

Analysis of Participation in the Biocore Biology Honors Program at UW-Madison

Introduction

Biocore is an undergraduate honors biology program with four lecture and three lab courses contributing to the core sequence. Undergraduates are eligible to start the Biocore program course sequence after they have 1) completed a calculus course (Math 221 or 217 or equivalent based on AP/IB tests), 2) completed Chemistry 104, 109, or 115 (beyond the introductory course, Chemistry 103) with a B or better, and 3) either have completed Chemistry 343 (Introductory Organic Chemistry) or are concurrently enrolled in Biocore 381.

Interested students must submit an application to confirm eligibility and their interest in participating. The first course of the Biocore program sequence is only offered in fall semesters. Therefore, the most typical timing of Biocore program participation starts with an application in the spring from a second semester student to start the Biocore program in the following fall semester (the student's third semester at UW-Madison).

Biocore program leadership is concerned about a decrease in applications as well as a decline in enrollments in the first course of the Biocore program sequence. They requested help from Academic Planning and Institutional Research to investigate possible causes of these decreases. They suggested that student concern about grades, time-to-degree, and recent changes to credit equivalencies for the Advanced Placement Biology exam might be affecting enrollments.

Analytic approach

We examined patterns in Biocore program eligibility and enrollments in Biocore courses for undergraduates who entered UW-Madison as new freshmen between fall 2011 and fall 2017. During this time period, 44,000 new freshmen enrolled at UW-Madison. Because the academic requirements for the Biocore program include completion of advanced chemistry and math courses which only 19% of UW-Madison undergraduates complete, we focus this analysis on the undergraduates who completed the Biocore program academic prerequisites rather than the general undergraduate population.

The analytic population for this analysis is 8,438 students who started as new freshmen at UW-Madison between fall 2011 and fall 2017 and became academically eligible for the Biocore program by the end of the spring 2018 semester. Of these students, 563 participated in the Biocore program, as evidenced by enrollment in Biocore 381, the first course in the Biocore sequence.

For these students, we examine trends in Biocore program participation across the cohorts including when eligibility for and participation in Biocore started, relative to entrance to UW-Madison. Because the questions from Biocore program leadership focus on changes in longstanding enrollment and application patterns, we examine whether there have been changes across these cohorts in eligibility for the Biocore program or participation rates among Biocore-eligible undergraduates. Only 2% of Biocore program participants enter UW-Madison as transfer students and we excluded them from this analysis because of the challenges of determining when they became eligible for Biocore from their transfer records.

