Courses Count: Preparing Students for Postsecondary Success

ACT Policy Report

ACT

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Executive Summary

Rigorous college preparatory course sequences—particularly in English, mathematics, and science—are critical to preparing students for postsecondary education and work. Yet, large numbers of students still do not participate in the most beneficial courses, and there is little evidence that the high school curriculum is rigorous enough to ensure that most students are adequately prepared for postsecondary success.

Roughly 75 percent of students who graduate from high school go on to some form of postsecondary education within two years of their high school graduation. Yet approximately 28 percent of freshmen entering postsecondary institutions enroll in one or more remedial courses in reading, writing, or mathematics.

Projections indicate that the number of postsecondary school graduates will not be sufficient to fill the more than 14 million new jobs that will be added to the labor market by 2008. And, leaving high school without being prepared for postsecondary training or entry into the workforce will cost our nation over $16 billion each year in remediation, lost productivity, and increased demands on criminal justice and welfare systems.

All of this leads to the key question, "Why aren't our students ready to succeed in postsecondary programs without remedial help when they leave high school?" This policy report examines three likely overlapping answers to this question:

1. The broad array of courses offered in our high schools and the varying course sequences that students can complete make very different contributions to postsecondary readiness.
2. Students do not always take those courses and course sequences that contribute most to postsecondary readiness.
3. The lack of rigor of the high school curriculum (expressed in terms of graduation requirements, curriculum depth, and alignment with the knowledge and skills required for successful transition to postsecondary education) does not result in all students being adequately prepared for college success.

Findings. A review of the high school curriculum—particularly in English, mathematics, and science—suggests three possible explanations for why students leave high school unprepared for postsecondary programs. First, some courses and course sequences prepare students better for postsecondary level work than others. Of the courses and sequences studied, English 9 through 12; Algebra 1, Geometry, Algebra 2, and at least one (or more) upper-level course such as Trigonometry; and Biology, Chemistry, and Physics had the biggest impact on achievement and the chances of success in college English Composition, Algebra, and Biology, respectively. These course sequences are consistent with those typically considered college preparatory and improve student achievement and chances for success better than taking fewer courses within each of the college preparatory sequences.

We also discovered cross-disciplinary benefits of specific courses. Taking at least one foreign language increased both achievement and the chances of being successful in college English Composition beyond the English sequence alone. Upper-level coursework in mathematics increased achievement and the chances of being successful in college Biology beyond the science sequence; and upper-level science courses added to the achievement and chances of being successful in college Algebra beyond the mathematics sequence.

Second, although most students pursue postsecondary education, they are not necessarily taking those courses that will best prepare them for success in postsecondary coursework. Less than half of all students take the courses they need to be prepared in mathematics and science. Participation rates are particularly low for students within underrepresented racial/ethnic groups.

Third, readiness is related not only to courses, but also to the rigor of those courses. Delineating high school graduation requirements in terms of minimum numbers of course credits, rather than in terms of specific courses, allows students to satisfy requirements without taking the sequence of courses that would best prepare them for postsecondary success. Covering a breadth of topics, to the exclusion of in-depth focus on key content areas, does not facilitate optimal learning. Further, misalignment between high school and college curriculum sends conflicting messages to students, parents, and teachers regarding the content knowledge and academic skills students need to be successful in college.

Recommendations. Ensuring that high school students take a college preparatory curriculum and increasing the rigor of the high school curriculum will significantly improve postsecondary readiness and success. The following are broad-based recommendations for educational leaders and policymakers.

1. ***Increase postsecondary readiness by requiring that all students take specific college preparatory course sequences in English, mathematics, science, and foreign language.***

2. ***Improve the rigor of high school coursework with a greater focus on in-depth content coverage and considerably greater secondary-to-postsecondary curriculum alignment.***

The number of students who are not ready for college (or the workplace) has recently been described as "nothing short of a crisis." The actions recommended here and elsewhere by ACT, based on solid evidence, suggest ways to begin to address this problem. Ultimately, it is in the best interest of our students and nation to ensure that everyone graduates from high school ready to enter and succeed in postsecondary educational programs and the workforce.

1

Introduction

Rigorous college preparatory course sequences—particularly in English, mathematics, and science—are critical to preparing students for postsecondary education and work. Yet, a large number of American students leave high school with a low level of achievement and less prepared for the world than students in many other countries with advanced economies (U.S. Department of Education, 2003). And no state currently requires its graduates to take the courses that reflect the real-world demands of work and postsecondary education (Achieve, 2004b).

Large numbers of students still do not participate in the most beneficial courses (ACT, 2004b). And there is little evidence that the high school curriculum is rigorous enough to ensure that most students are adequately prepared for postsecondary success (ACT, 2003a; ACT & The Education Trust, 2004; Campbell, Hombo, & Mazzeo, 2000; Mullis, Martin, Beaton, Gonzalez, Kelly, & Smith, 1998; National Research Council, 2002; Schmidt, McKnight, & Raizen, 1997).

Roughly 75 percent of students who graduate from high school go on to some form of postsecondary education within two years of their high school graduation (National Center for Education Statistics, 1998). Yet approximately 28 percent of freshmen entering postsecondary institutions enroll in one or more remedial courses in reading, writing, or mathematics (National Center for Education Statistics, 2003). In public two-year institutions, over 40 percent of entering freshmen enroll in at least one remedial course.

The need for remediation is costly to all concerned. When gaining basic knowledge and skills is postponed until and beyond entry into postsecondary education, students and colleges wind up spending time and money that could be devoted elsewhere and can diminish a student's commitment to pursuing a college credential (U.S. Department of Education, 2003). Students who require remedial assistance to participate in regular postsecondary-level courses are less likely to complete degree programs (Adelman, 2004). In fact, within eight years of postsecondary enrollment, 70 percent of students who took one or more remedial reading courses and 58 percent of students who took two or fewer remedial math courses did not persist to obtain a college degree or certificate.

Failing to earn a postsecondary credential severely limits job and income prospects (Bureau of Labor Statistics, 2000; Venezia, Kirst, & Antonio, 2003). All things being equal, people with some courses beyond high school but no degree can earn 5 to 11 percent more than high school graduates. An associate's degree generally increases workers' wages about 20 to 30 percent over a high school diploma (Carnevale & Desrochers, 2003). Workers with bachelor's degrees earn approximately twice that of high school graduates.

Projections indicate that, at current rates, the number of postsecondary school graduates will not be sufficient to fill the more than 14 million new jobs that will be added to the labor market by 2008 (Carnevale & Desrochers, 2001; Pathways to College Network, 2004). Greene (2000) estimates that leaving high school without being prepared for postsecondary training or entry into the workforce costs our nation more than $16 billion each year in remediation, lost productivity, and increased demands on criminal justice and welfare systems.

All of this leads to the key question, "Why aren't our students ready to succeed in postsecondary programs without remedial help when they leave high school?" This policy report examines three overlapping answers:

1. The broad array of courses offered in our high schools and the varying course sequences that students can complete make very different contributions to postsecondary readiness.

