

## Academic Assessment Report - AY 2012-2013

**College, School/Department, Name of Program: College of Natural, Applied & Health Sciences/School of Natural Sciences/Biology Program**

### Program SLOs:

**SLO #1: Acquire Knowledge of fundamental principles (diversity of living organisms/biological fundamentals/evolutionary biology) (KU 1, 2, 4) (GE K1, S5, V1)**

**SLO #2: Acquire the laboratory and field skills to gather and analyze data related to biological questions (KU 1, 2, 4) (GE K1, S3, S4, S5, V2)**

**SLO #3: Develop skills in critical thinking, scientific reasoning, and problem solving (KU 1, 2, 4) (GE K2, S1, S3, S4, S5, V1)**

**SLO #4: Develop the ability to apply biological principles to understand current issues (KU 1, 2, 3, 4) (GE K1, S3, S4, S5, V1, V3)**

**SLO #5: Develop the ability to effectively find, organize, and use resources from the literature and present results in oral, visual, and written communication (KU 1, 2, 4) (GE K1, S1, S2, S3, S4, S5, V1)**

**SLO #6: Develop an awareness of careers and professions available in the biological sciences (KU 2, 3, 4) (GE S4, S5, V4, V5)**

**SLO #7: Acquire adequate preparation to enter health professional programs and/or the work force in related fields (KU 2, 3, 4) (GE K1, K4, S5, V4, V5)**

Program Level Student Learning Outcomes	Assessment Measure(s)	Assessment Criteria	Results of Assessment	Action Taken
<b>SLO #1</b> Acquire Knowledge of fundamental principles (diversity of living organisms/biological fundamentals/evolutionary biology) (KU 1, 2, 4) (GE K1, S5, V1)	<b>Direct Measure #1:</b> ETS Biology Comprehensive Exam	<b>BIO 4970, Seminar in Integrative Biology</b> (Capstone);  Paper Exam Administered by Instructor, mailed to ETS, scored by ETS, and Results Report sent to the program	Results measure student knowledge in content area and provide a comparative benchmark of other colleges in the country <i>(Approved by Dean's Office)</i>	ETS assessment was administered in Spring 2013. Forty-four students participated in the survey, which yielded a mean score of 134 points. National mean for test is 153 points.
	<b>Direct Measure #2:</b> Written Laboratory Assignment	<b>BIO 2200, Cell Biology and BIO 3704 Principles of Genetics</b>  Faculty Developed Pre-post test survey (hard	Pre/Post-test comparison to determine remedial focus area for delivery of course content. <i>(September 2012)</i>	The pre-post test results have been compiled and presented during Research Day.  In Fall 2012, a pilot pre- and post-test study was conducted in BIO 2200 & BIO

		<p>copy) administered and scored by staff</p>		<p>3704 for BA Biology program to assess student learning outcomes.</p> <p>A common set of multiple-choice questions was developed and used as the pre-test for BIO 1 (BIO2200 – Cell Biology), BIO2 (BIO2400 – Genes, Organisms and Populations) and BIO3704 (Principles of Genetics). Another common set of multiple-choice questions was used as the post-test.</p> <p>The questions are grouped into three blocks.</p> <p>Block 1 assesses student understanding of principles underlying all branches of the sciences.</p> <p>Block 2 assesses student knowledge of the scientific method, a topic essential for all biological inquiries.</p> <p>Block 3 assesses basic math skills and analytical thinking abilities.</p> <p>To obtain unbiased data, pre- and post-test grades were incorporated into the calculation of the students’ final grade to encourage maximum effort by the students during both tests. The pre-test results provide the benchmark for which instructional efforts and focus will be directed throughout the semester.</p>
	<p><b>Direct Measure #3 A:</b> McGraw-Hill Connect Assessment</p>	<p><b>BIO 1000: Principles of Biology</b> On-line pre/post test examination requirement</p> <p>Exams will be electronically scored and results provided to the Instructor by McGraw-Hill</p>	<p>Arrangements were made with McGraw Hill to administer hard copies of test that wasn’t made available to Kean <b>(December 2012). A substitute instrument was developed, instead of depending upon students to access the</b></p>	<p><b>See Direct measure #3B.</b></p>

			<b>McGraw-Hill Connect from home, which had produced limited results in the past.</b>	
	<b>Direct Measure #3B:</b> Pre/post test Scientific Method & Quantitative Reasoning Assessment	<b>BIO 1000: Principles of Biology</b> pre/post test Scientific Method & Quantitative Reasoning Assessment	In Fall 2012, GE Assessment survey was revised to use in Biology 1000. Content remained the same but format was changed in Spring 2013	In Fall 2012, there was a 3.0% improvement between pre-post tests for 23 sections. The Spring 2013 results showed a gain of 11.4% due to credit being given for the activity.
	<b>Indirect Measure 1:</b> Kean Graduating Sr. Survey	<b>BIO 4970, Seminar in Integrative Biology</b> (Capstone)  Results will be electronically scored and provided to the Executive Director	Survey to be emailed to all seniors enrolled in BIO 4970 (Capstone) <b>(Spring 2013)</b>	There was a 32% response rate for Capstone Biology (awaiting final results).
	<b>Indirect: Measure 2:</b> Comparative Analysis of F/S 2012-13 grades	<b>BIO 4970, Seminar in Integrative Biology</b> Data obtained from Registrar's Office & analyzed in Excel	<b>In Progress.</b>	Awaiting Final Spring 2013 grades.
<b>SLO #2</b> <b>Acquire the laboratory and field skills to gather and analyze data related to biological questions (KU 1, 2, 4) (GE K1, S3, S4, S5, V2)</b>	<b>Direct Measure #1:</b> Written Lab Projects	<b>BIO 2200 Cell Biology &amp; BIO 2400 Principles of Genetics</b>  Faculty Developed Writing rubric scored by instructor for each student – first lab report	Peer Leadership Training to Administer Rubrics <b>(October 2012) One lab assistant was available, who oversaw faculty administration of the survey and scoring of the results.</b>	The Lab Report Rubric was developed and approved by faculty in Spring 2013. Instrument was then administered and incorporated into students' final grades.
	<b>Direct Measure #2:</b> Written Laboratory Assignment	<b>BIO 2200 Cell Biology &amp; BIO 2400 Principles of Genetics</b>  Faculty Developed Pre-test survey (hard copy) administered by Instructor	BIO 2200 results will serve as a benchmark for identifying students in need of remedial help in writing <b>(September 2012)</b>	The pre/post tests were conducted in Fall 2012 and Spring 2013. Results confirmed that students had difficulty with reading graphs. There was a 14% decrease in math skills.  <b>Results:</b> Detailed analysis of the results

