Biology Program
Health Science Program
Assessment Report
Spring, 2009

I. Introduction

The Biology program serves all OIT students wishing to major or minor in the biological sciences, including those entering the medical or health-related professions and those seeking post-graduate work in a biological career field or those preparing for admission into a graduate biology program..

The Biology program was implemented in early 2007, but several students in the Health Sciences Program transferred their major to Biology by completing BIO 426 Evolutionary Biology. Thus, ten (10) students graduated with B.S. degrees in Biology in 2007. Retention rates and graduate salaries will not be available for several years.

The Health Sciences (HSC) program serves all OIT students wishing to major in a course of study that prepares for entry into professional programs in medicine, dentistry, pharmacy, veterinary medicine, physical therapy, optometry, clinical laboratory sciences, and related health fields.

The HSC program was implemented in 1996. The number of students graduating in past years were 10 (2003), 10 (2004), 11 (2005), 7 (2006) and 1 (2007). Declining enrollment and number of graduates is expected as students elect to complete a pre-professional degree in Biology instead of Health Sciences. Both degrees will continue to be offered during the next several years.

II. Program Purpose, Objectives and Student Learning Outcomes

The purpose, goals, and objectives of the Biology program and Health Sciences program are nearly identical. As the Biology program matures, additional courses will be added each year and divergence from the curriculum of the HSC program will continue. Eventually, the Health Sciences program will be phased out and students will achieve the same curriculum as a distinct emphasis area within the Biology program.

Biology Program Purpose

The Bachelor of Science Program in Biology prepares undergraduate students for professional and graduate work in the biological and health sciences. The curriculum in biology includes didactic, laboratory and field experiences in anatomy, physiology, ecology, microbiology, zoology, botany, genetics, biochemistry, evolution, and applied biology. It is designed for students wishing to apply to graduate programs in biology, to professional schools in the medical sciences (medicine, dentistry, pharmacy, veterinary sciences, physical therapy, clinical laboratory sciences, etc.), those seeking careers in the applied biological sciences, and those wishing to pursue graduate teaching credentials with a specialty in biology. Students may also gain experience by participating in special field courses and undergraduate research opportunities at the Yamsi Ranch in Sprague River and at Crater Lake National Park.

Biology Program Objectives

- Provide an integrated foundation of knowledge in biological disciplines that includes morphological, physiological, developmental, ecological, and evolutionary principles.
- Present information on the life sciences that utilize the scientific method and emphasize skills in analysis, evaluation, and critical thinking.
- Prepare students for entrance into graduate schools and professional health schools, including preparation for national admissions examinations, such as the Graduate Record Examination (GRE), Medical College Admission Test (MCAT) and similar examinations.
- Provide students with practical skills that can qualify them for entry level positions in applied biology occupations, such as wildlife conservation, forest ranger, and environmental consulting.

Biology Program Student Learning Outcomes (PSLOs)

1. Acquires factual knowledge on living organisms and biological system functions.
2. Acquires theoretical concepts and fundamental principles in the biological sciences, including use of the scientific method.
3. Apply biological principles and methodology to solving biology-based problems.
4. Conduct effective literature searches and critically evaluate the results and conclusions presented in scientific papers and other resources.
5. Communicate with others orally, in written form, and present information effectively.
6. Utilize and apply mathematical concepts, including statistics and graphic analyses, to biological phenomena.

III. Three Year Cycle for Assessment for Student Learning Outcomes

The Natural Sciences faculty agreed to designate six programmatic student learning outcomes (PSLOs) with two to be assessed each year in a rotating three year cycle, as shown in Table 1, below. Each PSLO will be assessed in at least two different courses, each academic year. Note that the Natural Science faculty revised the PSLO descriptions and renumbered them effective 2008-09, different from those in the 2007-08 Assessment Report. PSLO #6 is repeated for 2008-09 to bring it in alignment with the OIT ISLO on mathematical ability.

Learning Outcomes	**'07-08**	**'08-09**	**'09-10**	**'10-11**	**'11-12**	**'12-13**
1. Acquires factual knowledge on living organisms and biological system functions.	**X**			**X**		
2. Acquires theoretical concepts and fundamental principles in the biological sciences, including use of the scientific method.		**X**			**X**	
3. Apply biological principles and methodology to solving biology-based problems.			**X**			**X**
4. Conduct effective literature searches and critically evaluate the results and conclusions presented in scientific papers and other resources.			**X**			**X**
5. Communicate with others orally, in written form, and present information effectively.				**X**		
6. Utilize and apply mathematical concepts, including statistics and graphic analyses, to biological phenomena.	**X**	**X**			**X**	

Table 1. *Biology Program Assessment Cycle.*

IV. Summary of 2008–2009 Assessment Activities

The faculty of the Biology Program conducted the following assessments during the 2008-09 academic year. The performance criteria and proficiency standards for PSLO-2 and PSLO-6 are indicated in Appendix A. The PSLOs to be assessed in 2008-09 are indicated in Table 2.

