BS in ENVIRONMENTAL SCIENCES
ASSESSMENT PLAN AND REPORT
201~~5~~4-201~~6~~5

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December 16, ~~2015~~2016

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1. Introduction

Oregon Tech began offering the BS in Environmental Sciences exclusively at the Klamath Falls campus in 1995. Enrollment has ranged from a low of eight in 1995 to a high of 51 in 2014 (Fig. 1). We believe the decline between 2002 and 2008 is related to the growth of the AAS degree Natural Resources at Klamath Community College (KCC) and the establishment in 2006 of Oregon Tech's BS in Biology. Since 2008, however, the BS in Environmental Sciences has experienced a steady increase then leveling-off in enrollment, which may be explained by a combination of the following factors: new core and advisory faculty, new dual-major programs in Civil and Renewable Energy Engineering, expanded recruiting efforts, suspension of the BS in Biology by the Natural Sciences Department, and a nationwide economic recession. Enrollment as of fall 2015 was 48 students, down three students from 2014 (Figure 1). The current enrollment goal for the program is approximately 60 students. Over the last five academic years, the Environmental Sciences Program has graduated 39 students. During the past two academic years, the program graduated 25 students; a higher number than the previous four years combined (Table 1).

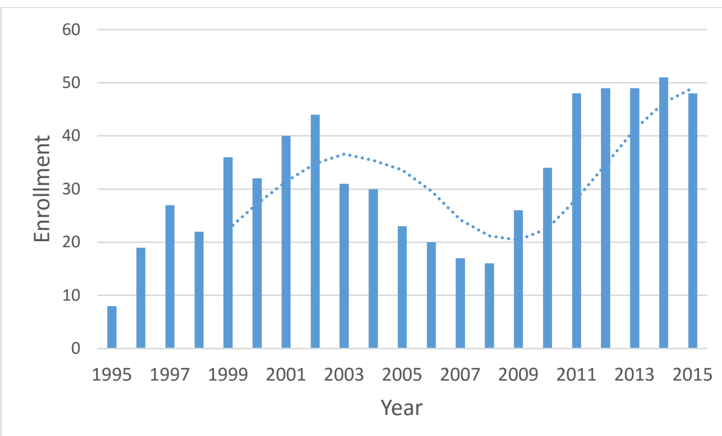

Figure 1. Number of students enrolled in the Environmental Sciences major (or dual Environmental Science and Civil Engineering majors) at the end of the fourth week of fall quarter for 1995 - 2015. Line represents 5-year moving average.

Table 1. Number of graduates in the Environmental Sciences major over the past six academic years.

Academic Year	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Number of Graduates	5	5	4	5	11	14

~~For the first time, a~~A senior exit survey was administered at the end of the spring quarter ~~2015~~ 2016 to all students that had graduated or were going to graduate between spring 2015~~4~~ – summer 2016~~5~~. Of the ~~12~~ 7 respondents, four~~ive~~ were employed full time, two were employed part time, and one was enrolled in a program of continuing education.~~four were seeking employment, and one was planning to continue their education but not yet enrolled.~~ Of the four that were enrolled full time, all were employed in a position related to their degree. Over the years, placement of graduates has occurred in both the public and private sectors. According to publicly available salary figures for typical job grades, graduates entering the job market are being paid at levels that are equal to or higher than graduates of similar fields at other institutions as well as graduates in similar or related fields at Oregon Tech.

2. Program Purpose, Objectives, and Student Learning Outcomes

In early fall 2015, program faculty and student advisors met to discuss the program student learning outcomes (PSLO's). Substantial changes have been proposed, and faculty will be continuing to discuss the proposed changes in light of ongoing curriculum changes during the upcoming academic year. For the purpose of the ~~2014~~2015-2016~~5~~ assessment report, the current accepted PSLOs were evaluated. The program purpose, objectives, and learning outcomes are detailed below.

2.1 Environmental Sciences Program Purpose

The Environmental Sciences program prepares students for immediate employment and graduate studies in the analysis and management of environmental problems. The program focuses on scientific methodology and applied analysis using a combination of traditional and state-of-the-art methodologies, instrumentation, and data analysis. The program is explicitly inter- and multi-disciplinary in its approach to the study of ecosystems and their human and non-human dimensions. The curriculum integrates four disciplinary foundations: natural sciences (geosciences, biology, chemistry, and physics); mathematics (including calculus and statistics); geographic information science (GIS); and integrated social sciences (including economics, geography, sustainability studies).

2.2 Program Educational Objectives

- Provide knowledge and training in the practical application of the scientific method utilizing appropriate analytical approaches and instrumentation-based methodologies.

