

# College Completion: Comparing AP<sup>®</sup>, Dual-Enrolled, and Nonadvanced Students

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## Executive Summary

The study presented here is an investigation and comparison of the relationships between the Advanced Placement Program® (AP®) and dual-enrolled high school courses and college outcomes. Previous research provides evidence that participation in AP, and subsequent success on AP Exams, is positively related to various college outcomes including an increased likelihood of graduating from college and better preparation for the academic rigor of the college classroom. This study aims to contribute to the understanding of the value of advanced course work in high school in preparing students for higher education success by investigating the relationships between participation and performance in AP courses and exams, dual enrollment courses, and regular courses and four different college outcomes including first-year subject-specific GPA, final subject-specific GPA, calendar time to bachelor's degree, and credit hours attempted. Results indicated that higher performance on AP Exams was related to higher college performance in the subject area, as well as fewer credit hours taken to bachelor's degree. Most dual enrollment course grades were at a C or higher, and students taking these courses tended to graduate from college in fewer calendar terms than other groups.

## Introduction

The College Board's AP Program was established in 1955 to provide students with the opportunity to take rigorous college-level courses and obtain college credits while still in high school. Each AP course culminates with an end-of-course AP Exam through which students have the opportunity to demonstrate their knowledge of the content learned. The AP Exam is criterion-referenced, with scores ranging from 1 to 5 indicating the proficiency level of students within a particular subject area. Scores of 3 or higher are typically considered successful scores, and the American Council on Education recommends that students obtaining a score of at least 3 be considered eligible to receive college credit or advanced placement. Currently, there are over 30 exams across six content areas (English, mathematics and computer science, sciences, history and social sciences, arts, and world languages and cultures) that are taken by students throughout the U.S. and around the world.

Since its inception, the AP Program has seen tremendous growth. Over the last 10 years, the number of seniors graduating from high school having taken one or more AP Exams has more than doubled. Similarly, the AP Program has seen a 7.9% increase in the number of graduating seniors that are successful on at least one AP Exam since 2002 (College Board, 2013). The expansion of the AP Program has resulted in a growing body of literature examining the impact of the AP experience on student outcomes (Ewing, 2006). A number of researchers have focused on the validity of AP Exam scores for course placement (Burnham & Hewitt, 1971; Dodd, Fitzpatrick, De Ayala, & Jennings, 2002; Ewing, Huff, & Kaliski, 2010; Keng & Dodd, 2008; Morgan & Ramist, 1998). Specifically, they have investigated whether students who scored a 3 or higher on an AP Exam and were exempted from the introductory course in college perform as well in subsequent courses as students who were not exempted from the introductory course.

Additionally, researchers have conducted studies to gauge the impact of AP participation and performance on other college outcomes such as college enrollment (Chajewski, Mattern, & Shaw, 2011), first-year GPA (Duffy, 2010; Hargrove, Godin, & Dodd, 2008; Keng & Dodd, 2008; Mattern, Shaw, & Xiong, 2009; Willingham & Morris, 1986), second-year and discipline specific GPA (Geiser & Santelices, 2004), fourth-year GPA (Hargrove et al., 2008), credit hours taken (Hargrove et al., 2008; Keng & Dodd, 2008), college retention (Duffy, 2010; Hargrove et al., 2008; Mattern et al., 2009) and college graduation (Doherty, Mellor, & Jian, 2006; Duffy, 2010; Hargrove et al., 2008). In general, results from these studies show that AP students outperform non-AP students on most college outcomes.

While there are more students enrolling in AP courses and taking AP Exams than ever before, AP is not the only means by which high school students can obtain college credit. Through dual enrollment (DE), many students are afforded the opportunity to participate in college-level courses while in high school and may obtain both college and high school credit for a course. Like AP, participation in dual enrollment is also on the rise (Waits, Setzer, Lewis, & Greene, 2005; Thomas, Marken, Gray, & Lewis, 2013). The simultaneous increase in AP and DE raises the question, how well are these students doing in college in comparison to one another, and in comparison to students who do not participate in either program?

While a few studies have been conducted comparing the effects of participation in dual-enrolled courses, also known as dual-credit courses, and AP courses on student outcomes (Eimers & Mullen, 2003; Hargrove et al., 2008; Klopfenstein, 2010; Murphy & Dodd, 2009; O'Brien & Nelson, 2004, Speroni, 2011<sup>a,b</sup>; Struhl & Vargas, 2012), there remains a dearth of rigorous, large-scale research directly comparing students who participate in AP and DE programs in terms of college outcomes. By rigorous research, we mean studies that use rigorous statistical methodologies and attempt to control for other variables or factors (e.g., prior achievement, socioeconomic status, etc.) that may account for why students who participate in one program versus another may or may not achieve different outcomes. In addition, the few rigorous studies that have been conducted have not always yielded similar findings. For example, one study found that DE students are more likely than AP course-takers to graduate in four, five, and six years after controlling for SAT/ACT scores, Texas Assessment of Academic Skills, participation in the National School Lunch Program, gender, and ethnicity (O'Brien & Nelson, 2004). However, a more recent study found no DE advantage over AP in terms of graduating in five years or less after controlling for Florida's Comprehensive Assessment Test scores and various demographic characteristics including gender, race/ethnicity, English language proficiency, and free lunch eligibility (Speroni, 2011<sup>a</sup>). It should also be noted that Speroni only took participation into account when comparing AP and dual enrollment, not performance. In addition, college achievement (such as course performance) was not explored. There is some indication that AP students are more likely than DE students to earn higher college grades (Eimers & Mullen, 2003; Hargrove et al., 2008) and take more credit hours than DE students (Hargrove et al., 2008; Murphy & Dodd, 2009); however, these studies included fewer covariates, focusing mainly on academic achievement and socioeconomic status.

A key element missing from prior research is performance on AP Exams and in DE courses; yet, there is evidence to suggest that the performance standards and entry requirements espoused by each program differ. Descriptive data suggest that it is more common to earn a DE course grade (typically C or higher) that meets eligibility requirements for postsecondary credit than it is to earn a passing score on an AP Exam that meets eligibility requirements. For example, in 2009–2010 in Florida, 94% of dual enrollment students earned postsecondary credit whereas only 41% of AP students earned postsecondary credit (Florida Department of Education Office of Articulation, 2013). Florida eligibility requirements for participation in DE programs indicate that students must pass a college placement test to enroll in Florida DE courses while AP students do not need to pass a college readiness test to enroll. Thus, the number of college credits earned by AP and DE students may also be associated with a college readiness factor prior to course-taking that needs to be accounted for when comparing AP and DE students.

Another confounding factor is related to the types of courses offered by AP and DE programs. DE programs often have a career and/or technical and vocational focus. Although DE programs typically have been reserved for academically focused students, increasing numbers of career and technical education programs are providing DE opportunities to their students (Karp, Calcagno, Hughes, Jeong, & Bailey, 2007). In the 2010-11 academic year, many high schools offered DE programs with a career and technical/vocational focus, and of the total DE enrollments, 29.5% were in courses with such a focus (Thomas et al., 2013). To more accurately compare outcomes for students who participate in AP and DE programs, more research is needed that identifies and focuses on the courses that are similar between the two programs.

The purpose of this study is to build on the existing body of literature examining the impact of Advanced Placement and dual enrollment on college outcomes. Specifically, this study examines the relationship between students' participation and performance levels in AP courses and exams and dual enrollment courses within specific subject areas (i.e., English, math, science, and history) and four college outcomes including first-year and final subject area college grade point average (GPA), calendar time to bachelor's degree, and credit hours attempted to degree. To ensure a more focused comparison of the AP and DE programs, this study only includes DE courses that are academically focused and were judged to be comparable with AP courses. AP and DE groups were disaggregated by AP Exam score and DE course grade categories to evaluate the relationship between performance in AP and DE programs (separate from participation) on college outcomes.

## Method

### Data

Data for this study were mostly acquired from the Department of Education (DOE) from a large, diverse state located in the continental United States, and are ideal for this study because of the large number of students who participate in AP and dual enrollment programs in the state. The DOE data set contains high school transcript data for each student, student enrollment records, high school awards (e.g., completed high school with a diploma, GED, or different degree), and high school GPA on record at time of graduation, among other variables. Additionally, the DOE supplied researchers with students' postsecondary enrollment data, including: college enrollment records, transcript data including grades, number of credits attempted, and the year and term of enrollment, as well as postsecondary awards (e.g., degrees awarded and GPA). These data were merged with data obtained from the College Board, providing achievement test scores for all students in the DOE files.

The sample of students was composed of high school diploma recipients between 2000 and 2001 who *immediately* enrolled in public, in-state higher education institutions following graduation from high school. This state has a large public higher education system, with over 25 institutions that serve the majority of state residents pursuing postsecondary education. Only students with public high school records for at least grades 10 through 12 were maintained in the base sample. Students who attended private high schools, had specialized diplomas, did not immediately enroll in a public, in-state higher education institution, or did not graduate from high school, were not included in the sample.

To distinguish dual enrollment courses, researchers first identified courses on students' high school course transcripts where the instructional institution was postsecondary and the course had a college level associated with it. These courses were further investigated using course title and brief summaries provided in the course catalogs of the higher education institutions. Those that were comparable to AP courses in each subject area, over 120 courses in total, were selected as DE courses for this study. It is possible that course may have been taught to students in some districts by the high school, as opposed to an institution of higher education, but due to the statewide common course numbering system, it was assumed the courses were to cover the same material and basic curriculum.

Students were identified as having participated in AP, DE, or neither. An AP student must have taken an AP course *and* exam in a given subject area and no DE courses in that area. A DE student must have taken a DE course in a given subject area, but not an AP course or exam in that area. A student identified as "neither" must not have taken an AP course, exam, or DE

course in that subject area. Any students not fitting these criteria were removed from analyses. In English, for example, 3% of the total sample participated in both AP and dual enrolled English courses and were therefore removed from analyses.

Four outcome variables were created: (1) calendar time, in number of *possible* terms (fall, spring, summer maximum of 30 terms or 10 years) to graduation with a bachelor's degree; (2) credit hours attempted for bachelor's degree; (3) first-year subject-specific college GPA; and (4) final subject-specific college GPA. Because of a statewide summer school requirement, *enrolled* terms to degree were calculated but not reasonably interpretable. One methodology note worth mentioning here is that credits to degree (measured in college credit hours awarded for courses attempted and completed) and time to degree (measured in enrolled terms) are only calculated using those students *who actually had a record of graduation*, limiting the number of students in the samples.

Other variables from the data include 10th-grade state assessment reading and math scores, percent of grades 9–10 course work taken at an honors or more advanced level, overall GPA for grades 9–10, subject-specific GPA for grades 9–10, gender (reference group, gender = 0, is male), race/ethnicity (reference group is white), and free/reduced lunch status. If a student received free/reduced lunch in any year in high school, this was set to 1. Otherwise, it was set to 0. If a student had multiple genders or race/ethnicities (other than missing) in his/her records, then his or her gender or race/ethnicity was set to missing.

## Procedures

For each subject area, two sets of analyses were completed for each of the four outcome variables: one using AP and DE participation groups as the key variable of interest, and one using AP and DE performance groups as the key variable of interest. The analyses involved a series of three multiple regression analyses including: (1) student covariates only (i.e., Model 1); (2) student covariates and AP and DE participation or performance group (i.e., Model 2); and (3) student covariates, AP and DE participation or performance group, and interactions between student variables and group membership (i.e., Model 3). Missing data were deleted listwise by default. Interactions were initially included in Model 3 in order to provide the most robust and thorough analyses, but were not of much interest theoretically. Interaction coefficients did not add practical value to the variance explained and therefore are not discussed here.

