BS in ENVIRONMENTAL SCIENCES ASSESSMENT PLAN AND REPORT 2011-2012

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I Environmental Sciences Program: Introduction and History

The BS in Environmental Sciences program started in 1995. It is offered only on the Klamath Falls campus of Oregon Institute of Technology.

Enrollment has ranged from a low of eight in 1995 to a high of 44 in 2002. There was a decline between 2002 and 2008. This decline was related to the growth of the AAS degree Natural Resources at Klamath Community College (KCC) and OIT's new BS in Biology degree (that began accepting students in 2006). Since 2008, however, there has been a marked increase in enrollment which is expected to continue to increase due to targeted recruitment efforts and new articulation agreements with Oregon community colleges. Enrollment for fall term 2011 was 41 students, which includes 5 dual majors.

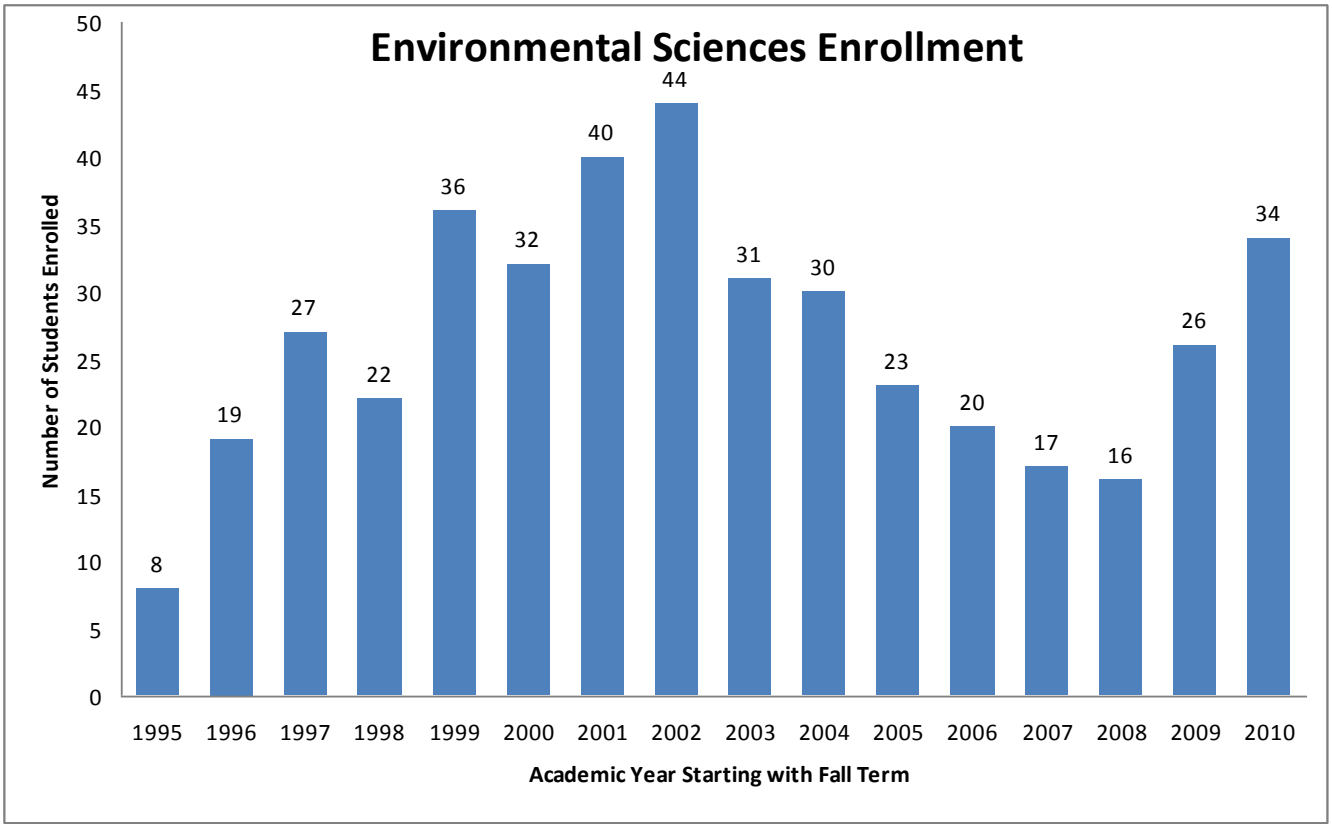

Figure 1. Environmental Sciences enrollment, fall term, 1995-2010.

The average salary of environmental sciences graduates as reported in 2006 was $46,667. This was 96% of the average of all OIT graduates in the survey, and was comparable to the average salaries of civil engineering ($47,990) and clinical laboratory sciences ($47,192).

II Environmental Sciences Program Purpose, Objectives, and Student Learning Outcomes

Environmental Sciences Program Purpose

The Environmental Sciences program prepares students for immediate employment and graduate studies in the analysis and mitigation of environmental problems. The program focuses on science methodology and applied analysis, applying state-of-the-art field methods, instrumentation, and data analysis to the study of the natural and human environment from an interdisciplinary systems perspective. The curriculum builds on four cores: natural sciences (biology, chemistry, and physics); mathematics (including calculus and statistics); geographic information science (GIS); and integrated social sciences (including economics, geography, and bioregional studies).

