

## **Biology - Health Sciences Program Assessment Report 2014-2015**

### **I. Introduction**

The Biology - Health Sciences program offered on the Klamath Falls campus 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, and related health fields.

Biology - Health Sciences was originally called Health Sciences but renamed in 2012-2013. The Health Sciences program was implemented in 1996. It is a popular program with an enrollment of approximately 150 students. The number of students graduating from the Biology - Health Sciences was 15 in 2012-2013, 17 in 2013-2014, and 27 in 2014-2015.

The number of students graduating in past years when the program was called Health Sciences was 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), 6 (2011-2012), 1 (2012-2013), and 0 (2013-2014).

The Biology program was implemented in 2006-2007 and removed from the catalog in 2012-2013. The number of students graduating in past years were 10 (2006-2007), 8 (2007-2008), 18 (2008-2009), 14 (2009-2010), 12 (2010-2011), 13 (2011-2012), 2 (2012-2013), 5 (2013-2014), and 2 (2014-2015).

We have limited information regarding employment rates and salaries, as most students go on to graduate school and are not employed for two to four years while working on their graduate degrees. Many take a year off while applying to graduate schools, making follow up more difficult, and generally only a low percentage of students complete the exiting senior surveys.

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

The purpose, goals, and objectives of the Biological - Health Sciences program were discussed by the program faculty during fall convocation 2014-2015 (September 2014). Everyone was satisfied with the current stated purpose, objectives, and student learning outcomes.

#### **Biology - Health Sciences Program Purpose**

The Bachelor of Science program in Biological - Health Sciences prepares undergraduate students for professional and graduate schools in the medical sciences (medicine, dentistry, pharmacy, veterinary sciences, physical therapy, physician assistant, etc.).

#### **Biology - Health Sciences Program Objectives**

- Provide an integrated foundation of knowledge in biological disciplines that includes genetics, pathophysiology, neurobiology, microbiology, immunology, cellular and molecular biology, physiological, developmental, 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), Dental School Admissions Test (DAT), and similar examinations, or provide students with practical skills that can qualify them for entry level positions in biology and health-related occupations.

#### **Biology - 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. Students will demonstrate mathematical knowledge and skills in the biological and health sciences.

# Assessment Report

2014-2015

### 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.

Program Student Learning Outcomes	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015
Assessment Coordinator	Powers	Powers	Sale	Li	Li	Clark	Clark	O'Shaughnessy
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. Students will demonstrate mathematical knowledge and skills in the biological sciences.	✓	✓			✓			✓

Table 1. Biology - Health Sciences Program Assessment Cycle.

### IV. Summary of 2014–2015 Assessment Activities

The faculty of the Biology – Health Sciences program conducted the following assessments during the 2014-2015 academic year as indicated in Table 2.

Program Student Learning Outcome	Fall	Winter	Spring
PSLO 5 Students will demonstrate mathematical knowledge and skills in the biological sciences.	✓ BIO 345 CHE 450		

Table 2. Biology – Health Sciences Program Assessment Activities for Academic Year 2014-2015.

This PSLO is mapped to the curriculum as shown in appendix A.

## Direct Assessment #1

21 Biology-Health Sciences seniors were assessed fall term of 2014 (201401). These students were enrolled in Dr. Ken Usher's CHE 450 Biochemistry I, a required course.

Two out of four performance criteria were assessed for this PSLO:

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.

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 were assessed via a grading rubric (see "SLO #5 Math Rubric" in Appendix B) 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.

See Appendix C "CHE 450 Math score sheet Fall 2014" for tabulated results.

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 2014-01.

### Results:

- Results indicated that all but one of the 21 students demonstrated "proficiency"
- 10 students demonstrated "high proficiency" in at least half of the criteria assessed.
- Rubric for this assessment is located in Appendix B
- Complete results are located in Appendix C

### Discussion: Strengths & Weaknesses in Student Learning

The math skills required for the tasks in this assessment are relatively straightforward, but they do require significant interpretation by the students. The results indicate that most of our students are doing well in this area, and that they are sufficiently prepared to do meaningful math-related work in their future careers.