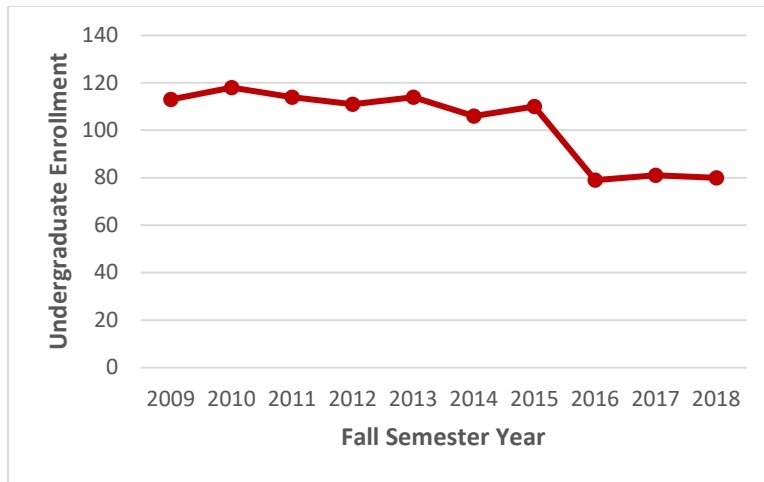
Key Findings

1. Each year, around 1,200 new undergraduates become eligible for the Biocore program, based on completion of the required academic prerequisites. Around 7% of undergraduates who complete the academic prerequisites for the Biocore program participate in the Biocore program.
2. More than half of the undergraduates who completed the academic prerequisites for the Biocore program completed them in their third semester at UW-Madison. Most of the other undergraduates who completed the academic prerequisites for the Biocore program completed them in their second or fourth semesters at UW-Madison.
3. Participation rates in the Biocore program are highest for students who complete the academic prerequisites for the Biocore program early (first or second semester). Participation rates in the Biocore program decrease the later the program's academic prerequisites are completed.
4. Over the last seven new freshman cohorts there has been a slight decrease in the percentage of new freshmen who complete the academic prerequisites for the Biocore program by their third semester at UW-Madison. This means that fewer students are eligible for the Biocore program at the time they are most likely to begin participation.
5. Almost all students who complete the academic prerequisites for the Biocore program are in degree-major programs in the Colleges of Agricultural and Life Sciences, Letters and Science, and Engineering. In recent years, there has been a decrease in Biocore program participation by students in the College of Agricultural and Life Sciences and an increase in participation by students in the College of Letters and Science (along with limited but steady participation by students in the College of Engineering). It is not clear what, if any, relationship this change has to do with declining participation rates in the Biocore program other than the fact that these students would likely have different academic advisors who are key recommenders of courses students take.
6. Over the same time, the number of undergraduates who were declared in a degree-major at the time they completed the academic prerequisites for the Biocore program increased. Because students in a declared degree-major are usually assigned different advisors than undecided students, this may be further evidence of the role of academic advisors in promoting the Biocore program.
7. Participation rates in the Biocore program by undergraduates who have completed the academic prerequisites vary significantly by major. This kind of analysis cannot pinpoint the reasons behind this differential participation but getting to the bottom of these differences seems critical to the development of strategies to increase participation in the Biocore program.
8. We did not find evidence to support the hypothesis that the change in 2013 in credit equivalencies for Advanced Placement (AP) Biology test scores is related to the decrease in participation in the Biocore program. The number of students affected by the change has not increased substantially since the change was made. Furthermore, participation in the Biocore program among students with AP Biology credit remains high.
9. Similarly, concerns about time-to-degree for Biocore participants are not substantiated. Undergraduates who complete the academic prerequisites for the Biocore program and participate in Biocore have similar time-to-degree compared to other Biocore-eligible undergraduates who did not participate in the Biocore program. For both groups of undergraduates, time-to-degree does increase the longer it takes to complete the Biocore course prerequisites.
10. We also did not find evidence to substantiate the prevailing sentiment that participation in the Biocore program results in a lower grade point average. We examined grade point averages of Biocore participants and other Biocore-eligible undergraduates at graduation. GPAs for both groups are high – over a 3.30. Grade point averages for Biocore participants are even higher at 3.55.

Biocore Enrollment Trends

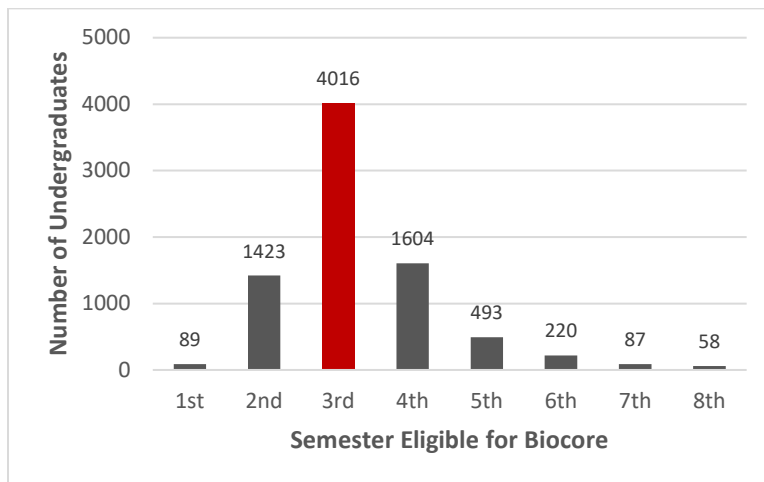
Prior to 2016 there were between 100 and 120 new undergraduates each year who enrolled in Biocore 381, the first course in four-semester Biocore sequence. Starting in 2016, enrollments in Biocore 381 dropped to around 80 new undergraduates per year (Figure 1). Although these declining enrollments were preceded by a decrease in applications for admission to the program, the application data is not kept in the UW-Madison student information system and the decrease is only evident in the data at the point of enrollment. Still, knowing that there was a preceding decrease in applications is important because it indicates a change in student behavior rather than problems or curricular conflicts with course offerings or enrollment issues.