		<p>at the beginning of the course. Post-test questions included in final examination and used to measure learning outcomes</p>		<p>from one section in Fall 2012 revealed that the average grade for "scientific principles" (block 1) went up from 62.1% on the pre-test to 82.8% on the post-test, the average grade for "scientific method" (block 2) went up from 61.3% to 76.5%, and that for "graphs" (block 3) went down from 48.4% to 34.4%.</p> <p>Analysis for other sections in Fall 2012 and collection of the pre-test data for Spring 2013 semester are currently underway. The pre- and post-test assessment is a standardized instrument that can be easily adopted and quickly quantitated to provide measurable evidence of student learning.</p>
<p><b>SLO #3</b>  <b>Develop skills in critical thinking, scientific reasoning, and problem solving (KU 1, 2, 4) (GE K2, S1, S3, S4, S5, V1)</b></p>	<p><b>Indirect Measure #1:</b>  Written Laboratory Assignment</p>	<p><b>BIO 3400, Zoology, Form, and Function</b></p> <p>NCSU Student Learning Inventory  On-line student learning inventory administered by lab assistant</p>	<p>Peer Leadership Training on Survey Administration (<b>October 2012</b>)</p>	<p>Zoology results were compiled and reflected the following gains: Peer Leaders were trained and monitored by Dr. James in Fall 2012/Spring 2013. Overall averages from the writing rubrics were added to final scores.</p>
	<p><b>Indirect Measure #2:</b>  Kean Graduating Sr. Survey</p>	<p><b>BIO 4970, Seminar in Integrative Biology (Capstone)</b></p> <p>Results will be electronically scored and provided to the Executive Director</p>	<p>Survey emailed to all seniors enrolled in BIO 4970 (Capstone ) <b>Spring 2013</b></p>	<p>There was a 32% response rate for the Capstone Biology (awaiting final results).</p>
	<p><b>Direct Measure #1:</b>  Written Lab &amp; Research Reports</p>	<p><b>BIO Core Courses (6) &amp; BIO 4970 (Capstone)</b></p> <p>Faculty Developed Writing rubric scored by instructor for each student – first lab &amp; Research Report</p>	<p>Peer Leadership Training on Rubric Administration (<b>October 2012</b>)</p>	<p>The Lab Report Rubric was developed and approved by the faculty in Spring 2013. Instrument was pilot-tested in BIO 1000, section 16. Results were incorporated into student's final grades.</p>

<p><b>Direct Measure #2:</b> Written Laboratory Assignment</p>	<p><b>BIO 2200 Cell Biology &amp; BIO 2400 Principles of Genetics</b></p> <p>Faculty Developed Quantitative Reasoning and Scientific Rubrics administered by Instructor</p>	<p>BIO 2200 results will serve as a benchmark for identifying students in need of remedial help in writing</p>	<p>The pre/post tests were conducted in Fall 2012 and Spring 2013. Results confirmed that students had difficulty with reading graphs. There was a 14% decrease in math skills.</p> <p><b>Results:</b> Detailed analysis of the results from one section in Fall 2012 revealed that the average grade for "scientific principles" (block 1) went up from 62.1% on the pre-test to 82.8% on the post-test, the average grade for "scientific method" (block 2) went up from 61.3% to 76.5%, and that for "graphs" (block 3) went down from 48.4% to 34.4%.</p> <p>Analysis for other sections in Fall 2012 and collection of the pre-test data for Spring 2013 semester are currently underway. The pre- and post-test assessment is a standardized instrument that can be easily adopted and quickly quantitated to provide measurable evidence of student learning.</p>
<p><b>Direct Measure #3:</b> Written Laboratory Assignment</p>	<p><b>BIO 2200 Cell Biology &amp; BIO 2400 Principles of Genetics</b></p> <p><b>Critical Thinking Values Rubric:</b> Validated Instrument will be used during lab to provide students with the opportunity to comprehensively explore scientific issues that require formulation of opinions and conclusions</p>	<p>Pre/Post-test comparison to determine remedial focus area for delivery of course content. <b>(September 2012)</b></p>	<p>The pre/post tests were conducted in Fall 2012 and Spring 2013. Results confirmed that students had difficulty with reading graphs. There was a 14% decrease in math skills.</p> <p><b>Results:</b> Detailed analysis of the results from one section in Fall 2012 revealed that the average grade for "scientific principles" (block 1) went up from 62.1% on the pre-test to 82.8% on the post-test, the average grade for "scientific method" (block 2) went up from 61.3% to 76.5%, and that for "graphs" (block 3) went down from 48.4% to 34.4%.</p>

				Analysis for other sections in Fall 2012 and collection of the pre-test data for Spring 2013 semester are currently underway. The pre- and post-test assessment is a standardized instrument that can be easily adopted and quickly quantitated to provide measurable evidence of student learning.
	<b>Indirect Measure #1:</b> Kean Graduating Sr. Survey	<b>BIO 4970, Seminar in Integrative Biology</b> (Capstone)  Results will be electronically scored and provided to the Executive Director	Survey emailed to all seniors enrolled in BIO 4970 (Capstone ) <b>(Spring 2013)</b>	There was a 32% response rate for the Capstone Biology (awaiting final results for analysis).
<b>SLO #4</b> <b>Develop the ability to apply biological principles to understand current issues (KU 1, 2, 3, 4) (GE K1, S3, S4, S5, V1, V3)</b>	<b>Direct Measure #1:</b> Written Lab & Research Reports	<b>BIO Core Courses (6) &amp; BIO 4970 (Capstone)</b>  Faculty Developed Writing rubric scored by instructor for each student – first lab & Research Report	Peer Leadership Training on Rubric Administration <b>(Spring 2013)</b>	The Lab Report Rubric was developed, tested and used in Spring 2013. Instrument had been piloted in BIO 1000, section 16 and was incorporated into student's final grades.
	<b>Direct Measure #2:</b> Written Laboratory Assignment	<b>BIO 2200 Cell Biology &amp; BIO 2400 Principles of Genetics</b>  Faculty Developed Quantitative Reasoning and Scientific Rubrics administered by Instructor	Pre and post-tests were developed and pilot tested in Fall 2012. Results were presented during the January 2013 Assessment Conference.	Pre and post-tests were developed and pilot tested in Fall 2012. Results were presented in January 2013 and during Research Day.  In Fall 2012, a pilot pre- and post-test study was conducted in BIO 2200 & BIO 3704 for BA Biology program to assess student learning outcomes.  A common set of multiple-choice questions was developed and used as the pre-test for BIO 1 (BIO2200 – Cell Biology), BIO2 (BIO2400 – Genes, Organisms and Populations) and BIO3704 (Principles of Genetics). Another common set of multiple-choice questions was used as the post-test.

