students and teachers regarding a student's progress towards meeting state standards in these content areas. Assessments must be offered at least two times per year to maximize opportunity for students to succeed. Students should be able to take assessments as soon as they believe they have reached proficiency in a content area, even if they have yet to enter high school.

Currently, the Pennsylvania State Board of Education requires students to be proficient on the Pennsylvania standards prior to graduation. The regulations allow two methods of showing proficiency: performing proficient or better on the PSSA; or demonstrating proficiency on an equivalent local assessment. The local determination of equivalency does not ensure a common, statewide graduation standard. As we continue our transition to a 21st Century economy, where competition is international, not only inter- and intra-state, we need to make sure that the state as a whole is consistently producing high quality graduates. For this reason, the Commission recommends replacing the local assessment option with a series Graduation Competency Assessments.

While this recommendation provides two pathways for every student to reach graduation--proficiency on the 11th grade PSSA or passage of the GCAs—the Graduation Competency Assessments must be used by every district with every student. The urgency of this recommendation cannot be overstated. While achieving full development and phase-in of all GCAs may take up to five years, removing the local assessment option and rollout of initial GCAs should begin as soon as possible. This will allow sufficient time for the Pennsylvania Department of Education to develop appropriate, high quality assessments in all subject areas while at the same time providing schools with the latest assessments as soon as they are available. Such a phase-in will also allow schools the time that they need to transition to such a rigorous core curriculum for all students.

Requiring students to pass a set of Graduation Competency Assessments in order to graduate from high school will both ensure high graduation standards, and equip districts with the information they need to provide timely intervention to those students falling behind. In particular, this strategy has the following positive educational advantages:

- *Graduation Competency Assessments give districts timely information on student progress towards proficiency.* Because the tests can be taken as soon as the content area is mastered, most students will not have to wait until 11th grade to take them. As a result, test results can serve as an early indicator of progress; and deficiencies can be identified and addressed in a timely manner with targeted tutoring and other interventions.
- *Graduation Competency Assessments provide a more in-depth assessment on each subject area than can a single comprehensive exit exam.* Comprehensive exams, such as the PSSA, test students on a range of subjects, and due to time constraints include relatively few questions on each subject. In contrast, Graduation Competency Assessments provide schools with the opportunity to test students on a range of subjects individually, allowing for more in-depth examination of student mastery.
- *Graduation Competency Assessments can be graded by practitioners in Pennsylvania.* The Commission recommends that Graduation Competency Assessments be developed at the state level, so as to ensure uniformity across districts. The Commission also recommends that the exams be graded regionally within Pennsylvania. This practice will ensure that teachers are intimately familiar with student performance in both their own districts and in others as well.
- *Graduation Competency Assessments provide an excellent tool for credit recovery and completion for students who have failed to graduate and are returning to complete their high school education.* The results of Graduation Competency Assessments become a permanent part of a student's academic record (see Recommendation 2). As a result, if a student must leave high school for any reason or transfer to another high school, then these exams will indicate which subjects a student has mastered, and which areas require additional work.

The Commission also recommends that the Pennsylvania Department of Education investigate the best means of aligning Graduation Competency Assessments with the requirements of the federal No Child Left Behind Act, particularly Annual Yearly Progress (AYP) to ensure that Pennsylvania has a coherent system of assessment from both a state and federal perspective.

Recommendation 2

Require all school districts to record PSSA scores and Graduation Competency Assessments on all student transcripts, and further recommends that postsecondary institutions and employers in the commonwealth be encouraged to use this information for admission, placement and employment.

One of the most important outcomes of increasing the rigor of Pennsylvania’s high school curriculum is that a high school diploma once again becomes a meaningful credential. Given the other recommendations put in place by this Commission that serve to dramatically increase the demands on high school students, it is important that the achievements of Pennsylvania students be recognized. The commonwealth must be at the forefront of ensuring that the products of its educational system—students—are backed by a meaningful credential that is used by employers as well as college admissions officers when making decisions about a student’s postsecondary future.

By including both PSSA scores and the GCA results on these transcripts, the state will ensure that the high school diploma includes detailed, meaningful information for employers and college admissions officers to review. The information pertaining to Graduation Competency Assessments will provide all stakeholders with specific data related to any skill set that each may desire to focus on.

Including test completion information on the diploma will also assure that students understand the importance of these exams. By making the results of these scores a permanent part of the academic record that employers and colleges actually use, the state will ensure that students understand the importance of these exams. Similarly, when colleges and employers use the results of these examinations for determining which students to admit or hire, they will also create clear expectations for students and be more deeply committed to ensuring continued alignment between high school exit standards and postsecondary expectations.

Industry needs the diploma to have substantive meaning. We want to know that if a prospective employee has graduated from a Pennsylvania high school, s/he can read, communicate, compute and problem-solve at a high level. It is inefficient and costly for us and the region to re-teach the basics to someone with a diploma in their hand. Moreover, it limits the person's employability prospects."

Jennie Rodriguez-Ortiz
Manager - Employment and Diversity
Carpenter Technology Corporation

Recommendation 3

Accept the definitions of college and career ready in mathematics, English and science developed by the Commission for use in the review of standards, development of assessments, and development of curriculum.

With the help of Achieve, a non-profit educational policy organization, the Commission has developed subject specific definitions of college and career readiness, College and Career Essentials, that have been drafted and vetted in consultation with businesses and colleges across Pennsylvania. After comparing the American Diploma Project (ADP) benchmarks with Pennsylvania standards, in January and February of 2006 the Commission held five days of regional workshops with faculty from all sectors of the higher education community. Faculty were asked to define college-ready in math and English. Meeting at Penn State University, La Salle University and La Roche College the Commission collected input from 140 faculty from community colleges, state system universities and major search universities. Faculty represented a variety of disciplines and taught courses to a broad range of incoming freshmen.

After developing these definitions, the Commission met with business leaders from across the state and invited their comments on the proposed definitions and standards, and asked as well for their suggestions as to how to include any other necessary elements that might have been overlooked.

While the work for the development of College and Career Essentials in math and English has been complete, the Commission is still working to develop such definitions for science. As the national work on defining college and career ready in science is not at the same point as math and English, the Commission's work in this area had to follow a different trajectory. Finishing this task will be imperative to establishing a vetted definition of college and career ready in science. As such, the Commission urges the Pennsylvania Department of Education to complete this work.

In order to infuse these College and Career Essentials into math, English and science into the curriculum offered in the state's 501 school districts, the Commission urges these essentials to guide the State Board of Education as part of their regular review of already-established standards, which will in turn have implications for the 11th grade PSSA and the ECAs. Additionally, we encourage colleges, universities and other postsecondary institutions to consult these Pennsylvania College and Career Essentials in math, English and science when they design and review their placement exams. These documents, created through consensus building with Pennsylvania higher education faculty members, can be helpful in sending a clearer message to students by aligning assessments preK-16.

Finally, we urge the Department of Education and the State Board of Education to communicate these College and Career Essentials broadly in both the current educator version and an abridged public version to ensure broad understanding and attention. These Essentials are the definition of what a Pennsylvania high school graduate must know to be prepared for post-graduation success. Therefore, students and parents must have access to the Essentials and understand their importance.

Recommendation 4

Expand the definition of college and career ready content areas to include social studies and develop model curricula and Graduation Competency Assessments in this area in addition to the standards, curriculum, and evaluations that support math, science and language arts.

The Commission recognizes that the mastery of American constitutional governance is essential to the development of individuals capable of contributing productively to the nation and the commonwealth as informed and engaged citizens. Although not originally the primary focus of the Commission, the weight of our deliberations convinces us that social studies are a necessary and essential component of the academic preparation all Pennsylvania students must have to succeed in college and career.

Current research commissioned by the National Conference on Citizenship - a non-profit and non-partisan organization chartered by the U.S. Congress - finds that "the nation's civic health shows a steep decline over the last 30 years." Their findings were reported in 2006 in *America's Civic Health Index: Broken Engagement*. The conclusions reached in this report were consistent with concerns raised by the 1998 blue ribbon National Commission on Civic Renewal.

The Civic Health Index report notes "a growing civic divide between those with a college education and those without one, with a particularly substantial gap between college graduates and high school dropouts." Further, it would be unwise to assume that students in colleges and universities will receive the necessary civic instruction. The Intercollegiate Studies Institute National Civic Literacy Board's 2006 study, *The Coming Crisis in Citizenship* reports that college seniors scored on average just 1.5 percent higher than freshmen when tested on the basics of American government, economics, political science and history. Students must develop a clear understanding of their citizenship roles well before entering college and must be expected to understand citizenship regardless of whether they attend college.