An example regression equation for Model 2 that includes both student covariates and an indicator for AP and DE participation groups using first-year college English GPA as the outcome variable is the following:

$$\text{English\_FYGPA}_i = b_0 + b_1 * \text{HS\_GPA\_9-10}_i + b_2 * \text{Percent\_honors\_plus}_i + b_3 * \text{English\_GPA\_9-10}_i + b_4 * \text{State\_math\_test}_i + b_5 * \text{State\_reading\_test}_i + b_6 * \text{Gender}_i + b_7 * \text{Lunch\_status}_i + b_8 * \text{Race=Asian}_i + b_9 * \text{Race=AfricanAmerican}_i + b_{10} * \text{Race=Hispanic}_i + b_{11} * \text{Race=Other}_i + b_{12} * \text{DualEnrollmentParticipation}_i + b_{13} * \text{APParticipation}_i + r_i.$$

An example of the same regression equation for Model 2 using performance groups as the key variable of interest is the following:

$$\text{English\_FYGPA}_i = b_0 + b_1 * \text{HS\_GPA\_9-10}_i + b_2 * \text{Percent\_honors\_plus}_i + b_3 * \text{English\_GPA\_9-10}_i + b_4 * \text{State\_math\_test}_i + b_5 * \text{State\_reading\_test}_i + b_6 * \text{Gender}_i + b_7 * \text{Lunch\_status}_i + b_8 * \text{Race=Asian}_i + b_9 * \text{Race=AfricanAmerican}_i + b_{10} * \text{Race=Hispanic}_i + b_{11} * \text{Race=Other}_i + b_{12} * \text{DualEnrollment\_GradeD-F}_i + b_{13} * \text{DualEnrollment\_GradeC}_i + b_{14} * \text{DualEnrollment\_GradeA-B}_i + b_{15} * \text{AP\_Exam1-2}_i + b_{16} * \text{AP\_Exam3}_i + b_{17} * \text{AP\_Exam4-5}_i + r_i.$$

To further interpret group comparisons when the outcome of interest was the performance groups, pairwise comparisons were conducted between the adjusted means for the groups, just like one would do within ANOVA and ANCOVA, but these were conducted within a regression framework by calculating the group intercepts and then using the intercepts to calculate the adjusted means. Group comparisons between the adjusted means were then calculated using Scheffé's method (see Pedhazur, 1997).

## Results

### Descriptives

The initial sample of students meeting study criteria was 97,205 students. Over half of the students in the sample were female (57.6%,  $n = 56,019$ ), and approximately 25.3% ( $n = 24,638$ ) of students received free/reduced lunch status at least once during their high school tenure. Table 1 lists the general breakdown of race/ethnicity in the base sample.

Race/Ethnicity	Percent
Missing	1.5%
Asian	3.2%
African American/Black	18.3%
Hispanic	14.6%
Other	0.4%
White	62.0%

The breakdown of race and gender may not strongly represent that of the state's entire high school cohorts due to sampling constraints. Information on those students who elected to pursue a private postsecondary education or higher education within another state is unknown. This base sample of students was used to create samples for each subject area: English, math (including computer science and statistics), science, and history.

## English Subject Area

A total of 74,884 students from the base sample were selected for the English sample. These students were categorized into three English participation groups: AP course and exam, DE course, and neither. AP English includes English Language and English Literature. The frequencies for each of these groups are presented in Table 2.

Participation Group	Percentage of Sample
Advanced Placement	14.2%
Dual Enrollment	8.2%
Neither	77.6%

These three participation groups were further defined by performance, and frequencies are listed in Table 3. One interesting result to note is that the majority of DE students received a grade of C or higher compared to a much smaller percentage of AP students earning a 3 or higher (only 56.0% of AP English students in the sample earned a 3 or higher on the exam, while 97.1% of DE students in the sample earned a final course grade of a C or higher.) This difference may have implications when comparing outcome variables between performance groups.

Group	Number of Students	Percentage of Participation Group	Percentage of Total English Sample
Neither	58,128	100%	77.6%
DE grade of D or F	177	2.9%	0.2%
DE grade of C	646	10.5%	0.9%
DE grade of A or B	5,331	86.6%	7.1%
AP score of 1 or 2	4,669	44.0%	6.2%
AP score of 3	3,732	35.2%	5.0%
AP score of 4 or 5	2,201	20.8%	2.9%

To understand the differences in academic achievement across the participation and performance groups before possible participation in AP or DE, the mean 10th-grade state assessment scores were calculated and are presented in Table 4. Students who participated in DE or AP English had a higher mean assessment score in both reading and math than students who did not, with AP students having the highest mean scores. Comparing performance groups, students who scored a 3 or higher on an AP English Exam had higher reading and math assessment scores than other students. Students who scored a 4 or 5 on the AP Exam had the highest mean assessment scores overall.

**Table 4.**

Mean 10th Grade State Assessment Scores by English Participation and Performance Group

Group	Reading Score	Math Score
<i>Participation</i>		
Neither	308.8	314.9
DE	337.6	340.1
AP	350.9	352.4
<i>Performance</i>		
DE grade D–F	333.0	334.6
DE grade C	324.0	330.3
DE grade A–B	339.4	341.5
AP score 1–2	336.4	339.7
AP score 3	357.2	358.0
AP score 4–5	371.1	370.1

Table 5 presents group means of the college outcomes for English, with standard deviations in parentheses. These results indicate that students with higher AP Exam scores in English have, on average and without taking group differences into account, higher first-year college English GPAs, higher final college English GPAs, graduate with a bachelor's degree in fewer terms, and earn a degree with fewer credit hours attempted at the institution.

<b>Table 5.</b>				
English Participation and Performance Group Means of Four Outcome Variables				
	First-Year GPA	Final GPA	Terms to Degree	Credits to Degree
<i>Participation</i>				
Neither	3.26 (0.69)	3.28 (0.61)	15.97 (3.95)	137.80 (23.22)
DE	3.31 (0.78)	3.39 (0.69)	14.04 (3.64)	137.89 (20.18)
AP	3.50 (0.61)	3.51 (0.56)	13.82 (3.05)	133.15 (21.0)
<i>Performance</i>				
DE grade D–F	---	---	16.79 (4.31)	139.51 (22.03)
DE grade C	3.06 (1.04)	3.08 (0.82)	15.61 (3.96)	141.64 (20.87)
DE grade A–B	3.34 (0.75)	3.41 (0.67)	13.89 (3.57)	137.61 (20.09)
AP score 1–2	3.43 (0.59)	3.41 (0.53)	14.52 (3.23)	137.04 (20.14)
AP score 3	3.58 (0.61)	3.57 (0.56)	13.57 (2.93)	131.73 (20.28)
AP score 4–5	3.64 (0.62)	3.64 (0.57)	13.02 (2.63)	128.60 (22.37)
Note: Missing values indicate fewer than 25 students with valid records. Standard deviations are in parentheses.				

In order to get a better idea of the impact of participation and performance in AP and dual-enrolled courses while controlling for relevant academic and demographic variables, a series of hierarchical regressions were calculated. Because interactions were not practically significant, only results from Model 2 are presented in Tables 6 and 7. Regression coefficients indicate the degree of change the outcome variable shows when changing the predictor variable by one unit, holding other variables constant. These values give an idea of the strength of the relationship between the predictors and the outcome. Only standardized coefficients significant at the 0.05 two-tailed alpha level are listed in the table, as well as R-square values to indicate model fit. Full regression model results for the English subject area are listed in Appendix A.

**Table 6.**

## English Participation Regression Results: Significant Standardized Coefficients

	First-Year English GPA	Final English GPA	Terms to Degree	Credits to Degree
Grades 9–10 GPA	0.10	0.11	-0.06	
Percent course work Honors+	0.10	0.09	-0.17	-0.04
Subject grades 9–10 GPA	0.15	0.16	-0.18	-0.10
10th-grade math assessment		0.03	-0.07	0.05
10th-grade reading assessment	0.07	0.07	-0.02	-0.05
Free/reduced lunch status			0.04	0.04
Gender	0.10	0.08	-0.08	-0.05
Race = Asian	-0.02		0.02	0.06
Race = African American/Black	-0.07	-0.09	-0.02	0.12
Race = Hispanic			0.03	0.04
AP participant	0.07	0.03		-0.07
DE participant	-0.06		-0.11	0.07
R-Square	0.144	0.163	0.194	0.051

**Table 7.**

## English Performance Regression Results: Significant Standardized Coefficients

	First-Year English GPA	Final English GPA	Terms to Degree	Credits to Degree
Grades 9–10 GPA	0.10	0.11	-0.06	
Percent course work Honors+	0.10	0.09	-0.17	-0.04
Subject grades 9–10 GPA	0.15	0.16	-0.18	-0.10
10th-grade math assessment		0.03	-0.07	0.05
10th-grade reading assessment	0.07	0.07	-0.02	-0.04
Free/reduced lunch status			0.04	0.04
Gender	0.10	0.08	-0.08	-0.05
Race = Asian	-0.02		0.02	0.06
Race = African American/Black	-0.07	-0.09	-0.02	0.12
Race = Hispanic			0.03	0.04
DE grade of C		-0.08		
DE grade of A–B			-0.13	0.08
AP score of 1–2	0.07			
AP score of 3	0.06			-0.07
AP score of 4–5				-0.11
R-Square	0.144	0.164	0.195	0.052

There were no significant effects found of earning a grade of D or F in dual-enrolled English, so this group has been removed completely from Table 7. In order to make group comparisons on the four outcome variables, adjusted means were calculated and compared using Scheffé's approach. Significant comparisons are presented in Table 8.

**Table 8.**

## Significant Pairwise Comparisons: English Performance Groups

Outcome	Group 1	Group 2	Group 1 – Group 2
First-Year English GPA	AP score of 1–2	DE grade of A–B	0.12
	AP score of 3	DE grade of A–B	0.13
Terms to Degree	AP score of 1–2	Neither	-0.37
	AP score of 1–2	DE grade of A–B	0.78
	AP score of 3	Neither	-0.50
	AP score of 3	DE grade of A–B	0.65
	AP score of 4–5	Neither	-0.52
	AP score of 4–5	DE grade of A–B	0.62
Credits to Degree	Neither	DE grade of A–B	-2.57
	AP score of 3	Neither	-2.24
	AP score of 3	DE grade of A–B	-4.81
	AP score of 3	AP score of 1–2	-2.90
	AP score of 4–5	Neither	-4.17
	AP score of 4–5	DE grade of C	-6.90
	AP score of 4–5	DE grade of A–B	-6.74
	AP score of 4–5	AP score of 1–2	-4.83

There were no significant differences between groups in final college English GPA, and only two significant comparisons among performance groups in first-year college English GPA. Students with AP Exam scores of 1, 2, or 3 tended to outperform dual-enrolled students with a course grade of A or B by a little over a tenth of a grade point. This means that, after accounting for previous course performance, state assessment scores in reading and math, gender, race, advanced course-taking, and so on, students who score a 1, 2, or 3 still outperform dual-enrolled students with a grade of A or B. One group that did not show a statistically significant higher first-year English GPA compared to the other groups was the AP students who scored a 4 or 5. A couple of reasons for why this may have happened are detailed in the Discussion section. English GPAs were calculated from grades in English, American and English literature, and composition courses.

When comparing performance groups on time and credits attempted to degree, a greater number of significant differences were found. AP students with a score of 1 or 2 on the exam tended to attempt more credits before degree attainment than AP students scoring a 3 or higher. AP students scoring at least a 3 on the exam graduated with fewer credits attempted than dual-enrolled students with a grade of A or B and students who did not take AP or dual-enrolled English in high school. Dual-enrolled English students with a course grade of A or B attempted significantly more credits, on average, than regular students.

Finally, comparing calendar terms to degree, once student background variables were taken into account, students at all five AP Exam score levels tended to take slightly longer (by less than one term) to graduate than students in dual-enrolled English with a course grade of A or B. Results and comparisons are explored further in the Discussion section.

## Math Subject Area

A total of 73,907 students were selected from the base sample for the math sample. Table 9 presents the percentage of students in the whole math sample by participation group. AP Math courses included Calculus AB, Calculus BC, Computer Science A, and Computer Science AB.

<b>Table 9.</b>	
Math Whole Sample Participation Frequencies	
Participation Group	Percentage of Sample
Advanced Placement	9.4%
Dual Enrollment	1.6%
Neither	88.9%

These three participation groups were further categorized into performance groups. Frequencies and percentages are presented in Table 10. As with English, students who participated in DE math received a grade of B or higher, whereas a smaller percentage of AP students earned a score of 3 or higher.

<b>Table 10.</b>			
Group Performance Frequencies			
Group	Number of Students	Percentage of Participation Group	Percentage of Total Math Sample
Neither	65,728	100%	88.9%
DE grade of D or F	97	8.0%	0.1%
DE grade of C	253	20.8%	0.3%
DE grade of A or B	865	71.2%	1.2%
AP score of 1 or 2	3,312	47.6%	4.5%
AP score of 3	1,686	24.2%	2.3%
AP score of 4 or 5	1,966	28.2%	2.7%

Like English, mean assessment scores were calculated to determine group differences before participation in AP, dual enrollment, or regular courses. These values are presented in Table 11. Similar to the English sample, students who participated in AP math and/or computer science had higher average 10th-grade state assessment scores in both reading and math than students who participated in dual-enrolled courses and students who did not participate in AP or DE courses.