				<p>The questions are grouped into three blocks.</p> <p>Block 1 assesses student understanding of principles underlying all branches of the sciences.</p> <p>Block 2 assesses student knowledge of the scientific method, a topic essential for all biological inquiries.</p> <p>Block 3 assesses basic math skills and analytical thinking abilities.</p> <p>To obtain unbiased data, pre- and post-test grades were incorporated into the calculation of the students' final grade to encourage maximum effort by the students during both tests. The pre-test results provide the benchmark for which instructional efforts and focus will be directed throughout the semester.</p>
	<p><b>Indirect Measure #1:</b> Kean Graduating Sr. Survey</p>	<p><b>BIO 4970, Seminar in Integrative Biology (Capstone)</b></p> <p>Results will be electronically scored and provided to the Executive Director</p>	<p>Survey emailed to all seniors enrolled in BIO 4970 (Capstone ) <b>(Spring 2013)</b></p>	<p>There was a 32% response rate for the Capstone Biology (awaiting final results and final analysis).</p>
<p><b>SLO #5</b> <b>Develop the ability to effectively find, organize, and use resources from the literature and present results in oral, visual, and written communication (KU 1, 2, 4) (GE K1, S1, S2, S3, S4, S5, V1)</b></p>	<p><b>Direct Measure #1:</b> Written Lab &amp; Research Reports</p>	<p><b>BIO Core Courses (6) &amp; BIO 4970 (Capstone)</b></p> <p>Faculty Developed Writing rubric scored by instructor for each student – first lab &amp; Research Report</p>	<p>Pre and post-tests were developed and pilot tested in Fall 2012. Results were presented during the January 2013 Assessment Conference.</p>	<p>The pre/post tests were conducted in Fall 2012 and Spring 2013. Results confirmed that students had difficulty with reading graphs. There was a 14% decrease in math skills.</p> <p><b>Results:</b> Detailed analysis of the results from one section in Fall 2012 revealed that the average grade for "scientific principles" (block 1) went up from 62.1% on the pre-test to 82.8% on the post-test, the average grade for "scientific</p>

				<p>method" (block 2) went up from 61.3% to 76.5%, and that for "graphs" (block 3) went down from 48.4% to 34.4%.</p> <p>Analysis for other sections in Fall 2012 and collection of the pre-test data for Spring 2013 semester are currently underway. The pre- and post-test assessment is a standardized instrument that can be easily adopted and quickly quantitated to provide measurable evidence of student learning.</p>
	<p><b>Direct Measure #2:</b> Oral Lab &amp; Research Presentations</p>	<p><b>BIO Core Courses (6) &amp; BIO 4970 (Capstone)</b></p> <p>Faculty Developed Presentation rubric scored by instructor for each student – Lab Report &amp; Research Report Presentations</p>	<p>Peer Leadership Training on Rubric Administration (<i>October 2012</i>)</p>	<p>Pre and post-tests were developed and pilot tested in Fall 2012. Results were presented during the January 2013 Assessment Conference.</p> <p>The pre/post tests were conducted in Fall 2012 and Spring 2013. Results confirmed that students had difficulty with reading graphs. There was a 14% decrease in math skills</p> <p><b>Results:</b> Detailed analysis of the results from one section in Fall 2012 revealed that the average grade for "scientific principles" (block 1) went up from 62.1% on the pre-test to 82.8% on the post-test, the average grade for "scientific method" (block 2) went up from 61.3% to 76.5%, and that for "graphs" (block 3) went down from 48.4% to 34.4%.</p> <p>Analysis for other sections in Fall 2012 and collection of the pre-test data for Spring 2013 semester are currently underway. The pre- and post-test assessment is a standardized instrument that can be easily adopted and quickly quantitated to provide measurable evidence of student learning.</p>



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<b>SLO #6</b> <b>Develop an awareness of careers and professions available in the biological sciences (KU 2, 3, 4) (GE S4, S5, V4, V5)</b>	<b>Direct Measure #1:</b> Written Lab & Research Reports	<b>BIO Core Courses (6) &amp; BIO 4970 (Capstone)</b>  Faculty Developed Writing rubric scored by instructor for each student – first lab & Research Report	Peer Leadership Training on Rubric Administration <b>(October 2012)</b>	The Lab Report Rubric was developed and tested and used by faculty in Spring 2013. Instrument was also piloted in BIO 1000, section 16 and is being incorporated into student's final grades.
	<b>Direct Measure #2:</b> Oral Lab & Research Presentations	<b>BIO Core Courses (6) &amp; BIO 4970 (Capstone)</b>  Faculty Developed Presentation rubric scored by instructor for each student – Lab Report & Research Report Presentations	Pre/Post-test comparison to determine remedial focus area for delivery of course content. <b>(September 2012)</b>	Pre and post-tests were developed and pilot tested in Fall 2012. Results were presented during the January 2013 Assessment Conference.  The pre/post tests were conducted in Fall 2012 and Spring 2013. Results confirmed that students had difficulty with reading graphs. There was a 14% decrease in math skills.  <b>Results:</b> Detailed analysis of the results from one section in Fall 2012 revealed that the average grade for "scientific principles" (block 1) went up from 62.1% on the pre-test to 82.8% on the post-test, the average grade for "scientific method" (block 2) went up from 61.3% to 76.5%, and that for "graphs" (block 3) went down from 48.4% to 34.4%.  Analysis for other sections in Fall 2012 and collection of the pre-test data for