Unless these trends are stemmed, success in math, science, and language arts alone will be insufficient to support college and career success. Like language arts, science, and math, formal education in social studies provides a foundation for citizenship. Without democratic capacity, our students will not be able to succeed in the 21st Century's political, economic, and social climate. It is imperative that the State develop a common definition of career and college readiness (which we would describe as citizenship-readiness) in Social Studies; that academic standards be developed that support a citizenship-readiness definition; and that all students be required to demonstrate proficiency in these Social Studies.

Recommendation 5

Develop preK-12 model curricula, including inquiry-based pedagogy, through which students can achieve academic standards and proceed on track to demonstrate proficiency on PSSA and Graduation Competency Assessments.

The Pennsylvania Department of Education should create innovative, model preK-12 curricula that blend theory and practice and are aligned with College and Career Essentials as established by this Commission. The development of the curriculum should incorporate hands-on, inquiry-based pedagogy. PDE should offer state sponsored professional development for teachers and principals on the implementation of this curriculum. This state support will enable all school districts to have access to a high quality curriculum that they can build upon and enhance as they so choose.

The importance of offering all students the highest quality curriculum cannot be overstated. A rigorous curriculum has been shown to increase student performance across the board. In *Ability Grouping and Student Learning* (2002), Maureen Hallinan finds that students, regardless of ability level, consistently perform better in more challenging coursework. Cliff Adelman's *Answers in the Tool Box* (1999) and the Southern Regional Education Board's *Middle Grades to High School: Mending a Weak Link* (2002) echo these findings for students regardless of ethnicity or socio-economic status. In fact, a solid high school curriculum might be called the great equalizer. Yet, the development and updating of such curricula for all grades is a monumental undertaking, which many districts cannot perform due to limited resources.

The Commission also recommends that the curriculum include supports for junior/senior year options, which allow students to experience post-secondary environments, such as dual enrollment. The Commission applauds the new Dual Enrollment program launched by Governor Rendell, and encourages its growth as well as recommending a similar statewide initiative in junior/senior year career internships. Pennsylvania students need to learn the Pennsylvania academic standards through real world examples, applications and experiences both inside and outside the classroom.

The commonwealth requires students to complete a senior year project in order to graduate. The Commission affirms this as a very important component of the high school. Both the national experts we consulted with, and the business members and faculty members we heard from underscored the importance of business project/research project development and management. The skills necessary to perform well in projects (problem-solving and written and oral communication) are best understood and evaluated in this manner as opposed to standardized testing. However, the quality of project support and grading seems to vary widely from district to district. A review of the guidelines related to the completion of state projects as well as the implementation of the effort should be conducted. To bring more support to districts in this area, the Commission recommends that the State Board and PDE develop supports, including scoring rubrics, professional development focused on project development and easily available exemplar projects, to schools as they increase the rigor of their expectations of senior projects.

Recommendation 6

Develop and implement a preK-16 student information system that is designed to collect information on student performance.

Making policy changes without having the data to understand their effect is akin to flying an airplane blindfolded. We must understand how our students are faring as they progress through the educational system; and we must know what factors predict success or, alternatively, place students at risk.

In 2005, the Bill and Melinda Gates Foundation launched The Data Quality Campaign, a national effort aimed at improving the collection, availability and use of high-quality, statewide educational data systems. As their most recent report states, “good information is critical to both the processes and outcomes of a high-performing education system...It is widely acknowledged that vital policy conversations now under way—conversations about increasing the rigor and relevance of high school, improving teacher quality, promoting higher graduation rates and reducing achievement gaps among student populations—cannot be successful unless they are informed by reliable longitudinal data.”

In Pennsylvania, a preK-16 single unit record data system will be critical to ensuring that the recommendations proposed by the Commission are having the intended effect. Such a system will allow us to track student performance over time within the preK-12 system and also allow us to determine how students fare in the postsecondary arena. Further, a comprehensive data system will enable the preK-12 and postsecondary sectors to share data, and to work together to identify challenges associated with increasing student achievement and develop solutions. The continual feedback on student performance will enable a rich dialogue on the definition of readiness, and ensure consistent expectations across high schools and colleges.

Whenever possible, all data and analysis should be made available at the student and classroom level for education leaders in order to effectively drive curriculum, instruction, professional development and student assessments. Such data must include estimates of value added, like those currently calculated by the Pennsylvania Value-Added Assessment System (PVASS). Using data to help improve teacher and school performance will be critical to identifying student needs and ensuring that all of Pennsylvania’s students reach proficiency.

The *Data Quality Campaign* finds the benefits of longitudinal data to include the ability to:

- follow students’ academic progress by grade;
- determine the value-added and effectiveness of specific programs;
- identify consistently higher-performing schools so that educators and the public can learn from best practices; and
- focus school systems on preparing a higher percentage of students to succeed in rigorous high school courses, college and challenging jobs.

The state of Pennsylvania has already developed and is implementing Pennsylvania SecureID, which provides a unique student identifier for every student in the state’s K-12 system, thanks in part to a \$4 million grant from the United States Department of Education. This system provides an excellent opportunity for the state to expand the use of a unique student identification number both downward to preschool and upward to the college level.

Recommendation 7

Identify early on those students in danger of falling behind in their achievement of academic standards. Provide additional instruction and support services to put those students back on track for success. This early warning system should begin no later than the sixth grade.

Every year in Pennsylvania, approximately one out of five high school students fails to graduate from the high school where they began four years ago. A 2005 study conducted by Johns Hopkins University and the Philadelphia Education Fund found that 6th grade behavior and academic performance are critical early indicators of dropout risk. Their research shows that 6th grade students, who do not attend school regularly, receive poor behavior marks, or fail math or English have no more than a 10% chance of graduating on time, and only a 20% chance of graduating one year late. Before students drop out, they will typically have multiple years of low-test scores, poor behavior and weak attendance—factors that affect not only those students, but also the schools that they attend.

Aligned with the commonwealth’s PASecureID education data management initiative, districts should be required to collect data on these clearly identified risk indicators to ensure that individualized interventions occur early with students who exhibit one or more of the dropout predictors noted above. This practice will help get these students back on track to reduce the dropout rate and will also have positive impacts on students’ test scores, attendance and behavior in school.

Identifying and helping low-performing students to get back on track is essential to ensure that all students meet more rigorous expectations for performance. Middle and high school literacy programs in Boston, Alabama, and other locations demonstrate the power of identifying problems and intervening early. Talent Development High Schools, begun in 1994 and being implemented in a number of districts, including Philadelphia, provide novel programs to 9th graders with the goal of building skills to move them on to 10th grade work on time. In another example of the kind of innovation we envision, the Luzerne County Academic Assessment Tracking System joins schools, colleges, and community organizations to both identify students having difficulty staying on track and link them to programs and services designed to improve achievement and retention.

The Commission recommends that school districts work to develop intervention models that are grounded in best practices, but are tailored to the individual needs of their students, families, and communities.

Recommendation 8

Take all necessary action and expend adequate resources to redefine the role of guidance counselors and student service coordinators as school-wide facilitators of student advising to ensure that all high school students are well advised in school concerning post-graduation expectations and how to transition successfully into both college and career.

In order for students to successfully navigate the more rigorous curriculum and transition to postsecondary education or career successfully, we must reconfigure and expand the roles and responsibilities of guidance counselors and other student support service providers, beginning in middle school, during 8th grade at the very latest. To achieve this goal, the state should revise the counselor preparation program guidelines to require more expertise in postsecondary advising, as well as in facilitating school-wide advising. The curriculum of school administrator training programs should be revised to reflect these new requirements as well.

Recognizing that too often the school counselor often plays multiple roles such as vice-principal, social worker, crisis manager, or therapist, the Commission firmly believes that other staff must be assigned to these roles, including the referral of students to outside social service providers. Counselors should instead serve as an educational professional focused specifically on advising students and faculty on postsecondary matters and connecting students to needed services and postsecondary experiences. Their specific duties should include:

- Ensuring that all students are proficient on the State Career and Work Standards
- Identifying and providing information to students on requirements and expectations of the postsecondary arena
- Facilitating the use of statistical information (students demographic information, performance data, etc.) to improve school programs and services
- Connecting students to internships, dual enrollment opportunities and other activities that encourage students to experience the postsecondary world while in high school
- Utilizing the state-required senior project as an opportunity for students to find out more about careers in which they are interested while giving real-world lessons about the education they are receiving

To achieve these goals, the Commission recommends providing high-level professional development opportunities for counselors, on both a statewide and local level, geared toward assisting and educating counselors in their roles as school-wide facilitators. Districts should be encouraged to work together in regions to do in-service training for counselors, as opposed to “fitting in” their counselor to district-wide teacher training. PDE should develop a website which provides information on high quality professional development.