2. Students do not always take those courses and course sequences that contribute most to postsecondary readiness.

3. The lack of rigor of the high school curriculum (expressed in terms of graduation requirements, curriculum depth, and alignment with the knowledge and skills required for successful transition to postsecondary education) does not result in all students being adequately prepared for college success.

This report investigates each of these possible reasons to help identify ways to improve the postsecondary readiness of high school graduates. This report is intended to help educational leaders and policymakers improve the rates of students who leave high school prepared for postsecondary education, as well as the rates of students who successfully complete postsecondary programs. We offer two key recommendations and related specific actions educational leaders can take to increase the postsecondary readiness of high school students.

2

High School Courses and Postsecondary Readiness

Many high school students and parents believe that simply meeting the number of credits required for graduation will provide adequate preparation for college (Venezia et al., 2003). Unfortunately, this assumption is incorrect. Students generally have multiple course options from which to choose to satisfy requirements and not all will suitably prepare them for postsecondary training. This is particularly true in mathematics and science (ACT, 2004b; Schmidt et al., 1997).

A recent ACT study identified the contribution that specific courses and course sequences made to college readiness. It found that taking the full course sequences typically considered college preparatory best prepared students for freshman-level college courses (Noble & Schnelker, in press). Highlights of this study are presented here.

Background

ACT has identified college readiness benchmarks on the ACT Assessment®[1] (ACT, 2003c) at which students have at least a 50 percent chance of earning a B or better and at least a 75–80 percent chance of earning a C or better in first-year, credit-bearing courses (Allen & Sconing, in press). An ACT English score of 18 is the college readiness benchmark for English Composition; an ACT Mathematics score of 22 is the benchmark for college Algebra; and an ACT Science score of 24 is the benchmark for college Biology. Using these benchmarks, we identified course sequences that increased the likelihood of students meeting the benchmarks.

Data from a subset of ACT test-takers who graduated in 2003 were used to explore the contribution of courses and course sequences to postsecondary readiness. The subset consisted of those students who took PLAN®[2] (ACT, 2003b) during their sophomore year and the ACT Assessment during their junior or senior year. The total sample included 403,381 students from 10,792 high schools. To be sure that we identified the impact of courses and course sequences alone, we statistically controlled for students' prior achievement and the grade they were in when they took the ACT Assessment.

The Course Grade Information Section of the ACT Assessment provides information about students' coursework in 30 specific high school courses. Students are asked to indicate whether they have taken or are currently taking a particular course, or whether they plan to take it before graduating high school. Course sequences investigated in this study were based on previous research (Blank & Langesen, 2001; Campbell et al., 2000; National Research Council, 2002; Noble, Davenport, Schiel, & Pommerich, 1999; O'Sullivan, Reese, & Mazzeo, 1997).

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1 The ACT Assessment contains four curriculum-based tests: English, Mathematics, Reading, and Science. These standardized multiple-choice tests are based on major areas of high school and postsecondary instructional programs.

2 Like the ACT Assessment, PLAN contains four curriculum-based, multiple-choice tests that measure student progress in English, mathematics, reading, and science. It is administered in grade 10.

Foreign language was included in the investigation to determine whether it contributed to ACT English scores and to the likelihood of meeting the English Composition benchmark, over and above the regular English coursework. Unlike courses in other disciplines, the Course Grade Information Section does not list specific courses within each language (e.g., introduction, first-year, second-year). Students report the number of languages (e.g., Spanish, French, German) they have studied or plan to study. Therefore, the contribution of foreign language is based on the number of languages studied rather than the number of courses taken or years studied in any one language.

Coursework, ACT English Scores, and the English Composition Benchmark

Although taking English 9–11[3] was not associated with a meaningful increase in ACT English scores relative to taking fewer courses, taking one or more foreign languages over and above English 9–11 increased students' ACT English score by 1.1 points, compared to taking only English 9–11. Failure to find a significant ACT score increase associated with taking English 9–11 is likely due to the fact that very few students reported taking less than English 9–11 (1%).

The contribution of English 9–11 (versus taking less than this sequence) to meeting the English Composition benchmark could not be evaluated due to the limited number of students who did not take this sequence while scoring below the readiness benchmark (less than 1 percent of all students). However, students who took English 9–11 had a 78 percent chance of meeting the benchmark. Compared to taking only English 9–11, also taking one or more foreign languages was typically associated with a 9 percent increase in students' chances of meeting or exceeding the benchmark (to 87 percent).

Coursework, ACT Mathematics Scores, and the College Algebra Benchmark

Figure 1 contains the results for the ACT Mathematics test. Seven mathematics course sequences were examined in total; students taking six course sequences were compared to students who took less than Algebra 1, Geometry, and Algebra 2. The average ACT Mathematics score of students taking less than Algebra 1, Geometry, and Algebra 2 was 16.7. Taking Algebra 1, Geometry, and Algebra 2 was associated with an average ACT Mathematics score of 17.8, an increase of 1.1 points for students taking less than these three courses. Taking either Trigonometry or other advanced mathematics,[4] in addition to these three courses, resulted in average ACT Mathematics scores of 18.8 and 19.3, respectively. Taking other advanced mathematics and Trigonometry increased ACT Mathematics scores by 3.1 points (to 19.8).

A relatively high average score (20.9 points) was associated with taking other advanced mathematics courses, Trigonometry, and Calculus, in addition to Algebra 1, Geometry, and Algebra 2. In a supplemental analysis, we found that

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3 English 12 was not included in the analysis because students who took the ACT Assessment as juniors would not have had the opportunity to participate in this course.