Figure 1: Enrollments in Biocore 381



Given the multiple and sequential steps that need to be completed or in progress for admission to the Biocore program, we explored whether a change in the timing of completion of these Biocore academic prerequisites may have contributed to the declining applications and enrollment. The first course of the Biocore program sequence is only offered in fall semesters. Therefore, if students are not eligible to start in the Biocore program by their 3rd semester at UW-Madison they may choose to complete another Biology course sequence in order to make progress towards graduation.

Figure 2: Number of Biocore-Eligible Undergraduates by Semester of Biocore Eligibility

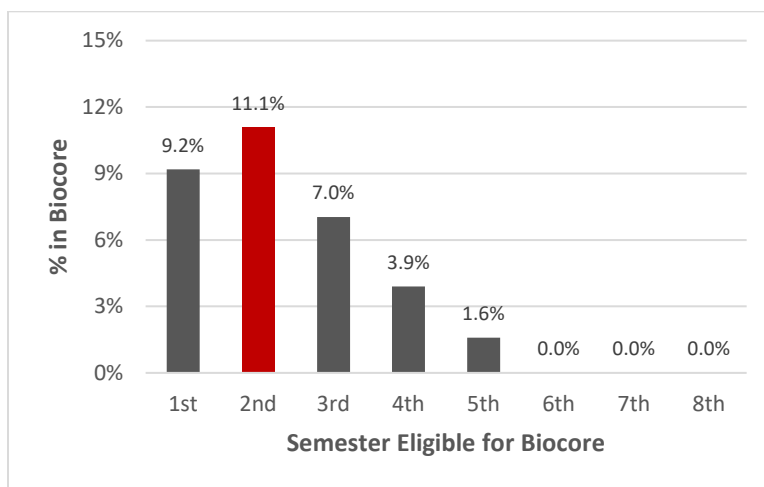


Among new freshmen who entered over the last seven fall new freshman cohorts (44,000 new freshmen), around 8,400 (19%) completed the three academic requirements for Biocore eligibility by the end of the spring 2018 semester. Half of these undergraduates met the Biocore academic eligibility requirements in their 3rd semester at UW-Madison (typically their second fall semester). An additional 18%-20% meet the Biocore academic eligibility requirements in their 2nd and 4th semesters respectively (Figure 2, above).

Biocore Participation Rates

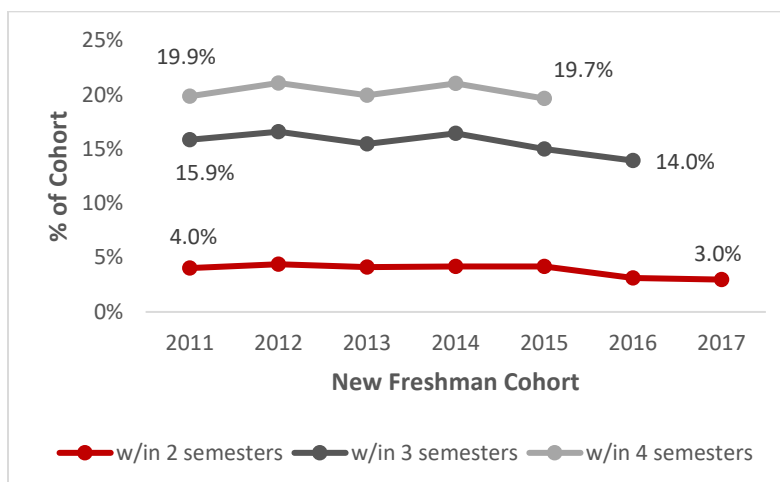
Overall, 6.7% of Biocore-eligible undergraduates participate in Biocore (around 1,200 new Biocore-eligible undergraduates per year). Participation rates are highest (11%) for students who complete the Biocore academic eligibility requirements in their 2nd semester. Participation rates are lower for undergraduates who complete the Biocore academic eligibility requirements in their 3rd and 4th semesters (7% and 4% respectively) when most Biocore-eligible undergraduates become eligible (Figure 3).

Figure 3: Biocore Participation Rates by Semester of Eligibility



Over the last seven cohort years, there has been a slight decrease in the percentage of undergraduates who are academically eligible for the Biocore program within two and three semesters. This has resulted in fewer students who are academically eligible for the Biocore program during the time that has the highest Biocore program participation rates (Figure 4).