- Prepare students for roles in resource management that require critical thinking and problem solving skills

- Prepare students for graduate studies in environmental sciences, natural resource management, environmental education, geography, geographic information science, and regulation.

- 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.

2.3 Program Student Learning Outcomes (PSLOs) 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 (ENV 226).

2. Use geographic information systems 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: ENV 261, 262, BIO 471, 472, 473, 474).

3. Three year Cycle for Assessment for Program Student Learning Outcomes

Table 2 shows the planned three-year assessment rotation cycle on a term-by-term basis for each of the four student learning outcomes.

Table 2. Environmental Sciences planned three-year assessment rotation cycle on a term-by-term basis for each of the four student learning outcomes.

Year		Fall	Winter	Spring
One 2014-2015	#1 Mathematical Competence			ENV 226: Environmental Data Analysis
	#4 Scientific Projects	BIO 471: Senior Project Proposal Research BIO 474: Senior Project Data Analysis & Presentation	ENV 261: Sophomore Proposal BIO 472: Senior Project Proposal	ENV 262: Sophomore Project BIO 473: Senior Project Data Collection
Two 2015-2016	#2 GIS Skills		GIS 316: Geospatial Vector Analysis I	GIS 205[1]: GIS Data Integration
Three 2016-2017	#3 Natural/Human Systems	BIO 111: Intro to Environmental Science		BIO 484: Sustainable Human Ecology

[1]GIS 205 has previously been offered in winter quarter, but in 2016 it will be offered in spring quarter

4. Summary of 2015~~4~~-2016~~5~~ Assessment Activities

The 2015~~4~~-2016~~5~~ assessment focused on PSLO #~~1~~ 2~~and #4. For PSLO #1; "apply mathematical concepts, including statistical methods, to field and laboratory data to study scientific phenomena", we assessed ENV 226; Environmental Data Analysis. For PSLO #4, "design and execute a scientific project", we assessed sophomore and student research posters at the fall 2014 Environmental Science research symposium. These posters represented the culmination of two courses for sophomores (ENV 261 and 262; Sophomore Proposal and Sophomore Project), and four courses for juniors-seniors (BIO471, 472, 473, and 474; Senior Project Proposal Research, Senior Project Proposal, Senior Project Data Collection, and Senior Project Data Analysis & Presentation).~~, "use geographic information systems to solve geospatial problems".

4.1 PSLO ~~1~~2: use geographic information systems to solve geospatial problems ~~apply mathematical concepts, including statistical methods, to field and laboratory data to study scientific phenomena~~

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4.1.1 Direct Assessment of PSLO 2~~1~~

We assessed this outcome in GIS 205 GIS Data Integration (spring 2016) and GIS 316 Geospatial Vector Analysis I (winter 2016). The instructor used a rubric with four levels (4 = high proficiency, 3 = proficient, 2 = limited proficiency, 1 = no proficiency) to directly assess each student's work based on three (GIS 205) or four (GIS 316) established criteria. In both courses, student projects were used for assessment.

In GIS 205, the project assessed required students to use a GPS unit to map the location of two point, line, and polygon features and to record the data in a GIS format. Students used these data to create a web map. The minimum acceptable performance at the 200 level is that at least half of the students are proficient for each criteria. Our results indicate that generally, students are proficient or highly proficient at recording GPS points and using the data to create maps (Table 3). One hundred percent of the students were highly proficient at using GPS to record location and attribute information for points, lines, and polygons; while only 50% of the students understood the fundamentals of GPS operations (Table 3).

Table 3. Direct assessment of student work from ~~ENV~~ GIS 205~~26~~. *n* = 2~~1~~2.

Assessment Item	Percentage of students proficient or highly proficient	Percentage of students with limited proficiency, proficiency, or high proficiency
~~Identifies appropriate type of mathematical test for a scientific problem~~Student understands fundamentals of GPS operation	~~71~~50	95
Student uses GPS to record location and attribute information~~Labels graphs~~	~~19~~100	90

appropriately (titles, axes, and units) and graph is displayed in a usable size		
Student communicates geospatial data via a web mapUses correct variables	8691	100
Uses appropriate graphical or statistical representation	62	90
Identifies sources of error and/or limitations of measurement	0	38
Makes appropriate inferences from data (conclusions)	43	100

In GIS 316, the project assessed required students to create a map; either a simple cartographic representation or as a result of researching a geospatial topic. The minimum acceptable performance at the 300 level is that at least two-thirds of the students are proficient for each criteria. Eighty six percent or more students were proficient or highly proficient in the four assessed criteria (Table 4). Students exhibited highest proficiency in designing an appropriate database for their data (Table 4).

Table 4. Direct assessment of student work from GIS 316. *n*=7.