Recommendation 9

Establish new regional alliances of business, high schools, and higher education institutions where necessary and more fully utilize existing alliances to address specific challenges in preparing students to be college and career ready. These challenges, perhaps unique to specific regions, will be overcome most effectively with local stakeholders working in concert with statewide efforts to achieve college and career readiness.

Developing and upgrading Pennsylvania's system of education to produce college- and career-ready high school graduates who can successfully transition to and complete postsecondary studies or technical training is a statewide responsibility that will require regional collaborations with business, industry and institutions of higher education. Such regional partnerships can yield considerable return on investment by:

- Providing relevant professional development related to core subjects
- Advising school boards, administrators and teachers about college and career expectations
- Infusing school curricula with innovative instructional practices and updated content in fast-changing fields such as science, technology, business and medicine
- Facilitating communication and joint activities between teachers and college faculty
- Serving as research dissemination hubs of effective practices and school planning
- Providing students with better-informed academic and career guidance as they undertake the exciting, but often confusing, transition to career and post-secondary education.
- Sharing student performance data
- Sustaining momentum for the high school redesign agenda laid out in these recommendations
- Creating college- and career-ready expectations in students as young as 8th grade
-

Pennsylvania's local Workforce Investment Boards (WIBs) and their associated Youth Councils are uniquely positioned to accelerate these regional efforts. Successful local business education partnerships, such as the Lehigh Valley Business/Education Partnership have also proven that they can produce effective results over the long haul. In Kentucky, the Prichard Committee has sustained momentum for the state's long-term educational improvement efforts for 20 years, and has made the state a leader in demonstrating how consistent business involvement can help sustain a specific educational policy agenda. There are several creative and effective partnership models in Pennsylvania that can serve as models of school improvement infrastructures. Examples include: Science In Motion, The Math/Science Partnership of Greater Philadelphia, and the Southwest Pennsylvania Math Science Partnership. These partnerships provide a mechanism for cost-effective sharing of expensive infrastructures, materials and resources. Such savings are especially important in vocational, engineering, and laboratory science education where the cost of owning and maintaining resources can be prohibitive to individual school districts. Learning from these examples, it is clear that the state should not mandate a single partnership model, but should instead ensure that all key stakeholders are involved in each regional partnership.

Recommendation 10

Increase and enhance the number of educational options available to high school students to achieve high standards with particular attention to career and technical education.

The Commission is acutely aware that while the expectations of performance for all high school graduates must be consistent, the pathways on which students proceed to develop the knowledge and skills necessary for college and career success may be very different. That is, the high school experience does not need to be the same for all students in order to ensure that they achieve rigorous standards. Students can and do learn in very different ways, and aligning students' needs with curricular options is a key element in ensuring that all students complete their high school education ready for college and career. The diverse needs of our students should be addressed through diverse strategies, but these strategies must all be linked together by the common thread of rigor. The development of model curricula, as presented in other recommendations in this report, should generate multiple creative and promising pathways for student success. Indeed, multiple pathways are essential if we are to not simply ensure increased rigor, but also increased graduation rates.

In addition to the various pathways that might exist in any high school, Pennsylvania's career and technical schools need to be positioned to help students to achieve rigorous academic standards aligned with the economic and workforce development priorities of their region and the commonwealth. Now, more than ever before, greater numbers of career and technical school graduates enroll in postsecondary education after completing their studies. We must ensure that all CTE graduates are prepared to enter college and are well prepared to meet the needs of the economy and able to earn family-sustaining salaries and wages directly upon graduation. Lehigh Career and Technical Institute provides us with an excellent model for replication.

As Gary Hoachlander discusses in *Ready for College and Career*, all Career and Technical schools must now prepare students for both college and work. They must weave "academics and technical education into coherent programs of comprehensive, demanding preparation for post-secondary education and career." Career and technical education opportunities are available to all students in Pennsylvania—and we must ensure that these reflect the kind of programming discussed by Hoachlander. In most cases, opportunities are provided to students on a part-time basis. Fewer students are enrolled in career and technical education at a full time or comprehensive technical school. The Commission believes that part time career and technical schools must work to assure that their students are taking rigorous academic courses at the home district while students at comprehensive schools are required to take rigorous academic courses taught as part of the comprehensive school curricula.

The opportunity to develop curricula joining traditional courses and subjects with applied and workplace learning, internships and co-op assignments holds great promise. However, the success of implementing more rigorous standards to ensure that all students are college and career ready will hinge on our ability to strengthen the capacity of career and technical schools.

Recommendation 11

Facilitate the coordination of existing, and the development of new, programs designed to encourage economically and educationally disadvantaged students to attend, be retained and complete their postsecondary education programs.

Over the past two decades, efforts to increase the number of students graduating from high school and moving on to college have had some partial success. This improvement, however, has not been uniform. *A Rising Tide: the Current State of Higher Education in Pennsylvania* (2006) finds that the enrollment in postsecondary education of students of color and for students living in rural areas has not grown at the same pace as for other students in Pennsylvania. Similarly, there are clear differences in participation rates by level of family income: the higher the income, the higher the participation rate. Students and their families need more and better information about postsecondary education to inform their decisions throughout middle and high school years.

Preparation for and knowledge of options for postsecondary education is essential for all students and their families so that their educational and career choices make sense. Currently, Pennsylvania's strategy has been to employ a patchwork of federal, state and non-profit initiatives to do this work. Local and regional GEAR UP programs work to put middle and high school age students on track for college success through comprehensive counseling and support. Project Forward Leap provides middle school students with on-campus academic experiences to raise their aspirations and skills for college success. The Pennsylvania Higher Education Assistance Agency's (PHEAA) Education Planner is a powerful online tool providing college and career information and financial planning. Pennsylvania's Act 101 Programs, on more than 80 campuses across the state, provide counseling and tutoring for educationally and economically disadvantaged students for more than 30 years. But the state needs to harness these multiple efforts into a single, coordinated strategy for ensuring that all students have the information and support that they need to make informed choices about life after high school graduation.

Beyond expectations, though, low-income students are often confronted by the insurmountable obstacle of affording college. To overcome this barrier, the state, in partnership with the Pennsylvania Higher Education Assistance Agency (PHEEA), needs to develop a strategy to close the affordability gap. *Measuring Up 2006* the extremely influential report issued annually by the National Center for Public Policy and Higher Education, gave Pennsylvania and 42 other states an "F" for affordability. It takes 35% of the average annual family income to cover the costs of attending one of the state system universities, Penn State, Temple and the University of Pittsburgh after accounting for financial aid (placing Pennsylvania 47th in the nation). In Pennsylvania, as across the country, students and their families are covering an increasing percentage of the costs of public higher education. While Pennsylvania, through PHEAA, funds one of the largest need-based student aid programs in the nation, the net cost of attendance to student and families continues to grow. Ensuring that students who least can afford higher education have access to resources to cover the costs of attendance must continue to be a priority.

Recommendation 12

Build systematic approaches to re-engage and re-enroll former dropouts in high-quality programming that yields a high school diploma and leads to college and career success. The Pennsylvania Department of Education should lead this statewide effort in cooperation with other relevant commonwealth agencies.

Each year thousands of Pennsylvania students leave high school without earning a diploma. Without this most basic educational credential, these young people will struggle to maintain self-sufficiency, and are unlikely to realize their potential as productive citizens. The commonwealth, too, will suffer in terms of lower productivity and higher social services costs. By any measure, the losses associated with the failure to graduate from high school are catastrophic for these young people, for the citizens of Pennsylvania and for the overall well being of the commonwealth.

Fortunately, increasing attention is now being focused on the dropout crisis, and on efforts to re-engage former dropouts in high-quality programming that enables them to earn a diploma and prepare for successful adulthood. In *Making Good on the Promise: What Policymakers Can Do to Support the Educational Persistence of Dropouts*, Jobs for the Future recommends that dropout recovery programs begin by focusing on providing the students they serve with access to the skills that are in demand in today's 21st century economy. The commonwealth is well-positioned to become a national leader in this area by taking a series of steps that can substantially increase the numbers of young people with a high school diploma. In particular, it can do this by:

- Creating a cross-agency work group, with representatives from Pennsylvania's Departments of Education, Labor and Industry, Public Welfare, Community and Economic Development, and other relevant agencies, to identify state policy issues that create barriers to re-enrollment, and consider new approaches that ease the transition back to school and/or to high-quality alternative educational programming.
- Creating data-sharing arrangements across agencies so that disconnected young people can be tracked within and across public agencies and coordinated efforts at re-engagement and re-connection can be made efficiently and effectively.
- As a first step, focusing on high schools with the lowest graduation rates. Through its annual data collection efforts the Department of Education can identify graduation rates by high school, and should develop and help local districts to put in place a set of research-based strategies to improve them.
- Continuing to expand support for Project 720 and Dual Enrollment, particularly as they promote efforts to support struggling students and to re-engage out-of-school youth into programs.