Figure 4: Trends in Biocore Eligibility



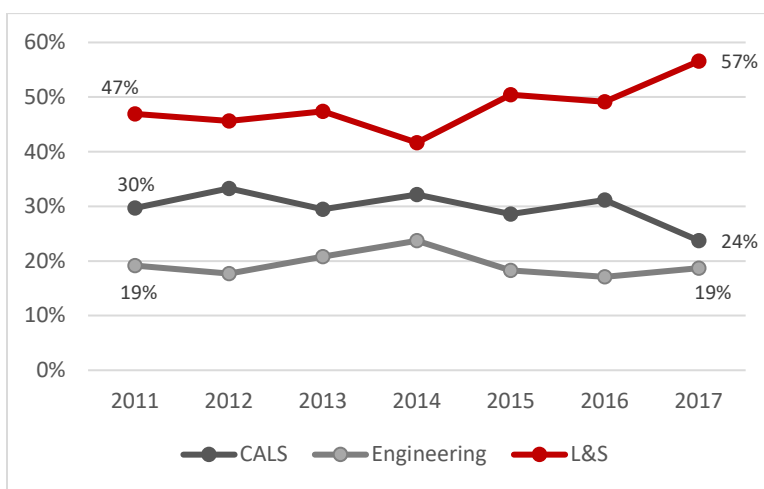
Although the percentage of undergraduates who are academically eligible for the Biocore program within four semesters has remained steady around 20% of each entrance cohort, the percentage of undergraduates who are academically eligible for the Biocore program by the end of their second semester dropped from 4% of freshman in 2011 to 3% of new freshman in 2017.

Similarly, the percentage of undergraduates who are academically eligible for the Biocore program by the end of their third semester at UW-Madison dropped from almost 16% of new freshmen who entered in 2011 to 14% of new freshmen who entered in 2017. This trend of later completion of the academic prerequisites for the Biocore program coupled with lower Biocore program participation rates among later completers may have contributed to the decrease in participation.

Biocore Participation by School/College and Major

Almost all undergraduates who are academically eligible for the Biocore program are in degree-major programs in the College of Letters and Science, the College of Agricultural and Life Sciences, or the College of Engineering. In addition to a shift towards later completion of the academic prerequisites for the Biocore program, there was also a change in the home college of undergraduates who completed the academic prerequisites for participation in the Biocore program. Starting in 2015, at the same time enrollments in Biocore 381 decreased, there was an increase in the proportion of Biocore-eligible undergraduates in the College of Letters and Science and a decrease in the proportion of Biocore-eligible undergraduates in the College of Agricultural and Life Sciences (Figure 5).

Figure 5: Trends in School/College of Biocore-Eligible Students

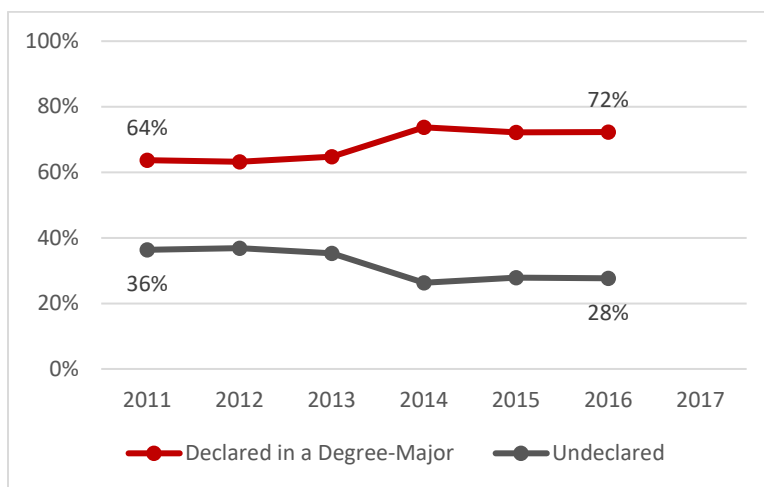


Among students who entered UW-Madison in 2011 and completed the academic prerequisites for the Biocore program, 47% of them were in degree-major programs in the College of Letters and Science at the time of academic eligibility for the Biocore program. By the 2017 cohort, 57% were in degree-major programs in the College of Letters and Science. Conversely, the proportion of Biocore-eligible undergraduates in the College of Agricultural and Life Sciences decreased from 30% in the 2011 cohort to 24% of the 2017 cohort. The proportion of undergraduates who have completed the academic prerequisites for the Biocore program in the College of Engineering has remained steady at 19% over the last seven years (concentrated in two specific majors - Chemical Engineering and Biomedical Engineering).