				Spring 2013 semester are currently underway. The pre- and post-test assessment is a standardized instrument that can be easily adopted and quickly quantitated to provide measurable evidence of student learning.
	<b>Indirect Measure #1:</b> Kean Graduating Sr. Survey	<b>BIO 4970, Seminar in Integrative Biology</b> (Capstone)  Results will be electronically scored and provided to the Executive Director	Survey emailed to all seniors enrolled in BIO 4970 (Capstone ) <b>(Spring 2013)</b>	There was a 32% response rate for the Capstone Biology (awaiting final results and analysis).
<b>SLO #7</b>  <b>Acquire adequate preparation to enter health professional programs and/or the work force in related fields (KU 2, 3, 4) (GE K1, K4, S5, V4, V5)</b>	<b>Direct Measure #1:</b> ETS Biology Comprehensive Exam	<b>BIO 4970, Seminar in Integrative Biology</b> (Capstone);	Paper Exam Administered by Instructor, mailed to ETS, scored by ETS, and Results Report sent to the program <b>(Approved by Dean, September 2012)</b>	ETS assessment was administered in Spring 2013. Forty-four students participated in the survey, which yielded a mean score of 134 points. National mean score for test is 153 points.
	<b>Direct Measure #2:</b> Written Lab & Research Reports	<b>BIO Core Courses (6) &amp; BIO 4970 (Capstone)</b>  Faculty Developed Writing rubric scored by instructor for each student – first lab & Research Report	Pre/Post-test comparison to determine remedial focus area for delivery of course content. <b>(September 2012)</b>	Pre and post-tests were developed and pilot tested in Fall 2012. Results were presented during the January 2013 Assessment Conference.  The pre/post tests were conducted in Fall 2012 and Spring 2013. Results confirmed that students had difficulty with reading graphs. There was a 14% decrease in math skills.  <b>Results:</b> Detailed analysis of the results from one section in Fall 2012 revealed that the average grade for "scientific principles" (block 1) went up from 62.1% on the pre-test to 82.8% on the post-

			<p>test, the average grade for "scientific method" (block 2) went up from 61.3% to 76.5%, and that for "graphs" (block 3) went down from 48.4% to 34.4%.</p> <p>Analysis for other sections in Fall 2012 and collection of the pre-test data for Spring 2013 semester are currently underway. The pre- and post-test assessment is a standardized instrument that can be easily adopted and quickly quantitated to provide measurable evidence of student learning.</p>
<p><b>Direct Measure #3:</b> Oral Lab &amp; Research Presentations</p>	<p><b>BIO Core Courses (6) &amp; BIO 4970 (Capstone)</b></p> <p>Faculty Developed Presentation rubric scored by instructor for each student – Lab Report &amp; Research Report Presentations</p>	<p>Pre/Post-test comparison to determine remedial focus area for delivery of course content. <i>(September 2012)</i></p>	<p>Pre and post-tests were developed and pilot tested in Fall 2012. Results were presented during the January 2013 Assessment Conference.</p> <p>The pre/post tests were conducted in Fall 2012 and Spring 2013 (in progress). Results confirmed that students had difficulty with reading graphs. There was a 14% decrease in math skills.(See below).</p> <p><b>Results:</b> Detailed analysis of the results from one section in Fall 2012 revealed that the average grade for "scientific principles" (block 1) went up from 62.1% on the pre-test to 82.8% on the post-test, the average grade for "scientific method" (block 2) went up from 61.3% to 76.5%, and that for "graphs" (block 3) went down from 48.4% to 34.4%.</p> <p>Analysis for other sections in Fall 2012 and collection of the pre-test data for Spring 2013 semester are currently underway. The pre- and post-test assessment is a standardized instrument that can be easily adopted and quickly</p>

				quantitated to provide measurable evidence of student learning.
	<b>Indirect Measure #1:</b> Kean Graduating Sr. Survey	<b>BIO 4970, Seminar in Integrative Biology</b> (Capstone)  Results will be electronically scored and provided to the Executive Director	Survey emailed to all seniors enrolled in BIO 4970 (Capstone ) <b>(Spring 2013)</b>	There was a 32% response rate for the Capstone Biology (awaiting final results).

**ATTACHMENT A: ETS Raw Data**

Test	Score	Date	Status	Test	Score	Date	Status	Test	Score	Date	Status
Biology	133	11/29/2012	Complete	Biology	142	12/18/2012	Complete				
		21:21				9:19					
Biology	138	11/29/2012	Complete	Biology	131	12/19/2012	Complete				
		21:32				13:37					
Biology	141	12/10/2012	Complete	Biology	164	11/29/2012	Complete				
		10:52				21:45					
Biology	132	12/10/2012	Complete	Biology	130	12/18/2012	Complete				
		10:42				9:22					
Biology	128	12/21/2012	Complete	Biology	142	12/20/2012	Complete				
		12:25				9:02					
Biology	168	11/29/2012	Complete	Biology	120	11/29/2012	Complete				
		23:13				21:28					
Biology	125	12/10/2012	Complete	Biology	125	12/21/2012	Complete				
		11:21				12:21					
Biology	138	12/18/2012	Complete	Biology	127	12/10/2012	Complete				
		9:16				11:14					
Biology	138	12/20/2012	Complete	Biology	146	12/10/2012	Complete				
		9:02				11:09					
Biology	163	12/10/2012	Complete	Biology	138	11/29/2012	Complete				
		11:17				21:56					
Biology	128	12/18/2012	Complete	Biology	134	12/19/2012	Complete				
		9:13				13:37					
Biology	125	12/21/2012	Complete	Biology	138	11/29/2012	Complete				
		12:12				21:29					
Biology	162	12/18/2012	Complete	Biology	136	12/10/2012	Complete				
		10:01				10:47					
Biology	129	12/10/2012	Complete	Biology	128	12/18/2012	Complete				
		11:19				8:47					
Biology	121	12/18/2012	Complete	Biology	125	11/29/2012	Complete				
		8:45				21:31					
Biology	132	11/29/2012	Complete	Biology	153	12/10/2012	Complete				
						11:04					

## ATTACHMENT B – Assessment Study Results

### Assessing Student Learning Outcomes Using Pre- and Post-tests

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#### ABSTRACT

The biology program has established a set of student learning outcomes that highlight the knowledge and skills expected of the students to demonstrate by the end of their program of study. In Fall 2012, a pilot pre- and post-test study was conducted in three courses of the BA Biology program to assess student learning outcomes. The three courses included the two courses in the first-year sequence (BIO2200 – Cell Biology, and BIO2400 – Genes, Organisms and Populations), and BIO3704 – Genetics Lecture. In the pre- and post-test study, a common set of 10 multiple-choice questions was developed and used as the pre-test for all sections of the three courses. Another common set of 10 multiple-choice questions was used as the post-test. The pre-test results provided the benchmark for which instructional efforts and focus were to be directed throughout the semester. Additionally, the data should provide insight into the significance of pre-requisite courses on cognitive development and conceptual understanding.