4 Includes courses beyond Algebra 2 other than Trigonometry and Calculus.

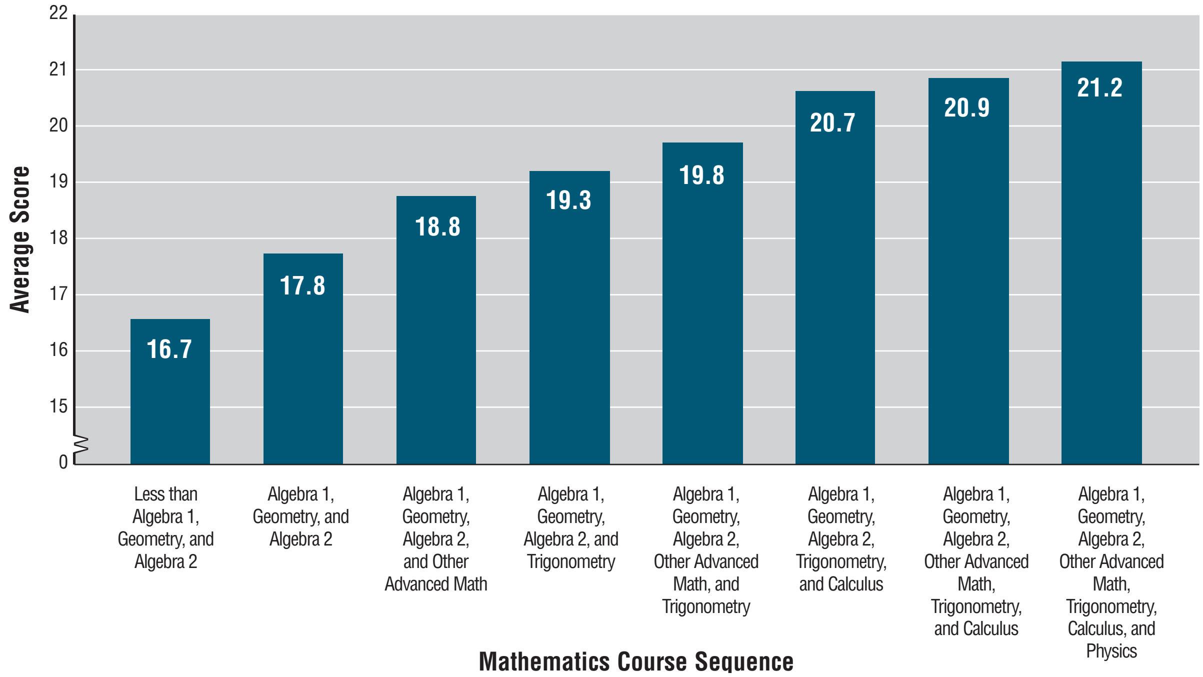


Figure 1: Average ACT Mathematics Score Associated with Mathematics Courses

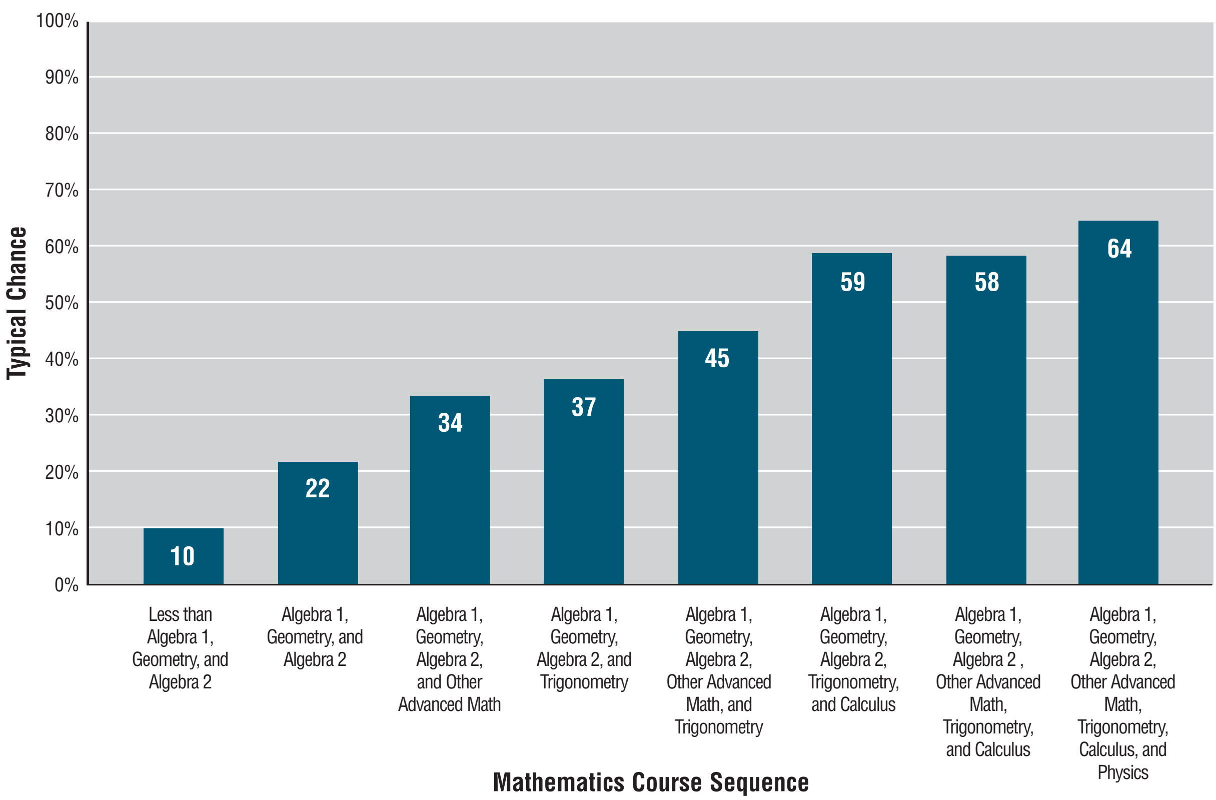


Figure 2: Typical Chances of Meeting the Readiness Benchmark for College Algebra

students who took Physics, in addition to the six mathematics courses, had an even higher average ACT Mathematics score (21.2), compared to 16.7 for those who had taken less than Algebra 1, Geometry, and Algebra 2 (Figure 1).

Figure 2 illustrates students' chances of meeting the college Algebra benchmark associated with taking various mathematics course sequences, compared to taking less than Algebra 1, Geometry, and Algebra 2. Students taking less than Algebra 1, Geometry, and Algebra 2 had a 10 percent chance of meeting the college Algebra benchmark.

Taking Algebra 1, Geometry, and Algebra 2 was typically associated with a 22 percent chance of meeting the benchmark (an increase of 12 percent over that for students taking less than Algebra 1, Geometry, and Algebra 2). Taking upper-level mathematics courses beyond Algebra 2 was associated with substantial increases in students' chances of meeting or exceeding the college Algebra benchmark. Chances ranged from 34 percent (other advanced mathematics) to 58 percent (other advanced mathematics, Trigonometry, and Calculus), compared to 10 percent for those taking less than Algebra 1, Geometry, and Algebra 2. Students taking these various course sequences were about 2 to 5 times as likely as those taking less than Algebra 1, Geometry, and Algebra 2 to meet the benchmark.

Students taking Physics, in addition to Algebra 1, Geometry, Algebra 2, other advanced mathematics, Trigonometry, and Calculus, typically had a 64 percent chance of meeting the college benchmark (an increase of 54 percent over those taking less than Algebra 1, Geometry, and Algebra 2) (Figure 2). This increase was 6 percentage points higher than that associated with taking the six mathematics course sequence.

Coursework, ACT Science Scores, and the College Biology Benchmark

Figure 3 contains the results for the ACT Science test. Four science course sequences were studied: Biology[5]; Biology and Chemistry; and Biology, Chemistry, and Physics were compared to taking General Science alone. Students who took General Science alone had an average ACT Science score of 17.9.

Taking Biology alone was associated with an average ACT Science score of 18.4 (a 0.5 point increase over taking General Science alone). Taking Biology and Chemistry, compared to taking General Science alone, was associated with an average ACT Science score of 19.7, nearly 4 times the increase associated with taking only Biology. The increase associated with taking Biology, Chemistry, and Physics (2.9) was over 1 score point greater than that associated with taking only Biology and Chemistry, resulting in an average ACT Science score of 20.8.

