The American Diploma Project

Ready or Not

Creating a High School Diploma That Counts

A partnership of

Achieve, Inc.

The Education Trust

Thomas B. Fordham Foundation

"Increasingly, the computer will do the computation … [but] thinking about the problem, developing the problem, understanding the problem, looking at it from all sides, deciding what important information is relevant to the problem … is the harder part. … You can't do that without an understanding of the computation."

▪▪ **manufacturing and distribution executive**

Look for these icons to help guide you through this report:

Workplace Tasks

Postsecondary Assignments

English Benchmarks

Mathematics Benchmarks

Ready or Not

Creating a High School Diploma That Counts

Supported by a grant from the William and Flora Hewlett Foundation

The American Diploma Project

"The ability to understand and apply the mathematical content typically taught in an Algebra II course is vital to a student's success in science and social sciences courses required by our university."

mathematics professor, Purdue University

Editorial assistance and design: KSA-Plus Communications, Inc.

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"We cannot employ people here who cannot articulate clearly, cannot think clearly, who do not have the ability to absorb data, read effectively, write effectively …"

- **head of a holding company with employees ranging from executive-level managers to administrative staff**

ADP Partner Organizations

Achieve, Inc. (www.achieve.org)

Michael Cohen, President

Created by the nation's governors and business leaders, Achieve, Inc., is a bipartisan, non-profit organization that helps states raise academic standards, improve assessments and strengthen accountability to prepare all young people for post-secondary education, work and citizenship. Achieve has helped nearly half the states benchmark their standards and tests against the best examples in this country and abroad and work in partnership to improve teaching and learning. Achieve serves as a significant national voice for quality in standards-based reform and regularly convenes governors, CEOs and other influential leaders at National Education Summits and other gatherings to sustain support for higher standards and achievement for all of America's schoolchildren.

The Education Trust (www.edtrust.org)

Kati Haycock, Director

The Education Trust works for the high academic achievement of all students at all levels, kindergarten through college. The organization focuses its work on the institutions most often left behind in initiatives to improve education — those serving concentrations of low-income, Latino, African American or Native American students. The trust was established in 1990 by the American Association for Higher Education as a special project to encourage colleges and universities to support K–12 reform. Since then, it has grown into an independent, non-profit organization whose mission is to help schools and colleges work for all of the students they serve. The trust staff spends most of its time providing assistance to local, state and national leaders in developing both policies and improvement strategies to raise achievement and close gaps between groups, K–16.

Thomas B. Fordham Foundation (www.edexcellence.net)

Chester E. Finn, Jr., President

The Thomas B. Fordham Foundation supports research, publications and action projects of national significance in elementary/secondary education reform, as well as directs programs in the Dayton, Ohio area. Its focus is on higher academic standards, accountability, equality of opportunity, educational diversity and competition, and capable teachers. The foundation is proactive, designing projects and seeking out suitable partners to further its missions of public awareness and education reform. The foundation's program seeks to make a difference in education not by adding resources to established organizations or supporting conventional ideas, but by seeking out well-conceived projects that go against the grain, challenge the conventional wisdom, alter the status quo and work outside the box.

"Regardless of a student's major, the ability to formulate and analyze arguments, both orally and in writing, is absolutely essential to academic success … . We can develop these skills at the postsecondary level, but students need to get a solid foundation in these basics when they are in high school, or they will fall behind quickly in college."

English professor, University of Nevada, Las Vegas

Introduction

For too many graduates, the American high school diploma signifies only a broken promise. While students and their parents may still believe that the diploma reflects adequate preparation for the intellectual demands of adult life, in reality it falls far short of this common sense goal. The confidence that students and parents place in the diploma contrasts sharply with the skepticism of employers and post-secondary institutions, who all but ignore the diploma, knowing that it often serves as little more than a certificate of attendance. In fact, in much of the United States, students can earn a high school diploma without having demonstrated the achievement of common academic standards or the ability to apply their knowledge in practical ways.

The diploma has lost its value because what it takes to earn one is disconnected from what it takes for graduates to compete successfully beyond high school — either in the classroom or in the workplace. Re-establishing the value of the diploma will require the creation of an inextricable link between high school exit expectations and the intellectual challenges that graduates invariably will face in credit-bearing college courses or in high-performance, high-growth jobs.

Establishing a stronger link between the secondary and postsecondary worlds is what Achieve, Inc.; The Education Trust; and the Thomas B. Fordham Foundation set out to do two years ago by launching the American Diploma Project (ADP). (The National Alliance of Business was originally a partner as well, and it made an important contribution to this project before closing.) This report presents the starting point for restoring the value of the American high school diploma by describing in specific terms the English and mathematics that graduates must have mastered by the time they leave high school if they expect to succeed in postsecondary education or in high-performance, high-growth jobs. The report also presents actual workplace tasks and postsecondary assignments that illustrate the practical application of the "must-have" competencies described in the benchmarks themselves. ADP's college and workplace readiness benchmarks offer the solid foundation upon which states can raise academic expectations and build education systems that will enable students to reach these goals. Without clear academic expectations that have currency beyond 12th grade — as those described in this report do — states' efforts to improve high schools undoubtedly will fail.

> Ours is a service organization, first and foremost … . If a person doesn't know they were served and doesn't feel served — if it doesn't occur for the customer — it didn't occur, and so communication … in our company is of critical importance.
>
> ■■ **human resources professional**

The Problem

Although almost 90 percent of 8th graders expect to participate in some form of postsecondary education[1] and nearly two-thirds of parents consider college a necessity for their children,[2] our education system sends a confusing set of signals to students about how they can reach that goal. High school students earn grades that cannot be compared from school to school and often are based as much on effort as on the actual mastery of academic content. They take state- and locally mandated tests that may count toward graduation, but very often do not. College-bound students take national admissions exams that may not align with the high school curriculum the students have been taught. If they reach college, students face an assortment of placement tests unrelated to any of the tests they have taken already, and these tests vary from campus to campus, even within a single college system. This confusing array of exams diminishes the potential value of standards-based high school exit assessments, even in the minority of states where they currently count as graduation requirements.

The situation is no better for graduates who want to begin careers. For the most part, employers never ask about high school achievement or performance on standards-based assessments. Moreover, states offer no easy access to information about graduates' academic records, even if employers want it.

The troubling result is that far too many young Americans are graduating from high school without the skills and knowledge they need to succeed. Consider:

- **Most high school graduates need remedial help in college.** More than 70 percent of graduates quickly take the next step into two- and four-year colleges,[3] but at least 28 percent of those students immediately take remedial English or math courses.[4] Transcripts show that during their college careers, 53 percent of students take at least one remedial English or math class.[5] The California State University system found that 59 percent of its entering students were placed into remedial English or math in 2002.[6] The need for remedial help is undoubtedly surprising to many graduates and their parents — costly, too, as they pay for coursework that yields no college credit.

- **Most college students never attain a degree.** While a majority of high school graduates enter college, fewer than half leave with a degree. Significantly fewer blacks and Hispanics than whites attain bachelor's degrees.[7] Many factors influence this attrition, but the preparation students receive in high school has been found to be the greatest predictor of bachelor's degree attainment. The courses students take in high school are more predictive of success than family income and race.[8] In fact, the gap in degree attainment is cut in half when white and minority students all enter college having completed a strong high school curriculum.[9]

- **Most employers say high school graduates lack basic skills.** More than 60 percent of employers question whether a high school diploma means that a typical student has learned even the basics, and they rate graduates' skills in grammar, spelling, writing and basic math as only "fair" or "poor."[10] Employers are paying a stiff price for the lack of academic preparation among workers. One study estimated the cost of remedial training in reading, writing and mathematics to a single state's employers at nearly $40 million a year.[11]

> If they can write, I'll take them.
>
> ■■ **power plant manager**

- **Most workers question the preparation that high schools provide.** A majority of workers give high schools a grade of C, D or F for their success in preparing students for success on the job.[12] They rate literacy and critical-thinking skills as much more important than job-specific or computer skills.

The Solution

What will it take to restore value to the American high school diploma? *First,* state policymakers need to anchor high school graduation requirements and assessments to the standards of the real world: to the knowledge and skills that colleges and employers actually expect if young people are to succeed in their institutions. *In return,* colleges and employers

need to start honoring and rewarding student achievement on state standards-based assessments by using these performance data in their admissions, placement and hiring practices.

To help states get started, ADP worked closely with K–12, postsecondary and business leaders in our five partner states (Indiana, Kentucky, Massachusetts, Nevada and Texas) to identify the English and mathematics knowledge and skills needed for success in both college and work. We first asked leading economists to examine market projections for the most promising jobs — those that pay enough to support a small family and provide real potential for career advancement — and to pinpoint the academic knowledge and skills required for success in those occupations. We also worked closely with two- and four-year postsecondary leaders in the partner states to determine the prerequisite English and mathematics knowledge and skills required for success in entry-level, credit-bearing courses in English, mathematics, the sciences, the social sciences and humanities.

The result of the research is a set of benchmarks that should serve as the anchor for every state's system of high school standards-based assessments and graduation requirements. States also can use the benchmarks to map back through the earlier grade levels to refine the standards, assessments and proficiency levels in English and mathematics required by the federal No Child Left Behind Act (NCLB). As we conducted the research, we found an important convergence around the core knowledge and skills that both colleges and employers — within and beyond the ADP states — require. Students who meet these standards therefore will be prepared for success, whatever path they choose to pursue after high school.

> Where are you going to get information to figure out what went wrong ... ? Maybe it's in a manual, maybe it's on the Internet, maybe it's a discussion with a manufacturer's rep ... maybe it's another technician in another department, maybe it's an engineer.
>
> **human resources director at a manufacturing company**

Although high school graduation requirements are established state by state, a high school diploma should represent a common currency nationwide. Families move across state lines, students apply to colleges outside their own state and employers hire people from across the country. States owe it to their students to set expectations for high school graduates that are portable to other states. The ADP benchmarks can help make this portability a reality. States that adopt these benchmarks will have a ready and persuasive answer for students when they ask, "Why do I have to learn these things?"

The ADP benchmarks are ambitious. In mathematics, they reflect content typically taught in Algebra I, Algebra II and Geometry, as well as Data Analysis and Statistics. The English benchmarks demand strong oral and written communication skills because these skills are staples in college classrooms and most 21st century jobs. They also contain analytic and reasoning skills that formerly were associated with advanced or honors courses

in high school. Today, however, colleges and employers agree that all high school graduates need these essential skills.

Although most states have worked hard in the last 10 years to raise the quality of academic standards and the rigor of assessments, the ADP benchmarks may seem even more demanding. For example, no state currently requires all students to take Algebra II to graduate, and few high school exit tests measure much of what ADP suggests that students need to know. In some cases, the knowledge and skills in the benchmarks are not sampled at all on state tests.

> It is a myth that mathematics and math-dependent majors in college do not require strong reading and writing skills. Students have to be able to comprehend complex informational text so they can identify which mathematical operations and concepts to apply to solve a particular problem.
>
> **economics professor, San Francisco State University**

How important is it for states to put themselves through the tribulations of reworking their graduation standards, rewriting their graduation tests and revisiting their "passing" scores? It is important only if we want our high school diplomas to signify true readiness for successful entry into the adult world — and if we want to ensure that every graduate is really prepared for college or work. States must provide the impetus for restoring value to the diploma, but success will depend upon specific actions taken by leaders from many sectors: governors, legislators, business leaders, state K–12 and postsecondary education officials, employers, trade unions, and non-profit organizations.

Incorporating the ADP benchmarks into state education systems is a long-term agenda, and progress will be measured by incremental steps rather than radical shifts. Because it will take time and because it will be difficult, some will reach for excuses to delay or temporize. State education leaders, already consumed by the procedural and accountability requirements of NCLB, will find it difficult to contemplate further changes to their system of standards and assessments, particularly changes that raise the standards. Governors and business leaders fighting to preserve their existing high school graduation exams in the face of initially high failure rates may be daunted by the prospect of making the high school graduation requirements even more demanding in the near future.

> You can be an excellent mathematician, but if you don't have a complement of verbal skills ... you'll never be promoted. If you're looking for high performance, you have to marry the two.
>
> **supervisor at a small engineering office**

However plausible the excuses, our inability to act will only shortchange students, communities and states. Working to increase the number of students who are *proficient* without ensuring that they also are *prepared* for the future will undermine not only the intent of NCLB, but also support for the education system itself. Awarding diplomas to students who pass a test

but cannot meet real-world demands will only mislead high school students about their chances for success as adults and minimize the potential of standards-based systems to ensure equity in the quality of instruction for all students.

Instead, state education and business leaders must devise strategies that build on, rather than discard, ongoing standards-based reforms; that sensibly ratchet up the rigor of standards, assessments and course-taking requirements over time; and that blend them into a coherent system of requirements for earning a high school diploma that signifies college and workplace readiness.

In the following section, we propose an action agenda for getting this essential work done. States that follow this path will indeed be able to create a high school diploma that opens doors, instead of shutting them — a diploma that counts for those who earn it.

Agenda for Action

No state can now claim that every student who earns a high school diploma is academically prepared for postsecondary education and work. The policy tools necessary to change this do in fact exist — but they are not being used effectively.

- Every state has standards and assessments in English and mathematics at the high school level, yet the standards and exams rarely are designed to reflect the real-world demands of postsecondary education and work. Instead, they tend to reflect a consensus among experts in the disciplines as to what would be desirable for young people to learn.

- Nearly half the states require students to pass exit exams to graduate, but these exams are generally pegged to 8th and 9th grade material, rather than reflecting the knowledge and skills students must acquire by the time they complete high school.

- Most states require high school students to take a certain number of courses in English and mathematics to graduate, but very few specify the particular courses students must take. Students may be required to take three years of mathematics, for example, but not necessarily the sequence of Algebra I, Geometry and Algebra II that will prepare them for college and work. Even fewer states have effective mechanisms for ensuring that the course content reflects the knowledge and skills required for success in college and work.

The challenge ahead is clear. Using the ADP benchmarks as an anchor, states must create a *system of assessments and graduation requirements that — considered together — signify readiness for college and work.* State policymakers have the primary responsibility for accomplishing this, working closely with local educators and postsecondary education institutions, but both federal policymakers and the nation's business leaders have an essential role to play as well.

What States and Postsecondary Institutions Should Do

Anchor Academic Standards in the Real World

The academic standards that states have developed over the past decade generally reflect a consensus among experts in each discipline about what is *desirable* for students to learn, but not necessarily what is *essential* for them to be prepared for further learning, work or citizenship after completing high school. These "first generation" standards were critical in getting standards-based reform launched in every state, but it is time to refine and update them so that they help ensure that every young person is prepared academically for the real world when she or he leaves high school.

States should:

- **Align academic standards in high school with the knowledge and skills required for college and workplace success.** State policymakers with responsibility for K–12 and postsecondary education should work closely with leading employers in the state to align high school standards in mathematics and English with the demands of postsecondary education and work. The ADP benchmarks are a valuable tool for doing this validation work. States can compare their current standards with the ADP benchmarks to determine how close — or far — their high school standards are from the demands of the postsecondary world.

Aligning State Standards to ADP Benchmarks

- Three different documents currently describe state academic standards in **Kentucky.** To halt the mixed messages sent by the disparate sets of expectations, Kentucky will use the new ADP benchmarks to help streamline its standards into one user-friendly document. Kentucky also will use ADP benchmarks to revise its adult education standards.

- **Back-map standards to create a coherent, focused, grade-by-grade progression from kindergarten through high school graduation.** High school graduation is the culmination of preparation that begins in the elementary grades. Therefore, the standards set for each grade must exhibit a clear progression of content and skills through high school completion. Unless all students are regularly exposed to a challenging curriculum in elementary and middle schools, they will forever be playing catch-up.

Require All Students To Take a Quality College and Workplace Readiness Curriculum

Successful preparation for both postsecondary education and employment requires learning the same rigorous English and mathematics content and skills. No longer do students

planning to go to work after high school need a different and less rigorous curriculum than those planning to go to college. In fact, nearly all students will require some postsecondary education, including on-the-job training, after completing high school. Therefore, a college and workplace readiness curriculum should be a graduation requirement, not an option, for all high school students. In the core areas of English and mathematics, the ADP benchmarks can provide strong guidance for effective course outlines.

To implement a core college and workplace readiness curriculum effectively, states should:

- **Define specific course-taking requirements in English and mathematics for high school graduation, and specify the core content for those courses.** Research and experience show that students who take a rigorous, "college-prep" curriculum in high school achieve at higher levels and are more likely to enroll and succeed in postsecondary education. The ADP benchmarks provide the framework states need for developing an innovative college and workplace readiness curriculum and the evidence they need to require all students to follow it. Requiring all students to take and pass specific courses and course sequences (e.g., Algebra I, Geometry, Algebra II) rather than simply "three years" of mathematics or "four years" of English will substantially increase the number of low-income and minority students, in particular, who graduate from high school academically prepared for college and work.

  Historically, identical course titles have often masked radically different course content, with less rigorous content often the only option for the most disadvantaged students. Therefore, states must also establish some mechanism for ensuring that the content they expect to be taught in

Indiana: Putting the Pieces Together

ADP's action agenda is ambitious, and only a few states have attempted to carry it out. In revamping its high school standards and tests over the last four years, Indiana has made college and workplace readiness the foundation of a coherent P–16 plan that reflects ADP's goal to help students make a seamless transition from high school to college or the workplace. For example:

- Indiana has created standards that compare favorably to preliminary ADP benchmarks and that contain much of the content that Indiana postsecondary faculty deem essential for student success.
- Indiana's Education Roundtable has approved a plan that will require all students in the state to follow a college and workplace readiness curriculum (the "Core 40" curriculum).
- The state is revising the content of both its 10th grade Graduation Qualifying Exam and its Core 40 end-of-course assessments to reflect the fullest possible range of content deemed necessary by Indiana postsecondary faculty and employers.
- Indiana's Education Roundtable has also approved a recommendation that would allow scores on the Core 40 end-of-course exams to be used for placement decisions in the state's institutions of higher education. Eligibility for financial aid at state colleges would also be linked to successful completion of the Core 40.

the courses actually gets taught and learned. One approach is to institute a series of end-of-course exams in core subjects, aligned with state standards and with the content that students are expected to learn. Another approach is to devise ways to assess the mastery of content as curricular units are completed, enabling students to progress through the material at different rates while ultimately reaching the same standards.

States also can improve the quality and consistency of core curricula by providing curriculum guides or model curricula that illustrate the content and the ways to teach it and/or by creating tools that enable local districts to align their curricula more effectively with revised state standards. Some state education agencies have the capacity to do this, while other states may want to enlist other organizations — such as universities, local school districts and non-profit organizations — to help.

Creating a Default Core Curriculum for All Students

- Starting with the graduating class of 2008, all students in **Texas** will be required to complete the state's college and workplace readiness curriculum, known as the Recommended High School Program (RHSP), to graduate. Texas requires the approval of both a counselor and parent for a student to opt out of the RHSP and into the Minimum Graduation Program. **Indiana**'s Education Roundtable has taken a similar step with its college and workplace readiness (Core 40) curriculum, and other states such as **South Carolina** and **Tennessee** are considering doing so as well.

- **Provide the option of organizing the required curricular content in different ways while keeping state standards and tests the constant.** In defining a core curriculum, states should make room for varied approaches and multiple pathways to help students meet standards aligned with the ADP benchmarks. Vocational programs that provide applied learning opportunities; small, focused, theme-based high schools that emphasize project-based learning; charter schools; and Advanced Placement and International Baccalaureate programs can all be effective approaches for helping students learn core content, even though the instructional strategies and curricular structure may vary from the state's main approach. The state can and should encourage these diverse approaches, while still insisting that schools and students participating in them are held to the same state English and mathematics standards and are assessed using the same state standards-based tests. For schools that structure the curriculum into unconventional courses, states may want to be flexible about when they give state assessments, but should require that the assessment be taken. Whether states administer grade-level tests or end-of-course tests, they must be responsible for ensuring that core English and mathematics content is taught to all students.

- **Ensure that other disciplines reinforce college and workplace readiness expectations.** While defining a core curriculum in English and mathematics, states should also look carefully at, and help define, the contributions that other subjects can make in preparing students to meet college and workplace readiness standards in mathematics and English. For example, laboratory reports in science, expository research in history and projects in the arts can and should strengthen in students the research, analytic and communication skills defined in the ADP benchmarks. Recognizing the ways in which mastery of English and mathematics is critical to success in other disciplines can also help provide needed focus in those disciplines, broaden the responsibility within the school for helping students meet standards and facilitate multidisciplinary approaches to curriculum where that approach best fits the mission of the school.

Measure What Matters and Make It Count

There is no shortage of testing of high school students, particularly those preparing to attend a postsecondary institution. The problem is that none of these tests are aligned with one another. States have developed high school assessments without much regard for what colleges need, and colleges use admissions and placement exams that are disconnected from the curriculum students study in high school. The result is too many tests and a mixed set of messages to students, parents and teachers about which ones matter most. States must streamline their assessment systems so that high school graduation and college admissions and placement decisions are based on student achievement of college and workplace readiness content.

States should:

- **Use high school graduation exams to ensure that students meet standards before earning a high school diploma.** Students should be required to pass certain exams to demonstrate that they are meeting standards. Whether states approach this as a single exam given at the end of 10th or 11th grade or as a series of end-of-course exams taken throughout a student's high school career, exit exams are necessary parts of a system of graduation requirements. They ensure that students who earn a diploma meet at least a floor of performance, and they can provide more credible and compelling evidence than course grades that students have met the standards. States that have graduation exams should not back away from requiring them. States that do not have such exams should put them in place.

- **Not set the floor too low.** High school exit exams, typically administered in 10th or 11th grade, should assess a substantial portion of the ADP benchmark expectations, even though they cannot measure them all. Basic fairness requires that students have multiple opportunities to take the exams, so it is reasonable for states to begin to administer the exams well before the end of 12th grade and to include only content that has been taught by the time the exam is first given. The timing of administration, however, should not be

Developing Assessments That Matter

- **Massachusetts** offers a good example of a state holding the line — and seeing significant gains. The Massachusetts Comprehensive Assessment System (MCAS) weathered a barrage of criticism when only 68 percent of the class of 2003 passed the 10th grade exit exam on the first try. Some urged the state to lower the passing standard or delay the graduation requirement, but officials instead concentrated on providing resources and support to students who hadn't passed. By August 2003, the passing rate for 2003 seniors had climbed to 95 percent. Although the MCAS exit exam does not sample all of the rigorous content in the ADP benchmarks , it is very strong compared to most other states' exams.

- Last year, **Texas** revised all of its assessments to reflect the state's more rigorous content standards, which compare favorably to ADP benchmarks. State officials then set two different "cut scores" on the revised high school assessments — one score to determine whether a student is ready to graduate and another to determine whether a student is ready for college. The revised assessments eventually may replace the less rigorous test now used for college placement.

an excuse for setting the bar too low. States should carefully review the exams currently in use. Tests are aiming too low when they sample content more heavily from the 8th and 9th grades — rather than from 10th or 11th grade — or when they include test items whose low cognitive demand makes it impossible for the tests to measure the more challenging content. As school systems develop greater capacity, states should carefully ratchet up the rigor of the exams.

- **Not let the floor become the ceiling.** Although it has been challenging to implement existing exit exams and to bring students up to the standards they measure, states must go beyond current requirements if students are to be prepared for college and work when they graduate from high school. Because current exams do not measure how well students meet the expectations of employers and postsecondary institutions, the students who pass them are not necessarily well prepared for either path. Ultimately, it is important for 12th grade students to be able to do 12th grade work, not just pass a 10th or 11th grade test.

  States can take a number of approaches to addressing this assessment gap. One approach would be to add 12th grade assessments that are well aligned to the ADP expectations and to state standards in English and mathematics. Unlike exit exams, these assessments might be factored into course grades. More importantly, they could provide valuable information that postsecondary institutions can use when making admissions and/or placement decisions and that employers can consider when making hiring decisions. Similarly, as an alternative to a single exit exam, states could add end-of-course exams for subjects such as

Algebra II or upper-level English. Once again, these assessments could be factored into course grades and considered by postsecondary institutions and employers when making hiring and admissions or placement decisions.

Another approach would be to build enough range into the current high school exit exam to measure a significant amount of the more challenging material expected by employers and postsecondary institutions. Recognizing the difficulty some students are having passing current exit exams, states employing this strategy may initially set two "cut scores" on the test — one that signifies eligibility for high school graduation and another higher score that signifies readiness for college and the workplace. Over time, states that rely on a single exit exam should strive to close the gap between the two scores. While this policy might cause more students to retake state tests to raise their scores, states owe students the opportunity to demonstrate that they have reached levels of proficiency that matter beyond high school.

Finally, states may want to consider administering current or augmented college placement exams to students in the 11th grade to provide timely information about how well prepared they are to take credit-bearing college courses and what additional preparation they might require.

