

Engaging Students in Biology: The Success of Biology Resource Center Students in Biology Courses



The Biology Resource Center (BRC) offers free individual or group tutoring to students in IUPUI Biology courses. Though the BRC has been in operation for several years, there has never been a systematic analysis of the success of students who received services. The following Research Brief explores the effect of attending the BRC on grades in specific Biology courses.

Key findings from this report include the following:

- Students who attend the BRC have a significantly higher cumulative GPA and are significantly more likely to be a biology or pre-biology major. However, there is still much that is not known about personality characteristics that might drive students to attend the BRC.
- In five courses, (K101, K103, K322, N217, and N261), students who attended the BRC earned a significantly higher grade, even when accounting for cumulative GPA and SAT score. In N261, the difference in grades between attendees and non-attendees was half of a grade.
- In these same five courses, the projected grade in each course would increase each time a student attends the BRC. For example, a Nursing major with a 3.0 cumulative GPA taking N261 would expect about a C+ if they never attend the BRC, but would expect a B if they attend the BRC five times.

Differences between Participants and Non-Participants

The BRC offers drop-in tutoring for five courses (Biology K101, K103, N212, N217, and N261), and appointment based tutoring for two courses (K322 and K384). Students included in this analysis

also came to the BRC for assistance in K102, N214, and CHEM-C384, though there were only enough students to conduct meaningful analysis for N214.

Table 1 depicts significant differences between students enrolled in one of the courses for which BRC provided tutoring during the Fall 2015, Spring 2016, and Fall 2016 semesters. Students who attended the BRC had a slightly higher cumulative GPA at the beginning of the semester, and were also significantly more likely to be female, African American, Latino/a, or enrolled full-time compared to non-participants.

Appendix A displays demographic and academic characteristics of students who did and did not receive tutoring from the BRC by course. In almost every course, students who received tutoring had a higher average cumulative GPA prior to the beginning of the semester. However, in K101 and N212, students who received tutoring from the BRC actually had a significantly lower mean SAT score. BRC attendees who sought help in K101, K103, or N212 were significantly more likely to be female compared to the entire student population in those courses.

Table 1
Demographics and Academic Preparation of Fall 2015, Spring 2016, and Fall 2016 of BRC Attendees and Non-Attendees

	Attend	Non-Attend
Best SAT Score ^a	1048	1058
Cumulative GPA ^{b*}	3.28	3.10
Percentage Female ^{c*}	73.8%	69.6%
Percentage African American ^{c*}	11.8%	9.7%
Percentage Latino/a ^{c*}	10.5%	8.0%
Percentage Full-Time ^{c*}	87.6%	84.4%

* Statistically significant difference at $\alpha \leq 0.05$.

^a4,956 students who received a grade in BRC courses had an SAT score on file

^b5,710 students who received a grade in BRC courses had a cumulative GPA prior to the beginning of the semester.

Because of the differences in characteristics between BRC attendees and non-attendees, a model was developed to better understand which students are likely to go to the BRC for assistance in their Biology courses. The full model can be found in Appendix B, and Table 2 displays projected probability of BRC attendance based on specific characteristics.

The variables that had the greatest impact on BRC attendance were cumulative GPA, SAT score, and major. Cumulative GPA had a specifically strong effect on BRC attendance. A female student with a 3.0 GPA, an average SAT score, and not majoring in a STEM or Health/Life Science field would have about a 9% probability of attending the BRC for help with a Biology class. Similarly, a similar student with a 4.0 GPA would have a 17% probability of seeking help from the BRC. Similarly, if that same student were majoring in a University College

pre-Biology program, they would have about a 29% probability of attending the BRC for tutoring. Further projected probabilities can be seen in Table 2 below. It should be noted however that this model only accounted for a 5% reduction in poorness of fit, suggesting that other factors that are not accounted for in the model are likely driving BRC attendance.

Table 2
Changes in Probability of Attending the Biology Resource Center for Fall 2015, Spring 2016, and Fall 2016 Students

Variable	Probabilities
Cumulative GPA 2.0 ¹	3.8%
Cumulative GPA 3.0 ¹	8.0%
Cumulative GPA 4.0 ¹	15.8%
Biology Major ²	19.8%
Pre-Biology Major ²	27.6%
Other STEM Major ²	17.0%

¹ Probabilities assume an average SAT score, Female, not majoring in Nursing, Biology, or any other STEM or Health/Life Science program. Other variables can be found in Appendix B.

