

**Biology Program  
Health Sciences Program  
Assessment Report  
2011-2012**

## **I. Introduction**

The Biology program serves all OIT students wishing to major or minor in the biological sciences. It is divided into two emphasis areas, one being Biological Sciences and the other being Premedical Professions. The curriculum map for the Premedical Professions emphasis is identical to the Health Sciences program curriculum map. They will be combined and renamed to the Biology-Health Sciences program for 2012-2013 in order to reduce confusion for students. The Biology program will then only offer the curriculum taken by Biological Sciences emphasis students.

The Biology program was implemented in 2006. The number of students graduating in past years were 10 (2006-2007), 8 (2007-2008), 18 (2008-2009), 14 (2009-2010), 12 (2010-2011), and 13 (2011-2012). These include students from both the Biological Sciences and Premedical Professions emphasis areas.

The Health Sciences 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, physician assistant, optometry, clinical laboratory sciences, and related health fields.

The Health Sciences program was implemented in 1996. The number of students graduating in past years were 8 (1999-2000), 2 (2000-2001), 9 (2001-2002), 10 (2002-2003), 10 (2003-2004), 11 (2004-2005), 7 (2005-2006), 1 (2006-2007), 3 (2007-2008), 2 (2008-2009), 2 (2009-2010), 1 (2010-2011), and 6 (2011-2012).

## **II. Program Purpose, Objectives and Student Learning Outcomes**

The purpose, goals, and objectives of the Biological Sciences emphasis within the Biology program differ from the Health Sciences program while the Premedical Professions emphasis within the Biology program is exactly the same as the Health Sciences program. We will combine results from these programs within this report. The purpose, goals, and objectives were discussed by the program faculty during fall convocation 2012 with a recommendation to update this assessment report. The faculty then approved the revised report on September 30, 2012.

### **Biology Program and Health Sciences Program Purpose**

The Bachelor of Science program in Biology – Biological Sciences emphasis prepares undergraduate students for graduate work in the biological sciences. The curriculum in biology includes various disciplines as listed at the end of the report. It is designed for students

wishing to apply to graduate programs in biology, 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.

The Bachelor of Science program in Biology – Premedical Professions emphasis and the Health Sciences program prepare undergraduate students for professional schools in the medical sciences (medicine, dentistry, pharmacy, veterinary sciences, physical therapy, clinical laboratory sciences, etc.).

### **Biology Program and Health Sciences Program Objectives**

- Provide an integrated foundation of knowledge in biological disciplines that includes morphological, cellular, molecular, 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 examination, such as the Graduate Record Examination (GRE), Medical College Admission Test (MCAT) and similar examinations, or provide students with practical skills that can qualify them for entry level positions in biology-related occupations.

### **Biology Program and Health Sciences Program Student Learning Outcomes (PSLOs)**

1. Students will demonstrate scientific knowledge and skills in scientific reasoning.
2. Students will be able to apply scientific principles to biology based problems.
3. Students will be able to effectively find and use resources from the literature.
4. Students will demonstrate effective oral, written and visual communication.
5. Biology students will demonstrate mathematical knowledge and skills in the biological sciences.

### **III. Three Year Cycle for Assessment for Student Learning Outcomes**

The Natural Sciences faculty agreed to designate five program student learning outcomes (PSLOs) with one or two to be assessed each year in a rotating three-year cycle, as shown in Table 1 below. Note that the Natural Science faculty revised the PSLO descriptions and renumbered them effective 2010-2011.

<b>Learning Outcomes</b>	<b>'07-08</b>	<b>'08-09</b>	<b>'09-10</b>	<b>'10-11</b>	<b>'11-12</b>	<b>'12-13</b>
1. Students will demonstrate scientific knowledge and skills in scientific reasoning.	X	X		X		
2. Students will be able to apply scientific principles to biology based problems.			X			X
3. Students will be able to effectively find and use resources from the literature.			X			X
4. Students will demonstrate effective oral, written and visual communication.				X		
5. Biology students will demonstrate mathematical knowledge and skills in the biological sciences.	X	X			X	

Table 1. Biology and Health Sciences Program Assessment Cycle.

#### **IV. Summary of 2011–2012 Assessment Activities**

The faculty of the Biology program conducted the following assessments during the 2011-2012 academic year as indicated in Table 2.