- **Not rely exclusively on large-scale assessments.** As critical as they are, large-scale assessments cannot measure everything that high school graduates need to know and be able to do. Making effective oral arguments, for example, is considered an essential skill by both employers and postsecondary educators. Both groups also stress the importance of conducting significant research projects. These skills — important aspects of the ADP benchmarks — are very difficult to assess on a paper-and-pencil test and may be better measured at the local and school levels. If states believe that all students should be responsible for mastering these essential skills, they should work with local districts to develop ways to incorporate research projects and oral examinations into instructional programs and to establish rigorous, systematic criteria for evaluating them across the state.

- **Regularly validate high school assessments as accurate predictors of postsecondary performance.** Regardless of the combination of assessments they use, states should conduct periodic studies of the predictive validity of the tests, particularly with respect to indicators of success in postsecondary education such as grades, persistence and degree attainment. Such studies will help ensure and improve the validity of the assessments and the appropriate use of the information they generate.

Bridge the Gap Between High School and College

In almost every state, K–12 and postsecondary education systems operate as separate entities. They are governed, financed and operated independently. As a result, young people face needless obstacles in moving from one system to the next. They face different expectations, different standards and different assessments to complete high school and then to enter college. Many students, particularly those with little access to help in negotiating their way, find their

Using Data To Align Secondary and Postsecondary Systems

- **California** education officials and faculty from the California State University (CSU) system have developed an early assessment for use in CSU placement decisions. Grounded primarily in California's standards-based tests for 11th grade, the early assessment also will provide students diagnostic information so that they have time to receive the help they may need to be ready to enter credit-bearing courses.

- Because a University of **Washington** study showed that the Washington state high school assessment is as good a predictor of college GPA as the SAT, postsecondary officials have agreed to use the state's high school assessment data in scholarship, admissions and placement decisions. Several technical revisions are being made to the K–12 and postsecondary systems before the new system is implemented.

- The City University of **New York** for several years has used data from the New York Regents exams for placement purposes. Despite predictions that doing so would cause applications to decline, applications have increased steadily since the implementation of the policy.

- Two efforts are under way in **Kentucky** to connect secondary and postsecondary expectations through assessments. The Kentucky Early Mathematics Testing Program (KEMTP) offers a voluntary, online test to help high school sophomores and juniors see if they are on track for college math and close any learning gaps. Data have demonstrated a correlation between students' KEMTP scores and their college mathematics grades. School districts in **Oklahoma, Tennessee** and **Washington** are using KEMTP or developing similar online testing models. Some districts and postsecondary institutions in Kentucky also are piloting the use of the state writing assessment as a placement tool for freshman English courses, which may prompt similar statewide use.

- As **Nevada** refines its high school proficiency exam to sample more of the college- and work-ready content in its state standards, the University and Community College System of Nevada (UCCSN) Board of Regents is working to address college readiness in other ways. The UCCSN gained legislative authority last year to define a core high school curriculum as part of the eligibility requirements to receive the state's Millennium Scholarship for college. Using the ADP benchmarks to inform the process, the UCCSN will send a clear signal about what students need to have learned to be successful in college. Previously, the scholarships were awarded based primarily on grade point averages.

college aspirations needlessly frustrated by conflicting signals about "necessary" academic preparation. In addition to using the ADP benchmarks to establish appropriate high school graduation requirements, states and postsecondary institutions can take several key steps to ensure that students receive clear, consistent and helpful information and that both high schools and postsecondary institutions have the necessary information and incentives to help students make an effective transition.

Postsecondary institutions should:

- **Use high school assessments for college admissions and placement.** Little justification exists for maintaining completely separate standards and testing systems for high school graduation on the one hand and college admissions and placement on the other. Postsecondary institutions need to reinforce efforts to raise standards in K–12 by making use of standards-based assessment data for admissions, for course placement and/or for the awarding of merit scholarships. Using assessment data in this way will send a message to students that hard work and good performance in high school pay off. Using standards-based test data also will reduce the number of tests students must take and for which a state (and in many cases, families) must pay.

- **Provide information to high schools on the academic performance of their graduates in college.** Only eight states make college remediation data readily available.[13] In most states and postsecondary institutions, reliable information about actual remediation practices is hard to find. Colleges and universities should track and report performance data such as remediation rates, GPAs, persistence and degree completion, and other indicators of achievement. In addition to providing better information about the academic preparation necessary for taking credit-bearing courses, tracking student performance will also provide high schools with valuable information that they can use to improve their programs.

States should:

- **Hold postsecondary institutions accountable for the academic success of the students they admit, including student learning, persistence and degree completion.** Most postsecondary institutions have few incentives to pay attention to deficiencies in the academic preparation of entering students. Ill-prepared students are simply placed in remedial, non-credit-bearing courses while still paying full tuition. Although students who take remedial courses suffer from significantly lowered prospects of completing a degree, the institutions themselves suffer no comparable consequence. Students who drop out are simply replaced by new students the next year. In the culture of postsecondary education, students bear the lion's share of the responsibility for their success or failure, while the institutions themselves bear little.

States therefore must provide greater incentives for postsecondary institutions to pay attention to the academic preparation of incoming students and to provide them with the support they need to succeed. Principles that have been applied to K–12 education can be sensibly and appropriately applied to the different context of postsecondary education. For example, postsecondary institutions should measure performance — including, but not limited to, student achievement, persistence and degree completion — and make the data widely available to students, parents and the public. States also should provide incentives for improved results by considering approaches to performance-based financing that tie some portion of the institution's funding to measured results.

What the Federal Government Should Do

The bulk of the leadership and responsibility for acting on the recommendations in this report falls to states and their leaders. However, the federal government can take several specific steps that would provide important support.

In particular, the President and Congress should:

- **Provide incentives, through the reauthorization of the Higher Education Act, for high school students to meet college and workplace readiness expectations.** As the President and Congress work to expand access to postsecondary education through the reauthorization of the Higher Education Act, they should also work to improve preparation. To encourage more students, particularly low-income students, to prepare for postsecondary education and work, the federal government should provide additional Pell grant funds, over and above what a student would already be eligible for, if she or he takes a rigorous, college and workplace readiness curriculum.

- **Offer resources, through the reauthorization of the Higher Education Act or other legislation, for states to align high school standards and graduation requirements with the knowledge and skills necessary for postsecondary education and work.** During both the first Bush and Clinton administrations, Congress helped states jump-start the standards movement with modest financial support for the development of state standards and assessments. A similar incentive now, aimed at aligning the academic expectations of secondary and postsecondary systems, can help states make rapid progress.

- **Require, through the reauthorization of the Higher Education Act, accountability for postsecondary education institutions.** At a minimum, postsecondary institutions that benefit from federal financial assistance should be required to report annually to students, parents and the public the evidence of student achievement, as well as rates of remediation, persistence and degree completion. In addition, the federal government should insist that postsecondary institutions that receive federal funds be accountable for their performance.

- **Align the 12th grade National Assessment of Educational Progress (NAEP) in English and mathematics with the ADP benchmarks, so that "the Nation's Report Card" will provide regular information on the extent to which high school seniors are ready for college and work.** The President and Congress should support the annual administration of a 12th grade NAEP in English and mathematics in every state, as they do for 4th and 8th grade NAEP under NCLB.

What Business Leaders Should Do

Business leaders have been the most stalwart advocates for significant education reform for the past two decades because they recognize the need for young people to be well prepared to participate in a knowledge-based economy. They have been strong voices for rigor, quality and a comprehensive approach to standards-based reform. They have brought a sense of urgency, coupled with an understanding that the necessary changes to K–12 systems constitute a long-term agenda for action. Finally, they have been instrumental in keeping standards-based reform on track and moving forward at the state and federal levels, throughout changes in governors, presidents and partisan control of the legislative branch.

State Scholars Initiative

In a growing number of states across the country, the business community is encouraging high school students to take a college and workplace readiness curriculum. The State Scholars Initiative began in **Arkansas, Tennessee** and **Texas** in the 1990s, and now operates in 12 states. Each initiative is led by a statewide business coalition, with the goal of increasing the percentage of high school students completing a defined sequence of rigorous academic courses — courses that will prepare them for life beyond high school. The minimum requirements are three years of mathematics (Algebra I, Algebra II and Geometry); three years of science (Biology, Chemistry and Physics); four years of English; three and a half years of social studies, including economics; and two years of a language other than English.

Evidence from the first decade of the program shows that it is working. If patterns identified through research and the pilot communities hold true, students who graduate after completing the course of study will be:

- twice as likely to be college-ready as their peers completing less challenging graduation plans;
- more likely to complete an associate's or bachelor's degree; and
- able to earn more in the years after high school.

Business leaders must continue their strong advocacy and, in particular:

- **Encourage states to align standards, assessments and graduation requirements with the knowledge and skills necessary for success in postsecondary education and work.** It will not be easy to convince state education leaders to review state standards and assessments; they reflect a considerable investment of intellectual and political capital. In many states, NCLB testing and accountability requirements provide added incentives to build on what is in place rather than open up the standards and tests to additional scrutiny and changes. Nonetheless, if states continue to expect too little of their high school graduates, they will continue to turn out graduates who are unprepared for work or further learning, at significant cost to themselves and their communities. Business leaders are one of the most important forces for making this case convincingly.

  Business leaders can start the process by joining with the governor to ask some basic questions: How many of our high school graduates require remedial courses in college? What do employers who hire high school graduates think of their preparation? How well do our state's high school graduation requirements align with the ADP benchmarks? What do our high school assessments measure, and what does it take to pass? The answers to these and related questions will help define the need for action and provide the data necessary to inform it.

- **Consider evidence such as high school assessment results and transcripts in making hiring decisions, and encourage other employers to do the same.** Employers who hire students immediately out of high school should insist that high school graduation requirements measure up to the ADP expectations and then consider evidence that applicants meet these expectations when making hiring decisions. In particular, employers should ask applicants for test results and high school transcripts.

State leaders began the standards movement more than two decades ago, as they responded to the challenges crystallized in the landmark report, *A Nation At Risk*. Then, as now, they were driven by an urgent need to better prepare *all* young people to participate and succeed in a knowledge-driven economy, an increasingly diverse society and an interdependent world. Supported by business leaders and the federal government, states have made substantial progress. They have adopted standards, implemented new assessments, focused accountability on results rather than on compliance, and worked to build the capacity of schools and school systems to respond to these new challenges. It is now time for states to take the next steps.

The action agenda we have proposed is a difficult one, but it is essential for states to embrace. Business leaders and the federal government must continue to support them. Postsecondary education leaders must join the effort. It is time to redefine the American high school diploma and make it count.

College and Workplace Readiness Benchmarks and Samples

College and Workplace Readiness Benchmarks and Samples

Benchmarks

The English and mathematics benchmarks that follow were identified and refined over 18 months of research conducted in postsecondary institutions and high-performance workplaces, both within and beyond the ADP partner states and in conjunction with K–12 educators. (See "Methodology" on page 105 for a description of the development process.) The benchmarks, as well as the workplace tasks and postsecondary assignments that accompany them, represent a collaborative effort among K–12 educators, postsecondary faculty and front-line managers to define a common core of fundamental literacy and numeracy — what high school graduates must know and be able to do to be fully prepared to succeed in credit-bearing college courses or in high-growth, highly skilled occupations.

The work of ADP differs in one significant respect from other praiseworthy state efforts to develop standards: It grounds its benchmarks in empirical evidence of what the postsecondary world — employers and educators — actually requires of employees and students. The innovative addition of actual workplace tasks and postsecondary assignments vividly illustrates the intellectual demand that high school students will encounter in high-performance workplaces or in credit-bearing first-year college courses.

The **English benchmarks** are organized into eight strands:

- Language
- Communication
- Writing
- Research
- Logic
- Informational Text
- Media
- Literature

The benchmarks were refined into their final form with every attention given to the ways in which each of the benchmarks is not only critical to the study of English, but also to the study of many academic subjects within the humanities, sciences and social sciences. Therefore, the ADP partners expect that in conjunction with the mathematics benchmarks, these fundamental literacy benchmarks will inform the development of standards and curricula in all content areas.

The **mathematics benchmarks** are organized into four strands:

- Number Sense and Numerical Operations
- Algebra
- Geometry
- Data Interpretation, Statistics and Probability

As with the English benchmarks, the mathematics benchmarks were refined into their final form with every attention given to the ways in which each of the benchmarks is not only critical to the study of mathematics, but also to the study of many academic subjects within the sciences and social sciences. Therefore, ADP expects that in conjunction with the English benchmarks, these fundamental numeracy benchmarks will inform the development of curricula in all content areas.

Defining Rigor: Reading Lists and Sample Mathematics Problems

In both English and mathematics, a deliberate attempt has been made to indicate the quality and complexity of the expectations by providing examples of the kinds of reading and mathematical problems the benchmarks are meant to describe.

In English, for example, it is not enough to ask high school students to analyze texts. According to employers and postsecondary faculty, students must have been expected to analyze particular kinds of rigorous texts, so that as graduates they will be prepared to meet the demands that face them after high school. For this reason, the ADP English

benchmarks are to be used in close coordination with the reading lists developed by two ADP partner states, Indiana and Massachusetts. These lists, which directly follow the benchmarks, were developed in thorough and inclusive processes in those states. They not only define the quality and complexity of reading expected of all high school graduates, but also suggest a common level of "cultural literacy" expected of all high school graduates, including representative works of various cultures both within and beyond the United States.

Defining rigor is handled differently in the mathematics benchmarks, with the inclusion of sample problems embedded within the benchmarks themselves to illustrate the quality and complexity of the corresponding mathematics benchmark.

Workplace Tasks and Postsecondary Assignments

Workplace tasks and postsecondary assignments follow the benchmarks to illustrate their practical application beyond high school. It is important to note that the workplace tasks and postsecondary assignments are *not* meant to describe the quality and complexity of *high school* assignments. Although the benchmarks, tasks and assignments may be used in the future to inform the development of high school lessons, the tasks and assignments included here are designed simply to illustrate the intellectual rigor of real-world environments beyond high school and the applicability of the ADP benchmarks in postsecondary and workplace settings.

The workplace tasks and postsecondary assignments have been gathered primarily from sources in the five ADP partner states — Indiana, Kentucky, Massachusetts, Nevada and Texas. They have been gathered from two- and four-year postsecondary institutions, as well as from companies whose workforces encompass the fast-growing occupations that were identified in the ADP workplace study. These include occupations such as:

- plant, production and construction managers;
- marketing and events managers;
- engineers and engineering technicians;
- technical writers and legal professionals;
- medical professionals and health technicians;
- environmental science technicians;
- foresters;
- financial, insurance and real estate professionals;
- machine operators, technicians and set-up personnel;
- computer programmers and information technology (IT) workers;
- skilled plumbers, pipe fitters and carpenters;
- repairers and service technicians; and
- teachers.

Similarly, the postsecondary assignments represent a broad range of English, mathematics, humanities, science and social science coursework.

Within each sample, the corresponding English and mathematics benchmarks are called out so that readers may easily recognize how, and in what context, the benchmarks are applied. A representative number of tasks and assignments is included in this print version of the report; additional samples are available at www.achieve.org.

These real tasks and assignments, whether in the workplace or in college classrooms, require the application of knowledge and skills that are contained in more than one ADP benchmark, often from more than one content area. Mastering individual skills without understanding their connections to other skills both within and across content areas is inconsistent with what is expected beyond high school, according to those who participated in the research. The samples therefore illustrate the need to integrate and apply more than one benchmark at a time, the importance of which both employers and postsecondary faculty stressed. To be successful, a high school graduate must be able to blend knowledge and skills from many areas to identify, formulate and solve problems; to connect new information to existing knowledge; and to access and assess knowledge from a variety of sources delivered through a variety of media.

One noticeable feature distinguishes the workplace tasks from the postsecondary assignments: The requisite skills are more tightly integrated at work than in typical postsecondary classroom assignments or assessments. Whereas most college courses focus on one subject or topic at a time for the purposes of instruction and assessment, these distinctions are not relevant to the workplace.

The workplace tasks tend to involve longer-term collaborative projects in which an individual contributes to a group effort. Cooperation demands greater versatility in communication — in listening and speaking, in reading and writing — than typically is required in writing a paper or solving a problem as part of a traditional course assignment. Postsecondary faculty who worked on the ADP research concur that these skills, while prevalent in workplace environments, are increasingly important to success in college classes.

How To Use the ADP Benchmarks, Workplace Tasks and Postsecondary Assignments

As noted above, the applicable English and mathematics benchmarks are identified within each task or assignment. In its online form, the reader is able to navigate back and forth between the samples and applicable benchmarks.

The ADP partners expect that students, parents, teachers, employers and state policymakers alike will glean useful information from the benchmarks themselves, the workplace tasks and the postsecondary assignments. **First,** the benchmarks reflect the higher level of fundamental intellectual demand that is now required of high school graduates who aspire to further education and training, whether graduates go directly into a career-track, high-growth, highly skilled job or into formal postsecondary study before pursuing a career. **Second,** the workplace tasks and postsecondary assignments can help students understand how the subjects they study in high school today are relevant to the challenges that await them tomorrow. **Third,** the benchmarks and sample tasks and assignments exemplify — in a way that state standards alone have not — how very complex and contextual real workplace and postsecondary challenges are. Every sample draws on skills from many different benchmark areas within both English and mathematics; no task or assignment illustrates just one or two isolated skills.

Finally, students, parents, teachers, employers and state education officials all can use the ADP work as an important tool for analyzing the efficacy of their current exit, entrance and placement systems. In particular, ADP anticipates that:

- **students and parents** will compare the curriculum of their local high schools to the ADP benchmarks to determine how much of the ADP benchmark content is addressed;
- **high school teachers** will refer to these workplace applications to develop effective curricula and to infuse dynamic, real-world contexts into their classroom teaching;
- **employers** will come to value, demand and use achievement data based on state standards that are aligned with these real-world expectations; and
- **K–12 and postsecondary policymakers** will refer to the tasks and assignments in close coordination with the benchmarks to determine how the content of their high school standards, curricula, assessments and graduation requirements compare to these real-world expectations.

The ADP benchmarks, sample tasks and assignments, grounded in the reality of actual, day-to-day experiences of people in the workplace and college classrooms, can provide a solid foundation to states for ensuring that their own standards are also grounded in real-world expectations. By providing a clear set of college and workplace readiness benchmarks, sample tasks and assignments, ADP hopes to embolden the efforts of state policymakers to hold the line on rigorous but fair high school exit standards and to reassure students that if they meet these standards they will be prepared for whatever path they choose beyond high school.

English Benchmarks

English Benchmarks

The American Diploma Project (ADP) college and workplace readiness benchmarks for English are organized into eight strands:

A. Language

Writers and speakers are taken seriously when their vocabulary is sophisticated and their sentences are free of grammatical errors. Without fail, employers and college faculty cite correct grammar, usage, punctuation, capitalization and spelling as absolutely essential to success in classrooms and workplaces beyond high school. Whether presenting a marketing concept to a team of colleagues or clients or presenting an interpretation of a secondary source in a college seminar, students and employers will need facility with these fundamental skills for the successful exchange of ideas and information.

B. Communication

Employers and college professors cite strong communication skills as being so essential to success that they insist schools should emphasize them, simultaneously with the transmittal of other academic knowledge. Success in credit-bearing college coursework, whether in the humanities, sciences or social sciences, depends heavily on effective communication about the concepts and detailed information contained within readings, lectures and class discussions. Success in the workplace, whatever the profession, is also heavily dependent on one's ability to listen attentively to colleagues or customers and to express ideas clearly and persuasively.

C. Writing

In the 21st century, strong writing skills have become an increasingly important commodity. High-growth, highly skilled jobs demand that employees can communicate essential information effectively via e-mail, for example. Many jobs require the writing of proposals to obtain new business, the communication of key instructions to colleagues or the conveying of policies to customers. Poor writing may easily affect a company's bottom line and even precipitate legal action. High-quality writing results from careful planning, drafting and meaningful revision. The discipline used to create, reshape and polish pieces of writing prepares students for occasions when they must write quickly and clearly on demand, whether in the workplace or in college classrooms. These benchmarks address skills that are applicable to all kinds of good writing, whether the goal is to interpret literature, analyze the results of a scientific experiment or communicate a new bank policy for granting loans.

D. Research*

Research requires the ability to frame, analyze and solve problems, while building on the ideas and contributions of others. As future college students or employees, students will be asked to hone these essential skills with increasing sophistication. Credit-bearing coursework in colleges and universities will require students to identify areas for research, narrow those topics and adjust research methodology as necessary. College students will be asked to consider various interpretations of both primary and secondary resources as they develop and defend their own conclusions. Thorough research is the foundation of the free exchange of ideas in a postsecondary academic environment. Similarly, in the workplace, employers depend heavily on employees to evaluate the credibility of existing research to establish, reject or refine products and services.

E. Logic

Employers and college professors cite the ability to reason — to think critically, logically and dispassionately — as an absolutely necessary skill for success. It is an essential area of English that until now has received little explicit attention in state standards. High school graduates today are increasingly expected to judge the credibility of sources, evaluate arguments, and understand and convey complex information in the college classroom, in the workplace and as they exercise their rights as citizens. The ability to reason allows for the systematic development of ideas, the ability to make sound choices, and the ability to make and understand persuasive arguments.

F. Informational Text

Literacy in today's workplace, as well as in postsecondary classrooms, requires that students read and interpret a wide range of reference materials: periodicals, memoranda and other documents that may contain technical information, including intricate charts and graphs. College students and employees need to know how to find, comprehend, interpret and judge the quality of information and evidence presented in such texts. They also need to be able to report their own evaluations, interpretations and judgments in ways that will either advance scholarship in an area of postsecondary study or contribute to workplace productivity.

*These skills, although critical to the study of English, are also necessary to the study of many academic subjects. Therefore, the study and reinforcement of these skills should not be confined to the English classroom or coursework.

G. Media

Media vehicles such as television, radio, film, Web sites and videos are prominent modes of communication. Moreover, the various media are more and more often combined in innovative ways. Unlike printed materials, electronic media use sound and moving images; therefore, they can convey information, entertain and persuade in ways that are distinct from the printed word alone. Students need to view non-print media with an equally appreciative, yet discriminating eye, to learn how a work changes when it is adapted from print to non-print media and to create their own media. Students, employees — all citizens — need to analyze information coming from a wide variety of media to interpret political messages, for example, or product advertisements. These interpretive skills can help students and employees develop reasonable positions on matters of public policy and personal interest. In particular, mastery of these skills will help graduates recognize potential bias in new and mixed media markets.

H. Literature

High school graduates today need to be well read to succeed in college, in careers and as citizens in our democratic society. Whether navigating the editorial pages of a local newspaper or communicating ideas to fellow colleagues or classmates, high school graduates who have been asked to analyze a variety of rich literature will be well prepared. Among the benefits of reading literature and carefully analyzing significant works from the literary heritage of both English and other languages is the appreciation of our common humanity. Regular practice in identifying and analyzing the aesthetic and expressive elements of literature also improves the quality of all kinds of student writing. Practice in providing evidence from literary works to support an interpretation fosters the skill of reading any text closely and teaches students to think, speak and write logically and coherently — priority skills identified by employers and postsecondary faculty. Employers report that employees who have considered the moral dilemmas encountered by literary characters are better able to tolerate ambiguity and nurture problem-solving skills in the workplace. Postsecondary faculty from a wide variety of disciplines note that the skills required by thorough literary analysis are applicable in a range of other humanities, science and social science disciplines.

A. Language

The high school graduate can:

A1. Demonstrate control of standard English through the use of grammar, punctuation, capitalization and spelling.
(Associated Workplace Tasks: #2, 3, 4, 5 and 6)
(Associated Postsecondary Assignments: #4, 5 and 6)

A2. Use general and specialized dictionaries, thesauruses and glossaries (print and electronic) to determine the definition, pronunciation, etymology, spelling and usage of words.
(Associated Postsecondary Assignment: #4)

A3. Use roots, affixes and cognates to determine the meaning of unfamiliar words.

A4. Use context to determine the meaning of unfamiliar words.

A5. Identify the meaning of common idioms, as well as literary, classical and biblical allusions; use them in oral and written communication.

A6. Recognize nuances in the meanings of words; choose words precisely to enhance communication.
(Associated Workplace Tasks: #2, 3, 4, 5 and 6)
(Associated Postsecondary Assignments: #4, 5 and 6)

A7. Comprehend and communicate quantitative, technical and mathematical information.
(Associated Workplace Tasks: #1 and 2)
(Associated Postsecondary Assignments: #2 and 3)

B. Communication

The high school graduate can:

B1. Give and follow spoken instructions to perform specific tasks, to answer questions or to solve problems.
(Associated Workplace Tasks: #1 and 2)

B2. Summarize information presented orally by others.

B3. Paraphrase information presented orally by others.

B4. Identify the thesis of a speech and determine the essential elements that elaborate it.

B5. Analyze the ways in which the style and structure of a speech support or confound its meaning or purpose.

B6. Make oral presentations that:

- exhibit a logical structure appropriate to the audience, context and purpose;
- group related ideas and maintain a consistent focus;

- include smooth transitions;
- support judgments with sound evidence and well-chosen details;
- make skillful use of rhetorical devices;
- provide a coherent conclusion; and
- employ proper eye contact, speaking rate, volume, enunciation, inflection and gestures to communicate ideas effectively.