**Table 11.**

Mean 10th Grade State Assessment Scores by Math Participation and Performance Group

Group	Reading Score	Math Score
<i>Participation</i>		
Neither	313.9	317.3
DE	342.5	352.6
AP	350.6	365.3
<i>Performance</i>		
DE grade D–F	330.3	339.9
DE grade C	333.9	346.2
DE grade A–B	346.4	355.9
AP score 1–2	344.3	355.7
AP score 3	352.6	368.7
AP score 4–5	359.6	378.7

Table 12 presents the performance group means for math, with standard deviations in parentheses. These results indicate that, on average, *without taking any group differences into account*, students with higher AP Exam scores in math had higher first-year and final college math GPAs and graduate with fewer credits attempted. Students with higher exam scores or better dual-enrolled course grades graduated in fewer calendar terms.

**Table 12.**

Math Participation and Performance Group Means of Four Outcome Variables

	First-Year GPA	Final GPA	Terms to Degree	Credits to Degree
<i>Participation</i>				
Neither	2.57 (1.05)	2.64 (0.87)	15.51 (3.95)	136.80 (22.68)
DE	2.78 (1.03)	2.84 (0.90)	13.33 (3.67)	140.46 (23.01)
AP	3.15 (0.86)	3.14 (0.76)	13.76 (2.89)	134.88 (21.24)
<i>Performance</i>				
DE grade D–F		2.43 (0.98)	14.12 (3.79)	144.58 (23.37)
DE grade C	2.45 (1.04)	2.58 (0.89)	14.09 (3.96)	141.47 (23.26)
DE grade A–B	2.87 (0.98)	2.93 (0.88)	13.09 (3.57)	139.86 (22.91)
AP score 1–2	3.00 (0.91)	3.01 (0.78)	14.04 (3.02)	136.04 (20.88)
AP score 3	3.21 (0.79)	3.18 (0.71)	13.69 (2.82)	134.89 (21.57)
AP score 4–5	3.33 (0.80)	3.32 (0.71)	13.37 (2.70)	133.10 (21.42)
Note: Missing values indicate fewer than 25 students with valid records. Standard deviations are presented in parentheses.				

Table 13 presents the coefficients from the regressions calculated using participation groups as well as the R-square values for model fit. Table 14 presents the standardized coefficients and R-square values from the models including performance groups. Like English, alpha levels were set at 0.05 and only significant coefficients are included. These coefficients are an indicator of the impact of the predictors on each of the outcome variables, holding all others constant. For full model results for math, see Appendix B.

<b>Table 13.</b>				
Math Participation Regression Results: Significant Standardized Coefficients				
	First-Year Math GPA	Final Math GPA	Terms to Degree	Credits to Degree
Grades 9–10 GPA	0.06	0.08	-0.14	-0.05
Percent course work Honors+	0.04	0.04	-0.18	-0.06
Subject grades 9–10 GPA	0.26	0.25	-0.09	-0.03
10th-grade math assessment	0.14	0.13	-0.05	0.05
10th-grade reading assessment	0.02	0.04	-0.05	-0.06
Free/reduced lunch status			0.04	0.04
Gender	0.06	0.08	-0.11	-0.06
Race = Asian			0.02	0.06
Race = African American/Black		-0.02	-0.02	0.12
Race = Hispanic			0.04	0.04
AP participant	0.12	0.10	0.09	-0.04
DE participant	-0.06	-0.06	-0.10	0.08
R-Square	0.209	0.215	0.180	0.046

<b>Table 14.</b>				
Math Performance Regression Results: Significant Standardized Coefficients				
	First-Year Math GPA	Final Math GPA	Terms to Degree	Credits to Degree
Grades 9–10 GPA	0.06	0.08	-0.14	-0.05
Percent course work Honors+	0.04	0.04	-0.18	-0.06
Subject grades 9–10 GPA	0.26	0.24	-0.09	-0.03
10th-grade math assessment	0.14	0.13	-0.05	0.05
10th-grade reading assessment	0.02	0.04	-0.05	-0.06
Free/reduced lunch status			0.04	0.04
Gender	0.06	0.08	-0.11	-0.06
Race = Asian			0.02	0.06
Race = African American/Black		-0.02	-0.02	0.12
Race = Hispanic			0.04	0.04
DE grade of D–F			-0.10	
DE grade of C			-0.06	
DE grade of A–B	-0.08	-0.06	-0.08	0.06
AP score of 1–2		0.06	0.08	-0.04
AP score of 3	0.07	0.07	0.08	-0.04
AP score of 4–5	0.07	0.10	0.08	-0.07
R-Square	0.209	0.216	0.180	0.046

Adjusted means were calculated using the results from the regression calculations, and pairwise comparisons of those means are presented in Table 15.

<b>Table 15.</b>			
<b>Significant Pairwise Comparisons: Math Performance Groups</b>			
<b>Outcome</b>	<b>Group 1</b>	<b>Group 2</b>	<b>Group 1 – Group 2</b>
First-Year Math GPA	AP score of 1–2	Neither	0.12
	AP score of 1–2	DE grade of A–B	0.26
	AP score of 3	Neither	0.17
	AP score of 3	DE grade of A–B	0.31
	AP score of 4–5	Neither	0.16
	AP score of 4–5	DE grade of A–B	0.30
Final Math GPA	AP score of 1–2	Neither	0.08
	AP score of 3	Neither	0.12
	AP score of 3	DE grade of A–B	0.22
	AP score of 4–5	Neither	0.15
	AP score of 4–5	DE grade of A–B	0.25
Terms to Degree	Neither	DE grade of A–B	1.14
	AP score of 1–2	DE grade of C	1.12
	AP score of 1–2	DE grade of A–B	1.22
	AP score of 3	DE grade of C	1.16
	AP score of 3	DE grade of A–B	1.26
	AP score of 4–5	DE grade of C	1.16
	AP score of 4–5	DE grade of A–B	1.26
Credits to Degree	DE grade of A–B	Neither	5.88
	DE grade of A–B	AP score of 1–2	4.23
	DE grade of A–B	AP score of 3	4.43
	DE grade of A–B	AP score of 4–5	5.90

For first-year college math GPA, AP students at all score levels outperformed their peers with dual-enrolled math course grades of A or B and students who took neither AP nor dual-enrolled math courses in high school. Comparing final college math GPA, AP students at all score levels had higher GPAs than regular students, and those with a score of 3 or higher in AP math outperformed their peers with dual enrollment course grades of A or B. Math GPAs were calculated from grades in mathematics, computer and information sciences, computer programming, and statistics courses.

When comparing credits taken to degree, math results were similar to English results. Dual-enrolled students with a grade of A–B took more credits before graduation than their peers in AP at all score levels and regular students who did not take AP or DE. These differences indicate that dual-enrolled math students with higher grades tend to take 1–2 more courses (i.e., 4–6 credit hours) before graduation than their AP and regular course-taking peers, once student background variables are taken into account.

After taking student background variables into account, DE students with a grade of A–B or C completed college, on average, one term faster than AP students. Dual-enrolled students with a grade of A or B also graduated over one term faster than regular students. These findings comparing AP and DE students are similar to those found in English, but are slightly larger here, indicating a slightly more intense effect in math and computer science. Implications from these results are discussed further in the Discussion section.

### Science Subject Area

A total of 73,884 students were selected from the base sample of all students to comprise the science whole sample. Table 16 presents the percentage of students in the whole science sample by participation group. AP Science courses included Biology, Chemistry, Environmental Science, Physics B, Physics C: Mechanics, and Physics C: Electricity and Magnetism.

<b>Table 16.</b>	
Science Whole Sample Participation Frequencies	
Participation Group	Percentage of Whole Sample
Advanced Placement	9.5%
Dual Enrollment	2.4%
Neither	88.1%

Frequencies and percentages for the seven participation and performance categories are listed in Table 17. Like English and math, the majority of dual-enrolled science students received a grade of B or higher whereas a much smaller percentage of AP students earned a score of 3 or higher.

<b>Table 17.</b>			
Science Group Performance Frequencies			
Group	Number of Students	Percentage of Participation Group	Percentage of Total Science Sample
Neither	65,106	100%	88.1%
DE grade of D or F	99	5.6%	0.1%
DE grade of C	325	18.3%	0.4%
DE grade of A or B	1,354	76.2%	1.8%
AP score of 1 or 2	4,319	61.7%	5.8%
AP score of 3	1,536	21.9%	2.1%
AP score of 4 or 5	1,145	16.4%	1.5%

Mean 10th-grade state assessment scores are presented in Table 18. Students who went on to take AP science courses and exams, as opposed to dual-enrolled or just regular courses, had the highest average reading and math scores.

**Table 18.**

Mean 10th Grade State Assessment Scores by Science Participation and Performance Group

Group	Reading Score	Math Score
<i>Participation</i>		
Neither	313.9	318.3
DE	338.3	342.1
AP	349.6	358.0
<i>Performance</i>		
DE grade D–F	322.1	327.6
DE grade C	326.0	331.3
DE grade A–B	342.4	345.8
AP score 1–2	342.4	349.6
AP score 3	358.0	367.1
AP score 4–5	365.3	377.3

Table 19 presents the performance group means of the four college outcome variables for science, with standard deviations in parentheses. On average, *without taking any group differences into account*, AP students have higher first-year and final science GPAs and graduate with fewer credits attempted to degree. Students who participated in dual-enrolled science courses graduated, on average, in the shortest time.

**Table 19.**

Science Participation and Performance Group Means of Four Outcome Variables

	First-Year GPA	Final GPA	Terms to Degree	Credits to Degree
<i>Participation</i>				
Neither	2.65 (0.96)	2.65 (0.85)	15.48 (3.91)	136.76 (22.64)
DE	2.73 (0.92)	2.75 (0.80)	13.36 (3.73)	138.98 (19.32)
AP	3.00 (0.82)	2.92 (0.75)	13.88 (3.07)	135.22 (22.16)
<i>Performance</i>				
DE grade D–F			15.33 (4.33)	142.54 (19.33)
DE grade C	2.17 (1.10)	2.27 (0.90)	14.06 (4.25)	139.48 (20.34)
DE grade A–B	2.83 (0.86)	2.84 (0.75)	13.17 (3.57)	138.77 (19.13)
AP score 1–2	2.85 (0.85)	2.79 (0.77)	14.24 (3.21)	136.67 (21.58)
AP score 3	3.02 (0.79)	3.00 (0.71)	13.46 (2.75)	133.90 (22.50)
AP score 4–5	3.35 (0.67)	3.25 (0.62)	13.24 (2.80)	132.23 (23.17)

Note: Missing values indicate fewer than 25 students with valid records.

Table 20 presents the significant standardized coefficients and R-square estimates from the regressions calculated using participation groups. Table 21 presents the significant standardized coefficients and R-square estimates from the models including performance groups. Alpha levels were set at 0.05. Full model results are listed in Appendix C.

<b>Table 20.</b>				
Science Participation Regression Results: Significant Standardized Coefficients				
	First-Year Science GPA	Final Science GPA	Terms to Degree	Credits to Degree
Grades 9–10 GPA	0.10	0.07	-0.15	-0.04
Percent course work Honors+	0.09	0.07	-0.18	-0.06
Subject grades 9–10 GPA	0.17	0.18	-0.07	-0.03
10th-grade math assessment	0.09	0.08	-0.06	0.05
10th-grade reading assessment	0.08	0.09	-0.05	-0.06
Free/reduced lunch status		0.03	0.04	0.05
Gender		0.02	-0.11	-0.06
Race = Asian		-0.03	0.02	0.06
Race = African American/Black	-0.09	-0.10	-0.02	0.12
Race = Hispanic	0.07	0.05	0.03	0.04
AP participant	0.05		0.08	-0.02
DE participant	-0.05		-0.11	0.06
R-Square	0.194	0.167	0.182	0.046

<b>Table 21.</b>				
Science Performance Regression Results: Significant Standardized Coefficients				
	First-Year Science GPA	Final Science GPA	Terms to Degree	Credits to Degree
Grades 9–10 GPA	0.10	0.07	-0.15	-0.04
Percent course work Honors+	0.09	0.07	-0.18	-0.06
Subject grades 9–10 GPA	0.17	0.17	-0.07	-0.03
10th-grade math assessment	0.09	0.08	-0.06	0.05
10th-grade reading assessment	0.08	0.08	-0.05	-0.06
Free/reduced lunch status		0.03	0.04	0.05
Gender		0.02	-0.11	-0.06
Race = Asian		-0.03	0.02	0.06
Race = African American/Black	-0.09	-0.10	-0.02	0.12
Race = Hispanic	0.07	0.05	0.03	0.04
DE grade of D–F				
DE grade of C		-0.15	-0.10	
DE grade of A–B			-0.11	0.06
AP score of 1–2			0.09	
AP score of 3			0.04	
AP score of 4–5	0.16	0.11	0.06	-0.06
R-Square	0.196	0.169	0.182	0.046

Adjusted means were calculated using the results from the regression calculations, and pairwise comparisons of those means are presented in Table 22.