We also examined the benefits of taking upper-level mathematics courses for increasing ACT Science scores. Taking Trigonometry, Calculus, Biology, Chemistry, and Physics was associated with an average ACT Science score of 21.9, an increase of 4.0 points over taking only General Science (Figure 3). This was a full point more than the increase associated with taking Biology, Chemistry, and Physics alone (2.9).

5 Biology included students who took Biology alone and those who took both General Science and Biology.

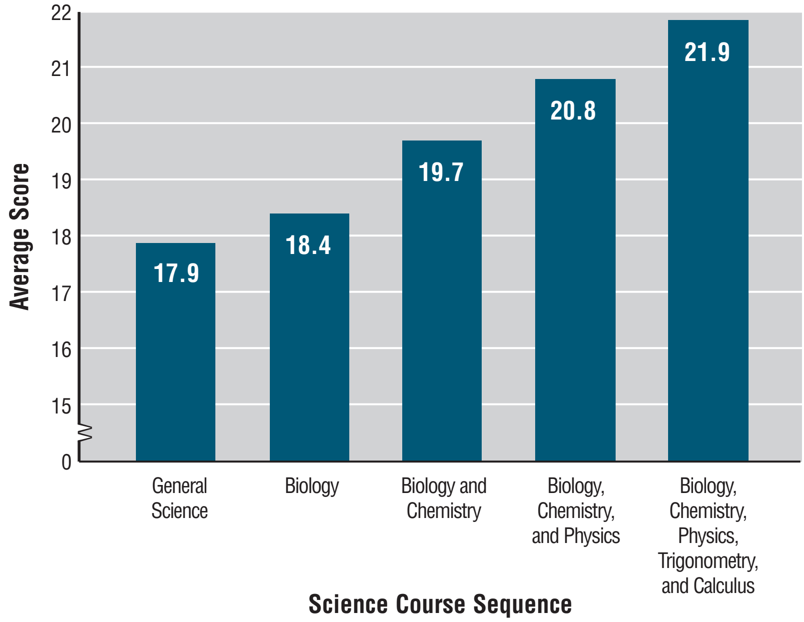


Figure 3: Average ACT Science Score Associated with Science Courses

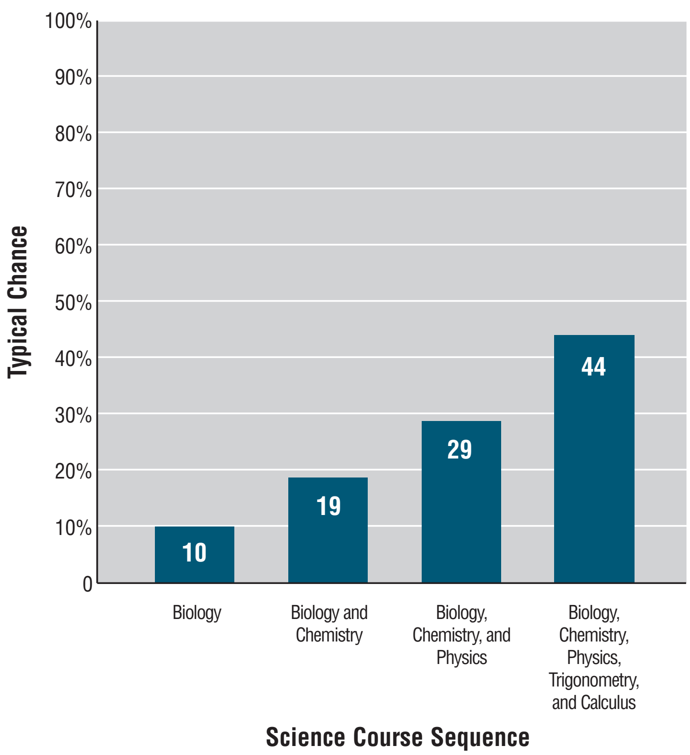


Figure 4: Typical Chances of Meeting the Readiness Benchmarks for College Biology

The contribution of Biology, compared to taking only General Science, to meeting the college Biology readiness benchmark could not be evaluated (due to the limited number of students who met the benchmark and took no more science beyond General Science—less than 1 percent of all students). Biology, rather than General Science alone, was therefore used to show the impact of taking science courses beyond Biology on students' chances of meeting the college Biology benchmark. Students who took Biology alone had a 10 percent chance of meeting the benchmark.

Figure 4 shows that taking Biology, in combination with other science courses, does have a significant impact on the chances of meeting the benchmark for college Biology, compared to taking only Biology. Taking Biology and Chemistry was typically associated with a 19 percent chance of meeting or exceeding the college Biology benchmark (a 9 percent increase over Biology alone). Students taking Biology, Chemistry, and Physics had a 29 percent chance of meeting the benchmark. Adding Trigonometry and Calculus to Biology, Chemistry, and Physics was typically associated with a 44 percent chance of meeting the college Biology readiness benchmark, an increase of 34 percent over taking only Biology (Figure 4).

Our findings support those of Adelman (1999): some courses and course sequences better prepare students for postsecondary-level work than others. Students increased their chances of meeting the readiness benchmark for college Algebra by taking Algebra 1, Geometry, Algebra 2, and at least one other upper-level mathematics course such as Trigonometry. Students increased their chances of meeting the readiness benchmark for college Biology by taking Physics in addition to Biology and Chemistry.

Preparation for each of the freshman college courses was enhanced by cross-disciplinary coursework. Taking a foreign language in addition to the complete English sequence increased students' chances of reaching the English Composition benchmark by at least 9 percent.

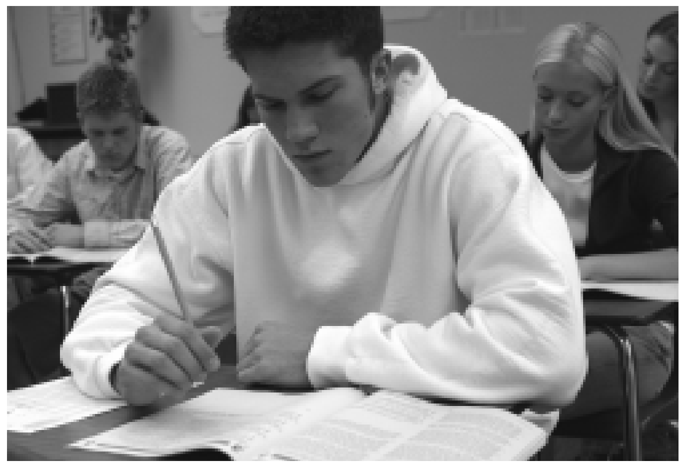
Taking Physics in addition to Algebra 1, Geometry, Algebra 2, other advanced mathematics, Trigonometry, and Calculus increased students' chances of meeting the college Algebra benchmark by over 50 percent compared to taking less than Algebra 1, Geometry, and Algebra 2. Adding Trigonometry and Calculus to Biology, Chemistry, and Physics increased students' chances of meeting the college Biology benchmark by over 30 percent compared to taking Biology. Relatedly, Adelman (1999) found that of all secondary curricula, the higher the level of mathematics students take in high school, the stronger the influence on completing a bachelor's degree.

