Oregon TECH

2017-18
Environmental Sciences Assessment Report
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Contents

Section 1 – Program Mission

The Bachelor of Science program in Environmental Sciences prepares students for immediate employment and graduate studies in the assessment and monitoring of environmental conditions and problems, including research, mitigation and restoration. The program focuses on applied scientific reasoning and methodology to study natural and human environments from interdisciplinary systems perspectives with strong emphasis on reading, writing, and oral communication. The curriculum builds on four cores: natural sciences (biology, chemistry, and physics); mathematics (including calculus and statistics); geographic information systems (GIS); and integrated social sciences (including economics, geography, and bioregional studies). This program offers numerous and diverse opportunities for undergraduate students to conduct scientific research with the support of faculty and professionals.

Mission Statement: Students analyze environmental conditions and problems through multidisciplinary studies, applied research, and fieldwork, all within the stunning natural setting of the Klamath Basin.

The mission, objectives, and student learning outcomes for the BES program are reviewed annually by BES faculty.

Section 2 – Program Educational Objectives

Starting with Introduction to Environmental Sciences in the first year, emphasis is placed on active experiential learning both in the laboratory setting and in the field. Upon completion of the program, students will have demonstrated the following abilities:

1. A strong applied foundational knowledge of environmental systems including aquatic and terrestrial ecology, natural resources, physical and biogeography, and environmental chemistry.
2. An understanding of the complex relationships between natural and human systems
3. The application of mathematical and statistical concepts, to field and laboratory data to study natural phenomena
4. Geospatial literacy through map interpretation, compass navigation, and the use of geographic information systems to address geospatial problems.
5. Design, execute, and communicate scientific projects.

Section 3 – Program Description and History

Program History

The BS in Environmental Sciences officially began in 1995 on the Klamath Falls Campus. Our students have built a positive reputation in the Klamath Basin for their involvement in scientific research and resource management as demonstrated by our many industry relationships (Table 4). The BES graduate success rate has remained high throughout the program's history with nearly 100% success from 2016-17. Fall enrollment trends from 2013-17 have varied from 49 to 41 students per year in the program. It is important to note that student enrollment by spring term may be significantly lower and could provide a valuable indicator of retention. The 5-year decline in enrollment can likely be attributed to a variety of factors including:

- previous lack of focused recruitment efforts
- a high turnover of Natural Science faculty leading to alterations in course curriculum based on professional expertise and changes in advisors for students.
- the continued increase of college expenses for students
- an improving economy making jobs more readily available without a degree.
- an increasingly competitive market for college education.

Based on this data, the BES program has set a goal of reaching a target fall enrollment of 60 students within the next 3-5byears. One of the limiting factors for increasing enrollment is faculty to teach classes within the program and to support student research. Currently, all BES faculty also teach a variety of general education courses within the Natural Science Department in addition to developing partnerships and designing and implementing research and field studies throughout much of the curriculum. Many of these studies require field trips throughout the Klamath Basin, Southern Oregon, and Northern California. The logistical requirements for

field trips are extensive. They include, but are not limited to, various administrative levels of paperwork for trip approval and documentation; locating, scheduling, and pickup/dropoff of rental vans (sometimes not available at local rental outlets); provision and preparation of food and other camp resources; continuous design and implementation of novel field exercises; and regulation of student conduct in field settings. While many of these requirements are not unique to the Environmental Sciences Program, we offer field trips more frequently than many other programs. For example, each core faculty member in the program generally implements two weekend-long field trips per year, and an additional 3-8 single day field trips each academic year. At 60 students, we recommend adding another full-time faculty member to effectively distribute work load and expand our course offerings into areas indicated both by student interest and industry job opportunity including fisheries, forestry, and fire ecology.

In 2017-18 BES was selected by Provost Kulek to receive targeted funds from Strategic Enrollment to create new marketing tools for the program including a promotional video which can be viewed on the BES program page, https://www.oit.edu/academics/degrees/environmental-sciences#curriculum .

Program Location: Klamath Falls Campus only.

