Science General Education Annual Assessment Report 2011-2012

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 2011 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.

Learning Outcomes	**'11-12**	**'12-13**	**'13-14**
SLO 1: Students will demonstrate scientific knowledge and skills in scientific reasoning.	X	"12-13	
SLO 2: Students will demonstrate mathematical knowledge and skills.	"11-12	X	
SLO 3: Students will be able to demonstrate a fundamental scientific principle.			X

Table 1. Science General Education Assessment Cycle

IV. Summary of 2010-11 Assessment Activities

During the 2011-12 academic year, the scheduled SLO 1 (scientific knowledge) for assessment was switched with SLO2 (math knowledge) as the math knowledge was assessed by the Biology Program and several courses offered by General Education are also core courses in Biology program curriculum. The data collected in this assessment was useful in Biology program assessment. 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 2011 term, using final exam questions clustered around the three performance criteria. There were 34 students involved in the assessment. The results are shown in Table 2 below.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Perform the mathematical computations required in the science courses they are taking.	4 Exam questions	1= correct 0 = incorrect	50% of students got 3 out of 4 correct	10% got 4 out of 4 correct 35% got 3 out of 4 correct 23% got 2 out of 4 correct 13% got 1 out of 4 correct 20% got 0 out of 4 correct
Read and comprehend written information relevant to the science courses they are taking	4 Exam questions	1= correct 0 = incorrect	50% of students got 3 out of 4 correct	23% got 4 out of 4 correct 45% got 3 out of 4 correct 26% got 2 out of 4 correct 6% got 1 out of 4: correct 0% got 0 out of 4: correct
Read and comprehend graphical quantitative information relevant to the science courses they are taking	2 Exam questions	1= correct 0 = incorrect	70% of students got 1 out of 2 correct.	32% got 2 out of 2 correct 26% got 1 out of 2 correct 42% got 0 out of 2 correct

Table 2. Assessment Results for SLO 2 in PHY 221, Fall 2011.
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Discusscussion:
Students met performance criteria for reading/comprehending written information, but did not meet the criteria for performing math computation and reading/comprehending graphical quantitative information.

Math Computation: The fact that the minimum performance for criteria #1 (i.e., perform mathematical computations) was not met is difficult to interpret since, in the realm of physics it is difficult to separate out the purely quantitative portion from the conceptual

understanding of what is to be done. In other words criteria #1 is intended to test the students to see if they can be successful in following the necessary mathematical computations to get the correct answer under the assumption that they know the correct procedure to follow. Unfortunately this assumption is not always true.

Written comprehension: This criterion was met and it indicates that the students can be successful in determining the underlying concept when mathematical computations are not substantively involved. Hence, an interpretation of the result of criteria #1 could be made in terms of the outcome of meeting the standard for criteria #2.

Graphical comprehension: The class did not meet the requirements for this criterion. This was a longitudinal assessment in that two different versions of the same question were posed to the students at two different times during the term. In the first issuance of the problem 21 students failed to show sufficient understanding of the problem. Out of these 21 students, only 7 were able to learn from their experience and solve the problem correctly for the second issuance of the problem. What is enlightening about this assessment is that the solution to the first issuance of the problem was fully available to the students prior the second issuance of the problem. This again points to the fundamental problem of student motivation and study skills.

The instructor felt that the major reason for their failure to meet the standard for criteria #1 is most likely due to a fundamentally low mathematical skill level. However, what cannot be ignored is the other side of the equation, meaning student motivation. In the case of the problems assessed for criteria #1, it turns out that the students had been exposed to very similar problems to three of the four problems that were chosen to be evaluated. What is even more enlightening is the fact that in preparation for the final exam (on which these three problems were placed for assessment) the students were given access to the full solutions to the prior versions of these problems. So while it is probably correct to say that the students could benefit from more, say graded homework and in-class examples, it is also true to say that the students failed to avail themselves to important study material that was immediately accessible to them and to recognize how to adjust their study habits so as to be able to generalize from examples of work given to them.

Direct Assessment #2

The faculty conducted an assessment of this SLO in PHY 221 during the winter 2012 term, using final exam clustered around the three performance criteria. There were 75 students involved in the assessment. The results are shown in Table 3 below.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Perform the mathematical computations required in the science courses they are taking	2 Exam questions	1= correct 0 = incorrect	75 % of students got 2 out of 2 correct	84% got 2 out of 2 correct 9% got 1 out of 2 correct 7% got 0 out of 2 correct
Read and comprehend written information relevant to the science courses they are taking	1 Exam questions	1= correct 0 = incorrect	70 % of students got 1 out of 1 correct	86.7% got 1 out of 1 correct
Read and comprehend graphical quantitative information relevant to the science courses they are taking	N/A			

Table 3. Assessment Results for SLO 2 in PHYS 222, Winter 2012.