The results also clearly indicate that postsecondary readiness is not a function of the number of courses taken in a particular discipline. Each incremental college preparatory course taken, particularly in mathematics and science (e.g., Trigonometry beyond Algebra 2, Physics beyond Chemistry), added to readiness more so than the number of courses in a discipline alone. English 12, then, should further add to students' readiness for college English Composition.

3

Taking Courses That Count

We have identified the college preparatory course sequences that contributed most to college readiness: English 9–12; Algebra 1, Geometry, Algebra 2, and one (or more) upper-level mathematics course; and Biology, Chemistry, and Physics. Taking a foreign language enhances the benefits of the English sequence, and the upper-level mathematics and science courses have cross-disciplinary benefits. Yet a review of enrollment figures among ACT test-takers for 2000 and 2004 (ACT, 2000, 2004a) demonstrates that a significant percentage of students do not participate in these courses and there has been little or no change in course-taking patterns over the last five years.[6]



Well over 90 percent of ACT test-takers in 2004 (93 percent) reported taking or planning to take English 9–12 (Table 1). Almost as many students also planned to take one or more foreign languages (89 percent).

In 2004, 36 percent reported taking or planning to take Algebra 1, Geometry, Algebra 2, and two or more mathematics courses beyond Algebra 2, such as Trigonometry and Calculus. Another 27 percent took or planned to take one upper-level mathematics course beyond Algebra 2. Still, 23 percent of students took, or planned to take, only Algebra 1, Geometry, and Algebra 2.

Less than one-half of ACT test-takers (44 percent) completed, or planned to complete, Biology, Chemistry, and Physics. Another 38 percent took or planned to take Biology and Chemistry only, while 13 percent planned to take Biology only.

In total, *only about 35 percent* of ACT-tested students took, or planned to take, all four years of English; one or more upper-level mathematics courses beyond Algebra 2; and Biology, Chemistry, and Physics. Notably, this combination of academic course sequences, which is unfortunately only taken by roughly a third of our high school students, is the best preparation for postsecondary success.

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6 Enrollment figures presented here include courses students took, were taking at the time of the ACT Assessment, and planned to take before leaving high school.

Gender Differences

The 2000 and 2004 percentages of students taking particular courses by gender were very similar. Gender differences in course taking were also consistent for both years. As shown in Table 2, though the percentages of males and females taking all four English courses were similar, a somewhat higher percentage of females than males also took one or more foreign languages (91 percent vs. 87 percent in 2004). In contrast, slightly higher percentages of males (37 percent) than females (35 percent) took Algebra 1, Geometry, Algebra 2, and at least two upper-level mathematics courses. However, slightly higher percentages of females (28 percent) than males (25 percent) took either Trigonometry or another advanced mathematics course beyond Algebra 2.

Table 1

Percentages of Students Taking Course Patterns by Year

Course Patterns	2000	2004
English		
English 9–12 and one or more foreign languages	90	89
English 9–12	95	93
Less than English 9–12	5	7
Mathematics		
Algebra 1, Geometry, Algebra 2, and at least two upper-level courses (Trigonometry, Calculus, or other advanced math course)[a]	37	36
Algebra 1, Geometry, Algebra 2, and Trigonometry or other advanced math course[a]	26	27
Algebra 1, Geometry, and Algebra 2	24	23
Less than Algebra 1, Geometry, and Algebra 2	11	12
Other non-sequential math course pattern	2	3
Natural Science		
Biology, Chemistry, Physics	44	44
Biology and Chemistry	38	38
Biology	14	13
Other non-sequential science course pattern	5	5
English 9–12; one or more upper-level mathematics courses beyond Algebra 2; and Biology, Chemistry, and Physics	**36**	**35**

Note: Column percentages in each discipline area may not add to 100% due to rounding.

[a] Other advanced math includes courses beyond Algebra 2 other than Trigonometry and Calculus.

Higher percentages of males (48 percent) than females (41 percent) also participated in Biology, Chemistry, and Physics courses, while higher percentages of females (42 percent) than males (32 percent) took Biology and Chemistry. Overall, higher percentages of males than females (38 percent vs. 33 percent in 2004) took all four English courses; at least one upper-level mathematics course beyond Algebra 2; and Biology, Chemistry, and Physics. This is largely due to the higher percentages of males taking upper-level science courses.

Table 2
Percentages of Students Taking Course Patterns by Gender and Year

	Males		Females	
Course Patterns	**2000**	**2004**	**2000**	**2004**
English				
English 9–12 and one or more foreign languages	87	87	92	91
English 9–12	94	92	95	94
Less than English 9–12	6	8	5	6
Mathematics				
Algebra 1, Geometry, Algebra 2, and at least two upper-level courses (Trigonometry, Calculus, or other advanced math course)[a]	38	37	36	35
Algebra 1, Geometry, Algebra 2, and Trigonometry or other advanced math course[a]	25	25	27	28
Algebra 1, Geometry, and Algebra 2	23	22	25	23
Less than Algebra 1, Geometry, and Algebra 2	11	12	10	11
Other non-sequential math course pattern	2	3	2	3
Natural Science				
Biology, Chemistry, Physics	48	48	41	41
Biology and Chemistry	32	32	42	42
Biology	14	14	13	13
Other non-sequential science course pattern	5	6	4	4
English 9–12; one or more upper-level mathematics courses beyond Algebra 2; and Biology, Chemistry, and Physics	**40**	**38**	**34**	**33**

Note: Column percentages in each discipline area may not add to 100% due to rounding.

[a] Other advanced math includes courses beyond Algebra 2 other than Trigonometry and Calculus.

Table 3

Percentages of Students Taking Course Patterns by Race/Ethnicity and Year

	African American		American Indian		Caucasian		Hispanic		Asian American	
Course Patterns	**2000**	**2004**	**2000**	**2004**	**2000**	**2004**	**2000**	**2004**	**2000**	**2004**
English										
English 9–12 and one or more foreign languages	89	89	84	83	90	89	92	92	92	91
English 9–12	95	94	95	93	95	93	95	93	95	94
Less than English 9–12	5	6	5	7	5	7	5	7	5	6
Mathematics										
Algebra 1, Geometry, Algebra 2, and at least two upper-level math courses (Trigonometry, Calculus, or other advanced math course)[a]	26	25	27	28	38	38	30	28	59	56
Algebra 1, Geometry, Algebra 2, and Trigonometry or other advanced math course[a]	25	28	24	25	27	27	26	27	20	21
Algebra 1, Geometry, and Algebra 2	32	30	29	29	23	22	29	29	12	12
Less than Algebra 1, Geometry, and Algebra 2	14	14	19	16	10	11	12	13	6	8
Other non-sequential math course pattern	3	3	2	2	2	3	3	4	3	4
Natural Science										
Biology, Chemistry, and Physics	37	37	31	32	44	44	43	43	69	66
Biology and Chemistry	43	43	37	38	38	38	38	39	23	26
Biology	15	15	26	24	14	13	14	12	5	5
Other non-sequential science course pattern	4	5	6	6	5	5	5	6	3	4
English 9-12; one or more upper-level math courses beyond Algebra 2; and Biology, Chemistry, and Physics	**28**	**27**	**25**	**25**	**37**	**36**	**32**	**30**	**60**	**55**

Note: Column percentages in each discipline area may not add to 100% due to rounding.