Another shift that occurred around the time that enrollments in Biocore 381 decreased in 2015 was the increase in students who are declared in a degree-major at the time they complete the academic prerequisites for the Biocore program (Figure 6). The percentage of students declared in a degree-major at the time of Biocore-

eligibility rose from 64% of new freshmen who entered UW-Madison in 2011 to 72% of new freshmen who entered UW-Madison in 2016. Students who entered in 2017 have not generally been enrolled long enough to have established patterns of major declaration.

Figure 6: Trends in Declared Major Status at Time of Biocore Eligibility



Two changes in advising-related practices around the time of the increase in major declaration may have contributed to this shift. First, institutional efforts to reduce time-to-degree led to expectations of students having a declared degree-major by the time they reach junior standing. Increased attention to this issue and formalization of policies about expectations for major declaration in every school/college likely impacted the timing of major declaration.

Second, applicants for UW-Madison admission were given the opportunity to indicate two intended majors at the time of application. Applicants who had not narrowed their interests to a single major (for example students interested in either Biology or Neurobiology) would sometimes indicate “undecided” on their application for admission leading to the assignment of an academic advisor for “undecided” students. The addition of a second intended major gave the students with two interests the opportunity to indicate both, resulting in the possibility of assignment to a major or discipline-specific advisor and earlier advising towards completion of degree-major requirements.

Even though the proportion of undergraduates who completed the academic prerequisites for the Biocore program and did not have a declared degree-major decreased between 2011 and 2017, almost one third (31%) of Biocore-eligible undergraduates are not declared in a degree-major at the time they become Biocore-eligible (Table 1). The source of the largest **number** of Biocore-eligible students is found in the plan codes for undecided students (BA/BS 000 and ALS 000) who are advised through Transitional Advising & Outreach Services in CALS or Cross College Advising Services, Academic Advising Services (AAS), or the Center for Academic Excellence (CAE) in L&S. Ensuring that advisors of these students are aware of the Biocore program and able to answer basic questions about it seems critical to maintaining or increasing enrollments.

Many students who enter UW-Madison assigned to advising units for “undecided” students eventually declare and graduate with degree-majors in biological science fields. Recruitment for the Biocore program that is focused on declared biological science students or students with a specific biological science interests at the time of application for admission will miss most students who eventually complete the academic prerequisites for the Biocore program.

Table 1: Biocore Participation Rates by Undergraduates without Declared Degree-Majors for 2011-2017 Entrance Cohorts

Plan Code	Plan Name	# Biocore Eligible	# in Biocore	Participation Rate
Overall		8,438	563	6.7%
BA/BS 000	Undeclared (L&S)	2,540	154	6.1%
ALS 000	Undeclared (CALs)	76	0	0.0%

Overall 6.7% of undergraduates who complete the academic prerequisites for the Biocore program participate in Biocore. Rates of participation range from more than 19% of Biocore-eligible L&S Biochemistry majors to none of the Environmental Sciences majors (Table 2). Understanding why participation rates in the Biocore program vary so much between degree-majors, including between the SAME major in different schools and colleges (see Microbiology in L&S and CALs), would identify potential strategies to increase Biocore enrollments and might identify additional contributing reasons to the decline in Biocore enrollments.

Table 2: Biocore Participation Rates by Degree-Major for 2011-2017 Entrance Cohorts

Plan Code	Plan Name	# Biocore Eligible	# in Biocore	Participation Rate
BS 103	Biochemistry (L&S)	134	26	19.4%
BS 677	Microbiology (L&S)	45	8	17.8%
ALS 103	Biochemistry (CALs)	447	72	16.1%
BS 684	Molecular Biology (L&S)	65	9	13.8%
BS 112	Biology (BS, L&S)	521	60	11.5%
BA 112	Biology (BA, L&S)	78	8	10.3%
ALS 459	Genetics and Genomics	369	37	10.0%
ALS 112	Biology (CALs)	904	68	7.5%
Overall		8,438	563	6.7%
BS 708	Neurobiology	152	10	6.6%
BME 115	Biomedical Engineering	621	39	6.3%
BS 832	Psychology	128	8	6.3%
BS 153	Chemistry	68	4	5.9%
ALS 677	Microbiology (CALs)	212	8	3.8%
ALS 717	Nutritional Sciences	89	3	3.4%
PKN/KNS 768	Kinesiology	116	3	2.6%
ALS 436	Food Science	133	1	0.8%
ALS 065	Animal Sciences	134	1	0.7%
CHE 148	Chemical Engineering	660	2	0.3%
ALS 414	Environmental Sciences	57	0	0.0%