#### Frequency of Assessment Impacts Learning in Undergraduate Biology

- Casem (2006) study examined how frequency of assessment impacts learning in undergraduate biology classes.
- 186 students enrolled in undergraduate core curriculum core course in biology that met twice weekly for 75 minutes per class.
- An active learning approach was employed that involves the use of focused reading assignments, quizzes, lecture presentations, in-class critical thinking problem solving activities and a series of comprehensive quizzes.
- During the fall semester, students participated in the "high frequency class" that required nine quizzes and one final examination.
- Those enrolled in the spring semester, participated in the traditional assessment plan of three tests and a comprehensive final examination.

#### SELECTED REFERENCES

Bowling, B.V., Huether, C.A., Wang, L., Myers, M, Markle, G., Dean, G.E., Acra, E.E., Wray, P., & Jacob, G. A. (2008). Genetic literacy of undergraduate non-science majors and the impact of introductory biology and genetics courses. *BioScience*, July/August 2008, V. 58, 7, 654-660.

Casem, M.L. (2006). Active learning is not enough. *Journal of College Science Teaching*. May/June 2006, 55-57.

Hunt, L., Koenders, A., & Gynnild (2012). Assessing practical laboratory skills in undergraduate molecular biology courses. *Assessment and Evaluation in Higher Education*, 37:7, 861-874.

#### APPROACHES

##### Undergraduate Biology Outcomes

- Results showed that the average performance for high frequency classes (HFC) tended to be slightly higher than those of the low-frequency classes (LFC).
- Achievement on the comprehensive final exam (77.8 HFC/52.5 LFC) and overall course grades were significantly better for the HFC (77.8%) than the LFC (67%) students.
- It appeared that student retention of course concepts was enhanced based on the high frequency of assessment regimen. Frequent assessment also appears to have altered the predictive relationship between student GPA and course performance, since those with higher GPAs in the LFC classes performed at a lower level than high achievers in the HFC group.

Table 1. Within-class and between class analysis of student performance on assessment of higher order thinking skills.

	Recall	Application	Analysis
High-frequency class	78%	60%	50%
Low-frequency class	61%	53%	46%

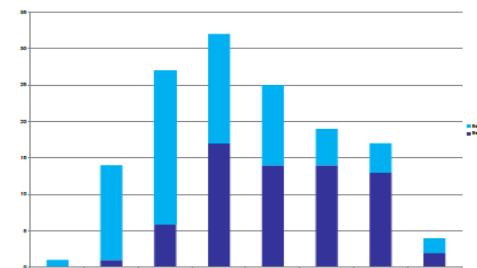
Percent values represent class averages for each question type. Within-class and between class performances were compared using a two-tailed paired t-test ( $p < 0.001$ ).

#### CONCLUSIONS

Detailed analysis of the results from one section in Fall 2012 revealed that the average grade for "scientific principles" (block 1) went up from 62.1% on the pre-test to 82.8% on the post-test, the average grade for "scientific method" (block 2) went up from 61.3% to 76.5%, and that for "graphs" (block 3) went down from 48.4% to 34.4%. Analysis for other sections in Fall 2012 and collection of the pre-test data for Spring 2013 semester are currently underway. The pre- and post-test assessment is a standardized instrument that can be easily adopted and quickly quantitated to provide measurable evidence of student learning.

##### BA Biology Student Learning Assessment

- In Fall 2012, a pilot pre- and post-test study is being conducted in all the core courses for BA Biology program to assess student learning outcomes.
- A common set of multiple-choice questions was developed and used as the pre-test for BIO 1 (BIO2200 – Cell Biology), BIO2 (BIO2400 – Genes, Organisms and Populations) and BIO3704 (Principles of Genetics). Another common set of multiple-choice questions will be used as the post-test.
- The questions are grouped into three blocks.
  - Block 1 assesses student understanding of principles underlying all branches of the sciences.
  - Block 2 assesses student knowledge of the scientific method, a topic essential for all biological inquiries.
  - Block 3 assesses basic math skills and analytical thinking abilities.
- To obtain unbiased data, pre- and post-test grades are incorporated into the calculation of the students' final grade to encourage maximum effort by the students during both tests. The pre-test results provide the benchmark for which instructional efforts and focus are to be directed throughout the semester.
- Additionally, the data should provide insight into the significance of pre-requisite courses.



**ATTACHMENT C Biology Lab Report Rubric (Pu, 2013)**

	<b>Style Categories (50 points)</b>	<b>Score</b>
1.	Use <b>double-space</b> throughout. Leave a 1-inch margin on all four sides. (5 points)	
2.	<b>Fonts</b> should be black and between 11 and 14 points throughout. (5 points)	
3.	Be <b>consistent</b> in the use of font throughout your report. (5 points)	
4.	All scientific names (genus and species) must be italicized. (5 points)	
5.	Numbers should be written as <b>numerals</b> when they are greater than ten or when they are associated with measurements. For example, write "6 mm" or "2 g" but " <i>two</i> " explanations or " <i>five</i> " parameters. When a set of measurements includes numbers over and under ten, all numbers may be expressed as numerals. For example, 20 wasps, 13 bees, and 2 flies. Never start a sentence with numerals. Spell all numbers that are at the beginning of sentences.(5 points)	
6.	A report or a section of a report should be divided into <b>paragraphs</b> whenever appropriate. The purpose of the paragraph should be made clear by the starting or the ending sentence. Every sentence must have a subject and a verb.(5 points)	
7.	<b>Avoid first person</b> (I, we, us, my, ours, etc) in writing. Keep your writing impersonal and in the third person. For example, instead of "We weighed the reagents and put them in a beaker," write, "The reagents were weighed and put in a beaker." (5 points)	
8.	Be consistent in the use of <b>tense</b> throughout a paragraph. Do not switch between past and present. Generally, past tense is preferred. (5 points)	
9.	<b>Be precise</b> and avoid ambiguity. Each sentence should present a clear message. The following example illustrates the lack of clarity: The title "Protection against Carcinogenesis by UV Light" leaves it unclear whether UV light protects from or causes cancer.(5 points)	
10.	<b>Good spelling and grammar</b> count. Check your report carefully for spelling and grammatical errors. (5 points)	
	<b>TOTAL SCORE</b>	

	<b>Content Categories (50 points)</b>	<b>Score</b>
1.	Title (3 points)	
2.	Abstract (5 points)	
3.	Introduction (10 points)	
4.	Materials and methods (5 points)	
5.	Results (10 points)	

6.	Discussion (15 points)	
7.	Literature cited (2 points)	
	<b>TOTAL SCORE</b>	

## Criteria

**Title:** The title should be short, straightforward and contain keywords that are of interest to researchers in a relevant field.