<b>Table 22.</b>			
<b>Significant Pairwise Comparisons: Science Performance Groups</b>			
<b>Outcome</b>	<b>Group 1</b>	<b>Group 2</b>	<b>Group 1 – Group 2</b>
First-Year Science GPA	AP score of 4–5	Neither	0.16
Final Science GPA	AP score of 4–5	Neither	0.14
	AP score of 4–5	DE grade of C	0.47
	AP score of 4–5	AP score of 1–2	0.18
Terms to Degree	Neither	DE grade of C	1.39
	Neither	DE grade of A–B	1.33
	AP score of 1–2	DE grade of C	1.43
	AP score of 1–2	DE grade of A–B	1.37
	AP score of 3	DE grade of C	1.23
	AP score of 3	DE grade of A–B	1.17
	AP score of 4–5	DE grade of C	1.37
	AP score of 4–5	DE grade of A–B	1.30
Credits to Degree	DE grade of A–B	Neither	4.77
	DE grade of A–B	AP score of 3	4.28
	DE grade of A–B	AP score of 4–5	5.33
	AP score of 1–2	Neither	2.02

Comparing first-year science GPA, AP students with exam scores of 4–5 outperformed regular students, even after variables were taken into account. With final science GPA, AP 4–5 students also outperformed regular students, AP students with exam scores of 1–2, and dual-enrolled students with a grade of C. College science GPAs were calculated using grades from biology and biological sciences, biophysics, chemistry, environmental science, and physics courses.

Results indicated that AP science students with exam scores of 1–2 took a couple more credits, on average, before graduating than students who did not take AP or DE science courses, once background variables were taken into account. Dual-enrolled science students with course grades of A–B tended to take more credits than their peers in regular high school courses, as well as AP science students with exam scores of 3 or higher. These results are similar to those found with English and math.

Comparing calendar terms to degree completion, science results show that, like English and math, dual-enrolled students tend to graduate quickest when all other background variables are taken into account. Adjusted means show that DE students with course grades of C or better graduate in fewer calendar terms than regular and AP students, with all comparisons showing a difference of less than 1.5 terms. These implications are discussed along with those for English and math in the Discussion section.

### History Subject Area

A total of 75,203 students were selected for the history sample. Table 23 presents the percentage of students in the history sample by participation group.

**Table 23.**

## History Whole Sample Participation Frequencies

Participation Group	Percentage of Whole Sample
Advanced Placement	12.1%
Dual Enrollment	3.6%
Neither	84.3%

Frequencies and percentages for the seven participation and performance categories are listed in Table 24. History students who took dual-enrolled courses were more likely to receive a higher grade (i.e., A or B) than lower. A much smaller percentage of AP history students earned a 3 or higher on the exam. Like English, math, and science, these findings may have implications later on.

**Table 24.**

## History Group Performance Frequencies

Group	Number of Students	Percentage of Participation Group	Percentage of Total History Sample
Neither	63,388	100%	84.3%
DE grade of D or F	76	2.8%	0.1%
DE grade of C	318	11.6%	0.4%
DE grade of A or B	2,346	85.6%	3.1%
AP score of 1 or 2	5,239	57.7%	7.0%
AP score of 3	2,250	24.8%	3.0%
AP score of 4 or 5	1,586	17.5%	2.1%

Mean 10th-grade state assessment scores are presented in Table 25. AP history students had the highest mean scores, even students who scored a 1 or 2 on the exam.

**Table 25.**

## Mean 10th Grade State Assessment Scores by History Participation and Performance Group

Group	Reading Score	Math Score
<i>Participation</i>		
Neither	311.6	317.2
DE	340.5	341.3
AP	351.2	354.8
<i>Performance</i>		
DE grade D–F	316.5	321.9
DE grade C	330.0	330.8
DE grade A–B	342.7	343.4
AP score 1–2	342.8	347.6
AP score 3	359.5	361.2
AP score 4–5	367.5	369.6

Table 26 presents the performance group means of the four college outcome variables for history, with standard deviations in parentheses. On average, without taking any group differences into account, AP students have the fewest credits attempted to degree, and graduate in fewer calendar terms, with a higher history GPA both in the first year and final year. Students with higher AP history scores have the highest GPAs and graduate with the fewest credits and in the fewest terms.

<b>Table 26.</b>				
History Participation and Performance Group Means of Four Outcome Variables				
	<b>First-Year GPA</b>	<b>Final GPA</b>	<b>Terms to Degree</b>	<b>Credits to Degree</b>
<i>Participation</i>				
Neither	2.81 (0.91)	2.89 (0.80)	15.63 (3.92)	137.45 (22.77)
DE	2.85 (0.93)	2.98 (0.88)	13.92 (3.81)	138.76 (20.47)
AP	3.18 (0.80)	3.17 (0.76)	13.81 (3.14)	133.41 (21.91)
<i>Performance</i>				
DE grade D–F				
DE grade C		2.52 (0.90)	15.35 (4.33)	140.26 (20.50)
DE grade A–B	2.94 (0.86)	3.03 (0.86)	13.76 (3.71)	138.59 (20.52)
AP score 1–2	3.06 (0.83)	3.07 (0.77)	14.29 (3.28)	136.08 (20.94)
AP score 3	3.34 (0.70)	3.29 (0.71)	13.45 (2.95)	131.56 (22.20)
AP score 4–5	3.52 (0.63)	3.43 (0.66)	12.98 (2.73)	128.52 (23.06)
Note: Missing values indicate fewer than 25 students with valid records.				

Table 27 presents the statistically significant coefficients and R-square estimates from the regressions calculated using participation groups. Table 28 presents the significant standardized coefficients and R-square estimates from the models including performance groups. Alpha levels were set at 0.05. For full model results, see Appendix D.

<b>Table 27.</b>				
History Participation Regression Results: Significant Standardized Coefficients				
	First-Year History GPA	Final History GPA	Terms to Degree	Credits to Degree
Grades 9–10 GPA	0.11	0.13	-0.14	-0.04
Percent course work Honors+	0.06	0.05	-0.17	-0.04
Subject grades 9–10 GPA	0.13	0.10	-0.09	-0.04
10th-grade math assessment			-0.07	0.05
10th-grade reading assessment	0.13	0.12	-0.03	-0.05
Free/reduced lunch status			0.04	0.05
Gender		0.02	-0.11	-0.06
Race = Asian			0.02	0.06
Race = African American/Black	0.08		-0.02	0.12
Race = Hispanic		0.04	0.03	0.04
AP participant	0.15	0.09		-0.09
DE participant	-0.06		-0.07	0.08
R-Square	0.125	0.112	0.183	0.047

<b>Table 28.</b>				
History Performance Regression Results: Significant Standardized Coefficients				
	First-Year GPA	Final GPA	Terms to Degree	Credits to Degree
Grades 9–10 GPA	0.11	0.13	-0.14	-0.04
Percent course work Honors+	0.06	0.05	-0.16	-0.03
Subject grades 9–10 GPA	0.12	0.10	-0.08	-0.04
10th-grade math assessment			-0.07	0.05
10th-grade reading assessment	0.12	0.12	-0.03	-0.05
Free/reduced lunch status			0.04	0.05
Gender		0.03	-0.11	-0.06
Race = Asian			0.02	0.06
Race = African American/Black	0.08	0.02	-0.02	0.12
Race = Hispanic		0.04	0.03	0.04
DE grade of D–F				
DE grade of C	-0.20	-0.19		
DE grade of A–B			-0.09	0.10
AP score of 1–2				
AP score of 3	0.18	0.11		-0.08
AP score of 4–5	0.23	0.13		-0.13
R-Square	0.128	0.114	0.183	0.049

Adjusted means were calculated using the results from the regression calculations, and pairwise comparisons of those means are presented in Table 29. Implications from these findings are discussed in detail in the Discussion section.

<b>Table 29.</b>			
<b>Significant Pairwise Comparisons: History Performance Groups</b>			
<b>Outcome</b>	<b>Group 1</b>	<b>Group 2</b>	<b>Group 1 – Group 2</b>
First-Year History GPA	AP score of 1–2	Neither	0.16
	AP score of 3	Neither	0.31
	AP score of 4–5	DE grade of A–B	0.40
	AP score of 4–5	AP score of 1–2	0.25
Final History GPA	AP score of 3	Neither	0.20
	AP score of 3	DE grade of C	0.52
	AP score of 4–5	Neither	0.25
	AP score of 4–5	DE grade of C	0.58
	AP score of 4–5	DE grade of A–B	0.23
	AP score of 4–5	AP score of 1–2	0.16
Terms to Degree	Neither	DE grade of A–B	0.96
	Neither	AP score of 3	0.48
	Neither	AP score of 4–5	0.56
	AP score of 1–2	DE grade of A–B	0.73
	AP score of 3	DE grade of A–B	0.48
Credits to Degree	Neither	AP score of 3	3.22
	Neither	AP score of 4–5	5.50
	DE grade of C	AP score of 4–5	8.38
	DE grade of A–B	Neither	3.95
	DE grade of A–B	AP score of 1–2	3.93
	DE grade of A–B	AP score of 3	7.17
	DE grade of A–B	AP score of 4–5	9.45
	AP score of 1–2	AP score of 3	3.24
	AP score of 1–2	AP score of 4–5	5.52

College history course grades saw a similar trend to the other subjects. AP students with a score of 1, 2, or 3 had a significantly higher first-year history GPA than regular students who took neither AP nor DE history courses in high school. Students with higher AP history exam scores of 4 or 5 had significantly higher first-year course grades than AP students with a score of 1 or 2 and dual-enrolled students with a course grade of A or B, once background variables were taken into account. Comparing final college history course GPA, AP students with exam scores of 3 or higher tended to fare better than other students. Students with an AP Exam score of 3 outperformed dual-enrolled students with a course grade of C and regular students in college history courses. AP history exam takers with a score of 4 or 5 outperformed those same students, as well as dual-enrolled students with course grades of A–B and AP students with exam scores of 1–2. College history GPAs were calculated using history courses and the more specific courses noted as African history, American history, Asian history, European history, world history, and Latin American history.

Comparing credits taken to degree, once background variables were accounted for, AP students tended to attempt fewer credits, on average, than the other performance groups.

Like the previous subjects showed, regular students who took neither AP nor DE history courses in high school tended to take more credits than AP students with exam scores of 3 or higher, with differences between one and two courses, assuming a standard 3-credit-hour structure. Dual-enrolled history students with course grades of A–B took, on average, one to three more courses than AP students, with AP history students with scores of 4–5 attempting the fewest credit hours before graduation.

In history, calendar-terms-to-degree results appeared relatively similar to the other subject areas. Students who did not take any AP or DE history courses in high school tended to take at least a half term longer to graduate, on average, once background variables were taken into account, than students who were dual-enrolled with course grades of A–B and AP students with exam scores of 3 or higher. Dual-enrolled history students with course grades of A–B graduated, on average, one-half to three-quarters of a term quicker than AP history students with exam scores of 3 or lower. Implications of these findings, as well as possible reasons for the dissonance between credits to degree and terms to degree, are discussed further in the following section.

## Discussion

Although the samples were different for each subject area, several differences among participation and performance groups were constant across all four subject areas. The majority of students who took dual-enrolled courses received final course grade of A or B (possibly entitling them to college credit), while much smaller percentages of AP students earned a 3 or higher on the exam. However, in terms of academic ability, AP students had the highest mean state assessment scores in math and reading, followed by dual-enrolled students, indicating that higher ability students were more inclined to take Advanced Placement than dual enrollment or regular courses. This has implications when comparing outcome variables, as groups were not randomly equivalent before course choice and participation.

Comparing group means for each of the four outcome variables, AP students had the most positive outcomes: higher first-year and final subject-specific GPAs, fewer credits attempted to degree, and fewer calendar terms to degree. However, because these means do not take into account inherent group differences on various student background characteristics, it is difficult to directly attribute outcome differences to course participation and performance. For this reason, regression models were estimated to compare groups on the outcome variables with covariates included to explain preexisting group differences and, theoretically, remove their effects from analyses.

Regression results indicated that group differences did exist on the college outcomes even after controlling for relevant characteristics. Regression models included student background variables, meaning the presented effects of performance group membership are above and beyond any differences between the groups, including state assessment scores, grades 9–10 GPAs in the given subject area, percent of high school course work taken at an advanced level, race, gender, and so on. Although participation group differences were presented in this study, performance results provide a clearer insight into those differences. In general, higher AP scores were associated with higher first-year and final grades in the same subject area with the exception of English, where higher performance in dual-enrolled courses did not show the same trends of positive effects when compared to lower course performance, perhaps because DE course grades tended to show little to no variability. Overall, it appears that higher performing AP examinees have higher first-year and final subject-specific college grades than their dual-enrolled peers.