## Direct Assessment #2

Thirty-nine Biology-Health Sciences sophomores were assessed fall term of 2014 (201401). These students were enrolled in Dr. Burt Clark's BIO 345 Medical Microbiology, a required course.

Three out of four performance criteria were assessed for this PSLO:

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.**

The faculty conducted an assessment of this PSLO in BIO 345 during fall term 2014 using weekly lecture quiz questions, lecture final exam questions, weekly lab quiz questions, and lab final exam questions clustered around three performance criteria; perform mathematical computations, read and comprehend written and graphical quantitative information, and interpret the results of statistical and mathematical computations. The results are shown in Table 4 below.

Performance Criteria used in <a href="#">Direct Assessment #2</a>	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
1. Perform mathematical computations.	3 quiz questions	✓ = correct ✗ = incorrect	70 % of students with $\geq 2$ out of 3 correct	20% got 3 out of 3 correct 50% got 2 out of 3 correct 26% got 1 out of 3 correct
2. Read and comprehend written and graphical quantitative information.	3 quiz questions	✓ = correct ✗ = incorrect	70 % of students with $\geq 2$ out of 3 correct	69% got 3 out of 3 correct 26% got 2 out of 3 correct 5% got 1 out of 3 correct
4. Interpret the results of statistical and mathematical computations.	3 exam questions	✓ = correct ✗ = incorrect	70 % of students got $\geq 2$ out of 3 correct	64% got 3 out of 3 correct 31% got 2 out of 3 correct 05% got 1 out of 3 correct

Table 4. Assessment Results for PSLO 5 in BIO 345, Fall 2014-01.

### Results:

- Results indicated that all 39 students demonstrated proficiency at the minimum acceptable performance level.
- Twenty-five students demonstrated proficiency in two-thirds of the criteria assessed.
- Complete results are located in Appendix D

### Discussion:

#### Perform mathematical computations:

The Instructor used three problems from lecture and lab quizzes for the purposes of this assessment. Students met performance expectations of seventy percent having two of three questions correct. The students needed to know the formula for the questions since they were not provided on the assessment piece. However, examples were covered in lecture and lab, and several similar problems were given on homework, graded, and returned both with their chosen answers and the correct answers prior to all quizzes. All homework was done using BlackBoard and students had unlimited access to review questions, answers, and feedback on how the correct answer is calculated prior to the quizzes. The instructor will introduce additional mathematical computation questions on homework in order to provide more feedback for students prior to assessments. The instructor also plans to give more problems in which the student must derive the equation rather than "plug" values into an equation, and possibly not have a deeper understanding of "why".

#### Read and comprehend written and graphical quantitative information:

In these problems, the students had to read graphs and study figures. Then they used the data to do mathematical computations to reach a correct answer. The minimum performance expectation was that 70% of students would correctly answer two of three questions. Students met performance expectations with 95% having two of three questions correct. It appears that students had the most difficulty with the first question in this assessment (Lecture Quiz #6, Question #1). While these questions were multiple-choice questions, an answer had to be commuted. This first question was especially challenging since the answer was "e. none of the above". The students had to be very confident in their calculation to choose this. Overall, similar homework questions were done on BlackBoard and students had unlimited access to review questions, answers, and feedback on how correct answers were calculated prior to the quizzes.

#### Interpret the results of statistical and mathematical computations:

In these three problems, students had to interpret the results in the word problems, and then use the information to do mathematical calculations on how the results were reached. The minimum performance expectation was that 70% of students would correctly answer two of three questions. Students met performance expectations with 95% having two of three questions correct and 64% had all three questions correct. These three questions are from the lecture final exam. Students had seen earlier examples on lecture homework and quiz assessments.

## Indirect Assessment #1

Two questions on the Senior Exit Survey dealt with how students felt they were prepared in regards to mathematical skills.

Question #2 asked students “Rate your proficiency in the following areas”

Question	Highly proficient	Proficient	Somewhat Proficient	No/ Limited Proficiency	Total responses
Rate your proficiency in the following areas: 3. Mathematical knowledge & skills	33.3%	66.7%	0%	0%	9

Table 5. Responses of Biology-Health Sciences graduates to how proficient they were in regards to mathematical knowledge and skills.

Question #3 asked students “Please indicate how well the Biology-Health Sciences Program prepared you are in the area of mathematical knowledge and skills.