Program Educational Objectives

1. Provide knowledge and training in the practical application of the scientific method utilizing appropriate analytical approaches and instrumentation-based methodologies.
2. Prepare students for roles in resource management that require critical thinking and problem solving skills.
3. Prepare students for graduate studies in environmental sciences, natural resource management, environmental education, geography, geographic information science, and regulation.
4. Provide students with technical and analytical skills that enable them to find employment in federal and state resource agencies, consulting firms, community-based education, and industrial firms tasked with environmental compliance.

Expected Learning Outcomes and courses where they will be assessed

Upon completion of the program, students will have demonstrated the following abilities:
1. Apply mathematical concepts, including statistical methods, to field and laboratory data to study scientific phenomena (**BIO 112, BIO 434/MATH 362**).
2. Use GIS to solve geospatial problems (**GIS 205, GIS 316**).
3. Understand the complex relationships between natural and human systems (**BIO 111, BIO 484**).
4. Design and execute a scientific project. (**Project course series: BIO 261, 262, BIO 471, 472, 473, 474**).

III Environmental Sciences Program Assessment Matrix

Table 1 shows the planned three-year assessment rotation cycle on a term-by-term basis for each of the four student learning outcomes.

Table 1. Three-year assessment cycle.

Year		Fall	Winter	Spring
One **2011-2012**	#4 Scientific Projects Revisit Ethics ISLO Revisit Career Planning & Lifelong Learning ISLO Revisit Written Communication #1 Mathematical Competence & Mathematics ISLO	BIO 471: Senior Project Proposal Research BIO 474: Senior Project Data Analysis and Presentation BIO 484: Sustainable Human Ecology BIO 474: Senior Project Data Analysis and Presentation BIO 474: Senior Project Data Analysis and Presentation	BIO 261: Sophomore Project Proposal BIO 472: Senior Project Proposal BIO 112: Introduction to Data Analysis MATH 362: Statistical Methods II	BIO 262: Sophomore Project BIO 473: Senior Project Data Collection
Two **2012-2013**	#2 GIS Skills		GIS 205: GIS Data Integration GIS 316: Geospatial Vector Analysis I	
Three **2013-2014**	#3 Natural/Human Systems	BIO 111: Introduction to Environmental Science BIO 484: Sustainable Human Ecology		

IV Summary of 2011-2012 Student Learning Outcomes Assessment Activities

The outcomes assessed during 2011-2012 were: SLO #1 Mathematical Competence and SLO #4 Scientific Projects. Assessment activities, including direct and indirect measures, are addressed in this section.

Student Learning Outcome #1: Apply mathematical concepts, including statistical methods, to field and laboratory data to study scientific phenomena (see Curriculum map in Appendix A).

This outcome was to be evaluated in BIO 112 Introduction to Data Analysis (winter 2012) and MATH 362 Statistical Methods II (winter 2012) using a performance criteria rubric (see Appendix B) filled out by the professor (direct measure) and the students (indirect measure) indicating levels of proficiency; however, only two students in the Environmental Sciences Program were enrolled in MATH 362 during winter 2012. Two students would be an insufficient basis for

assessment, therefore this course was not included in this report. Criteria for this SLO as they pertain to BIO 112 include being able to label graphs appropriately, use correct variables when constructing graphs, use appropriate graphical representation, and make appropriate inferences from data. Performance criteria related to identifying appropriate type of mathematical test for a scientific problem and identifying sources of error and/or limitations of measurement were not included in this assessment. Identifying an appropriate type of mathematical test is a skill that is more advanced than the 100 level of BIO 112, whereas identifying sources of error or limitations of measurement pertain to methods of data collection, which are covered in later parts of the program curriculum. Minimum acceptable performance requirements are 60% of students at "high proficiency" or "proficient."

Table 2. Indirect measure, student self-assessment results for SLO #1: Mathematical Competence for BIO 112 (winter 2012).

Performance Criteria	Assessment Method	Measurement Scale (High Proficiency, Proficient, Limited Proficiency, No Proficiency—1-3 Scale)	Minimum Acceptable Performance	Results
NA	Self-assessment form	% at 2 or 3	60% at 2 or 3	NA
	Self-assessment form	% at 2 or 3	60% at 2 or 3	
	Self-assessment form	% at 2 or 3	60% at 2 or 3	
	Self-assessment form	% at 2 or 3	60% at 2 or 3	

Table 3. Direct measure, faculty assessment results for SLO #1: Mathematical Competence for BIO 112 (winter 2012).

Performance Criteria	Assessment Method	Measurement Scale (High Proficiency, Proficient, Limited Proficiency or No Proficiency—1-3 Scale)	Minimum Acceptable Performance	Results
Labels graphs appropriately (titles, axes, and units) and graph is displayed in a usable size	Homework exercise	% at 2 or 3	60% at 2 or 3	70% at 2 or 3
Uses correct variables	Homework exercise	% at 2 or 3	60% at 2 or 3	100% at 2 or 3
Uses appropriate graphical or statistical representation	Homework exercise	% at 2 or 3	60% at 2 or 3	70% at 2 or 3
Makes appropriate inferences from data	Homework exercise	% at 2 or 3	60% at 2 or 3	70% at 2 or 3

Table 4. Indirect measure, student self- assessment results for SLO #1: Mathematical Competence for MATH 362 (winter 2012).