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Discussion:

Math computation: In this case the 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. The score of 84% is satisfactory, but it should be since these students have had calculus and should be able to solve an algebraic equation or perform simple mathematical computations. 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 the instructor was pleased with the results of this part of the assessment. However, one disturbing thing did appear. While 84% of the students performed computations correctly only 42% of students got both questions entirely correct. 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. The instructor felt 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. From discussions with other instructors the instructor believes that this is a major problem in most math and physics classes. The instructor is intending to implement some ways of addressing this problem in future classes. One of these ways is to emphasize more strongly that equations should be understood. The instructor also plans to give more problems in which the student must derive the equation rather than just look it up.

Reading comprehension: 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. The instructor was quite pleased that 86.7% of the students were able to read the graph correctly and most of them were able to determine the correct speed. The instructor had done a problem similar to this one in class only one time so the students seem to have a good understanding of determining quantities from a graph.

Direct Assessment #3

The faculty conducted an assessment of this SLO in CHE 202 during the winter 2012 term, using final exam questions clustered around the three performance criteria. There were 49 students involved in the assessment. The results are shown in Table 4 below.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results
Perform the mathematical computations required in the science courses they are taking	4 Exam questions	1= correct 0 = incorrect	75% of students got 2 out of 4 correct	14.3% got 4 out of 4 correct. 34.7% got 3 out of 4 correct 38.8% got 2 out of 4 correct 8.2% got 1 out of 4 correct 4.1% got 0 out of 4 correct
Read and comprehend written information relevant to the science courses they are taking	3 Exam questions	1= correct 0 = incorrect	60% of students got 2 out of 3 correct	14.3% got 3 out of 3 correct 28.6% got 2 out of 3 correct 46.9% got 1 out of 3 correct 10.2% got 0 out of 3 correct
Read and comprehend graphical quantitative information relevant to the science courses they are taking	3 Exam questions	1= correct 0 = incorrect	60% of students got 2 out of 3 correct	12.2% got 3 out of 3 correct 34.7% got 2 out of 3 correct 36.7% got 1 out of 3 correct 16.3% got 0 out of 3 correct

Table 4. Assessment Results for SLO 2 in CHE 202, Winter 2012

Discussion:

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

Math computation: Students surpassed met the performance criteria for performing math computations. The instructor's impression is that basic mathematical skills are solid among this student population.

Written comprehension: The assessment questions involved interpretation of written information ("word problems"), including questions in which more quantitative information was provided that was necessary to solve the problem. The instructor's observations of the student population corroborate this weakness in students' problem-solving abilities, as many students were observed to become frustrated when dealing with quantitative problems that involved multiple steps or were phrased in unexpected ways. In the future, the instructor will include greater emphasis on these types of problems on homework assignments and in-class exercises. This will include activities in which students will be provided with scaffolding to help them become aware of and use appropriate problem-solving strategies for questions requiring interpretation of written information.

Graphical comprehension: The assessment questions involved interpretation of graphs provided as part of the question, and students did not meet the performance criteria. The instructor also observed that many students exhibited a lack of confidence regarding creating or interpreting graphs in the laboratory portion of the course, in part possibly because many activities involving graphs were collaborative activities in which some students did not participate as fully in graph-making or interpretation. In the future, the instructor will place greater emphasis on students' individually creating and interpreting graphs as part of laboratory activities.

V. Summary of Student Learning

SLO 2: Students will demonstrate mathematical knowledge and skills.
Strengths: Two out of three assessments demonstrated that students were equipped with solid math computation skills as shown in assessments #2 and #3. Both assessments in Physics (assessment #1 and #2) showed that students were proficient in reading and comprehending written information.

Weaknesses: Assessment results showed that students did not meet instructors' expectation in reading and comprehending graphical quantitative information relevant to the science courses they are taking.

Actions: In the future, the instructors will include greater emphasis on graphing types of problems on homework assignments and in-class exercises. This will include activities in which students will be provided with scaffolding to help them become aware of and use appropriate problem-solving strategies for questions requiring interpretation of written information.

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

SLO 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 #3 is taught in the course.

	100 Level		**200 Level**	
FALL	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
WINTER	CHE101	Elementary CHE	CHE 202/222	General CHE
	CHE 102	Elementary CHE	BIO 212	Principles of BIO (?? Check ion winter)
	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
SPRING	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