(Associated Workplace Task: #3)

B7. Participate productively in self-directed work teams for a particular purpose (for example, to interpret literature, write or critique a proposal, solve a problem, make a decision), including:

- posing relevant questions;
- listening with civility to the ideas of others;
- extracting essential information from others' input;
- building on the ideas of others and contributing relevant information or ideas in group discussions;
- consulting texts as a source of ideas;
- gaining the floor in respectful ways;
- defining individuals' roles and responsibilities and setting clear goals;
- acknowledging the ideas and contributions of individuals in the group;
- understanding the purpose of the team project and the ground rules for decision-making;
- maintaining independence of judgment, offering dissent courteously, ensuring a hearing for the range of positions on an issue and avoiding premature consensus;
- tolerating ambiguity and a lack of consensus; and
- selecting leader/spokesperson when necessary.

(Associated Postsecondary Assignment: #4)

C. Writing

The high school graduate can:

C1. Plan writing by taking notes, writing informal outlines and researching.

(Associated Workplace Tasks: #4, 5 and 6)

(Associated Postsecondary Assignments: #4, 5 and 6)

C2. Select and use formal, informal, literary or technical language appropriate for the purpose, audience and context of the communication.

(Associated Workplace Tasks: #4, 5 and 6)

(Associated Postsecondary Assignments: #4, 5 and 6)

C3. Organize ideas in writing with a thesis statement in the introduction, well-constructed paragraphs, a conclusion and transition sentences that connect paragraphs into a coherent whole.

(Associated Workplace Tasks: #4, 5 and 6)

(Associated Postsecondary Assignments: #4, 5 and 6)

C4. 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.

(Associated Workplace Tasks: #4, 5 and 6)
(Associated Postsecondary Assignments: #4, 5 and 6)

C5. Edit both one's own and others' work for grammar, style and tone appropriate to audience, purpose and context.

(Associated Workplace Tasks: #4, 5 and 6)
(Associated Postsecondary Assignments: #4, 5 and 6)

C6. Cite print or electronic sources properly when paraphrasing or summarizing information, quoting, or using graphics.

C7. Determine how, when and whether to employ technologies (such as computer software, photographs and video) in lieu of, or in addition to, written communication.

C8. 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.

C9. Write an academic essay (for example, a summary, an explanation, a description, a literary analysis essay) that:

- develops a thesis;
- creates an organizing structure appropriate to purpose, audience and context;
- includes relevant information and excludes extraneous information;
- makes valid inferences;
- supports judgments with relevant and substantial evidence and well-chosen details; and
- provides a coherent conclusion.

(Associated Postsecondary Assignments: #4, 5 and 6)

C10. Produce work-related texts (for example, memos, e-mails, correspondence, project plans, work orders, proposals, bios) that:

- address audience needs, stated purpose and context;
- translate technical language into non-technical English;
- include relevant information and exclude extraneous information;
- 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;
- anticipate potential problems, mistakes and misunderstandings that might arise for the reader;

- create predictable structures through the use of headings, white space and graphics, as appropriate; and
- adopt a customary format, including proper salutation, closing and signature, when appropriate.

(Associated Workplace Tasks: #4, 5 and 6)

D. Research

The high school graduate can:

D1. Define and narrow a problem or research topic.
(Associated Workplace Tasks: #4 and 6)

D2. Gather relevant information from a variety of print and electronic sources, as well as from direct observation, interviews and surveys.
(Associated Workplace Tasks: #3, 4, 5 and 6)
(Associated Postsecondary Assignment: #4)

D3. Make distinctions about the credibility, reliability, consistency, strengths and limitations of resources, including information gathered from Web sites.
(Associated Workplace Task: #5)

D4. Report findings within prescribed time and/or length requirements, as appropriate.
(Associated Workplace Tasks: #4, 5 and 6)

D5. Write an extended research essay (approximately six to 10 pages), building on primary and secondary sources, that:

- marshals evidence in support of a clear thesis statement and related claims;
- paraphrases and summarizes with accuracy and fidelity the range of arguments and evidence supporting or refuting the thesis, as appropriate; and
- cites sources correctly and documents quotations, paraphrases and other information using a standard format.

(Associated Workplace Task: #4)

E. Logic

The high school graduate can:

E1. Distinguish among facts and opinions, evidence and inferences.
(Associated Postsecondary Assignment: #5)

E2. Identify false premises in an argument.
(Associated Postsecondary Assignment: #5)

E3. Describe the structure of a given argument; identify its claims and evidence; and evaluate connections among evidence, inferences and claims.
(Associated Postsecondary Assignment: #5)

E4. Evaluate the range and quality of evidence used to support or oppose an argument.

(Associated Workplace Task: #6)

E5. 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.

E6. Analyze written or oral communications for false assumptions, errors, loaded terms, caricature, sarcasm, leading questions and faulty reasoning.

E7. 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).

(Associated Workplace Task: #4)

E8. Analyze two or more texts addressing the same topic to determine how authors reach similar or different conclusions.

E9. Construct arguments (both orally and in writing) that:

- develop a thesis that demonstrates clear and knowledgeable judgment;
- structure ideas in a sustained and logical fashion;
- use a range of strategies to elaborate and persuade, such as descriptions, anecdotes, case studies, analogies and illustrations;
- clarify and defend positions with precise and relevant evidence, including facts, expert opinions, quotations and/or expressions of commonly accepted beliefs and logical reasoning;
- anticipate and address the reader's concerns and counterclaims; and
- provide clear and effective conclusions.

(Associated Postsecondary Assignments: #5 and 6)

F. Informational Text

The high school graduate can:

F1. Follow instructions in informational or technical texts to perform specific tasks, answer questions or solve problems.

F2. Identify the main ideas of informational text and determine the essential elements that elaborate them.

English Benchmarks

F3. Summarize informational and technical texts and explain the visual components that support them.
(Associated Workplace Tasks: #3 and 6)

F4. Distinguish between a summary and a critique.

F5. Interpret and use information in maps, charts, graphs, time lines, tables and diagrams.
(Associated Workplace Tasks: #3 and 4)
(Associated Postsecondary Assignments: #2 and 3)

F6. Identify interrelationships between and among ideas and concepts within a text, such as cause-and-effect relationships.

F7. Synthesize information from multiple informational and technical sources.
(Associated Workplace Tasks: #4, 5 and 6)

F8. Draw conclusions based on evidence from informational and technical texts.

F9. Analyze the ways in which a text's organizational structure supports or confounds its meaning or purpose.
(Associated Workplace Tasks: #5 and 6)

F10. Recognize the use or abuse of ambiguity, contradiction, paradox, irony, incongruities, overstatement and understatement in text and explain their effect on the reader.

F11. Evaluate informational and technical texts for their clarity, simplicity and coherence and for the appropriateness of their graphics and visual appeal.

G. Media

The high school graduate can:

G1. Evaluate the aural, visual and written images and other special effects used in television, radio, film and the Internet for their ability to inform, persuade and entertain (for example, anecdote, expert witness, vivid detail, tearful testimony and humor).

G2. Examine the intersections and conflicts between the visual (such as media images, painting, film and graphic arts) and the verbal.
(Associated Postsecondary Assignment: #4)

G3. Recognize how visual and sound techniques or design (such as special effects, camera angles and music) carry or influence messages in various media.
(Associated Postsecondary Assignment: #4)

G4. Apply and adapt the principles of written composition to create 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).

H. Literature

The high school graduate can:

H1. Demonstrate knowledge of 18th and 19th century foundational works of American literature.
(Associated Postsecondary Assignment: #6)

H2. Analyze foundational U.S. documents for their historical and literary significance (for example, The Declaration of Independence, the Preamble to the U.S. Constitution, Abraham Lincoln's "Gettysburg Address," Martin Luther King's "Letter from Birmingham Jail").

H3. Interpret significant works from various forms of literature: poetry, novel, biography, short story, essay and dramatic literature; use understanding of genre characteristics to make deeper and subtler interpretations of the meaning of the text.
(Associated Postsecondary Assignments: #5 and 6)

H4. Analyze the setting, plot, theme, characterization and narration of classic and contemporary short stories and novels.
(Associated Postsecondary Assignment: #6)

H5. Demonstrate knowledge of metrics, rhyme scheme, rhythm, alliteration and other conventions of verse in poetry.
(Associated Postsecondary Assignments: #4 and 6)

H6. Identify how elements of dramatic literature (for example, dramatic irony, soliloquy, stage direction and dialogue) articulate a playwright's vision.

H7. Analyze works of literature for what they suggest about the historical period in which they were written.
(Associated Postsecondary Assignment: #5)

H8. Analyze the moral dilemmas in works of literature, as revealed by characters' motivation and behavior.

H9. Identify and explain the themes found in a single literary work; analyze the ways in which similar themes and ideas are developed in more than one literary work.

A Note about Literary and Informational Text

The only way to determine the rigor of academic expectations that address literary and informational text is to be explicit about the quality and complexity of the works students are asked to read and analyze. Students must also be exposed to the greatest works of literature in English and other literature in translation to understand our common literary heritage and to gain an appreciation for the rich literary traditions from all cultures.

Because Indiana and Massachusetts, two of our partner states, have done an effective job of defining core lists of essential literature and informational texts that address both of the these purposes, we have appended those lists here with the assumption that readers will refer to these authors and titles when designing curricula to help students achieve mastery of the ADP benchmarks.

Sample Reading List — Indiana

Level 4
Grades 9–12

Designed as a companion piece to Indiana's Academic Standards in English/Language Arts, the following selections of the Indiana Reading List illustrate the quality and complexity of the suggested reading materials for students in Grades 9–12. The Indiana Reading List is not required reading nor is it meant to be all-inclusive. Teachers and parents are encouraged to review the selections to ensure suitability for the individual student.

Fiction: Classic and Contemporary

The Abduction – Newth, Mette and Tiina Nunnally
The Adventures of Augie March – Bellow, Saul
The Adventures of Huckleberry Finn – Twain, Mark
The Age of Innocence – Wharton, Edith
Animal Farm – Orwell, George
The Assistant – Malamud, Bernard
Autobiography of Miss Jane Pittman – Gaines, Ernest J.
The Bean Trees – Kingsolver, Barbara
Billy Budd – Melville, Herman
Bless Me, Ultima – Anaya, Rudolfo
Buried Onions – Soto, Gary
Catcher in the Rye – Salinger, J.D.
Ceremony – Silko, Leslie Marmon
The Contender – Lipsyte, Robert
Crime and Punishment – Dostoyevsky, Fyodor
Davita's Harp – Potok, Chaim
Frankenstein – Shelley, Mary
A Girl of the Limberlost – Stratton-Porter, Gene
Great Expectations – Dickens, Charles
The Great Gatsby – Fitzgerald, F. Scott
Heart of Darkness – Conrad, Joseph
House on Mango Street – Cisneros, Sandra
If Beale Street Could Talk – Baldwin, James
In the Time of the Butterflies – Alvarez, Julia
Invisible Man – Ellison, Ralph
Jane Eyre – Brontë, Charlotte
The Joy Luck Club – Tan, Amy
The Magnificent Ambersons – Tarkington, Booth
The Metamorphosis – Kafka, Franz
Of Mice and Men – Steinbeck, John
The Old Man and the Sea – Hemingway, Ernest
A Portrait of the Artist as a Young Man – Joyce, James
Pride and Prejudice – Austen, Jane
The Return of the Native – Hardy, Thomas
The Scarlet Letter – Hawthorne, Nathaniel
Sense and Sensibility – Austen, Jane
A Separate Peace – Knowles, John
Shoeless Joe – Kinsella, Ray
Silas Marner – Eliot, George
The Sound and the Fury – Faulkner, William
The Stranger – Camus, Albert
Things Fall Apart – Achebe, Chinua
To Kill a Mockingbird – Lee, Harper
To the Lighthouse – Woolf, Virginia
Typical American – Jen, Gish
Wheels for Walking – Richmond, Sandra

Historical Fiction

All Quiet on the Western Front – Remarque, Erich Maria
A Bell for Adano – Hersey, John

The Burning Time – Lasky, Kathryn
Cry, the Beloved Country – Paton, Alan
A Farewell to Arms – Hemingway, Ernest
Freedom Road – Fast, Howard
The Grapes of Wrath – Steinbeck, John
The Jungle – Sinclair, Upton
My Antonia – Cather, Willa
The Red Badge of Courage – Crane, Stephen
A Tale of Two Cities – Dickens, Charles
This Strange New Feeling – Lester, Julius

Science Fiction/Fantasy

1984 – Orwell, George
2001: A Space Odyssey – Clarke, Arthur C.
Brave New World – Huxley, Aldous
Fahrenheit 451 – Bradbury, Ray
Foundation – Asimov, Issac
The Lord of the Rings – Tolkien, J. R. R.
The Martian Chronicles – Bradbury, Ray
The War of the Worlds – Wells, H.G.
Watership Down – Adams, Richard

Folklore/Fairy Tales/Mythology

The Acts of King Arthur and His Noble Knights – Steinbeck, John
The Adventures of Ulysses – Evslin, Bernard
Beowulf – author unknown
Greek Mythology – Hamilton, Edith
The Iliad – Homer
Le Morte D'Arthur – Malory, Sir Thomas
The Metamorphoses – Ovid
Mules and Men – Hurston, Zora Neale
North American Indian Mythology – Burland, Cottie Arthur
The Odyssey – Homer
The Once and Future King – White, T.H.
The Power of Myth – Campbell, Joseph
Treasury of Irish Folklore – Colum, Padraic (ed.)
The Way to Rainy Mountain – Momaday, N. Scott

Poetry

"The Bean Eaters" – Brooks, Gwendolyn
Selections from *Born of a Woman* – Knightbridge, Etheridge
The Canterbury Tales – Chaucer, Geoffrey
"Chicago" – Sandburg, Carl
Selections from *Collected Poems* – Eliot, T. S.
Selections from *The Collected Poems* – Plath, Sylvia
The Complete Poems of Emily Dickinson – Dickinson, Emily
Selections from *Complete Poetical Works* – Lowell, Amy
Selections from *The Complete Poetical Works* – Riley, James Whitcomb
"Easter 1916" and "Sailing to Byzantium" – Yeats, William Butler
"Fish" – Bishop, Elizabeth
"I Hear America Singing" and "O Captain! My Captain!" – Whitman, Walt
"I Wandered Lonely as a Cloud" – Wordsworth, William
"In Memoriam" – Tennyson, Alfred Lord
"One More Round" and "Human Family" – Angelou, Maya
Selections from *Poems of Pablo Neruda* – Neruda, Pablo
Selections from *The Poetical Works* – Shelley, Percy Bysshe
Selections from *The Poetry of Robert Frost* – Frost, Robert

Sample Reading List — Indiana

"The Raven" and "Annabel Lee" – Poe, Edgar Allan
"The Rime of the Ancient Mariner" – Coleridge, Samuel Taylor
Selections from *Selected Poems* – Heaney, Seamus
Selections from *Selected Poems of Langston Hughes* – Hughes, Langston
Selections from *Sonnets* – Keats, John
Selections from *Sonnets* – Shakespeare, William
Selections from *Spoon River Anthology* – Masters, Edgar Lee
"The Tiger" and "The Lamb" – Blake, William
"To Freedom" and "This Life" – Dove, Rita
Treasury of Great Poems – Untermeyer, Louis (ed.)

Short Stories

"Bartleby the Scrivener" – Melville, Herman
Selections from *The Best Short Stories* – Dreiser, Theodore
Selections from *The Collected Short Stories* – Welty, Eudora
"The Egg" – Anderson, Sherwood
"Gift of the Magi" – Henry, O.
"The Lady or the Tiger" – Stockton, Frank
"The Life You Save May Be Your Own" – O'Connor, Flannery
"The Lottery" – Jackson, Shirley
"The Red Convertible" – Erdich, Louise
"The Richer, the Poorer" – West, Dorothy
Selections from *Short Stories* – Chekhov, Anton
"The Story of Poe" – Ade, George
Selections from *Tales and Poems of Edgar Allan Poe* – Poe, Edgar Allan
"Two or Three Things I Know for Sure" – Allison, Dorothy
"What Means Switch?" – Jen, Gish
"Where Have You Been, Where Are You Going?" – Oates, Joyce Carol
"The White Heron" – Jewett, Sarah Orne
"Young Goodman Brown" – Hawthorne, Nathaniel

Drama

"Antigone" – Sophocles
"The Crucible" – Miller, Arthur
"Death of a Salesman" – Miller, Arthur
"A Doll's House" – Ibsen, Henrik
"Fences" – Wilson, August
"The Glass Menagerie" – Williams, Tennessee
"Hamlet" – Shakespeare, William
"Julius Caesar" – Shakespeare, William
"Macbeth" – Shakespeare, William
"Oedipus Rex" – Sophocles
"Pygmalion" – Shaw, George Bernard
"A Raisin in the Sun" – Hansberry, Lorraine
"Romeo and Juliet" – Shakespeare, William
"The Tempest" – Shakespeare, William
"Twelve Angry Men" – Rose, Reginald
"Waiting for Godot" – Beckett, Samuel

Essays and Speeches

"Choice: A Tribute to Martin Luther King, Jr." – Walker, Alice
"Day of Infamy" – Roosevelt, Franklin D.
"The Declaration of Independence" – Jefferson, Thomas
"The Fire Next Time" – Baldwin, James
"Floyd Patterson: The Essence of a Competitor" – Oates, Joyce Carol
"The Gettysburg Address" – Lincoln, Abraham
"House Divided" – Lincoln, Abraham
"I Have a Dream" – King, Martin Luther, Jr.

"I Will Fight No More Forever" – Chief Joseph
Inaugural Address, 1961 – Kennedy, John F.
"Letter from Birmingham Jail" – King, Martin Luther, Jr.
Nobel Prize Acceptance Speech, 1950 – Faulkner, William
Selections from *Pilgrim at Tinker Creek* – Dillard, Annie
"Self-Reliance" – Emerson, Ralph Waldo
"Sharing the American Dream" – Powell, Colin
Selections from *A Small Place* – Kincaid, Jamaica
"Straw Into Gold" – Cisneros, Sandra
"We Will Never Surrender" – Churchill, Winston

Nonfiction: Science, Social Studies, and Mathematics

The Americans: The National Experience – Boorstin, Daniel
The Assassination of Lincoln: History and Myth – Lewis, Lloyd
Black Holes and Baby Universes and Other Essays – Hawking, Stephen
Black Like Me – Griffin, John Howard
A Brief History of Time – Hawking, Stephen
Coming of Age in the Milky Way – Ferris, Timothy
Connections – Burke, James
Cosmos – Sagan, Carl
The Creators – Boorstin, Daniel
The Day the Universe Changed – Burke, James
Democracy in America – de Tocqueville, Alexis
The Discoverers – Boorstin, Daniel
The Einstein Paradox and Other Mysteries Solved by Sherlock Holmes – Bruce, Colin
Ernie's War: The Best of Ernie Pyle's World War II Dispatches – Nichols, David (ed.)
Full Steam Ahead: The Race to Build the Transcontinental Railroad – Blumberg, Rhoda
HerStory: Women Who Changed the World – Ashby, Ruth (ed.)
A Hoosier Holiday – Dreiser, Theodore
The Immense Journey – Eiseley, Loren
In the Spirit of Crazy Horse – Mathiessen, Peter
Lisa and David – Rubin, Theodore
Lives of a Cell: Notes of a Biology Watcher – Thomas, Lewis
The Mathematical Tourist: Snapshots of Modern Mathematics – Peterson, Ivars
The Meaning of It All – Feynman, Richard
The Mind's Sky: Human Intelligence in a Cosmic Context – Ferris, Timothy
The Mismeasure of Man – Gould, Steven Jay
New Kids in Town: Oral Histories of Immigrant Teens – Bode, Janet
Now Is Your Time! The African American Struggle for Freedom – Myers, Walter Dean
On Growth and Form – Thompson, D'Arcy
Riding the Rails: Teenagers on the Move During the Great Depression – Uys, Errol Lincoln
Roots – Haley, Alex
The Seven Habits of Highly Effective People – Covey, Stephen
Shakespeare's Theatre – Morley, Jacqueline
Silent Spring – Carson, Rachel
Tell Them We Remember: Story of the Holocaust – Bachrach, Susan D.
The Third Wave – Toffler, Alvin
Thursday's Universe – Bartusiak, Marcia
Time's Arrows – Morris, Richard
To Be a Slave – Lester, Julius
The World of Mathematics – Newman, James

Sample Reading List — Indiana

Biography/Autobiography

Growing Up – Baker, Russell

Alexander Graham Bell: Making Connections – Pasachoff, Naomi

John Wilkes Booth: A Sister's Memoir – Clarke, Asia Booth

Out of Darkness: The Story of Louis Braille – Freedman, Russell

The Childhood Story of Christy Brown [previously *My Left Foot*] – Brown, Christy

Madame Curie – Curie, Eve

Narrative of the Life of Frederick Douglass – Douglass, Frederick

Barrio Boy – Galarza, Ernesto

Gandhi, Great Soul – Severance, John

A Mathematician's Apology – Hardy, G. H.

The Story of My Life – Keller, Helen

The Woman Warrior – Kingston, Maxine Hong

Home Before Night – Leonard, Hugh

Winning Ways: A Photohistory of Women in Sports – Macy, Sue

Blue Highways – Moon, William Least Heat

Franklin Delano Roosevelt – Freedman, Russell

Not for Ourselves Alone: The Story of Elizabeth Cady Stanton and Susan B. Anthony – Ward, Geoffrey

Maria Tallchief: America's Prima Ballerina – Tallchief, Maria

Walden – Thoreau, Henry David

Night – Wiesel, Elie

One Writer's Beginnings – Welty, Eudora

Passion to Know: The Scientists of Today's World – Wilson, Mitchell

The Right Stuff – Wolfe, Tom

Black Boy: A Record of Childhood and Youth – Wright, Richard

Magazines/Newspapers

Audubon Magazine

Business Week

Consumer Reports

National Geographic

Natural History

The New York Times

Newsweek

Popular Mechanics

Scientific American

Smithsonian

Sports Illustrated

Time

The Wall Street Journal

Reference Tools (in printed and electronic format)

Atlas/Almanac, such as:

Printed: *National Geographic Atlas of the World; World Almanac and Book of Facts 2000*

CD-ROM: *Microsoft Encarta Interactive World Atlas 2001*

Online: *The World Factbook* (www.odci.gov/cia/publications/factbook/)

Dictionary, such as:

Printed: *DK Illustrated Oxford Dictionary; Merriam-Webster's Collegiate Dictionary; Oxford English Dictionary*

CD-ROM: *Merriam-Webster's Collegiate Dictionary*

Online: *Merriam-Webster Online Dictionary* (www.m-w.com)

Encyclopedia, such as:

Printed: *Compton's Encyclopedia*

CD-ROM: *Encyclopedia Britannica 2000 Deluxe; Microsoft Encarta Encyclopedia 2001*

Online: *Encarta* (www.encarta.msn.com); *Britannica* (www.britannica.com)

Other Resources, such as:

Printed: *Bartlett's Familiar Quotations; College Placement Annual; Scientists: The Lives and Works of 150 Scientists; United States Government Manual; Worldmark Encyclopedia of the States*

Online: *Internet Public Library Reference Center* (www.ipl.org/ref); *Research-It!* (www.itools.com/research-it)

Thesaurus, such as:

Printed: *The American Heritage Student Thesaurus; Bartlett's Roget's Thesaurus*

CD-ROM: *Merriam-Webster's Collegiate Thesaurus*

Online: *Merriam-Webster Online Thesaurus* (www.m-w.com)

Informational, Technical, and Practical Documents

Applications: job, college admission, college financial aid, consumer loan, credit card

Catalogs

Help-Wanted Advertisements

Indiana Drivers Manual

Invoices

Lease/Rental Agreements: apartment, automobile

Letters: personal, business

Loan Agreements: credit card, consumer loan

Manuals: computer, electronic equipment, appliance, automotive

Medical Records

Military Enrollment Forms

Periodic Financial Statements: checking account, savings account, loan, credit card

Reports: stock and mutual funds, corporate financial, local/state/federal government

Resumes

Travel Schedules and Itineraries

Voter Registration and Ballots

Web Disclaimer: Due to the ever-changing nature of Internet materials, parents and educators are strongly advised to monitor the suggested Web sites to ensure that content remains appropriate for students.

Questions? The Indiana Reading List is a suggested reading resource for students and teachers. Check with your local school to see if there is a required reading list. For additional information or questions, call 1.888.544.7837 or visit the Department of Education's Web site: www.doe.state.in.us/standards.

