



Analysis of Advanced Placement Credit Equivalency

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Executive Summary

In recent years about 74 percent of UW-Madison new freshmen have received course credit or elective credit based on scores on the College Board's Advanced Placement (AP) exams. There are 16 AP exams for which more than 5 percent of UW-Madison new freshman earn course or elective credit.

Consequently, AP exams represent an important substitute for entry-level college courses. This allows students to avoid paying tuition for entry level courses that cover material already learned, allows students to move on to intermediate-level coursework more quickly, supports timely progress to degree, and allows the university to make sure that seats in entry-level courses are filled with students who need them.

Given strong incentives for awarding AP credit, this study asks the question, how do we know that students really should get UW-Madison college course credit for AP exam scores?

In this study we identified nine sequences of introductory and subsequent courses in which the first course can be taken at UW-Madison or course credit can be earned through an AP exam score of 4 or 5. We analyzed the success of students in the second course in the sequence based on whether they earned credit for the first course by taking the UW-Madison course or by AP exam score.

The sequences studied in this report include Introductory Biology, Introductory Chemistry, Calculus, Economics, and Psychology.

For all of the course sequences, the AP exam score signaled sufficient preparation for students to be successful in the subsequent course when compared to students who took the UW-Madison course that corresponds to the AP exam. These findings replicate the findings of our 2009 study on this same topic (by Academic Planning and Institutional Research), and are also consistent with numerous studies conducted by the College Board.

These findings confirm the validity of the AP course equivalency assignments and give program faculty and staff confidence that students can be advised and supported to make use of their AP credit as a prerequisite for UW-Madison college work, with all the benefits that brings the student and the University.

The AP Program

The AP program is based on the premise that college-level material can be successfully taught by high school teachers to well-prepared high school students. AP courses are modeled after, and are designed to correspond to courses offered at most colleges and universities, using a committee of experienced teachers and college faculty. There are currently 37 different AP courses in a variety of subject areas.

Comprehensive exams for each AP course are administered on a common date nationally each May. Exams are scored by experienced AP teachers and college faculty using standards developed by the committee that developed the course curriculum. Exams consist of both multiple choice questions and a free response section. All exams are scored on a 5-point scale, with a score of 5 considered “extremely well qualified,” comparable to an A grade in the corresponding college course. Sitting for an AP exam does not require enrollment in or completion of the corresponding AP course.

AP and UW-Madison

The American Council on Education, the major coordinating body for higher education in the United States, recommends that college credit be awarded for AP exam scores of 3 or higher. In 1991, the UW System Board of Regents adopted a policy requiring the awarding of degree credit for scores of 3 or higher.

About 74 percent of UW-Madison new freshmen now receive credit for scores on at least one AP exam, and there are 16 AP exams for which credit is earned by more than 5 percent of new freshmen. For example, 27 percent of new freshmen take the AP Psychology exam, 27 percent take the English Literature AP exam, and 26 percent take the English Language AP exam. See Appendix I for a full listing of AP exams and the number of UW-Madison new freshmen with scores of 3 (the threshold to receive credit) or better.

Course credit should be awarded for AP so that students receive credit for material they have learned, but care must be taken not to disadvantage students by placing them at a course level for which they are not fully prepared. At UW-Madison, for most AP exams students with AP exam scores of 3 receive elective or general education credit; students with scores of 4 or 5 receive credit for the corresponding UW-Madison courses. The Office of Undergraduate Admissions consults with academic departments to determine the most appropriate credit equivalencies for AP exam scores. For some AP exams, elective credit is awarded for scores of 4 or 5, rather than course credit, because a departmental faculty has determined the AP course is not equivalent to any existing UW-Madison course. Table 1 summarizes the UW-Madison credit given for each AP exam that is taken by more than 5 percent of UW-Madison new freshmen.

