

**STANDARD-SETTING  
STUDY REPORT**

**Standard-Setting Study of the  
University of Texas at Austin  
Credit by Exam  
for Credit in Biology 311C  
Fall 2005**

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## I. Introduction

### *Purpose*

At the request of the Department of Biological Sciences, the Instructional Assessment and Evaluation (IAE) group, a component of the Division of Instructional Innovation and Assessment (DIIA), conducted a validity study for the Credit by Exam (CBE) in Biology to assist the department in examining the decision scores for student placement and the award of credit by examination for Biology 311C. The Biological Sciences department has recently changed its sequence of courses from BIO 211 and BIO 212 to BIO 311C. UT Austin policy requires that score ranges used as the basis for the award of credit by examination shall reflect the same standard of performance for students who receive credit by examination as for students who complete the coursework.

### *Course Descriptions*

Biology (BIO) 311C, Introductory Biology I, is a three-credit introductory course followed by BIO 311D, Introductory Biology II. BIO 311C with a grade of C or better is a prerequisite for BIO 311D. BIO 311C provides an introduction to biological macromolecules, major cell processes, and molecular genetics (Biological Sciences Course Descriptions, 2006).

## II. Method

### *Participants*

A total of 1,505 undergraduate students enrolled during fall 2005 in BIO 311C (encompasses 74 sections) took the test at the end of the semester. Among them, 29 were not included in the final data set due to incomplete information or dropping the course. Final data resulted in sample size of 1,476.

### *Test Description*

The Credit by Exam (CBE) in Biology 311C has been developed by faculty members in the Biological Sciences department at the University of Texas at Austin. This is a one-hour test with 50 multiple choices questions covering cell biology and molecular genetics. Each item has only one correct answer. The test is scored as number of correct answers, thus results in a possible score range of 0-50.

### *Procedure*

*Examination process.* Students enrolled in BIO 311C in fall 2005 took the test that was designed for Credit by Exam (CBE) in Biology 311C during the last week of classes. Students were informed about the purpose of the test, which was to establish the criteria for credit-qualifying scores from the test for future use. Students would not receive credit by examination for this administration. However, students were required to take the test for 5% of their final grade. Students were directed to register for the test on-line in the DIIA Test Registration System. The test was administered during the two day period that the test was scheduled in large groups in classroom settings using UT testing personnel.

*Validation Process.* Concurrent validity evidence in the form of preliminary course grades, which included all course grades except for the UT CBE in BIO 311C and final exam, was collected prior to the administration of the UT CBE in BIO 311C. Grades were on a scale of 0 to 4, with 0 = F, 1 = D, 2 = C, 3 = B, and 4 = A. Using the data consisting of preliminary course grade and test score, IAE staff calculated the coefficient of correlation between test scores and preliminary course grades and tabulated a two-way frequency table of test scores by preliminary course grades. A linear regression equation was used to calculate expected test scores and expected grades. Finally, using six possible guidelines for making cut-score decisions, a candidate for the cut-off score was determined for each of the six guidelines.

### III. Results

#### *Summary Statistics*

Descriptive statistics for BIO 311C course are shown in Table 1. Correlation between the preliminary course grades and the test scores on UT CBE in BIO 311C was .71, which is statistically significant at  $p < .001$  level.

Table 1

*Descriptive Statistics on the UT CBE in BIO 311C in Relation to Student Performance in BIO 311C*

Preliminary Grade	N	Mean	SD	Minimum	Maximum
<b>Total (All grades)</b>	<b>1476</b>	<b>31.1</b>	<b>7.72</b>	<b>9</b>	<b>49</b>
Grade A	225	39.5	4.71	26	48
Grade B	438	34.7	5.31	15	49
Grade C	466	29.4	5.47	11	45
Grade D	223	24.8	5.48	14	46
Grade F	124	21	6.69	9	40

#### *Analyses*

The results of the standard-setting study of BIO 311C are presented in Tables 2-5. Table 2 shows a frequency distribution for test scores by preliminary course grades. In order to shorten Table 2, grade frequencies for test scores of 9-18 have been summarized in one row, and the same has been done for test scores 45-48. The second column shows the expected grade corresponding to each test score, calculated from the Expected Grade regression equation. The bottom row shows the expected test score corresponding to each preliminary grade, calculated from the Expected Score regression equation. Those regression equations are:

$$\text{Expected Grade} = (\text{Test Score} \times 0.1053) - 0.9937$$

$$\text{Expected Score} = (\text{Preliminary Grade} \times 4.7756) + 20.2127$$

From Table 2, the criterion for awarding credit based on the same standard of performance for students who take an examination as for students who complete course work can be determined. According to Table 2, the minimally satisfactory grade of C (2.00) may be expected for students with a test score of 29, or for students receiving the minimally satisfactory grade of C the expected test score is 30.