Performance Criteria	Assessment Method	Measurement Scale (High Proficiency, Proficient, Limited Proficiency, No Proficiency—1-3 Scale)	Minimum Acceptable Performance	Results
NA	Self-assessment form	% at 2 or 3	80% at 2 or 3	NA
	Self-assessment form	% at 2 or 3	80% at 2 or 3	
	Self-assessment form	% at 2 or 3	80% at 2 or 3	
	Self-assessment form	% at 2 or 3	80% at 2 or 3	

Table 5. Direct measure, faculty assessment results for SLO #1: Mathematical Competence for MATH 362 (winter 2012).

Performance Criteria	Assessment Method	Measurement Scale (High Proficiency, Proficient, Limited Proficiency, No Proficiency—1-3 Scale)	Minimum Acceptable Performance	Results
NA		% at 2 or 3	80% at 2 or 3	NA
		% at 2 or 3	80% at 2 or 3	
		% at 2 or 3	80% at 2 or 3	
		% at 2 or 3	80% at 2 or 3	

Results of the BIO 112 assessment indicate a proficient or highly proficient level of performance for the four performance criteria directly assessed. Results may be artificially high for the criteria related to using correct variables since the variables were given for the exercise that was assessed.

Student Learning Outcome #4: Design and execute a scientific project (see Curriculum map in Appendix C). This outcome was evaluated in all project classes (BIO 261 Sophomore Project Proposal, BIO 262 Sophomore Project, BIO 471 Senior Project Proposal Research, BIO 472 Senior Project Proposal, BIO 473 Senior Project Data Collection, and BIO 474 Senior Project Data Analysis and Presentation) using a performance criteria rubric (see Appendix D) filled out by the professor (direct measure) and the students (indirect measure) indicating levels of proficiency. Assessments

were conducted over a three-year period, from spring of 2008 to winter of 2011 because of small class sizes. Even with three years of data, however, total number of students evaluated varied from 8 to 16—still small for statistical analysis—but large enough to decipher some trends.

Criteria for this SLO include being able to identify a scientific problem; conduct an effective background information search on the problem; develop a project to assess the problem; implement and complete the designed project; evaluate project results and methods; and articulate project results and implications in written and oral format. Minimum acceptable performance requirements are 40% of students at "high proficiency" or "proficient" for the sophomore project courses, BIO 261 and 262, because they are sophomore-level courses introducing students to project development skills. The upper division courses, however, are junior and senior-level courses where students should be proficient in this SLO; therefore, the minimum acceptable performance requirements are at least 80% of students at "high proficiency" or "proficient."

Table 6. Indirect measure, student self-assessment results for SLO #4: Scientific Projects for BIO 261 and BIO 262 (spring 2008-winter 2011).

Performance Criteria	Course and Assessment Method	Measurement Scale (High Proficiency, Proficient, Limited Proficiency, No Proficiency—1-4 Scale)	Minimum Acceptable Performance	Results
Identify a scientific problem	BIO 261: Self-assessment form	% at 3 or 4	40% at 3 or 4	87% at 3 or 4
Conduct an effective background information search on the problem	BIO 261: Self-assessment form	% at 3 or 4	40% at 3 or 4	93% at 3 or 4
Develop a project to assess the problem	BIO 261: Self-assessment form	% at 3 or 4	40% at 3 or 4	93% at 3 or 4
Implement and complete the designed project	BIO 262: Self-assessment form	% at 3 or 4	40% at 3 or 4	86% at 3 or 4
Evaluate project results and methods	BIO 262: Self-assessment form	% at 3 or 4	40% at 3 or 4	100% at 3 or 4
Articulate project results and implications in written and oral format	BIO 262: Self-assessment form	% at 3 or 4	40% at 3 or 4	100% at 3 or 4

Table 7. Direct measure, faculty assessment results for SLO #4: Scientific Projects for BIO 261 and BIO 262 (spring 2008-winter 2011).

Performance Criteria	Assessment Method	Measurement Scale (High Proficiency, Proficient, Limited Proficiency, No Proficiency—1-4 Scale)	Minimum Acceptable Performance	Results
Identify a scientific problem	BIO 471: Hypothesis/Problem Assignments	% at 3 or 4	40% at 3 or 4	87% at 3 or 4
Conduct an effective background information search on the problem	BIO 471: Library Research Assignments	% at 3 or 4	40% at 3 or 4	100% at 3 or 4
Develop a project to assess the problem	BIO 472: Proposals	% at 3 or 4	40% at 3 or 4	67% at 3 or 4
Implement and complete the designed project	BIO 473: Field/Progress Reports	% at 3 or 4	40% at 3 or 4	80% at 3 or 4
Evaluate project results and methods	BIO 474: Project report and presentation	% at 3 or 4	40% at 3 or 4	90% at 3 or 4
Articulate project results and implications in written and oral format	BIO 474: Project report and Presentation	% at 3 or 4	40% at 3 or 4	80% at 3 or 4

Table 8. Indirect measure, student self-assessment results for SLO #4: Scientific Projects for BIO 471, 472, 473, and 474 (spring 2008-winter 2011).