Table 1
AP Scores and UW-Madison Course or Elective Equivalencies

AP Exam	Score	UW-Madison Course or Elective Equivalent	Credits
Biology	3	Biological science elective	3
	4, 5	Biology 151	5
Calculus AB	3	Mathematics elective, QR-A ¹	3
	4, 5	Math 221	5
Calculus BC	3	Mathematics elective, QR-A ¹	3
	4, 5	Math 221 and Math 222	9
Chemistry	3	Chemistry elective	3
	4, 5	Chemistry 103	3
English Language and Composition	3	English composition elective	3
	4, 5	English composition elective, Com-A ²	3
English Literature and Composition	3	English literature elective	3
	4, 5	English literature elective, Com-A ²	3
Environmental Science	3, 4, 5	Biological science elective	3
European History	3	General elective	3
	4, 5	History elective	3
Macroeconomics	3	General elective	3
	4, 5	Economics 102	4
Microeconomics	3	General elective	3
	4, 5	Economics 101	4
Physics B	3	Physics elective	3
	4, 5	Physics 201 or 207 ³	5
Psychology	3	Psychology electives	3
	4, 5	Psychology 202	3
Statistics	3	Statistics elective	3
	4, 5	Statistics 301	3
U.S. Government and Politics	3	Political science elective	3
	4, 5	Political Science 104	4
U.S. History	3	General elective	3
	4, 5	History elective	3
World History	3	General elective	3
	4, 5	History elective	3

¹Meets General Education requirement for Quantitative Reasoning A.

²Meets General Education requirement for Communication A.

³Whether a student receives credit for Physics 201 or 207 depends on the student's proposed major.

Rationale and Methodology

This analysis looks at whether AP exam scores are valid indicators of a student's readiness for placement into a course beyond the introductory course. We examine whether students with AP credit for a course are as successful in subsequent closely related courses compared to students who take the course at UW-Madison. For example, do students who earn credit for Chemistry 103 (General Chemistry I) based on the AP Chemistry exam perform as well in Chemistry 104 (General Chemistry II) as students who took Chemistry 103 at UW-Madison?

The first step of our analysis was to identify students who entered UW-Madison as new freshmen in the same year they graduated high school, from fall 2010 through fall 2014—a total of 30,037 students. Then, we identified pairs of courses that included an introductory course that has a corresponding AP exam that was taken by at least 5 percent of UW-Madison new freshmen and a closely related subsequent course. We found nine such pairs of courses (Table 2).

Table 2
AP Exam and UW-Madison Course Pairings Analyzed

AP Exam	UW-Madison Students with AP Credit	UW-Madison Equivalent Course	UW-Madison Subsequent Course(s)
Biology	16%	Biology 151	Biology 152
Calculus AB	23%	Math 221	Math 222
Calculus BC	15%	Math 221 and 222	Math 234 Math 320 Engineering Mechanics and Astronautics 201
Chemistry	12%	Chemistry 103	Chemistry 104
Macroeconomics	9%	Economics 102	Economics 302
Microeconomics	8%	Economics 101	Economics 301
Psychology	27%	Psychology 202	Psychology 509

Next, for each pair of courses, from the set of 30,037 students, we identified three groups (Table 3):

1. Students who were awarded credit for the introductory course based on an AP exam score of 4 and took the subsequent course at UW-Madison.
2. Students who were awarded credit for the introductory course based on an AP exam score of 5 and took the subsequent course at UW-Madison.
3. Students who took the introductory course at UW-Madison, did not have AP credit for the introductory course, and took the subsequent course at UW-Madison.

Table 3
Selection of AP Group and Comparison Group

	AP Group		Comparison Group
	Score 4	Score 5	
Entered UW-Madison as a new freshman?	Yes	Yes	Yes
Took specified AP exam?	Yes	Yes	No
Score on AP exam?	4	5	N/a
Took AP-equivalent course?	No	No	Yes
Took subsequent closely related course?	Yes	Yes	Yes

We then compared the course outcomes of each of the two AP credit groups to the group of students that did not have AP credit for the introductory course. We used three points of comparison: the proportion of

students with a successful course outcome (grade of C or better), the proportion of students with an exemplary course outcome (grade of A), and the course GPA.

