2019-20
Environmental Sciences Assessment Report
Prepared by Christy VanRooyen

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 BES program focuses on interdisciplinary scientific study of ecology, natural resources, and sustainability with emphases on management, research, and communication. The curriculum is comprised of four integrated core areas in ecology & natural resources; data analysis & statistics; geographic information systems (GIS); and social sciences.

Students within the Environmental Sciences program put their knowledge into practice in the best place possible—the great outdoors. Emphasis is placed on active experiential learning. The program offers numerous and diverse opportunities for students to engage in applied research and resource management projects with the support of faculty and professionals through local and regional partnerships.

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

We believe there is a place in our program for everyone with an interest in natural resources, environmental issues, conservation and sustainability, or just being in the great outdoors! Environmental science and natural resources is a huge field that can accommodate a wide range of individual interests and skills whether it's working with wild animals, plants, people, or computers and technology. Our faculty and partners are here to help build an impressive resume of academic and work experience that will place students in the job or graduate program of their choice.

Graduates can expect to find employment in federal, state, and tribal government agencies, non-governmental organizations (NGOs), and education and research institutions. Students are also well prepared to enter graduate school. Students graduating from our program have taken positions with the U.S. Geological Survey, U.S. Bureau of Reclamation, U.S. Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Forest Service, Oregon Department of Forestry, Oregon State Police Wildlife Enforcement, Klamath County Health Department, Klamath Irrigation District, Klamath County Soil and Water Conservation District, the Nature Conservancy, and JELD-WEN Windows and Doors.

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

Section 2 – Program Educational Objectives

Upon completion of the program, students will have demonstrated the following abilities:

- A strong applied foundational knowledge of environmental systems including physical and biogeography, aquatic and terrestrial ecology, and environmental chemistry.
- An understanding of the complex relationships between natural and human systems.
- The application of mathematical and statistical concepts, to field and laboratory data to study natural phenomena.
- Use of GIS to solve geospatial problems.
- Design, execute, and communicate a scientific project. 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.

Section 3 – Program Description and History

Program History

The BS in Environmental Sciences officially began in 1995 on the Klamath Falls Campus. The Environmental Sciences program has a significant history of partnering with community stakeholders to address current environmental problems. From student involvement in research related to the 2001 water shutoff in the Klamath Irrigation District to a new grant partnership with Klamath County Public Health and the DEQ to monitor the effectiveness of woodstove change outs to improve air quality, BES students utilize their strong data analysis skills to drive positive environmental change in the Klamath Basin. See Table 4 for more information about our many industry relationships (Table 4).

One of our major achievements in the 2019-20 academic year was to submit a CPC proposal for lesser revisions to the BES curriculum (Appendix A). This revision is designed to meet goals and objectives our program faculty identified during a day-long strategic planning workshop in May 2019. The revision includes changes to both the required and elective curriculum to 1) align with our revised Program Student Learning Objectives (PSLOs), 2) compliment the combined expertise of faculty that now comprise our program, 3) meet job qualifications for the careers our students are entering both during summer and post-graduation employment, 4) provide increased opportunity for students to tailor their degree through a broader range of environmental science electives, and 5) ensure sufficient enrollment in upper division ENV courses.

Based on exit surveys and advising interviews, 90-95% of students in the ENV major are taking seasonal and permanent positions during summer breaks and following graduation in fields of natural resource management and ecology, primarily forestry, wildland fire, and wildlife and fisheries. Under the new curriculum students will be able to receive college credit for these professional experiences in the new Externship in Environmental Science course (ENV 420). This work experience is a driving force behind our amazing BES graduate success rate which was 100% in 2019-20. In 2020, 8 of our 9 graduates accepted positions with the US Forest Service in natural resource related positions highlighting the value of the above mentioned curriculum changes.

Improved enrollment and retention continues to be the primary goal for Environmental Sciences with a target fall enrollment of 60 students within the next 3-5 years. Central to achieving this goal are the strong relationships with community partners that are being built and the development of mentorship within the program. One of the changes made to our curriculum in the last two years was to offer a fall term Mentorship and Teambuilding class which is taken by the majority of the students in the program and counts toward technical elective. In this course students are grouped into teams with both upper and lower classman which we hope fosters better connections throughout the entire program. In fall of 2019, the mentorship class included an overnight camp trip to the Lava Beds National Monument, where teams got to take a variety of mini lessons on things like land navigation, astronomy, mammal skull identification, and natural resource management. The students also got to build relationships through social activities like hiking, yoga, and dining together (Figure 1).

Figure 1: BES students and faculty at the Lava Beds National Monument learning about bats during the Mentorship and Teambuilding class October 2019.

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.

Program Location: Klamath Falls Campus only.

Program Enrollment:

Table 1: BES Enrollment 2015-19

Fall 2015	Fall 2016	Fall 2017	Fall 2018	Fall 2019	5 Year Difference	5 Year % Change
48	42	41	42	37	11	-22.9%

Program Graduates:

Table 2: BES Number of Graduates 2013-19

2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
4	5	11	14	3	8	9

Employment Rates and Salaries:

Employment rate and salary data is based on the 2019 graduates of the BES program, and was collected via exit surveys, career services surveys, and Linkedln. It is important to note that only 7 of 9 graduates responded to the surveys.

Table 3: BES Graduate Success Rates based on respondents to FDS and personal contact with students.

Employed	Continuing Education	Looking for Work	Not Seeking	Median Salary	Success Rate
7	0	0	0	$33,949	100%

Industry Relationships:

Table 4: Current relationships between BES and local agencies.

Industry Relationships
Klamath County Public Health Students will be monitoring air quality changes in the Klamath Basin related to Woodstove change outs over the next two years. PI Addie Clark Washington Department of Natural Resources PI Jherime Kellerman Three River Misquito and Vector Contorl PI Jherime Kellerman US Fish and Wildlife 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 Erin Cox. US Fish & Wildlife Service Student Worker Internship & Mentoring (SWIM) Program. (2016-2018) PI Erin Cox 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 Klamath Falls City Parks Vegetation type inventory at Moore Park. Students taking plant ecology and forest ecology participate in these surveys annually. PI Kerry Ferris Lake County Resource Initiative Students acting as field assistants collecting 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. • VanRooyen, C. & Bennet, J*. 2019. "Geospatial Analysis of Apis mellifera Colonies". Presented at the Western Apicultural Society Conference. July, 2019.