Performance Criteria	Assessment Method	Measurement Scale (High Proficiency, Proficient, Limited Proficiency, No Proficiency—1-4 Scale)	Minimum Acceptable Performance	Results
Identify a scientific problem	BIO 261: Self-assessment form	% at 3 or 4	80% at 3 or 4	100% at 3 or 4
Conduct an effective background information search on the problem	BIO 261: Self-assessment form	% at 3 or 4	80% at 3 or 4	100% at 3 or 4
Develop a project to assess the problem	BIO 261: Self-assessment form	% at 3 or 4	80% at 3 or 4	81% at 3 or 4
Implement and complete the designed project	BIO 262: Self-assessment form	% at 3 or 4	80% at 3 or 4	86% at 3 or 4
Evaluate project results and methods	BIO 262: Self-assessment form	% at 3 or 4	80% at 3 or 4	88% at 3 or 4
Articulate project results and implications in written and oral format	BIO 262: Self-assessment form	% at 3 or 4	80% at 3 or 4	100% at 3 or 4

Table 9. Direct measure, faculty assessment results for SLO #: Scientific Projects for BIO 471, 472, 473, and 474 (spring 2008-winter 2011).

Performance Criteria	Assessment Method	Measurement Scale (High Proficiency, Proficient, Limited Proficiency, No Proficiency—1-4 Scale)	Minimum Acceptable Performance	Results
Identify a scientific problem	BIO 471: Hypothesis/Problem Assignments	% at 3 or 4	80% at 3 or 4	88% at 3 or 4
Conduct an effective background information search on the problem	BIO 471: Library Research Assignments	% at 3 or 4	80% at 3 or 4	94% at 3 or 4
Develop a project to assess the problem	BIO 472: Proposals	% at 3 or 4	80% at 3 or 4	88% at 3 or 4
Implement and complete the designed project	BIO 473: Field/Progress Reports	% at 3 or 4	80% at 3 or 4	100% at 3 or 4
Evaluate project results and methods	BIO 474: Project report and presentation	% at 3 or 4	80% at 3 or 4	88% at 3 or 4
Articulate project results and implications in written and oral format	BIO 474: Project report and Presentation	% at 3 or 4	80% at 3 or 4	75% at 3 or 4

Minimum acceptable performance levels were met in all categories in all classes, with the exception of the direct measure of "Articulate project results and implications in written and oral format" in which only 8 students were evaluated in the senior project series. Clearly, students are performing well in both the sophomore and senior project series across the performance criteria. One anecdotal observation, however, as well as the lower performance in the above mentioned criteria, is in students' ability to analyze project results. Through the study period reflected here, students were taking MATH 362 Statistical Methods II instead of the alternate, BIO 434 Data Analysis Methods because of insufficient student enrollment for this course. A pilot BIO 434 course was offered winter of 2011 and although assessment results are not represented in this report, improvement in student application of statistical concepts in their projects is already being observed. Unfortunately, the math department cannot continue to offer BIO 434, so students will again be taking MATH 362 instead of BIO 434 in winter of 2012. A separate assessment of mathematical understanding will be conducted this assessment cycle to evaluate efficacy of mathematical understanding in this course.

Other than evaluating student learning in MATH 362 this assessment cycle, no "closing the loop" activities are recommended for SLO #4 Scientific Projects.

V Summary of 2011-2012 Institutional Student Learning Outcomes (ISLO) Assessment Activities

The ISLO reviewed this academic year was "Mathematical knowledge, skills, and applications."

Mathematical Knowledge, Skills, and Applications

ISLO, "Mathematical knowledge, skills, and applications" was assessed in BIO 112 Introduction to Data Analysis. Results demonstrate that students are proficient or highly proficient with respect to the performance criteria directly assessed.

VI Plans for Addressing Student Learning Outcomes 2012-2013

The program will monitor enrollment in MATH 362 to identify possible opportunities to assess student performance with respect to mathematical knowledge, skills, and applications. BIO 112 may undergo some formatting changes, so the program may also consider revision of some of the performance criteria to bring them into better alignment with any new course learning objectives.

VII Changes resulting from 2010-2011Assessments

Ethics

During the 2009-2010 assessment cycle, a BIO 407 Field Methods in Environmental Sciences course was used to assess the Ethics ISLO and minimum performance standards for the ISLO were not met in three of the categories (see Table 10 for results). The same exact assignment was again given fall of 2010 in a BIO 407 Sustainable Human Ecology to a class of eight upperclassmen students (see Table 10 for comparison). Because one category showed a decline in performance—describing and analyzing alternative approaches— and minimum acceptable performance levels were not met in three categories, the assignment was re-administered in BIO 484 Sustainable Human Ecology in fall of 2011 (see Table 10 for results).

Table 10. Upperclassmen student assessment results for ethics ISLO from BIO 407 Field Methods in Environmental Sciences class fall 2009, BIO 407 Sustainable Human Ecology course fall 2010, and BIO 484 Sustainable Human Ecology course fall 2011.