Sample Reading List — Massachusetts

Massachusetts English Language Arts Curriculum Framework June 2001

Appendix A: Suggested Authors, Illustrators, and Works Reflecting Our Common Literary and Cultural Heritage

All American students should acquire knowledge of a range of literary works reflecting a common literary heritage that goes back thousands of years to the ancient world. In addition, all students should become familiar with some of the outstanding works in the rich body of literature that is their particular heritage in the English-speaking world. This includes the first literature in the world created just for children—its authors viewing childhood as a special period in life. The suggestions in Appendix A constitute a core list of those authors, illustrators, or works that comprise the literary and intellectual capital drawn on by those who write in English, whether for novels, poems, nonfiction, newspapers, or public speeches, in this country or elsewhere. Knowledge of these authors, illustrators, and works in their original, adapted, or revised editions will contribute significantly to a student's ability to understand literary allusions and participate effectively in our common civic culture. Many more suggested contemporary authors, illustrators, and works from around the world are included in Appendix B. This list includes the many excellent writers and illustrators of children's books of recent years.*

In planning a curriculum, it is important to balance depth with breadth. As teachers in schools and districts work with this curriculum framework to develop literature units, they will often combine works from the two lists into thematic units. Exemplary curriculum is always evolving—we urge districts to take initiative to create programs meeting the needs of their students.

The lists of suggested authors and works in Appendices A and B are organized by the grade spans of PreK–2, 3–4, 5–8 and 9–12. Certain key works or authors are repeated in adjoining grade spans, giving teachers the option to match individual students with the books that suit their interests and developmental levels. The decision to present a Grades 9–12 list (as opposed to Grades 9–10 and 11–12) stems from the recognition that teachers should be free to choose selections that challenge, but do not overwhelm, their students.

Note: For the purposes of this report we have included only the lists of authors and works corresponding to the 9–12 grade span. The full Appendix A, including authors and works corresponding to the PreK–2, 3–4 and 5–8 grade spans, is available on the Massachusetts Department of Education Web site (http://www.doe.mass.edu/frameworks/ela/0601.pdf).

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*Selections for PreK–8 on both Appendix A and Appendix B were reviewed by Roger Sutton, Editor-in-Chief, and Martha V. Parravano, Senior Editor of the *Horn Book Magazine.* We gratefully acknowledge their contributions.

A. Grades 9–12

In addition to the 5–8 Selections:

Traditional and Classical literature:

A higher level rereading of Greek mythology

Substantial selections from epic poetry: Homer's *Odyssey* and *Iliad;* Virgil's *Aeneid*

Classical Greek drama (Aeschylus, Sophocles, Euripides)

The Bible as literature:

Genesis, Ten Commandments, selected psalms and proverbs, Job, Sermon on the Mount, selected parables

1. American Literature

Historical Documents of Literary and Philosophical Significance:

Abraham Lincoln's Gettysburg address

The Declaration of Independence

Martin Luther King Jr.'s "Letter from Birmingham Jail" or his "I Have a Dream" speech

John F. Kennedy's inaugural speech

William Faulkner's Nobel Prize lecture

Important Writers of the 18th and 19th Centuries:

James Fenimore Cooper
Stephen Crane
Emily Dickinson
Frederick Douglass
Ralph Waldo Emerson
Benjamin Franklin
Nathaniel Hawthorne
Henry James
Thomas Jefferson
Herman Melville
Edgar Allan Poe
Henry David Thoreau
Mark Twain
Phillis Wheatley
Walt Whitman

Important Writers of the First Half of the 20th Century:

Henry Adams
James Baldwin
Arna Bontemps
Willa Cather
Kate Chopin
Countee Cullen
Ralph Ellison
William Faulkner
Jessie Fauset
F. Scott Fitzgerald
Charlotte Gilman
Ernest Hemingway
O. Henry
Langston Hughes
Zora Neale Hurston
Sarah Orne Jewett
James Weldon Johnson
Flannery O'Connor
Gertrude Stein
John Steinbeck
James Thurber
Jean Toomer
Booker T. Washington
Edith Wharton
Richard Wright

In addition to the PreK–8 Selections:

Playwrights:

Lorraine Hansberry
Lillian Hellman
Arthur Miller
Eugene O'Neill
Thornton Wilder
Tennessee Williams
August Wilson

Poets:

Elizabeth Bishop
e e cummings
Robert Frost
T. S. Eliot
Robinson Jeffers
Amy Lowell
Robert Lowell

Sample Reading List — Massachusetts

Edgar Lee Masters
Edna St. Vincent Millay
Marianne Moore
Sylvia Plath
Ezra Pound
John Crowe Ransom
Edward Arlington Robinson
Theodore Roethke
Wallace Stevens
Alan Tate
Sara Teasdale
William Carlos Williams

Immigrant Experience:
Works about the European, South and East Asian, Caribbean, Central American, and South American immigrant experience (Ole Rolvaag, Younghill Kang, Abraham Cahan), the experiences of Native Americans, and slave narratives (Harriet Jacobs).

2. British and European Literature

Poetry:
Selections from Chaucer's *Canterbury Tales*
Epic poetry: Dante and John Milton
Sonnets: William Shakespeare, John Milton, Edmund Spenser
Metaphysical poetry: John Donne, George Herbert, Andrew Marvell
Romantic poets: William Blake, Lord Byron, Samuel Taylor Coleridge, John Keats, Percy Bysshe Shelley, William Wordsworth
Victorian poetry: Matthew Arnold, Elizabeth Barrett Browning, Robert Browning, Dante Gabriel Rossetti, Alfred Lord Tennyson
Twentieth Century: W. H. Auden, A. E. Housman, Dylan Thomas, William Butler Yeats

Drama:
William Shakespeare
Anton Chekhov, Henrik Ibsen, George Bernard Shaw, Oscar Wilde

Essays:
British essays:
- Joseph Addison
- Sir Francis Bacon
- Samuel Johnson in "The Rambler"
- Charles Lamb
- George Orwell
- Leonard Woolf

Enlightenment essays:
- Voltaire
- Diderot and other Encyclopédistes
- Jean-Jacques Rousseau

Fiction:
Selections from an early novel:
- Miguel de Cervantes' *Don Quixote*
- Henry Fielding's *Joseph Andrews*
- Oliver Goldsmith's *The Vicar of Wakefield*

Selections from John Bunyan's allegory, *Pilgrim's Progress*

Satire, or mock epic, verse or prose: Lord Byron, Alexander Pope, Jonathan Swift

19th century novels:
- Jane Austen
- Emily Brontë
- Joseph Conrad
- Charles Dickens
- Fyodor Dostoyevsky
- George Eliot
- Thomas Hardy
- Victor Hugo
- Mary Shelley
- Leo Tolstoy

20th century novels:
- Albert Camus
- André Gide
- James Joyce
- Franz Kafka
- D. H. Lawrence
- Jean-Paul Sartre
- Virginia Woolf

Massachusetts English Language Arts Curriculum Framework June 2001

Appendix B: Suggested Authors and Illustrators of Contemporary American Literature and World Literature

All students should be familiar with American authors and illustrators of the present and those who established their reputations after the end of World War II, as well as important writers from around the world, both historical and contemporary. During the last half of the 20th century, the publishing industry in the United States devoted increasing resources to children's and young adult literature created by writers and illustrators from a variety of backgrounds. Many newer anthologies and textbooks offer excellent selections of contemporary and world literature.

As they choose works for class reading or suggest books for independent reading, teachers should ensure that their students are both engaged and appropriately challenged by their selections. The lists following are organized by grade clusters PreK–2, 3–4, 5–8 and 9–12, but these divisions are far from rigid, particularly for the elementary and middle grades. Many contemporary authors write stories, poetry, and non-fiction for very young children, for those in the middle grades, and for adults as well. As children become independent readers, they often are eager and ready to read authors that may be listed at a higher level. As suggested earlier in the Reading and Literature Strand of this framework, teachers and librarians need to be good matchmakers, capable of getting the right books into a child's hands at the right time.

The lists below are provided as a starting point; they are necessarily incomplete, because excellent new writers appear every year. As all English teachers know, some authors have written many works, not all of which are of equally high quality. We expect teachers to use their literary judgment in selecting any particular work. It is hoped that teachers will find here many authors with whose works they are already familiar, and will be introduced to yet others. **A comprehensive literature curriculum balances these authors and illustrators with those found in Appendix A.**

Note: For the purposes of this report we have included only the lists of authors and works corresponding to the 9–12 grade cluster. The full Appendix B, including authors and works corresponding to the PreK–2, 3–4 and 5–8 grade clusters, is available on the Massachusetts Department of Education Web site (http://www.doe.mass.edu/frameworks/ela/0601.pdf).

Sample Reading List — Massachusetts

Grades 9–12

Contemporary American Literature

Fiction:

James Agee
Maya Angelou
Saul Bellow
Pearl Buck
Raymond Carver
John Cheever
Sandra Cisneros
Arthur C. Clarke
E. L. Doctorow
Louise Erdrich
Nicholas Gage
Ernest K. Gaines
Alex Haley
Joseph Heller
William Hoffman
John Irving
William Kennedy
Ken Kesey
Jamaica Kincaid
Maxine Hong Kingston
Jon Krakauer
Harper Lee
Bernard Malamud
Carson McCullers
Toni Morrison
Joyce Carol Oates
Tim O'Brien
Edwin O'Connor
Cynthia Ozick
Chaim Potok
Reynolds Price
Annie Proulx
Ayn Rand
Richard Rodriguez
Leo Rosten
Saki
J. D. Salinger
William Saroyan
May Sarton
Jane Smiley
Betty Smith
Wallace Stegner
Amy Tan
Anne Tyler
John Updike
Kurt Vonnegut, Jr.
Alice Walker
Robert Penn Warren
Eudora Welty
Thomas Wolfe
Tobias Wolff
Anzia Yezierska

Poetry:

Claribel Alegria
Julia Alvarez
A. R. Ammons
Maya Angelou
John Ashberry
Jimmy Santiago Baca
Amiri Baraka (LeRoi Jones)
Elizabeth Bishop
Robert Bly
Louise Bogan
Arna Bontemps
Gwendolyn Brooks
Sterling Brown
Hayden Carruth
J. V. Cunningham
Rita Dove
Alan Dugan
Richard Eberhart
Martin Espada
Allen Ginsberg
Louise Gluck
John Haines
Donald Hall
Robert Hayden
Anthony Hecht
Randall Jarrell
June Jordan
Galway Kinnell
Stanley Kunitz
Philip Levine
Audrey Lord
Amy Lowell
Robert Lowell
Louis MacNeice
James Merrill
Mary Tall Mountain
Sylvia Plath
Anna Quindlen
Ishmael Reed
Adrienne Rich
Theodore Roethke

Anne Sexton
Karl Shapiro
Gary Snyder
William Stafford
Mark Strand
May Swenson
Margaret Walker
Richard Wilbur
Charles Wright
Elinor Wylie

Essay/Nonfiction (Contemporary and Historical):
Edward Abbey
Susan B. Anthony
Russell Baker
Ambrose Bierce
Carol Bly
Dee Brown
Art Buchwald
William F. Buckley
Rachel Carson
Margaret Cheney
Marilyn Chin
Stanley Crouch
Joan Didion
Annie Dillard
W. E. B. Du Bois
Gretel Ehrlich
Loren Eiseley
Henry Louis Gates, Jr.
Doris Goodwin
Stephen Jay Gould
John Gunther
John Hersey
Edward Hoagland
Helen Keller
William Least Heat Moon
Barry Lopez
J. Anthony Lukas
Mary McCarthy
Edward McClanahan
David McCullough
John McPhee
William Manchester
H. L. Mencken
N. Scott Momaday
Samuel Eliot Morison
Lance Morrow
Bill Moyers
John Muir
Anna Quindlen
Chet Raymo
Richard Rodriguez
Eleanor Roosevelt
Franklin D. Roosevelt
Theodore Roosevelt
Carl Sagan
William Shirer
Shelby Steele
Lewis Thomas
Cornell West
Walter Muir Whitehill
Malcolm X

Drama:
Edward Albee
Robert Bolt
Jerome Lawrence and Robert E. Lee
Archibald MacLeish
Terrence Rattigan
Ntozake Shange
Neil Simon
Orson Welles

Sample Reading List — Massachusetts

Grades 9–12

Historical and Contemporary World Literature

Fiction:

Chinua Achebe
S. Y. Agnon
Ilse Aichinger
Isabel Allende
Jerzy Andrzejewski
Margaret Atwood
Isaac Babel
James Berry
Heinrich Böll
Jorge Luis Borges
Mikhail Bulgakov
Dino Buzzati
A.S. Byatt
Italo Calvino
Karl Capek
Carlo Cassola
Camillo Jose Cela
Julio Cortazar
Isak Dinesen
E. M. Forster
Gabriel Garcia Marquez
Nikolai Gogol
William Golding
Robert Graves
Hermann Hesse
Wolfgang Hildesheimer
Aldous Huxley
Kazuo Ishiguro
Yuri Kazakov
Milan Kundera
Stanislaw Lem
Primo Levi
Jacov Lind
Clarice Lispector
Naguib Mahfouz
Thomas Mann
Alberto Moravia
Mordecai Richler
Alice Munro
Vladimir Nabokov
V. S. Naipaul
Alan Paton
Cesar Pavese
Santha Rama Rau
Rainer Maria Rilke
Ignazio Silone
Isaac Bashevis Singer
Aleksandr Solzhenitsyn
Niccolo Tucci
Mario Vargas-Llosa
Elie Wiesel
Emile Zola

Poetry:

Bella Akhmadulina
Anna Akhmatova
Rafael Alberti
Josif Brodsky
Constantine Cavafis
Odysseus Elytis
Federico García Lorca
Seamus Heaney
Ted Hughes
Philip Larkin
Czeslaw Milosz
Gabriela Mistral
Pablo Neruda
Octavio Paz
Jacques Prévert
Alexander Pushkin
Salvatore Quasimodo
Juan Ramon Ramirez
Arthur Rimbaud
Pierre de Ronsard
George Seferis
Léopold Sédar Senghor
Wole Soyinka
Marina Tsvetaeva
Paul Verlaine
Andrei Voznesensky
Derek Walcott
Yevgeny Yevtushenko

Essay/Nonfiction:

Winston Churchill
Mahatma Gandhi
Stephen Hawking
Arthur Koestler
Margaret Laurence
Michel de Montaigne
Shiva Naipaul
Octavio Paz
Jean-Jacques Rousseau
Alexis de Tocqueville
Voltaire
Rebecca West
Marguerite Yourcenar

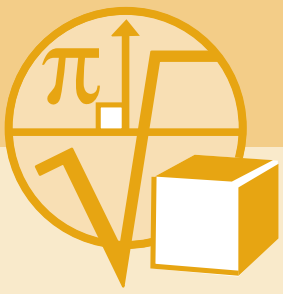
Drama:

Jean Anouilh
Fernando Arrabal
Samuel Beckett
Bertolt Brecht
Albert Camus
Jean Cocteau
Athol Fugard
Jean Giraudoux
Eugene Ionesco
Molière
John Mortimer
Sean O'Casey
John Osborne
Harold Pinter
Luigi Pirandello
Jean-Paul Sartre
John Millington Synge

Religious Literature:

Analects of Confucius
Bhagavad-Gita
The Koran
Tao Te Ching
Book of the Hopi
Zen parables
Buddhist scripture

Mathematics Benchmarks



Mathematics Benchmarks

The American Diploma Project (ADP) college and workplace readiness benchmarks for mathematics are organized into four strands:

I. Number Sense and Numerical Operations

Number sense is the cornerstone for mathematics in everyday life. Comparing prices, deciding whether to buy or lease a car, estimating tax on a purchase, balancing a checkbook, understanding salary increases in the context of annual inflation rates, deciding where to invest savings and understanding much of what appears in a daily newspaper all require understanding of and facility with quantified information. At the heart of the study of numbers is an appreciation of how numbers are used to represent real world objects and their attributes. Working with numbers requires an understanding of the relationships between numbers, the magnitude of numbers and when to use which operation, as well as the ability to make reasonable estimations and mental computations.

J. Algebra

Mathematicians regularly identify sources of change, distinguish patterns in that change and seek multiple representations — verbal, symbolic, numeric and graphic — to express what transpires. The language of algebra provides a means of operating with these concepts at an abstract level and extending specific examples to broad generalizations. Predicting savings based on a rate of interest, projecting business revenues, knowing how costs will increase as the square footage of a building increases and estimating future world populations based on known population growth rates are all possible once a pattern has been identified. Such relationships can be described in terms of what has changed and how it has changed.

K. Geometry

Geometry is an ancient mathematical endeavor, dating back to 300 B.C. and Euclid. Euclidean geometry, a milestone in the development of mathematics and other academic disciplines, is the study of points, lines, planes and other geometric figures, resulting in a logical system that offers students a way to formulate and test hypotheses and to justify arguments in formal and informal ways. Geometry also provides students with an understanding of the structure of space and spatial relations, such as resolving the best way to fit an oversized object through a door, deciding how to design a house for maximum living space with minimal timber costs and comparing the amount of a product contained in packages of different shapes. Geometric measurement is the basis by which we quantify the world. Building a house, reading a map and assessing blood pressure all require some form of measurement. Through

measurement, students develop respect for precision and accuracy. They also learn to spot potential and actual errors in those measurements and learn how those errors may be compounded in computations.

L. Data Interpretation, Statistics and Probability

Statistical data from opinion polls and market research are integral to informing business decisions and governmental policies. Many jobs require workers who are able to analyze, interpret and describe data quickly and to create visual representations of data — charts, graphs, diagrams — to help get a point across succinctly and accurately. A free society is dependent on its citizens understanding information, evaluating claims presented as facts, detecting misrepresentations and distortions, and making sound judgments based on available data. When students learn to make predictions and develop and evaluate inferences from data, they are able to rely on data to answer such questions as "Will a college degree improve my earnings?" or "Which kinds of college degrees will give me access to the most opportunities and the highest pay?" The ability to apply basic concepts of probability is connected to the ability to interpret data. The world is filled with uncertainties, and probability is one way of addressing risk in daily living and reducing those uncertainties.

A Note about Mathematical Reasoning

The study of mathematics is an exercise in reasoning. Beyond acquiring procedural mathematical skills with their clear methods and boundaries, students need to master the more subjective skills of reading, interpreting, representing and "mathematicizing" a problem. As college students and employees, high school graduates will need to use mathematics in contexts quite different from the high school classroom. They will need to make judgments about what problem needs to be solved and, therefore, about which operations and procedures to apply. 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:

- Using inductive and deductive reasoning to arrive at valid conclusions.
- Using multiple representations (literal, symbolic, graphic) to represent problems and solutions.
- Understanding the role of definitions, proofs and counter-examples in mathematical reasoning; constructing simple proofs.
- Using the special symbols of mathematics correctly and precisely.
- Recognizing when an estimate or approximation is more appropriate than an exact answer and understanding the limits on precision of approximations.
- Distinguishing relevant from irrelevant information, identifying missing information, and either finding what is needed or making appropriate estimates.
- Recognizing and using the process of mathematical modeling: recognizing and clarifying mathematical structures that are embedded in other contexts, formulating a problem in mathematical terms, using mathematical strategies to reach a solution, and interpreting the solution in the context of the original problem.
- When solving problems, thinking ahead about strategy, testing ideas with special cases, trying different approaches, checking for errors and reasonableness of solutions as a regular part of routine work, and devising independent ways to verify results.
- Shifting regularly between the specific and the general, using examples to understand general ideas, and extending specific results to more general cases to gain insight.

Mathematics Benchmarks

Because major areas of study at postsecondary institutions have different prerequisites, 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.

I. Number Sense and Numerical Operations

The high school graduate can:

I1. Compute with rational numbers fluently and accurately without a calculator:

I1.1. Add, subtract, multiply and divide integers, fractions and decimals.
(Associated Workplace Tasks: #1, 2, 3 and 6)
(Associated Postsecondary Assignments: #1 and 2)

Example: $3\frac{3}{4} \div 1.2 = 15/4 \div 6/5 = 15/4 \times 5/6 = 75/24 = 25/8 = 3\frac{1}{8} = 3.125$

Example: Estimate the total of a column of 10 to 15 numbers (typically, dollars and cents) and add them manually (e.g., by grouping 10s).

I1.2. Calculate and apply ratios, proportions, rates and percentages to solve problems.
(Associated Workplace Tasks: #1, 2, 3 and 6)
(Associated Postsecondary Assignment: #2)

Example: In the last four quarters, the returns reported for your mutual fund were, in succession, +2.33%, -1.75%, +3.02%, -2.54%. What was your return for the year?

I1.3. Use the correct order of operations to evaluate arithmetic expressions, including those containing parentheses.

I1.4. Explain and apply basic number theory concepts such as prime number, factor, divisibility, least common multiple and greatest common divisor.

I1.5. Multiply and divide numbers expressed in scientific notation.
(Associated Postsecondary Assignment: #2)

Example: Multiply 3.6×10^3 by 4.5×10^4 to obtain 16.2×10^7, adjust to conform first to the standard form for scientific notation to obtain 1.62×10^8, and round to the appropriate number of significant digits as determined by the original equation to obtain 1.6×10^8.

* Benchmarks marked with an asterisk represent content that is recommended for all students but is *required* for those students who plan to take calculus in college.

I2. Recognize and apply magnitude (absolute value) and ordering of real numbers:

I2.1. 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.

I2.2. 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.

Example: Determine which of the two fractions -3/5 and -4/7 is larger and which has greater magnitude without using a calculator.

Example: Order the following numbers from least to greatest without using a calculator: $\sqrt{12}$, 3, $\sqrt[3]{18}$, 2, $\sqrt{15}$, 4.

Example: Approximate how much larger 6×10^4 is than 3×10^{-5} and check that approximation by dividing 6×10^4 by 3×10^{-5} to obtain $(6 \times 10^4) \div (3 \times 10^{-5}) = 2 \times 10^9$ to see that 6×10^4 is two billion times as large as 3×10^{-5}.

I3. 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.

(Associated Workplace Task: #3)

(Associated Postsecondary Assignments: #1 and 2)

Note: Negative integers are required to measure quantities such as temperatures below zero, rational numbers are required to measure quantities that are not integers such as the length of each piece of a 5-foot wire cut into two equal pieces, irrational numbers are required to measure quantities such as the length of the diagonal of a unit square, and complex numbers are required to solve equations such as $x^2 + 1 = 0$.

I4. Understand the capabilities and the limitations of calculators and computers in solving problems:

I4.1. Use calculators appropriately and make estimations without a calculator regularly to detect potential errors.

(Associated Workplace Task: #2)

* Benchmarks marked with an asterisk represent content that is recommended for all students but is *required* for those students who plan to take calculus in college.

I4.2. Use graphing calculators and computer spreadsheets.
(Associated Workplace Tasks: #3 and 6)
(Associated Postsecondary Assignment: #2)

J. Algebra

The high school graduate can:

J1. Perform basic operations on algebraic expressions fluently and accurately:

J1.1. Understand the properties of integer exponents and roots and apply these properties to simplify algebraic expressions.

Example: Simplify the expression $\left(\frac{a}{b}\right)^m \cdot c^{2m}$ to obtain either $\frac{(ac^2)^m}{b^m}$ or $\left(\frac{ac^2}{b}\right)^m$.

J1.2. * Understand the properties of rational exponents and apply these properties to simplify algebraic expressions.

Example: Explain why $\sqrt[3]{x^2} \cdot \sqrt{x} = x^{\frac{2}{3}} \cdot x^{\frac{1}{2}} = x^{\frac{7}{6}} = \sqrt[6]{x^7} = x\sqrt[6]{x}$ for any negative number x.

J1.3. Add, subtract and multiply polynomials; divide a polynomial by a low-degree polynomial.

Example: Divide $x^3 - 8$ by $x - 2$ to obtain $x^2 + 2x + 4$; divide $x^4 - 5x^3 - 2x$ by x^2 to obtain $x^2 - 5x - \frac{2}{x}$.

Example: Divide $x^3 - x^2 + x - 2$ by $x^2 + 1$ to obtain $x - 1 + \frac{-1}{x^2+1}$ and understand that also means that $(x^2 + 1)(x - 1) - 1 = x^3 - x^2 + x - 2$.

J1.4. Factor polynomials by removing the greatest common factor; factor quadratic polynomials.

Example: Remove the greatest common factor $3x^3y$ from $12x^3y^2 + 9x^4y + 6x^5y^3$ to obtain the factorization $3x^3y(4y + 3x + 2x^2y^2)$.

Example: Factor $x^2 - 36$, $4x^2 + 12xy + 9y^2$ and $x^2 - 5x - 6$ to obtain $(x + 6)(x - 6)$, $(2x + 3y)^2$ and $(x - 6)(x + 1)$ respectively.

J1.5. Add, subtract, multiply, divide and simplify rational expressions.
(Associated Workplace Task: #1)
(Associated Postsecondary Assignments: #1 and 2)

* Benchmarks marked with an asterisk represent content that is recommended for all students but is *required* for those students who plan to take calculus in college.

Example: Express $\frac{1}{x}+\frac{1}{y}$ as a single fraction to obtain $\frac{x+y}{xy}$.

Example: Simplify $\frac{a^2-b^2}{2b} \cdot \frac{6ab}{a+b}$ to obtain $3a(a-b)$.

J1.6. Evaluate polynomial and rational expressions and expressions containing radicals and absolute values at specified values of their variables.

J1.7. * 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).

Example: Derive the formula for the sum *S* of the first *N* terms of a geometric series whose first term is 1 and common ratio is *r* to obtain $S = 1 + r + r^2 + r^3 + \ldots + r^{N-1} = \frac{1-r^N}{1-r}$.