Note: Students are counted once in each declared major in the semester that they completed the academic prerequisites for the Biocore program. Majors with 40 or more Biocore-eligible undergraduates are included.

Relationship between Credit for Advanced Placement (AP) Biology Test Scores and Biocore Participation

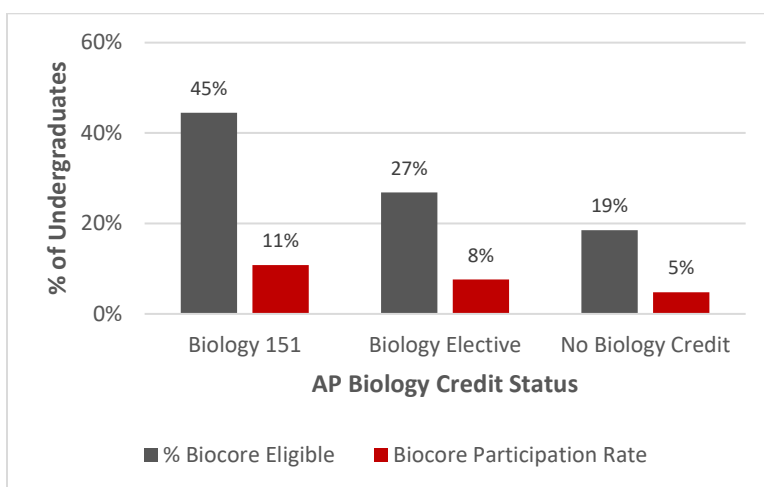
In 2013, the credits awarded for high scores on the AP Biology test were changed from elective credit to direct course equivalent credit for Biology/Botany/Zoology 151 (Introductory Biology). Biocore staff wonder whether the decrease in Biocore enrollments might be tied to this decision since undergraduates would have already completed the first course of a two-course Biology sequence via the AP credit as opposed to enrolling in a four-course honors biology course sequence.

Although this change in AP course credit equivalencies may have affected the decision to participate in Biocore for some individual students it is unlikely to be a systemic contributor to the declining enrollments in Biocore. For one, the decision to award course equivalent credit for AP Biology scores of 4 or 5 mainly corrected an inequity in the practice by allowing ALL undergraduates who scored a 4 or 5 to have credit for Biology 151. Previously, direct equivalencies for Biology 151 were routinely granted on an individual basis to students who knew who to talk to about this and pursued the issue.

Since 2013 when the policy on AP credit for Biology changed to awarding to all high scoring students, the actual **number** of new freshmen submitting AP Biology test scores has increased significantly. However, the increase has been almost entirely in students with scores of 3 who continue to receive biology elective course credit rather than credit for Biology 151. The number of undergraduates entering UW-Madison with scores of 4 or 5 on the AP Biology test (scores that might affect Biocore participation) has not increased markedly.

Second, the proportion of new freshmen entering UW-Madison who become Biocore-eligible is highest among the students who had AP Biology credit for Biology 151. Their participation rates in Biocore are also higher than other students (Figure 7). Forty-five percent (45%) of undergraduates with AP credit for Biology 151 become Biocore-eligible compared to 27% of undergraduates with AP credit for a biology elective (score of 3 on the AP Biology test) and 19% of undergraduates who did not submit scores of the AP Biology test. Among Biocore-eligible students, Biocore participation rates are highest for students with AP credit for Biology 151 (11%) and are lower for students with biology elective credit (8%) or no AP Biology credit (5%).

Figure 7: Biocore Participation and Eligibility and AP Biology



Grades in Commonly-Taken Courses

Biocore program leaders also wondered how undergraduates participating in the Biocore program performed in commonly-taken courses outside of the Biocore program relative to other students who are not Biocore program participants. One interesting finding is just how few courses are in common among undergraduates who completed the academic prerequisites for the Biocore program. The following eleven courses are the only

biological-science-related courses that at least 40 students in each group took after completing the academic prerequisites for the Biocore program (Table 3).