[a] Other advanced math includes courses beyond Algebra 2 other than Trigonometry and Calculus.

Race/Ethnicity Differences

Differences across racial/ethnic groups in the percentages of students taking particular course patterns remained roughly the same between 2000 and 2004. Over 90 percent of students in all racial/ethnic categories reported taking or planning to take English 9–12 (Table 3). However, in 2004 smaller percentages of American Indian students (83 percent) reported also taking one or more foreign languages, compared to students from other racial/ethnic groups. Percentages of students who took Algebra 1, Geometry, Algebra 2, and one or more upper-level mathematics course beyond Algebra 2 were highest for Caucasian (65 percent) and Asian American (77 percent) students. Percentages of African American, Hispanic, and American Indian students who took this sequence were much lower (53 to 55 percent).

The greatest concentrations of African American (30 percent), American Indian (29 percent), and Hispanic (29 percent) students took only Algebra 1, Geometry, and Algebra 2 in 2004. American Indian students were most likely not to complete even this course sequence (16 percent).

Percentages of students who took Biology, Chemistry, and Physics ranged from 32 percent (American Indian) to 66 percent (Asian American) in 2004. African American (43 percent) and American Indian (38 percent) students were more likely to take Biology and Chemistry only. This was not the case among Caucasian, Hispanic, and Asian American students. The percentage of Asian American students who took only Biology (5 percent) was considerably smaller than corresponding percentages for all other racial/ethnic groups (12 to 24 percent) in 2004. In contrast, for example, 24 percent of American Indian students took only Biology.

In 2004, 55 percent of Asian American students took all four English courses, one or more upper-level mathematics courses, and Biology, Chemistry, and Physics (the optimum course sequence combination for college readiness); however, less than 40 percent of students from all other racial/ethnic groups took all of these courses. African American (27 percent) and American Indian (25 percent) students were least likely to take all of these courses.

Thus, relative to the courses found to contribute the most to college readiness:

- Essentially all students take sufficient coursework to be adequately prepared in English.
- Less than 40 percent of all ACT test-takers take two or more upper-level mathematics courses beyond Algebra 2. An additional 27 percent take only one upper-level mathematics course beyond Algebra 2. Another 35 percent take only Algebra 1, Geometry, and Algebra 2 or fewer than these courses—clearly insufficient mathematics coursework to ensure readiness for college Algebra.

- Just over 40 percent of all students take the coursework (i.e., Biology, Chemistry, and Physics) to prepare them for college-level science.
- Nearly two-thirds of males and females take upper-level mathematics courses, but males take slightly more of these courses.
- More males (48 percent) than females (41 percent) take upper-level science courses.
- American Indian students are least likely of all racial/ethnic groups to take a foreign language.
- While two-thirds of Asian American students take the courses to best prepare them for college-level science, only approximately one-third of African American and American Indian students do so.
- The greatest percentage of students who take a complete college preparatory course sequence in mathematics (Algebra 1 through one or more upper-level mathematics courses) occurred among Asian American students (77 percent). The greatest concentration of African American, American Indian, and Hispanic students take only Algebra 1, Geometry, and Algebra 2.
- American Indian students are most likely of all racial/ethnic groups to take less than Algebra 1, Geometry, and Algebra 2 (16 percent) and less than Biology, Chemistry, and Physics (68 percent).
- Only about one-third of ACT-tested students take all of the courses and course sequences needed to prepare them for college-level work.

4

Curriculum Rigor

Though college preparatory courses clearly contribute to postsecondary readiness, courses per se may not be sufficient to ensure readiness (for either college or work). For example, just having the right course name does not guarantee that the course content will develop the skills students need to be ready for college (ACT & The Education Trust, 2004). Readiness for postsecondary coursework also depends on the rigor of the high school courses taken.

A growing body of evidence suggests that the U.S. curriculum lacks rigor—an ongoing concern, particularly in science and mathematics. Many have called for an education that is more focused (especially on central ideas and capacities), provides more depth in at least some areas, and provides rigorous, powerful, and meaningful content that is likely to produce learning that lasts (Schmidt et al., 1997).

Rigor is defined and construed in a myriad of ways (e.g., breadth and depth of specific course content, amount of material covered, teacher preparation and expectations, teaching and learning methodologies, types and amount of assessments, alignment with next level preparation expectations). Related to the focus of this study (i.e., courses leading to postsecondary readiness), we examine rigor in terms of:

- the number and nature of high school courses required for graduation,
- a function of curriculum depth, and
- the alignment of curriculum between secondary and postsecondary institutions.

These three definitions of rigor relate directly to postsecondary readiness (ACT, 2003a; Campbell et al., 2000; Mullis et al., 1998; National Research Council, 2002; O'Sullivan et al., 1997; Schmidt et al., 1997) and allow us to tie these elements directly to the issue of coursework as related to college preparation.

High School Graduation Requirements

A rigorous curriculum is evident in high school graduation requirements that include college preparatory courses. These courses should be offered in sufficient numbers and in sufficient vertical curriculum depth to encourage student interest, participation, and academic growth. A review of state education policies indicates, however, that it may be easy for many students to meet graduation requirements but bypass the English, mathematics, and science courses and course sequences that contribute most to postsecondary readiness (Campbell et al., 2000; Mullis et al., 1998; National Research Council, 1999a, 2002; Potts, Blank, & Williams, 2002).

For example, graduation requirements are often expressed in terms of credits[7] (e.g., the amount of credits in various subject areas needed to graduate), rather than as specific academic courses (Potts et al., 2002). To the extent that high schools offer courses other than those in the college preparatory sequences, students may satisfy graduation requirements (i.e., amount of credits) without taking the specific courses that would best prepare them for further education (and work). That students choose such alternative coursework is clearly demonstrated in the percentages of students who took course combinations that may or may not have included the courses previously described.

Table 4

Mathematics and Science Course Sequences and the Grades in Which Courses are Typically Taken[a]

Grade	Mathematics	Science
9	Algebra 1	General Science
10	Geometry	Biology*
11	Algebra 2*	Chemistry
12	Trigonometry	Physics

* Completes average graduation requirements

a Blank & Langesen, 2001; Campbell et al., 2000; National Research Council, 2002; Noble et al., 1999; O'Sullivan et al., 1997.