Example: Determine the 126th term of the arithmetic sequence whose third term is 5 and seventh term is 29.

J2. Understand functions, their representations and their properties:

J2.1. Recognize whether a relationship given in symbolic or graphical form is a function.

J2.2. * Determine the domain of a function represented in either symbolic or graphical form.

Example: Determine that the domain of the function $f(x)=\sqrt{x-2}$ can be written in interval form as $[2,\infty)$ and the domain of the function $g(x)=\frac{1}{x^2-9}$ contains all real numbers except 3 and -3.

J2.3. Understand functional notation and evaluate a function at a specified point in its domain.
(Associated Postsecondary Assignment: #1)

J2.4. * Combine functions by composition, as well as by addition, subtraction, multiplication and division.

J2.5. * 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 $y = x$.

* Benchmarks marked with an asterisk represent content that is recommended for all students but is *required* for those students who plan to take calculus in college.

J2.6. * Know that 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.

J3. Apply basic algebraic operations to solve equations and inequalities:

J3.1. Solve linear equations and inequalities in one variable including those involving the absolute value of a linear function.

Example: The length L of a spring in centimeters is given by $L = \frac{4}{7}F + 9$, where F is the applied force in dynes. What force F will produce a spring length of 14 centimeters?

Example: A pipe is to be cut to a length of 5 meters accurate to within a tenth of a centimeter. Recognize that an acceptable length x (in meters) of the pipe satisfies the inequality $|x - 5| \leq 0.001$.

J3.2. Solve an equation involving several variables for one variable in terms of the others.

(Associated Postsecondary Assignment: #2)

Example: If C represents the temperature in degrees Celsius and F represents the temperature in degrees Fahrenheit, then $C = \frac{5}{9}(F - 32)$. Solve this equation for F to obtain $F = \frac{9}{5}C + 32$.

Example: Newton's law of gravitation says that the force F exerted by a body of mass m on a body of mass M is $F = \frac{GmM}{r^2}$ where G is the gravitational constant and r is the distance between the bodies. Solve this equation for r to obtain $r = \sqrt{\frac{GmM}{F}}$.

J3.3. Solve systems of two linear equations in two variables.

J3.4. * Solve systems of three linear equations in three variables.

(Associated Postsecondary Assignment: #1)

J3.5. Solve quadratic equations in one variable.

(Associated Postsecondary Assignment: #1)

Example: Solve $x^2 - x - 6 = 0$ by recognizing that $x^2 - x - 6 = (x - 3)(x + 2)$ can be factored to obtain the two solutions $x = 3$ and $x = -2$.

Example: Solve $x^2 + 4x + 2 = 0$ by using the quadratic formula or by completing the square.

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J4. 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:

J4.1. Graph a linear equation and demonstrate that it has a constant rate of change.

(Associated Postsecondary Assignment: #1)

J4.2. Understand the relationship between the coefficients of a linear equation and the slope and x- and y-intercepts of its graph.

(Associated Postsecondary Assignment: #3)

J4.3. Understand the relationship between a solution of a system of two linear equations in two variables and the graphs of the corresponding lines.

J4.4. 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.

Example: Graph the solution set of the system of linear inequalities:

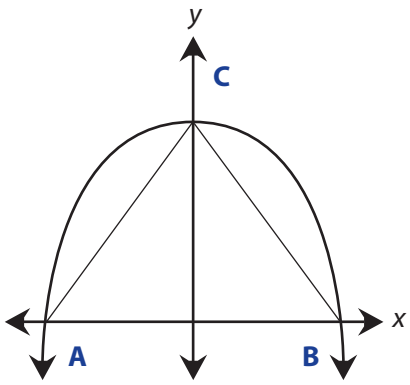
$2x + y \leq 4$

$x \geq 1$.

J4.5. Graph a quadratic function and understand the relationship between its real zeros and the x-intercepts of its graph.

(Associated Postsecondary Assignment: #1)

Example: The parabola shown below has equation $y = -x^2 + 2$ and passes through the points A, B and C. What is the area of the triangle ABC, rounded to two decimal places?



J4.6. * 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.

J4.7. Graph exponential functions and identify their key characteristics.

Example: Graph the exponential function $y(x) = 2^x$. Recognize that $y(x+1)$ is twice as large as $y(x)$ since $y(x + 1) = 2^{x+1} = 2 \cdot 2^x = 2 \cdot y(x)$.

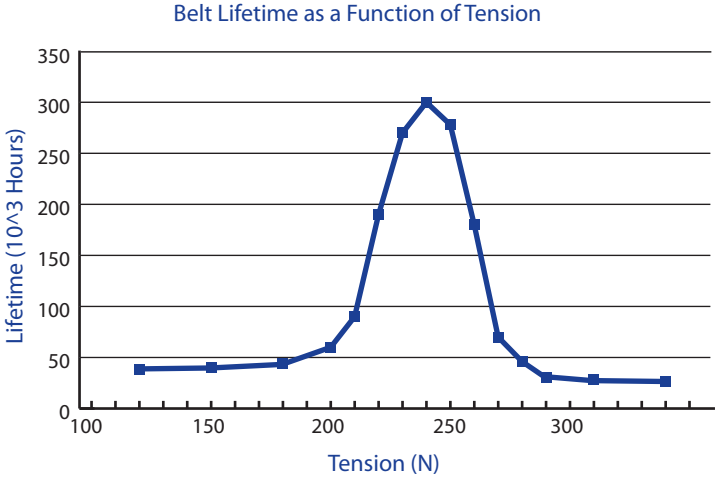
* Benchmarks marked with an asterisk represent content that is recommended for all students but is *required* for those students who plan to take calculus in college.

Mathematics Benchmarks

Example: How much money must be invested at 6% annual interest if you want to have $40,000 in 20 years?

J4.8. Read information and draw conclusions from graphs; identify properties of a graph that provide useful information about the original problem.
(Associated Postsecondary Assignment: #3)

Example: The lifetime of the timing belt in your car depends on the tensioning of the belt. The manufacturer specifies 240 N as the proper tension, but the mechanic working on your car can be off by as much as 10%. Use the following graph to estimate the reduction in the life of the belt that can occur with this error in tensioning.



J5. 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:

J5.1. 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.
(Associated Workplace Tasks: #1 and 2)
(Associated Postsecondary Assignment: #2)

J5.2. Recognize and solve problems that can be modeled using a system of two equations in two variables, such as mixture problems.
(Associated Postsecondary Assignment: #2)

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Example: A chemist has available two solutions of acid. The first solution contains 12% acid, and the second solution contains 20% acid. He wants to mix the two solutions to obtain a 500-milliliter mixture containing 15% acid. How many milliliters of each solution should he mix?

J5.3. Recognize and solve problems that can be modeled using a quadratic equation, such as the motion of an object under the force of gravity.
(Associated Postsecondary Assignment: #1)

Example: A stone is dropped off a cliff 660 feet above ground. When will the stone hit the ground if its height in feet at time t seconds after it is dropped is given by $h(t) = 660 - 16 \cdot t^2$?

J5.4. Recognize and solve problems that can be modeled using an exponential function, such as compound interest problems.

J5.5. * 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.
(Associated Postsecondary Assignments: #1 and 2)

Example: How long will it take the balance in your savings account to double if you earn 1.5% interest compounded annually?

J5.6. Recognize and solve problems that can be modeled using a finite geometric series, such as home mortgage problems and other compound interest problems.
(Associated Workplace Task: #3)
(Associated Postsecondary Assignment: #1)

Example: How much money will you have in a retirement fund if you deposit $1,000 each year for 20 years and the interest rate remains constant at 4%?

J6. * Understand the binomial theorem and its connections to combinatorics, Pascal's triangle and probability.

K. Geometry

The high school graduate can:

K1. Understand the different roles played by axioms, definitions and theorems in the logical structure of mathematics, especially in geometry:

K1.1. Identify, explain the necessity of and give examples of definitions, axioms and theorems.

* Benchmarks marked with an asterisk represent content that is recommended for all students but is *required* for those students who plan to take calculus in college.

K1.2. 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.

K1.3. Recognize that there are geometries, other than Euclidean geometry, in which the parallel postulate is not true.

Example: On a globe the lines of longitude intersect at both the North and South Poles creating a closed figure with only two sides; this is an example of a situation that cannot occur in Euclidean geometry but does occur in spherical geometry.

K2. 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:

K2.1. 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.

K2.2. 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.

K2.3. 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.

K3. Know the basic theorems about congruent and similar triangles and use them to prove additional theorems and solve problems.

Example: When you set a projector 12 feet from the screen, the image on the screen measures 8 feet across. What will the width of the image be if you move the projector 3 feet further from the screen?

* Benchmarks marked with an asterisk represent content that is recommended for all students but is *required* for those students who plan to take calculus in college.

K4. Know the definitions and basic properties of a circle and use them to prove basic theorems and solve problems.

(Associated Postsecondary Assignment: #1)

Example: A line tangent to a circle is perpendicular to the line segment from the center of the circle to the point of tangency.

K5. Apply the Pythagorean theorem, its converse and properties of special right triangles to solve problems.

(Associated Postsecondary Assignment: #1)

Example: Given the lengths of two sides of a right triangle, find the length of the third side.

Example: Given a triangle with side lengths of 12 and 13 inches, identify the triangle as acute, right, obtuse or not a triangle at all for various lengths of the third side such as 4, 5, 6, 18 or 26 inches. Justify your answers.

Example: Determine the lengths of the sides of the special right triangle with angles 30, 60 and 90 degrees and the special right triangle with angles 45, 45 and 90 degrees if the length of the smallest side in each case is 1 meter.

K6. Use rigid motions (compositions of reflections, translations and rotations) to determine whether two geometric figures are congruent and to create and analyze geometric designs.

Example: Prove the side-angle-side criterion for showing that two triangles are congruent.

Example: Analyze tessellations of the plane.

K7. Know about the similarity of figures and use the scale factor to solve problems.

Example: Read and extract information from scale drawings; compute lengths and areas from scale drawings.

K8. 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:

* Benchmarks marked with an asterisk represent content that is recommended for all students but is *required* for those students who plan to take calculus in college.

Mathematics Benchmarks

K8.1. 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.

(Associated Workplace Tasks: #1 and 2)

(Associated Postsecondary Assignment: #2)

Example: Convert feet per second to miles per hour, and use dimensional analysis to verify that the calculation yields the appropriate measurement unit.

$$1\frac{\text{ft}}{\text{sec}} = 1\frac{\text{ft}}{\text{sec}} \times 3600\frac{\text{sec}}{\text{hr}} \times \frac{1}{5280}\frac{\text{mi}}{\text{ft}} = \frac{30}{44}\frac{\text{mi}}{\text{hr}}$$

Example: Confirm that the distance traveled in 45 minutes at the rate of 2.4 meters per second is 6.48 kilometers.

$$d = rt = 2.4\frac{\text{m}}{\text{sec}} \times \frac{1}{1000}\frac{\text{km}}{\text{m}} \times 45\,\text{min} \times 60\frac{\text{sec}}{\text{min}} = 6.48\,\text{km}$$

Example: Convert speed of 150 meters per second to miles per hour.

$$150\frac{\text{meters}}{\text{second}} = \frac{150\text{ meters}}{1\text{ second}} \times \frac{3600\text{ seconds}}{1\text{ hour}} \times \frac{1\text{ mile}}{1610\text{ meters}} \approx 335\frac{\text{miles}}{\text{hour}}$$

K8.2. 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.

(Associated Workplace Task: #1)

(Associated Postsecondary Assignment: #1)

Example: How much material is removed when you drill a hole with a diameter of 2 cm through a block of metal that is 3 cm thick?

K8.3. 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.

Example: Know that a 16" (diameter) pizza has four times as much pizza as an 8" (diameter) pizza.

K9. 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.

* Benchmarks marked with an asterisk represent content that is recommended for all students but is *required* for those students who plan to take calculus in college.

K10. Represent geometric objects and figures algebraically using coordinates; use algebra to solve geometric problems:

(Associated Postsecondary Assignment: #1)

K10.1. 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.

K10.2. Describe a line by a linear equation.

Example: Find an equation for the line containing the points (32, 0) and (212, 100). If the first coordinate of a point on this line is 98.6, what is the second coordinate? Identify the point on this line where the two coordinates are the same.

K10.3. Find the distance between two points using their coordinates and the Pythagorean theorem.

K10.4. * Find an equation of a circle given its center and radius and, given an equation of a circle, find its center and radius.

(Associated Postsecondary Assignment: #1)

Example: The circle with radius 5 and center at (1, 0) has equation $(x-1)^2+y^2=25$.

Example: Transform the quadratic equation $x^2+2x+y^2-4y=4$ into the form $(x+1)^2+(y-2)^2=9$ by completing the square; realize that the graph of the equation is a circle with center at (-1, 2) and with radius 3.

K11. Understand basic right-triangle trigonometry and apply it to solve problems:

K11.1. 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.

(Associated Postsecondary Assignment: #1)

K11.2. 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.

Example: Safety regulations require that the angle between a ladder and the wall should be between 25 and 30 degrees. What is the range of safe placements (distance from the wall) for the bottom of a 12-foot ladder? Where should the base of a 20-foot ladder be placed to satisfy the same safety regulation?

* Benchmarks marked with an asterisk represent content that is recommended for all students but is *required* for those students who plan to take calculus in college.

K11.3. Use the standard formula for the area of a triangle, $A = \frac{1}{2}\, bh$, to explain the area formula, $A = \frac{1}{2}\, ab\sin C$ 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 the lengths of two of its sides and the included angle.

K12. * 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:

K12.1. * 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 $s = rt$.

K12.2. * Know and use the basic identities, such as $\sin^2(x) + \cos^2(x) = 1$ and $\cos\left(\frac{\pi}{2} - x\right) = \sin(x)$ and formulas for sine and cosine, such as addition and double angle formulas.

Example: Use the identity $\sin^2(x) + \cos^2(x) = 1$ to determine the sine of an angle when its cosine is known.

Example: Use the addition formula to find the amplitude, period and phase shift of $a\cos(wt) + b\sin(wt)$ by expressing it as $c\sin(wt+d)$ for some constants c and d.

K12.3. * Graph sine, cosine and tangent as well as their reciprocals, secant, cosecant and cotangent; identify key characteristics.

K12.4. * Know and use the law of cosines and the law of sines to find missing sides and angles of a triangle.

* Benchmarks marked with an asterisk represent content that is recommended for all students but is *required* for those students who plan to take calculus in college.

L. Data Interpretation, Statistics and Probability

The high school graduate can:

L1. Explain and apply quantitative information:

L1.1. Organize and display data using appropriate methods (including spreadsheets) to detect patterns and departures from patterns.
(Associated Workplace Task: #4)

L1.2. Read and interpret tables, charts and graphs.
(Associated Workplace Tasks: #3 and 4)

L1.3. Compute and explain summary statistics for distributions of data including measures of center (mean, median) and spread (range, percentiles, variance, standard deviation).

L1.4. Compare data sets using graphs and summary statistics.

Example: Create a box plot of a school's test scores for 1995 and for 2000 and ask what changes occurred in the five years.

L1.5. Create scatter plots, analyze patterns and describe relationships in paired data.

L1.6. Know the characteristics of the Gaussian normal distribution (bell-shaped curve).

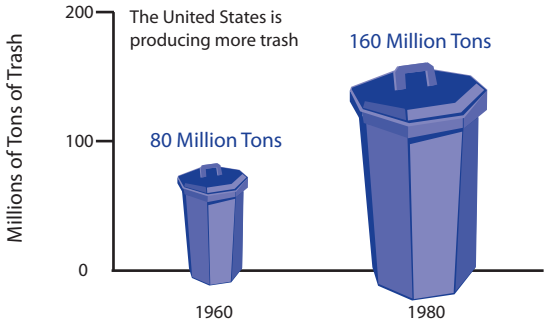
Example: If a set of data is approximately normally distributed, know that approximately 95% of the data in the set are within two standard deviations of the mean and that approximately 99% of the data in the set are within three standard deviations of the mean.

L2. Explain and critique alternative ways of presenting and using information:

L2.1. 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.

L2.2. Identify and explain misleading uses of data.

Example: Explain why the following graphic misrepresents the data it is intended to illustrate.



* Benchmarks marked with an asterisk represent content that is recommended for all students but is *required* for those students who plan to take calculus in college.

Mathematics Benchmarks

L2.3. Recognize when arguments based on data confuse correlation with causation.

Example: Researchers have noticed that the number of golf courses and the number of divorces in the United States are strongly correlated and both have been increasing over the last several decades. Can you conclude that the increasing number of golf courses is causing the number of divorces to increase? Explain your answer.

L3. Explain the use of data and statistical thinking to draw inferences, make predictions and justify conclusions:

L3.1. Explain the impact of sampling methods, bias and the phrasing of questions asked during data collection and the conclusions that can rightfully be made.

L3.2. Design simple experiments or investigations to collect data to answer questions of interest.
(Associated Workplace Task: #4)

L3.3. Explain the differences between randomized experiments and observational studies.
(Associated Workplace Task: #4)

L3.4. 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.

Example: The following table gives the winning speeds (in miles per hour) at the Indianapolis 500 race for 20 years (Source: The World Almanac). Explain why it is not appropriate to use the linear regression equation for these data to estimate what the winning time was in 1920 or to predict the winning speed in 1990.

year	1961	1962	1963	1964	1965
speed (mph)	139.1	140.3	143.1	147.4	151.4

year	1966	1967	1968	1969	1970
speed (mph)	144.3	151.2	152.9	156.9	155.7

year	1971	1972	1973	1974	1975
speed (mph)	157.7	163.5	159.0	158.6	149.2

year	1976	1977	1978	1979	1980
speed (mph)	148.7	161.3	161.4	158.9	142.9

* Benchmarks marked with an asterisk represent content that is recommended for all students but is *required* for those students who plan to take calculus in college.

L4. Explain and apply probability concepts and calculate simple probabilities:

L4.1. Explain how probability quantifies the likelihood that an event occurs in terms of numbers.
(Associated Workplace Task: #3)

L4.2. Explain how the relative frequency of a specified outcome of an event can be used to estimate the probability of the outcome.

Example: Typically, 35 out of every 100 teenagers in a certain community have received a traffic ticket. Of those teenagers who have received a ticket, 55% were charged with speeding. What is the probability that a teenager chosen at random will have received a speeding ticket?

L4.3. Explain how the law of large numbers can be applied in simple examples.

Example: Toss a fair coin 10 times, record the number of heads and apply the data to estimate the probability of getting heads on a single toss of the coin. Toss the coin 20 more times, add the results to the previous data and apply the 30 tosses to estimate the probability of getting a heads. Toss the coin 30 more times and make another estimate of the probability of getting a heads. What can you observe about the probability as the number of tosses increases?

L4.4. Apply probability concepts such as conditional probability and independent events to calculate simple probabilities.

Example: A fair coin is tossed three times, and three heads are obtained. Understand that the probability of obtaining a head on the fourth toss is 1/2 because this event is independent of outcomes of the three previous tosses.

Example: If two marbles are drawn randomly one after the other without replacement from a bag containing 4 red and 6 blue marbles, the probability that both marbles drawn are red is $\frac{4}{10} \times \frac{3}{9} = \frac{2}{15}$ because the probability of drawing a red marble on the second draw depends, or is conditional upon, the color of the first marble drawn.

* Benchmarks marked with an asterisk represent content that is recommended for all students but is *required* for those students who plan to take calculus in college.

L4.5. Apply probability concepts to practical situations to make informed decisions.

(Associated Workplace Tasks: #3 and 4)

Example: A company has 6 telephone lines coming into its business. Efficiency experts performed a study for a week and determined that the following table could give the number of lines in use at any one time.

# of lines in use	0	1	2	3	4	5	6
percent of time	0.15	0.10	0.20	0.25	0.15	0.11	0.04

Determine the probability that at most four lines were in use at one time during the week.

* Benchmarks marked with an asterisk represent content that is recommended for all students but is *required* for those students who plan to take calculus in college.

Workplace Tasks

Workplace Task #1

Machine Operator

Eastman Chemical Company, *Kingsport, Tennessee*

Manufacturing companies looking to fill **machine operator** openings need candidates who possess strong fundamental skills, especially mathematics. The Texas division of Eastman Chemical has an established company-run Operator Apprenticeship Program to train new machine operators. **Operator apprentices** are evaluated on the basis of their ability to perform tasks that require the ability to solve multiple-step arithmetic problems and present solutions in the appropriate unit of measure or dimension.

Career Outlook

JOB	COMPENSATION	EDUCATION	NUMBER OF JOBS	OUTLOOK
Machine setters, operators and tenders	Median hourly earnings in 2000 range from $10.40 to $16.07.	On-the-job. Although no formal specialized education is required for most operating jobs, employers prefer to hire applicants with good basic skills.	1.6 million jobs in 2000	Employment will be affected by the rate of technological implementation, the demand for the goods they produce, the effects of trade and the reorganization of production processes.

Source: Occupational Outlook Handbook, 2002–03, *Bureau of Labor Statistics, U.S. Department of Labor.*

Associated Benchmarks

ADP benchmarks that address the knowledge and skills required to complete these tasks are:

CONTENT AREA	STRAND	NUMBER
English	Language	**A7**
	Communication	**B1**
Mathematics	Number Sense and Numerical Operations	**I1.1, I1.2**
	Algebra	**J1.5, J5.1**
	Geometry	**K8.1, K8.2**

SAMPLE TASKS

TASK #1:

Computing Concentration

Ask the apprentice to mix a solution (#1) of 5 g Peters fertilizer and 50 g of distilled water.

- **Determine the percent concentration-by-weight of this solution.**
  The basic formula is *Weight of the solute divided by the combined weight of the solute and solvent equals percent concentration-by-weight.*
- **Example:** 5 g ÷ (5 g + 50 g) = 5 g ÷ 55 g ≈ 0.09 or 9% concentration-by-weight
- **Calculate the density of this solution (#1).**
  Divide the weight by the volume to determine the density in gm/ml.

Ask the apprentice to make a solution (#2) using 10 g of Peters and 50 g of distilled water.

- **Determine the percent concentration-by-weight.**
- **Ask the apprentice:** Why is the concentration-by-weight of solution #2 not double the concentration-by-weight of solution #1 since the solute is doubled?

$$C = \frac{x}{x+V} \text{ and } \frac{2x}{2x+V} \neq 2\frac{x}{x+V}$$

- **Ask the apprentice to use the formula to explain.**

TASK #2:

Computing Volume and Weight

Ask the apprentice to compute the volume of the liquid in a rectangular tank.

- **Measure the inside dimensions (length, width and actual depth of the liquid) to the nearest eighth of an inch.**
- **Multiply length, width and height to get volume in cubic inches.**

  $V = L \times W \times D = 10 \times 15\frac{3}{4} \times 28 = 4410 \text{ in}^3$
- **Convert the volume in in^3 to ft^3, lb and gal.** (Assume that the liquid is distilled water.)

  There are 12" x 12" x 12" = 1728 in^3
  so the volume in cubic feet is
  $V = (4410 \text{ in}^3) \div (1728 \text{ in}^3) = 2.552 \text{ ft}^3$.

  One cubic foot of water weighs 62.4 pounds so
  Weight = $(2.552 \text{ ft}^3) \times (62.4 \text{ lb/ft}^3) = 159.25$ pounds.

  The volume can be converted to gallons using
  (159.25 lb) ÷ (8.34 lb/gal) = 19.1 gallons.
- **Calculate the weight of the liquid in the tank if it were oil with a specific gravity of 0.9233.**

  159.25 lb x 0.9233 = 147.04 pounds

TASK #3:

Application of Weight and Volume

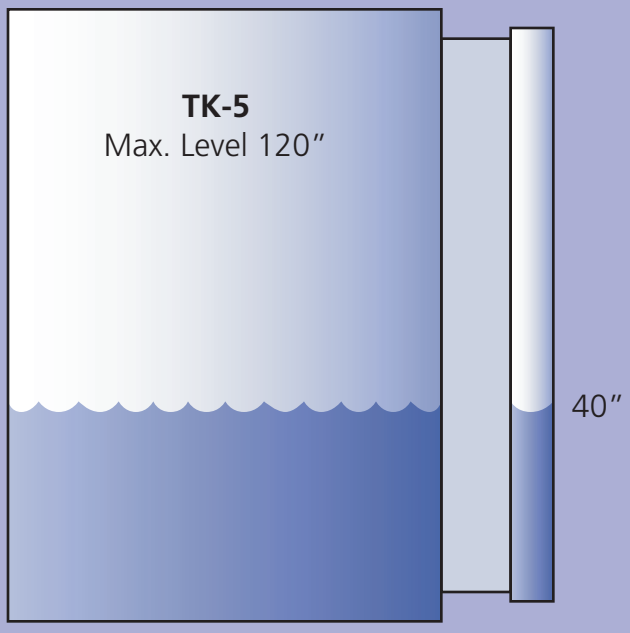
Ask the apprentice: If you needed to add 300 lbs. of a material to a mix tank, how would you determine if you had enough room?