Conclusion

Over the past 20 years, while America was busy focusing on other priorities, our economy changed substantially. Globalization, the rapid diffusion of ever-evolving technology, and rising educational levels around the world have all meant new roles for American workers, including those in Pennsylvania. In fact, we have moved beyond the Information Age to an era that can best be described as the Conceptual Age. To be successful, whether as individuals or as a commonwealth, today's new workers need to be nimble, with high-level skill-sets and the capacity to take on complex challenges. They must compete with the best and the brightest from around the world in Asia, India, and Europe. Unfortunately, these aren't the workers we are currently educating in the vast majority of Pennsylvania's schools. Walk into any high school. Chances are you will see an education system that is a mirror image of what high school was like 30 years ago. Even though many of our high schools do an excellent job at what they were designed to do in the 1950s, 60s and 70s, they are fulfilling the needs of yesterday's economy.

Such is the harsh reality that the Commission confronted time and again over the course of its work. Yet we remain hopeful, because not only have we seen high schools that are successful models of what all of our high schools need to be, but also because we are confident in the understanding we have reached about what needs to be done to get all of our high schools there. Taken together the recommendations of this Commission mean dramatic changes to the high school experience in Pennsylvania. Accomplishing even the first recommendation would be a significant step towards guaranteeing the college and career success of all of the state's students. However, if we are truly serious about transforming the high school experience for all students, we believe it is necessary to implement all 12 recommendations and to do so with a high degree of fidelity. Increasing rigor, expectations and supports will create a high challenge, high support environment in all of our high schools, where all of our students can succeed.

Fundamentally redesigning the high school experience in Pennsylvania will be difficult. It will require the collaboration of teachers, administrators, parents, students, policymakers, college faculty and employers. It will require even greater leadership from a Governor and Legislature who have already shown commitment to educational reform. And it will require that every citizen in this commonwealth recommit to providing every student in Pennsylvania with the best education possible. Failing to do so will not only foreclose opportunities for a living wage for our workforce; it will erode our overall competitiveness for jobs, sap our future tax base and thus diminish resources for every other vital government service from healthcare for the aged to rebuilding local infrastructure. But it can be done.

Every Pennsylvania student must graduate from high school college- and career-ready if our commonwealth's economy is to fulfill its promise. And it is our collective responsibility to make sure that happens. As teachers, administrators, students, legislators and most of all as Pennsylvanians, this Commission is confident in our ability to create high schools capable of offering the best in education to not just a select few, but to everyone. We hope that you will join us in this commitment.

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Appendix A.

Executive Order

***COMMONWEALTH OF PENNSYLVANIA
GOVERNOR'S OFFICE
EXECUTIVE ORDER***

Subject:

Commission on College and Career Success

Date:

August 10, 2005

Number:

2005-06

By Direction of:

Edward G. Rendell, Governor

WHEREAS, the education of all children is a moral and economic development priority for the Commonwealth of Pennsylvania; and

WHEREAS, for every 100 ninth graders in Pennsylvania only 77 graduate on time, 47 enroll in college after graduation and only 28 receive degrees; and

WHEREAS, the Commonwealth is one of only six states in the nation that fails to establish uniform graduation requirements for high school students; and

WHEREAS, the Commonwealth 46th among the states in its percentage of residents who have more than a high school diploma; and

WHEREAS, a high school graduate earns more than three times as much as a Pennsylvanian who does not graduate high school, and a college graduate earns nearly double the amount as a high school graduate earns; and

WHEREAS, the Commonwealth desires to prepare a citizenry and workforce of world-class quality that will enable industry to grow in Pennsylvania; and

WHEREAS, the Commonwealth's enacted 2005-06 Budget takes important strides in transforming Pennsylvania's high schools by providing \$4.7 million for the Project 720 High School Reform Initiative, \$5 million for dual enrollment and \$66 million for tutoring – much of which is focused on grades 7-12; and

NOW, THEREFORE, I, Edward G. Rendell, Governor of the Commonwealth of Pennsylvania, by virtue of the authority vested in me by the Constitution of the Commonwealth of Pennsylvania and other laws, do hereby establish the Commission on College and Career Success (hereinafter referred to as "Commission") as hereinafter set forth:

1. Purpose. The Commission shall:

- a. Undertake a comprehensive review of the Commonwealth's laws, regulations and policies to ascertain whether they set clear and consistent expectations for high school success to ensure that all students graduate ready for college and careers.
- b. Conduct qualitative and quantitative research, which includes Pennsylvania, national and international studies.
- c. Encourage and endorse strategies for school districts to increase academic achievement and graduation rates in high school.
- d. Encourage and endorse strategies for higher education to increase retention through the first two years of post-secondary education.
- e. Produce a final report that includes recommendations for any necessary changes to legislation, regulations and policies consistent with the mission of the Commission.

2. Responsibilities. The Commission shall:

- a. Define "college and career ready" in Mathematics, English, and Science.
- b. Examine and make specific recommendations for better alignment of academic standards and assessments across the secondary and post-secondary educational sectors as well as industry in Pennsylvania.
- c. Encourage local school districts to adopt a core high school curriculum for all Pennsylvania students.
- d. Present to the Governor a legislative and regulatory package that would address the needs outlined in their findings.
- e. Investigate policies and programs that ensure a higher number of prepared students enter and remain in our colleges and universities.

3. Composition and Appointments.

- a. The Commission's members shall be appointed by the Governor unless otherwise noted and shall consist of a wide spectrum of stakeholders that include the following:
 - (1) The Governor.
 - (2) The Secretary of Education.

(3) Three members of the State Board of Education, one of whom shall serve as vice-chair of the Commission.

(4) Three representatives of Pennsylvania higher education institutions, one of whom shall serve as co-chair of the Commission.

(5) Three representatives of the business community, one of whom shall serve as co-chair of the Commission.

(6) One local superintendent.

(7) One local high school teacher or principal.

(8) One member of a local board of school directors.

(9) Two members appointed by the Senate, one appointed by the Majority Leader of the Senate and one appointed by the Minority Leader of the Senate.

(10) Two members appointed by the House of Representatives, one appointed by the Majority Leader of the House of Representatives and one appointed by the Minority Leader of the House of Representatives.

b. A Commission member may designate an alternant to attend meetings.

c. Commission work groups, appointed by the Commission chairs and composed of select members of the Commission and others, will conduct work as designated by the Commission with the assistance of Pennsylvania Department of Education staff and consultants. Work groups and consultants will help facilitate key sessions, conduct necessary research and issue a final report. The topics and tasks of workgroups will be identified by the Commission.

d. The Pennsylvania Department of Education shall provide administrative support to the Commission.

e. A Commission member may designate an alternate to attend Commission meetings, if required.

4. Terms of membership.

a. Members of the Commission shall serve at the pleasure of the Governor.

b. Should a vacancy occur on the Commission due to resignation, disability, or death of a member, the Governor or other appointing authority, as applicable, should appoint a successor as expeditiously as possible.

5. Compensation. Members of the Commission shall receive no compensation for their services, except that members may be reimbursed for actual travel and related expenses in accordance with Commonwealth travel and subsistence policies.

6. Reports. The Commission shall issue a report containing a summary of its progress and recommendations for legislation, regulations and secondary and post-secondary policies in Pennsylvania. A preliminary report shall be produced no later than May 1, 2006, and a final report shall be produced no later than December 31, 2006.

7. Executive Agencies. All agencies under the Governor's jurisdiction shall provide assistance to the Commission as requested by the Chair(s).

8. Duration. This Executive Order shall be effective immediately.

9. Termination Date. This Executive Order shall continue in force for 18 months

Appendix B.

Commission Members

Commission on College and Career Success

Dr. Judy G. Hample (Co-Chair)
Chancellor
Pennsylvania State System of Higher Education

Mr. Daniel Fogarty (Co-Chair)
Director, Salaried Personnel and Development
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Mr. Jermaine Beaumont
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PA Partnerships for Children

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Dr. Jeremy Cohen
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Senior Associate Dean for
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The Pennsylvania State University

The Honorable Donna Cooper
Secretary of Planning and Policy
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Ms. Pamela Crawley
Senior Vice President
Director of Public Affairs
Citizens Bank

The Honorable Frank Dermody
House of Representatives
Commonwealth of Pennsylvania

The Honorable Wayne Fontana
Senate of Pennsylvania
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Associate Professor and Director
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**The Honorable Michael Nutter
Councilman
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**The Honorable Bernard O'Neill
House of Representatives
Commonwealth of Pennsylvania**

**The Honorable James J. Rhoades
Senate of Pennsylvania
Commonwealth of Pennsylvania**

**Ms. Irene Runco
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Wachovia Bank**

**The Honorable Gerald Zahorchak
Secretary
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Associate Participants

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Pennsylvania Workforce Investment Board**

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James E. Barker
Superintendent
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Councilman
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Vice President – Director Security Services Division
WorldNet Technology Consultants, A Core BTS Company

Appendix C.