Student Learning Outcome	Fall	Winter	Spring
PSLO 1 Factual Knowledge			
PSLO 2 Theoretical Concepts	BIO 426 Evolutionary Biology Larry Powers	BIO 212 Principles of Biology II Larry Powers	
PSLO 3 Application			
PSLO 4 Reference Search			
PSLO 5 Communication Skills			
PSLO 6 Mathematics Skills	CHE 450 Biochemistry I Ken Usher		CHE 223 General Chemistry III Vira Schechtel

Table 2. *Biology Program Assessment Activities for Academic Year 2008-09.*

PSLO-2. Acquires theoretical concepts and fundamental principles in the biological sciences, including use of the scientific method.

Direct Assessment #1: BIO 426 (Lawrence Powers), PSLO-2. Fall quarter, 2008.

An essay paper on sexual dimorphism in humans assessed knowledge of evolutionary principles. Performance criteria #1 and #2 were primarily addressed; #3 and 4 were measured for information purposes but were not considered integral to this particular exercise.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Recognizes major theoretical concepts and principles in the biological sciences.	Critical essay	1 - 3 (highest)	2	18/18 = 100%
Correlates theory to factual knowledge of specific biological functions and events.	Critical essay	1 - 3 (highest)	2	18/18 = 100%
Describes the scientific method and the relationships between observations, hypotheses, and theories.	Critical essay	1 -3 (highest)	2	12/18 = 66.7%
Applies the principles of falsification and validation to hypothesis testing.	Critical essay	1 - 3 (highest)	2	11/17 = 61.1%

Table 3. Assessment Results for PSLO #2 in BIO 426 Evolutionary Biology, Fall 2008.

Results are presented as percent of students achieving a proficiency level of “2” or “3”. Success criterion for the course was set at 80% or greater proficiency at “2” or above. All of the students (n = 18) achieved either a

2 (proficient) or 3 (highly proficient) on the two criteria addressed in the critical essay. For criterion #1, 12/18 students scored a “3” and for criterion #2, 12/18 students scored a “3”, but different students received a “3” for the two criteria. Because the last two criteria (3 and 4) were not emphasized during instructions for the exercise, students did not realize proficiency to the same extent. These criteria will be addressed in a different course (BIO 212) during the winter term.

Since 100% of the students achieved at least a proficiency of “2”, no corrective actions were deemed necessary for the two criteria assessed. However, the exercise will be reviewed for future years to ascertain whether it can be improved or utilized in a different format. The particular question on this essay, regarding the evolution of sexual dimorphism in humans, was an interesting one for most students and they were enthusiastic in researching the controversial aspects of the subject. Application of this assessment to other topics might result in lower levels of proficiency because the biological principles and applications may not be as clear.

Direct Assessment #2: BIO 212 (Lawrence Powers). PSLO-2. Winter quarter, 2009.

Part of an examination on ecological principles will assess knowledge of theoretical concepts based on real data for population estimates. Performance criteria #1 and #3 will be addressed.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Recognizes major theoretical concepts and principles in the biological sciences. (no. 1)	Essay exam	1 - 3 (highest)	2	33/38 = 86.8%
Describes the scientific method and the relationships between observations, hypotheses, and theories. (no. 3)	Essay exam	1 -3 (highest)	2	28/38 = 73.7%

Table 4. Assessment Results for PSLO #2 in BIO 212 Principles of Biology, Winter 2009.

Two questions on the mid-term examination presented field sampling data on estimating rodent and lizard populations. Students were asked to interpret the numerical results with respect to principles of dispersal and the potential for sampling error. For both performance criteria tested, a course level of 80% of successful performance was designated. Students met the first criterion (86.8%) but they had difficulty identifying sources of error and connecting actual observations with hypothetical population estimates (73.7% met the minimum acceptable performance level).

Two actions are proposed to address the shortcomings observed in criterion #3. First, additional instructions on interpreting sampling error will be prepared for BIO 212 and distributed as handouts with the lecture material covering this topic. It will contain a series of thought problems to guide students in making the connections between observations and interpretations. Second, a laboratory exercise will be developed to reinforce this approach and give students time to solve problems and receive feedback from instructors. The examination will follow this additional preparation.

PSLO-6. Utilize and apply mathematical concepts, including statistics and graphic analyses, to biological phenomena.