- **Determine the equivalent of one inch in pounds or gallons.** Do this by draining one inch from the tank weighing the liquid. (1 in = 25 lbs)
- **Divide the specified amount in pounds by the lb/in to get total inches required.**

  300 lb ÷ 25 lb/in = 12 in
- **Determine the room available in the mix tank. Subtract actual tank level from maximum tank level.**

  120 in – 40 in = 80 in
- **Compare to total inches required.**

  12 inches needed, 80 inches available



Workplace Task #2

Licensed Nurse

SETON Healthcare Network, *Austin, Texas*

Nursing is a demanding profession that requires workers to use sophisticated technologies, administer pharmaceutical agents and communicate effectively with patients from a wide range of backgrounds. Licensed **nurses** working for SETON, a network of hospitals and other medical facilities in central Texas, routinely administer medications in specific dosages that affect the safety, survival and recovery of patients. The difference between life and death in many instances depends on the precise calculations of quantities involving ratios and various units of measurement. Nurses are also called upon to explain dosage calculations to colleagues and patients in ways that are easily understood.

Career Outlook

JOB	COMPENSATION	EDUCATION	NUMBER OF JOBS	OUTLOOK
Registered nurses	Median annual earnings were $44,840 in 2000.	There are three major educational paths to registered nursing: associate degree in nursing (ADN), bachelor of science degree in nursing and diploma. ADN programs, offered by community and junior colleges, take about two to three years.	2.2 million jobs in 2000	Faster than average

Source: Occupational Outlook Handbook, 2002–03, *Bureau of Labor Statistics, U.S. Department of Labor.*

Associated Benchmarks

ADP benchmarks that address the knowledge and skills required to complete these tasks are:

CONTENT AREA	STRAND	NUMBER
English	Language	**A1, A6, A7**
	Communication	**B1**
Mathematics	Number Sense and Numerical Operations	**I1.1, I1.2, I4.1**
	Algebra	**J5.1**
	Geometry	**K8.1**

SAMPLE TASKS

Task #1

The doctor orders Ceclor elixir 25 mg/kg for a child who weighs 20.4 lbs. The available Ceclor elixir contains 250 mg per 5 ml. A nurse must determine the proper dose for the child.

The nurse converts the child's weight from standard pounds (20.4 lbs) to metric kilograms (9.26 kg) and uses a calculator to quickly calculate a dose of:

$$25 \times 9.26 \times \left(\frac{250}{5}\right) = 11{,}575.$$

This number is clearly too large for a drug dose, so the nurse must check the calculation by rewriting the equation with units rather than just with numbers. With units, the calculation just completed appears as follows:

$$\left(\frac{\text{mg}}{\text{kg}}\right) \times (\text{kg}) \times \left(\frac{\text{mg}}{\text{ml}}\right) = \left(\frac{\text{mg}^2}{\text{ml}}\right).$$

Since the units in the calculator version are not ml's, as they should be, it is easy for the nurse to identify the mistake: The last term (mg/ml) should have been inverted (ml/mg). So the nurse must repeat the calculation to obtain the correct dosage:

$$\left(\frac{25\,\text{mg}}{\text{kg}}\right) \times (9.26\,\text{kg}) \times \left(\frac{5\,\text{ml}}{250\,\text{mg}}\right) = 4.63\,\text{ml}.$$

Task #2

An advanced practice nurse must teach a diabetic patient who has been started on an intensive insulin therapy regimen how to determine the proper dose of insulin to use before a meal. The patient will be on a regimen of *Lantus* 20 units at bedtime and *Novolog* 5 units before each meal. Before meeting with the patient, the nurse must review the patient's records for several factors needed to perform the dosage calculations.

First, the nurse must know the patient's "average" **Total Daily Dose** (TDD), the total amount of long-acting and rapid-acting insulin used in a single day.

- The patient's regimen of 20 units of *Lantus* and 5 units of *Novolog* before each meal produces a TDD of 35 units.

$$20 \text{ units} + \left(\frac{5 \text{ units}}{\text{meal}} \text{ x } 3 \text{ meals}\right) = 35 \text{ units}$$

Second, the nurse must calculate the patient's **Insulin Sensitivity Factor**, also called the Correction Factor. The Insulin Sensitivity Factor is a measure of the lowering effect of 1 unit of insulin on the blood glucose (BG) level in milligrams/deciliter (mg/dl), and it is determined using the "1,800 rule": 1,800 divided by TDD.

$$\frac{1800}{35 \text{ units}} \approx 51.4 \text{ mg/dl}$$

After rounding 51.4 mg/dl to the nearest unit, the nurse will know that 1 unit of insulin will lower the blood glucose (BG) by 51 mg/dl.

Third, the nurse must calculate the **Insulin to CHO (Carbohydrate) Ratio**. The Insulin to CHO Ratio indicates how many grams (gms) of carbohydrate will be offset by 1 unit of insulin. It is determined using the "500 rule": 500 divided by TDD.

$$\frac{500}{35 \text{ units}} \approx 14.3 \text{ mg/dl}$$

After rounding 14.3 gms to the nearest unit, the nurse will know that the patient will need an additional unit of *Novolog* for every 14 grams of carbohydrate consumed (a 1:14 ratio).

With this information and the blood glucose goal of 120 mg/dl, the nurse teaches the patient to use two formulas to calculate insulin dosages needed before each meal.

The first formula involves the patient's actual blood glucose before the meal (*BG*), the blood glucose goal of 120 mg/dl (*Y*) and the Insulin Sensitivity or Correction Factor (*X*). For instance, before lunch, the patient takes a blood glucose reading of 280 mg/dl:

$$\frac{BG - Y}{X} \text{ or } \frac{280 - 120 \text{ mg/dl}}{51 \text{ mg/dl}} = \frac{160}{51} \approx 3 \text{ units of } \textit{Novolog}.$$

The second formula involves the number of grams of carbohydrate in the patient's lunch and the number of insulin units needed. For instance, the patient's lunch will contain 45 gms of CHO. Using the Insulin to CHO Ratio:

$$\frac{45 \text{ gms}}{14} \approx 3 \text{ units of } \textit{Novolog}.$$

The combination of these two results means that the patient will need a dose of 6 units of *Novolog* before this particular lunch.

The formulas are used as a guide and may be modified based on patient history. For example, if the patient has frequent hypoglycemia and the nurse's review of patient records indicates that the Insulin Sensitivity Factor of 51 will not be safe, the nurse may round it up to 55 or 60.

Workplace Task #3

Actuary

A national "name brand" insurance company

Insurance is protection at a price, and **actuaries** employed by large national insurance companies use data to set the price for that protection by balancing costs of coverage against risks to be covered. When new data become available, actuaries must evaluate the impact of policy adjustments prompted by the data on the cost of future claims and determine if new pricing is needed. One type of insurance product is a *child rider,* a low-cost addition to traditional insurance policies that provides a death benefit for all children in a family under age 21. The cost of such a policy is sensitive to changes in life-expectancy data. Using calculators and spreadsheets, an actuary will create mathematical models, calculate the likelihood of events and use the results to make practical decisions regarding the price of the child rider. Once the necessary changes to the product price have been made, the actuary must brief the company's **insurance agents** so they are able to explain it to their customers.

Career Outlook

JOB	COMPENSATION	EDUCATION	NUMBER OF JOBS	OUTLOOK
Actuaries	Median annual earnings were $66,590 in 2000.	Bachelor's degree in mathematics, actuarial science, statistics or a business-related discipline, such as economics, finance or accounting	14,000 jobs in 2000	Slower than average
Insurance sales agents	Median annual earnings were $38,750 in 2000.	Bachelor's degree or high school graduates with proved sales experience	378,000 jobs in 2000	Slower than average

Source: Occupational Outlook Handbook, 2002–03, *Bureau of Labor Statistics, U.S. Department of Labor.*

Associated Benchmarks

ADP benchmarks that address the knowledge and skills required to complete this task are:

CONTENT AREA	STRAND	NUMBER
English	Language	**A1, A6**
	Communication	**B6**
	Research	**D2**
	Informational Text	**F3, F5**
Mathematics	Number Sense and Numerical Operations	**I1.1, I1.2, I3, I4.2**
	Algebra	**J5.6**
	Data Interpretation, Statistics and Probability	**L1.2, L4.1, L4.5**

SAMPLE TASK

The original rider was priced in 1971, using mortality tables containing data from 1953. An actuary is asked to use more recent mortality data to estimate the cost of the rider and determine whether a change in price is warranted. Also, the company wants to know if it can now include coverage for infants age 0–14 days without a change in price.

The Original Cost Estimate

The actuary assumes that the company sells 1,000 rider policies. Then the actual number of children covered will be about 2.3 times 1,000 because the average number of children per family in the United States is 2.3 in 1953. In a population of 1,000 newborns, approximately 46 will die before reaching age 21. Twenty-seven of these deaths occur in the first two weeks of life and are not covered. If the company sells 1,000 rider policies offering a death benefit of $1,000 per child, the cost (just the death benefit) per family incurred over the 21 years is roughly

$$\text{Total Cost} = \$1000 \times 2.3 \times (19/1000) = \$43.70.$$

Divide by 21, the number of years in which the 19 deaths occur, to get a cost of roughly $2.08 per family per year.

In the last half-century, improvements in medicine have significantly reduced child mortality. This change is reflected in child mortality data from 1999.

Table: Improvement in Child Mortality

1953 Mortality Data				1999 Mortality Data			
Age		Age		Age		Age	
1	0.02870	11	0.0005	1	0.00706	11	0.00013
2	0.00230	12	0.0005	2	0.00053	12	0.00013
3	0.00140	13	0.0005	3	0.00036	13	0.00017
4	0.00100	14	0.0006	4	0.00027	14	0.00026
5	0.00080	15	0.0007	5	0.00022	15	0.00038
6	0.00080	16	0.0009	6	0.00020	16	0.00051
7	0.00070	17	0.0010	7	0.00019	17	0.00063
8	0.00060	18	0.0011	8	0.00018	18	0.00073
9	0.00050	19	0.0012	9	0.00016	19	0.00079
10	0.00050	20	0.0013	10	0.00014	20	0.00084
		21	0.0013			21	0.00088

For example, whereas 28.7 out of 1,000 children in the United States died before reaching age one in 1953, only about seven out of 1,000 died at the same age in 1999.

The actuary sees cost reduction in the child mortality data from 1999: Only 34 children out of 1,000 will die before age 21. In addition, the number of children per family is smaller in 1999 (about 1.7) than it was in 1953, reducing costs further. These cost reductions allow the insurance company to extend coverage to include the first 14 days of life — heretofore excluded — for a total cost of about $2.75 per year per family. Because the increased coverage more than justifies the increased cost, the actuary recommends that the company drop the clause limiting coverage on children age 14 days and under.

This is a significant change, especially for the agents who will sell the policy. The actuary must explain the change to the agents in a way the agents can understand and explain to their customers.

Extensions

There are many simplifying assumptions made in the above calculations. Here are a few:

- All of the children in the population are the same age.
- All of the children in all of the families were born on the first day of the year.
- The premium is paid at the start of the year, and deaths all occur at the end of the year.
- There is no inflation, and the insurance company earns no interest on reserves.
- No other benefits are included in the policy.
- The average number of children per family for the insured population matches the U.S. population.

All of these can be replaced by more realistic assumptions. For example, the actuary would compute the present value of a stream of future premium payments as the sum of a finite geometric series rather than a back-of-the-envelope calculation. It is perhaps just as important to be able to deduce which assumptions tend to underestimate costs and which tend to overestimate costs. For example, the census data giving 2.3 children per family is probably not a good estimate for the population insured by the company (in 1953 or today). The expected number of children in a family, given that the family has purchased life insurance, is probably larger than the expected number for the full U.S. population. In real applications, the trade-off is often between getting a "pretty good" solution today and a "very good" solution next month.

Workplace Task #4

Wafer Fabrication Technician and Manufacturing Technician

Advanced Micro Devices, Inc., *Boise, Idaho*

Manufacturing today requires front-line employees to have a greater level of skill than was demanded of their predecessors. At Advanced Micro Devices, Inc. (AMD), a supplier of integrated circuits for the global computer and communications markets, **wafer fabrication technicians** and **manufacturing technicians** must be able to carry out tasks directly related to circuit production and write recommendations for improving the production processes. Progress up the career ladder depends upon the ability of employees to produce these recommendations in technical reports — critical tools for communicating with colleagues — and the company provides training courses to teach technicians to write them. Writing these reports requires the ability to understand and synthesize complex, technical information from a variety of sources and convey the findings to colleagues.

Career Outlook

JOB	COMPENSATION	EDUCATION	NUMBER OF JOBS	OUTLOOK
Semiconductor processors (i.e., wafer fabrication technicians)	Median hourly earnings were $12.23 in 2000.	Employers prefer to hire persons who have completed associate degree programs for semiconductor processor jobs. A high school diploma or equivalent is the minimum requirement for entry-level operator jobs in semiconductor fabrication plants.	52,000 jobs in 2000	Faster than average
Engineering technicians (i.e., manufacturing technicians)	Median annual earnings were $35,990 in 2000.	Employers prefer to hire persons with at least a two-year associate degree in engineering technology.	519,000 jobs in 2000	Average

Source: Occupational Outlook Handbook, 2002–03, *Bureau of Labor Statistics, U.S. Department of Labor.*

Associated Benchmarks

ADP benchmarks that address the knowledge and skills required to complete this task are:

CONTENT AREA	STRAND	NUMBER
English	Language	**A1, A6**
	Writing	**C1, C2, C3, C4, C5, C10**
	Research	**D1, D2, D4, D5**
	Logic	**E7**
	Informational Text	**F5, F7**
Mathematics	Data Interpretation, Statistics and Probability	**L1.1, L1.2, L3.2, L3.3, L4.5**

SAMPLE TASK

As part of AMD's on-the-job training internal coursework, technicians are asked to write a project report that describes the regulation of gas-tray solenoid voltage on Fab 10 diffusion furnaces.

Excerpt of a project report that met the requirements of AMD's internal coursework for technicians:

Project Report

During this project, solenoids showing excessive wear from operation with the unregulated voltage will be replaced. The unregulated voltage is outside upper control limits for gas tray solenoids, which causes premature failure of solenoids and process aborts. This project was selected because once implemented, it will reduce diffusion furnace aborts, thereby reducing scrap for Fab 10. The cost of the project is minimal compared to the cost of scrapped wafers as a result of solenoid induced furnace aborts.

The goal of the project is to further AMD profits by bringing solenoid voltage within control limits to prevent unnecessary diffusion furnace aborts. There are four components to the report:

- Measurement and Responses
- Capability Study
- Experiments
- Results

Measurements and Responses

There are four critical measurements for this project which require response:

1. Measurement of the DC supply voltage used to power the diffusion furnace gas tray solenoids (found in furnace regulator modification tables)
2. Visual inspection of the gas tray solenoids
3. Analysis of furnace regulator modification costs
4. Reduction in solenoid induced diffusion furnace aborts

Capability Study

For this project, 24 VDC regulators and replacement gas tray solenoids need to be sourced. Coordinating this project in a production Fab is also a consideration[…].

Experiments

(Note: This section of the report refers to tables, also compiled by the technicians.) Thirty-three diffusion furnaces require the 24 VDC regulator modification. The success of the initial modifications proved a more aggressive modification schedule to be appropriate. None of the furnaces within this sample have aborted due to solenoid failures.

Results

This project is a success. The Furnace Regulator Modification Table 1 demonstrates the gas tray solenoids to be operating within control limits. Gas tray solenoid life cycles are now more stable. There have been no aborts due to premature solenoid failure on any diffusion furnaces with the 24 VDC regulator project complete. Furthermore, data in Table 2 shows that the cost to modify each furnace is very low in comparison to the cost of wafer scrap due to an abort.

By monitoring diffusion furnaces as they were modified, data indicated the 24 VDC modification should be performed on all diffusion furnaces. Of the 33 diffusion furnaces needing the 24 VDC modification, 25 are complete, and 8 are scheduled for completion by the end of the first quarter.

Workplace Task #5

Events Manager

"I Write the Songs" Radio Program, *Highland Village, Texas*

Publicity and public events managers must perform budgeting, hiring, contracting and writing tasks. The **events manager** for "I Write the Songs," a Texas radio program for and about songwriters, organizes a local workshop that will host a panel of locally and nationally renowned songwriters. The events manager must produce during the course of this project letters to each of the panel invitees, as well as biographies and discographies for each panelist. The events manager must know well both the business of songwriting and the interests of workshop attendees to draft materials that are persuasive and powerful. These tasks also require the ability to research and incorporate additional information.

Career Outlook

JOB	COMPENSATION	EDUCATION	NUMBER OF JOBS	OUTLOOK
Advertising, marketing, promotions, public relations and sales managers	Median annual earnings in 2000 for advertising and promotions managers were $53,360; marketing managers, $71,240; sales managers, $68,520; and public relations managers, $54,540.	Bachelor's or master's degree	707,000 jobs in 2000	Faster than average

Source: Occupational Outlook Handbook, 2002–03, *Bureau of Labor Statistics, U.S. Department of Labor.*

Associated Benchmarks

ADP benchmarks that address the knowledge and skills required to complete this task are:

CONTENT AREA	STRAND	NUMBER
English	Language	**A1, A6**
	Writing	**C1, C2, C3, C4, C5, C10**
	Research	**D2, D3, D4**
	Informational Text	**F7, F9**

SAMPLE TASK

Identifying Issues and Speakers

The events manager's first task is to identify the issues and speakers to be featured at the annual workshops. To determine the emerging and important issues in the music industry that directly affect the songwriting profession, the manager must review information contained within Web sites, trade magazines and industry papers (e.g., *Billboard, Spin, Rolling Stone, Indie Music Newsletter*). The next step is to identify locally or nationally successful songwriters to be speakers at workshops by considering songwriters' past work history, success, speaking experience at workshops and conferences, genres of music, and whether or not they have written any books or articles. Subsequently, the events manager must contact the necessary individuals and organizations to obtain information, permissions and commitments.

Writing Letters and Bios

The letter of invitation is essentially a piece of persuasive writing that must build a convincing and cogent argument, and it demands that the writer be well informed about her or his reader. The events manager may already be familiar with the invitee, or she or he may have to search for background information through databases, the Internet or trade magazines. No matter how the list of invitees is determined, the contents and style of the letter must be in tune with the audience — the reader/invitee — to have a favorable chance of being accepted. Once the panelists are determined, the events manager must write a short biographical sketch, often simply referred to as a "bio," of each workshop panelist. To draft bios of the panelists who accept their invitations, the events manager may actually have to conduct interviews with the panelists or have them submit lists of their accomplishments, awards and bits of personal history, from which the events manager then composes a narrative. For those panelists who are established songwriters, the events manager then compiles discographies (a descriptive list of songs a songwriter has written or co-written) to have on hand for workshop attendees to provide them with valuable information about the panelist. The events manager must be sure to make the format uniform and cite all information accurately (e.g., title, songwriter, artist, copyright date).

Sample Invitation Letter

August 29, 2003

Courtney Delaney
4400 Moulton St., Ste. D
Greenville, TX 75401

Dear Courtney:

This is a letter to invite you to participate as a panelist and mentor at the 2004 "I Write the Songs" Songwriting Conference in Dallas, Texas. The event will take place at the Intercontinental Hotel July 16–18, 2004.

For the last five years, "I Write the Songs" has been an on-air songwriting workshop designed for songwriters of all levels. In 1989, *Billboard Magazine* estimated that there were more than 40 million songwriters throughout the United States. "I Write the Songs" was created to be a resource for those 40 million songwriters who are interested in learning and improving their songwriting craft. To do this, "I Write the Songs" features shows that offer instruction in songwriting, interviews with famous songwriters, stories of great songs and how they were written, and on-air critiques of original songs submitted by listeners. Guests featured on "I Write the Songs" have included Willie Nelson, Janis Ian, Paul Williams, Richard Carpenter, Andrew Gold, Sheila Davis, Jim Brickman and others.

In an effort to provide other opportunities for songwriters and artists to improve musically and to enhance their understanding of the music industry, "I Write the Songs" is joining forces with its parent company, CQK Music Publishing, and our sister Web site, Lyricalline.com, to offer a weekend of education, networking and creative expression in the first "I Write the Songs" Songwriting Conference. Our hope is that all in attendance will be given the opportunity to advance their knowledge of both the craft and business of songwriting through workshops and mentoring sessions.

Over the last several years, we at "I Write the Songs" have admired the work that you have done to offer independent songwriters and artists an outlet for their music to be heard through your Internet radio site at OutboundMusic.com. The advent of the Internet has brought overwhelming change to the music industry, and we feel that it is essential to properly instruct the attendees at the conference in the ways to take advantage of opportunities. Someone of your experience and expertise would not only be essential to the education of these songwriters and artists but would also be a source of inspiration.

"I Write the Songs" is prepared to provide you with hotel accommodations at the Intercontinental Hotel for the weekend of July 16–18, 2004, as well as to take care of your airfare and travel expenses. We also look forward to giving you a $500 honorarium for your time and participation.

If this is acceptable to you and if you would be interested in being a part of the event, please contact me at your earliest convenience at 972-555-5555, or you can email me at sarah@cqkmusic.com.

Thanks for your consideration of this matter,

Sarah Marshall
"I Write the Songs"/CQK Music

Workplace Task #6

Loan Officer

Sterling Bank, *Houston, Texas*

When banks lend money to customers, they must consider the ability of the customers to repay the loan in a timely manner as measured against the known risks and the value of the collateral offered. It is the job of a bank's **loan officer** to evaluate the merits of a loan request and then make a recommendation regarding whether or not to lend the money. To evaluate the commercial loan request described at right, a loan officer at Sterling Bank in Houston must gather information from a variety of sources, judge what information is most pertinent to a loan decision and synthesize the selected information into a credit request memo. This memo must convey findings of a technical nature to the loan committee members in a way that allows them to make the best decision on whether to approve the loan request.

Career Outlook

JOB	COMPENSATION	EDUCATION	NUMBER OF JOBS	OUTLOOK
Loan officers	Median annual earnings were $32,160 in 2000.	Bachelor's degree in finance, economics or a related field	265,000 jobs in 2000	Loan officers: slower than average; loan counselors: average

Source: Occupational Outlook Handbook, 2002–03, *Bureau of Labor Statistics, U.S. Department of Labor.*

Associated Benchmarks

ADP benchmarks that address the knowledge and skills required to complete this task are:

CONTENT AREA	STRAND	NUMBER
English	Language	**A1, A6**
	Writing	**C1, C2, C3, C4, C5, C10**
	Research	**D1, D2, D4**
	Logic	**E4**
	Informational Text	**F3, F7, F9**
Mathematics	Number Sense and Numerical Operations	**I1.1, I1.2, I4.2**

SAMPLE TASK

Representatives of Acme Enterprises, LTD have approached Sterling Bank in Houston, Texas, to borrow $1.7 million needed to purchase two Gulfstream II aircraft. To evaluate Acme Enterprises' request, a loan officer must research every aspect of the loan request and write the credit request memo to be submitted to the bank's Senior Loan Committee charged with the final decision of whether to loan Acme Enterprises the $1.7 million. (Note: In the task below, the Roman numeral *M* indicates 1,000 and *MM* indicates 1,000-thousands or 1 million.) The loan officer must report information to the committee regarding the aircraft (including their condition), how the aircraft will be used by Acme Enterprises (i.e., how they plan to make the money needed to repay the loan), how likely it is that Acme Enterprises' plan will work given the realities of the marketplace and the operation costs involved, and the financial health and credit worthiness of Acme Enterprises. Based on the research, the loan officer must weigh the pros and cons of the loan and make a final recommendation to the committee.

Following are excerpts from a credit request memo written by a loan officer for approval by the Senior Loan Committee.

Credit Request

This is a request from Acme Enterprises, LTD to borrow $1.7MM to purchase two Gulfstream II aircraft. Both planes and a $200M Sterling Bank CD will initially secure this loan. Proceeds from the sale of parts from the older Gulfstream will be used to reduce the outstanding balance of the loan and the debt will then be placed on a 7-year amortization. The CD will be released under the terms outlined in the collateral section listed on page 2. The 1972 G-II will be used as an international air ambulance. The 1968 G-II will be used as a parts plane.

The 1972 G-II currently has two engines that will need replacing because they are nearing the maximum number of allowable operating hours since last overhaul allowable under Part 91 of FAA regulations. This plane is in exceptional condition, with several valuable modifications outlined below. It does however need "new"/overhauled engines and the cost to overhaul these Rolls Royce jet engines is $750,000 each. Most Gulfstream operators cannot fulfill their operating contracts if their aircraft is down for the several weeks needed to complete the overhaul, so in this case — as in many cases the owner/operator placed this plane for sale after buying another aircraft with acceptable hours on the engines. Our borrower wants to make an offer of $1,000,000 for this plane.