Assessment Item	Percentage of students proficient or highly proficient	Percentage of students with limited proficiency, proficiency, or high proficiency
Student creates a topologically appealing representation	86	100
Student designs a cartographically appealing representation	86	86
Student designs an appropriate database	100	100
Student applies an appropriate geospatial analysis	86	86

4.1.2 Indirect Assessment of PSLO 2~~1~~

In the senior exit survey, we asked students to self-assess how well their education at Oregon Tech prepared them in the areas of the program learning outcomes. We asked the question “please indicate how much your experience at~~well~~ Oregon Tech contributed to your knowledge, skills, and personal development ~~the Environmental Sciences program prepared you~~ to ~~apply quantitative skills, including statistical methods, to field and laboratory data related to environmental phenomena~~use geographic information systems (GIS) to solve geospatial problems”. ~~Of~~ All ~~the ten~~ seven students ~~(of 16 possible graduates) that r~~ responded to the question. One student ~~, half of the students~~ believed that Oregon Tech had prepared them quite a bit to use GIS~~their education had prepared them~~ to solve geospatial problems, and six students believed that Oregon Tech had prepared them very much to use GIS to solve geospatial problems~~to apply quantitative skills, and half the students believed that they were highly prepared to apply quantitative skills to environmental phenomena~~ (Table 5).

Table 5. Indirect assessment of Environmental Sciences program graduating seniors perception of how Oregon Tech prepared them to use geographic information systems to solve geospatial problems. *n* = 7.

Learning Outcome	~~Inadequately prepared~~ Very Little	~~Prepared~~ Some	~~Highly Prepared~~ Quite a Bit	Very Much
~~Apply quantitative skills, including statistical methods, to field and laboratory data related to environmental phenomena.~~Use	0	~~5~~20	~~5~~1	6

geographic information systems (GIS) to solve geospatial problems				

5. Summary and Discussion of Student Learning

5.1 PSLO 2: use geographic information systems to solve geospatial problems

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Assessing our student's work in the sophomore and junior level GIS courses was a useful exercise for faculty. In general, we were pleased with the competency of students in these courses; and we met or exceeded the minimum acceptable performance for each criteria.

Compared to the previous assessment cycle for PSLO 2 (2012 – 2013 Assessment Report), our results indicate that faculty have made strides to improve student outcomes. In GIS 205 in 2012-2013, none of the students assessed understood the fundamentals of GPS operation, and only 50% were able to use GPS to record location and attribute information. In contrast, during the current assessment cycle, 50% and 100% of students met those criteria, respectively (Table 3). However, there is still room for improvement, as it is our hope that 100% of all students understood the fundamentals of GPS operations by the time they complete the course. Faculty in the Environmental Sciences Program will continue to work towards that goal.

We observed similar promising results in GIS 316. In 2012 – 2013, we met our minimum acceptable performance criteria in three of the four criteria assessed, but only 67% of students met the criteria. In contrast, during the current assessment cycle, 86 or 100 % of students met the criteria! Importantly, in 2012 – 2013, students did not meet the minimum acceptable performance for the criteria "design an appropriate database". In the current assessment cycle, 100% of students assessed met this criteria; which is a large and noteworthy improvement.

Additionally, our indirect assessment of students via the student exit survey indicates that students perceive that Oregon Tech has very much prepared them to use GIS to solve geospatial problems. GIS is a strong selling point of the Environmental Sciences program, and students consistently make positive comments on their exit survey in this area. For example:

"Dr. Ritter though his passion of teacher and want for my success has made me the student I am today. He pushed me hard but was very helpful and forgiving. Because of him I have a true passion for gis."

"I think transferring to oit was the best decision for my future in env and gis"

6. Plans for Addressing Student Learning Outcomes 2016 ~~5~~- 20176

In 201~~5~~6-17~~6~~ the program will re-assess PSLO #3: understand the complex relationships between natural and human systems. This will be assessed in fall quarter for BIO 111 and spring quarter for BIO 484.~~PSLO #2: Use geographic information systems to solv e geospatial problems. This will be assessed in winter quarter in GIS 316 and spring quarter in GIS 205.~~ The program will also assess Oregon Tech's Essential Student Learning Outcome #~~6~~1: Oregon Tech students will communicate effectively orally and in writing. ~~explore diverse perspectives.~~

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7. Changes Resulting for 2015 – 2016 Assessment

Substantial course changes were made after the last assessment cycle of PSLO 2, including combining two courses and changing the term in which GIS 205 is offered, to streamline the GIS curriculum for Environmental Science students. This was the first assessment of PSLO 2 since these curriculum adjustments have been made. The results of the current assessment will be shared with Environmental Science faculty, and faculty will continue to try and achieve greater student success, even though our assessment indicates that we have improved student learning and students are meeting each of our criteria.