Program Enrollment:

Table 1: BES Enrollment 2013-17

Fall 2013	Fall 2014	Fall 2015	Fall 2016	Fall 2017	5 Year Difference	5 Year % Change
49	51	48	42	41	8	-16.8%

Program Graduates:

Table 2: BES Number of Graduates 2011-17

2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
5	5	4	5	11	14	3

Employment Rates and Salaries:

Employment rate and salary data is based on the 2016 and 2017 graduates of the BES program, and was collected via exit surveys, career services surveys, and Linkedln. While the employment data suggests 100% success, there was one of the 17 students who was employed outside of the field of environmental sciences. While the below numbers align with the federal standards for measuring college success, using employment post college within the field of study would be a better representation of true success. A 95% success rate in the field of study is an exceptional achievement for the BES program.

Table 3: BES Graduate Success Rates

Employed	Continuing Education	Looking for Work	Not Seeking	Median Salary	Success Rate
15	2	0	0	$39,800	100%

Industry Relationships:

Table 4: Current relationships between BES and local agencies.

Industry Relationships

BES Advisory Board
Faculty within the ENV program are actively recruiting members to re-establish the Environmental Science Advisory Board. This board would lend support to strategic planning for the program and better connect our students to industry partners.

US Forest Service
Memorandum of understanding with the Forest Service. PI Kerry Farris.

Klamath Watershed Partnership
We have students working on a project funded through the OR Tech Foundation. PI Jherime Kellerman.

Western Native Plants
Students are doing restoration work with Western Native Plants in fall of 2018. PI Jherime Kellerman.

Bureau of Reclamation – WADRS
A large grant from the BOR to fund the collection of hydrologic data in the Klamath Basin for Water Assessment for Drought Resilience & Sustainability (WADRS). PI Michael Hughes and Erin Cox.

US Fish & Wildlife Service
Student Worker Internship & Mentoring (SWIM) Program. (2016-2018) PI Michael Hughes

Department of Environmental Quality
OIT recently purchased an air quality monitor to track particulate matter. Data from this monitor will be shared with the DEQ. PI Addie Clark

Oregon Bee Atlas Project – Oregon State University, Oregon Department of Agriculture, and Xerces Society.
Students are collecting bee specimens for identification and inclusion in the Oregon Bee Atlas project. This initiative aims to identify bee species in Oregon. PI Christy VanRooyen.

Lake County Resource Initiative
Students will be field assistants collecting field data as part of a larger crew examining the effects of alternative silvicultural treatments on ponderosa pine recruitment. PI Kerry Farris

Table 5: Recent BES publications and conference proceedings.

Showcase Learning Experiences

These recent publications/conference proceedings included student researchers. *identifies student name.

- O'Leary*, D., J.L. Kellermann, & C. Wayne. 2018. Snowmelt, spring phenology, and extended growing season in Crater Lake National Park. International Journal of Biometeorology. DOI 10.1007/s00484-017-1449-3
- Gunning, A.* & J.L. Kellermann. 2017. Black-backed Woodpecker and Wood-boring Beetle Associations with post-fire burn severity following the National Creek Fire. Northwest Scientific Association Annual Meeting, Ashland, OR.
- Kellermann, J.L., J. Lajoie*, S. Mohren, & A. Robatcek*. 2014. Black-backed woodpecker occupancy and Mountain Pine Beetle disturbance at multiple scales: Crater Lake National Park, Oregon. American Ornithologist's Union, Cooper Ornithological Society, Society of Canadian Ornithologists 2014 Joint Meeting, Estes Park, Colorado.

Table 6: BES Graduate Success Stories 2017-18

Success Stories
Chloe Smith, BES graduate 2018, won the President's Senior Cup for her exceptional academic record as well as her commitment to promoting sustainability at OIT. She is the first ENV graduate to complete the degree as well as three minors: biology, chemistry, and sustainability. Baker McDonald, duel REE and BES graduate 2018, and Ory Foltz won 3rd place in the Catalyze Klamath Competition for their prototype of a 3D printed water flow meter. Their meter was printed at a fraction of the cost of a traditional flow meter.