The relatively few number of “common” courses plus both the differences in time over when students took these courses and the variety of instructors of them (for example, the Biochemistry 501 students took the course in 24 different semester/section combinations) and other differences in the populations that are known predictors of course outcomes are a caution about their comparability. Nonetheless, the relatively high average GPAs and high “B or Better” rates suggest that these students are well-prepared for subsequent major-related coursework and do well.

Table 3: Grades for Biocore-Eligible Undergraduates in Commonly Taken Courses

	Number Enrolled	Enrollment Rate	Average GPA	B or Better Rate	D/F Rate
Biochemistry 501 – Not in Biocore Prog.	4,025	50%	3.14	73%	2%
Biochemistry 501 – In Biocore Program	288	51%	3.34	82%	1%
Biochemistry 507 – Not in Biocore Prog.	681	8%	3.02	66%	3%
Biochemistry 507 – In Biocore Program	130	23%	3.28	80%	1%
Biochemistry 508 – Not in Biocore Prog.	587	54%	2.83	61%	6%
Biochemistry 508 – In Biocore Program	122	61%	3.08	79%	2%
Biochemistry 551/651 – Not in Biocore Prog.	512	53%	3.39	53%	2%
Biochemistry 551/651 – In Biocore Program	87	58%	3.73	58%	1%
Chemistry 565 – Not in Biocore Prog.	472	6%	3.13	73%	3%
Chemistry 565 – In Biocore Program	86	15%	3.41	83%	3%
Medical Microbiology 341 – Not in Biocore Prog.	938	56%	3.76	94%	0%
Medical Microbiology 341 – In Biocore Program	58	55%	3.78	93%	0%
Microbiology 303 – Not in Biocore Prog.	1,970	24%	3.14	76%	3%
Microbiology 303 – In Biocore Program	87	15%	3.36	83%	3%
Microbiology 304 – Not in Biocore Prog.	1,180	57%	3.30	57%	0%
Microbiology 304 – In Biocore Program	52	55%	3.46	55%	0%
Population Health 370 – Not in Biocore Prog.	752	55%	3.61	96%	0%
Population Health 370 – In Biocore Program	76	57%	3.68	97%	0%
Psychology 509/405 – Not in Biocore Prog.	569	54%	3.36	86%	2%
Psychology 509/405 – In Biocore Program	64	56%	3.38	84%	2%
Zoology 523 – Not in Biocore Prog.	864	55%	3.38	88%	2%
Zoology 523 – In Biocore Program	98	59%	3.62	94%	0%

Notes: 1) enrollment rate is the percentage of Biocore-eligible students in this study who enrolled in the course. 2) average GPA is the average course grades of the enrolled students who completed the course for a grade by July 5, 2018 (doesn't include pass/fail or grades that were incomplete). 3) B or better rate is the percentage of course completers with a grade where the final grade was a B, AB, or A. 4) The D/F rate is the percentage of course completers with a grade where the final grade was a D or F or U (unsatisfactory grade for students who took the course pass/fail).

Time-to-Degree (Elapsed Calendar Years)

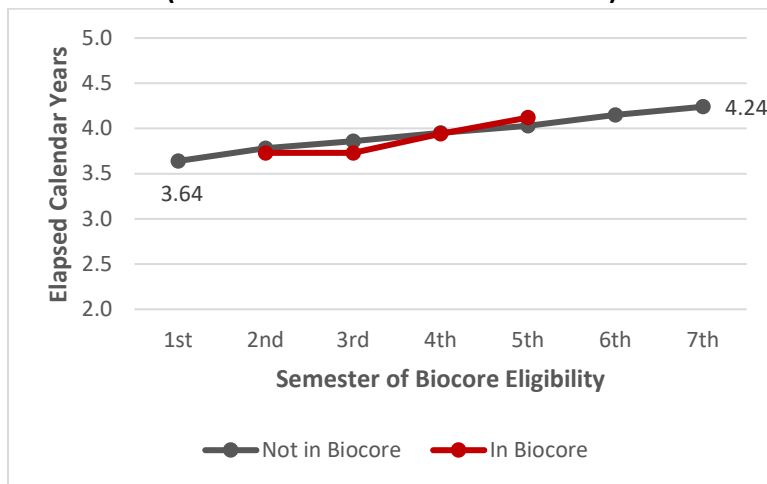
Biocore program faculty and staff also wondered whether concern about time-to-degree, either real or perceived, may be a contributing factor to the decreasing participation in the Biocore program. Because Biocore is a four-semester course sequence, students may think that it will take longer to complete their degree than if they took another course sequence.