² Probabilities assume 3.0 cumulative GPA, average SAT score, and Female. Other variables can be found in Appendix B.

Figure 1 compares the average grade for BRC attendees and non-attendees in courses for which the BRC has tutoring services and had more than 25 students receiving tutoring between Fall 2015 and Fall 2016. In each course, students who had received services from the BRC had received a significantly higher grade in the course than students who did not. For every course except N212 and N214, BRC students still earned higher grades even when controlling for cumulative GPA and SAT score.

Table 3
Difference in Course Grade by BRC Attendance ¹

	Unadjusted (N)		Adjusted ²	
	Attend	Non-Attend	Attend	Non-Attend
BIOL K101 ^{ab}	2.96 (179)	2.75 (534)	2.99	2.74
BIOL K103 ^{ab}	2.89 (155)	2.66 (393)	2.82	2.69
BIOL K322 ^{ab}	3.47 (71)	2.64 (313)	3.15	2.71
BIOL N212 ^a	2.98 (25)	2.40 (374)	2.74	2.41
BIOL N214	2.68 (36)	2.57 (155)	2.60	2.59
BIOL N217 ^{ab}	2.96 (66)	2.56 (672)	2.90	2.57
BIOL N261 ^{ab}	3.18 (131)	2.72 (966)	3.02	2.74

¹ Of students who had a greater than 0.0 cumulative GPA prior to the semester. N's are included in parenthesis.

² Adjusted based on cumulative GPA and students' best SAT score.

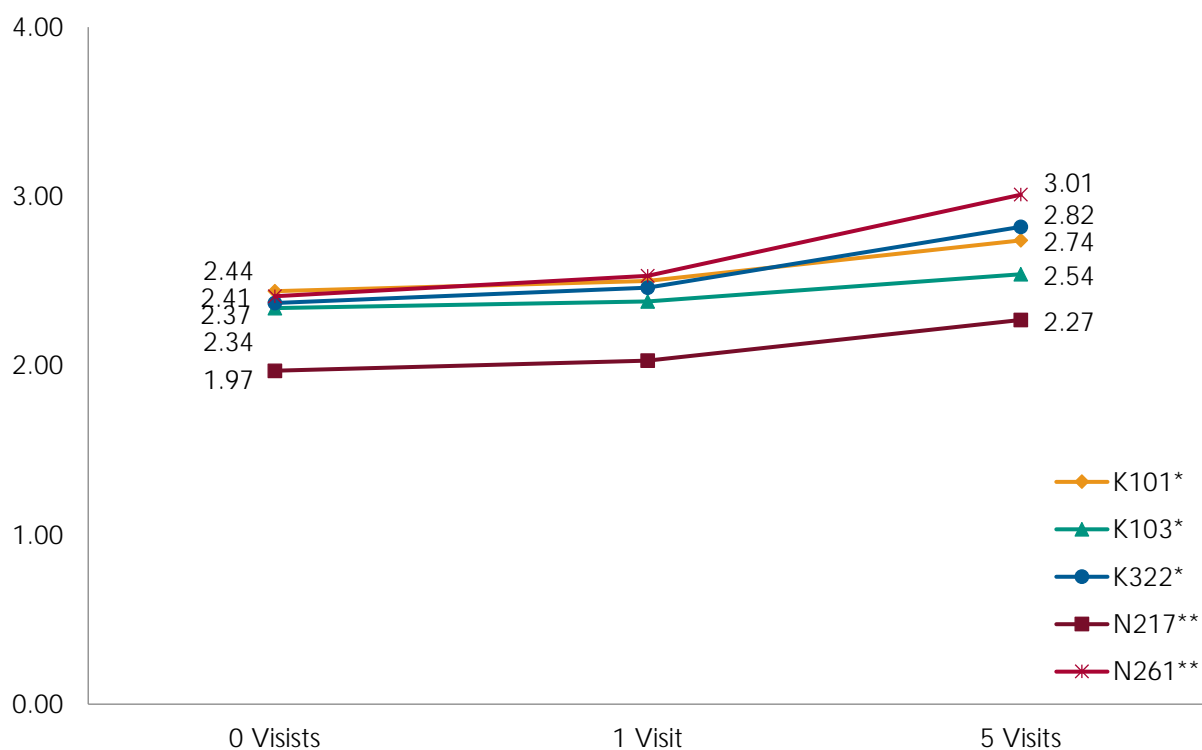
^a T-Test revealed significant difference in unadjusted means at $\alpha \leq 0.05$