Section 4 – Program Student Learning Outcomes

The ENV Faculty recently revised our PSLOs to better align with the skills necessary for job success post-graduation. It is helpful to note that very few of our graduates will start out their career fully implementing a scientific study from start to finish. Because of this, while all graduates will have gone through the scientific process of study design and implementation, they will not be expected to have a complete mastery of this objective. We hope that being exposed to research as an undergrad will better prepare them for graduate school and/or advancement in their careers.

Currently, the rubrics for evaluating these PSLOs are incomplete, leaving room for inconsistencies in our assessment process. This year, we will be developing a standard rubric for measuring the degree to which a student meets these objectives at the foundational, practice, and capstone levels. Further, we plan to track student ID with the PSLO assessment data, so we can ***monitor change over time in specific individuals.*** We hope that this data will be much more meaningful than and will be used to drive our strategic planning about curriculum changes and equipment needs.

Upon graduating from the BSES program at Oregon Tech, students will have demonstrated an ability to:

- **PSLO 1 BES Quantitative Analysis:** Collect and organize scientific data in a clear and competent manner that appropriately addresses a scientific question and hypothesis. Apply quantitative reasoning to the data and communicate the results to both the scientific community and the general public.

- **PSLO 2 BES Geospatial Literacy:** Demonstrate geospatial literacy through map interpretation, compass navigation, and the utilization of current technologies such as global positioning systems, remote sensing equipment and data, and geographic information systems to address environmental problems.

- **PSLO 3 BES Collaborative Problem Solving:** Demonstrate a knowledge of ecosystems while successfully collaborating with a diverse group of individuals to solve environmental problems.

- **PSLO 4 BES Scientific Project:** Competently implement an individual or group scientific project, which may include literature review, experimental design, question, hypothesis, and prediction formation, data collection, data analysis, and reporting.

Section 5 – Curriculum Map

Please note that this section is incomplete. The ENV curriculum has been unstable the last few years with a large curriculum overhaul and faculty turnover leading to changes in scientific expertise. We are excited to work on completing this table over the 2018-19 academic year and evaluating how our courses help us meet our objectives. We suspect that going through this exercise might drive our strategic planning and could potentially lead to further curriculum changes.

Table 7: BES curriculum map and learning objectives. Level of application: F – Foundational P – Practicing C - Capstone

COURSE	PSLO 1	PSLO 2	PSLO 3	PSLO 4	ESLO 1	ESLO 2	ESLO 3	ESLO 4	ESLO 5	ESLO 6
BIO 211										
ENV 111		F				F				
GIS 103		F								
GEOG 105		P								
WRI 121										
BIO 212			P							
GIS 134		P								
MA 111										
WRI 122										
BIO 213										
GIS 205		P								
MA 112										
ENV 214										
CHE 221										
MA 251										
CHE 221										
ENV 275										
MA 252										
ENV 224	F			F						
CHE 223										
SPE 111										
ENV 226	P									

CHE 331										
PHY 221										
WRI 227										
ENV 365	P	P	P							
ENV 314			F							
CHE 315			P			P				
MA 361										
PHY 222										
ECO 201										
BIO 3XX ecology			P	P						
CHE 465			P							
PHY 223										
ENV 434 or MA 362	C									
SPE 321										
WRI Elec										
ENV 475										
ENV 484			C							
ENV 485			C							

Section 6 – Assessment Cycle

Table 8: BES PSLO and ESLO assessment cycle.

Environmental Science BS PSLO and ESLO Assessment Cycle

Outcome	2018-19	2019-20	2020-21
PSLO 1 Quantitative Analysis			ENV226 ENV434 Research Elective
PSLO 2 Geospatial Literacy	GEOG 105 ENV 365 Exit Interview		
PSLO 3 Collaborative Problem Solving		ENV 111 BIO 484 Research Elective	
PSLO 4 Research Project			ENV226 ENV434 Research Elective
ESLO 1 Communication			
ESLO 2 Inquiry and Analysis			
ESLO 3 Ethical Reasoning	ENV 111 CHE 315 Exit Interview		
ESLO 4 Teamwork			
ESLO 5 Quantitative Literacy			
ESLO 6 Diverse Perspectives			

Section 7 – Methods for Assessment

PSLO Assessment 2018-19

Unfortunately, PSLO data was not collected in 2017-18 and an assessment report for BES has not been completed since Fall of 2016. Due to this, we are resetting the assessment process for the program. In Section 6, you can see the assessment cycle for our newly written PSLOs.

