

# **Science General Education Annual Assessment Report 2009-2010**

## **I. Introduction**

The Science General Education Program serves all OIT degree students, who are each required to complete 12 science credits selected by the student or specified by the major department.

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

The faculty in the Natural Science Department who are part of the Science General Education Program met in September 2009 to review the Science General Education program purpose, objectives, and student learning outcomes. The faculty affirmed them without changes.

### **Science General Education Program Purpose**

To provide lower division science courses appropriate for science, technology, engineering, health, and liberal arts students.

### **Program Educational Objectives**

1. Understanding of fundamental scientific principles or concepts.
2. The ability to apply fundamental principles or concepts to solve problems.

### **Student Learning Outcomes**

The student learning outcomes and performance criteria for the Science General Education program are as follows:

#### **SLO 1: Students will demonstrate scientific knowledge and skills in scientific reasoning.**

Criteria for Assessment: Students will be able to

1. Demonstrate factual knowledge of a science (terminology, organization, classifications, methods, fundamental principles, generalizations, or theories).
2. Use appropriate scientific reasoning skills to interpret and analyze content in the natural sciences.

#### **SLO 2: Students will demonstrate mathematical knowledge and skills.**

Criteria for Assessment: Students will be able to

1. Perform the mathematical computations required in the science courses they are taking.

2. Read and comprehend written information relevant to the science courses they are taking.
3. Read and comprehend graphical quantitative information relevant to the science courses they are taking.

**SLO 3: Students will be able to demonstrate a fundamental scientific principle.**

Criteria for Assessment: Students will be able to

1. Collect data, making appropriate measurements.
2. Precisely record data, including use of appropriate units.
3. Analyze data to determine its relationship to the scientific principle and evaluate the data for errors.

**III. Three-Year Cycle for Assessment of Student Learning Outcomes**

The faculty agreed on a three-year cycle of assessment for the three program learning outcomes, as shown in Table 1 below.

<b>Learning Outcomes</b>	<b>'08-09</b>	<b>' 09-10</b>	<b>'10-11</b>
SLO 1: Students will demonstrate scientific knowledge and skills in scientific reasoning.	X		
SLO 2: Students will demonstrate mathematical knowledge and skills.		X	
SLO 3: Students will be able to demonstrate a fundamental scientific principle.			X

Table 1. Science General Education Assessment Cycle

**IV. Summary of 2009-10 Assessment Activities**

During the 2009-10 academic year, the program faculty conducted formal assessment of SLO #2: Students will demonstrate mathematical knowledge and skills, using the performance criteria noted above. This learning outcome has been mapped to the science general education curriculum as shown in Appendix A.

### Direct Assessment #1

The faculty conducted an assessment of this SLO in PHY 221 during the fall 2009 term, using final exam questions clustered around the three performance criteria. There were 62 students involved in the assessment. The results are shown in Table 2 below.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Performs math computations	2 Exam questions	1 = correct 0 = incorrect	70% correct for each question	60.94% Q #4 45.31% Q# 17
Reads/comprehends written quantitative information	2 Exam questions	1 = correct 0 = incorrect	70% correct for each question	39.06% Q#14 45.31% Q#15
Reads/comprehends graphical quantitative information	2 Exam questions	1 = correct 0 = incorrect	70% correct for each question	17.19% Q#11 43.75% Q#12

Table 2. Assessment Results for SLO #2 in PHY 221 Fall, 2009

Questions from three categories (performs math with computations, reads/comprehends written quantitative information, and read/comprehends graphical quantitative information) were assessed for the percentage of students that answered each item correctly. The minimum acceptable performance for each question was 70%.

**Math computation:** Students did not meet this performance criterion. Physics is one the most challenging fields in science general education courses. The results showed that math computation is below acceptable limits, exacerbated by the need for students to identify related equations/relationships.

**Written comprehension:** Students did not meet this performance criterion. This is an assessment where students have to read written problems and devise several formulas. This element is core work in the class. The instructor felt the students did better in hourly exams than in the final exam.

**Graphic comprehension:** Students did not meet this performance criterion. The instructor felt the first problem was harder than the second one, although it was covered in lectures and a homework assignment. It required recognition of a non-obvious point which may have eluded many students. For this reason, this problem should probably be eliminated from consideration. Formula identification is also a component of these problems, which is traditionally difficult for students.

### Direct Assessment #2

The faculty conducted an assessment of this SLO in CHE 101/CHE104 during the winter 2010 term. Math computation and written comprehension questions were drawn from the lecture final exam, and graphic comprehension questions were drawn from lab

quizzes. There were 80 students involved in the lecture and 65 of them also participated in the lab component of this course. The results are shown in Table 3 below.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Performs math computations	4 Exam questions	1= correct 0 = incorrect	75% achieve 3 out of 4	60%
Reads/comprehends written quantitative information	4 Exam questions	1= correct 0 = incorrect	75% achieve 2 out of 3	90.1%
Reads/comprehends graphical quantitative information	8 quizzes questions	1= correct 0 = incorrect	75% achieve 5 out of 8	96.9%

Table 3. Assessment Results for SLO #2 in CHE101/CHE104, winter 2010.

Students met performance criteria for reading/comprehending written quantitative information and reading/comprehending graphical quantitative information. They did not meet the performance criterion for performing math computations.