^b Analysis of covariance revealed significant difference in adjusted means at $\alpha \leq 0.05$

Appendix C displays the results of regression analyses exploring the association between course grade and BRC attendance and a number of other factors associated with student success. Attending the BRC at least once was significantly associated with the student's grade in every course except for N212, even net the effect of all the control variables. Cumulative

GPA, SAT score, and enrollment as a Non-Bachelor's seeking student were the only other variables that had a similar effect across multiple different courses. Students' projected grade also seems to increase with each BRC session. Figure 1 displays projected grades for students who attended the BRC 0, 1, and 5 times for their Biology class. For example, a female, African American Nursing student with a 3.0 GPA taking N 261 would be expected to earn about a C+ in her course (2.41). If that student were to visit the BRC 5 times, the expected grade would improve to about a B (3.01). Similarly, that same student would be projected to earn a C in N217 (1.97) but would be expected to earn a C+ after attending 5 BRC sessions (2.27). The effect of number of BRC sessions is significant for both of these courses as well as K101, K103, and K322 (see Appendix D for the full model).

Figure 1
Projected Course Grade by Number of BRC Visits¹



¹ Model assumes student with a 3.0 cumulative GPA, average SAT score for their course, female, African American, full-time, Bachelor's seeking non-transfer. K101, K103, and K322 assumes student is a pre-Biology major. N217 and N261 results assume student is a Nursing or pre-Nursing major.

Conclusion

Students receiving services from the Biology Resource Center tend to have a higher cumulative GPA than students who did not. Despite this, BRC attendees tend to receive a higher grade in their Biology course than students who do not receive services, even when controlling for cumulative GPA, SAT score, and a number of other factors. This effect is present for every course except N212 and N214, though these results may be affected by the fact that students receive extra credit in N214. Projected grades for students also seem to increase in K101, K103, K322, N217, and N261 with each appearance at the BRC. However, current data

does not provide a great deal of insight into the factors that influence which students attend the BRC and which do not. Future research might look into psychological variables, such as self-efficacy or achievement needs, that might drive students' tendency to seek out BRC services.

Appendix A

Demographic Comparisons of Fall 2015, Spring 2016, and Fall 2016 of BRC Attendees and Non-Attendees by Class