Direct Assessment #1: CHE 450 (Ken Usher). PSLO-6. Fall quarter, 2008.

A problem set on interpreting enzyme graphs and quantitative data was presented as part of a laboratory report and quiz. Student’s performance was assessed against a proficiency rubric for these tasks. Students were given the rubric and were asked to include it within their lab report.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Labels graphs appropriately (titles, axes & units)	scored lab report	1 - 3 (highest)	2	21/23 = 91.3%
Uses variables appropriately	scored lab report	1 - 3 (highest)	2	21/23 = 91.3%
Uses appropriate graphical or statistical representation	scored lab report	1 - 3 (highest)	2	21/23 = 91.3%
Identifies sources of error and/or limitations of measurement	scored lab report	1 - 3 (highest)	2	20/23 = 90.0%
Makes appropriate inferences from data	scored lab report	1 - 3 (highest)	2	20/23 = 90.0%

Table 5. Assessment Results for SLO #6 in CHE 450 Biochemistry Laboratory, Fall 2008

Results are presented as percent of students (n = 23) achieving a proficiency level of “2” or “3”. The assessment results indicate that most students knew how to construct accurate graphs, although their proficiency, particularly at drawing non-linear trend-lines, declined when asked to do this on a quiz. Use of non-linear trend-lines and providing meaningful graph titles were weaknesses for some students. Identifying axes and graphing the data points were easy for almost all students.

Most students were also able to correctly interpret graphed data and relate it to underlying biology, including cases where the actual graphs did not match their initial expectations. Some students did not make a numerical estimate of the accuracy of their data; it is not clear whether this was because they did not know how to, or because they did not feel they were required to. This aspect of the assignment will be revised to be more explicit in asking them to make such an estimate.

Direct Assessment #2: CHE 223 (Vira Schechtel). PSLO-6. Spring quarter, 2009.

A problem set of chemical calculations will be scored according to a proficiency rubric. This set will also be used to assess mathematics ability for ISLO 6.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Labels graphs appropriately (titles, axes & units)	scored problem set	1 - 3 (highest)	2	14/14 = 100%
Uses variables appropriately	scored problem set	1 - 3 (highest)	2	14/14 = 100%
Uses appropriate graphical or statistical representation	scored problem set	1 - 3 (highest)	2	14/14 = 100%
Makes appropriate inferences from data	scored problem set	1 - 3 (highest)	2	14/14 = 100%

Table 6. Assessment Results for SLO #6 in CHE 223 General Chemistry Laboratory, Spring 2009.

A comprehensive chemistry problem was presented to students during the last chemistry laboratory session. Students were assigned levels of proficiency based on the number of points earned:

7-8 demonstrated high proficiency = 3;
5-6 points demonstrated proficiency =2;
less than 5 points demonstrated no proficiency.

Five of 14 students met the proficient level (2) and nine of 14 met the highly proficient level (3). The positive results were as expected. This is due to continual exposure of students to data collection and graphing

methodology during all three General Chemistry courses: Fall term (CHE 221), Winter term (CHE 222) and Spring term (CHE 223).

V. Summary of Student Learning

During the 2008-2009 academic year, the Department of Natural Sciences assessed two student learning outcomes: PSLO-2 on acquiring and applying theoretical concepts and PSLO-6 on mathematical ability.

PSLO-2. Acquires theoretical concepts and fundamental principles in the biological sciences, including use of the scientific method.

Strengths: There are four criteria embedded within this learning outcome. The first, recognizing theoretical concepts and principles, appears to be met successfully (100% and 86.8%) when two different tasks were presented in BIO 426 (Fall, 2008) and BIO 212 (Winter, 2009), respectively. The second criterion, correlating theory to factual knowledge, also yielded a 100% proficiency result when presented in BIO 426 (Fall, 2008). The third criterion, describing the scientific method and relating observations to hypotheses, presents some difficulties. This was tested twice with lower than acceptable performance scores each time (66.7% in BIO 426 and 73.7% in BIO 212). The fourth criterion, interpreting falsification and validation concepts, was only tested in BIO 426 and it also demonstrated a need for further improvement (61.1% met the minimal acceptable performance level). Note that the two assessments were completed for a lower division course and an upper division course.

Improvement Plans: Linking observational data to hypotheses and theories is a skill that comes with educational experience and practice. This requires a combination of didactic and hands on approaches, using both lecture and laboratory/field materials. A handout addressing this relationship in scientific methodology will be developed for distribution in BIO 426 and BIO 212 next year (2009-10). The concepts of validation and falsification will also be added to the lecture material and the study guides, using appropriate examples from historical scientific discoveries (e.g., the Piltdown Man hoax).