In English, final college English GPA had no significant differences among performance groups once background variables were taken into account, and first-year GPA had only a couple of significant differences for AP students scoring a 1, 2, or 3. Because English tends to be a general education course with requirements for all majors, this subject may perform slightly differently than others. Students with high AP scores and high DE grades may have received credit for first-year composition courses, thus fulfilling a requirement and resulting in no further English courses taken. Students in this scenario would not be included in the English sample for comparisons. In addition, courses in strongly related subjects such as journalism and mass communications were not included in this study, and may have been another option for exploring the skills and subsequent academic performance of these students. Results from the other three subjects were similar to previous research findings that AP students tend to outperform their peers in both first-year and final college academic outcomes.

Higher AP Exam scores were also associated with fewer credit hours taken to bachelor's degree. In all four subject areas, after adjusting for background student variables, AP students with exam scores of 4–5 take fewer credits to graduate than other groups, including dual-enrolled students with course grades of A–B. These differences range from 5.33 credit hours to 9.45, meaning that AP students with scores of 4–5 tend to take two to three standard 3-hour courses fewer than their peers with grades of A–B in dual enrollment courses. Differences between students with AP scores of 3 or higher and regular students who did not take AP or DE courses in the subject area are intuitive, as it is likely students with higher AP Exam scores were awarded credits toward graduation requirements. In fact, these results differ from previous research, which found that AP takers tend to make more credit hours in college than dual-enrolled students (Hargrove et al., 2008; Murphy & Dodd, 2009), likely due to different AP credit-granting policies in place. However, dual-enrolled students with course grades of A–B are also likely to be awarded credits toward a degree, and means adjusted for various background variables indicate that they still take more credit hours to degree than their peers in AP. One potential reason for these differences could be choice of majors. AP students may be less likely to change majors, or more likely to declare earlier and thus establish a course plan earlier, than non-AP students. Future research could explore the role of AP and DE in the choice of (and propensity to change) major.

Among students who graduated with a bachelor's degree within six years, those who were dual enrolled tended to graduate in the shortest time, followed by AP and regular students who did not participate in AP or DE in high school. With the exception of the history subject area, dual-enrolled students with course grades of A–B graduate in significantly fewer calendar terms than students with AP Exam scores of 4–5. These differences range from 0.62 to 1.30, meaning that, on average, DE students with grades of A–B graduate a half-term to over one term quicker than AP students with exam scores of 4–5. In history, dual-enrolled students with grades of A–B graduated in fewer terms than AP students with exam scores of 3 or below, but differences were not significant with AP Exam scores of 4–5. These findings are somewhat perplexing but, as mentioned earlier, AP students may be less likely to change major, transfer institutions, or fail course work. Future research should explore these aspects of higher education. There are several contextual notes to keep in mind when interpreting differences in terms to degree. There is a statewide scholarship program in place in this state that provides students with college funding for up to seven years or a certain number of accumulated credit hours as long as they meet certain GPA requirements. Therefore, students with higher GPAs experience some small incentive in the form of financial support to remain in school and either take more advanced courses before graduation or a reduced course load

each term. There is also a statewide requirement for summer school credits that may play a role in the number of terms to graduation if students delay summer school until their final year of college education.

This study had a few additional limitations. First, there was no accounting for college course levels when calculating first-year and final college subject GPAs. For example, some students may have been enrolled in introductory courses while other students were taking more advanced course work. These differences were not specified in the model and may be of some interest in comparing differences between performance groups. Second, DE students in one subject area may be taking AP courses in another subject and vice versa; therefore, it is difficult to attribute specific effects within subject area when looking at overall outcomes like credit hours and calendar terms to degree. Follow-up research could investigate the overall impact of participation and performance in AP, DE, and both across subject areas on graduation and time to degree. Third, postsecondary school selectivity was also not included in the models but would be interesting for future research. Therefore, differences between colleges and universities the students attended may have played a role in course grades, time to graduation, and credits that could be inadvertently attributed to group membership, particularly if different performance groups were more or less likely to attend different institutions with different academic selectivity and expectations. A final limitation to the approach presented here is that AP and dual enrollment credit-granting policies vary across schools. Those differences were not available; therefore they could not be controlled for within our analyses.

Future research comparing dual enrollment and AP performance groups on college outcomes should consider taking several things into account: school choice, course load per semester, major selection, and advanced course-taking. This study was unique in that it took students' course and exam performance into account to better understand outcomes. However, it may be interesting to explore the postsecondary choices made by students of varying performance in these programs. As mentioned previously, students who are offered course credit by way of AP Exam scores or dual-enrolled course grades may choose to take a relaxed course load while enrolled in college. It may be valuable to determine if students are electing to take fewer courses rather than reducing the number of terms they are enrolled in college. Exploring course loads may help researchers support institutions' understanding of their students' pathways to graduation.

In summary, results from this study agree with previous research suggesting that there are benefits to participating in college credit-offering programs like Advanced Placement and dual enrollment courses. Higher performance on AP Exams was positively related to higher college performance in the subject area, as well as fewer credit hours taken to bachelor's degree. Most dual enrollment students earned a grade of C or better, and higher performers tended to graduate college in fewer calendar terms than other groups. This study adds unique information to the field by studying AP and dual enrollment effects, not only taking performance in those courses/exams into account, but also considering other student background variables that may play a role in selection into those course types, and lends support to the notion that taking more advanced, rigorous course work in high school, and performing well in those courses, leads to positive college outcomes.

## References

- Burnham, P. S., & Hewitt, B. A., (1971). Advanced Placement scores: Their predictive validity. *Educational and Psychological Measurement*, 31(4), 939–945.
- Chajewski, M., Mattern, K. D., & Shaw, E. J. (2011). AP participation and college enrollment. *Educational Measurement: Issues and Practice*, 30(4), 16–27.
- College Board. (2013). *The 9th annual AP report to the nation*. New York: The College Board.
- Dodd, B. G., Fitzpatrick, S. J., De Ayala, R. J., & Jennings, J. A. (2002). *An investigation of the validity of the AP grades of 3 and a comparison of AP and non-AP student groups* (College Board Research Report No. 2002-9). New York: The College Board.
- Doherty, C., Mellor, L., & Jian, S. (2006). *The relationship between Advanced Placement and college graduation* (National Center for Educational Accountability: 2005 AP Study Series, Report 1). Austin, Texas: National Center for Educational Accountability.
- Duffy II, W. R. (2010). Persistence and performance at a four-year university: The relationship with advanced coursework during high school. In P. M. Sadler, G. Sonnert, R. H. Tai, & K. Klopfenstein (Eds.), *AP: A critical examination of the Advanced Placement Program* (pp. 139–163). Cambridge, MA: Harvard Education Press.
- Eimers, M. T., & Mullen, R. (2003). Dual credit and Advanced Placement: Do they help prepare students for success in college? Paper presented at the Association for Institutional Research Fall Conference, Tampa, FL.
- Ewing, M. (2006). *The AP Program and student outcomes: A summary of research* (College Board Research Notes, RN-29, November 2006). New York: The College Board.
- Ewing, M., Huff, K., & Kaliski, P. (2010). Validating AP Exam scores: Current research and new directions. In P. M. Sadler, G. Sonnert, R. H. Tai, & K. Klopfenstein (Eds.), *AP: A critical examination of the Advanced Placement Program* (pp. 85–106). Cambridge, MA: Harvard Education Press.
- Florida Department of Education Office of Articulation. (2013). *Comparison of Florida's articulated acceleration programs*. Retrieved June 1, 2013, from <http://www.fldoe.org/articulation/pdf/cfaap.pdf>.
- Geiser, S., & Santelices, V. (2004). *The role of Advanced Placement and honors courses in college admissions*. Berkeley, CA: Center for Studies in Higher Education, University of California, Berkeley. Retrieved February 9, 2011, from <http://cshe.berkeley.edu/publications/docs/ROP.Geiser.4.04.pdf>
- Hargrove, L., Godin, D., & Dodd, B. (2008). *College outcomes comparisons by AP and non-AP high school experiences* (College Board Research Report No. 2008-03). New York: The College Board.
- Karp, M. M., Calcagno, J. C., Hughes, K. L., Jeong, D. W., & Bailey, T. R. (2007). *The postsecondary achievement of participants in dual enrollment: An analysis of student outcomes in two states*. St. Paul, MN: National Research Center for Career and Technical Education, University of Minnesota.
- Keng, L., & Dodd, B. G. (2008). *A comparison of college performances of AP and non-AP student groups in 10 subject areas* (College Board Research Report No. 2008-7). New York: The College Board.
- Klopfenstein, K. (2010). Does the Advanced Placement Program save taxpayers money? In P. M. Sadler, G. Sonnert, R. H. Tai, & K. Klopfenstein (Eds.), *AP: A critical examination of the Advanced Placement Program* (pp.189–218). Cambridge, MA: Harvard Education Press.

- Mattern, K. D., Shaw, E. J., & Xiong, X. (2009). *The relationship between AP Exam performance and college outcomes* (College Board Research Report No. 2009-4). New York: The College Board.
- Morgan, R., & Ramist, L. (1998). *Advanced Placement students in college: An investigation of course grades at 21 colleges* (ETS Statistical Report No. 98-13). Princeton, NJ: Educational Testing Service.
- Murphy, D., & Dodd, B. (2009). *A comparison of college performance of matched AP and non-AP student groups* (College Board Research Report No. 2009-6). New York: The College Board.
- O'Brien, D. M., & Nelson, T. D. (2004). *Strengthening college preparation and access through concurrent enrollment in high school and community college* (State of Texas Education Research Center Working Paper). Dallas: The University of Texas at Dallas.
- O'Keefe, L., Hayes, D., Easton-Brooks, D., & Johnson, T. (2010). Advanced Placement, dual credit, and four-year college graduation. *Enrollment Management Journal*, 4(3), 69–88.
- Pedhazur, E. J. (1997). *Multiple regression in behavioral research: Explanation and prediction*. Belmont, CA: Wadsworth Publishing.
- Speroni, C. (2011)<sup>a</sup>. *Determinants of students' success: The role of Advanced Placement and dual enrollment programs* (National Center for Postsecondary Research Working Paper). New York: The National Center for Postsecondary Research.
- Speroni, C. (2011)<sup>b</sup>. *High school dual enrollment programs: Are we fast-tracking students too fast?* (National Center for Postsecondary Research Working Paper). New York: The National Center for Postsecondary Research.
- Struhl, B., & Vargas, J. (2012). *Taking college courses in high school: A strategy for college readiness* (Jobs for the Future Research Report, October 2012). Boston: Jobs for the Future.
- Thomas, N., Marken, S., Gray, L., & Lewis, L. (2013). *Dual credit and exam-based courses in U.S. public high schools: 2010-11* (NCES 2013-001). U.S. Department of Education. Washington, DC: National Center for Education Statistics. Retrieved September 17, 2013, from <http://nces.ed.gov/pubs2013/2013001.pdf>.
- Waits, T., Setzer, J. C., & Lewis, L. (2005). *Dual credit and exam-based courses in U.S. public high schools: 2002-03* (NCES 2005-009). U.S. Department of Education. Washington, DC: National Center for Education Statistics. Retrieved September 17, 2013, from <http://nces.ed.gov/pubs2005/2005009.pdf>.
- Willingham, W. W., & Morris, M. (1986). *Four years later: A longitudinal study of Advanced Placement students in college* (College Board Research Report No. 86-2). New York: The College Board.