Figure 8 shows the average time-to-degree of UW-Madison bachelors degree recipients in the last five years who completed the academic prerequisites for the Biocore program. Average time-to-degree increases with each semester it takes to complete the academic prerequisites for the Biocore program. The relatively few (42) graduates who completed the academic prerequisites for the Biocore program in their first semester had an average time-to-degree of 3.64 years (slightly less than the 3.78 years to a traditional four-year degree) compared to an average time-to-degree of 4.24 years for the relatively few (53) graduates who completed the academic prerequisites for the Biocore program in their 7th semester.

The average time-to-degree of graduates who participated in the Biocore program is like that of other graduates who completed the academic prerequisites for Biocore but did not participate in the program. Average time-to-degree ranged from 3.73 years for Biocore program participants who completed academic prerequisites in their 2nd and 3rd UW-Madison semesters to 4.12 years for Biocore program participants who completed the academic prerequisites in their 5th UW-Madison semester.

In general, Biocore program leaders should feel confident in assuring students that they can participate in the Biocore program without adding to time-to-degree. However, completing the academic prerequisites for the Biocore program and entering Biocore as soon as academically eligible are key to keeping time-to-degree as low as possible.

Figure 8: Time-to-Degree for Biocore-Eligible Bachelors Degree Recipients (2013-14 to 2017-18 Academic Years)



Grade Point Average at Graduation

Biocore program faculty and staff also wondered whether concern about grade point averages, either real or perceived, may be a contributing factor to the decreasing participation in the Biocore program. Academic advisors that we interviewed during this analysis also confirmed that the sentiment “Biocore kills your GPA” is prevalent among students and is sometimes cited as a reason for not participating. Concern about grades and grade point averages seems particularly important to Biocore-eligible students who are often intending to pursue graduate and professional programs where GPA weighs heavily into admission considerations.

Ideally, comparisons of GPAs are done at the course level where the grades originate. Comparisons of average GPAs across student populations who took different courses are difficult to interpret, particularly when attempting to evaluate the impact of a program or particular activity. However, since we have already established that undergraduate Biocore participants take different courses than other Biocore-eligible students, a course-specific GPA comparison is not possible.

With that said, average GPAs at graduation of all Biocore-eligible students are high – over 3.30. The average GPAs at graduation for Biocore program participants are even higher with an average of 3.55. Biocore leaders and academic advisors who are often key recommenders of the Biocore program to eligible students can feel confident assuring students that Biocore participation and a high GPA are mutually achievable.

Table 4: Grade Point Averages (GPA) at Graduation for Biocore-Eligible Undergraduates

School/College Awarding Degree	Graduates not in Biocore Program		Graduates in Biocore Program	
	Number of Grads	Average GPA	Number of Grads	Average GPA
Agricultural and Life Sciences	1,859	3.34	165	3.51
Engineering	711	3.41	26	3.66
Letters and Science	1,662	3.37	184	3.58
Pharmacy	163	3.57	7	3.82
Overall	4,587	3.37	387	3.55

Note: Overall figure includes all graduates including some who did not graduate from the schools/colleges above. Schools/colleges from which fewer than five Biocore program participants graduated are not shown separately.

Summary

This analysis did not identify a specific, single cause of declining participation in the Biocore program. Instead we note subtle changes towards delay of completion of the academic prerequisites courses for the Biocore program which may have created discontinuities in when students became eligible for the Biocore program relative to when the first Biocore course is offered. Other shifts in enrollments between the College of Letters and Science and Agricultural and Life Sciences and trends towards earlier declaration of majors likely caused shifts in the academic advisors of these undergraduates who may be key recommenders of the Biocore program.

This analysis did not confirm any of the rumors circulating among students and staff about the Biocore program having a negative effect on grade point averages or time-to-degree. Instead it confirms that students participating in the Biocore program are successful at UW-Madison and graduate on time and well positioned for future graduate and professional endeavors.