**Abstract:** An abstract is a concise (100 to 200 words) summary of the purpose of the report, the data presented, and the major conclusions. The purpose of the abstract is to allow the reader to judge whether it would serve his or her purposes to read the entire report.

**Introduction:** The introduction should outline the scientific purpose(s) or objective(s) for the research performed and provide the reader with sufficient background to understand the rest of the report. Care should be taken to limit the background to what is pertinent to the experiment. A good introduction will answer several questions, including the following:

- ◆ *Why was this study performed?*
- ◆ *What were the specific purposes of the study?*
- ◆ *What were the hypotheses and/ experimental design for addressing the purposes of the study?*

**Materials and Methods:** This section reports on the materials and methods used in the experiments. Enough detail should be provided for the reader to understand the experiment. Minute details should be left out. When procedures from a lab manual or another printed source are followed exactly, simply cite the work, noting that details can be found in that particular source. However, it is still necessary to describe special pieces of equipment and the general theory of the assays used. The following questions should be answered in this section:

- ◆ *What materials were used?*
- ◆ *How were the data collected?*
- ◆ *How were the data analyzed?*

**Results:** The results section should summarize the data from the experiments without discussing their implications. The data should be RAW DATA (including photographs) as obtained during the experiments and organized into tables and figures. Data included in a table should not be duplicated in a figure, and vice versa. Figures include line drawings, graphs, charts and photographs.

All figures and tables should have descriptive titles and should include a legend explaining any symbols, abbreviations, or special methods used. Figures and tables should be numbered separately and should be referred to in the text by number. For example:

1. Figure 1 shows that the sensitivity of the protein decreased after five minutes.
2. The sensitivity of the protein decreased after five minutes (fig. 1).



The reader should be able to understand the figures and tables without referring to the text. All columns and rows in tables and all axes in figures should be labeled.

**Discussion:** This section may restate the results, but more importantly, should emphasize interpretation of the data and their relation to the hypotheses, existing theory and knowledge. The logic that allows you to accept or reject your original hypotheses should be explained. Suggestions for the improvement of techniques or experimental design may also be included in this section, as well as future experiments that might clarify areas of doubt in your results.

**Literature Cited (References):** This section lists all articles, books or web resources cited in your report. The listing should be alphabetized by the last names of the authors. Different journals require different formats for citing literature. Some examples are listed below.

**For articles:**

Eggenchwiler JT, Espinoza E, Anderson KV. 2001. Rab23 is an essential negative regulator of the mouse Sonic hedgehog signalling pathway. *Nature* 412: 194-198.

**For chapters in books:**

Ko HW, Liu A, Eggenchwiler JT. 2009. Analysis of hedgehog signaling in mouse intraflagellar transport mutants. *Methods in Cell Biology* 93: 347-369.

When citing references in the text, refer to articles by the author's name and the year the paper was published. For example:

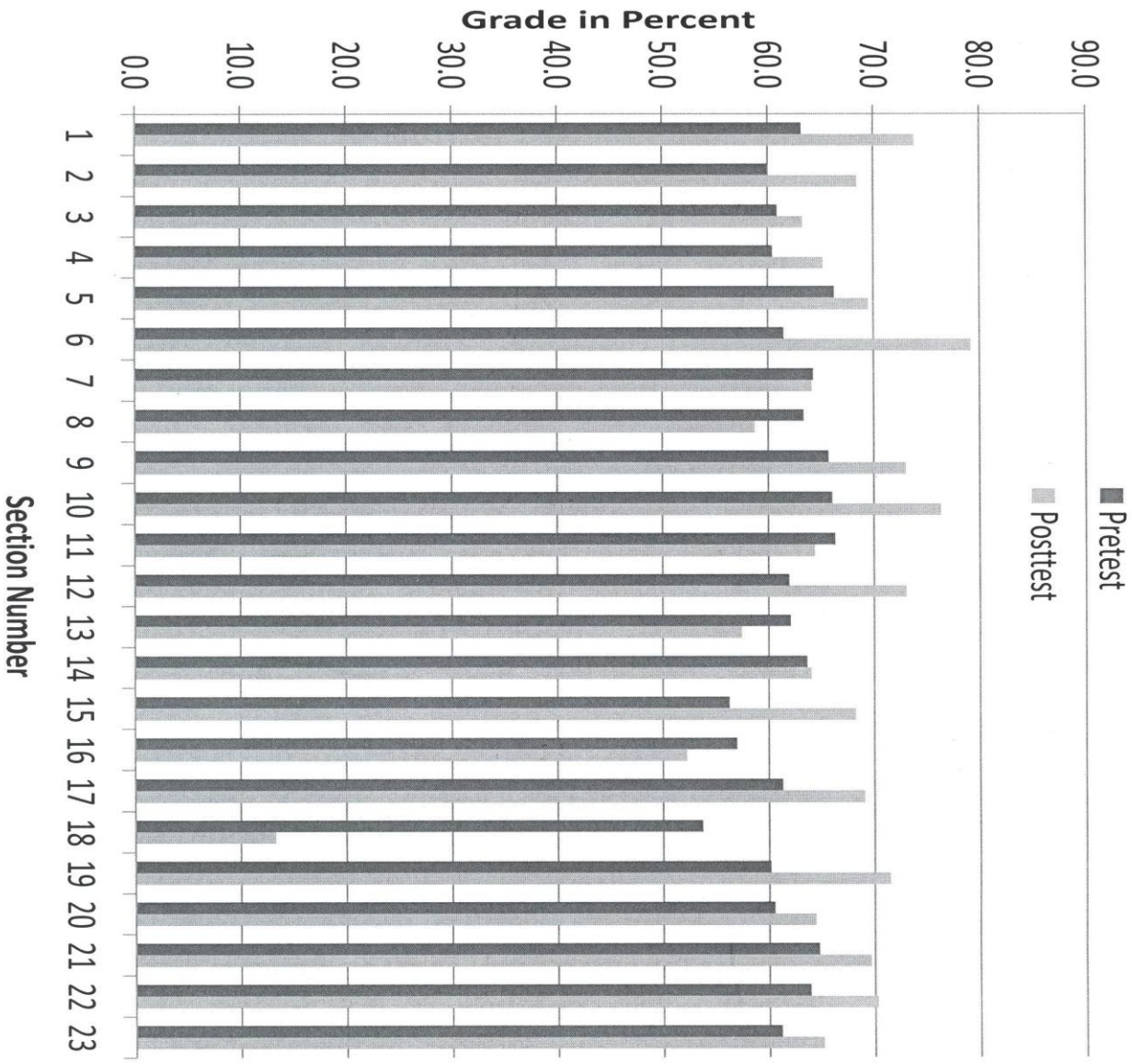
1. Anderson (1998) investigated the role of Hedgehog proteins in mammalian pattern formation.
2. Hedgehog proteins play a role in mammalian pattern formation (Anderson, 1998).