#### Math computation:

This is an assessment where students have to understand the data, relate the questions to multivariable problems, and apply appropriate formulas to solve the problems. Math computation is a core element of this assessment. The instructor felt the weakness in learning for this criterion is due to lack of practice and the low attendance rate in lecture. Problem solving procedures were explained in lecture and such concepts are more difficult to grasp if students do not attend the lecture. Most of the students in this course are freshmen who may be adjusting to the demands of college. The faculty gear their instructional delivery to these students by providing extra weekly study materials and weekly quizzes.

#### Written comprehension:

The instructor felt students were well equipped to comprehend written quantitative questions and to solve the problems without difficulty. The results exceeded expected performance.

#### Graphical comprehension:

This assessment is conducted using questions from different lab quizzes. Students had to collect data from the lab experiments and relate the data to graphic information. Students performed well with this criterion.

#### Direct Assessment #3

The faculty conducted an assessment of this SLO in CHE 223 during the spring 2010 term. Math computation and written comprehension questions were drawn from the lecture final exam, and graphic comprehension questions were drawn from lab quizzes.

There were 49 students involved in the lecture and 46 of them took the lab quiz. The results are shown in Table 4 below.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Performs math computations	5 Exam questions	1 = correct 0 = incorrect	75% achieve 4 or above	73.5%
Reads/comprehends written quantitative information	5 Exam questions	1 = correct 0 = incorrect	75% achieve 4 or above	87.8%
Reads/comprehends graphical quantitative information	2 lecture quiz questions	1 = correct 0 = incorrect	100% achieve 1 or above	89.0%

Table 4. Assessment Results for SLO #2 in (course, survey, etc), (term)

Students met performance criteria for performing math computations and reading/comprehending written quantitative information. They did not meet the criteria for reading/comprehending graphical quantitative information.

**Math computation:**

Students essentially met the performance criteria for performing math computations. Math 111 is a prerequisite for CHE 223, so students performed more strongly in this assessment than CHE 101 students did.

**Written comprehension:**

The instructor felt students were well equipped to comprehend written quantitative questions and to solve the problems without difficulty. The results exceeded faculty expectations.

**Graphical comprehension:**

This assessment is conducted using questions from one lab quiz. Students had to construct a graph based on written information and interpret the implication of the constructed graph. Students did not meet the minimum acceptable level of 100%, but 89% of the group assessed was able to do so. Similar questions were practiced in class. The instructor felt students did not put enough effort into studying concepts such as this due to the fact that the lab component weighs only 20 percent of the total final grade.

## V. Summary of Student Learning

SLO 2: Students will demonstrate mathematical knowledge and skills.

### Strengths:

For the Chemistry courses in this assessment, student performance met faculty expectations overall, with some weaknesses noted. The Physics results are discussed separately below.

### Weaknesses:

While math computation did not meet faculty expectations in CHE 101, students in CHE 223 did meet performance criteria in this area.

### Actions:

Despite the issues with math computation in CHE 101, the faculty decided to keep the 75% performance standard for lower division courses. Most of the students in CHE 101 have placed into MATH 100, which is a pre- or co-requisite for the course. This means that many of them are taking MATH 100 while taking CHE 101. The faculty decided not to pursue making MATH 100 a pre-requisite, because doing so would throw students out of sequence and affect their entry into sophomore professional programs.

Currently the faculty provide extensive help sessions, study guides, extra worksheets, and weekly quizzes to support student learning in lower division Chemistry courses. The faculty decided to continue with these instructional support strategies for the time being, and will revisit student performance in math during the next regularly scheduled assessment.

The issues identified in Physics were addressed separately during 2009-10 within the Physics program. During 2008-09, the institution assessed science general education in conjunction with the Natural Sciences Department. That assessment identified a number of issues with Physics that parallel the findings above. For additional information, see "Closing the Loop on Science ISLO-Winter 2010" at <http://www.oit.edu/provost/learningoutcomes/gened/science>.

## Appendix A: PSLO #2 Mapped to the Science General Education Curriculum Map

PSLO #2: Students will demonstrate mathematical knowledge and skills.

This is a list of courses that are considered part of the General Science Education program at Oregon Institute of Technology. Courses that are shaded below indicate that PSLO #2 is taught in the course.

	100 Level		200 Level	
<b>FALL</b>	CHE 101	Elementary CHE	CHE 201/CHE 221	General CHE
	BIO 101	General BIO	BIO 207	Medical terminology
	BIO 111	Intro Env. Science	BIO 211	Principles of BIO
	GEOG 115	Climatology	BIO 231	Human A&P I
			PHYS 201	General PHYS
			PHYS 221	General PHYS w/calc
			PHYS 223	General PHYS w/calc
<b>WINTER</b>	CHE101	Elementary CHE	CHE 202/222	General CHE
	CHE 102	Elementary CHE	BIO 212	Principles of BIO
	BIO 102	General BIO	BIO 232	Human A&P II
	BIO 105	Microbiology	PHYS 202	General PHYS
	GEOG 105	Geomorphology	PHYS 221	General PHYS w/calc
			PHYS 222	General PHYS w/calc
<b>SPRING</b>	CHE 101	Elementary CHE	CHE 223	General CHE
	CHE 103	Elementary CHE	CHE 231	Streamwater CHE
	BIO 103	General BIO	CHE 232	Streamwater Sampling
			BIO 213	Principles of BIO
			BIO 216	Intro to Vet. Medicine
			BIO 233	Human A&P III
			PHYS 203	General PHYS
			PHYS 222	General PHYS w/calc
			PHYS 223	General PHYS w/calc