Performance Criteria	Assessment Method	Measurement Scale	Minimum Acceptable Performance	Results 2009 BIO 407 Mixed Rankings	Results 2010 BIO 407 All Upperclassmen	Results 2011 BIO 484 All Upperclassmen
Using code of ethics, describes ethical issue(s).	Ethics Assignment & Ethics Rubric	1-4 scale % at 3 or higher	80% at 3 or higher	50%	75%	87.5%
Describes parties involved and discusses their points of view.	Ethics Assignment & Ethics Rubric	1-4 scale % at 3 or higher	80% at 3 or higher	50%	75%	100%
Describes and analyzes possible/alternative approaches.	Ethics Assignment & Ethics Rubric	1-4 scale % at 3 or higher	80% at 3 or higher	83%	37.5%	100%
Chooses an approach and explains the benefits and risks.	Ethics Assignment & Ethics Rubric	1-4 scale % at 3 or higher	80% at 3 or higher	83%	100%	100%

Again, the data set was small (BIO 407 Field Methods course had 15 students of mixed ranking, BIO 407 had 8 upperclassmen students, and BIO 484 had 8 upperclassmen students) and it is therefore difficult to come to any definite conclusions, however, minor changes in the assignment instructions to correlate with expectations in the rubric increased student understanding of expectations. For example, in the "describes and analyzes

possible/alternative approaches" category is that in the assignment, students are only asked to "describe and analyze possible/alternative approaches to the issue(s)." The rubric, however, evaluates the student on whether or not each alternative is analyzed in terms of effects on parties involved. Unless a student thoroughly read the rubric, they would not know to include this analysis in their assignments. The improved assignment made this expectation clear; additionally, the scenario was modified to include a component of personal conflict of interest which is also addressed in the rubric, but was not in the scenario in the first two years the assignment was used.

Student performance showed that the modifications in the assignment and scenario greatly increased student performance. Minimum expected performance levels were met for all criteria. The majority of scores, however, were at "proficiency" rather than "high proficiency," indicating that this may still be an area to observe and reassess when it comes up again in the ISLO assessment cycle. Performance may also be enhanced for this ISLO with the 2011-2012 catalog change where students are encouraged to take an ethics class as part of the Environmental Sciences curriculum.

Lifelong Learning

Upperclassmen students in BIO 474 Senior Project Data Analysis and Presentation fall of 2010 performed above minimum acceptable performance levels (80% of students at proficiency [3] or high proficiency [4]) in all criteria areas with the exception of "Professional Societies" for the Lifelong Learning ISLO. In order to ameliorate this gap in learning, the OIT Environmental Sciences Advisory Board was consulted on recommended professional societies for students and graduates. Students were provided this information in the BIO 111 Introduction to Environmental Sciences course and the BIO 474 Senior Project Data Analysis and Presentation courses. Additionally, based on feedback from the 2010-2011 ISLO assessment, changes were made to the Lifelong Learning assignment. For example, the three criteria of "professional societies and organizations," "credentials," and "continuing education" were combined under one criteria, "professional development." Additionally, the assignment was more closely correlated to the grading rubric.

Nine BIO 474 students were re-assessed in fall of 2011 using the 2011-2012 new Lifelong Learning assignment (See Appendix E). Results (shown in Table 10) demonstrate a marked increase in student performance in both sets of criteria as well as competency in the other criteria.

Table 10. Student assessment results for Lifelong Learning and Written Communication ISLO.

Performance Criteria	Measurement Scale	Minimum Acceptable Performance	Results 2010 BIO 474	Results 2011 BIO 474
Lifelong Learning				
Lifelong learning	1-4 scale, % at 3 or 4	80% at 3 or 4	100% at 3 or 4	89% at 3 or 4
Professional societies (2010-2011)	1-4 scale, % at 3 or 4	80% at 3 or 4	33% at 3 or 4	N/A
Credentials (2010-2011)	1-4 scale, % at 3 or 4	80% at 3 or 4	100% at 3 or 4	N/A
Continuing education (2010-2011)	1-4 scale, % at 3 or 4	80% at 3 or 4	100% at 3 or 4	N/A
Professional Development (2011-2012)	1-4 scale, % at 3 or 4	80% at 3 or 4	N/A	100% at 3 or 4
Short and long term career plans	1-4 scale, % at 3 or 4	80% at 3 or 4	100% at 3 or 4	100 % at 3 or 4
Written Communication				
Purpose and ideas	1-4 scale, % at 3 or 4	80% at 3 or 4	67% at 3 or 4	100% at 3 or 4
Organization	1-4 scale, % at 3 or 4	80% at 3 or 4	33% at 3 or 4	89% at 3 or 4
Support	1-4 scale, % at 3 or 4	80% at 3 or 4	100% at 3 or 4	78% at 3 or 4
Style	1-4 scale, % at 3 or 4	80% at 3 or 4	100% at 3 or 4	89% at 3 or 4
Conventions	1-4 scale, % at 3 or 4	80% at 3 or 4	100% at 3 or 4	100% at 3 or 4
Documentation	1-4 scale, % at 3 or 4	80% at 3 or 4	100% at 3 or 4	33% at 3 or 4

Written Communication

In terms of the ISLO written communication assessment in fall of 2010, all students were a 3 or 4 for "providing supporting evidence," "using a professional writing style appropriate for the assignment," "complying with writing conventions," and "documenting sources where relevant." On the other hand, only 2 students of the 3 were a 3 or above for having "clearly stated purpose and ideas" and only one student received a 3 or better on "organization." Because of the small data set, the assessment was conducted again in fall of 2011 with BIO 474 students (results are shown in Table 10).

Eighty percent or more of the nine students in this second assessment demonstrated proficiency or higher in "purpose and ideas," "style," and "conventions." Seventy-eight percent demonstrated proficiency or higher in "support," while only 33% demonstrated proficiency or higher in "documentation." The minimum acceptable performance level was met, however, in 2010-2011 for these criteria. Given the small data set for these evaluations, the fluctuation in scores may be more due to the small data set. Additionally, many students didn't see how "documentation" fit with the assignment, given that it was not a technical report. Students in the Environmental Sciences program are required to provide extensive documentation on their sophomore and senior projects, so low performance levels on this criterion may be due to oversight rather than lack of ability.