## Appendix A: English Regression Results

<b>Table A1.</b>					
English Participation Regression Results: First Year College English GPA					
	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	1.227	0.093		13.158	<0.001
Grades 9–10 GPA	0.165	0.020	0.104	8.257	<0.001
Percent course work Honors+	0.462	0.048	0.097	9.540	<0.001
English grades 9–10 GPA	0.219	0.017	0.152	12.546	<0.001
10th-grade math assessment	0.000	0.000	0.016	1.399	0.162
10th-grade reading assessment	0.002	0.000	0.067	6.641	<0.001
Gender	0.142	0.012	0.101	11.906	<0.001
Free/reduced lunch status	-0.018	0.016	-0.010	-1.139	0.255
Race = Asian	-0.079	0.027	-0.024	-2.957	0.003
Race = African American/Black	-0.116	0.017	-0.066	-6.897	<0.001
Race = Hispanic	-0.017	0.019	-0.008	-0.898	0.369
AP English participant	0.057	0.011	0.074	5.012	<0.001
DE English participant	-0.069	0.016	-0.059	-4.254	<0.001

<b>Table A2.</b>					
English Performance Regression Results: First Year College English GPA					
	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	1.212	0.099		12.264	<0.001
Grades 9–10 GPA	0.165	0.020	0.104	8.243	<0.001
Percent course work Honors+	0.462	0.048	0.097	9.547	<0.001
English grades 9–10 GPA	0.219	0.018	0.152	12.445	<0.001
10th-grade math assessment	0.000	0.000	0.016	1.421	0.155
10th-grade reading assessment	0.002	0.000	0.068	6.634	<0.001
Gender	0.141	0.012	0.101	11.871	<0.001
Free/reduced lunch status	-0.018	0.016	-0.010	-1.139	0.255
Race = Asian	-0.080	0.027	-0.024	-2.964	0.003
Race = African American/Black	-0.116	0.017	-0.066	-6.884	<0.001
Race = Hispanic	-0.017	0.019	-0.008	-0.910	0.363
DE English grade of D–F	-0.047	0.151	-0.032	-0.311	0.756
DE English grade of C	-0.102	0.073	-0.072	-1.396	0.163
DE English grade of A–B	-0.056	0.035	-0.048	-1.602	0.109
AP English score of 1–2	0.068	0.031	0.073	2.193	0.028
AP English score of 3	0.069	0.033	0.065	2.100	0.036
AP English score of 4–5	0.049	0.039	0.039	1.249	0.212

**Table A3.**

## English Participation Regression Results: Final College English GPA

	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	1.392	0.069		20.215	<0.001
Grades 9–10 GPA	0.154	0.015	0.113	10.152	<0.001
Percent course work Honors+	0.362	0.037	0.088	9.795	<0.001
English grades 9–10 GPA	0.197	0.013	0.158	14.968	<0.001
10th-grade math assessment	0.001	0.000	0.027	2.741	0.006
10th-grade reading assessment	0.001	0.000	0.075	8.375	<0.001
Gender	0.097	0.009	0.077	10.652	<0.001
Free/reduced lunch status	-0.011	0.013	-0.006	-0.837	0.402
Race = Asian	-0.037	0.021	-0.012	-1.759	0.079
Race = African American/Black	-0.145	0.013	-0.088	-10.923	<0.001
Race = Hispanic	0.011	0.015	0.006	0.781	0.435
AP English participant	0.023	0.008	0.034	2.877	0.004
DE English participant	-0.018	0.010	-0.019	-1.714	0.087

**Table A4.**

## English Performance Regression Results: Final College English GPA

	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	1.404	0.073		19.240	<0.001
Grades 9–10 GPA	0.155	0.015	0.113	10.174	<0.001
Percent course work Honors+	0.363	0.037	0.088	9.803	<0.001
English grades 9–10 GPA	0.195	0.013	0.156	14.674	<0.001
10th-grade math assessment	0.001	0.000	0.027	2.702	0.007
10th-grade reading assessment	0.001	0.000	0.074	8.255	<0.001
Gender	0.096	0.009	0.077	10.608	<0.001
Free/reduced lunch status	-0.010	0.013	-0.006	-0.819	0.413
Race = Asian	-0.036	0.021	-0.012	-1.733	0.083
Race = African American/Black	-0.145	0.013	-0.088	-10.874	<0.001
Race = Hispanic	0.011	0.015	0.006	0.781	0.435
DE English grade of D–F	0.064	0.105	0.051	0.608	0.543
DE English grade of C	-0.105	0.049	-0.085	-2.150	0.032
DE English grade of A–B	-0.014	0.023	-0.015	-0.614	0.539
AP English score of 1–2	0.016	0.022	0.018	0.710	0.478
AP English score of 3	0.029	0.023	0.032	1.287	0.198
AP English score of 4–5	0.018	0.026	0.017	0.706	0.480

**Table A5.**

## English Participation Regression Results: Calendar Terms to Degree

	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	25.742	0.327		78.737	<0.001
Grades 9–10 GPA	-0.455	0.074	-0.056	-6.145	<0.001
Percent course work Honors+	-4.217	0.185	-0.169	-22.751	<0.001
English grades 9–10 GPA	-1.330	0.064	-0.179	-20.735	<0.001
10th-grade math assessment	-0.009	0.001	-0.071	-8.702	<0.001
10th-grade reading assessment	-0.002	0.001	-0.019	-2.550	0.011
Gender	-0.655	0.045	-0.083	-14.516	<0.001
Free/reduced lunch status	0.411	0.063	0.040	6.516	<0.001
Race = Asian	0.332	0.108	0.017	3.090	0.002
Race = African American/Black	-0.242	0.069	-0.022	-3.529	<0.001
Race = Hispanic	0.375	0.073	0.030	5.151	<0.001
AP English participant	0.072	0.040	0.016	1.809	0.070
DE English participant	-0.584	0.044	-0.108	-13.321	<0.001

**Table A6.**

## English Performance Regression Results: Calendar Terms to Degree

	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	25.713	0.345		74.479	<0.001
Grades 9–10 GPA	-0.469	0.074	-0.058	-6.326	<0.001
Percent course work Honors+	-4.214	0.185	-0.169	-22.735	<0.001
English grades 9–10 GPA	-1.301	0.065	-0.175	-20.057	<0.001
10th-grade math assessment	-0.009	0.001	-0.070	-8.567	<0.001
10th-grade reading assessment	-0.002	0.001	-0.018	-2.385	0.017
Gender	-0.656	0.045	-0.083	-14.548	<0.001
Free/reduced lunch status	0.409	0.063	0.039	6.476	<0.001
Race = Asian	0.330	0.108	0.017	3.065	0.002
Race = African American/Black	-0.244	0.069	-0.022	-3.557	<0.001
Race = Hispanic	0.377	0.073	0.030	5.166	<0.001
DE English grade of D–F	0.810	0.470	0.103	1.725	0.085
DE English grade of C	-0.351	0.214	-0.046	-1.639	0.101
DE English grade of A–B	-0.730	0.102	-0.132	-7.143	<0.001
AP English score of 1–2	0.048	0.105	0.008	0.463	0.644
AP English score of 3	-0.083	0.107	-0.014	-0.782	0.434
AP English score of 4–5	-0.109	0.118	-0.017	-0.925	0.355

**Table A7.**

## English Participation Regression Results: Credits to Degree

	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	150.479	2.077		72.464	<0.001
Grades 9–10 GPA	0.432	0.470	0.009	0.920	0.358
Percent course work Honors+	-6.166	1.177	-0.042	-5.239	<0.001
English grades 9–10 GPA	-4.539	0.407	-0.105	-11.145	<0.001
10th-grade math assessment	0.035	0.006	0.047	5.344	<0.001
10th-grade reading assessment	-0.034	0.006	-0.049	-6.082	<0.001
Gender	-2.117	0.286	-0.046	-7.391	<0.001
Free/reduced lunch status	2.664	0.400	0.044	6.654	<0.001
Race = Asian	6.844	0.682	0.060	10.042	<0.001
Race = African American/Black	7.542	0.435	0.117	17.353	<0.001
Race = Hispanic	2.945	0.462	0.041	6.370	<0.001
AP English participant	-1.754	0.253	-0.067	-6.919	<0.001
DE English participant	2.235	0.278	0.071	8.032	<0.001

**Table A8.**

## English Performance Regression Results: Credits to Degree

	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	147.275	2.191		67.217	<0.001
Grades 9–10 GPA	0.348	0.471	0.007	0.739	0.460
Percent course work Honors+	-6.215	1.176	-0.043	-5.284	<0.001
English grades 9–10 GPA	-4.318	0.411	0.100	-10.498	<0.001
10th-grade math assessment	0.037	0.006	0.051	5.797	<0.001
10th-grade reading assessment	-0.029	0.006	0.042	-5.245	<0.001
Gender	-2.120	0.286	-0.046	-7.408	<0.001
Free/reduced lunch status	2.648	0.400	0.044	6.618	<0.001
Race = Asian	6.752	0.681	0.059	9.913	<0.001
Race = African American/Black	7.480	0.434	0.116	17.217	<0.001
Race = Hispanic	2.911	0.462	0.040	6.301	<0.001
DE English grade of D–F	0.946	2.977	0.021	0.318	0.751
DE English grade of C	2.650	1.356	0.059	1.954	0.051
DE English grade of A–B	2.486	0.648	0.077	3.835	<0.001
AP English score of 1–2	0.574	0.663	0.017	0.865	0.387
AP English score of 3	-2.322	0.676	0.068	-3.436	0.001
AP English score of 4–5	-4.252	0.749	0.113	-5.676	<0.001

## Appendix B: Math Regression Results

<b>Table B1.</b>					
Math Participation Regression Results: First Year College Math GPA					
	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	-1.301	0.144		-9.060	<0.001
Grades 9–10 GPA	0.148	0.030	0.061	4.967	<0.001
Percent course work Honors+	0.281	0.070	0.039	4.039	<0.001
Math grades 9–10 GPA	0.433	0.020	0.259	21.557	<0.001
10th-grade math assessment	0.005	0.000	0.144	12.456	<0.001
10th-grade reading assessment	0.001	0.000	0.020	2.074	0.038
Gender	0.137	0.017	0.064	7.943	<0.001
Free/reduced lunch status	-0.030	0.024	0.010	-1.210	0.226
Race = Asian	-0.011	0.037	-0.002	-0.294	0.768
Race = African American/Black	-0.015	0.026	-0.005	-0.590	0.555
Race = Hispanic	-0.047	0.028	0.014	-1.692	0.091
AP Math participant	0.139	0.024	0.117	5.898	<0.001
DE Math participant	-0.136	0.040	-0.064	-3.374	0.001

<b>Table B2.</b>					
Math Performance Regression Results: First Year College Math GPA					
	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	-1.247	0.150		-8.299	<0.001
Grades 9–10 GPA	0.149	0.030	0.061	4.998	<0.001
Percent course work Honors+	0.280	0.070	0.039	4.018	<0.001
Math grades 9–10 GPA	0.432	0.020	0.258	21.375	<0.001
10th-grade math assessment	0.005	0.000	0.142	12.250	<0.001
10th-grade reading assessment	0.001	0.000	0.020	2.048	0.041
Gender	0.138	0.017	0.065	8.005	<0.001
Free/reduced lunch status	-0.029	0.024	0.010	-1.204	0.229
Race = Asian	-0.011	0.037	-0.002	-0.286	0.775
Race = African American/Black	-0.016	0.026	-0.006	-0.640	0.522
Race = Hispanic	-0.048	0.028	0.014	-1.712	0.087
DE Math grade of D–F	0.107	0.207	0.046	0.520	0.603
DE Math grade of C	-0.234	0.131	0.102	-1.786	0.074
DE Math grade of A–B	-0.176	0.071	-0.082	-2.484	0.013
AP Math score of 1–2	0.087	0.046	0.058	1.872	0.061
AP Math score of 3	0.130	0.051	0.072	2.553	0.011
AP Math score of 4–5	0.123	0.049	0.074	2.511	0.012

**Table B3.**

## Math Participation Regression Results: Final College Math GPA

	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	-0.530	0.096		-5.500	<0.001
Grades 9–10 GPA	0.150	0.020	0.077	7.433	<0.001
Percent course work Honors+	0.238	0.049	0.041	4.895	<0.001
Math grades 9–10 GPA	0.333	0.014	0.246	24.268	<0.001
10th-grade math assessment	0.004	0.000	0.130	13.211	<0.001
10th-grade reading assessment	0.001	0.000	0.037	4.358	<0.001
Gender	0.139	0.012	0.078	11.540	<0.001
Free/reduced lunch status	-0.003	0.017	0.001	-0.173	0.863
Race = Asian	0.018	0.027	0.004	0.678	0.498
Race = African American/Black	-0.050	0.018	0.021	-2.758	0.006
Race = Hispanic	-0.026	0.020	-0.009	-1.337	0.181
AP Math participant	0.108	0.016	0.102	6.588	<0.001
DE Math participant	-0.105	0.027	-0.058	-3.922	<0.001

**Table B4.**

## Math Performance Regression Results: Final College Math GPA

	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	-0.498	0.100		-4.970	<0.001
Grades 9–10 GPA	0.152	0.020	0.078	7.510	<0.001
Percent course work Honors+	0.237	0.049	0.041	4.878	<0.001
Math grades 9–10 GPA	0.330	0.014	0.244	23.936	<0.001
10th-grade math assessment	0.004	0.000	0.128	12.909	<0.001
10th-grade reading assessment	0.001	0.000	0.037	4.332	<0.001
Gender	0.141	0.012	0.079	11.676	<0.001
Free/reduced lunch status	-0.003	0.017	0.001	-0.188	0.851
Race = Asian	0.019	0.027	0.005	0.694	0.488
Race = African American/Black	-0.051	0.018	0.021	-2.797	0.005
Race = Hispanic	-0.026	0.020	-0.009	-1.341	0.180
DE Math grade of D–F	-0.068	0.125	-0.033	-0.543	0.587
DE Math grade of C	-0.155	0.086	0.077	-1.807	0.071
DE Math grade of A–B	-0.103	0.047	-0.055	-2.211	0.027
AP Math score of 1–2	0.075	0.030	0.056	2.463	0.014
AP Math score of 3	0.116	0.034	0.074	3.444	0.001
AP Math score of 4–5	0.143	0.033	0.096	4.357	<0.001