Demographic	Biology K101 ^c		Biology K103 ^b		Biology K322 ^c		Biology N212 ^d		Biology N214 ^e		Biology N217 ^f		Biology N261 ^g	
	Attend	Non-Attend	Attend	Non-Attend	Attend	Non-Attend	Attend	Non-Attend	Attend	Non-Attend	Attend	Non-Attend	Attend	Non-Attend
Gender														
Female	70.7%	62.6%	68.9%	59.5%	60.0%	57.9%	89.7%	75.7%	84.6%	73.2%	83.1%	77.0%	82.8%	76.1%
Male	29.3%	37.4%	31.1%	40.5%	40.0%	42.1%	10.3%	24.3%	15.4%	26.8%	16.9%	23.1%	17.8%	23.9%
Ethnicity														
African American	15.7%	8.5%	13.0%	8.8%	6.3%	8.5%	8.8%	12.4%	7.9%	8.6%	7.9%	10.0%	9.5%	10.6%
Latinx	10.8%	7.7%	10.9%	9.2%	6.3%	9.7%	8.8%	9.5%	26.3%	8.6%	5.3%	7.5%	10.0%	7.2%
Native American/ Alaska Native	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Asian	10.0%	7.7%	9.9%	9.0%	15.0%	10.1%	3.5%	2.8%	2.6%	2.5%	5.3%	6.2%	6.3%	4.4%
Native Hawaiian/ Pacific Islander	0.3%	0.2%	0.5%	0.0%	1.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Two or more races	4.9%	4.6%	3.1%	5.3%	5.0%	5.1%	1.8%	4.4%	2.6%	3.5%	5.3%	3.0%	4.7%	5.5%
White	54.9%	67.0%	59.9%	64.3%	65.0%	63.5%	75.4%	68.1%	60.5%	74.8%	75.0%	72.3%	68.4%	71.0%
International	3.5%	4.2%	2.6%	3.5%	1.3%	3.2%	1.8%	2.8%	0.0%	2.0%	1.3%	1.1%	1.1%	1.4%
Admit Type														
First time UG	83.1%	80.3%	78.2%	79.6%	76.3%	70.6%	86.2%	77.4%	82.1%	75.3%	80.5%	71.3%	71.7%	74.0%
External Transfer	14.8%	17.6%	19.7%	17.9%	18.8%	21.5%	12.1%	21.7%	18.0%	23.7%	15.6%	24.0%	22.0%	21.5%
Other admit type ¹	2.1%	2.1%	2.1%	2.5%	4.9%	7.9%	1.7%	0.9%	0.0%	1.0%	3.9%	4.7%	6.3%	4.5%
Part-Time	6.7%	9.8%	12.4%	12.3%	11.3%	10.2%	6.9%	10.0%	2.6%	15.2%	24.7%	23.7%	20.4%	19.4%
Best SAT score ²	1033	1084	1100	1109	1170	1143	923	972	939	984	1019	1049	1008	1012
Mean Cumulative GPA ³	3.14	3.00	3.31	3.11	3.50	3.15	3.25	2.83	3.08	2.92	3.51	3.29	3.25	3.04

Bold and Italicized items are significant for that course.

^a1,490 students received a grade in K101 during this period. 372 attended tutoring at the BRC and 1,118 did not.

^b707 students received a grade in K103. 193 attended tutoring at the BRC and 514 did not.

^c522 students received a grade in K322. 80 attended tutoring at the BRC and 442 did not.

^d836 students received a grade in N212. 58 attended tutoring at the BRC and 778 did not.

^e237 students received a grade in N214. 39 attended tutoring at the BRC and 198 did not.

^f1,027 students received a grade in N217. 77 attended tutoring at the BRC and 950 did not.

^g1,722 students received a grade in N261. 191 attended tutoring at the BRC and 1,531 did not.

¹Other admit types include second Bachelor's, graduate student, high school student, returning undergraduate, and visiting student

²Of those students who have an SAT score on file. Many transfer students or other admit types do not submit an SAT score.

³Cumulative GPA as of the beginning of the semester.

Appendix B

Results of Logistic Regression on Biology Resource Center Attendance for Fall 2015, Spring 2016, and Fall 2016 Student Enrolled in BRC Courses

Parameter	B ¹	Std. Error	Odds Ratio
Cumulative GPA* ²	0.77	0.09	2.16
SAT* ³	-0.29	0.06	0.17
Biology major ^{4*}	1.05	0.23	2.86
Pre-Biology major ^{4*}	1.48	0.24	4.41
Nursing major	-0.10	0.22	0.90
Other STEM major ^{5*}	0.87	0.21	2.38
Other Health/Life Science major ⁶	0.36	0.21	1.44
Female	0.21	0.11	1.23
African American	0.28	0.15	1.32
Latinx	0.21	0.16	1.23
Attending part-time	-0.05	0.18	0.95
Transfer student	-0.31	0.16	0.73
Non-Bachelor's student	0.08	0.32	1.08
Intercept ⁷	-2.66	0.21	

Chi-Square= 176.76, model was statistically significant at $\alpha \leq 0.05$; McFadden's $R^2=0.05$

* Effect was statistically significant at $\alpha \leq 0.05$ net the effect of the other independent variables.

¹ Regression coefficient for this variable. Used in calculating expected odds of attending the BRC.

² In order to aid in interpretation, GPA was centered around a 3.0 GPA. Therefore, the odds of attending the BRC would be 2.16 times greater for a student who earned a 4.0 cumulative GPA prior to the semester than it would be for a student who earned a 3.0.