Appendix A

Environmental Sciences Student Learning Outcomes Curriculum Map 2011-2012 SLO #1

SLO # 1: Apply mathematical concepts, including statistical methods, to field and laboratory data to study scientific phenomena.

Courses that are shaded below indicate that the SLO above is taught in the course, students demonstrate skills or knowledge in the SLO, and students receive feedback on their performance on the SLO. I = Introduced R = Reinforced E = Emphasized

	Freshman			Sophomore			Junior			Senior		
Fall	BIO 211	Principles of Biology		CHE 221	General Chemistry	I	CHE 331	Organic Chemistry I		BIO 474	Senior Project Data Analysis, Presentation	E
	BIO 111	Intro to Env. Sciences		BIO 225	Riparian Assessment	I	PHY 221	General Physics with Calculus	E	BIO 484	Sustainable Human Ecology	
	MA 111	College Algebra		SPE 111	Fundamentals of Speech		SPE 321	Small Group and Team Com.		SOC Elec	Social Science Elective	
	WRI 121	English Composition		MIS 275	Intro to Relational Databases*		MA 361	Statistical Methods I	E	HU Elec/ PHIL 331	Humanities Elective: PHIL 331 or PHIL 307 Recommended	
	GIS 103	Introduction to GIS^		MA 251	Differential Calculus	R	BIO 471	Senior Project Proposal Research		TEC Elec	Technical Emphasis	
Win	BIO 212	Principles of Biology		CHE 222	General Chemistry	R	PSCI 307	Environmental Policy		SOC Elec	Social Science Elective	
	HU Elec	Humanities Elective		BIO 261	Soph Project Proposal		BIO 472	Senior Project Proposal	E	TEC Elec	Technical Emphasis	
	GIS 105	Map and Compass/GPS		WRI 227	Technical Report Writing		BIO 434 or MA 362	Data Analysis Methods or Statistical Methods II	E	TEC Elec	Technical Emphasis	
	GEO 105 or GEO 115	Physical Geography: Geomorphology or Physical Geography: Climatology		GIS 205	GIS Data Integration#		PHY 222	General Physics with Calculus	E	SOC Elec	Social Science Elective	
	MA 112	Trigonometry	I	MA 252	Integral Calculus	R	TEC Elec	Technical Emphasis				
	BIO112 or MIS 102	Intro to Data Analysis or Spreadsheet Software Lab										
Spr	BIO 213	Principles of Biology		CHE 223	General Chemistry	R	BIO 327	General Ecology		TEC Elec°	Technical Emphasis	
	ECO 210N	Principles of Economics and Micro		BIO 262	Sophomore Project	R	BIO 473	Senior Project Data Collection		TEC Elec	Technical Emphasis	
	GME 134	Geographical Information Systems		WRI Elec	WRI 327, 328, 350, 410, 415, or 420		PHY 223	General Physics with Calculus	E	HU Elec	Humanities Elective	
	WRI 122	English Composition		CHE 235	Streamwater Chemistry & Sampling		TEC Elec	Technical Emphasis		TEC	Technical Emphasis	

Revised 4/6/11

Appendix B

Course Proficiency Rubric for Mathematical Competence, SLO #1
"Apply mathematical concepts, including statistical methods, to field and laboratory data to study scientific phenomena."

Student Name: **Date Assessed:**

Course Assessed:

Highlight the course and assessment method used for this student. Faculty circles the level of proficiency.

Performance Criteria & Course Assessed	Assessment Method	High Proficiency 3	Proficient 2	No/Limited Proficiency 1
Identifies appropriate type of mathematical test for a scientific problem		Appropriate test method is chosen and applied to a scientific problem.	An adequate test method is chosen and applied to a scientific problem, but other, better options were available but not used.	Inappropriate test method was chosen and applied to a scientific problem.
Labels graphs appropriately (titles, axes, and units) and graph is displayed in a usable size		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. Graphed data is spread out across at least ½ of the page.	Graph has a title, axes are correctly labeled, and points are graphed correctly. Axes are correctly labeled. Graph is crowded into a small area.	Graph lacks a title or its title does not identify the content of the graph. Axes lack labels. Graph is crowded into a small area.
Uses correct variables		Points are all graphed accurately. Correct variables are used.	Most points are graphed accurately. Correct variables are used.	Axes are swapped. Incorrect variables are used.
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 trend line that clearly does not fit the data.
Identifies sources of error and/or limitations of measurement		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.	Interpretation of the graph in is consistent with the scientific principle being tested or measured, but the written discussion does not highlight the connection.	Any errors or deviation from theoretical values or behavior are not discussed.
Makes appropriate inferences from data		Interpretation of the graph clearly and correctly explains the scientific principle being tested or measured.	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.	Interpretation of the graph demonstrates a *mis*understanding of the scientific principles being tested or measured.

*Modified from Performance Criteria Rubric for OIT Biology program (Powers, 2008).

Appendix C

Environmental Sciences Student Learning Outcomes Curriculum Map 2011-2012 SLO #4

SLO # 4: Design and execute a scientific project.