**Table B5.**

## Math Participation Regression Results: Calendar Terms to Degree

	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	25.644	0.341		75.254	<0.001
Grades 9–10 GPA	-1.160	0.072	-0.143	-16.132	<0.001
Percent course work Honors+	-4.409	0.180	-0.177	-24.487	<0.001
Math grades 9–10 GPA	-0.505	0.049	-0.088	-10.272	<0.001
10th-grade math assessment	-0.006	0.001	-0.047	-5.503	<0.001
10th-grade reading assessment	-0.006	0.001	-0.054	-7.378	<0.001
Gender	-0.839	0.045	-0.106	-18.727	<0.001
Free/reduced lunch status	0.456	0.064	0.044	7.188	<0.001
Race = Asian	0.426	0.108	0.022	3.947	<0.001
Race = African American/Black	-0.180	0.069	-0.016	-2.612	0.009
Race = Hispanic	0.461	0.073	0.037	6.302	<0.001
AP Math participant	0.443	0.058	0.088	7.601	<0.001
DE Math participant	-0.792	0.088	-0.098	-9.015	<0.001

**Table B6.**

## Math Performance Regression Results: Calendar Terms to Degree

	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	25.539	0.353		72.407	<0.001
Grades 9–10 GPA	-1.159	0.072	-0.143	-16.107	<0.001
Percent course work Honors+	-4.407	0.180	-0.177	-24.470	<0.001
Math grades 9–10 GPA	-0.507	0.049	-0.089	-10.250	<0.001
10th-grade math assessment	-0.006	0.001	-0.047	-5.516	<0.001
10th-grade reading assessment	-0.006	0.001	-0.054	-7.376	<0.001
Gender	-0.838	0.045	-0.106	-18.682	<0.001
Free/reduced lunch status	0.457	0.064	0.044	7.190	<0.001
Race = Asian	0.427	0.108	0.022	3.950	<0.001
Race = African American/Black	-0.179	0.069	-0.016	-2.606	0.009
Race = Hispanic	0.461	0.073	0.037	6.300	<0.001
DE Math grade of D–F	-0.909	0.435	-0.096	-2.089	0.037
DE Math grade of C	-0.577	0.270	-0.062	-2.135	0.033
DE Math grade of A–B	-0.677	0.154	-0.081	-4.399	<0.001
AP Math score of 1–2	0.540	0.110	0.084	4.919	<0.001
AP Math score of 3	0.578	0.125	0.078	4.624	<0.001
AP Math score of 4–5	0.579	0.121	0.081	4.790	<0.001

**Table B7.**

## Math Participation Regression Results: Credits to Degree

	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	152.495	2.150		70.917	<0.001
Grades 9–10 GPA	-2.316	0.454	-0.049	-5.105	<0.001
Percent course work Honors+	-8.922	1.136	-0.061	-7.855	<0.001
Math grades 9–10 GPA	-0.944	0.310	-0.028	-3.041	0.002
10th-grade math assessment	0.035	0.007	0.048	5.217	<0.001
10th-grade reading assessment	-0.041	0.005	-0.060	-7.504	<0.001
Gender	-2.604	0.283	-0.056	-9.211	<0.001
Free/reduced lunch status	2.663	0.400	0.044	6.654	<0.001
Race = Asian	6.636	0.680	0.058	9.754	<0.001
Race = African American/Black	7.442	0.433	0.115	17.173	<0.001
Race = Hispanic	2.911	0.461	0.040	6.315	<0.001
AP Math participant	-1.193	0.368	-0.040	-3.240	0.001
DE Math participant	3.556	0.556	0.076	6.397	<0.001

**Table B8.**

## Math Performance Regression Results: Credits to Degree

	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	152.767	2.225		68.647	<0.001
Grades 9–10 GPA	-2.347	0.454	-0.050	-5.171	<0.001
Percent course work Honors+	-8.915	1.136	-0.061	-7.847	<0.001
Math grades 9–10 GPA	-0.893	0.312	-0.027	-2.861	0.004
10th-grade math assessment	0.036	0.007	0.049	5.363	<0.001
10th-grade reading assessment	-0.041	0.005	-0.059	-7.485	<0.001
Gender	-2.639	0.283	-0.057	-9.318	<0.001
Free/reduced lunch status	2.664	0.400	0.044	6.656	<0.001
Race = Asian	6.625	0.680	0.058	9.738	<0.001
Race = African American/Black	7.450	0.433	0.115	17.189	<0.001
Race = Hispanic	2.919	0.461	0.040	6.331	<0.001
DE Math grade of D–F	3.773	2.741	0.068	1.376	0.169
DE Math grade of C	2.500	1.708	0.046	1.464	0.143
DE Math grade of A–B	2.831	0.974	0.058	2.908	0.004
AP Math score of 1–2	-1.395	0.692	-0.037	-2.016	0.044
AP Math score of 3	-1.597	0.789	-0.037	-2.023	0.043
AP Math score of 4–5	-3.064	0.764	-0.074	-4.011	<0.001

## Appendix C: Science Regression Results

<b>Table C1.</b>					
Science Participation Regression Results: First Year College Science GPA					
	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	-1.030	0.152		-6.787	<0.001
Grades 9–10 GPA	0.222	0.035	0.101	6.412	<0.001
Percent course work Honors+	0.579	0.080	0.090	7.283	<0.001
Science grades 9–10 GPA	0.305	0.027	0.175	11.522	<0.001
10th-grade math assessment	0.003	0.000	0.089	6.494	<0.001
10th-grade reading assessment	0.002	0.000	0.079	6.575	<0.001
Gender	-0.009	0.019	-0.004	-0.445	0.657
Free/reduced lunch status	0.025	0.026	0.010	0.951	0.341
Race = Asian	-0.043	0.037	0.011	-1.165	0.244
Race = African American/Black	-0.235	0.028	-0.092	-8.280	<0.001
Race = Hispanic	0.197	0.030	0.068	6.631	<0.001
AP Science participant	0.055	0.024	0.053	2.343	0.019
DE Science participant	-0.086	0.039	-0.048	-2.225	0.026

<b>Table C2.</b>					
Science Performance Regression Results: First Year College Science GPA					
	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	-1.028	0.166		-6.205	<0.001
Grades 9–10 GPA	0.229	0.035	0.104	6.591	<0.001
Percent course work Honors+	0.577	0.079	0.089	7.260	<0.001
Science grades 9–10 GPA	0.293	0.027	0.167	10.973	<0.001
10th-grade math assessment	0.003	0.000	0.085	6.198	<0.001
10th-grade reading assessment	0.002	0.000	0.077	6.434	<0.001
Gender	-0.003	0.019	-0.001	-0.147	0.883
Free/reduced lunch status	0.025	0.026	0.010	0.940	0.347
Race = Asian	-0.043	0.037	0.011	-1.171	0.242
Race = African American/Black	-0.236	0.028	-0.093	-8.340	<0.001
Race = Hispanic	0.197	0.030	0.068	6.648	<0.001
DE Science grade of D–F	-0.333	0.361	0.164	-0.922	0.357
DE Science grade of C	-0.250	0.152	0.125	-1.644	0.100
DE Science grade of A–B	0.029	0.083	0.016	0.351	0.725
AP Science score of 1–2	0.104	0.068	0.082	1.520	0.129
AP Science score of 3	0.090	0.072	0.058	1.247	0.212
AP Science score of 4–5	0.257	0.074	0.162	3.502	<0.001

**Table C3.**

## Science Participation Regression Results: Final College Science GPA

	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	-0.234	0.102		-2.288	0.022
Grades 9–10 GPA	0.129	0.023	0.069	5.506	<0.001
Percent course work Honors+	0.406	0.055	0.073	7.320	<0.001
Science grades 9–10 GPA	0.266	0.018	0.178	14.948	<0.001
10th-grade math assessment	0.002	0.000	0.080	7.161	<0.001
10th-grade reading assessment	0.002	0.000	0.087	8.806	<0.001
Gender	0.032	0.014	0.019	2.371	0.018
Free/reduced lunch status	0.066	0.018	0.030	3.573	<0.001
Race = Asian	-0.102	0.028	-0.028	-3.583	<0.001
Race = African American/Black	-0.230	0.020	-0.103	-11.626	<0.001
Race = Hispanic	0.126	0.021	0.048	5.890	<0.001
AP Science participant	0.026	0.017	0.025	1.512	0.131
DE Science participant	-0.050	0.027	-0.030	-1.854	0.064

**Table C4.**

## Science Performance Regression Results: Final College Science GPA

	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	-0.172	0.109		-1.572	0.116
Grades 9–10 GPA	0.135	0.023	0.073	5.763	<0.001
Percent course work Honors+	0.404	0.055	0.072	7.285	<0.001
Science grades 9–10 GPA	0.256	0.018	0.171	14.228	<0.001
10th-grade math assessment	0.002	0.000	0.077	6.805	<0.001
10th-grade reading assessment	0.002	0.000	0.084	8.571	<0.001
Gender	0.038	0.014	0.022	2.821	0.005
Free/reduced lunch status	0.065	0.018	0.030	3.547	<0.001
Race = Asian	-0.103	0.028	-0.028	-3.602	<0.001
Race = African American/Black	-0.232	0.020	-0.104	-11.737	<0.001
Race = Hispanic	0.127	0.021	0.048	5.926	<0.001
DE Science grade of D–F	0.074	0.199	0.038	0.372	0.710
DE Science grade of C	-0.293	0.102	-0.153	-2.882	0.004
DE Science grade of A–B	-0.010	0.052	-0.006	-0.195	0.845
AP Science score of 1–2	-0.010	0.041	-0.008	-0.234	0.815
AP Science score of 3	0.038	0.045	0.025	0.850	0.396
AP Science score of 4–5	0.172	0.047	0.110	3.676	<0.001

**Table C5.**

## Science Participation Regression Results: Calendar Terms to Degree

	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	26.080	0.324		80.522	<0.001
Grades 9–10 GPA	-1.209	0.075	-0.150	-16.215	<0.001
Percent course work Honors+	-4.411	0.184	-0.177	-24.019	<0.001
Science grades 9–10 GPA	-0.455	0.057	-0.068	-7.975	<0.001
10th-grade math assessment	-0.008	0.001	-0.063	-7.661	<0.001
10th-grade reading assessment	-0.005	0.001	-0.046	-6.346	<0.001
Gender	-0.844	0.045	-0.107	-18.935	<0.001
Free/reduced lunch status	0.422	0.063	0.040	6.665	<0.001
Race = Asian	0.405	0.107	0.021	3.779	<0.001
Race = African American/Black	-0.205	0.069	-0.019	-2.986	0.003
Race = Hispanic	0.429	0.073	0.034	5.866	<0.001
AP Science participant	0.430	0.055	0.084	7.823	<0.001
DE Science participant	-0.872	0.078	-0.114	-11.241	<0.001

**Table C6.**

## Science Performance Regression Results: Calendar Terms to Degree

	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	25.999	0.343		75.809	<0.001
Grades 9–10 GPA	-1.213	0.075	-0.150	-16.243	<0.001
Percent course work Honors+	-4.411	0.184	-0.177	-24.015	<0.001
Science grades 9–10 GPA	-0.448	0.057	-0.067	-7.787	<0.001
10th-grade math assessment	-0.008	0.001	-0.062	-7.590	<0.001
10th-grade reading assessment	-0.005	0.001	-0.046	-6.286	<0.001
Gender	-0.847	0.045	-0.107	-18.958	<0.001
Free/reduced lunch status	0.423	0.063	0.040	6.675	<0.001
Race = Asian	0.406	0.107	0.021	3.790	<0.001
Race = African American/Black	-0.207	0.069	-0.019	-3.007	0.003
Race = Hispanic	0.428	0.073	0.034	5.853	<0.001
DE Science grade of D–F	-0.041	0.588	-0.004	-0.070	0.944
DE Science grade of C	-0.907	0.261	-0.099	-3.483	<0.001
DE Science grade of A–B	-0.845	0.152	-0.106	-5.562	<0.001
AP Science score of 1–2	0.527	0.125	0.087	4.229	<0.001
AP Science score of 3	0.323	0.143	0.043	2.252	0.024
AP Science score of 4–5	0.460	0.153	0.058	3.001	0.003