For convenience in interpreting the data for awarding credit by examination, Table 3 collapses the preliminary course grades into two categories – Unsatisfactory (preliminary course grades *F* and *D*) and Satisfactory (preliminary course grades *C*, *B* and *A*) – and shows the frequencies in these two categories by test scores.

Table 4 shows the accuracy of student placement (supposing that the students who participated in the study would have been placed based on the UT CBE in BIO 311C score) for each test score as a hypothetical cut-off score. The table shows the numbers and percentages of students, for each test score as a cut-off score, whose placement would have been Correct, Too High, and Too Low, as determined by the students' preliminary course grade. Table 4 indicates the accuracy with which students would be placed by possible scores ranging from 21 to 30 (the range shown in Table 4 was truncated to the most relevant portion from the whole range 9 to 49).

Table 2

*Scores on the UT CBE in BIO 311C in Relation to Student Performance in BIO 311C:  
Frequency distributions, Expected Grades, and Expected Scores*

Test Score	Expected Grade	Preliminary Grade in BIO 311C					Total N
		0 F	1 D	2 C	3 B	4 A	
45-49	3.74-4.00	0	1	2	15	30	48
44	3.64	0	0	1	8	13	22
43	3.53	0	0	2	9	22	33
42	3.43	0	0	1	7	22	30
41	3.32	0	0	2	18	17	37
40	3.22	2	0	5	24	15	46
39	3.11	1	0	4	22	25	52
38	3.01	2	1	10	36	13	62
37	2.90	0	6	19	26	14	65
36	2.80	1	2	18	30	9	60
35	2.69	0	2	21	41	10	74
34	2.59	0	4	26	29	8	67
33	2.48	0	1	30	29	8	68
32	2.38	3	3	27	35	4	72
31	2.27	4	12	21	19	2	58
30	2.17	1	11	43	15	5	75
29	2.06	3	13	37	18	3	74
28	1.95	1	13	34	7	2	57
27	1.85	2	13	20	17	2	54
26	1.74	4	15	23	11	1	54
25	1.64	6	17	25	8	0	56
24	1.53	7	14	19	10	0	50
23	1.43	8	17	24	1	0	50
22	1.32	8	10	18	2	0	38
21	1.22	7	12	14	0	0	33
20	1.11	9	15	7	0	0	31
19	1.01	7	18	5	0	0	30
9-18	0.00-0.94	48	23	8	1	0	80
Total		124	223	466	438	225	1476
Percent		8%	15%	32%	30%	15%	100%
Expected Score		20	25	30	35	39	

Table 3  
*Scores on the UT CBE in BIO 311C in Relation to Student Performance in BIO 311C: Combined Frequency Distributions*

Test Score	Preliminary Grade in BIO 311C		Total N
	Unsatisfactory 0,1	Satisfactory 2-4	
45-49	1	47	48
44	0	22	22
43	0	33	33
42	0	30	30
41	0	37	37
40	2	44	46
39	1	51	52
38	3	59	62
37	6	59	65
36	3	57	60
35	2	72	74
34	4	63	67
33	1	67	68
32	6	66	72
31	16	42	58
30	12	63	75
29	16	58	74
28	14	43	57
27	15	39	54
26	19	35	54
25	23	33	56
24	21	29	50
23	25	25	50
22	18	20	38
21	19	14	33
20	24	7	31
19	25	5	30
9-18	71	9	80
Total	347	1129	1476
Percent	24%	77%	100%
Mean Score	23.5	33.5	31.1
Standard Deviation	6.23	6.51	7.72

Table 4

*Scores on the UT CBE in BIO 311C in Relation to Student Performance in BIO 311C: Possible Decision Scores and Corresponding Accuracies of Placement*