Section 4 – Program Student Learning Outcomes

Over the last two years, BES faculty have revised our PSLOs to better align with the skills necessary for job success post-graduation. These changes were made in response to updated federal job requirements as listed under current openings on USA jobs as well as conversations with our industry partners about what they are looking for in our graduates.

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

1. Attain applicable foundational knowledge, technical skills, information literacy, and experience in several core areas of natural resources & environmental sciences.
2. Constructively work within and among diverse communities and perspectives.
3. Make and advocate for science-based and sustainable solutions to local and global environmental issues.
4. Apply appropriate analytical and statistical techniques to answer data driven scientific questions.
5. Demonstrate geospatial literacy through the utilization of appropriate technology to identify and address environmental problems.
6. Effectively communicate science to a diverse range of community stakeholders.

Section 5 – Curriculum Map

We are proud to report this updated BES curriculum map which includes the changes that were approved by CPC in Spring of 2020 (Table 7). The new curriculum was specifically designed to better address our PSLOs. For instance, students will now focus on analytical and statistical techniques through the following sequence of courses: Scientific Reasoning and Methodology (ENV 224), Environmental Data Analysis (ENV 226), Statistical Methods I (MATH 361), and Advanced Data Analysis (ENV 434) in addition to GIS classes. Students will be expected to apply these analysis skills in their upper division ENV and BIO courses. The new curriculum allows for more customization through technical electives after a broad foundational knowledge in biology, chemistry, physical geography and general physics.

Table 6: BES curriculum map by term

FRESHMAN			SOPHOMORE			JUNIOR			SENIOR		
BIO 211	Principles of Biology	4	CHE 221	General Chemistry	5	PHY 201 or PHY 221	General Physics	4	ENV 108	Mentorship & Team Building	1
ENV 111	Intro to Env Sci	4	ENV 217	Intro Natural Resource Management	4	ENV 355	Careers in Environmental Science	3	SPE 321	Small Group and Team Com.	3
GIS 103	The Digital Earth	3	MATH 251	Differential Calculus	4	ENV 108	Mentorship & Team Building	1	WRI Elec	WRI 327, 328, 345, 350, or 410	3
GEOG 105	Physical Geography	4	SPE 111	Public Speaking	3	SOC Elective	Social Science elective	3	Tech Elec	Technical Elective *	3
ENV 108	Mentorship & Team Building	1	CHE 222	General Chemistry	5	Tech Elec	Technical Elective *	4	Tech Elec	Technical Elective *	4
BIO 212	Principles of Biology	4	ENV 224	Scientific Reasoning & Methodology	3	ENV 314	Env Science, Law, and Policy	3	ENV 485	Ecoregional Management	3
GIS 134	Geographic Information Systems	3	ECO 201 or ECO 202	Principles of Economics	3	CHE 315	Environmental Chem & Tox	3	HUM Elec	Humanities Elective	3
MATH 111	College Algebra	4	HUM Elec	Humanities elective	3	MA 361	Statistical Methods I	4	SOC Elective	Social Science elective	3
WRI 121	English Composition	3	SOC Elec	Social Science elective	3	Tech Elec	Technical Elective *	4	Tech Elec	Technical Elective *	3
BIO 213	Principles of Biology	4	CHE 223	General Chemistry	5	CHE 465	Fate and Transport of Pollutants	4	Tech Elec	Technical Elective *	3
GIS 205	GIS Data Integration	2	ENV 226	Environmental Data Analysis	3	ENV 434	Advanced Data Analysis	4	ENV 484	Sustainable Human Ecology	4
MATH 112	Trigonometry	4	WRI 227	Technical Report Writing	3	Plant Elec	Plant Elective **	4	HUM Elec	Humanities Elective	3
WRI 122	Argumentative Writing	3	Tech Elec	Technical Elective *	4	Tech Elec	Technical Elective *	4	Wildlife elec	Wildlife elective ***	4
	Total	43		Total	48		Total	45	Tech Elec	Technical Elective *	4
										Total	44
										Total credits for B.S.	**180**

Section 6 – Assessment Cycle

Table 7: BES PSLO and ESLO assessment cycle.

Environmental Science BS PSLO and ESLO Assessment Cycle

Outcome	2018-19	2019-20	2020-21	2021-22	2022-23
PSLO 1 Foundational Knowledge	Assessed annually through completion of course curriculum	Assessed annually through completion of course curriculum	Assessed annually through completion of course curriculum	Assessed annually through completion of course curriculum	Assessed annually through completion of course curriculum
PSLO 2 Constructive Group Work		BIO 212 - Winter BIO 377 - Spring Exit Interview			
PSLO 3 Environmental Advocacy				ENV 475 Exit Interviews	
PSLO 4 Data Analysis			ENV 226-Winter PHY 201 - Winter ENV 434 – Spring Exit Interview		
PSLO 5 Geospatial Literacy	GEOG 105 ENV 365 Exit Interview				
PSLO 6 Communicating Science					WRI 345 ENV 495 BIO 386
ESLO 1 Communication					
ESLO 2 Inquiry and Analysis					
ESLO 3 Ethical Reasoning	ENV 111 CHE 315 Exit Interview				
ESLO 4 Teamwork		BIO 212 - Winter BIO 377 - Spring			
ESLO 5 Quantitative Literacy					
ESLO 6 Diverse Perspectives					

Section 7 – Methods for Assessment

PSLO Assessment 2019-20 and

In 2019 the following PSLO was assessed: Constructively work within and among diverse communities and perspectives. Direct measures were collected in BIO 212 where students do an extensive group project as part of their lab (Appendix B). Data was scheduled to be collected in ENV 377 Wildlife Ecology, however due to the transition to remote learning in spring 2020 in response to COVID no data was obtained from this course.

The same Teamwork Rubric (Appendix C) which was developed by the Teamwork ESLO committee was used to evaluate work related to this PSLO since it nicely encompasses project success, student roles within a group, and the group's ability to adapt to cultural differences.

Student groups from BIO 212 had average scores between 2.6 and 3.0 out of 4 in all categories indicating that the students worked very well together with clearly identified objectives and roles provided by the professor. It is important to note that the project goals and group roles were highly scaffolded in this assignment and students signed a participation contract prior to beginning the work which eliminated the opportunity to score a 4 of 4 in many of the categories on the rubric. As most students take BIO 212 in their first year of the BES program outlining group expectations is vital to the development of student teamwork skills. In future assessment years we look forward to comparing results from lower division courses to one of our junior/senior level ENV courses which would have less of the scaffolding in place to see how students develop teamwork throughout the program.