Question	High prepared	Prepared	inadequately prepared	Mean	Total responses
Please indicate how well the Biology-Health Sciences program prepared you in the area of mathematical knowledge and skills	22.2%	77.8%	0%	1.78	9

Table 6. Responses of Biology-Health Sciences graduates to how well the Biology-Health Sciences program prepared them in skills and scientific reasoning.

## Discussion:

All students considered themselves to be proficient and prepared for their future careers. Not many considered themselves to be highly proficient and highly prepared, which is acceptable. Mathematical skill is required, but not a high priority among the large number of different skills that they must acquire and use daily for their careers.

## VI. Evidence of Student Learning

The department Faculty concluded that the Biology – Health Sciences students are all meeting, and some exceeding their expectations in regards to mathematical knowledge and skills.

The faculty are not considering any changes in the mathematics portion of the curriculum at this time.

## V. Changes Resulting from Assessments

There have not been any changes made in response to earlier assessments of mathematical knowledge and skill.

## Appendix A. Curriculum Map for Biology - Health Sciences

Year	Fall	Outcome*	Winter	Outcome*	Spring	Outcome*
<b>F 1</b>						
	BIO 211 Principles of Biology	I	BIO 109 Intro to Medical Sciences		BIO 213 Principles of Biology	I
	MATH 111 College Algebra	I	BIO 212 Principles of Biology	I	MATH 361 Statistical Methods I	
	WRI 121 English Composition		MATH 112 Trigonometry		Health Biology Elective (lower division)	
	Social Science Elective		WRI 122 English Composition		Humanities Elective	
			Social Science Elective			
<b>S 2</b>						
	BIO 345 Medical Microbiology	R	BIO 209 Current Research Topics in Medical Sciences I		CHE 223 General Chemistry	R
	CHE 221 General Chemistry	R	CHE 222 General Chemistry	R	WRI 227 Technical Report Writing	
	MATH 251 Differential Calculus		MATH 252 Integral Calculus		Health Biology Elective (upper division)	R
	SPE 111 Fundamental of Speech		SPE 321 Small Group Communication		Humanities Elective	
			‡ Health Biology Elective (upper division)			
<b>J 3</b>						
	BIO 331 Human Anatomy & Physiology I		BIO 332 Human Anatomy & Physiology II		BIO 333 Human Anatomy & Physiology III	
	CHE 331 Organic Chemistry I	R	CHE 332 Organic Chemistry II	R	CHE 333 Organic Chemistry III	R
	PHY 221 General Physics with Calculus	R	PHY 222 General Physics with Calculus	R	PHY 223 General Physics with Calculus	R
			Humanities Elective		WRI 327 Advanced Technical Writing	
<b>S 4</b>						
	CHE 450 Biochemistry I	R	BIO 346 Pathophysiology I		BIO436 Immunology	
	Health Biology Elective (upper division)		BIO 409 Current Research Topics in Medical Sciences II		Health Biology Elective (upper division)	
	Social Science Elective		CHE 451 Biochemistry II	R	Health Biology Elective (upper division)	
	Elective		Social Science Elective		Health Biology Elective (upper division)	
	Elective				Elective	

\* In these columns, the outcome is either introduced (I), reinforced (R), or emphasized (E) in each course. It is left blank if not applicable.

## Appendix B: Rubric for Direct Assessment #1

Biochemistry CHE 450 Lab #1 "Dilutions and Bacterial Growth", Fall 2011

Part of your work (on using and applying math and graphs to biology) in this lab will be scored using the following rubric.