When citing papers that have two authors, both names must be listed. When three or more authors are involved, the Latin *et al.* meaning "and others" may be used. A paper by Anderson, Garcia and Smith published in 1998 would be cited in the text as:

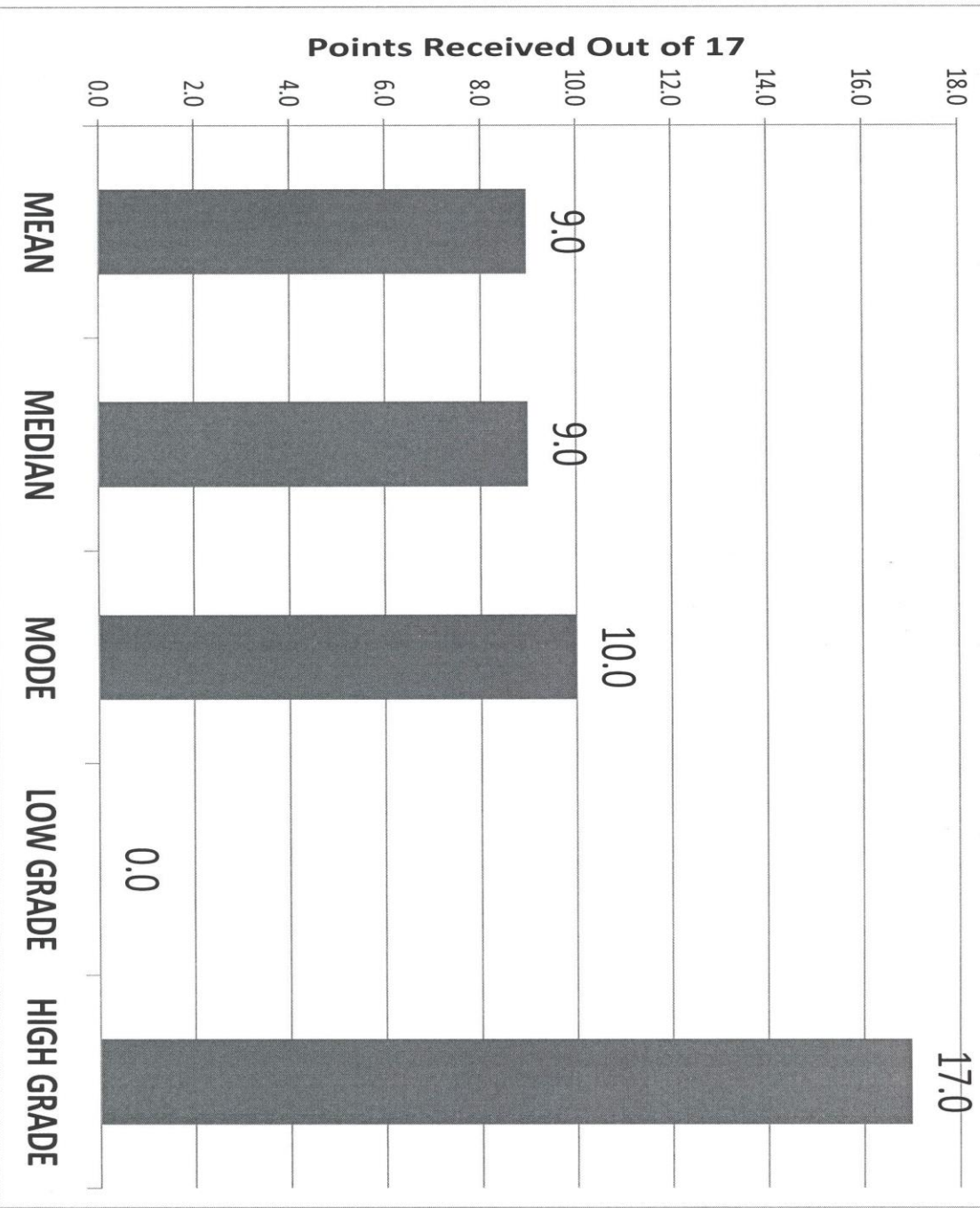
Anderson et al. (1998) have shown that...

This short form is for use in the body of the text. In the Literature Cited, all names should be listed, usually last name preceding initials.