PSLO 2 on Geospatial Literacy will be assessed during the 2018-19 academic year. Direct measures will be taken in GEOG 105 and ENV 365. We have tentatively chosen assignments in each of these courses which align well with the geospatial literacy objectives. In GEOG 105 Students will be performing an orienteering exercise and interpreting data from a topographic map. (See Appendix 1 for the full map assignment) In ENV 365 students will be using GPS radio collar data to track animal behaviors (this assignment is still under development). Students will incorporate this information into a GIS.

The following table is a draft of the geospatial literacy rubric. The assessment of geospatial literacy will focus on six distinct areas: map interpretation, orienteering, cartography, GIS, coordinate systems, and spatial thinking and problem solving. An assignment which touches on only 1 of these areas would be considered a

foundational level, 2-3 areas would be practicing, and 4 or more areas would be a capstone level assignment. Within each category, students will be assigned a score of 1-4: 1 beginning, 2 developing, 3 proficient, 4 exemplary. The criteria under each category are given to help assessors differentiate between the various levels of geospatial literacy.

Further, geospatial literacy will be assessed indirectly using exit interview feedback from students about their perceived personal growth in geospatial literacy resulting from their instruction at OIT.

Table 9: Draft Geospatial Literacy Rubric.

Draft Geospatial Literacy Rubric	
Map Interpretation	Extract elevation data from a topographic map
	calculate relief
	correctly interpret data portrayed on a thematic map
	use a map scale to accurately estimate distance on the earth
Orienteering	Correctly take a bearing
	Correctly follow a heading
	Apply declination
	accurately perform Triangulation
Cartography	No map elements are missing
	Symbolization is effective
	No grammatical or accuracy errors
	Credits and explanation are present
GIS	Sophisticated use of geoprocessing tasks: distance, proximity, overlay, queries
	Collected, organized and documented data with both spatial and attribute data
	The map includes a layer which is the result of analytical operations
	Includes static or animated (e.g. movies) 3-D geovisualizations
Coordinate System	Geographic coordinates were acquired.
	Student included information about the geographic coordinates in the metadata
	Students can discuss positional uncertainty and spatial accuracy in the context of map-making and spatial analysis
	Students translated data of different coordinate systems so that they overlay in a GIS
Spatial Thinking in Problem Solving	Geospatial data is used to answer questions relevant to solving a problem
	The answers are formulated in a spatial way and translated into maps
	Student can identify the layers necessary to answer a geospatial question.
	Student chooses appropriate technology for geospatial data collection.

This table provides an example of how data will be recorded once the assessment is complete. As this is a practicing level assignment, only 2 of the six criteria are being addressed.

Table 10: Example assessment results table for geospatial literacy assessment in GEOG 105

PSLO 2 BES: Klamath Falls Campus, GEOG 105, 201801, Christy VanRooyen				
PSLO 2: Demonstrate geospatial literacy through map interpretation, compass navigation, and the utilization of current technologies such as global positioning systems, remote sensing equipment, and geographic information systems to address environmental problems.				
Performance Criteria	**Assessment Methods**	**Measurement Scale**	**Minimum Acceptable Performance**	**Results**
Map Interpretation	Assignment evaluated by course instructor using BES Geospatial literacy rubric.	1-4 according to rubric criteria	75% of students scoring 3 or higher	
Orienteering	Assignment evaluated by course instructor using BES Geospatial literacy rubric.	1-4 according to rubric criteria	75% of students scoring 3 or higher	
Cartography	N/A			
GIS	N/A			
Spatial Thinking in Problem Solving	N/A			
Coordinate System	N/A			

ESLO Assessment 2018-19

This year we will be collecting data on the Ethical Reasoning ESLO for institutional assessment purposes. This ESLO states, "Oregon Tech students will make and defend reasonable ethical judgments." Direct assessment data will be collected in ENV 111 introduction to environmental sciences and CHE 315 chemical fate and transport. Both courses include assignments which require ethical reasoning about environmental issues. We expect students in ENV 111 to be at a foundational level of ethical reasoning, and students in CHE 315 to be more at a capstone level. The OIT ethical reasoning assessment rubric will be utilized for scoring. Exit interview data will be used for indirect assessment of the ESLO.