Courses that are shaded below indicate that the SLO above is taught in the course, students demonstrate skills or knowledge in the SLO, and students receive feedback on their performance on the SLO. I = Introduced R = Reinforced E = Emphasized

	Freshman			Sophomore			Junior			Senior		
Fall	BIO 211	Principles of Biology		CHE 221	General Chemistry		CHE 331	Organic Chemistry I		BIO 474	Senior Project Data Analysis, Presentation	E
	BIO 111	Intro to Env. Sciences		BIO 225	Riparian Assessment	I	PHY 221	General Physics with Calculus		BIO 484	Sustainable Human Ecology	
	MA 111	College Algebra		SPE 111	Fundamentals of Speech		SPE 321	Small Group and Team Com.		SOC Elec	Social Science Elective	
	WRI 121	English Composition		MIS 275	Intro to Relational Databases*		MA 361	Statistical Methods I		HU Elec/ PHIL 331	Humanities Elective: PHIL 331 or PHIL 307 Recommended	
	GIS 103	Introduction to GIS^		MA 251	Differential Calculus		BIO 471	Senior Project Proposal Research	E	TEC Elec	Technical Emphasis	
Win	BIO 212	Principles of Biology		CHE 222	General Chemistry		PSCI 307	Environmental Policy		SOC Elec	Social Science Elective	
	HU Elec	Humanities Elective		BIO 261	Soph Project Proposal	R	BIO 472	Senior Project Proposal	E	TEC Elec	Technical Emphasis	
	GIS 105	Map and Compass/GPS		WRI 227	Technical Report Writing	R	BIO 434 or MA 362	Data Analysis Methods or Statistical Methods II		TEC Elec	Technical Emphasis	
	GEO 105 or GEO 115	Physical Geography: Geomorphology or Physical Geography: Climatology		GIS 205	GIS Data Integration#		PHY 222	General Physics with Calculus		SOC Elec	Social Science Elective	
	MA 112	Trigonometry		MA 252	Integral Calculus		TEC Elec	Technical Emphasis				
	BIO112 or MIS 102	Intro to Data Analysis or Spreadsheet Software Lab	I									
Spr	BIO 213	Principles of Biology		CHE 223	General Chemistry		BIO 327	General Ecology		TEC Elec°	Technical Emphasis	
	ECO 210N	Principles of Economics and Micro		BIO 262	Sophomore Project	R	BIO 473	Senior Project Data Collection	E	TEC Elec	Technical Emphasis	
	GME 134	Geographical Information Systems	I	WRI Elec	WRI 327, 328, 350, 410, 415, or 420		PHY 223	General Physics with Calculus		HU Elec	Humanities Elective	
	WRI 122	English Composition		CHE 235	Streamwater Chemistry & Sampling		TEC Elec	Technical Emphasis		TEC	Technical Emphasis	

Appendix D

Course Proficiency Rubric for ENV Project Course Series 2010-2011

Student Name: **Date Assessed:** **Course Assessed:**

Highlight the course and assessment method used for this student. Circle the level of proficiency.

Performance Criteria & Courses Assessed	Assessment Method	High Proficiency 4	Proficient 3	Limited Proficiency 2	No Proficiency 1
BIO 261 BIO 471 Identify a scientific problem	Hypothesis /Problem Assignments	Problem or testable hypothesis is identified, stated succinctly and easy to understand.	Problem or testable hypothesis is identified and stated, but may not be succinct or easy to understand.	Problem identified and stated but is difficult to understand or hypothesis is not testable.	Problem/hypothesis not identified or stated.
BIO 261 BIO 471 Conduct an effective background information search on the problem	Library Research Assignments	The majority of background information on the problem comes from peer-reviewed journal articles, government documents, or books.	At least 2/3 of the background information on the problem comes from peer-reviewed journal articles, government documents, or books.	Less than half of the background information on the problem comes from peer-reviewed journal articles, government documents, or books.	None of the background information comes from peer-reviewed journal article, government documents, or books.
BIO 261 BIO 472 Develop a project to assess the problem	BIO 261: Introduction, Background, & Q and/or Methods Assignment BIO 472: Final Proposal	A significant amount of relevant background research supports project. Methods fully addresses stated problem.	Some background information is used to support project. The methods addresses stated problem.	Background research only partially justifies the need for the project or the methods do not adequately address stated problem.	Background research is insufficient to justify the need for the project or the methods do not address stated problem.
BIO 262 BIO 473 Collect data	Field/Progress Reports	Appropriate methods are complete and clear enough so that someone else could conduct the same experiment. Proper protocols from other research is followed. QAQC concerns and safety issues are completely addressed.	Methods are appropriate but not complete or clear enough so that someone else could conduct the same experiment. Protocol from other research is followed. QAQC concerns and safety issues are addressed.	Methods are somewhat incomplete and some else would have difficulty repeating the experiment. Some protocols from other research are followed. Limited QAQC concerns and safety issues are not addressed.	Methods are incomplete and cannot be repeated. No protocols are followed. QAQC and safety concerns are not addressed.
BIO 262 BIO 474 Evaluate project results and methods	Project report and presentation	Information presented on a spreadsheet or database is complete and all data clearly documented. Results presented in tables and/or charts with appropriate labels and significant digits. Hypothesis or problem is approached correctly and correct statistical tests are used, if applicable.	Information presented on a spreadsheet or database is complete and data mostly documented. Results presented in tables and/or charts. Hypothesis or problem is approached correctly; only limited explanation regarding choice of statistical test.	Information presented on a spreadsheet or database is incomplete or data not documented completely. Hypothesis or problem is not approached correctly and statistical test is not used correctly. Results not presented in clearly labeled tables and/or charts.	Information is not presented on a spreadsheet and database was not created. Hypothesis or problem is not approached correctly and statistical test is not used. Results are not presented.
BIO 262 BIO 474 Articulate project results and implications in written and oral format	Project report and presentation	Results are significant and are discussed in correct terminology. Correct conclusion clearly stated and defended. Results are of use to a larger audience.	Results discussed in mostly correct terminology. Correct conclusion clearly stated; reasoning is mostly correct. Results might be useful to a larger audience.	Results not discussed in correct terminology. Conclusion not clearly stated and defended or incorrect conclusion stated. Results are not useful to a larger audience.	Results are not discussed. Conclusion is not stated or is incorrect. Results are not useful to a larger audience.