In comparing course outcomes between the AP students and the non-AP students, we evaluated whether differences in proportions of students with successful and exemplary course outcomes were statistically significant based on a chi-square test at the 5 percent level, and whether differences in mean GPAs were statistically significant based on a t-test at the 5 percent level. If there is no significant difference in positive course outcomes for AP students versus non-AP students, or if the AP students have a significantly higher proportion of positive course outcomes, that would be evidence that our AP equivalencies for those courses are appropriate.

Biology

About 16 percent of UW-Madison new freshmen earn course or elective credit with the AP Biology exam. Scores of 4 or 5 on the AP Biology exam are intended to signal learning equivalent to a first-year college biology course for biology majors.

At the time of our 2009 report, students with a score of 4 or 5 on the AP Biology exam were awarded elective credit rather than course credit. Beginning in fall 2013, UW-Madison new freshmen began receiving five credits for Biology 151 (Introductory Biology 1) with an AP Biology exam score of 4 or 5. Many of these students subsequently take Biology 152 (Introductory Biology 2), which is the second course of the sequence. Because course credit was not awarded until fall 2013 for AP Biology, we looked at Biology 152 course outcomes from fall 2013 through spring 2015.

Findings (Table 4): Students who prepared for Biology 152 with AP Biology were as successful or more successful in Biology 152 than students who prepared by taking Biology 151. Students who earned credit for Biology 151 with an AP score of 4 earned higher grades on average (3.11) in Biology 152 than those who took Biology 151 (2.99).

Table 4
Biology 152 Final Course Grades, by Source of Biology 151 Credit
Fall 2013 through Spring 2015

	AP Biology Group		Comparison Group Biology 151
	Score 4	Score 5	
Number of students	219	115	698
Biology 152 GPA	3.11*	3.44*	2.99
Percentage As	21	43*	18
Percentage C or better	98	100	97

*Significantly different from the comparison group. Significance of differences in GPA means is based on a t-test at the 5% level; significance of differences in proportions of exemplary (A) and successful (C or better) course outcomes is based on a chi-square test at the 5% level.

Chemistry

About 12 percent of UW-Madison new freshmen earn course or elective credit with the AP Chemistry exam. Scores of 4 or 5 on the AP Chemistry exam are intended to signal learning equivalent to a first-year college general chemistry course.

Students who earn a score of 4 or 5 on the AP Chemistry exam receive three credits for Chemistry 103 (General Chemistry I), which is the first semester of the General Chemistry sequence. Many of these students subsequently take Chemistry 104 (General Chemistry II), which is the second course of the sequence.

Findings (Table 5): Students who prepared for Chemistry 104 with AP Chemistry were as successful or more successful in Chemistry 104 than students who prepared by taking Chemistry 103. Students who earned credit for Chemistry 103 with a score of 4 on the exam earned higher grades on average (3.66) in Chemistry 104 than students who took Chemistry 103 (2.93).

Table 5
Chemistry 104 Final Course Grades, by Source of Chemistry 103 Credit
Fall 2010 through Spring 2015

	AP Chemistry Group		Comparison Group Chemistry 103
	Score 4	Score 5	
Number of students	134	49	8,003
Chemistry 104 GPA	3.66*	3.71*	2.93
Percentage As	63*	71*	21
Percentage C or better	100*	100	95

*Significantly different from the comparison group. Significance of differences in GPA means is based on a t-test at the 5% level; significance of differences in proportions of exemplary (A) and successful (C or better) course outcomes is based on a chi-square test at the 5% level.

Economics

About 9 percent of UW-Madison new freshman earn course or elective credit with the AP Macroeconomics exam, and about 8 percent earn course or elective credit with the AP Microeconomics exam. Scores of 4 or 5 on the AP Macroeconomics and Microeconomics exams are intended to signal learning equivalent to introductory college economics courses.

Macroeconomics

Students who earn a score of 4 or 5 on the AP Macroeconomics exam receive four credits for Economics 102 (Principles of Macroeconomics). Some of these students subsequently take Economics 302 (Intermediate Macroeconomic Theory).