Criteria	High Proficiency (3)	Proficiency (2)	No/Limited Proficiency (1)
<b>1. Mechanics:</b>			
Labels graphs appropriately (titles, axes, & units)	<ul style="list-style-type: none"> <li>Title clearly identifies and states the purpose of the graph, does not restate axis labels.</li> <li>Axes are correctly labeled, with appropriate gridlines and units shown</li> </ul>	<ul style="list-style-type: none"> <li>Graph has a title, axes are correctly labeled, points are graphed correctly</li> <li>Axes are correctly labeled</li> </ul>	<ul style="list-style-type: none"> <li>Graph lacks a title or its title does not identify the content of the graph</li> <li>Axes lack labels</li> </ul>
Uses variables appropriately	<ul style="list-style-type: none"> <li>Points are all graphed accurately, and graphed data is spread out across at least half of the page</li> <li>Appropriate/correct variables are graphed/chosen</li> </ul>	<ul style="list-style-type: none"> <li>Points are graphed accurately, but graph is crowded into a small area</li> </ul>	<ul style="list-style-type: none"> <li>Axes are swapped</li> <li>Points are graphed incorrectly</li> <li>Inappropriate/incorrect variables are graphed</li> </ul>
Uses appropriate graphical or statistical representation	<ul style="list-style-type: none"> <li>A smooth trend-line reflects both the measured data and any equations known to govern the graph.</li> </ul>	<ul style="list-style-type: none"> <li>Trend-line just connects the points of the graph</li> </ul>	<ul style="list-style-type: none"> <li>No trend-line or a trend-line that clearly does not fit the data.</li> </ul>
<b>2. Interpretation:</b>			
Identifies sources of error and/or limitations of measurement	<ul style="list-style-type: none"> <li>Any 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.</li> </ul>	<ul style="list-style-type: none"> <li>Interpretation of the graph in the lab report is consistent with the scientific principle being tested or measured, but the written discussion does not highlight the connection.</li> </ul>	<ul style="list-style-type: none"> <li>Any errors or deviations from theoretical values or behavior are ignored.</li> </ul>
Makes appropriate inferences from data	<ul style="list-style-type: none"> <li>Interpretation of the graph in the lab report clearly and correctly explains the scientific principle being tested or measured.</li> </ul>	<ul style="list-style-type: none"> <li>Any errors or deviations from theoretical values or behavior are pointed out but not discussed, and some numerical estimate of the accuracy limits of the interpreted data is included.</li> </ul>	<ul style="list-style-type: none"> <li>Interpretation of the graph in the lab report demonstrates a misunderstanding of the scientific principle being tested or measured.</li> </ul>



## Appendix C: Results for Direct Assessment #1

	Mechanics				Interpretation		Overall Proficiency?		
Student	Labels	Variables	Representation		Error Source	Inference			Y/N
Ana	3	3	3	3	3	3	3	3	High
Renee	3	3	3	3	2.5	3	2.75	2.917	High
Ashton	3	3	1	2.333	1.5	2	1.75	2.139	Y
Sadie	2	3	1.5	2.167	2.5	3	2.75	2.361	Y
Mandy	3	3	2	2.667	2	2	2	2.444	Y
Michelle	3	3	2	2.667	2	3	2.5	2.611	High
Ben	2.5	3	3	2.833	3	3	3	2.889	High
Brittany	2.5	3	2.5	2.667	3	3	3	2.778	High
Kaitlin	3	3	3	3	3	3	3	3	High
Tyler	2	3	3	2.667	3	3	3	2.778	High
Jenny	3	3	2	2.667	2	2	2	2.444	Y
Kim	3	3	1	2.333	2	2	2	2.222	Y
Alex	3	3	2	2.667	2	2.5	2.25	2.528	High
Aubrey	3	3	3	3	2	2	2	2.667	High
Alexis	3	3	3	3	3	3	3	3	High
Karen	2.5	3	1	2.167	3	2.5	2.75	2.361	Y
Lynn	3	1	2	2	2	2	2	2	Y
Cord	3	3	3	3	3	3	3	3	High
Garrett	1	1	1	1	1	1	1	1	N
Kerby	3	3	2	2.667	2	1	1.5	2.278	Y
BJ	2	3	1	2	2	3	2.5	2.167	Y
% students with 3	39.13	52.17	39.13		30.43	39.13			
% students with 2	43.48	30.43	39.13		69.57	60.87			
% students at 2 or 3	82.61	82.61	78.26		100.00	100.00			