PSLO-6. Utilize and apply mathematical concepts, including statistics and graphic analyses, to biological phenomena.

Strengths: All of the four criteria for mathematical ability were met in both of the courses assessed, CHE 450 (Fall, 2008) and CHE 223 (Spring, 2009). Note that the two assessments were completed for a lower division course and an upper division course.

Improvement Plans: No improvements or actions are proposed for this learning outcome at this time.

VI. Changes Resulting from Assessment

During the 2007-08 academic year, PSLO-6 was assessed, and the following improvement plans were suggested:

> Mathematical skills presented in General Ecology (BIO 327) will be introduced and reinforced by laboratory sessions devoted to interpreting graphs, identifying data types, and solving problems in population biology and population genetics.

As noted above, assessment of PSLO-6 was repeated in 2008-09 to bring it in alignment with the OIT ISLO on mathematical ability. Although BIO 327 was not assessed again this year, students met all performance criteria for this learning outcome, as described above.

Appendix A. Rubrics for 2008-09 Assessments

Performance Criteria Rubric PSLO-2

Student Learning Outcome #2: Acquires theoretical concepts and fundamental principles in the biological sciences, including use of the scientific method.

Criteria	High Proficiency (3)	Proficiency (2)	No/Limited Proficiency (1)
1. Acquisition of concepts:			
Recognizes major theoretical concepts and principles in the biological sciences	• Demonstrates advanced knowledge of biological principles and their theoretical basis, with examples	• Recognizes most biological concepts and can explain underlying principle	• Theoretical concepts are poorly recognized or understood
2. Correlation to factual information:			
Correlates theory to factual knowledge of specific biological functions and events	• Demonstrates advanced ability to apply concepts to observations and data sets, including extrapolation of generalizations	• Relates most concepts to relevant observations • Able to correlate some data sets with theoretical concepts	• Unable to relate concepts to data sets or observations • Unable to define correlation
3. Scientific methodology			
Describes the scientific method and the relationships between observations, hypotheses, and theories	• Demonstrates advanced recognition of the scientific method and cites complex examples of the process	• Recites the steps in the scientific method and cites simplified examples	• Limited or no recognition of the scientific method and its application
Applies the principles of falsification and validation to hypothesis testing	• Demonstrates readily the principles of hypothesis testing, with examples	• Defines the terms and can cite simple examples	• Cannot properly define falsification and/or validation

Rubric modification history: LP 9/23/08; LP 9/25/08; LP 10/03/08

Performance Criteria Rubric PSLO-6

Student Learning Outcome #6: Utilize and apply mathematical concepts, including statistics and graphic analyses, to scientific phenomena.

Criteria	High Proficiency (3)	Proficiency (2)	No/Limited Proficiency (1)
1. Mechanics:			
Labels graphs appropriately (titles, axes, & units)	• Title clearly identifies and states the purpose of the graph, does not re-state axis labels. • Axes are correctly labeled, with appropriate gridlines and units shown	• Graph has a title, axes are correctly labeled, points are graphed correctly • Axes are correctly labeled	• Graph lacks a title or its title does not identify the content of the graph • Axes lack labels
Uses variables appropriately	• Points are all graphed accurately, and graphed data is spread out across at least half of the page • Appropriate/correct variables are graphed/chosen	• Points are graphed accurately and axes identified and labeled appropriately.	• Axes are swapped • Points are graphed incorrectly • Inappropriate/incorrect variables are graphed
Uses appropriate graphical or statistical representation	• A smooth trend-line reflects both the measured data and any equations known to govern the graph.	• Trend-line just connects the points of the graph	• No trend-line or a trend-line that clearly does not fit the data.

2. Interpretation:			
Identifies sources of error and/or limitations of measurement	• Errors or deviations from theoretical values or behavior are discussed, and a reasonable numerical estimate of the accuracy limits of the interpreted data is included.	• Interpretation of the graph in the lab report is consistent with the scientific principle being tested or measured.	• Any errors or deviations from theoretical values or behavior are ignored.
Makes appropriate inferences from data	• Interpretation of the graph in the lab report clearly and correctly explains the scientific principle being tested or measured. • Errors, deviations, and accuracy limits are discussed.	• Any errors or deviations from theoretical values or behavior are identified. • Some numerical estimate of the accuracy limits of the interpreted data is included.	• Interpretation of the graph in the lab report demonstrates a *mis*understanding of the scientific principle being tested or measured.

Rubric modification history: BM 4/7/08; KU 4/25/08; LP 9/22/08; LP 9/25/08; LP 10/03/08