Findings (Table 6): Students who prepared for Economics 302 with AP Macroeconomics were as successful or more successful in Economics 302 than students who prepared by taking Economics 102.

Students who earned credit for Economics 102 with a score of 4 on the exam had no significant differences from students who took Economics 102 prior to Economics 302.

Table 6
Economics 302 Final Course Grades, by Source of Economics 102 Credit
 Fall 2010 through Spring 2015

	AP Macroeconomics Group		Comparison Group
	Score 4	Score 5	Economics 102
Number of students	168	121	1,159
Economics 302 GPA	3.16	3.50*	3.08
Percentage As	20	51*	22
Percentage C or better	97	98	96

*Significantly different from the comparison group. Significance of differences in GPA means is based on a t-test at the 5% level; significance of differences in proportions of exemplary (A) and successful (C or better) course outcomes is based on a chi-square test at the 5% level.

Microeconomics

Students who earn a score of 4 or 5 on the AP Microeconomics exam receive four credits for Economics 101 (Principles of Microeconomics). Some of these students subsequently take Economics 301 (Intermediate Microeconomic Theory).

Findings (Table 7): Students who prepared for Economics 301 with AP Microeconomics were as successful or more successful in Economics 301 than students who were prepared by taking Economics 101. Students who earned credit for Economics 101 with a score of 4 on the AP Microeconomics exam earned higher grades on average (3.15) in Economics 301 than students who took Economics 101 (2.90).

Table 7
Economics 301 Final Course Grades, by Source of Economics 101 Credit
 Fall 2010 through Spring 2015

	AP Microeconomics Group		Comparison Group
	Score 4	Score 5	Economics 101
Number of students	171	112	1,146
Economics 301 GPA	3.15*	3.46*	2.90
Percentage As	23*	48*	17
Percentage C or better	97	96	95

*Significantly different from the comparison group. Significance of differences in GPA means is based on a t-test at the 5% level; significance of differences in proportions of exemplary (A) and successful (C or better) course outcomes is based on a chi-square test at the 5% level.

Mathematics

About 23 percent of UW-Madison new freshmen earn course or elective credit with the Calculus AB exam and 15 percent earn course or elective credit with the Calculus BC exam. Scores of 4 or 5 on the AP Calculus AB exam are intended to signal learning equivalent to a first semester college calculus course devoted to topics in differential and integral calculus. Scores of 4 or 5 on the AP Calculus BC exam are intended to signal learning equivalent to both first and second semester college calculus courses.

Calculus AB

Students who earn a score of 4 or 5 on the AP Calculus AB exam receive five credits for Math 221 (Calculus and Analytic Geometry 1), which is the first semester of the calculus sequence. Many of these students subsequently take Math 222 (Calculus and Analytic Geometry 2), which is the second semester of the calculus sequence.

Findings (Table 8): Students who prepared for Math 222 with AP Calculus AB were as successful or more successful in Math 222 than students who prepared by taking Math 221. Math 222 students who earned credit for Math 221 with a score of 4 on the AP Calculus AB exam had a higher percentage of successful course outcomes (91 percent) in Math 222 than students who took Math 221 (88 percent).

Table 8
Math 222 Final Course Grades, by Source of Math 221 Credit
Fall 2010 through Spring 2015

	AP Calculus AB [†] Group		Comparison Group Math 221
	Score 4	Score 5	
Number of students	877	1,499	2,598
Math 222 GPA	2.67	3.15*	2.73
Percentage As	11*	32*	19
Percentage C or better	91*	96*	88

[†]Includes Calculus AB subscore for students who scored a 3 on the Calculus BC exam.

*Significantly different from the comparison group. Significance of differences in GPA means is based on a t-test at the 5% level; significance of differences in proportions of exemplary (A) and successful (C or better) course outcomes is based on a chi-square test at the 5% level.