<b>Student Learning Outcome</b>	<b>Fall</b>	<b>Winter</b>	<b>Spring</b>
PSLO 5 Biology students will demonstrate mathematical knowledge and skills in the biological sciences.	CHE 450 Biochemistry	PSY 221 General Physics	

Table 2. Biology Program Assessment Activities for Academic Year 2011-12.

**PSLO 5: Biology students will demonstrate mathematical knowledge and skills in the biological sciences.** This PSLO is mapped to the curriculum as shown in appendix A.

Four performance criteria were assessed:

1. Perform mathematical computations.
2. Read and comprehend written and graphical quantitative information.
3. Students will be able to properly graph quantitative information.
4. Interpret the results of statistical and mathematical computations.

**Direct Assessment #1**

The faculty conducted an assessment of this PSLO in CHE 450 during the Fall 2011 term. Mathematical concepts were assessed as part of a laboratory experiment on bacterial growth curves. This lab required quantitative measurement of data and graphing in both linear and non-linear forms. Students must relate values from graphs back to established theories about bacterial growth, and must also discuss the limits and usefulness of their imperfectly measured data. Students' ability to graph and apply mathematical concepts was via a grading rubric that was used to assess the graphs and graph interpretation in the student lab reports and in the quiz that students took when they handed in the lab report. The results are shown in Table 3 below.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
2. Read and comprehend written and graphical quantitative information.	Rubric to assess 2 homework questions & 1 exam question	3= high proficiency 2 = proficiency 1= no/limited proficiency	80% of students scored 2 or higher	100% of students scored 2 or higher
3. Students will be able to properly graph quantitative information	Rubric to assess 3 homework questions & 2 exam questions	3= high proficiency 2 = proficiency 1= no/limited proficiency	80% of students scored 2 or higher	83% of students scored 2 or higher

Table 3. Assessment Results for PSLO 5 in CHE 450, Fall 2012.

**Discussion:**

Results indicated that all but one of the 23 students demonstrated “proficiency”. Nine students demonstrated “high proficiency” in at least half of the criteria assessed. Students met performance criteria for reading/comprehending written information and performing math computation and reading/comprehending graphical quantitative information.

## Direct Assessment #2

The faculty conducted an assessment of this PSLO in PHYS 221 during the Winter 2012 term, using final exam questions clustered around the three performance criteria. There were 13 students involved in the assessment. The results are shown in Table 4 below.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
1. Perform mathematical computations.	2 Exam questions	1= correct 0 = incorrect	75 % of students got 2 out of 2 correct	69% got 2 out of 2 correct 23% got 1 out of 2 correct
2. Read and comprehend written and graphical quantitative information.	1 Exam questions	1= correct 0 = incorrect	70 % of students got 1 out of 1 correct	77% got 1 out of 1 correct 23% got 0 of 1 correct
3. Students will be able to properly graph quantitative information	1 Exam question	1= correct 0 = incorrect	70 % of students got 1 out of 1 correct	77% got 1 out of 1 correct 23% got 0 out of 1 correct
4. Interpret the results of statistical and mathematical computations.	1 Exam question	1= correct 0 = incorrect	60 % of students got 1 out of 1 correct	47% got 1 out of 1 correct 53% got 0 out of 1 correct

Table 4. Assessment Results for PSLO 5 in PHYS 221, Winter 2012.

### Discussion:

Perform mathematical computations: Instructor used problems 1 and 2 of the exam because they were done early in the class and, for the purposes of this assessment; instructor scored the problems as correct if the mathematical computations were done correctly even if the student were not actually using the right equation or in some other way answering the problem incorrectly. Most of the problems that were 'incorrect' were due to the fact that the student either didn't do the problem or was so far from using the right equation that instructor couldn't determine whether they were performing calculations correctly or not. Overall this seems due to the fact that a couple of the equations needed for the problems were not listed on the formula sheet. The instructor had hoped that students would be able to remember where these equations come from since if they had remembered the basic idea behind them the equations are easy to reproduce. This indicates that the students put too much effort into looking for an equation to plug numbers into rather than into understanding the meaning behind the equations. It seems this is a major problem in most math and physics classes. The instructor will implement some ways of addressing this problem in future classes. One of these ways is to emphasize more strongly that equations should be understood.