Appendix E
Course Proficiency Rubric for ISLO "Lifelong Learning"

OIT Lifelong Learning Rubric

Performance Criteria	Limited or No Proficiency (1)	Some Proficiency (2)	Proficiency (3)	High Proficiency (4)	Score
1. Lifelong learning	Fails to identify the need for "lifelong learning" and/or omits discussion of their own learning and relevant examples.	Misses important elements in discussing "lifelong learning," applying concepts to their own learning or providing a relevant example.	Defines the concept of "lifelong learning." Demonstrates self-awareness by accurately identifying strengths/ weaknesses in their own ability to learn independently. Gives a relevant example.	Defines the concept of "lifelong learning" and its importance. Demonstrates self-awareness by accurately discussing strengths/ weaknesses in their own ability to learn independently. Gives relevant example(s).	
2. Professional Development	Fails to identify professional development opportunities.	Discusses professional development opportunities that are either inappropriate or irrelevant.	Identifies appropriate professional development opportunities.	Identifies and thoroughly discusses appropriate professional development opportunities.	
3. Short- and long-term career plans	Vaguely describes career goals and/or does not include a plan to meet them.	Career goals after graduation do not include both long and short term plans and/or the plan is unrealistic.	Describes short- and long-term career goals after graduation. Includes a realistic plan to meet these goals.	Describes short- and long-term career goals after graduation. Includes a realistic, thorough, and thoughtful plan to meet these goals.	

Appendix F
Course Proficiency Rubric for Written Communication

OIT Essay Rubric					
Performance Criteria	**No Proficiency (0)**	**Limited Proficiency (1)**	**Some Proficiency (2)**	**Proficiency (3)**	**High Proficiency (4)**
Purpose and Ideas	Writing lacks focus. Purpose and main ideas are unclear and require extensive inferences from the reader.	Writing has limited focus. Purpose and main ideas are unclear and require some inferences from reader.	Reader can discern the purpose and main ideas although they may be overly broad or simplistic.	Writing is clear and focused. Reader can easily understand the purpose and main ideas.	Purpose and main ideas are exceptionally focused, clear, and interesting.
Organization	Writing lacks organizational structure or is too short to demonstrate organizational skills. Introduction, body, or conclusion may be missing.	Organizational structure is present but unclear. Introduction and conclusion may be underdeveloped or too obvious.	Order and structure are present but overly formulaic. Introduction and conclusion may be underdeveloped or too obvious.	Order and structure are clear and easy to follow. Introduction draws in the reader and conclusion brings satisfying closure.	Order and structure are compelling and move the reader through the text easily. Introduction draws in the reader and conclusion brings satisfying closure.
Support	Development is insufficient. Most supporting details are irrelevant or repetitious.	Development is minimal. Some supporting details are irrelevant or repetitious.	Supporting details are relevant, but are limited or rather general. Support may be based on clichés, stereotypes, or questionable sources or evidence.	The main ideas are well developed by supporting details. When appropriate, use of outside sources provides credible support.	Main ideas are well developed by strong support and rich details. When appropriate, use of outside sources provides strong, credible support.
Style	Voice is inappropriate for topic, purpose, and audience. Wording is incorrect and detracts from meaning. Overall, sentences are choppy, rambling, and awkward.	Voice is inappropriate for topic, purpose, or audience. Wording is monotonous or detracts from impact. Sentences tend to be choppy, rambling, and awkward.	Voice is inconsistent for topic, purpose, and audience. Wording is quite ordinary, lacking interest, precision, and variety, and may rely on clichés. Sentences tend to be mechanical rather than fluid with an overuse of simple sentence structures.	Voice is generally appropriate for topic, purpose, and audience. Generally, wording conveys message in an interesting, precise, and natural way. Sentences are carefully crafted with variations in structure.	Voice is appropriate for topic, purpose, and audience. Wording is fresh and specific, with a striking and varied vocabulary. Sentences are highly crafted, with varied structure that makes reading easy and enjoyable.
Conventions	Errors often impede readability. Substantial editing needed.	Numerous errors in usage, spelling, punctuation, and/or grammar. Errors sometime impede readability. Substantial editing needed.	Writing contains punctuation, spelling, and/or grammar errors, but they do not impede readability and are not extensive. Moderate need for editing.	Writing demonstrates control of standard writing conventions and uses them effectively to enhance communication. Few errors.	Writing demonstrates strong control of standard writing conventions and uses them well to enhance communication. Very few or no errors.
Documentation	Documentation is not present.	Documentation has major errors.	Documentation has frequent errors.	Documentation is correct except for a few errors.	Documentation is meticulous.