Presenters at Commission Meetings

Dr. Michael Cohen, President, Achieve, Inc.

Dr. Robert Feir, Executive Director, Governor's Commission on Training America's Teachers, and former Executive Director of the State Board of Education

Mr. Michael Golden, Deputy Secretary, Office of Educational Technology, Pennsylvania Department of Education

Dr. Kenneth C. Gray, Professor of Education, The Pennsylvania State University

Dr. Katie Haycock, Executive Director of the Education Trust

Dr. Gary Hoachlander, MPR Associates, Inc.

Mr. Raymond McNulty, Senior Consultant at International Center for Leadership in Education and Executive Director of the Successful Practices Network

Dr. Lorraine Mulfinger, Associate Professor and Director for Science Outreach at Juniata College and a member of the Governor's Commission on College and Career Success

Dr. Shula Nedley, Bureau of Assessment and Accountability, Office of Elementary and Secondary Education, Pennsylvania Department of Education

Dr. Amy Hodges Slamp, Assistant to the Superintendent, Elizabethtown Area School District, and former Director of Teaching and Learning, Pennsylvania Department of Education

Ms. Jan Somerville, Staff Officer, National Association of System Heads

Dr. Adria Steinberg, Associate Vice President, Jobs for the Future

Dr. Laurence Steinberg, Professor of Psychology at Temple University

Mr. David Wakelyn, Senior Policy Analyst, National Governor's Association

Appendix D.

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Appendix E.

140 faculty members who teach freshmen at these 30 Pennsylvania colleges and universities created and reviewed the College and Career Essentials in English and Mathematics

Arcadia University
Butler County Community College
Bryn Mawr College
Community College of Allegheny County
Community College of Philadelphia
California University of Pennsylvania
Carnegie Mellon University
Drexel University
East Stroudsburg University
Edinboro University
Geneva College
Harrisburg Community College
Holy Family University
Juniata College
LaRoche College
LaSalle University
Lehigh Carbon Community College
Lockhaven University
Mansfield University
Montgomery County Community College
Northampton Community College
Pennsylvania Highlands Community College
Pennsylvania State University
St. Francis University
St. Vincent University
Shippensburg University
Slippery Rock University
University of Pittsburgh
Villanova University
West Chester University

These Corporations, Business Associations and Unions helped to create and edit the Pennsylvania College and Career Essentials in English and Mathematics.

1199C (Health Care Worker's Union)
Allied Personnel Services
AmeriCold Logistics-Bethlehem
Barry Isett & Associates, Inc
ESSROC Cement
Good Shepherd Rehabilitation Network
Greater Hotel Restaurant Association
Guardian Life Insurance
The Hartford
Lafayette Ambassador Bank
Lehigh Valley Workforce Investment Board, Inc
Lockheed Martin
Nestle Purina PetCare North America
PPL Corporation
Philadelphia Academies, Inc.
PECO
Right Management Consultants
Subaru
Sunoco

Appendix F.

Pennsylvania's College and Career Essentials in English and Mathematics

PA Benchmarks: English

A. Language – The high school graduate can:

- A1. Demonstrate control of standard English conventions for punctuation, capitalization, spelling and sentence structure.
- A2. Use general and specialized dictionaries, thesauruses and glossaries (print and electronic) to determine the definition, pronunciation, etymology, spelling and usage of words.
- A3. Use roots, affixes, cognates to determine the meaning of unfamiliar words.
- A4. Use context to determine the meaning of unfamiliar words.
- A5. Identify literary, classical and biblical allusions as well as the meaning of common idioms; use them in oral and written communication.
- A6. Recognize nuances in the meanings of words; choose words precisely to enhance communication.
- A7. Comprehend and communicate quantitative, technical and mathematical information.

B. Communication – The high school graduate can:

- B1. Give and follow spoken instructions to perform specific tasks, to answer questions or to solve problems.
- B2. Listen to information and ideas presented orally, for example, speeches, debates, lectures, dramatic presentations, meetings, briefings, oral readings, in order to:
 - B6.1. Summarize

B6.2. Paraphrase
B6.3. Analyze
B6.4. Critique
B3. Identify the thesis or proposition of a speech and determine the essential elements that elaborate it.
B4. Analyze the ways in which the style and structure of a speech support or confound its meaning or purpose.
<p>B5. Make oral presentations that</p> <ul style="list-style-type: none"> B6.1. Exhibit a logical structure appropriate to the audience, context and purpose B6.2. Group related ideas and maintain a consistent focus B6.3. Include smooth transitions B6.4. Support judgments with sound evidence and well-chosen details B6.5. Make skillful use of rhetorical devices B6.6. Provide a coherent conclusion B6.7. Employ proper eye contact, speaking rate, volume, enunciation, inflection and gestures to communicate ideas effectively
<p>B6. Participate productively in self-directed work teams for a particular purpose (for example, to interpret literature, write or critique a report, solve a problem, make a decision), including:</p> <ul style="list-style-type: none"> B6.1. Posing relevant questions B6.2. Listening with civility to the ideas of others B6.3. Taking relevant notes B6.4. Extracting essential information from others' input B6.5. Building on the ideas of others and contributing relevant information or ideas in group discussions B6.6. Consulting texts as a source of ideas B6.7. Gaining the floor in respectful ways

B6.8. Defining individuals' roles and responsibilities and setting clear goals
B6.9. Acknowledging the ideas and contributions of individuals in the group
B6.10. Understanding the purpose of the team project and the ground rules for decision-making
B6.11. Maintaining independence of judgment, offering dissent courteously, ensuring a hearing for the range of positions on an issue and avoiding premature consensus
B6.12. Tolerating ambiguity and a lack of consensus
B6.13. Selecting a leader/spokesperson when necessary
C. Reading – The high school graduate can:
C1. Demonstrate fluency in the oral and silent reading of everyday texts that adults encounter
C2. Choose a stance toward the text according to the reader's purpose and the genre of the text.
C3. Adjust reading strategies according to reading purpose and the demands of the text
C4. Engage in reading, writing and speaking as interconnected processes.
C5. Construct a close reading, in writing, of a passage by paying attention to its language, syntax, tone and context
C6. Identify and define a text's key terms and concepts as the writer uses them throughout the essay
C7. Examine a text's ideas and examples in relation to personal experience or other texts (print or electronic media)
C8. Ask critical questions about the ideas, examples and assumption of a text.
D. Writing – The high school graduate can:
D1. Plan writing by taking notes, writing informal outlines and researching.
D2. Select and use formal, informal, literary or technical language appropriate for

the purpose, audience and context of the communication.
<p>D3. Organize ideas in writing with</p> <p>D10.1. An introduction that presents a thesis statement, research question or project statement</p> <p>D10.2. Well-developed body paragraphs or sections arranged in a logical order</p> <p>D10.3. A conclusion</p> <p>D10.4. Transitional sentences or elements to create a coherent whole</p>
<p>D4. Drawing on readers' comments on working drafts, revise documents to develop or support ideas more clearly, address potential objections, ensure effective transitions between paragraphs and correct errors in logic.</p>
<p>D5. Proofread and edit one's own work and the work of others for</p> <p>D10.1. Grammar</p> <p>D10.2. Style and tone appropriate to audience and purpose</p> <p>D10.3. Context</p>
<p>D6. Use sources responsibly and ethically:</p> <p>D10.1. Cite print or electronic sources properly when quoting, paraphrasing, or summarizing</p> <p>D10.2. Document sources using a bibliography, list of references or works cited</p>
<p>D7. Determine how, when and whether to employ technologies (such as computer software, photographs and video) in lieu of, or in addition to, written communication.</p>
<p>D8. Present written material using basic software programs (such as Word, Excel and PowerPoint) and graphics (such as charts, ratios and tables) to present information and ideas best understood visually.</p>
<p>D9. Write an academic essay (for example, a literary analysis, or critical argument) that:</p> <p>D10.1. Develops a thesis or sets up a project</p> <p>D10.2. Creates an organizing structure appropriate to purpose, audience and</p>