³ In order to aid in interpretation, SAT score weights reflect the Z score of SAT based on a mean of 1052 and standard deviation of 165.

⁴ Biology majors include Biology BS, Biology BA, Biology Teaching, and Masters' Biology students. Pre-Biology majors include University College students in Biology pre-majors.

⁵ Other STEM majors include students in Science, Engineering & Technology, and University College Science and Engineering and Technology students not majoring in Biology.

⁶ Other Health/Life Science majors include students in majors and pre-majors served by the Health and Life Sciences Advising Center. A complete list can be found here: <https://hls.iupui.edu/majors/index.html>.

⁷ Intercept also refers to the constant in a regression equation. This value represents the log of the odds that a student with none of the characteristics listed in the model would visit the Biology Resource Center. In other words, a student with none of the characteristics listed, a 3.0 cumulative GPA, and an average SAT score.

Appendix C

Results of BRC Attendance on Grades by Class

Parameter	K 101 ¹		K 103 ²		K 322 ³		N 212 ⁴		N 217 ⁵		N 261 ⁶	
	B	Std. Error	B	Std. Error	B	Std. Error	B	Std. Error	B	Std. Error	B	Std. Error
Attended BRC	0.27	0.07	0.14	0.06	0.45	0.11	0.27	0.20	0.32	0.10	0.27	0.09
Cumulative GPA ^a	0.74	0.05	0.78	0.05	0.58	0.06	0.80	0.08	1.08	0.07	0.90	0.05
SAT score ^b	0.22	0.04	0.24	0.03	0.32	0.05	0.12	0.05	0.21	0.03	0.24	0.03
Biology major	-0.03	0.11	-0.07	0.09	0.11	0.09	0.89	0.54	0.50	0.14	0.45	0.14
Pre-Biology major	-0.20	0.11	-0.20	0.10	-0.15	0.28	0.56	0.48	0.03	0.39	0.19	0.20
Nursing major	-0.15	0.25	-0.05	0.43	1.82	0.84	-0.33	0.26	<0.01	0.07	0.15	0.07
Other STEM major	-0.11	0.09	-0.22	0.08	--	--	-0.26	0.14	0.13	0.12	0.15	0.10
Other non-Health/Life Science major	-0.24	0.12	-0.23	0.14	--	--	-0.36	0.13	0.20	0.15	-0.25	0.11
Female	-0.18	0.07	-0.07	0.05	-0.21	0.08	-0.25	0.11	-0.16	0.07	-0.01	0.07
African American	-0.07	0.11	-0.09	0.09	0.07	0.17	-0.32	0.16	-0.02	0.11	-0.25	0.10
Latinx	-0.19	0.12	-0.18	0.09	-0.14	0.14	0.05	0.16	-0.10	0.11	-0.02	0.11
Attending part-time	0.48	0.14	0.38	0.11	-0.53	0.20	0.29	0.17	0.19	0.09	<0.01	0.10
Transfer student	0.10	0.10	0.42	0.09	0.15	0.14	-0.29	0.17	-0.02	0.09	0.09	0.09
Non-Bachelor's student	0.13	0.23	0.40	0.19	2.19	0.23	1.08	0.58	0.50	0.18	0.78	0.17
Intercept	2.85	0.08	2.67	0.08	2.61	0.10	2.82	0.11	2.15	0.08	2.52	0.08

Bold and italic effects are statistically significant at $\alpha \leq 0.05$. Includes Fall 2015, Spring 2016, and Fall 2016 course grades only. Students with no Cumulative GPA prior to the semester were excluded.

¹N=713, F=32.53, statistically significant at $\alpha \leq 0.05$. $R^2 = 0.39$.

²N=548, F=53.60, statistically significant at $\alpha \leq 0.05$. $R^2 = 0.58$.

³N=406, F=26.62, statistically significant at $\alpha \leq 0.05$. $R^2 = 0.45$.

⁴N=399, F=14.15, statistically significant at $\alpha \leq 0.05$. $R^2 = 0.34$.

⁵N=738, F=42.62, statistically significant at $\alpha \leq 0.05$. $R^2 = 0.45$.

⁶N=1,097, F=53.04, statistically significant at $\alpha \leq 0.05$. $R^2 = 0.41$.