## Appendix D: Results for Direct Assessment #2

Criteria	1. Perform mathematical computations.			2. Read and comprehend written and graphical quantitative information.			4. Interpret the results of statistical and mathematical computations.						
Student	Lecture Quiz #2, Question #5	Lab Quiz #4, Question #12	Lab Final Exam, Question #70	Lecture Quiz #6, Question #1	Lecture Quiz #6, Question #40	Lecture Quiz #7, Question #39	Lecture Final Exam, Question #38	Lecture Final Exam, Question #109	Lecture Final Exam, Question #148	Percent grade in course	Criterion #1 questions correct	Criterion #2 questions correct	Criterion #4 questions correct
Student 01	✓	X	✓	✓	✓	✓	✓	✓	✓	98.1	2	3	3
Student 02	✓	X	X	✓	✓	✓	✓	✓	X	89.6	1	3	2
Student 03	✓	✓	X	✓	✓	X	✓	✓	X	88.3	2	2	2
Student 04	✓	X	✓	✓	✓	✓	✓	✓	✓	96.0	2	3	3
Student 05	✓	✓	✓	✓	✓	✓	✓	✓	✓	98.4	3	3	3
Student 06	✓	X	✓	✓	✓	✓	✓	✓	✓	96.8	2	3	3
Student 07	✓	X	✓	X	✓	X	✓	✓	✓	82.3	2	2	3
Student 08	✓	✓	X	✓	X	X	✓	✓	X	92.9	2	2	2
Student 09	✓	na	✓	✓	✓	X	✓	✓	✓	85.6	2	2	3
Student 10	✓	✓	✓	✓	X	✓	✓	✓	✓	89.6	3	2	3
Student 11	✓	✓	✓	✓	✓	✓	✓	✓	✓	95.1	3	3	3
Student 12	X	✓	X	✓	✓	✓	✓	✓	✓	76.8	1	3	3
Student 13	X	X	X	✓	✓	✓	✓	✓	X	76.3	0	3	2
Student 14	X	X	X	X	✓	✓	✓	✓	X	84.7	0	3	2
Student 15	✓	✓	✓	✓	✓	✓	✓	✓	X	90.9	3	3	2
Student 16	✓	X	✓	✓	✓	✓	✓	✓	X	95.7	2	3	2
Student 17	✓	✓	✓	✓	✓	✓	✓	✓	✓	95.0	3	3	3
Student 18	✓	✓	✓	✓	X	✓	✓	✓	✓	99.5	3	2	3
Student 19	X	✓	X	✓	X	✓	✓	✓	✓	80.4	1	2	3
Student 20	✓	X	✓	✓	✓	✓	✓	✓	✓	96.0	2	3	3
Student 21	✓	✓	✓	✓	✓	✓	✓	✓	✓	100.0	3	3	3
Student 22	X	✓	✓	X	✓	✓	✓	✓	✓	96.7	2	3	3
Student 23	✓	✓	✓	✓	✓	✓	✓	✓	✓	96.3	3	3	3
Student 24	✓	X	✓	✓	✓	✓	✓	✓	✓	100.0	2	3	3
Student 25	✓	X	X	✓	✓	✓	✓	✓	✓	92.1	1	3	3
Student 26	✓	✓	X	X	X	X	✓	✓	X	92.0	2	1	2
Student 27	✓	✓	X	X	✓	✓	✓	✓	✓	94.9	2	3	3
Student 28	X	✓	X	✓	✓	✓	✓	✓	✓	88.4	1	3	3
Student 29	X	X	✓	X	X	✓	✓	✓	X	72.0	1	2	2
Student 30	✓	X	X	X	✓	✓	✓	✓	X	83.3	1	3	2
Student 31	✓	X	X	✓	✓	✓	✓	✓	X	93.3	1	3	2
Student 32	✓	✓	X	X	X	X	X	✓	X	75.6	2	0	1
Student 33	✓	X	X	X	✓	✓	✓	✓	✓	78.8	1	3	3
Student 34	✓	✓	X	X	✓	X	✓	✓	X	80.3	2	2	2
Student 35	✓	✓	X	✓	✓	✓	✓	✓	✓	93.1	2	3	3
Student 36	✓	X	✓	X	✓	✓	✓	✓	✓	95.4	2	3	3
Student 37	✓	✓	X	✓	✓	✓	✓	✓	✓	85.0	2	3	3
Student 38	✓	X	X	X	✓	✓	X	✓	X	77.4	1	2	1
Student 39	✓	X	✓	✓	✓	✓	✓	✓	✓	97.2	2	3	3