Because the 1968 G II has not received any of the key update modifications (see below — Especially RVSM) our borrower feels that the plane may be acquired for a bid of $700M — even though the engines on the plane still have 6,000 useful hours on them. The engines will be removed from the 1968 G-II and installed on the 1972 G-II. These replacement engines have roughly 10 years of flight time remaining on them. The borrowers also have a committed buyer of specific parts on the 1968 G-II that will sell for $200M. This money will be applied to the principal portion of the loan. The labor cost of the engine replacement will be covered by the sale of additional parts. Ultimately, when the 1972 G II has been completed and the appraisal is certified at the "as completed value" the CD will be released.

Full Collateral Description and Valuation/Analysis

1972 Gulfstream II/SP Model G-1159 G II, S/N 109; Engines make/model: Rolls Royce/MK511-8. Aircraft blue book value is $4.275MM. This plane will have both engines replaced with engines from the other aircraft securing this loan. The two replacement engines will allow the aircraft approximately 6,000 more hours or 10 more years in flying time. This aircraft also comes with three major modifications that cost approximately $1MM.

1968 Gulfstream G-II Model N244DM S/N 21; Engines Make/Model: Rolls Royce/MK 511-8 Spey. Aircraft blue book value is $3.888MM. This plane will be used as a parts plane. They will initially remove the two engines from this plane and install them on the 1972 G-II. They will also sell $200M worth of parts which will be used to reduce the principal balance of this loan.

$200M SB CD will be released upon a $200M principal reduction, completion of the engine installation, and appraisal confirmation of the "as completed" value.

Strengths & Weaknesses

Strengths:

- Experience of the Borrower
- Financial Strength of Blank Emergency Medical Service; sales growth during the past three years and improving gross and profit margins.
- Loan to value
- Meets all 3-2-1-2 guidelines
- Rapid payback

Weaknesses:

- Loan to cost

Postsecondary Assignments

Postsecondary Assignment #1

College Algebra and Calculus

In collecting samples from first-year mathematics courses across the nation, ADP found — perhaps not surprisingly — that the level of mathematics demanded is notably consistent. As these sample problems from institutions in Indiana, Kentucky, New Mexico and Texas demonstrate, first-year courses in algebra and calculus demand that students understand different number systems and geometric properties, as well as model mathematics problems, and solve algebraic equations.

Associated Benchmarks

ADP benchmarks that address the knowledge and skills required to complete these tasks are:

CONTENT AREA	STRAND	NUMBER
Mathematics	Number Sense and Numerical Operations	**I1.1, I3**
	Algebra	**J1.5, J2.3, J3.4, J3.5, J4.1, J4.5, J5.3, J5.5, J5.6**
	Geometry	**K4, K5, K8.2, K10, K10.4, K11.1**

TASK #1:

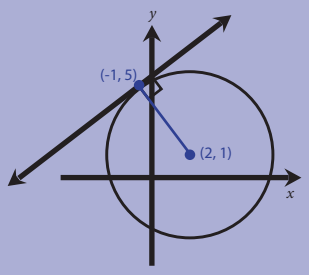
Tangent Lines without Calculus

(University of New Mexico)

A tangent line to a circle is a line that passes through just one point of the circle and is perpendicular to the radius line. Find the equation of the tangent line to the circle defined by $(x-2)^2+(y-1)^2=25$ at the point (-1, 5).

The student should be able to sketch the figure to picture the problem. The slope of the segment joining the center of the circle (2, 1) to the point (-1, 5) is -4/3, and so the slope of a perpendicular line is 3/4. The equation for the line through (-1, 5) with this slope is

$$(y-5)=\frac{3}{4}(x+1).$$



TASK #2:

Computing Average Rates of Change

(University of New Mexico)

Find the average rate of change of the function $g(x)=\frac{2}{x+1}$ between $x=0$ and $x=h$.

The student needs to understand that the "average rate of change" is the net change in the function value on the interval divided by length of the interval. The solution requires that the student simplify rational expressions:

$$\text{Average rate of change}=\frac{g(x+h)-g(x)}{h}$$

$$=\left[\left(\frac{2}{x+h+1}\right)-\left(\frac{2}{x+1}\right)\right]\cdot\left(\frac{1}{h}\right)$$

$$=\left[\left(\frac{2x+2-2x-2h-2}{(x+h+1)\cdot(x+1)}\right)\right]\cdot\left(\frac{1}{h}\right)$$

$$=\left[\left(\frac{-2h}{(x+h+1)\cdot(x+1)}\right)\right]\cdot\left(\frac{1}{h}\right)$$

$$=\left(\frac{-2}{(x+h+1)\cdot(x+1)}\right).$$

TASK #3:

Solving Equations

(Purdue University)

Find the zeros of the following functions.

(a) $f(t)=\frac{2t-9}{t}$

(b) $g(x)=1-x^2$

(c) $a(b)=2b^2-24b+70$

In each case, the student must be able to rearrange and simplify the equation. In addition, the student must be able to recognize that "*x*" is not the only variable used in mathematics (or in applications of mathematics).

TASK #4:

Solve a Quadratic (in Disguise)

(Purdue University)

Solve the following equation for *x*: $x^4+5x^2-36=0$.

The student must recognize that this is a quadratic equation, but for $y=x^2$ (and not for *x*). The first step is to solve $y^2+5y-36=(y+9)(y-4)=0$.

One solution, $y=-9$, gives a pair of complex solutions: $x=\pm 3i$. The other solution, $y=+4$, gives a pair of real solutions: $x=\pm 2$. These are the four solutions to the original equation.

College Algebra and Calculus

TASK #5:

Circles and Completing Squares

(Purdue University)

Identify the circle described by the following equation:
$x^2 + y^2 - 8x + 4y + 11 = 0$.

The students must be able to regroup the terms in the equation and then complete the square (twice):

$$\begin{aligned} 0 &= (x^2 - 8x) + (y^2 + 4y) + 11 \\ &= (x^2 - 8x + 16) + (y^2 + 4y + 4) + 11 - 16 - 4 \\ &= (x-4)^2 + (y+2)^2 - 9. \end{aligned}$$

This is equivalent to $(x-4)^2 + (y+2)^2 = 9$, so the equation describes a circle with radius 3 centered at $(x, y) = (4, -2)$.

TASK #6:

Plot a Graph

(Purdue University)

Graph the function given by $h(x) = \begin{cases} x+3 & \text{if } x \le -1 \\ x^2 & \text{if } x > -1. \end{cases}$

The graph consists of two separate branches. The left branch is a ray with slope 1 containing the point $(x, y) = (-1, 2)$ (which is the endpoint of the ray). The right branch is a parabola (opening up) with vertex at $(x, y) = (0, 0)$. Notice that the right branch starts at, but does not contain, the point $(x, y) = (-1, 1)$; there is a jump in the graph at this point.

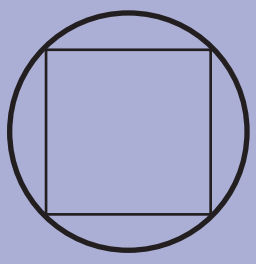
TASK #7:

Basic Geometry

(Northern Kentucky University)

The square shown below has a side length of 6 inches and is inscribed in a circle so that each vertex of the square lies on the circle. What is the radius of the circle in inches?

Draw radii from the center to each of two adjacent corners to obtain a right triangle with two sides of length r and hypotenuse of length 6. The Pythagorean theorem provides the equation $2r^2 = 36$, so $r = \sqrt{18} = 3\sqrt{2}$.



TASK #8:

Geometric Series

(Northern Kentucky University)

A ball dropped from a height of 18 feet above the ground as shown rebounds to 2/3 of its previous height after each bounce so that after the first bounce, it rebounds to 12 feet, after the second bounce to 8 feet and so forth.

A. To what height does it rebound after its third bounce?
B. Find an expression for the height to which it rebounds after the nth bounce as a function of n, where n is a positive integer.
C. Find the total distance the ball has traveled at the point where it hits the ground on its nth bounce as a function of n, where n is a positive integer. For example, on the first bounce, it has traveled 18 feet; on the second bounce, 18 + 12 + 12 = 42 feet; on the third bounce, 18 + 12 + 12 + 8 + 8 = 58 feet; and so forth.

The height of the nth bounce will be $h_n = 18 \cdot \left(\frac{2}{3}\right)^n$, and the sum of the distances traveled on the first n bounces is $h_0 + 2h_1 + 2h_2 + \ldots 2h_n = 18 + 2 \cdot 18 \cdot \sum_{k=1}^{n} \left(\frac{2}{3}\right)^k$.

The value for the final summation is $\sum_{k=1}^{n} \left(\frac{2}{3}\right)^k = \frac{(2/3) - (2/3)^{n+1}}{1 - (2/3)}$.

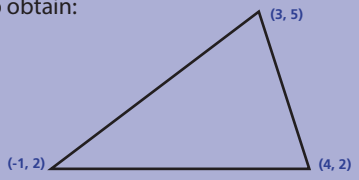
TASK #9:

Triangles and Area

(Northern Kentucky University)

A triangle has vertices (-1, 2), (4, 2) and (3, 5) as shown. What is the area of the triangle?

The student should be able to draw the figure, with points labeled to obtain:



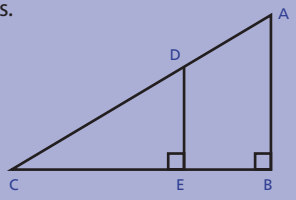
The triangle has base 5 = 4 – (-1) and height 3 = 5 – 2 so the area is $\text{Area} = \frac{1}{2} \cdot 5 \cdot 3 = \frac{15}{2}$.

TASK #10:

Similar Triangles

(Northern Kentucky University)

In the right triangles ABC and CDE shown below, AB has a length of 8 feet, BE has a length of 5 feet and CE has a length of 7 feet. What is the length of DE? Round your answer to two decimal places.



Use similar triangles: $\frac{\overline{DE}}{\overline{CE}} = \frac{\overline{BA}}{\overline{CB}} \Leftrightarrow \overline{DE} = \frac{8}{5+7} \cdot 7 = \frac{14}{3} \approx 4.67.$

TASK #11:

Parabolas and Completing the Square

(Angelo State University)

If $y = -x^2 + 4x - 10$, find the largest value attained by y. Do this without using calculus.

The solution to the problem is to find the vertex for the parabola. One approach is to complete the square and obtain $y = -(x-2)^2 - 6$.

So the graph is a parabola opening down, and the vertex is at the point $(x, y) = (2, -6)$.

Hence the largest value is $y = -6$.

TASK #12:

Properties of Logarithms

(Angelo State University)

Explain why $\log\left(\frac{x^{-1}}{y^{-1}}\right)$ is equivalent to $\log(y) - \log(x)$.

The key property to remember is $\log\left(\frac{a}{b}\right) = \log(a) - \log(b)$.

Apply this formula twice, along with log(1) = 0 to get the result.

TASK #13:

Solving Systems of Equations

(Angelo State University)

Solve the linear system of equations below using the elimination-substitution procedure. (Note: The student also needs to know how to apply matrix techniques using the augmented matrix in solving this and other similar linear systems of equations.)

$$x - 2y + 6z = 2$$
$$-x + y - 2z = -1$$
$$2x - 3y + 8z = 3$$

The problem is complicated by the fact that there are infinitely many solutions. In fact, any point of the form $(x, y, z) = (2z, 4z - 1, z)$, where z is a real number, is a solution.

Postsecondary Assignment #2

Introductory Chemistry

Ball State University, *Muncie, Indiana*
Worcester Polytechnic Institute,
Worcester, Massachusetts

Introductory chemistry courses at Ball State University and Worcester Polytechnic Institute challenge students to interpret, manipulate, process and present quantitative information accurately; use technology such as graphing calculators appropriately; and present solutions in the appropriate unit of measure or dimension.

Associated Benchmarks

ADP benchmarks that address the knowledge and skills required to complete these tasks are:

CONTENT AREA	STRAND	NUMBER
English	Language	**A7**
	Informational Text	**F5**
Mathematics	Number Sense and Numerical Operations	**I1.1, I1.2, I1.5, I3, I4.2**
	Algebra	**J1.5, J3.2, J5.1, J5.2, J5.5**
	Geometry	**K8.1**

SAMPLE TASKS

Task #1

Use percent composition information to calculate either the empirical formula or the molecular formula for a compound.

Problem: Trichloroethylene (TCE) is a common solvent used to degrease machine parts. Calculate the empirical formula for TCE if the percent composition is 18.25% C, 0.77% H and 80.99% Cl.

Solution: Consider having a 100 g sample of trichloroethylene. The percent composition is then 18.25 g C, 0.77 g H and 80.99 g Cl. Find the number of moles of each element.

18.25 g C × (1 mol C/12.01 g C) = 1.520 mol C
0.77 g H × (1 mol H/1.008 g H) = 0.76 mol H
80.99 g Cl × (1 mol Cl/35.45 g Cl) = 2.285 mol Cl

Chemical formulas are written with whole numbers, so divide by the smallest number of moles to find the empirical formula.

Because C: 1.520/0.76 = 2 and H: 0.76/0.76 = 1 and Cl: 2.285/0.76 ≈ 3, the empirical formula is C_2HCl_3.

Task #2

Analyze complex mathematical models in which several parameters appear. In many cases, the first step in analyzing the model is to determine the conditions that will reduce the complex model to a simpler case. The Van der Waal equation of state is an extension of the ideal gas law for real gasses:

$$\left(P + \frac{n^2 a}{V^2}\right)(V - nb) = nRT$$

where P is pressure, V is volume, T is temperature, R is the universal gas constant, n is the number of moles, and a and b are constants. Rewrite the equation of state to see that it approaches the equation of the ideal gas law for large V.

For an ideal gas, $Z = \frac{PV}{nRT} = 1$.

Rearrange the Van der Waal equation to obtain the same ratio, and the result is

$$Z = \frac{PV}{nRT} = \frac{V}{V - b} - \frac{an}{RTV}.$$

The terms on the right are close to 1 if V is sufficiently large.

Task #3

Use formulas such as the ideal gas law ($P \cdot V = nR \cdot T$) to calculate unknown quantities such as pressure, temperature, volume, molar mass, density or molecular formula.

Problem: What is the temperature of 0.520 mol of argon gas that occupies 4.25 L at 750 torr?

Solution: Use the ideal gas law: $PV = nRT$. Solve the ideal gas law for T, and substitute the known information.

$$T = \frac{PV}{nR} = \frac{(750.0\ \text{torr})(1\ \text{atm}/760\ \text{torr})(4.25\ \text{L})}{(0.520\ \text{mol})(0.0821\ \text{L atm mol}^{-1}\text{K}^{-1})} \approx 98\ \text{K}$$

Task #4

The *half-life* of a chemical reaction is the time required for half of the reactant initially present to decompose. The first-order rate law leads to $c = c_0 e^{-k \cdot t}$ where c is the concentration at time t, c_0 is the initial concentration, k is a positive constant and t is time.

Solve this equation for t and $t = \frac{1}{k} \cdot \ln\left(\frac{c_0}{c}\right)$.

If $c = \frac{1}{2} c_0$, this equation gives the half-life as $t_{1/2} = \frac{\ln(2)}{k}$.

Task #5

A mixture of methane and ethane is contained in a glass bulb of 500 cm^3 capacity at 25°C. The pressure is 1.25 bar, and the mass of gas in the bulb is 0.530 g. What is the mole fraction of methane?

To find a solution to this problem, the student must solve a system of two equations and two unknowns. Once the number of moles of either compound is found, there is sufficient information to calculate the mole fraction of methane.

First, use the ideal gas law to find the total number of moles of gas.

$PV = nRT \Leftrightarrow n = \frac{PV}{RT}$ so

$$n = \frac{(1.25\ \text{bar})(10^5\ \text{Pa}/1.0\ \text{bar}) \cdot (500\ \text{cm}^3) \cdot (1\ \text{m}^3/10^6\ \text{cm}^3)}{(8.314\ \text{J/mole K}) \cdot (298\ \text{K})}$$

$$= 0.0252\ \text{moles of gas.}$$

Let n_E = moles of ethane, m_E = mass of ethane, n_M = moles of methane, and m_M = mass of methane. Then we can write 0.0252 moles = $n_E + n_M$, and we know from the given information that

$0.530\ \text{g} = (30.068\ \text{g/mole}) \cdot n_E + (16.042\ \text{g/mole}) \cdot n_M$.

This system of equations can be solved by substitution. The most direct way to determine the mole fraction of methane in the system is to solve for n_M, the number of moles of methane. Proceeding along these lines one finds $n_M = 0.0162$.

The mole fraction methane is simply the ratio of moles of methane to the total number of moles.

$$X = \text{the mole fraction of methane} = \frac{0.0162}{0.0252} = 0.64$$

Task #6

Calculate the pH of a 0.50 M HF solution at 25°C. The K_a is 7.1 x 10^{-4}, and the ionization of HF is given by
$HF\ (aq) \Leftrightarrow H^+(aq) + F^-(aq)$.

The students use a table to organize the data to solve this problem.

	HF (aq)	H^+(aq)	F^-(aq)
Initial (M)	0.50	0.00	0.00
Change (M)	-*x*	*x*	*x*
Equilibrium (M)	0.50 – *x*	*x*	*x*

Then use the equilibrium constant to find x.

$$K_a = \frac{[H^+] \cdot [F^-]}{[HF]} = \frac{x \cdot x}{0.50 - x} = 7.1 \times 10^{-4}$$

One could use the quadratic formula to solve this equation, but an approximation could be made to solve the problem more easily. Since HF is a weak acid we could reason that x must be small compared to 0.50. Thus we make the approximation $0.50 - x \approx 0.50$.

Now K_a can be written as $K_a = \frac{x \cdot x}{0.50} = 7.1 \times 10^{-4}$.

Solving for x we find $x = 0.109$M. Before calculating the pH of the solution, it is wise to determine if the approximation was legitimate. If x is less than 5% of the number it was subtracted from, then the approximation is valid.

$$\frac{0.019\text{M}}{0.50\text{M}} \cdot 100 = 3.8\%$$

Thus the approximation is valid. The pH can be calculated as follows.

$$pH = -\log[H^+] = -\log[0.019] \approx 1.72$$

Postsecondary Assignment #3

Introductory Microeconomics

William Rainey Harper College, *Palatine, Illinois*

In studying topics such as economic growth and government intervention in markets, students must apply their understanding of key microeconomic principles such as supply and demand to interpret the graphic representations of macroeconomic relationships. As these samples from William Rainey Harper College demonstrate, students must be able to interpret graphic representations of linear equations and the meaning of slopes.

Associated Benchmarks

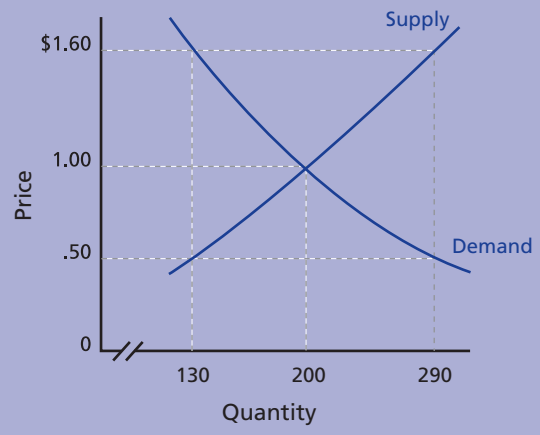
ADP benchmarks that address the knowledge and skills required to complete these tasks are:

CONTENT AREA	STRAND	NUMBER
English	Language	**A7**
	Informational Text	**F5**
Mathematics	Algebra	**J4.2, J4.8**

SAMPLE TASKS

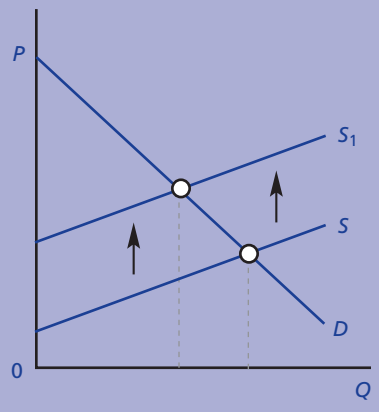
Task #1

In the diagram below, what is the equilibrium price and quantity in this market?



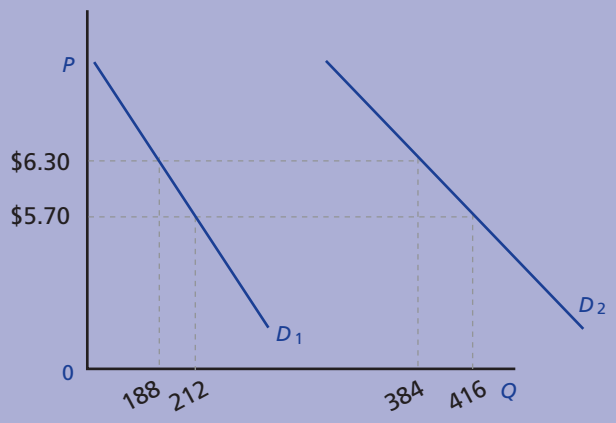
Task #2

In the diagram below, S is the market supply curve, and S_1 is a supply curve comprising all costs of production, including external costs. Assume that the number of people affected by these external costs is large. How could the government establish an optimal allocation of resources in this market? Explain your answer.



Task #3

In the diagram at right, assume a single good. If the price of the good increased from $5.70 to $6.30 along D_1, what would the price elasticity of demand along this portion of the demand curve be? Explain your answer.

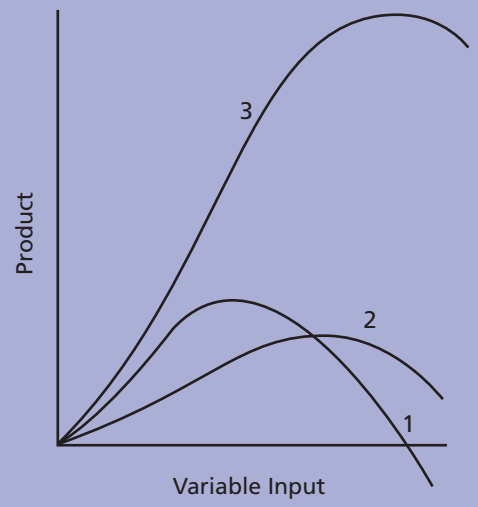


Introductory Microeconomics

William Rainey Harper College, *Palatine, Illinois*

Task #4

Identify the average*, marginal** and total product*** curves in the diagram below. Explain your answer.



The **average product curve graphically illustrates the relation between average product and the quantity of the variable input, holding all other inputs fixed. This curve indicates the per-unit output at each level of the variable input.*

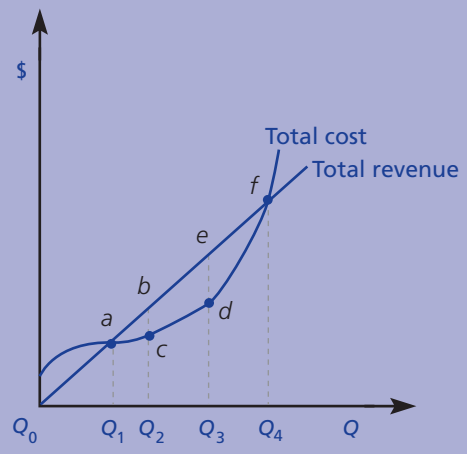
***The **marginal product curve** graphically illustrates the relation between marginal product and the quantity of the variable input, holding all other inputs fixed. This curve indicates the incremental change in output at each level of the variable input.*

****The **total product curve** graphically represents the relation between total production by a firm in the short run and the quantity of a variable input added to a fixed input. When constructing this curve, it is assumed that total product changes from changes in the quantity of a variable input like labor, while we hold fixed one or more other inputs, like capital.*

*Source: The AmosWEB GLOSS*arama is a searchable database of 1,800 economic terms and concepts, http://www.amosweb.com/gls/.*

Task #5

In the diagram below, what is the profit-maximizing* output level for this firm? Explain your answer.

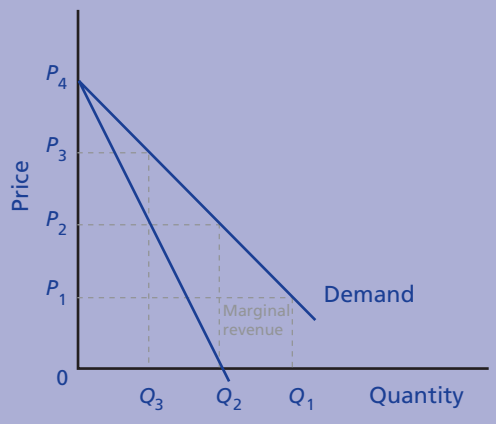


Profit maximization is the process of obtaining the highest possible level of profit through the production and sale of goods and services. The profit-maximization assumption is the guiding principle underlying short-run production by a firm.*

*Source: The AmosWEB GLOSS*arama is a searchable database of 1,800 economic terms and concepts, http://www.amosweb.com/gls/.*

Task #6

In the diagram to the right, at what point or in what range is demand relatively inelastic? Explain your answer.