Student comments indicated that they mostly get along well with their peers, although there was the occasional frustration expressed about specific students who failed to contribute to the group.

The assessment of the Teamwork PSLO highlights the value of having well designed instructions for group projects. BES faculty are working on developing common language to be included in all group projects given in ENV courses in hopes of better standardizing our expectations and effectively prioritizing those skills which are highly valued by industry partners.

In addition to direct measures for Teamwork we are also using the indirect measure of self-reported efficacy from exit interviews. According to our exit interviews, 100% of our students felt that they are highly proficient at being effective group members and that their experiences at Oregon Tech **very much** contributed to their ability to perform in groups.

One challenge of doing assessment within a relatively small program like BES, is that when we collect data within courses, the sample size is not statistically significant. Further, many of our students come in as transfer students so individual experiences outside of the BES program may be influencing PSLO assessment results. In response to these challenges, we are in the process of implementing a new method for program assessment. In our teambuilding and mentorship course (ENV 108) Fall 2020, BES faculty held a workshop where the PSLOs were presented and students learned how to build a portfolio within Portfolium. Over fall term students will be uploading different projects/work examples in their portfolios which exemplify each of the environmental science PSLOs. For example, a student might upload a map that they created using GIS as an example of the Geospatial Literacy PSLO or share a video of a presentation that they gave to address the Scientific Communication PSLO. BES faculty (particularly Christy VanRooyen assessment coordinator and Jherime Kellerman program director) will be creating or improving the rubrics for evaluating these samples which students will provide. BES faculty will then meet to evaluate all provided projects thus assessing all of the PSLOs each year. Students will be granted digital badges on their portfolios using customized PSLO badges created by VanRooyen using the program Badgr. These badges will act as records for assessment purposes and allow students to better track their personal progress related to the primary learning objectives.

Going forward, Portfolium will be integrated into all of the ENV courses and students will be encouraged to continue to upload samples of work related to specific PSLOs. Collecting PSLO samples through Portfolium will greatly improve the BES assessment process. We will be able to monitor individual progress over time, identify courses which directly contribute to PSLO progress, and provide students with a professional portfolio which can be shared with potential employers. We hope that this integrated approach will provide more robust and meaningful assessment data.

ESLO Assessment 2018-19 and 2019-20

In 2019-20 we collected data on the Teamwork ESLO for institutional assessment purposes. Direct assessment data was collected in BIO 212 and ENV 355. The Teamwork ESLO assessment report was discussed in our department meeting with individual department members submitting feedback to assessment coordinators. The BES program will continue to support the Teamwork ESLO by integrating group projects into environmental science courses and encouraging group cohesion through intentional scaffolding of assignments. Multiple natural science members noted that it was interesting how consistent average scores were from both students and faculty lending more weight to the value of the data. Laboratory classes are a natural setting for teamwork and faculty who teach these labs could better discuss effective teamwork early in the quarter to promote positive group interactions.

In 2020-21 we will be assessing the Quantitative Literacy and Inquiry and Analysis ESLOs. Direct assessment data will be collected in ENV 434 and PHY 201 in winter term and in ENV 226 in spring term.

Section 8 - Evidence of Improvement in Student Learning

PSLOs in the BES program were updated in 2019 and the PSLO on teamwork was added then. Due to this, there is no prior data for comparison.

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

As a team of positive and forward-thinking individuals the BES faculty are pleased to be making progress on strategic plans for the program. The newly adopted BES curriculum is the direct result of revisions to the PSLOs which were revised in response to exit interview data and communication with industry partners. Now that industry driven PSLOs are in place with appropriate curriculum, focus has shifted toward collecting valuable assessment data through the implementation of student portfolios. Further, changes in the assessment process as dictated by accrediting boards in higher education will allow for more flexibility in the gathering of assessment data. For instance grades can now be used as an indirect measure of PSLO progress.

Based on exit interview data from the last five years the following strengths and weaknesses within the program have been identified.

Things we do well:

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

Opportunities for Improvement

- Add diversity to our staff and student body
- Better distribute electives throughout the year
- Making science and math requirements more relevant for our students
- Advisors need to be more available and do a better job helping the students achieve their professional goals.
- Update lab equipment.
- Reduce scheduling conflicts.

Many of the opportunities for improvement listed above were addressed during the program curriculum revision (Appendix A). Approximately 33% of students reported on the 2018-19 exit surveys that the lower division courses did not provide the foundation necessary for upper division courses. In response to this, course work was redistributed in a more meaningful way by developing sequences of classes which are now required to be taken in order. Electives are better distributed with new elective offerings. PHY 201 which will be a more theoretical approach to physics with examples specifically related to environmental issues will be taught for the first time in Winter 2020. The math requirements have shifted more heavily toward data analysis which aligns with professional expectations for our students.

Program director, Jherime Kellerman, created a valuable transition advising tool in Excel which can be used by students to plan their academic progress within the program. The Environmental Externship class will allow students to receive credit while working with our industry partners. Christy VanRooyen is in the process of developing the paperwork for formalizing BES externs and creating an assessment tool for employers to evaluate student progress related to PSLOs.

With the completion of the Gerda Hyde Watershed Lab in 2018 and the upcoming renovation of Boivin Hall many of our laboratories will soon be taught in labs that meet current industry standards. Faculty partnerships and grants continue to provide equipment and software for research projects.

The BES faculty are making every effort to connect our students to regional scientific research. The many partnerships we have formed (Table 4) provide our students with professional experience and connect them to expertise and tools which we may be unable to provide here on campus given our small program size. 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 2024.

Improving retention rates is another critical goal of the program. We continue to reach out to students who have stopped attending Oregon Tech or who transfer out of the program. Based on these conversations it appears that many of the students who leave our program do so for financial and personal reasons which are beyond our control.

We will continue to utilize assessment data to drive decision 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 which is one of the learning objectives for the program (PSLO 3)!