Calculus BC

Students who earn a score of 4 or 5 on the AP Calculus BC exam receive nine credits: five credits for Math 221 (Calculus and Analytic Geometry 1) and four credits for Math 222 (Calculus and Analytic Geometry 2). Many of these students subsequently take higher-level math or engineering courses requiring credit for Math 222. Commonly taken subsequent courses include Math 234 (Calculus-Functions of Several Variables), Math 320 (Linear Algebra and Differential Equations), and Engineering Mechanics and Astronautics 201 (Statics).

Findings: In Math 234, Math 320, and Engineering Mechanics and Astronautics 201, students with AP Calculus BC as their preparation were as successful or more successful than students who prepared by taking Math 222.

Students who earned credit for Math 222 with a score of 4 on the AP exam had a lower percentage of exemplary course outcomes than students who took Math 222, but there was not a significant difference in the percentage of successful course outcomes or GPA in Math 234 (Table 9).

Table 9
Math 234 Final Course Grades, by Source of Math 222 Credit
 Fall 2010 through Spring 2015

	AP Calculus BC Group		Comparison Group Math 222
	Score 4	Score 5	
Number of students	454	1,378	3,834
Math 234 GPA	2.73	3.31	2.78
Percentage As	15*	42*	22
Percentage C or better	91	97*	89

*Significantly different from the comparison group. Significance of differences in GPA means is based on a t-test at the 5% level; significance of differences in proportions of exemplary (A) and successful (C or better) course outcomes is based on a chi-square test at the 5% level.

Students who earned credit for Math 222 with a score of 4 on the exam had no significant differences compared to students who took Math 222 (Table 10).

Table 10
Math 320 Final Course Grades, by Source of Math 222 Credit
 Fall 2010 through Spring 2015

	AP Calculus BC Group		Comparison Group Math 222
	Score 4	Score 5	
Number of students	159	539	1,498
Math 320 GPA	2.77	3.15*	2.77
Percentage As	14	33*	18
Percentage C or better	91	94*	90

*Significantly different from the comparison group. Significance of differences in GPA means is based on a t-test at the 5% level; significance of differences in proportions of exemplary (A) and successful (C or better) course outcomes is based on a chi-square test at the 5% level.

In Engineering Mechanics and Astronautics 201, students who earned credit for Math 222 with a score of 4 on the exam had no significant differences compared to students who took Math 222 (Table 11).

Table 11
Engineering Mechanics and Astronautics 201 Final Course Grades, by Source of Math 222 Credit
 Fall 2010 through Spring 2015

	AP Calculus BC Group		Comparison Group Math 222
	Score 4	Score 5	
Number of students	181	469	1,804
Engineering Mechanics 201 GPA	2.67	3.12*	2.53
Percentage As	10	30*	12
Percentage C or better	89	97*	86

*Significantly different from the comparison group. Significance of differences in GPA means is based on a t-test at the 5% level; significance of differences in proportions of exemplary (A) and successful (C or better) course outcomes is based on a chi-square test at the 5% level.

Psychology

About 27 percent of UW-Madison new freshmen earn course or elective credit with the AP Psychology exam. Scores of 4 or 5 on the AP Psychology exam are intended to signal learning equivalent to an introductory college psychology course that broadly covers the discipline of psychology.

Students who earn a 4 or 5 on the AP Psychology exam receive three credits for Psychology 202 (Introduction to Psychology). Some of these students subsequently take Psychology 509 (Abnormal Psychology).

Findings (Table 12): Psychology 509 students who earned credit for Psychology 202 with a score of 4 on the AP exam had a lower GPA in Psychology 509 (2.62) but no significant difference in the percentage of successful course outcomes compared to students who took Psychology 202.

Table 12
Psychology 509 Final Course Grades, by Source of Psychology 202 Credit
 Fall 2010 through Spring 2015

	AP Psychology Group		Comparison Group
	Score 4	Score 5	Psychology 202
Number of students	308	479	539
Psychology 509 GPA	2.62*	3.04*	2.88
Percentage As	9*	23*	17
Percentage C or better	89	95	92

*Significantly different from the comparison group. Significance of differences in GPA means is based on a t-test at the 5% level; significance of differences in proportions of exemplary (A) and successful (C or better) course outcomes is based on a chi-square test at the 5% level.