context
<p>D10.3. Includes relevant information and excludes extraneous information</p> <p>D10.4. Makes valid inferences</p> <p>D10.5. Uses relevant graphics (e.g., maps, charts, graphs, tables, illustrations, photographs) and formatting techniques (e.g., headings, graphics) to aid reader understanding</p> <p>D10.6. Supports judgments with relevant and substantial evidence and well-chosen details from primary and secondary materials</p> <p>D10.7. Cites sources correctly and documents quotations, paraphrases and other information using a standard format</p> <p>D10.8. Provides a coherent conclusion</p>
<p>D10. Produce work-related texts (for example, memos, e-mails, correspondence, project plans, work orders, proposals, bios, and resumes) that:</p> <p>D10.1. Address audience needs, stated purposes and context</p> <p>D10.2. Translate technical language into non-technical English</p> <p>D10.3. Include relevant information and exclude extraneous information</p> <p>D10.4. Use appropriate strategies, such as providing facts and details, describing or analyzing the subject, explaining benefits or limitations, comparing or contrasting, and providing a scenario to illustrate</p> <p>D10.5. Anticipate potential problems, mistakes and misunderstandings that might arise for the reader</p> <p>D10.6. Create predictable structures through the use of headings, white space and graphics, as appropriate</p> <p>D10.7. Adopt a customary format, including proper salutation, closing and signature, when appropriate</p>
<p>E. Research – The high school graduate can:</p>
<p>E1. Define and narrow a research problem/project and identify the audience.</p>
<p>E2. Locate, gather and organize relevant information from a variety of print and electronic sources, as well as from direct observation, interviews and surveys.</p>

E3. Use key words, Boolean operators, and advanced search protocols to locate information from electronic databases, indices, data sets and other reference materials.
E4. Make distinctions about the credibility, reliability, consistency, strengths and limitations of resources, including information gathered from Web sites.
E5. Report findings within prescribed time and/or length requirements, as appropriate, using various forms of media.
E6. Write an extended research essay or report (approximately 6 to 10 pages), building on primary and secondary sources, that <ul style="list-style-type: none"> E6.1. marshals evidence to address a research question, support a clear thesis and related claims, or carry out a stated project E6.2. paraphrases and summarizes with accuracy and fidelity the range of arguments and evidence pertinent to the research project, as appropriate E6.3. synthesizes materials from sources and original ideas E6.4. cites sources correctly and documents quotations, paraphrases, and other information using a standard format E6.5. develop a set of reasonable conclusions from the research and justify your choices.

F. Logic – The high school graduate can:

F1. Distinguish among facts and opinions, evidence and inferences.
F2. Identify false premises in an argument.
F3. Describe the structure of a given argument; identify its claims and evidence; evaluate connections among evidence, inferences and claims.
F4. Evaluate the range and quality of evidence used to support or oppose an argument or position.
F5. Recognize common logical fallacies, such as the appeal to pity (argumentum ad misericordiam), the personal attack (argumentum ad hominem), the appeal to common opinion (argumentum ad populum) and the false dilemma (assuming only two options when there are more options available); understand why these

fallacies do not prove the point being argued.
F6. Analyze and critique written or oral communications for false assumptions, errors, loaded terms, caricature, sarcasm, leading questions and faulty reasoning.
F7. Understand the distinction between a deductive argument (where, if the premises are all true and the argument’s form is valid, the conclusion is inescapably true) and inductive argument (in which the conclusion provides the best or most probable explanation of the truth of the premises, but is not necessarily true).
F8. Analyze two or more texts addressing the same topic to determine how authors reach similar or different conclusions.
F9. Construct arguments (both orally and in writing) that: <ul style="list-style-type: none"> F9.1. Develop a thesis that demonstrates clear and knowledgeable judgment F9.2. Structure ideas in a sustained and logical fashion F9.3. Use a range of strategies to elaborate and persuade, such as descriptions, anecdotes, case studies, analogies and illustrations F9.4. Clarify and defend positions with precise and relevant evidence, including facts, expert opinions, quotations and/or expressions of commonly accepted beliefs and logical reasoning F9.5. Anticipate and address the reader’s concerns and counterclaims F9.6. Provide clear and effective conclusions
G. Informational Text – The high school graduate can:
G1. Follow instructions in informational or technical texts to perform specific tasks, answer questions and/or predict and solve problems.
G2. Identify the main ideas of informational text and determine the essential elements that elaborate them.
G3. Summarize informational and technical texts, reflect on what is read or heard and explain the visual components that support the text.
G4. Distinguish between a summary and a critique.
G5. Interpret and use information in maps, charts, graphs, time lines, tables and

diagrams.
G6. Identify interrelationships between and among ideas and concepts within a text, such as cause-and-effect relationships.
G7. Synthesize information from multiple informational and technical sources.
G8. Draw conclusions based on evidence from informational and technical texts.
G9. Analyze the ways in which a text’s organizational structure supports or confounds its meaning or purpose.
G10. Recognize the use or abuse of ambiguity, contradiction, paradox, irony, incongruities, overstatement and understatement in text and explain their effect on the reader.
G11. Evaluate and critique informational and technical texts and public documents for their clarity, simplicity and coherence and for the appropriateness of their graphics and visual appeal.

H. Media – The high school graduate can:

H1. Evaluate the aural, visual and written images and other special effects used in television, radio, film, the Internet, and other media for their ability to inform, persuade and entertain (for example, anecdote, expert witness, vivid detail, tearful testimony, humor and other strategies).
H2. Examine the intersections and conflicts between the visual (such as media images, painting, film and graphic arts) and the verbal.
H3. Recognize how visual and sound techniques or design (such as special effects, camera angles and music) carry or influence messages in various media.
H4. Apply and adapt the principles of written composition by creating coherent media productions using effective images, text, graphics, music and/or sound effects — if possible — and present a distinctive point of view on a topic (for example, PowerPoint presentations, videos).

I. Literature – The high school graduate can:

I1. Demonstrate knowledge of 18th and 19th century foundational works of American literature.

I2.	Analyze foundational U.S. documents for their historical and literary significance (for example, The Declaration of Independence, the Preamble to the U.S. Constitution, the letters of John and Abigail Adams, Thomas Jefferson’s <i>Notes on the State of Virginia</i> , Abraham Lincoln’s “Gettysburg Address,” <i>Black Elk Speaks</i> , Martin Luther King’s “Letter from Birmingham Jail”).
I3.	Interpret significant works from various forms of literature: poetry, novel, biography, short story, essay and dramatic literature; use understanding of genre characteristics and figurative language (e.g. imagery, metaphor, symbol, allusion, irony, understatement) to make deeper and subtler interpretations of the meaning of the text.
I4.	Develop a knowledge of and analyze world literature, regional American literature and literature by women and people of color in the United States.
I5.	Analyze the setting, plot, theme, tone, style, characterization and narration of classic and contemporary short stories and novels.
I6.	Demonstrate knowledge of metrics, rhyme scheme, rhythm, organizational structure, alliteration, diction and other formal conventions of verse in poetry.
I7.	Identify how elements of dramatic literature (for example, dramatic irony, soliloquy, stage direction and dialogue) and articulate a playwright’s vision.
I8.	Analyze works of literature for what they suggest about the historical period in which they were written.
I9.	Analyze the moral dilemmas in works of literature, as revealed by characters’ motivation.
I10.	Identify and explain the themes found in a single literary work; analyze the ways in which writers develop similar themes in more than one literary work.

PA Benchmarks: Mathematics

Certain mathematics benchmarks are marked with an asterisk (*). These asterisked benchmarks represent content that is recommended for all students, but is required for those students who plan to take calculus in college, a requisite for mathematics and many mathematics intensive majors.

J. Number Sense and Numerical Operations - The high school graduate can:

<p>J1. Compute with rational numbers fluently and accurately without a calculator:</p>	<p>J4.1. Add, subtract, multiply and divide integers, fractions and decimals.</p> <p>J4.2. Calculate and apply ratios, proportions, rates and percentages to solve problems.</p> <p>J4.3. Use the correct order of operations to evaluate arithmetic expressions, including those containing parentheses, exponents and scientific notation.</p> <p>J4.4. Explain and apply basic number theory concepts such as prime number, factor, divisibility, least common multiple and greatest common divisor.</p> <p>J4.5. Multiply and divide numbers expressed in scientific notation.</p> <p>J4.6. Use and/or describe the concept of unit rate, ratio and slope in the context of rate of change.</p>
<p>J2. Recognize and apply magnitude (absolute value) and ordering of real numbers:</p>	<p>J4.1. Locate the position of a number on the number line, know that its distance from the origin is its absolute value and know that the distance between two numbers on the number line is the absolute value of their difference.</p> <p>J4.2. Determine the relative position on the number line of numbers and the relative magnitude of numbers expressed in fractional form, in decimal form, as roots or in scientific notation.</p> <p>J4.3. Estimate the value of irrational numbers.</p> <p>J4.4. Distinguish between and order rational and irrational numbers.</p>
<p>J3. Understand that to solve certain problems and equations, number systems need to be extended from whole numbers to the set of all integers (positive, negative and zero), from integers to rational numbers, from rational numbers to real numbers (rational and irrational numbers) and from real numbers to complex numbers; define and give examples of each of these types of numbers.</p>	
<p>J4. Understand the capabilities and the limitations of calculators and computers in solving problems:</p>	<p>J4.1. Use calculators appropriately and make estimations without a calculator regularly to detect potential errors.</p>

- J4.2. Use scientific and graphing calculators and computer spreadsheets to organize and analyze data.
- J4.3. Select and use appropriate strategies to solve systems of equations and inequalities using graphing calculators, symbol manipulators, spreadsheets and other software.
- J4.4. Construct and manipulate geometric figures using dynamic geometry tools (e.g., Geometer's Sketchpad, Cabri Geometre).
- J4.5. *Use graphing calculators to display periodic and circular functions; describe properties of the graphs.