Task #7

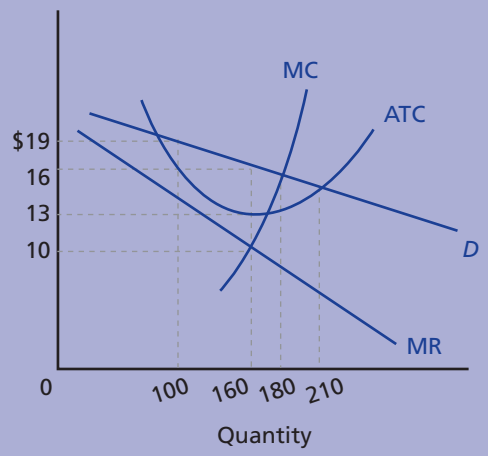
In the diagram to the right of a monopolistically competitive firm in **short-run equilibrium** …

a. What will this firm's profit-maximizing price and output be?

b. What economic loss or profit will this firm realize?

c. In the long-run equilibrium, what economic loss or profit will this firm realize?

Explain your answers.



Postsecondary Assignment #4

Introductory English Survey Course

Sam Houston State University, *Huntsville, Texas*

The study of English often can take students beyond the written word and demand that they explore connections across genres and media. This assignment from an introductory English course at Sam Houston State University focuses on the relationship between the verbal and the non-verbal, between poetry and painting, and between novels or plays and the films that attempt to interpret them. In doing so, it challenges students' language, communication and media skills. A central feature of this assignment is a professor-led discussion, demanding students be able to express themselves verbally and listen effectively.

Associated Benchmarks

ADP benchmarks that address the knowledge and skills required to complete this task are:

CONTENT AREA	STRAND	NUMBER
English	Language	**A1, A2, A6**
	Communication	**B7**
	Writing	**C1, C2, C3, C4, C5, C9**
	Research	**D2**
	Media	**G2, G3**
	Literature	**H5**

SAMPLE TASK

The Set-Up Assignment

On your course CD, open the JPEG file "Icarus" and take a look at the picture (see right). For now, just notice what draws your attention (and write a few sentences about why you think that's where your eye fell). For our purposes, we'll call this the "visual focal point" of the painting. Now, go back and perform a careful viewing of the painting (much the same way we have learned to perform analytical reading of a written text). Based on your close "reading" of this painting, what do you think the painter was trying to "say"? If you have difficulty with this, look in the painting for any details that seem important, startling or hard to explain. If you are still having trouble, consider the title of this painting: *The Fall of Icarus.* Do an Internet word search for "Icarus." Using what you have discovered, determine the main idea presented by Pieter Bruegel's painting *The Fall of Icarus.*

Day Two (in class or out)

We will begin class with a reading of two poems written about *The Fall of Icarus:* "Landscape with the Fall of Icarus," by William Carlos Williams, and "Musee des Beaux Arts," by W. H. Auden. This is not the focus of our assignment, but you should understand that in the world of art, as in the worlds of movies, television and magazines, the people who send the messages are acutely aware of the interplay between words and images. In our discussions, we have arrived at a consensus that the red sleeves of the farmer seem to be the visual focal point and that the legs of Icarus disappearing beneath the water seem to be the thematic focal point. We have agreed, roughly, that the painting seems to be saying something about how life goes on despite tragic events (even events that are downright fantastic). Think about how this idea is conveyed in images and about how it could be (or, in the case of the poems we read, is) conveyed in words. Then think about the differences and similarities between those conveyances.

Paper: The Verbal and the Visual in Contemporary Media

Using the principles you have learned about theme, verbal messages, visual focal point, thematic focal point, and other principles of language and media, locate an excellent example of how words and images work together to create a theme (which might also mean to make a point or sell a product). The definition of media for this assignment is diverse. It may be a printed magazine or television ads, music videos, cartoons (moving or still), or practically any other medium. You will have a week to locate your subject and write a preliminary draft of a paper in which you analyze the interplay between the visual and the verbal in it. (Considering our discussion about how sometimes words and images disconnect rather than connect, you might even choose an example in which there is dissonance rather than harmony between the verbal and the visual.) After the preliminary draft, we will proceed to the final paper.

Postsecondary Assignment #5

Introductory Philosophy

Montclair State University, *Montclair, New Jersey*

First-year philosophy courses require students to reason — to think critically, logically and dispassionately — and to make effective arguments. In this assignment from Montclair State University, students not only must read texts carefully to make judgments about the validity of the author's reasoning, but also must structure an essay in a way that advances the explanation of these ideas.

Associated Benchmarks

ADP benchmarks that address the knowledge and skills required to complete this task are:

CONTENT AREA	STRAND	NUMBER
English	Language	**A1, A6**
	Writing	**C1, C2, C3, C4, C5, C9**
	Logic	**E1, E2, E3, E9**
	Literature	**H3, H7**

SAMPLE TASK

500-Word Expository Essay

For the expository essay option, topics that are fairly well defined and self-contained can be found in the texts covered in the course. Carrying out this assignment involves two distinct steps.

First, you must make the idea your own — i.e., you must understand it, make sense of it, see it as a candidate for adoption, sufficiently so as to be able to produce an intelligible presentation of it (or at least a sketch of or an outline for such a presentation) to a specific audience (think of an audience made up of your fellow students or any other audience whose characteristics you can effectively represent to yourself). (Note that this rhetorical situation in which you are required to explain somebody else's idea to others is not only common in college classrooms, but it is also very common in professional work where you as a manager may be asked to explain ideas or policies that you did not yourself invent and that you may not find either valid or particularly interesting.)

Second, you must develop a strategy for rendering the idea intelligible to your chosen audience as succinctly as possible (so as to remain fairly close to a target of 500 words in length). Unlike the "text-focused" essays, here you have the widest possible latitude with regard to organization and structure. Analysis, interpretation and argument are intellectual tasks sufficiently identifiable as to make at least plausible the claim that an ideal rhetorical organization can be specified for each, but this is not so for exposition. Of course, any good exposition of an idea or policy must do its job effectively, i.e., it must actually succeed in rendering its subject matter intelligible to its audience. Needless to say, to do this job successfully the expositor must have a modest grasp of that subject matter. Beyond that, the most effective strategy or order of exposition cannot be determined in advance. Many very different organizational strategies can be equally successful in presenting the same subject matter.

Sample 500-Word Essay Topics

1. Explain Nietzsche's statement that the doctrine of *will to power* offers the "solution to the problem of procreation and nourishment."
2. Explain Nietzsche's claim that "faith in the categories of reason is the cause of nihilism."
3. Explain Spinoza's critique of the use of final causes in explanation.
4. Explain Aristotle's conception of the relationship between moral virtue and practical wisdom.
5. Explain the way in which Plato distinguishes and relates thinking *(dianoia)* and belief *(pistis)*.

Postsecondary Assignment #6

Introductory English

Western Nevada Community College, *Carson City, Nevada*

Tests in first-year English courses often require students to identify excerpts from course readings and to explain their significance. To perform well on this midterm exam from Western Nevada Community College, students must have been able to develop a solid understanding of the themes and literary techniques employed in a broad selection of short stories and poems. Students must also be able to describe how the works relate to one another.

Associated Benchmarks

ADP benchmarks that address the knowledge and skills required to complete this task are:

CONTENT AREA	STRAND	NUMBER
English	Language	**A1, A6**
	Writing	**C1, C2, C3, C4, C5, C9**
	Logic	**E9**
	Literature	**H1, H3, H4, H5**

SAMPLE TASKS

English 102 Midterm Exam [Total of 100 Points]

Part One. Fiction. Respond to eight of the 10 quotations.
Five points per question.

Explain the significance of each excerpt, especially the section in bold, as it relates to each story's theme (NOT PLOT) or to the story's main character.

1. "Jupiter was an anomaly. His retrieving instincts and **his high spirits were out of place** in Shady Hill. ... Jupiter went where he pleased, ransacking. ..." ("The Country Husband")
2. "I replied to the yells of him who clamoured. I **re-echoed, I aided, I surpassed them in volume** and in strength. I did this, and the clamourer grew still." ("The Cask of Amontillado")
3. "Her poems are always cool and intellectual; **that is their form, which is contradicted or supported by** a gravely sensuous texture." ("Our Friend Judith")
4. "She **believes in those signs:** Speed Monitored by Aircraft. It doesn't matter that you can look up and see that the sky is empty." ("No One's a Mystery")
5. "'I don't feel any way,' the girl said. **'I just know things.'**" ("Hills Like White Elephants")
6. "You will have a full bag. People will seem to know what you have done, where you are going. They will have his eyes, the same pair, passed along on the street from face to face, like secrets, like glasses at the opera." ("How")
7. Gurov has just alluded to the "charming woman" he had met in Yalta to one of his card-partners. The card-partner replies. "'You were quite right, you know — the sturgeon was just a leetle off.' **These words, in themselves so commonplace, for some reason infuriated Gurov, seemed to him humiliating, gross."** ("The Lady and the Dog") Explain Gurov's reaction.
8. "On errands of life, these letters speed to death." ("Bartleby the Scrivener")
9. "The flat is shabby and badly heated. The furniture is old, was never anything but ugly, is now frankly rickety and fraying. ... She ... eats very little, **from preference, not self-discipline."** ("Our Friend Judith")
10. "Besides casual onlookers there were also relays of permanent watchers selected by the public, usually butchers, strangely enough. ..." **Why would the narrator seem to think it strange that butchers should be watchers?** ("The Hunger Artist")

Part Two. Poetry. Respond to five of the seven quotations.
Five points for each one.

Explain the significance of the excerpted lines, focusing especially on the words that are in bold type.

1. "Back from the hospital, his mind rattling/Like the suitcase, swinging from his hand,/That contains **shaving cream, a piggy bank,/A book he sometimes pretends to read,"** ("Alzheimer's," p. 637)
2. "My mother, after a life/of it, says, 'This is the last straw.'/**And it is. We're all clutching."** ("You Didn't Fit," p. 635)
3. "— and, if God choose,/I shall but love thee better after death." **Explain how one can love someone better after one is dead.** ("How Do I Love Thee?" p. 601)
4. "and in one another's blameless eyes go blind." ("The Tally Stick," p. 602) **Explain the paradox in this metaphor — in what way blameless? In what way blind?**
5. "It lies/among keys to abandoned houses,/nails waiting to be needed and hammered/into some wall,/telephone numbers with no names attached;/idle paperclips." ("Wedding-Ring," p. 606) **What does the ring have in common with these other items? Explain the logic.**
6. "When I came in, and I was embarrassed/By old men standing up to shake my hand …" ("Mid-Term Break," p. 610) **Explain. Why should the speaker be embarrassed?**
7. "Pack up the moon and dismantle the sun;/Pour away the ocean and sweep up the wood" ("Stop all the clocks, cut off the telephone," p. 615) **What is the effect of these particular images (especially as compared to the earlier images of the first and second stanzas)?**

Part Three. Essay question. *35 points.*

Refer to stories we have read ("How," "Hills Like White Elephants," "No One's a Mystery," "The Country Husband" and "Our Friend Judith") as well as several poems ("The Tally Stick," "love poem," "Wedding-Ring," and "What lips my lips have kissed, and where, and why" or any other 20th century poem we have read) and write an essay on the following topic:

The nature of love and marriage (these are TWO topics), as depicted in 20th century fiction and poetry, IS or IS NOT consistent. (Choose whichever point of view you think you can best defend by using the above stories and poems as your "support.") You will first have to identify WHAT IS the nature of love and the nature of marriage and state each definition. You also need to explain how you understand the term "is consistent" or "is not consistent."

Methodology

ADP and partner organization staff spent nearly two years gathering empirical evidence to codify the knowledge and skills — in both English and mathematics — that all high school graduates actually need to do credit-bearing coursework at state colleges and universities or to embark successfully on career-track positions in high-growth, highly skilled "good" jobs. Because they are the languages through which students access all other kinds of knowledge and skills, we deemed English and mathematics our priority content areas.

Working closely with two- and four-year postsecondary English and mathematics faculty; with a wide array of humanities, sciences and social sciences faculty; and with front-line managers in those high-growth, highly skilled occupations (within and beyond ADP partner states), we were able to identify the "must-have" competencies in English and mathematics for success in all of these arenas.

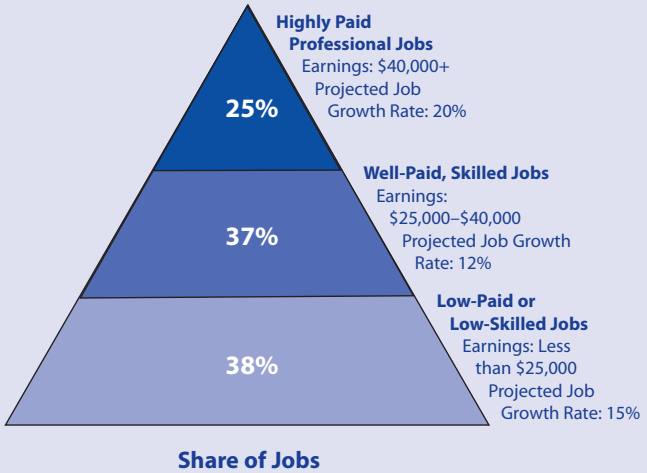
Step One: Defining Workplace Expectations

Commissioned by ADP, Educational Testing Service (ETS) researchers Anthony P. Carnevale and Donna M. Desrochers used data from the Bureau of Labor Statistics and the U.S. Department of Education's National Educational Longitudinal Survey (NELS) to define the relationship between education, employment and earnings.[14] First, Carnevale and Desrochers defined "good" jobs for the purposes of the ADP study. Factors such as entry-level salary; provision of benefits; and opportunities for further career advancement, education and training were all considered in the creation of these job categories. We chose to focus the ADP effort on the occupations listed in the top two tiers of the employment pyramid shown here, for these are the jobs that pay enough to support a family well above the poverty level, provide benefits, and offer clear pathways for career advancement through further education and training.

The top two tiers of the pyramid also represent 62 percent of all jobs over the next 10 years.

The researchers were able, using the NELS data, to offer a detailed account of the high school courses taken — and grades earned — by the survey participants. In addition to a bat-

More Jobs Are Highly Paid or Skilled, Require More Education



Source: American Diploma Project, 2002

tery of questions on students' backgrounds, families, school activities, postsecondary education and subsequent employment, the participants' high school transcripts provided a look into the course-taking patterns of young adults in their twenties who currently hold the highly paid professional jobs and well-paid, white- and blue-collar jobs in the top two tiers of the pyramid.[15]

The ETS study revealed that fully 84 percent of those who currently hold highly paid professional jobs (the top tier of the pyramid) had taken Algebra II (or higher) as their last high school math course. Even among those who currently hold well-paid, white-collar, skilled jobs, 61 percent had taken Algebra II or a higher-level math course. Seventy-eight percent had taken Geometry or a higher-level math course. In contrast, only 30 percent of employees in the bottom tier had taken Algebra II.

The researchers also determined that "four years of English that is at least at grade level" emerged as the course-taking pattern for employees in the vast majority of good jobs. Far more workers in highly paid professional jobs had taken honors English courses, literature and composition, while twice as many workers at the bottom of the jobs pyramid had taken remedial English or English as a Second Language courses to meet English course requirements.

Building on the data generated in the ETS study, two panels of curricular experts helped ADP delineate the content that comprises the courses identified by the study (English I–IV, Algebra I, Geometry and Algebra II). We used this content delineation to develop ADP's set of preliminary workplace expectations for English and mathematics. The next step was to present this set of preliminary expectations to our first round of employers for their review.

Step Two: Securing Input from Employers on Preliminary Workplace Expectations

It is important to note that rather than asking employers to discuss desirable employee traits in the abstract, as most surveys of employers have done in the past, ADP made a deliberate effort to establish or refute potential connections between what students learn in high school and what knowledge and skills are necessary to be successful in the workplace. In a process developed by the National Alliance of Business (NAB), one of the original ADP partner organizations, we circulated the preliminary workplace expectations among actual front-line managers from the occupations identified in the top two tiers of the employment pyramid. Representatives from such industries as health care, gaming, high-tech manufacturing, semiconductor technology, information technology, law, telecommunications, energy, television media, shipping and transportation, retail, and financial services all participated in the interviews.

These front-line employers confirmed the importance of the content in the preliminary benchmarks, particularly the ability of workers to think creatively and logically and to identify and solve problems, skills that were emphasized in both English and mathematics discussions.

Employers specifically reiterated the value of the knowledge and skills typically taught in Algebra I, Geometry and Algebra II. Employers not only validated the importance of the content and skills that those courses convey, but also recognized the usefulness for students in having taken those courses to stay on a positive intellectual trajectory. Staying on the trajectory, they reasoned, is the best way for students to preserve the choice to complete any degree-granting or other postsecondary education and training programs, including apprenticeships in the "skilled trades." Employers verified the ETS finding that a majority of the fastest-growing occupations in the top two tiers of the employment pyramid require some education beyond high school, typically a certificate, a bachelor's degree, an associate degree or on-the-job training. Whether they receive their further education through apprenticeships or other kinds of on-the-job training, however, all high school graduates will definitely be held to a higher intellectual standard than ever before.

ADP staff, in consultation with ETS and NAB staff, then refined the preliminary set of workplace expectations to reflect the feedback from those employer interviews, while defining preliminary postsecondary expectations as well.

Step Three: Defining Postsecondary Expectations for Credit-Bearing Coursework

Defining postsecondary expectations for credit-bearing coursework was a two-part process. In part one, staff from The Education Trust assembled English and mathematics faculty members from K–12 systems and from two- and four-year colleges and universities in each of the ADP partner states. These postsecondary institutions enroll the vast majority of high school graduates going on to college: community colleges, as well as four-year state institutions, but generally not the more highly selective "flagship" campuses.[16]

At these meetings, using a protocol developed by The Education Trust, the faculty members examined the content of partner state high school graduation tests; national college admissions and placement tests (SAT, ACT, COMPASS, Accuplacer); a sampling of postsecondary placement tests; and the GED. The goal of these discussions was to codify what the *de facto* standards are for students by evaluating the content of the various assessments they are asked to take, however disparate their purposes may be.

In part two, Achieve and ADP staff examined the alignment between partner state high school standards for English and mathematics and their high school standards-based

assessments. With both the test content analysis (part one) and alignment studies (part two) complete, Achieve and ADP staff then met with faculty members from two- and four-year colleges, representing a broad range of content areas, and asked them to:

1. define in detail the English and mathematics content and skills necessary for success in freshman, credit-bearing courses at their institutions;

2. locate these "must-have" English and mathematics competencies in the state standards (if possible), and prioritize them in terms of their importance for preparing students to be successful in their classes;

3. determine the degree to which current state standards and assessments reflect the expectations described in items 1 and 2; and

4. identify gaps (missing prioritized content) in the state standards and assessments.

In a deliberate effort to define and analyze the ways in which English and mathematics knowledge and skills are applied in other content areas, ADP secured participation from faculty across the humanities, engineering, the sciences and the social sciences, in addition to math and English faculty, for each state conversation. Partner state team members made these important meetings possible. In many states, the meetings represented the first time that K–12 and postsecondary faculty had convened to examine together what their state K–12 system requires of all high school students and to compare those requirements to the demands of credit-bearing coursework in their state colleges and universities.

Results from these state-based studies indicate a surprising degree of consensus both within states (across two- and four-year systems) and across states about the core competencies necessary to do credit-bearing work at state colleges and universities.[17]

Our hypothesis that postsecondary and workplace expectations are converging was reinforced in this stage of the process. Postsecondary faculty descriptions of the intellectual demands of credit-bearing coursework proved consistent with the intellectual demands of the targeted occupations in the ETS study, which were verified for us by employers. Although some marginal differences emerged in terms of relative emphasis to be placed on particular content or strands, it was clear that their sets of expectations are remarkably similar.

For example, both employers and postsecondary faculty emphasized:

- the importance of facility with correct English grammar and usage, both to aid reading comprehension and to support effective oral and written communication;

- the essential skills of developing and analyzing an argument, both in English and mathematics;

- the capacity to apply basic knowledge and skills in new and unfamiliar contexts; and

- the ability to define and research a "problem," as well as present a well-reasoned position on — or solution to — the problem.

The subtle differences in emphasis emerged almost exclusively in the area of mathematics where, for example, employers stressed the importance of accounting, budgeting and data analysis skills that postsecondary science and social science faculty did not underscore as heavily. In English, almost no differences emerged. Instead, similar knowledge and skills were emphasized for different reasons and with slightly different applications, such as the shared interest in research skills. In an academic environment, of course, the purpose and delivery mechanisms for research skills would be teacher- and classmate-focused, whereas in the workplace, research skills would be brought to bear to solve a product- or services-development issue or an implementation problem.

Step Four: Synthesizing the Preliminary Workplace and Postsecondary Expectations

We took these two sets of preliminary expectations, one workplace and one postsecondary, and combined them into a draft set of ADP college and workplace readiness benchmarks. The new draft expectations were then circulated among postsecondary faculty and employers throughout the country for further assurance that this set of combined expectations really does represent the convergence of formerly disparate sets of "college-ready" and "workplace-ready" skills. (This process is described in step five.)

It is important to note that at this point, the draft expectations represented more of a merging of the two sets of preliminary expectations, rather than an intersection of their common ground, although the overlap between the two sets was significant. Because marginal differences did exist between postsecondary and workplace participants concerning areas of relative emphasis in mathematics, all content identified by both groups was represented in the draft document. For example, differences in the expectations for what math and math-dependent majors in college might need to have mastered before entering college and what is required for non-math majors (and for some occupations that require advanced degrees) were to be resolved in the next phase of the work by our panels of content area experts and employers.

Step Five: Convening Content Area Expert/Employer Panels

ADP convened panels of business representatives and content area experts to advise us as we conducted an iterative process of feedback and revision of the draft benchmarks. ADP partner state employers and content experts served on the panels, as well as a cross-section of employers and content experts from throughout the country. The panels worked over a period of months to consider, for example, which benchmarks would represent the best intersection of employer and postsecondary demands, thereby comprising the knowledge and skills that will best prepare all students for success in either arena.

In mathematics, for example, the panel determined that while almost all of the benchmarks must be required of all students, some may be necessary only for those intending to major in mathematics or math-dependent fields in college. (The latter are marked with asterisks in the "Mathematics Benchmarks" section.) In English, the task of resolving differences was much easier, with the most difficult issue being which literary analysis knowledge and skills remain essential, whether pursuing degrees in literature or not.

Step Six: Gathering Tasks and Assignments from Employers and Postsecondary Faculty

Finally, as part of the benchmark review and revision process described previously, we collected sample workplace tasks and postsecondary assignments from high-performance employers and postsecondary faculty in an iterative process designed to ensure that the benchmarks and samples are consistent, are complementary, and contain the most accurate picture of current workplace and college demands.

Both the benchmarks and sample tasks and assignments can be found in "College and Workplace Readiness Benchmarks and Samples" on page 19. They are purposefully contained within the same section of this report to emphasize that they should be considered together. Although the samples represent the intellectual demand that students will face in college or on the job (and not the tasks that students in high school should be doing every day in class), they do reflect together the academic content knowledge and skills to be learned in high school and how they are applied in depth in a variety of postsecondary environments.

Finally, the samples and benchmarks on the Achieve Web site (www.achieve.org) include links so that users may navigate between them for easy cross-reference. Additional tasks and assignments also can be found on the Web site.

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Content Area Experts and Employers

The following list comprises content area experts in the fields of English and mathematics, as well as employers who worked to refine the ADP benchmarks to ensure that they are consistent with postsecondary and employer expectations. Many of these individuals also provided ADP with samples of work from their companies or institutions of higher education to help illustrate how high school graduates would use the skills and knowledge found in the ADP benchmarks once they left high school.

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Current and Former Partner State Team Members

Before applying to participate as an ADP partner state, each state assembled a team of state leaders — the governor, the chief state school officer, state higher education system heads, a business leader and others — to support, guide and contribute to the work of the project. It is through the efforts of these individuals that policy changes reflecting the ADP benchmarks have been implemented in various partner states and also through their efforts that much of the work of the project has been made possible.

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Postsecondary Study (Gap Analysis) Participants

The following people participated in the ADP's Gap Analysis meetings. They analyzed the content of state high school exit exams and postsecondary admissions and placement tests. Representing two- and four-year state colleges and university systems, many also helped to define the postsecondary expectations for incoming freshmen reflected in the ADP benchmarks. Many of these individuals also provided ADP with samples of work from their institutions of higher education to help illustrate how high school graduates would use the skills and knowledge found in the ADP benchmarks once they left high school.

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Workplace Study Participants

In 2002, the following business professionals were surveyed and interviewed by staff from the National Alliance of Business, an original ADP partner organization, to confirm the set of skills and knowledge necessary for success in the high-growth and highly skilled occupations identified in the ADP workplace study. This research resulted in the preliminary draft of the ADP workplace expectations. Many of these individuals also provided ADP with samples of work from their companies to help illustrate how high school graduates would use the skills and knowledge found in the ADP benchmarks once they left high school.

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Endnotes

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[15] For the complete analysis, see "Connecting Education Standards and Employment: Course-taking Patterns of Young Workers" at www.achieve.org.

[16] In some states, representatives from "flagship" campuses participated in the study as well.

[17] State-by-state findings were published and shared with partner states. They are available at www.achieve.org.

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