Section 8 - Evidence of Improvement in Student Learning

The previous PSLO related to geospatial literacy was focused more directly on the use of GPS and GIS. This was last assessed in 2015-16. While we have expanded the skill set we would like students to graduate with, it is useful to note that historically our students have performed well with geospatial literacy. 86% of students met the criteria during the last assessment cycle (2015). This was up from 67% in 2012.

Section 9 - Data-driven Action Plans: Changes Resulting from Assessment

This is an exciting year for the BES program. With new leadership at the helm and a team of positive and forward-thinking individuals, the faculty are pleased to be making progress on a formalized assessment plan. As a starting point for our strategic planning, we reviewed exit interview data from the last five years. Trends in the data were identified. The following comments showed up multiple times in exit interviews.

Things we do well:

- Providing opportunities to get professional experience.
- The field experiences offered were well received.
- Application of book theory to field work.

Things to improve upon:

- We need more electives offered throughout the year.
- More field classes and time spent outdoors.
- A year of physics takes up too much of their schedules and was not perceived as beneficial.
- Advisors need to be more available and do a better job helping the students achieve their professional goals.
- A lot of the equipment in labs is outdated.
- Reduce scheduling conflicts.
- Students should be required to complete a project.

In response to the advising comments, all advisors within BES are actively contacting our advisees this term as we prepare for winter registration. A current curriculum map has been shared with all advisors, and many have printed copies for our advisees.

We are examining the distribution of our course offerings so that students can take upper division BES requirements and electives every term. Season is a limiting factor for when many of our field courses can be offered. We are considering shifting some of our less field intensive courses to winter term. For example, Ecoregional Studies BIO 485 will be a winter course this year and Environmental Chemistry and Toxicology has been moved to spring. Another possible solution for better distribution of tech electives is to increase our summer course offerings. Historically, enrollment in summer BES courses has been low, and faculty availability is often limited making this a less viable option than redistribution of classes. However, small class sizes can be conducive to intensive, week-long field courses that explore a particular topic and location through experiential research learning. There is also interest in implementing international summer study abroad programs.

There was one particular comment in the exit interview data where a student made an accusation about the behavior of a faculty member on a field trip. This accusation was taken very seriously by the BES program director and was appropriately reported for investigation. In light of this concern, the BES program will likely adopt a formal field trip alcohol and tobacco free policy during any class affiliated trip. While this has always been the generally accepted standard, we hope that by including this statement in our syllabi, all involved parties can be held accountable for their actions.

The exit interview data suggests that students felt we could do better at helping them develop skills related to ethical reasoning and diverse perspectives with 2 of 5 students indicating that their experience at Oregon Tech minimally contributed to their development in these areas. In some courses we address these ESLOs, but the relationship between the objective and an assignment may not be clear to our students. From now on, we plan to point out (either verbally or in writing) when we are doing ethical reasoning or considering diverse perspectives. We hope that the familiarity of this language will help students recognize the efforts we are already making. Additionally, we are considering potential alterations to course curricula ensuring that all PSLOs and ESLOs are tied to our course requirements. We expect that this alignment process may alter our curriculum map over the next few years.

Increasing student enrollment is of highest priority for the BES program. As mentioned in Section 3 of this report, we have set a target enrollment of 60 students by fall of 2023. This would be an increase of 46% from the 2017 fall enrollment of 41.

We will continue to utilize assessment data to drive de cision making within the BES program. We believe that this will lead to a higher recruitment, retention, graduate success rates, and improve learning objective performance. Our use of assessment data will also act as a model for our students about making data driven decisions in the field of educational science!