Table 4 lists the college preparatory course sequences for mathematics and science and the grade levels in which they are typically taken. In 2002, 25 of 53 U.S. states and territories required 3 credits in mathematics (5 required more than 3), and 21 required 2 credits in science (24 required more than 2) (Potts et al., 2002). If students do not begin college preparatory sequences in mathematics and science until high school, they can complete minimum graduation requirements before taking Trigonometry, Calculus, Chemistry, and Physics. According to 2002 data, graduation requirements for very few states included sufficient numbers of courses to increase the chances of students taking the upper-level courses they need to prepare adequately for postsecondary coursework (Potts et al., 2002).

According to Achieve (2004c), no state currently requires every high school student to take a college- and work-preparatory curriculum to earn a diploma. While some states offer students the option to pursue a truly rigorous course of study, a less rigorous set of course requirements remains the standard in almost every state. These inadequacies may explain why so many students fulfill the requirements and graduate from high school but are not prepared for postsecondary-level work.

7 A credit is often defined as a Carnegie unit, an academic year course.

Curriculum Depth

State graduation requirements appear to lack the specificity, numbers, and vertical depth of courses necessary to ensure that most students take those courses needed to adequately prepare them for postsecondary education. In addition, there is widespread concern that the U.S. high school curriculum in many academic areas has become "a mile wide and an inch deep." Specifically, the U.S. curriculum strives to cover a wide breadth of topics within a given discipline, is not often integrated, and fails to focus in an in-depth fashion on more than a few (if any) key content and skill areas.

The Third International Mathematics and Science Study (TIMSS) was the largest and most rigorous international comparison of education ever undertaken (U.S. Department of Education, 1998). U.S. twelfth graders performed below the international average and among the lowest 21 TIMSS countries in both mathematics general knowledge and science general knowledge (e.g., the knowledge of mathematics and science needed to function effectively in society as an adult). Even the performance of America's most advanced mathematics and science students was ranked among the lowest of the participating countries.

In *A Splintered Vision*, Schmidt et al. (1997) reported on the TIMSS curriculum analyses. They found that states across the nation planned to cover so many topics (i.e., discipline sub-areas) that the state composite average included more topics until the ninth (mathematics) or tenth (science) grade than 50–75% of the other countries included in TIMSS. They further reported that U.S. mathematics and science textbooks included far more topics than were typically covered internationally, at all grade levels.

Also, U.S. textbooks tended to switch from topic to topic much more frequently than did textbooks used in other countries (National Research Council, 1999a). The National Research Council (2002) later reported that while academic preparation for advanced study begins in middle school, mathematics and science courses in these grades often lacked focus, covered too many topics, repeated material, and were implemented inconsistently.

Schmidt et al. (1997) hypothesized that these unfocused curricula and textbooks likely influenced teachers to implement diffuse learning goals in their classrooms, emphasize familiarity with many topics rather than concentrate attention on a few, and lowered the academic performance of students who spent years in such learning environments. They concluded that this preoccupation with breadth rather than depth, with quantity rather than quality, probably affected how well U.S. students performed in relation to their counterparts in other countries.

As a practical follow-up to the landmark study *How People Learn* (1999b), the National Research Council (1999c) focused on the implications of key findings most directly relevant to classroom practice. In particular, the Council urged that teachers teach some subject matter in depth (including many examples in which the same concept is at work) and provide a firm foundation of factual knowledge. They contended that superficial coverage of all topics in a subject area must be replaced by in-depth coverage of fewer topics, which would allow key concepts in that discipline to be understood. Similarly, science standards developed by both the American Association for the Advancement of Science and the National Research Council call for increased emphasis on inquiry and in-depth study of fewer topics (National Research Council, 2002). One principle common to both sets of standards, for example, was to select the most important biology content rather than try to cover all concepts in biology (Leonard, 2004). Also, mathematics standards from the National Council of Teachers of Mathematics now emphasize learning of concepts and helping students understand mathematics more deeply (National Research Council, 2002).

Essentially, effective mathematics and science curricula are coherent, focus on important ideas within the disciplines, and are sequenced to optimize learning. Such curricula provide ample opportunities for exploring mathematics and science ideas in depth and for developing familiarity with the discourse and modes of inquiry of the disciplines (National Research Council, 2002).

Secondary-to-Postsecondary Curriculum Alignment

A rigorous curriculum is also aligned across grades and education levels. Such alignment allows teachers to build on prior knowledge, reduces duplication and unnecessary reviews of material, and promotes steady, more direct progress through the curriculum (Achieve, 2004a; National Council of Teachers of Mathematics, 2000). Yet, evidence suggests that current secondary-to-postsecondary curriculum alignment is characterized by the lack of agreement between educators at different levels regarding the number of courses students should complete, the topics that should be covered in those courses, and the skills students should have by the time they leave high school to be prepared for entry-level postsecondary coursework (ACT, 2003a; Sommerville & Yi, 2002).

Number of Courses and Topics. Sommerville and Yi (2002) looked at the number of courses and topics required by K–12 systems relative to the admission requirements of postsecondary institutions in 20 states. In almost no state did they find consensus between K–12 and postsecondary systems on the courses and topics students should cover in high school.

Although educators at both levels consistently agreed that students should take English every year throughout high school, higher education systems placed greater emphasis on writing than did K–12 system requirements. While higher education consistently wanted one or more science laboratory courses, few K–12 science requirements included laboratory courses. Almost one-half of the higher education systems required 1 to 2 years of a foreign language among their entrance requirements, yet few K–12 systems included foreign language in their graduation requirements.

Some convergence may be occurring between secondary and postsecondary systems regarding the courses and topics required in mathematics. A growing number of educational systems at both levels are requiring 3 (or more) years of mathematics, and almost all higher education systems required Algebra 1, Geometry, and Algebra 2 (Sommerville & Yi, 2002). However, Sommerville and Yi found that most K–12 system requirements stopped at Geometry (thus not including Algebra 2), which is also consistent with the findings of Potts et al. (2002).

Skill Expectations. As part of our continuing efforts to support the content validity of our achievement tests, ACT conducts the *ACT National Curriculum Survey®* (ACT, 2003a) every three years. Results of the latest survey identified differences between the skills high school faculty thought were important to emphasize in high school and the skills college faculty believed were prerequisites to success in college.

Writing. College and high school faculty agreed on the top purpose of writing: to develop logical arguments and support them with valid evidence. However, high school teachers ranked writing an argumentative or persuasive essay as the second top purpose of writing while college faculty ranked this as their fourth top purpose.

The writing skill considered most important (i.e., ranked first) for entering students by college instructors—grammar and usage skills—ranked sixth in importance among high school teachers. High school faculty considered writing strategy the most important skill, yet college faculty ranked it third. In terms of the top criteria for evaluating student writing, both high school and college faculty ranked developing ideas using relevant examples and details first. However, high school teachers ranked using a clear beginning, middle, and ending second while college faculty ranked this evaluation criterion fourth.

Reading. Regarding students' developed ability to read and understand different broad reading content areas, high school teachers ranked prose fiction first (college faculty ranked this third). College faculty ranked reading social sciences-based texts first, whereas high school teachers ranked it third.