~~**Assessment Item**~~	~~**High Proficiency (3)**~~	~~**Proficient (2)**~~	~~**Limited Proficiency (1)**~~	~~**No Proficiency (0)**~~
~~Identifies appropriate type of mathematical test for a scientific problem~~				
~~Labels graphs appropriately (titles, axes, and units) and graph is displayed in a usable size~~				
~~Uses correct variables~~				
~~Uses appropriate graphical or statistical representation~~				
~~Identifies sources of error and/or limitations of measurement~~				
~~Makes appropriate inferences from data (conclusions)~~				

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Appendix 3. Student Project Assessment Rubric

Circle the level of proficiency, and provide any additional comments in the space provided below. Check the box to signify if your assessment score on an item was due to conversation, not material presented on poster.

Assessment Item	High Proficiency (4)	Proficient (3)	Limited Proficiency (2)	No Proficiency (1)
Topic Selection ☐ Score based on additional conversations with student	Identifies creative, focused, & manageable topic that has the potential to generate new knowledge or deeper understandings of system(s).	Identifies focused & manageable topic in a routine manner (e.g., student able to modify a single variable in experiment, or uncover knowledge that is new to their learning experience).	Identifies topic that while manageable/ doable, is too narrowly focused & leaves out relevant aspects of topic, or can't explain their hypothesis when asked.	Identifies topic that is far too general & wide-ranging as to be manageable and doable, & can't explain their hypothesis when asked.
Existing Knowledge & Research ☐ Score based on additional conversations with student	Synthesizes in-depth information from relevant sources representing various approaches (e.g., student competently draws from the research literature).	Presents in-depth information from relevant sources representing various approaches (e.g. student draws on background information such as textbooks, life experience, & prior course knowledge).	Presents limited, out-of-context, or poorly explained information from relevant sources representing limited approaches.	Presents information from irrelevant sources representing limited approaches or doesn't include relevant background information on poster.
Project Design & Methodology ☐ Score based on additional conversations with student	All elements of the methodology skillfully developed. Appropriate methodology is specific to pro-fesssionals in the field or synthesized from across disciplines, and is well-justified. (e.g. student adapted experimental protocols to the particular constraints of the project, or to resource limitations). Methods explained well enough that project could be replicated.	Critical elements of the methodology are appropriately developed, yet more subtle elements are ignored or unaccounted for (e.g. student designed experiment appropriate to their academic experiences, but may lack creativity or originality in methods). Methods explained well enough that project could be replicated.	Critical elements of methodology are missing, incorrectly developed, or unfocused. Methods are vague and could not easily be replicated.	Inquiry design demonstrates a misunderstanding of the methodology. Methods are vague and could not easily be replicated.
Data Analysis & Presentation ☐ Score based on additional conversations with student	Organizes, synthesizes, and presents evidence to reveal insightful patterns, differences, similarities, or gaps in knowledge. Uses appropriate analytical approaches to evaluate evidence. Data are presented in a map & figures &/or tables that are properly structured and labeled, easy to interpret, and powerfully convey key results. Student can explain data analysis methods when prompted.	Organizes and presents evidence. May require prompting in order to reveal important patterns, differences, or similarities. Uses basic analytical approaches (e.g., summary statistics). Data are presented in a map & figures &/or tables that are appropriate, but may benefit from further clarification. Student can explain data analysis methods when prompted.	Organizes evidence, but the organization is not effective in revealing important patterns, differences, or similarities (e.g. map/figures/tables don't convey key results or are poorly structured and labeled, or student is unable to explain data analysis).	Lists evidence, but it is not organized and/or is unrelated to project. Map/figures/tables do not make sense and/or are lacking. Student cannot explain data analysis.
Conclusions ☐ Score based on additional conversations with student	States a conclusion(s) that is logical extrapolation from project findings. Conclusions are insightful (e.g., students' conclusion should inform models of how a system works, rather than being mere generalizations).	States conclusion(s) beyond a simple summary of the analysis, but may focus solely on the inquiry findings.	States a general conclusion that, because it is so general, is not fully supported by the project findings.	States an ambiguous, illogical, or unsupportable conclusion from project findings.
Limitations & Implications ☐ Score based on additional conversations with student	Insightfully discusses relevant & supported limitations & implications (e.g. students should be able to discuss measurement uncertainty, human error, be able to consider how their work connects to the greater academic community, or propose creative extensions of their projects).	Student can at least partially discuss relevant & supported limitations & implications (e.g. students should be able to discuss measurement uncertainty, human error, etc., and propose straightforward extensions of their work, but perhaps not connect their work to the greater academic community).	Discusses some relevant & supported limitations and implications.	Discusses limitations & implications, but they are possibly irrelevant and unsupported.