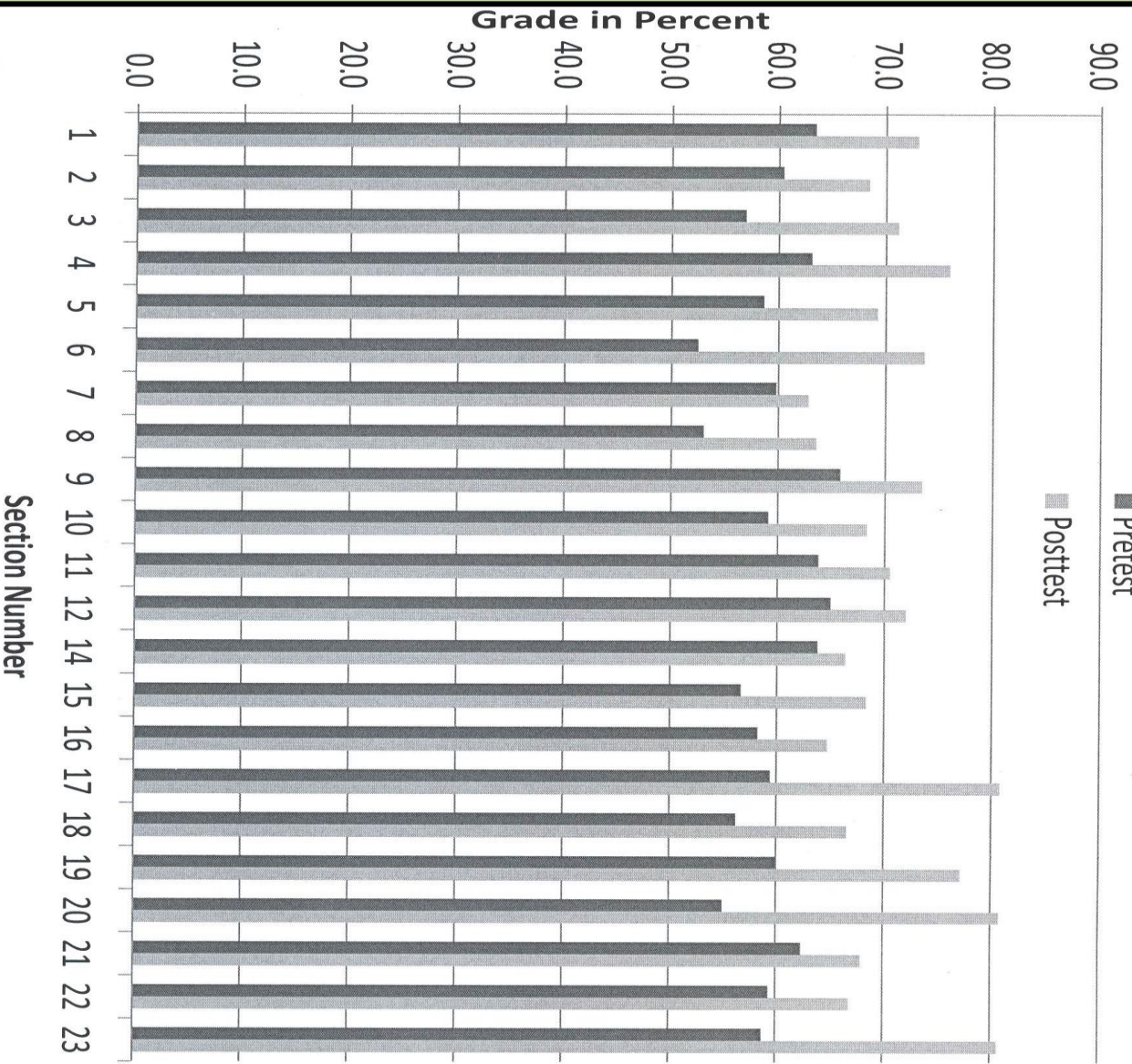
## Results Comparison of Pretest and Posttest Each Section of BIO1000



# GE Assessment Administered to BIO 1000 Sections 01-23 17-point test



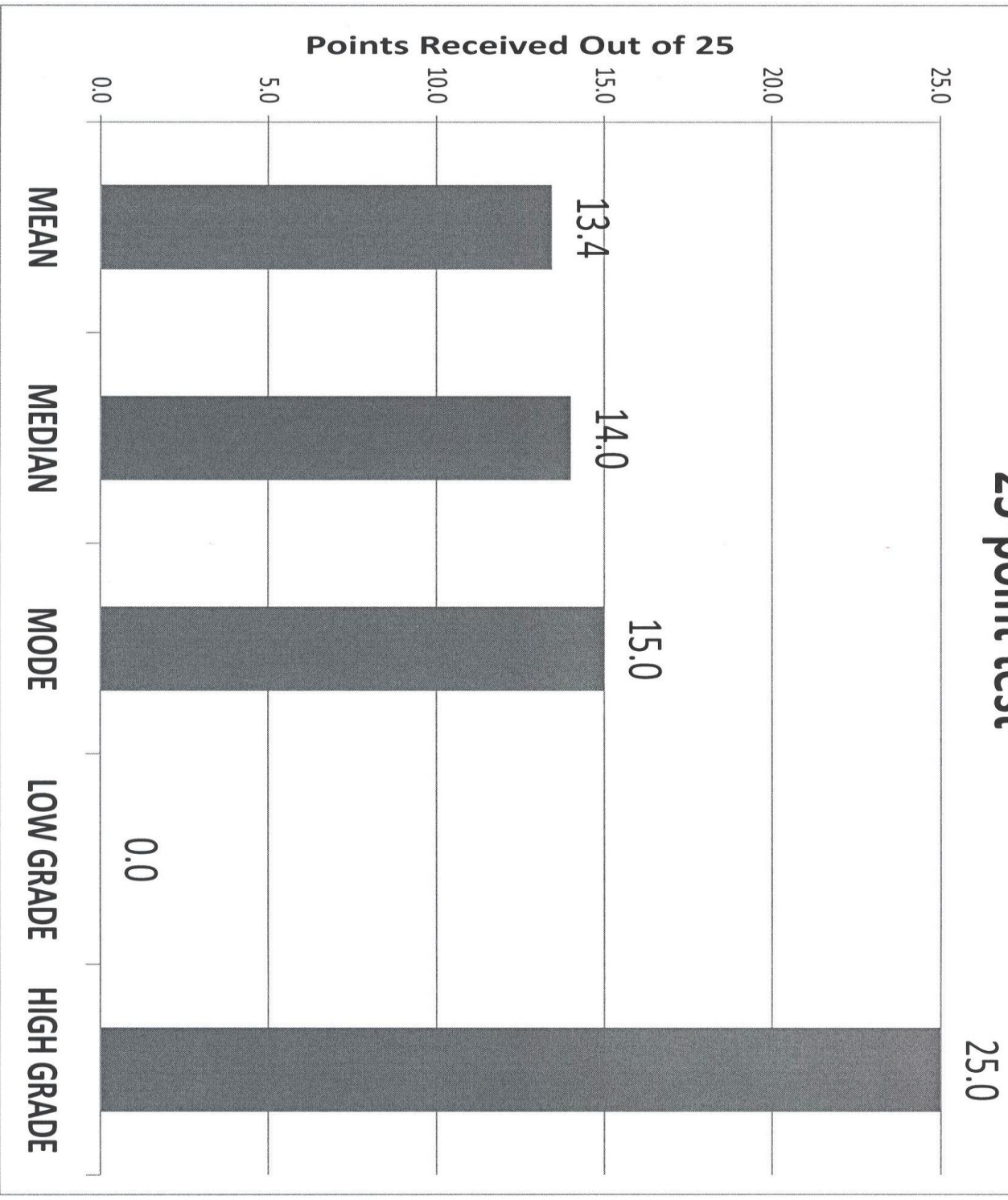
## Results Comparison of Pretest and Posttest Each Section of BIO1000







# GE Assessment Administered to BIO 1000 Sections 01-23 25-point test



# Comparison of Semester Percent Differences Between Pre and Post Tests