Appendix A: ENV Curriculum Revisions Summary

Lesser Program Revision: Environmental Sciences

Purpose:

This revision is designed to meet goals and objectives our program faculty identified during a day-long strategic planning workshop in May 2019. The revision includes changes to both the required and elective curriculum to 1) align with our revised Program Student Learning Objectives (PSLOs), 2) compliment the combined expertise of faculty that now comprise our program, 3) meet job qualifications for the careers our students are entering both during summer and post-graduation employment, 4) provide increased opportunity for students to tailor their degree through a broader range of environmental science electives, and 5) ensure sufficient enrollment in upper division ENV courses. Based on exit surveys and advising interviews, 90-95% of students in the ENV major are taking seasonal and permanent positions during summer breaks and following graduation in fields of natural resource management and ecology, primarily forestry, wildland fire, and wildlife and fisheries. The career interests of our students are well matched to our program faculty's expertise, which is in the disciplines of ecology, wildlife, forestry, and environmental chemistry. Furthermore, we have taken a number of initiatives to develop cohesion, mentorship, community, and professionalism within our program. Our program faculty, student body, and curriculum are evolving and this CPC revision reflects the appropriate adaptations to this positive change.

Course Specific Changes:

Remove ENV275 (Careers in Environmental Sciences) and ENV475 (Professionalism and Job Readiness) from the curriculum and catalog. They will be replaced with a single new course ENV355 (Careers & Professionalism in Environmental Science.

Remove ENV214 (Watershed Science & Technology) from the curriculum. We are replacing this course in the required curriculum with the new course ENV217 (Introduction to Natural Resource Management).

Remove PHY221, PHY222, and PHY223 (General Physics w/ Calculus) from the curriculum. We are moving to a requirement of one term of physics as PHY201 General Physics.

Remove MATH252 (Integral Calculus) from the curriculum. This was only required as a prerequisite of PHY221 which is being removed.

Remove MATH362 (Statistical Methods II) from curriculum. It currently exists as an alternative to ENV434 (Advanced Data Analysis). Students will now be required to take ENV434 only. Students will now be able to take MATH362 as an upper division technical elective (see below). ENV434 is tailored to the specific applied skill sets that employers desire in our graduates utilizing discipline relevant examples, data sets, methods, and computer applications.

Remove CHEM331 (Organic Chemistry) from the curriculum. This was required as a prerequisite for CHEM315 (see below).

Add ENV217 (Introduction to Natural Resource Management) to the required curriculum.

Add PHY201 (General Physics) to the required curriculum as an alternative to PHY221 so that it reads PHY201 *or* PHY221. For the next few years we plan to offer PHY 201 only in alternating years and advise our students accordingly, in order to ensure robust enrollment in that course.

Add ECO202 (Principles of Macroeconomics) to the Social Science Requirement so that students may take ECO201 or ECO202. This will provide diversity and avoid scheduling conflicts.

Add WRI345 (Science writing) to the Communications Elective options in addition to WRI327 (Advanced Tech Writing) and WRI410 (Grant Writing). This will provide greater diversity of options for students and provide critical skill development for our students entering careers where science writing is an integral job duty and a priority for employers.

Add ENV108 (Mentorship & Team Building), ENV217 (Introduction to Natural Resource Management), and ENV355 (Careers & Professionalism in Environmental Science) to the required curriculum. ENV108 will be taken every fall by all students for a maximum total of 4 credits. ENV217 is replacing ENV214 in the curriculum. ENV355 is replacing ENV275 and ENV475 in the curriculum. The remaining 2 credits from this replacement are being added to the technical elective credit pool.

Add BIO354 (Environmental Health), BIO426 (Evolutionary Biology), CE374 (Hydrology), CE405 (Sustainability & Infrastructure), CE489 (Treatment Wetlands), CHEM331 (Organic Chemistry), ENV375 (Forest Ecology & Management), ENV420 (Externship in Environmental Science), ENV495 (Research in Environmental Science), MATH252 (Integral calculus), MATH362 (Statistical Methods II), PHY222 (General Physics w/ calculus), PHY223 (General Physics w/ calculus), PHY107, PHY207, PHY307, PHY407 as new upper division technical elective courses.

Remove CHE 341 (Instr Methods/Data Acqustn I), CHE 342 (Instr Methods/Data Acqustn II), ENV265 (Field Methods in Environmental Science), ENV336 (Environmental Hydrology), GEOG305 (Geomorphology), GEOG315 (Climatology & Atmospheric Science) from the Technical Electives list.

Change title, description and prerequisites of (CHEM315 Environmental Chemistry & Toxicology) and the description and prerequisites of CHEM465 (Fate & Transport of Pollutants). These courses will now form a more coherent series following the CHEM220 series. CHEM315 will now be titled Environmental Analytical Chemistry, while toxicology will become a separate course (not part of this CC proposal). CHEM315 will no longer have CHEM331 (Organic Chemistry) as a prerequisite (see above).

Change the title, description, prerequisites of ENV314 (Environmental Science Law and Policy) to better reflect and clarify the course's focus and content, avoid scheduling conflicts with other required coursework, and avoid prerequisite overrides for CE-ENV dual majors who were not required to take ENV275.

Change description and prerequisites ENV434 (Advanced Environmental Data Analysis) to create a purposeful series with ENV224 and ENV226.

Change title and prerequisites ENV485 (Ecoregional studies) to better reflect the course content and focus and avoid scheduling conflicts.

Non-course Specific changes:

Remove Ecology Elective. We will replace the general ecology elective with separate plant and wildlife elective requirements (see below). This will help ensure that students 1) take a diversity of upper division ecology courses in multiple fields of study 2) maximize qualifications for technical job series with federal and state agencies, 3) meet enrollment requirements for elective courses

Create Plant Elective which may be filled by ENV375 (Forest Ecology & Management), BIO367 (Plant Ecology), or BIO313 (Botany).

Create Wildlife Elective which may be filled by BIO377 (Wildlife Ecology) or BIO386 (Ornithology) or BIO 366 (Zoology).

Change Total Technical elective credits from 26 to 33 credits. This increase in technical elective credits will allow students to tailor and adapt their academic experience to meet their particular career interests and ensure greater enrollment in elective course offerings through strategic scheduling and increased demand.

Change total credits required from 183/184* (*the total credit number is 183 and 184 in Degree Works and the Catalog respectively) to 180, the typical number of credits required for programs at Oregon Tech. The ENV program does not have any accreditation requirements that necessitate a larger credit number for degree attainment.

Assessment/Accreditation Statement:

- The ENV program has no programmatic accreditation, so that is not applicable.
- We have revised our Programmatic Student Learning Objectives which we are integrating into our programmatic assessment. These curriculum changes will allow more effective assessment of PSLOs.