Placement category	Cumulative Number of Students				Percent of Students in Each Placement Category				Overall Accuracy of Placement		
	Unsatisfactory 0, 1 (N=347)		Satisfactory 2-4 (N=1129)		Unsatisfactory		Satisfactory		Placement Accuracy	Number of Students	% of Students
30 - up	Too High	57	812	Correct	Too High	16%	72%	Correct	Too High	57	4%
Below 30	Correct	290	317	Too Low	Correct	84%	28%	Too Low	Correct	1102	75%
29 - up	Too High	73	870	Correct	Too High	21%	77%	Correct	Too High	73	5%
Below 29	Correct	274	259	Too Low	Correct	79%	23%	Too Low	Correct	1144	78%
28 - up	Too High	87	913	Correct	Too High	25%	81%	Correct	Too High	87	6%
Below 28	Correct	260	216	Too Low	Correct	75%	19%	Too Low	Correct	1173	79%
27 - up	Too High	102	952	Correct	Too High	29%	84%	Correct	Too High	102	7%
Below 27	Correct	245	177	Too Low	Correct	71%	16%	Too Low	Correct	1197	81%
26 - up	Too High	121	987	Correct	Too High	35%	87%	Correct	Too High	121	8%
Below 26	Correct	226	142	Too Low	Correct	65%	13%	Too Low	Correct	1213	82%
25 - up	Too High	144	1020	Correct	Too High	41%	90%	Correct	Too High	144	10%
Below 25	Correct	203	109	Too Low	Correct	59%	10%	Too Low	Correct	1223	83%
24 - up	Too High	165	1049	Correct	Too High	48%	93%	Correct	Too High	165	11%
Below 24	Correct	182	80	Too Low	Correct	52%	7%	Too Low	Correct	1231	83%
23 - up	Too High	190	1074	Correct	Too High	55%	95%	Correct	Too High	190	13%
Below 23	Correct	157	55	Too Low	Correct	45%	5%	Too Low	Correct	1231	83%
22 - up	Too High	208	1094	Correct	Too High	60%	97%	Correct	Too High	208	14%
Below 22	Correct	139	35	Too Low	Correct	40%	3%	Too Low	Correct	1233	84%
21 - up	Too High	227	1108	Correct	Too High	65%	98%	Correct	Too High	227	15%
Below 21	Correct	120	21	Too Low	Correct	35%	2%	Too Low	Correct	1228	83%
									Too Low	21	1%

#### IV. Recommendation

##### *Decision Score Determination*

Several guidelines in choosing decision scores for course placement and awarding credit by examination can be found in the professional literature. Table 5 shows scores suggested by six guidelines for selecting decision scores for course placement and awarding credit by examination. The first column explains the rationale for each guideline and indicates specific reference tables used to get each decision score. Based on these guidelines, possible decision scores for UT CBE in BIO 311C range from 22 to 30. Table 6 shows possible decision scores to award letter grades credit of C, B, or A according to two guidelines.

Table 5

*Scores on the UT CBE in BIO 311C in Relation to Student Performance in BIO 311C: Scores Suggested by Six Guidelines for Use in Selecting Decision Scores*

	Guideline	Test Score
1	Expected Score for students whose performance in course was just minimally satisfactory (i.e., students with preliminary grades of C; see Expected Score row at bottom of Table 2)	30
2	Score for which Expected Grade was just minimally satisfactory (i.e., C; see Expected Grade column in Table 2.)	29
3	Score for which percents of errors of students in each academic performance category (Unsatisfactory, Satisfactory) were most nearly equal. (See % Too High and % Too Low values in middle columns of Table 4.)	29
4	Score for which overall percents of errors were most nearly equal. (See % Too High and % Too Low values in last column of Table 4.)	26
5	Score that would have cut off (or held back) approximately the same number of students as were in the Unsatisfactory performance group. (See Table 3 for number of students in the Unsatisfactory group and the test score that most nearly identifies that number of low-scoring students.)	25
6	Score that would have maximized overall accuracy of placement. (See number Correct in next-to-last column of Table 4.)	22

Table 6

*Scores on the UT CBE in BIO 311C in Relation to Student Performance in BIO 311C: Scores Suggested for Use in Selecting Decision Scores for awarding Letter Grades C, B, or A*

	Guideline	Score for C	Score for B	Score for A
1	Expected Score for students whose performance in course was satisfactory for C, B, or A	30	35	39
2	Score for which Expected Grade was satisfactory for C, B, or A	29	38	43

## V. References

*Biological Sciences Course Descriptions*. (2006). Retrieved January 25, 2006, from the University of Texas at Austin, College of Natural Sciences Web site:  
<http://www.biosci.utexas.edu/bsac/syllabi/>

*Testing Period and Test Descriptions*. (2005-2006). Retrieved January 25, 2006, from the University of Texas at Austin, Division of Instructional Innovation and Assessment Website: <http://www.utexas.edu/academic/mec/cbe/testperiod.html>