^aIn order to aid in interpretation, cumulative GPA was centered around a 3.0 GPA.

^bIn order to aid in interpretation, SAT was standardized around the mean SAT and standard deviation for that course.

Appendix D

Results of Number of BRC Visits on Grades by Class

Parameter	K 101 ¹		K 103 ²		K 322 ³		N 212 ⁴		N 217 ⁵		N 261 ⁶	
	B	Std. Error	B	Std. Error	B	Std. Error	B	Std. Error	B	Std. Error	B	Std. Error
Number of BRC visits	<i>0.06</i>	<i>0.01</i>	<i>0.04</i>	<i>0.01</i>	<i>0.09</i>	<i>0.02</i>	0.11	0.08	<i>0.06</i>	<i>0.02</i>	<i>0.12</i>	<i>0.03</i>
Cumulative GPA ^a	<i>0.73</i>	<i>0.05</i>	<i>0.77</i>	<i>0.05</i>	<i>0.61</i>	<i>0.06</i>	<i>0.80</i>	<i>0.08</i>	<i>1.10</i>	<i>0.07</i>	<i>0.90</i>	<i>0.05</i>
SAT score ^b	<i>0.23</i>	<i>0.04</i>	<i>0.24</i>	<i>0.03</i>	<i>0.31</i>	<i>0.05</i>	<i>0.12</i>	<i>0.05</i>	<i>0.21</i>	<i>0.03</i>	<i>0.24</i>	<i>0.03</i>
Biology major	-0.01	0.11	-0.09	0.09	0.09	0.09	0.94	0.55	<i>0.50</i>	<i>0.14</i>	<i>0.45</i>	<i>0.14</i>
Pre-Biology major	-0.19	0.11	<i>-0.21</i>	<i>0.10</i>	-0.16	0.28	0.56	0.48	0.02	0.39	0.20	0.20
Nursing major	-0.17	0.25	-0.07	0.43	<i>1.79</i>	<i>0.84</i>	-0.34	0.26	<0.01	0.07	<i>0.15</i>	<i>0.07</i>
Other STEM major	-0.09	0.09	<i>-0.23</i>	<i>0.08</i>	--	--	-0.26	0.14	0.13	0.12	0.15	0.10
Other non-Health/Life Science major	<i>-0.24</i>	<i>0.12</i>	-0.25	0.14	--	--	<i>-0.36</i>	<i>0.13</i>	0.21	0.15	<i>-0.28</i>	<i>0.12</i>
Female	<i>-0.16</i>	<i>0.07</i>	-0.06	0.05	<i>-0.20</i>	<i>0.08</i>	<i>-0.24</i>	<i>0.11</i>	<i>-0.16</i>	<i>0.07</i>	-0.01	0.07
African American	-0.06	0.11	-0.08	0.09	0.09	0.17	<i>-0.32</i>	<i>0.16</i>	-0.02	0.11	<i>-0.25</i>	<i>0.10</i>
Latinx	-0.21	0.11	<i>-0.18</i>	<i>0.09</i>	-0.13	0.14	0.04	0.16	-0.11	0.11	-0.02	0.11
Attending part-time	<i>0.45</i>	<i>0.14</i>	<i>0.35</i>	<i>0.11</i>	<i>-0.53</i>	<i>0.20</i>	0.29	0.17	<i>0.20</i>	<i>0.09</i>	0.01	0.10
Transfer student	0.08	0.10	<i>0.43</i>	<i>0.09</i>	0.14	0.14	<i>-0.29</i>	<i>0.14</i>	-0.02	0.09	0.10	0.09
Non-Bachelor's student	0.20	0.23	<i>0.44</i>	<i>0.19</i>	<i>2.28</i>	<i>0.23</i>	1.09	0.58	<i>0.49</i>	<i>0.18</i>	<i>0.79</i>	<i>0.17</i>
Intercept	2.85	0.08	2.69	0.08	2.64	0.10	2.82	0.11	2.15	0.08	2.52	0.08

Bold and italic effects are statistically significant at $\alpha \leq 0.05$. Includes Fall 2015, Spring 2016, and Fall 2016 course grades only. Students with no Cumulative GPA prior to the semester were excluded.

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