K. Algebra - The high school graduate can:

- K1. Perform basic operations on algebraic expressions fluently and accurately:
 - K3.1. Understand the properties of integer exponents and roots and apply these properties to simplify algebraic expressions.
 - K3.2. *Understand the properties of rational exponents and apply these properties to simplify algebraic expressions.
 - K3.3. Add, subtract and multiply polynomials; divide a polynomial by a low degree polynomial.
 - K3.4. Factor polynomials by removing the greatest common factor; factor quadratic polynomials.
 - K3.5. Add, subtract, multiply, divide and simplify rational expressions.
 - K3.6. Evaluate polynomial and rational expressions and expressions containing radicals and absolute values at specified values of their variables.
 - K3.7. *Derive and use the formulas for the general term and summation of finite arithmetic and geometric series; find the sum of an infinite geometric series whose common ratio, r , is in the interval $(-1, 1)$.
- K2. Understand functions, their representations and their properties:
 - K3.1. Recognize whether a relationship given in symbolic or graphical form is a function

K3.2. Determine the domain and range of a function represented in either symbolic or graphical form.

K3.3. Understand functional notation and evaluate a function at a specified point in its domain.

K3.4. *Combine functions by composition, as well as by addition, subtraction, multiplication and division.

K3.5. *Identify whether a function has an inverse and when functions are inverses of each other; explain why the graph of a function and its inverse are reflections of one another over the line $y = x$.

K3.6. *Know the inverse of an exponential function is a logarithm, prove basic properties of a logarithm using properties of its inverse and apply those properties to solve problems.

K3.7. Represent functional relationships in tables, charts and graphs.

K3.8. Create and interpret functional models.

K3.9. Analyze properties and relationships of functions (e.g., linear, polynomial, rational, trigonometric, exponential, logarithmic).

K3.10. Analyze and categorize functions by their characteristics.

K3.11. Determine maximum and minimum values of a function over a specified interval.

K3.12. Analyze a given set of data for the existence of a pattern and represent the pattern algebraically and graphically.

K3.13. Estimate areas under curves using sequences of areas.

K3.14. Interpret maximum and minimum values in problem situations.

K3.15. *Analyze and categorize functions by their characteristics (e.g. linear, polynomial, rational, trigonometric, exponential, logarithmic).

K3. Apply basic algebraic operations to solve equations and inequalities:

K3.1. Solve linear equations and inequalities in one variable including those involving the absolute value of a linear function.

K3.2. Solve an equation involving several variables for one variable in terms of the others.

K3.3. Solve systems of two linear equations in two variables.

<p>K3.4. *Solve systems of three linear equations in three variables.</p>
<p>K3.5. Identify whether systems of equations and inequalities are <i>consistent</i> or <i>inconsistent</i></p> <p>K3.6. Solve linear, quadratic and exponential equations in one variable both symbolically and graphically.</p>
<p>K4. Graph a variety of equations and inequalities in two variables, demonstrate understanding of the relationships between the algebraic properties of an equation and the geometric properties of its graph, and interpret a graph:</p> <p>K7.1. Graph a linear equation and demonstrate that it has a constant rate of change.</p> <p>K7.2. Analyze a relation to determine whether a direct or inverse variation exists and represent it algebraically and graphically.</p> <p>K7.3. Understand the relationship between the coefficients of a linear equation and the slope and x- and y-intercepts of its graph.</p> <p>K7.4. Select, justify and apply an appropriate technique to graph a linear function in two variables, including slope-intercept, x- and y-intercepts, graphing by transformations and the use of a graphing calculator.</p> <p>K7.5. Analyze a relation to determine whether a direct or inverse variation exists and represent it algebraically and graphically.</p> <p>K7.6. Understand the relationship between a solution of a system of two linear equations in two variables and the graphs of the corresponding lines.</p> <p>K7.7. Graph the solution set of a linear inequality and identify whether the solution set is an open or a closed half-plane; graph the solution set of a system of two or three linear inequalities.</p> <p>K7.8. Graph a quadratic function and understand the relationship between its real zeros and the x-intercepts of its graph.</p> <p>K7.9. *Graph ellipses and hyperbolas whose axes are parallel to the x and y axes and demonstrate understanding of the relationship between their standard algebraic form and their graphical characteristics.</p> <p>K7.10. *Use equations to represent curves (e.g., circles, ellipses, parabolas, hyperbolas).</p>

K7.11. Graph exponential functions and identify their key characteristics.

K7.12. Read information and draw conclusions from graphs; identify properties of a graph that provide useful information about the original problem.

K5. Solve problems by converting the verbal information given into an appropriate mathematical model involving equations or systems of equations; apply appropriate mathematical techniques to analyze these mathematical models; and interpret the solution obtained in written form using appropriate units of measurement:

K7.1. Recognize and solve problems that can be modeled using a linear equation in one variable, such as time/rate/distance problems, percentage increase or decrease problems, and ratio and proportion problems.

K7.2. Recognize and solve problems that can be modeled using a system of two equations in two variables, such as mixture problems.

K7.3. Recognize and solve problems that can be modeled using a quadratic equation, such as the motion of an object under the force of gravity.

K7.4. Recognize and solve problems that can be modeled using an exponential function, such as compound interest problems.

K7.5. *Recognize and solve problems that can be modeled using an exponential function but whose solution requires facility with logarithms, such as exponential growth and decay problems.

K7.6. Recognize and solve problems that can be modeled using a finite geometric series, such as home mortgage problems and other compound interest problems.

K6. *Understand the binomial theorem and its connections to combinatorics, Pascal's triangle and probability.

K7. *Matrices

K7.1. *Use matrices to organize and manipulate data, including matrix addition, subtraction, multiplication and scalar multiplication.

K7.2. *Analyze and explain systems of matrices.

K7.3. *Formulate matrices to model routine and non-routine problem

situations.

L. Geometry - The high school graduate can:

L1. Understand the different roles played by axioms, definitions and theorems in the logical structure of mathematics, especially in geometry:

L12.1. Identify, explain the necessity of and give examples of definitions, axioms and theorems.

L12.2. State and prove key basic theorems in geometry such as the Pythagorean theorem, the sum of the angles of a triangle is 180 degrees, and the line joining the midpoints of two sides of a triangle is parallel to the third side and half its length.

L12.3. Recognize that there are geometries, other than Euclidean geometry, in which the parallel postulate is not true.

L12.4. Model situations geometrically to formulate and solve problems.

L2. Identify and apply the definitions related to lines and angles and use them to prove theorems in (Euclidean) geometry, solve problems, and perform basic geometric constructions using a straight edge and compass:

L12.1. Identify and apply properties of and theorems about parallel lines and use them to prove theorems such as two lines parallel to a third are parallel to each other and to perform constructions such as a line parallel to a given line through a point not on the line.

L12.2. Identify and apply properties of and theorems about perpendicular lines and use them to prove theorems such as the perpendicular bisectors of line segments are the set of all points equidistant from the two end points and to perform constructions such as the perpendicular bisector of a line segment.

L12.3. Identify and apply properties of and theorems about angles and use them to prove theorems such as two lines are parallel exactly when the alternate interior angles they make with a transversal are equal and to perform constructions such as the bisector of an angle

L12.4. Draw, label, measure and list the properties of complementary, supplementary and vertical angles

L12.5. Construct parallel lines, draw a transversal and measure and compare angles formed (e.g., alternate interior and exterior angles).