Financial Impact Statement:

- Adding 5-10 students per year in WRI 345 should have a favorable impact on the Communication Department, since it will help boost enrollment in courses that are related to their Professional Writing major, which as it starts up has had comparatively low enrollments that have made it difficult to offer them sometimes. Also, having some flexibility in which course a student takes may actually add a little flexibility for staffing, since once one course section is full, students can be directed to one of the other courses without interfering with their progress towards graduation.
- Adding PHY201 as an alternative to PHY221: For the next few years we plan to offer PHY 201 only in alternating years and advise our students accordingly, in order to ensure robust enrollment in that course
- Teaching BIO345 (Environmental Health), ENV355 (Careers and Professionalism in Environmental Science), ENV217 (Introduction to Natural Resource Management), ENV108 (Mentorship & Team Building), ENV420 (Externship in Environmental Science) can readily be met within current staffing levels in the Natural Sciences department. As stated previously,

having more choices for upper-division electives helps recruit and retain students. Strategic scheduling and advising will help ensure sufficient enrollment.

- The research courses (ENV 495) also will not change our staffing needs, and since they sometimes only have 1-2 students in them they will often not even qualify for faculty workload under current guidelines. Nonetheless, having this avenue for student research is important, for students, for faculty and for the university, and it may encourage externally sponsored research projects that will benefit the university financially.
- The externship courses (ENV 420) also will not immediately change our staffing needs, since in the near future they will have 5 or fewer students in them and will be offered as individual study courses, with minimal faculty workload under current guidelines. Nonetheless, having this avenue for students is important for students and for the university, and it may encourage external partnerships that will benefit the university financially.
- Adding CE prefix courses to the list of technical electives for ENV that we encourage students to take simply codifies something that already happens routinely and will reduce the number of course substitution forms that need to be written and further supports and advances our dual degree program.

Appendix B: BIO 212 Group Assignment

Name: _____ Lab Partners: _____

Laboratory

1

Rapid Ecological Study (RES) Project

Part I: An Introduction to the RES Project

The primary goal of this term project is for you to gain experience in the complete scientific process, including asking scientific questions, developing hypotheses that can be tested, devising a study design, performing research, and analyzing and presenting your results in written and oral form. During the course of this term project you and your group members will:

- Formulate a research question on a topic relevant to topics covered this term
- Do a background literature search
- Develop a study design
- Perform original group research in the field or lab
- Analyze your data
- Present your results via an oral group presentation AND an individual scientific paper

The unique aspect of this project is the intended length and scope of the project - RAPID. While research can often take months or years to complete, you will conduct your field or lab research over just a few hours. Similarly, many published scientific papers in ecology are over 5,000 words, however your papers will be only 500 words – yet they will contain all the typical aspects of a paper including abstract, introduction, methods, results, and discussion, plus one or two figures or tables.

In addition to your individual scientific paper, your group will present your project via a 15-minute PowerPoint talk. You will not only be evaluated by your instructor, but also by your peers; an essential part of science. All papers published in scientific journals are rigorously peer-reviewed. Therefore, you want your presentation to be interesting and engaging to your instructor and your peers. Furthermore, as a reviewer, you should provide constructive feedback to your fellow lab mates.

Part II: A Closer Look at the Steps of the Scientific Process

This portion of the lab will help you review the steps involved in the scientific process. Please carefully read through each step and complete the associated tasks.

***Step 1 – Developing a Research Hypothesis*:** Any scientific inquiry begins with an observation we are trying to understand and explain. Hypotheses are potential explanations for our observations in the natural world. In science, a hypothesis proposes a *relationship between factors called variables*. A good hypothesis relates an *independent variable* and a *dependent variable*. The effect on the dependent variable is determined by what happens when you change levels of the independent variable. For example, we might notice that in October, when the days become both shorter and colder, the leaves on the maple trees in our neighborhood change color. We might then predict that there is a relationship between temperature and/or daylight length (the independent variable) and leaf color (the dependent variable).

Once an idea for a hypothesis is reached, the next step is to frame the question. An effective research hypothesis must be both *testable* and *predictive*. There are several ways to satisfy this requirement. The first is to simply

describe the hypothesized relationship between the variables, which will inherently include a prediction, "As day length and nighttime low temperatures decrease, the leaves of maple trees change in color from green to yellow to red." Another way is to think of research hypotheses in terms of an if/then statement, "If there is a relationship between day length/air temperature and leaf color, then as day length and temperature decrease, leaf color will change."

Task 1.1 Working independently, or with a partner, examine the example topics below and write a hypothesis/prediction for each.

Topic 1: Effects of soil salinity on plant growth

Hypothesis 1:
_____

Topic 2: Bacterial growth and temperature

Hypothesis 2:
_____

Topic 3: Is the density of western juniper trees affected by wildfire?

Hypothesis 3:
_____

A helpful tip in the formulation of a hypothesis is to concentrate on the variables. Which variable are you observing? Which variable are you measuring? Can you control or manipulate one or the other in an experiment? In the leaf example, we observe that the colors of the leaves are changing. We hypothesize that this is due to temperature; therefore, our two variables are leaf color and temperature. Leaf color is the *dependent* variable because we hypothesize that it is affected by, and therefore, "dependent" on air temperature) and temperature is the *independent* variable.

Task 1.2 Return to the 3 topics from *Task 1.* This time, list the independent (x) and dependent (y) variables in your hypotheses.

Topic 1: Effects of soil salinity on plant growth

Independent Variable (x): _____ *Dependent Variable* (y) _____

Topic 2: Bacterial growth and temperature

Independent Variable (x): _____ *Dependent Variable* (y) _____

Topic 3: Is the density of western juniper trees affected by wildfire?

Independent Variable (x): _____ *Dependent Variable* (y) _____

Step 2 – Research What is Already Known About the Topic: This step is sometimes called a "literature review". Basically, you need to find out what other research has been conducted on the selected topic. A literature review is a valuable step in any research project. Not only does it provide you with greater knowledge on the topic,

but a literature review may also lead you to alter, or completely abandon your original hypotheses based on your findings. Lab 2 will be devoted to learning how to effectively search for reliable information using Oregon Tech excellent library services.

Step 3 – Develop a Study Design: A study design is a specific plan or protocol for conducting research. It allows the investigator (you) to translate the conceptual hypothesis into an operational one. At first, this can seem daunting, but go back and examine the hypotheses you wrote in *Step 1*. Write down the variables and think about *how* you will measure and/or observe them.