Instructor also plans to give more problems in which the student must derive the equation rather than just look it up.

Read and comprehend written and graphical quantitative information: In this problem the students had to read the area of the graph and realize that this gives the work done by the variable force. They then had to use this work to determine the final speed of the object. Students' performance has met instructor's expectation.

Graph quantitative information: The instructor does not often have students make graphs in the class, but they do so in the lab. The instructor was pleased that most students answered this problem correctly. Though the results met instructor's expectation, the instructor plans on having the students work more with graphing and graphs in general throughout the class in the future.

Interpret the results of statistical and mathematical computations: This problem was the most difficult one on the exam and instructor gave credit for the problem only if it was done completely correctly. The steps are such that each succeeding step depends on the one before it. Most students were able to get the first or second steps, but then missed the last step. The last step used methods that were covered in the last couple of weeks of class so the problem may be that the material had not been fully digested yet. Only 47% of students got the problem entirely correct, but type of result is quite typical for the most difficult problems in physics. It is one of the most difficult things for students to use information from one method or concept in another concept. The problem goes back to #1 – that students tend to focus on hunting for equations to use instead of the meaning behind the equations or the connections between them.

#### Indirect Assessment #1

The faculty conducted an assessment of this SLO in CHE 450 during the Fall 2011 term. Mathematical concepts were assessed as part of a laboratory experiment on bacterial growth curves. This lab required quantitative measurement of data and graphing in both linear and non-linear forms. Students must relate values from graphs back to established theories about bacterial growth, and must also discuss the limits and usefulness of their imperfectly measured data.

Students' ability to graph and apply mathematical concepts was assessed via a student survey (appendix B), administered to students along with the lab quiz.

Results showed that nearly all students agreed that their coursework at OIT had prepared them well in each of the criteria/outcomes identified in the math PSLO, including the graphing and interpretation outcomes being assessed in the current exercise. Students felt more confident in their preparation to "properly graph quantitative information" than in their preparation to "interpret the results of statistical and mathematical computations". This is borne out somewhat by the direct assessment results, although students may overestimate their proficiency at constructing graphs, as

there were few “highly proficient” students in this area than ones marking “strongly agree” in this area on the survey.

#### Indirect Assessment #2

The faculty indirectly assessed this outcome in Spring 2012. Seniors completed an exit survey that asked students to rate how well the Biology and Health Sciences programs prepared them with regards to the program-specific student learning outcomes and corresponding competencies. Seventeen out of nineteen Biology & Health Sciences graduates completed the senior survey. The survey results for this outcome are presented in Table 5 below.

Program-specific learning outcome	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Demonstrate mathematical knowledge and skills in the biological sciences	Student rating	1-4 Scale	80% of graduates indicate a 3 or 4 rating	94% (4/4 and 3/4)

Table 5. Assessment Results for SLO 5 in Senior Exit Survey, Spring 2012

Discussion: Nearly 90% of seniors participated in the senior exit survey. Ninety-four percent of participants indicated that the program prepared them with ability in demonstrating mathematical knowledge and skills in the biological sciences. This result is consistent with those in indirect assessment #1 assessed in CHE 450.

## V. Summary of Student Learning

### **PSLO 5: Biology students will demonstrate mathematical knowledge and skills in the biological sciences.**

Strengths: Four assessments (two direct and two indirect) were conducted to assess this learning outcome. The results demonstrated that Biology & Health Sciences students were competent in reading/comprehending written and graphical quantitative information (criterion #2) and were able to properly graph quantitative information (criterion #3). It is interesting to note that the results from student survey showed that students felt that they were well equipped with overall mathematical knowledge and skill in the biological sciences.

Weaknesses: The direct assessment #2 which targeted individual performance criterion indicated there is a lack of proficiency in performing mathematical computation and interpreting the results of statistical and mathematical computations. It seems that when students encounter problems involved in more challenging math, students tend to focus on hunting for equations to use instead of the meaning behind the equations or the connections between them.