Implications and Recommendations

Students enrolling at UW-Madison are awarded elective, general education, or course credit for AP exam scores of 3 or greater. From fall 2010 through fall 2014, 74 percent of new freshmen earned credit based on AP exam scores. In this analysis, we examine the appropriateness of AP course equivalency by comparing success in the subsequent course for students who earned AP credit for an introductory course to students who took the introductory course at UW-Madison.

We analyzed nine pairs of courses that consisted of an introductory course for which at least 5 percent of UW-Madison new freshmen are awarded credit by AP exam, and a closely related subsequent course. In all cases, we found that the AP exam demonstrates adequate preparation for subsequent courses, as compared to students who took the introductory AP-equivalent course at UW-Madison. For each of the nine cases, we found that the proportion of AP students with successful course outcomes was either higher or not significantly different than the non-AP group. In six of the nine cases, we found that the proportion of AP students with exemplary course outcomes was either higher or not significantly different than the non-AP group. These results are consistent with the findings in our 2009 report; student success in courses confirms that AP credit awarded is appropriate.

One of the nine pairs of courses we analyzed was Biology 151 and Biology 152. At the time of our 2009 report, the AP Biology/Biology 151 course equivalency had not been established. We find that equivalency to be supported by the data.

This analysis confirms that the AP program plays a key role in helping UW-Madison students fulfill general education and course requirements for graduation, thereby contributing to timely progress to degree, saving students from having to take courses covering content the student has already learned, and saving spaces in many of these high-demand courses for students who need to learn the material.

These findings can help individuals throughout the University who provide information and advice to students on course selection be confident that AP preparation is sufficient for courses that follow or build

on AP-equivalent courses. Students should not be advised to take a course for which they earned credit by AP exam before taking a subsequent course as a standard practice. In some instances, due to individual circumstances, it may be appropriate for a student to take a course for which she has AP credit, but we find no evidence that taking a course for which a student has AP credit results in a higher likelihood of a successful outcome in subsequent related courses.

Appendix I

UW-Madison New Freshmen AP Exam Scores Fall 2010 through Spring 2015

AP Exam	Score			Total
	3	4	5	
Art History	83	87	42	212
Biology	1,652	1,808	1,234	4,694
Calculus AB	2,047	2,234	2,710	6,991
Calculus BC	992	1,000	2,274	4,266
Chemistry	1,348	1,421	881	3,650
Chinese Language and Culture	17	5	79	101
Comparative Government and Politics	126	175	162	463
Computer Science A	91	163	144	398
English Language and Composition	3,069	3,055	1,606	7,730
English Literature and Composition	4,252	2,963	986	8,201
Environmental Science	410	801	342	1,553
European History	1,099	928	522	2,549
French Language and Culture	174	96	55	325
German Languages and Culture	72	54	31	157
Human Geography	266	398	345	1,009
Italian Language and Culture	4	7	2	13
Japanese Language and Culture	2	2	9	13
Latin	24	12	6	42
Macroeconomics	711	1,352	768	2,831
Microeconomics	666	1,225	588	2,479
Music Theory	62	46	63	171
Physics B	905	818	543	2,266
Physics C: Electricity and Magnetism	92	182	182	456
Physics C: Mechanics	313	457	409	1,179
Psychology	1,177	3,197	3,842	8,216
Spanish Language and Culture	552	590	350	1,492
Spanish Literature and Culture	23	40	9	72
Statistics	1,497	1,892	1,050	4,439
Studio Art: 2-D Design	57	33	34	124
Studio Art: 3-D Design	14	7	13	34
Studio Art: Drawing	57	72	39	168
U.S. Government and Politics	1,730	1,151	1,096	3,977
U.S. History	2,564	3,336	1,776	7,676
World History	752	759	427	1,938