**Table C7.**

## Science Participation Regression Results: Credits to Degree

	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	152.020	2.049		74.198	<0.001
Grades 9–10 GPA	-2.077	0.471	-0.044	-4.409	<0.001
Percent course work Honors+	-8.921	1.161	-0.061	-7.684	<0.001
Science grades 9–10 GPA	-1.302	0.360	-0.033	-3.614	<0.001
10th-grade math assessment	0.038	0.006	0.052	5.827	<0.001
10th-grade reading assessment	-0.042	0.005	-0.061	-7.715	<0.001
Gender	-2.571	0.282	-0.056	-9.122	<0.001
Free/reduced lunch status	2.785	0.400	0.046	6.962	<0.001
Race = Asian	6.625	0.677	0.058	9.790	<0.001
Race = African American/Black	7.490	0.434	0.116	17.257	<0.001
Race = Hispanic	2.847	0.462	0.039	6.167	<0.001
AP Science participant	-0.683	0.347	-0.023	-1.965	0.049
DE Science participant	2.629	0.490	0.059	5.360	<0.001

**Table C8.**

## Science Performance Regression Results: Credits to Degree

	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	151.437	2.169		69.825	<0.001
Grades 9–10 GPA	-2.113	0.472	-0.045	-4.477	<0.001
Percent course work Honors+	-8.911	1.161	-0.061	-7.675	<0.001
Science grades 9–10 GPA	-1.230	0.363	-0.032	-3.386	0.001
10th-grade math assessment	0.039	0.006	0.053	5.997	<0.001
10th-grade reading assessment	-0.041	0.005	-0.060	-7.604	<0.001
Gender	-2.635	0.283	-0.057	-9.326	<0.001
Free/reduced lunch status	2.786	0.400	0.046	6.965	<0.001
Race = Asian	6.630	0.677	0.059	9.799	<0.001
Race = African American/Black	7.500	0.434	0.116	17.277	<0.001
Race = Hispanic	2.833	0.462	0.039	6.138	<0.001
DE Science grade of D–F	1.776	3.712	0.032	0.478	0.632
DE Science grade of C	1.506	1.645	0.028	0.916	0.360
DE Science grade of A–B	2.770	0.959	0.060	2.888	0.004
AP Science score of 1–2	0.022	0.787	0.001	0.028	0.977
AP Science score of 3	-1.510	0.906	-0.034	-1.667	0.096
AP Science score of 4–5	-2.564	0.971	-0.055	-2.640	0.008

## Appendix D: History Regression Results

<b>Table D1.</b>					
History Participation Regression Results: First Year College History GPA					
	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	-0.358	0.188		-1.904	0.057
Grades 9–10 GPA	0.235	0.037	0.111	6.362	<0.001
Percent course work Honors+	0.396	0.101	0.061	3.912	<0.001
History grades 9–10 GPA	0.200	0.026	0.128	7.786	<0.001
10th-grade math assessment	0.001	0.001	0.030	1.773	0.076
10th-grade reading assessment	0.004	0.000	0.128	8.222	<0.001
Gender	0.026	0.024	0.014	1.113	0.266
Free/reduced lunch status	-0.005	0.036	-0.002	-0.133	0.894
Race = Asian	0.014	0.069	0.003	0.206	0.837
Race = African American/Black	0.176	0.034	0.077	5.239	<0.001
Race = Hispanic	0.018	0.047	0.005	0.386	0.700
AP History participant	0.162	0.031	0.152	5.268	<0.001
DE History participant	-0.103	0.050	-0.057	-2.057	0.040

<b>Table D2.</b>					
History Performance Regression Results: First Year College History GPA					
	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	-0.325	0.208		-1.561	0.119
Grades 9–10 GPA	0.240	0.037	0.114	6.486	<0.001
Percent course work Honors+	0.378	0.101	0.058	3.736	<0.001
History grades 9–10 GPA	0.186	0.026	0.119	7.174	<0.001
10th-grade math assessment	0.001	0.001	0.030	1.768	0.077
10th-grade reading assessment	0.004	0.000	0.124	7.942	<0.001
Gender	0.035	0.024	0.019	1.470	0.142
Free/reduced lunch status	-0.004	0.035	-0.002	-0.118	0.906
Race = Asian	0.015	0.069	0.003	0.223	0.823
Race = African American/Black	0.178	0.033	0.078	5.322	<0.001
Race = Hispanic	0.022	0.047	0.006	0.462	0.644
DE History grade of D–F	-0.394	0.511	-0.192	-0.771	0.441
DE History grade of C	-0.407	0.205	-0.201	-1.984	0.047
DE History grade of A–B	-0.009	0.114	-0.005	-0.080	0.937
AP History score of 1–2	0.142	0.095	0.117	1.496	0.135
AP History score of 3	0.292	0.102	0.181	2.873	0.004
AP History score of 4–5	0.393	0.107	0.225	3.661	<0.001

**Table D3.**

## History Participation Regression Results: Final College History GPA

	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	0.344	0.111		3.102	0.002
Grades 9–10 GPA	0.240	0.022	0.132	10.938	<0.001
Percent course work Honors+	0.268	0.061	0.048	4.414	<0.001
History grades 9–10 GPA	0.145	0.015	0.105	9.368	<0.001
10th-grade math assessment	0.001	0.000	0.021	1.776	0.076
10th-grade reading assessment	0.003	0.000	0.119	10.911	<0.001
Gender	0.039	0.014	0.024	2.700	0.007
Free/reduced lunch status	0.008	0.020	0.004	0.401	0.689
Race = Asian	0.004	0.039	0.001	0.113	0.910
Race = African American/Black	0.040	0.021	0.019	1.924	0.054
Race = Hispanic	0.096	0.023	0.038	4.150	<0.001
AP History participant	0.091	0.018	0.092	4.933	<0.001
DE History participant	-0.055	0.029	-0.034	-1.894	0.058

**Table D4.**

## History Performance Regression Results: Final College History GPA

	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	0.394	0.119		3.309	0.001
Grades 9–10 GPA	0.244	0.022	0.134	11.105	<0.001
Percent course work Honors+	0.257	0.061	0.046	4.241	<0.001
History grades 9–10 GPA	0.136	0.016	0.098	8.726	<0.001
10th-grade math assessment	0.001	0.000	0.021	1.727	0.084
10th-grade reading assessment	0.003	0.000	0.116	10.578	<0.001
Gender	0.044	0.015	0.026	3.000	0.003
Free/reduced lunch status	0.008	0.020	0.004	0.407	0.684
Race = Asian	0.005	0.039	0.001	0.116	0.908
Race = African American/Black	0.041	0.021	0.020	1.976	0.048
Race = Hispanic	0.099	0.023	0.039	4.291	<0.001
DE History grade of D–F	-0.001	0.231	0.000	-0.003	0.997
DE History grade of C	-0.363	0.127	-0.194	-2.859	0.004
DE History grade of A–B	-0.021	0.059	-0.013	-0.366	0.715
AP History score of 1–2	0.048	0.047	0.042	1.009	0.313
AP History score of 3	0.161	0.052	0.107	3.059	0.002
AP History score of 4–5	0.212	0.056	0.133	3.773	<0.001

**Table D5.**

## History Participation Regression Results: Calendar Terms to Degree

	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	25.941	0.324		80.046	<0.001
Grades 9–10 GPA	-1.155	0.068	-0.143	-16.983	<0.001
Percent course work Honors+	-4.124	0.188	-0.166	-21.941	<0.001
History grades 9–10 GPA	-0.554	0.048	-0.088	-11.633	<0.001
10th-grade math assessment	-0.009	0.001	-0.069	-8.456	<0.001
10th-grade reading assessment	-0.003	0.001	-0.030	-3.988	<0.001
Gender	-0.890	0.045	-0.112	-19.948	<0.001
Free/reduced lunch status	0.446	0.064	0.043	7.014	<0.001
Race = Asian	0.440	0.108	0.023	4.079	<0.001
Race = African American/Black	-0.180	0.069	-0.016	-2.607	0.009
Race = Hispanic	0.433	0.073	0.035	5.905	<0.001
AP History participant	0.070	0.048	0.015	1.459	0.145
DE History participant	-0.489	0.064	-0.073	-7.664	<0.001

**Table D6.**

## History Performance Regression Results: Calendar Terms to Degree

	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	25.929	0.349		74.331	<0.001
Grades 9–10 GPA	-1.165	0.068	-0.144	-17.121	<0.001
Percent course work Honors+	-4.102	0.188	-0.165	-21.808	<0.001
History grades 9–10 GPA	-0.531	0.048	-0.084	-11.031	<0.001
10th-grade math assessment	-0.009	0.001	-0.069	-8.404	<0.001
10th-grade reading assessment	-0.003	0.001	-0.028	-3.776	<0.001
Gender	-0.899	0.045	-0.114	-20.107	<0.001
Free/reduced lunch status	0.442	0.064	0.042	6.959	<0.001
Race = Asian	0.441	0.108	0.023	4.090	<0.001
Race = African American/Black	-0.182	0.069	-0.016	-2.633	0.008
Race = Hispanic	0.431	0.073	0.034	5.881	<0.001
DE History grade of D–F	0.930	0.706	0.107	1.317	0.188
DE History grade of C	-0.277	0.302	-0.033	-0.916	0.360
DE History grade of A–B	-0.646	0.152	-0.094	-4.245	<0.001
AP History score of 1–2	0.087	0.140	0.015	0.624	0.533
AP History score of 3	-0.166	0.150	-0.025	-1.109	0.268
AP History score of 4–5	-0.242	0.158	-0.034	-1.532	0.125

**Table D7.**

## History Participation Regression Results: Credits to Degree

	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	149.862	2.057		72.838	<0.001
Grades 9–10 GPA	-2.057	0.432	-0.043	-4.767	<0.001
Percent course work Honors+	-5.350	1.193	-0.037	-4.484	<0.001
History grades 9–10 GPA	-1.545	0.302	-0.042	-5.112	<0.001
10th-grade math assessment	0.038	0.006	0.052	5.868	<0.001
10th-grade reading assessment	-0.038	0.006	-0.055	-6.832	<0.001
Gender	-2.773	0.283	-0.060	-9.791	<0.001
Free/reduced lunch status	2.874	0.403	0.047	7.129	<0.001
Race = Asian	6.850	0.683	0.060	10.026	<0.001
Race = African American/Black	7.567	0.438	0.116	17.284	<0.001
Race = Hispanic	3.022	0.465	0.041	6.505	<0.001
AP History participant	-2.468	0.306	-0.089	-8.070	<0.001
DE History participant	3.198	0.405	0.081	7.895	<0.001

**Table D8.**

## History Performance Regression Results: Credits to Degree

	Unstandardized B	Coefficients Std. Error	Standardized Beta Coefficients	t	Sig.
Constant	147.649	2.213		66.732	<0.001
Grades 9–10 GPA	-2.123	0.432	-0.045	-4.919	<0.001
Percent course work Honors+	-5.007	1.193	-0.034	-4.198	<0.001
History grades 9–10 GPA	-1.353	0.305	-0.036	-4.435	<0.001
10th-grade math assessment	0.038	0.006	0.053	5.939	<0.001
10th-grade reading assessment	-0.035	0.006	-0.051	-6.305	<0.001
Gender	-2.912	0.284	-0.063	-10.269	<0.001
Free/reduced lunch status	2.866	0.403	0.047	7.115	<0.001
Race = Asian	6.861	0.683	0.060	10.052	<0.001
Race = African American/Black	7.555	0.437	0.116	17.272	<0.001
Race = Hispanic	2.974	0.464	0.040	6.408	<0.001
DE History grade of D–F	1.727	4.469	0.034	0.387	0.699
DE History grade of C	2.898	1.914	0.058	1.514	0.130
DE History grade of A–B	3.973	0.965	0.099	4.118	<0.001
AP History score of 1–2	0.046	0.884	0.001	0.052	0.958
AP History score of 3	-3.193	0.953	-0.081	-3.352	0.001
AP History score of 4–5	-5.478	1.005	-0.131	-5.452	<0.001







# The Research department actively supports the College Board's mission by:

- Providing data-based solutions to important educational problems and questions
- Applying scientific procedures and research to inform our work
- Designing and evaluating improvements to current assessments and developing new assessments as well as educational tools to ensure the highest technical standards
- Analyzing and resolving critical issues for all programs, including AP<sup>®</sup>, SAT<sup>®</sup>, PSAT/NMSQT<sup>®</sup>
- Publishing findings and presenting our work at key scientific and education conferences
- Generating new knowledge and forward-thinking ideas with a highly trained and credentialed staff

## Our work focuses on the following areas

<b>Admission</b>	<b>Measurement</b>
<b>Alignment</b>	<b>Research</b>
<b>Evaluation</b>	<b>Trends</b>
<b>Fairness</b>	<b>Validity</b>