<p>L3. Know the basic theorems about congruent and similar triangles and other polygons and use them to prove additional theorems and solve problems.</p>
<p>L4. Know the definitions and basic properties of a circle and use them to prove basic theorems and solve problems.</p> <p>L12.1. *Use the properties of angles, arcs, chords, tangents and secants to solve problems involving circles.</p> <p>L12.2. *Solve problems involving inscribed and circumscribed polygons.</p> <p>L12.3. Identify and/or use properties of triangles (e.g., medians, altitudes, angle bisectors, side/angle relationships, Triangle Inequality Theorem).</p> <p>L12.4. Recognize and/or apply properties of angles, triangles and quadrilaterals.</p> <p>L12.5. Identify and/or use properties of quadrilaterals (e.g., parallel sides, diagonals, bisectors, congruent sides/angles and supplementary angles).</p> <p>L12.6. Identify and/or use properties of isosceles and equilateral triangles</p>
<p>L5. Apply the Pythagorean theorem, its converse and properties of special right triangles to solve problems.</p>
<p>L6. Use rigid motions (compositions of reflections, translations and rotations) to determine whether two geometric figures are congruent and to create and analyze geometric designs.</p>
<p>L7. Know about the similarity of figures and use the scale factor to solve problems.</p>
<p>L8. Know that geometric measurements (length, area, perimeter, volume) depend on the choice of a unit and that measurements made on physical objects are approximations; calculate the measurements of common plane and solid geometric figures:</p> <p>L12.1. Understand that numerical values associated with measurements of physical quantities must be assigned units of measurement or dimensions; apply such units correctly in expressions, equations and problem solutions that involve measurements; and convert a measurement using one unit of measurement to another unit of measurement.</p>

<p>L12.2. Determine the perimeter of a polygon and the circumference of a circle; the area of a rectangle, a circle, a triangle and a polygon with more than four sides by decomposing it into triangles; the surface area of a prism, a pyramid, a cone and a sphere; and the volume of a rectangular box, a prism, a pyramid, a cone and a sphere.</p> <p>L12.3. Know that the effect of a scale factor k on length, area and volume is to multiply each by k, k^2 and k^3, respectively.</p>
<p>L9. Visualize solids and surfaces in three-dimensional space when given two-dimensional representations (e.g., nets, multiple views) and create two-dimensional representations for the surfaces of three-dimensional objects.</p>
<p>L10. Represent geometric objects and figures algebraically using coordinates; use algebra to solve geometric problems:</p> <p>L12.1. Express the intuitive concept of the “slant” of a line in terms of the precise concept of slope, use the coordinates of two points on a line to define its slope, and use slope to express the parallelism and perpendicularity of lines.</p> <p>L12.2. Describe a line by a linear equation.</p> <p>L12.3. Find the distance between two points and/or the midpoint between the points.</p> <p>L12.4. *Find an equation of a circle given its center and radius and, given an equation of a circle, find its center and radius.</p>
<p>L11. Understand basic right-triangle trigonometry and apply it to solve problems:</p> <p>L12.1. Understand how similarity of right triangles allows the trigonometric functions sine, cosine and tangent to be defined as ratios of sides and be able to use these functions to solve problems.</p> <p>L12.2. Apply the trigonometric functions sine, cosine and tangent to solve for an unknown length of a side of a right triangle, given one of the acute angles and the length of another side.</p> <p>L12.3. Use the standard formula for the area of a triangle, $A = \frac{1}{2}bh$, to explain the area formula, $A = \frac{1}{2}absinC$ where a and b are the lengths of two sides of a triangle and C is the measure of the included angle formed by these two sides, and use it to find the area of a triangle when given</p>

the lengths of two of its sides and the included angle.

L12. *Know how the trigonometric functions can be extended to periodic functions on the real line, derive basic formulas involving these functions, and use these functions and formulas to solve problems:

L12.1. *Know that the trigonometric functions sine and cosine, and thus all trigonometric functions, can be extended to periodic functions on the real line by defining them as functions on the unit circle, that radian measure of an angle between 0 and 360 degrees is the arc length of the unit circle subtended by that central angle, and that by similarity, the arc length s of a circle of radius r subtended by a central angle of measure t radians is $s = rt$.

L12.2. *Know and use the basic identities, such as $\sin^2(x) + \cos^2(x) = 1$ and $\cos(\pi/2 - x) = \sin(x)$ and formulas for sine and cosine, such as addition and double angle formulas.

L12.3. *Graph sine, cosine and tangent as well as their reciprocals, secant, cosecant and cotangent; identify key characteristics.

L12.4. *Know and use the law of cosines and the law of sines to find missing sides and angles of a triangle.

M. Data Interpretation, Statistics and Probability - The high school graduate can:

M1. Explain and apply quantitative information:

M4.1. Organize and display data using appropriate methods (including spreadsheets) stem-and-leaf and box-and-whisker, pictures, tallies, tables, charts, bar graphs and circle graphs to detect patterns and departures from patterns.

M4.2. Use scientific and graphing calculators and computer spreadsheets to organize and analyze data.

M4.3. Read and interpret tables, charts and graphs.

M4.4. Compute and explain summary statistics for distributions of data including measures of center (mean, median) and spread (range, percentiles, variance, standard deviation).

M4.5. Compare and contrast data sets using values of mean, median, mode, quartiles and range.

M4.6. Create scatter plots, analyze patterns and describe relationships in paired data.

M4.7. Know the characteristics of the Gaussian normal distribution (bell-shaped curve) and use its properties to answer questions about sets of data that are assumed to be normally distributed.

M2. Explain and critique alternative ways of presenting and using information:

M4.1. Evaluate reports based on data published in the media by considering the source of the data, the design of the study, and the way the data are analyzed and displayed.

M4.2. Identify and explain misleading uses of data.

M4.3. Recognize when arguments based on data confuse correlation with causation.

M3. Explain the use of data and statistical thinking to draw inferences, make predictions and justify conclusions:

M4.1. Explain the impact of sampling methods, bias and the phrasing of questions asked during data collection and the conclusions that can rightfully be made.

M4.2. Determine the validity of the sampling method described in a given study.

M4.3. Use sampling techniques to draw inferences about large populations.

M4.4. Explain effects of sampling procedures and missing or incorrect information on reliability

M4.5. Draw and justify a conclusion regarding the validity of a probability or statistical argument.

M4.6. Design and conduct simple experiments or investigations using random sampling to collect data to answer questions of interest. Describe the data as an example of a distribution using statistical measures of center and spread. Organize and represent the results with graphs.

M4.7. Explain the differences between randomized experiments and

observational studies. Describe questions of experimental design, control groups, treatment groups, cluster sampling and reliability.

M4.8. Construct a scatter plot of a set of paired data, and if it demonstrates a linear trend, use a graphing calculator to find the regression line that best fits this data; recognize that the correlation coefficient measures goodness of fit and explain when it is appropriate to use the regression line to make predictions

M4. Explain and apply probability concepts and calculate simple probabilities:

M4.1. Explain how probability quantifies the likelihood that an event occurs in terms of numbers. Predict and determine why some outcomes are certain, more likely, less likely, equally likely or impossible.

M4.2. Explain how the relative frequency of a specified outcome of an event can be used to estimate the probability of the outcome.

M4.3. Explain how the law of large numbers can be applied in simple examples.

M4.4. Apply probability concepts such as conditional probability and independent events to calculate simple probabilities.

M4.5. Determine the number of combinations and permutations for an event.

M4.6. Apply probability and/or odds to practical situations to make informed decisions.

N. Mathematical Reasoning: Woven throughout the four domains of mathematics — Number Sense and Numerical Operations; Algebra; Geometry; and Data Interpretation, Statistics and Probability — are the following mathematical reasoning skills:

N1. Use inductive and deductive reasoning to arrive at valid conclusions.

N2. Use multiple representations (literal, symbolic, graphic) to represent problems and solutions.

N3. Understand the role of definitions, proofs (direct and indirect) and counter-examples in mathematical reasoning; constructing simple proofs.

N4. *Use truth tables to reveal the logic of mathematical statements.

N5. *Use if...then statements to construct simple, valid arguments.

N6. Use the special symbols of mathematics correctly and precisely.

N7. Recognize when an estimate or approximation is more appropriate than an exact answer and understand the limits on precision of approximations.

N8. Distinguish relevant from irrelevant information, identify missing information and either find what is needed or make appropriate estimates.

N9. Recognize and use the process of mathematical modeling: recognize and clarify mathematical structures that are embedded in other contexts, formulate a problem in mathematical terms, use mathematical strategies (e.g., solving a simpler problem, drawing a picture or diagram) to reach a solution, and interpret the solution in the context of the original problem.

N10. When solving problems, think ahead about strategy, test ideas with special cases, try different approaches, check for errors and reasonableness of solutions as a regular part of routine work, and devise independent ways to verify results.

N11. Shift regularly between the specific and the general, using examples to understand general ideas, and extending specific results to more general cases to gain insight.