For example, in the leaf color/temperature/day length project, we would need to select a population of trees (say maple trees on campus) and record the color of the leaves on each tree for a set period (say every Monday for the months of September and October). Additionally, we would need a record of temperature and day length for that same period. We could acquire these from a known weather station or take the ambient air temperature ourselves. Another helpful way to formulate your study design is to think about how you will record your data by creating a draft field data form similar to one below which also lists one day worth of data from 3 individual trees:

date	daylight (min)	tree	leaf color
15-Sep	749	1	green
15-Sep	749	2	green
15-Sep	749	3	green
22-Sep	730	1	green
22-Sep	730	2	yellow
22-Sep	730	3	green
29-Sep	710	1	yellow
29-Sep	710	2	yellow
29-Sep	710	3	green

Task 3.1 Create the top row of a field data form based on the variables you hypothesized to be related (simply write the data you would collect in a row format).

Topic 1 Data:

Topic 2 Data:

Topic 3 Data:

Step 4 – Perform Original Research in the Field in or Lab: During this step, you go out in the field, or into the lab to collect your observations (data). Prior to heading out into the field, you need to be sure that you have a firm handle on your study design. How are you going to collect the data? Is your group going to meet and collect it together? Do you need to set up transportation? What sort of equipment might you need to most efficiently make use of your field and/or lab time? In the temperature/leaf example, there is no special equipment required beyond a notebook and pencil to write down your observations.

Task 4.1 Make a list of any equipment that might be required for each of the research project topics.

Topic 1 Equipment:

Topic 2 Equipment:

Topic 3 Equipment:

Step 5 – Analyzing the Data. This step can be daunting for many, fun for others. This is where you get to examine the data you collected and look for relationships between your variables. This can be in the form of simple summary tables and graphs, or more complex if you are so inclined to run some statistical analyses.

Task 5.1 Examine the sample data from the hypothetical leaf color/temperature/day length project below and think about the best way to display these results, keeping in mind the original research hypothesis: "As day length and nighttime low temperatures decrease, the leaves of maple trees change in color from green to yellow to red." Are we looking for trends? Comparing means? What do we need to do first?

date	daylight	tree	leaf color
15-Sep	749	1	green
15-Sep	749	2	green
15-Sep	749	3	green
22-Sep	730	1	green
22-Sep	730	2	yellow
22-Sep	730	3	green
29-Sep	710	1	yellow
29-Sep	710	2	yellow
29-Sep	710	3	green
6-Oct	690	1	yellow
6-Oct	690	2	yellow
6-Oct	690	3	yellow
13-Oct	677	1	yellow
13-Oct	677	2	red
13-Oct	677	3	yellow
20-Oct	652	1	red
20-Oct	652	2	red
20-Oct	652	3	yellow
27-Oct	633	1	red
27-Oct	633	2	red
27-Oct	633	3	red

Step 6 – Communicate Your Results*.* The last step in the scientific process is to communicate your results. There are two major ways that scientific information gets communicated among colleagues and the general public. The first is an oral presentation, often conducted during a conference gathering of scientists with similar interests (The

Ecological Society of America, for example). The second is a written publication in a peer-reviewed scientific journal. For the RES project, your group will synthesize everything you have done into a brief, yet informative, *collaborative oral presentation* AND an *individual 500-word maximum scientific paper.*

Oral Presentation Pointers:

- one message per slide
- use slides as props for you to deliver your message, not the other way around
- the most important part of your slide should be the biggest
- use contrast to focus the viewer's attention and a black slide background
- no more than six objects per slide
- talk ***to*** your audience, ***not the screen***

While your oral presentation will be a collaborative effort, your written report will be completed individually. Your paper will be concise yet include each of the following *eight key aspects of a successful scientific paper*:

1. *Title:* Strive for a concise, yet informative title that lets the reader know what the paper is about.

2. *Abstract*: This is a very brief summary of the entire paper. It should include a sentence that states the research question and why it is important to the larger topic being studied; a sentence describing the methods; one or two sentences about your results; and a concluding sentence. It should be very brief concise. Citations do not belong in the abstract.

3. *Introduction*: This section establishes the context for your research. Open with the larger importance of the topic you are studying, i.e. why should the reader care about this topic. Then briefly summarize current knowledge, i.e. your literature review. You should cite your references in this section. Then point out how your research fits into the larger picture, i.e. what is important about your project. Then state your research question and hypothesis. In essence, an introduction starts "big" introducing your general field of research and works down to how your specific study fits into that large picture. This is the opposite of your discussion (see hourglass figure below).

4. *Methods*: This section explains how you did your research. It should have enough detail to allow a reader to replicate your study. Use an active voice – "we counted plants", not "plants were counted". You do not need to mention small details, such as the type of pencil you used, who recorded the data, etc- just the core methods that would be most important to someone trying to read your paper and replicate your study.

5. *Results*: These are the results of your analysis of your data. *DO NOT* report raw data! Report your core findings only. You will refer to your figure or table in this section too. For example: "We found 50% more plants at site 1 (Figure 1)." This lets the reader know they should refer to figure 1 in your paper for a visual representation of your findings.

6. *Figure or Table*: You must include at least one figure or table in your paper. Figures and tables should ***summarize*** your data and emphasize your key result. They should not show raw (summarized or unanalyzed) data. Figures and tables should also include a caption. A figure caption goes below the figure, while a table caption goes above the table. A caption should completely describe the figure or table. In other words, the reader should be able to read the caption and know what it means. Therefore, you should include where and when the data was collected.

7. *Discussion*: Begin this section by reiterating your key results using short summarizing statements, but do not report hard numbers or statistics. Then state the significance of your results to the larger field of study to which your research applies. If your results were not as you expected (did not support your hypothesis) discuss why that may be. Was it your methods? Study sites? The time of year? Etc. Finally, mention possibilities for future research. In contrast to the introduction, a discussion starts "small" with the results of your single study and shows its

importance to the larger field of study your research is part of. You will also cite other studies in this section, such as papers that had similar results and thus support your study, or papers that found different results. In the latter case you may discuss why your studies differed.

8. *Literature Cited*: Here you will list all the papers you cited within your RES report in alphabetical order. We will use the official format and style of the Ecological Society of America (ESA) which publishes numerous professional journals in the field of ecology. ESA style formatting is as follows:

- *Internal Citations* are those where you are citing information within the body of your paper. These sorts of citations are used to back up *any statement of fact*. If your source is from a single author, it simply includes the author's last name and the year of the publication and would look like this: (Barrow 2000). Citations of a paper authored by two researchers: (Leu and Murray 2006). Citations of papers where more than two authors contributed lists the first author's name, followed by "et al" and the year: (Schoustra et al. 2005). If you make a statement that is supported by more than one source, you separate *each source* with a comma (Barrow 2000, Leu and Murray 2006, Dettman et al. 2007). No page references are included in internal citations.