In terms of specific types of texts, high school teachers ranked poetry/drama as the most important to learn how to read in high school, while college faculty ranked this category only ninth. College faculty ranked reading editorials and opinion pieces first and news and feature articles second; these ranked fourth and fifth, respectively, on the list of text types considered important by high school faculty.

When determining the most important reading skills, both high school and college faculty agreed on the three most important: drawing conclusions from information given, making inferences from the text concerning the main idea(s), and making inferences from the text about details that support the main idea(s). However, the next three ranked skills in importance differed for each group. Specifically, high school teachers' rankings were recognizing and recalling main ideas by summarizing (fourth), determining specific meanings of words and phrases from the context in which they appear (fifth), and making inferences from the text concerning cause-effect relationships (sixth). College faculty ranked as fourth, fifth, and sixth, respectively, distinguishing between fact, opinion, and reasoned judgement; recognizing and recalling cause-effect relationships; and recognizing and recalling main ideas by summarizing.

Mathematics. College faculty considered a strong foundation most important for success in college-level mathematics courses, and their top three mathematics process skills were: performing basic operations with a calculator (first); quickly recalling basic facts, definitions, formulas, and algebraic procedures and then using them correctly to solve a problem (second—high school teachers ranked this fifth); and planning and carrying out a strategy for solving multi-step problems (third). The process skills considered most important by high school mathematics instructors were: planning and carrying out a strategy for solving multi-step problems (first); solving problems posed in real-world settings and interpreting the solution (second—college faculty ranked this fourth); and performing basic operations with a calculator (third).

College and high school faculty also differed in their rankings of important mathematics content skills. College faculty ranked as the most important content skills: performing addition, subtraction, multiplication, and division on signed rational numbers (first); evaluating algebraic expressions by substitution (second—high school teachers ranked this sixth); and simplifying algebraic expressions (third—high school teachers ranked this fifth). High school teachers' top three content rankings were: performing addition, subtraction, multiplication, and division on signed rational numbers (first); finding the slope of a line (second—college faculty ranked this sixth); and using the Pythagorean theorem (third—college faculty ranked this twelfth).

Science. Results from the *ACT Curriculum Survey* suggest that both high school and college educators believe that, in general, science skills are more important for success in high school or as prerequisites for entry-level college science classes than are content topics. However, there were some differences between high school and college faculty in rankings of science skills.

The top four science skill rankings by college faculty were: understanding the basic features of, or data points in, tables or graphs (first); understanding basic scientific concepts or assumptions underlying given information (tied for second); translating data/information into a graph or diagram (tied for second); and determining whether data/information supports or is consistent with given data/information (fourth). High school teachers' top four rankings were: translating data/information into a graph or diagram (first); understanding the basic features of, or data points in, tables or graphs (second); determining whether data/information supports or is consistent with a stated hypothesis or conclusion (third); and understanding basic scientific concepts or assumptions underlying given information (fourth).

In trying to determine why so many U.S. students are not prepared to succeed in college without remedial help, this section has examined the notion of academic rigor in three contexts: high school graduation requirements that prepare students to succeed in education and work, curriculum depth, and the alignment between high school and college curricula.

We have seen that high school graduation requirements are clearly lacking across the country when they focus on credits and equivalent years of study rather than on requiring those courses that will best prepare students for the future. There is also concern that the U.S. curriculum covers a breadth of topics but fails to focus in depth on more than a few content areas at best. And, there is limited alignment between the importance placed on many content and skill areas of the high school and college curricula across the four areas traditionally measured by the ACT Assessment: writing, reading, mathematics, and science.

5

Conclusions and Recommendations

A review of the high school curriculum—particularly in English, mathematics, and science—suggests three possible explanations for why students leave high school unprepared for postsecondary programs. First, some courses and course sequences prepare students better for postsecondary-level work than others. Of the courses and sequences studied, English 9 through 12; Algebra 1, Geometry, Algebra 2, and at least one (or more) upper-level course such as Trigonometry; and Biology, Chemistry, and Physics had the greatest impact on achievement and chances of success in college English (composition), college Algebra, and Biology, respectively. These course sequences are consistent with those typically considered college preparatory and improve student achievement and chances of success better than taking fewer courses within each of the college preparatory sequences.

We also discovered cross-disciplinary benefits of specific courses. Taking at least one foreign language increased both achievement and chances of success in college English Composition beyond the English sequence alone. In addition, upper-level coursework in mathematics contributed to achievement and the chances of success in college Biology beyond the science sequence; and upper-level science courses added to achievement and chances of success in college Algebra beyond the mathematics sequence.

Second, although most students pursue postsecondary education, they are not necessarily taking the courses that will best prepare them for success in postsecondary coursework. Less than half of all students take the courses they need to be prepared in mathematics and science. Participation rates are particularly low for students in underrepresented racial/ethnic groups.

Third, readiness is related not only to courses, but also to the rigor of those courses. Delineating high school graduation requirements in terms of minimum numbers of course credits instead of specific courses allows students to satisfy requirements without taking the sequence of courses that would best prepare them for postsecondary success. Covering a breadth of topics to the exclusion of in-depth focus on key content areas does not facilitate optimal learning. Further, misalignment between high school and college curriculum sends conflicting messages to students, parents, and teachers regarding the content knowledge and academic skills students need to succeed in college.

Recommendations

Ensuring that high school students take a college preparatory curriculum and increasing the rigor of the high school curriculum will significantly improve postsecondary readiness and success. We believe the following broad-based recommendations and action steps for educational leaders and policymakers will go a long way toward achieving these important outcomes.

Recommendation #1: Increase postsecondary readiness by requiring that all students take specific college preparatory course sequences in English, mathematics, science, and foreign language.

Action Steps

At the state and/or district level, graduation criteria should be defined by specific courses and course sequences (rather than number of credits) and should require that students take, at a minimum:

- English 9–12
- Algebra 1, Geometry, Algebra 2, and at least one other advanced mathematics course beyond Algebra 2
- Biology, Chemistry, and Physics
- One to two years of a foreign language

Recommendation #2: Improve the rigor of high school coursework with a greater focus on in-depth content coverage and considerably greater secondary-to-postsecondary curriculum alignment.

Action Steps

- Educators at the K–12 and higher education levels must reach consensus regarding the content and skill expectations students should know and be able to do to succeed in entry-level postsecondary courses. (ACT's *College Readiness Standards* might serve as a resource for this process.)
- Educators should align content and skill expectations from middle school through college.
- Educators should monitor student achievement of aligned curriculum content and skill expectations through systematic assessments to ensure continuous curriculum alignment as well as continued academic growth. (ACT's Educational Planning and Assessment System® and Collegiate Assessment of Academic Proficiency® provide useful resources to this end.)

The number of students who are not ready for college (or the workplace) has recently been described as "nothing short of a crisis" (ACT, 2004b). The actions recommended here and elsewhere by ACT (2004b), based on solid evidence, suggest ways to begin to address this problem. Ultimately, it is in the best interest of our students and nation to ensure that everyone graduates from high school ready to enter and succeed in postsecondary educational programs and the workforce.

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