Actions: The faculty of Biology & Health Sciences program will focus on the weakness of students' performance and continue to provide help sessions and work sheets to enhance students' knowledge and skills in math. The faculty also think students should be equipped with the motivation and capacity to apply math knowledge in biological problems. One avenue in educating students to value math skills is to offer method courses. Currently there is a method course offered to environmental science program students. A similar course offered to Biology & Health Sciences students will be beneficial.

## Appendix A Curriculum Map for Biology & Health Sciences (Combined)

**PSLO 5: Biology students will demonstrate mathematical knowledge and skills in the biological sciences.** Courses that are shaded indicate that the PSLO is taught in the course.

Year	Fall	Winter	Spring
<b>F 1</b>			
	BIO 211 Principles of Biology	BIO 212 Principles of Biology	BIO 213 Principles of Biology
	MATH 111 College Algebra	MATH 112 Trigonometry	BIO 200 Medical Terminology
	WRI 121 English Composition	WRI 122 English Composition	MATH 361 Statistical Methods I
	Social Science Elective	BIO 109 Introduction to Medical Sciences	Humanities elective
		Social Science Elective	
<b>S 2</b>			
	BIO 345 Medical Microbiology	BIO 209 Current Research Topics	BIO 206 Nutrition
	CHE 221 General Chemistry	BIO 341 or alternative Medical Genetics	BIO 342 Cell Biology
	MATH 251 Differential Calculus	CHE 222 General Chemistry	CHE 223 General Chemistry
	SPE 111	MATH 252 Integral Calculus	Humanities Elective
		WRI 227 Technical Report Writing	
<b>J 3</b>			
	CHE 331 Organic Chemistry I	CHE 332 Organic Chemistry II	CHE 333 Organic Chemistry III
	BIO 331 Human Anatomy & Physiology I	BIO 332 Human Anatomy & Physiology II	BIO 333 Human Anatomy & Physiology III
	PHY 221 General Physics Calculus	PHY 222 General Physics Calculus	PHY 223 General Physics Calculus
			WRI 327 Advanced Technical Writing
<b>S 4</b>			
	CHE 450 Biochemistry I	CHE 451 Biochemistry II	CHE 452 Biochemistry III

	Elective	BIO 346 Pathophysiology I		BIO 347 Pathophysiology II
	Elective	BIO 357 Introduction to Neurosciences		BIO 436 Immunology
	Elective	BIO 409 Current Research Topics		Elective
	Elective	Social Science Elective		

## Appendix B

**Numbers in brackets below indicate how often students gave that response (23 students total)**

### Anonymous survey to accompany CHE 450 Lab Quiz 1 (Oct 2011)

*No, this does not affect your grade in any way, but I appreciate your assistance as we try to make the Biology & Health Sciences programs even better in the future!*

1. One of the student learning outcomes for OIT's Biology & Health Sciences program is that *"students will demonstrate mathematical knowledge and skills in the biological sciences."* As you near completion of your degree, do you feel that this is an important learning outcome for you?

Strongly disagree / disagree / neutral / agree (10) / strongly agree (13)

4. Do you feel that your coursework at OIT has prepared you well to *perform mathematical computations* in biochemistry?

Strongly disagree / disagree / neutral (3) / agree (15) / strongly agree (4)

5. Do you feel that your coursework at OIT has prepared you well to *read and comprehend written and graphical quantitative information* in biochemistry?

Strongly disagree / disagree / neutral (3) / agree (13) / strongly agree (7)

6. Do you feel that your coursework at OIT has prepared you well to *properly graph quantitative information* in biochemistry?

Strongly disagree / disagree (1) / neutral / agree (10) / strongly agree (12)

7. Do you feel that your coursework at OIT has prepared you well to *interpret the results of statistical and mathematical computations* in biochemistry?

Strongly disagree / disagree / neutral (2) / agree (16) / strongly agree (5)

8. Name two classes (in the sciences or elsewhere) that you have taken, which most *teach* these skills.

*Responses: general chemistry (11), statistics (8), microbiology (6), other math (7), other science (9)*

9. Name two classes (in the sciences or elsewhere) that you have taken, which most *use* these skills. [These could be the same classes as in question 8, or different ones.]

*Responses: general chemistry (9), biochemistry (8), physics (5), statistics (4), microbiology (4), organic chemistry (4), other math (6), other science (6)*