- *Citation List* is the full list of all sources that you cited throughout your paper. Only list those sources that you cite. Below is the format for citing various types of sources:

  Books
  Last Name, First Name Initial. Second Initial. Year of Publication. Italicize book title: capitalize only the first word (no capitalization after a colon). Publisher's name, City, State, Country.

  Futuyma, D. J. 2009. Evolution. Second edition. Sinauer Associates, Sunderland, Massachusetts, USA.

  Book Chapter
  Last Name, First Name Initial. Second Initial. Year of Publication. If applicable provide title of chapter in book: Capitalize only first word or proper nouns. "Pages" number to number in (italicize) First initial. Second initial. Last Name, editor(s). Italicized title of book title. Publisher's name, City, State, Country.

  Abrams, P.A., B.A. Menge, and G.G. Mittelbach. 1995. The role of indirect effects in food webs. Pages 371-395 in G. Polis and K.O. Winemiller, editors. Food webs: integration of patters and dynamics. Chapman and Hall, New York, New York, USA.

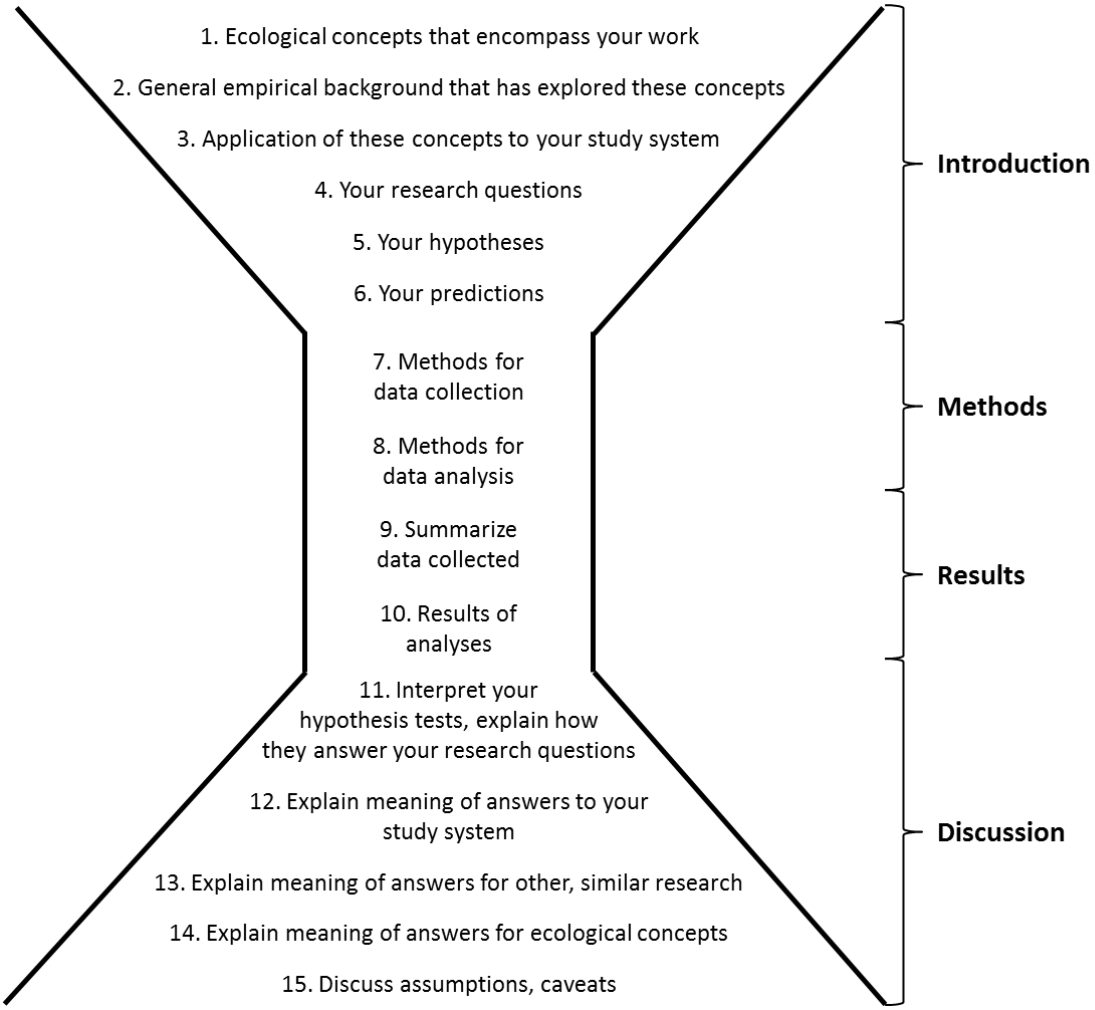
  Article in Peer-Reviewed Journal
  Last Name, First Initial. Second Initial. Year of publication. Title of article. Italicized Title of Journal. Volume number in bold: page or pages with no space between colon.

  Allison, S. D., C. A. Hanson, and K. K. Treseder. 2007. Nitrogen fertilization reduces diversity and alters community structure of active fungi in boreal ecosystems. Soil Biology and Biochemistry 39:1878–1887.

  Article in Online Journal (web only)
  Last Name, First Initial. Second Initial. Year of publication. Title of article. Italicized Title of Journal. Volume number in bold: page or pages with no space between colon. Follow volume number with web link address. No period after web link for online journal, but include period after doi or http address.

  London, J. M., J. M. Ver Hoef, S. J. Jeffries, M. M. Lance, and P. L. Boveng. 2012. Haul-out behavior of harbor seals (Phoca vitulina) in Hood Canal, Washington. PLoS ONE 7:e38180.

Illustrated in the figure below is a helpful way to organize your thoughts when constructing your research project; especially in the organization of your paper. The scientific process goes from a broad concept about your topic and narrows when we formulate our hypothesis. Our focus then becomes very specific while we collect and analyze our data but begins to broaden back out as we draw conclusions and relate our findings to the broader body of knowledge on the topic.



Part III: Effective Group Work

What are the benefits of group work? We've all heard the axioms, "More hands make for lighter work."; "Two heads are better than one."; "The more the merrier." These adages speak to the potential groups have to be more productive, creative, and motivated than individuals on their own. Group projects can help you develop a host of skills that are increasingly important in the professional world such as planning and managing time, developing strong communication skills, sharing diverse perspectives, and learning to delegate. Moreover, positive group experiences have been shown to contribute to student learning, retention and overall college success.

Often times however, working in a group leads to a host of frustrating experiences including a lack of coordination among members regarding schedules, difficulty making collective decisions, resistance to the integration of all members, etc. One of the most common sources of frustration in collaborative work involves the various motivation levels of group members. Free riders may leave all more most of the work to a few diligent individuals, which erodes

the long-term motivation of hard-working students. In contrast, domineering students may take over all tasks, disregarding input from other members and thereby further encouraging free riders to do even less.

Task. List below positive and negative aspects of group work based on your previous experiences. Then brainstorm strategies for preventing or mitigating potentially negative aspects of group work.

Positive Aspects

Negative Aspects	
Problem	*Solution*
One student didn't do any work! I had to do everything or get an F!	*I could work to establish clear expectations of group members ahead of time by setting ground rules, or creating a "contract" I could improve my communication and conflict resolution skills.*

While group work can be extremely challenging, it has tremendous payoffs in your ability to develop key skills important for success in college, your future career and life in general including the ability to:

- break complex tasks into parts and steps
- plan and manage time
- refine understanding through discussion and explanation
- give and receive feedback on performance
- challenge assumptions
- develop stronger communication skills.
- tackle more complex problems than you could on your own
- delegate roles and responsibilities
- share diverse perspectives
- pool knowledge and skills
- hold one another (and be held) accountable
- receive social support and encouragement to take risks
- develop new approaches to resolving differences
- establish a shared identity with other group members
- find effective peers to emulate
- develop your own voice and perspectives in relation to peers

In order to mitigate some of the challenges mentioned above and to help your group get off to a good start this

quarter, we are going to complete the following exercises:

1. *Inventory Your Situation and Skills* – completing the situation and skills inventory below will help you objectively examine what you can best contribute to group work and assist you in forming a group of compatible individuals.

Major	
Course Load	
Live on or off campus?	
Outside Employment (hours/week)	
For each skill area below, rate yourself on a scale of 1-4 where: *4 = skilled or experienced – likely well above average* *3 = reasonably skilled or experienced – likely above average* *2 = some skill or experience – likely below average* *1 = little or no experience – likely well below average*	
General Organization	
Time Management	
Taking Notes	
Communication Skills	
Brainstorming Ideas	
Observation Skills (e.g., patient, careful)	
Data Collection Skills (e.g., neat writing, organization)	
Field Skills (e.g. navigating, comfortable outside)	
Laboratory Skills (e.g., microscope use, measuring, etc)	
Spreadsheet Use (ms excel or google sheets)	
Presentation Ability (e.g., conveying results, speaking, etc.)	
Writing Ability	
Visually Creative	

2. *Group Formation* – considering the information you provided above, please form a project group of 3 students (depending on the class size there may be one group that is comprised of 2 or 4 members, but a lab section cannot have more than 8 total project groups). When forming your group consider the following:
    a. *Your Academic Major* – try to form your groups around similar majors as this might eliminate potential coordination conflicts. Presumably, if you are in the same major, your schedules might be easier to coordinate. Similarly, athletes on the same team might try to form groups as your schedules are even tighter, but long travel might present opportunities for project meetings.
    b. *Your Compatibility* – if you know other students and have a history of working or studying well together, try to include them in your project group. If you don't know anyone, perhaps attempt to work with other students who share a similar life situation as you (e.g., lives off campus and works 20 hours/week).
3. *Group Roles* – building on the information you provided in your skills inventory above, complete the group roles sheet provided by your instructor. This assessment will help you get an idea of what each member of your group can contribute to a successful term project.
4. *Group Contract* – thinking back to the exercise on page 8 regarding your previous experiences with group work, complete the group contract sheet provided by your instructor. This should help your group proactively discuss some of the common challenges of collaborative work and agree to a set of common solutions.

Part III: Specific Requirements and Due Dates for the RES Project

The following sections outlines in detail what is required of you to successfully complete the RES project this term. Included are a timeline of due dates and a list of specific requirements for portion of the project.

Overview of RES Project Requirements and Due Dates

Week	Due Date	Type of Submission	Part Due (% of total RES grade)
1	end lab period 7 or 9 Jan	Group via hard copy to instructor	Group Roles and Group Contract (5%)
2	11:59pm on 14 or 16 Jan	Group via Canvas	General Subject of Project and Key Search Words (5%)
3	11:59pm on 21 or 23 Jan	Group via Canvas	Library Lab Exercises and List of Sources (5%)
4	11:59pm on 28 or 30 Jan	Group via Canvas	Research Hypothesis, Task List, and Timeline for Completing Project (5%)
5	11:59pm on 4 or 6 Feb	Group via Canvas	Study Design, Data Collection Sheet, and Needed Equipment (5%)
6	11:59pm on 11 or 13 Feb	Individual via Canvas	Draft of the Introduction Section of Your Paper (5%)
7	11:59pm on 18 or 20 Feb	Group via Canvas	Raw Data and Preliminary Data Analysis (5%)
8	11:59pm on 25 or 27 Feb	Group via Canvas	Preliminary Presentation Slides (5%)
9	during lab on 3 or 5 Mar	Group via presentation	Oral Presentations and Peer Review (30%)
10	11:00am on 10 or 12 Mar	Individual via Canvas	Final Paper (30%)

Detail of Required Aspects of Each Project Submission

Week 1: Group Roles and Group Contract
Due: end of the lab period on 7 or 9 Jan (depending on your assigned lab day) as a hard copy – ***group submission***
What to Include: Hard copies of the worksheets examining group roles and contractual agreements completed by all group members.

Week 2: General Subject of Project and Key Search Words
Due: 11:59 pm on 14 or 16 Jan (depending on your assigned lab day) to Canvas - ***group submission***
What to Include: While we don't have a formal lab scheduled for this week, this is time we have set aside for your group to meet. During this meeting your group should accomplish the following: 1) narrow down your potential research topics to **two** using the handout posted on Canvas titled, "RES Topic List"; 2) construct a list of 3-5 key

words for both of your potential topics; 3) begin thinking and planning how you would carry out the details of each project so you can discuss this with your instructor during week 3's lab period.

Week 3: Library Lab Exercises and List of Sources
Due: 11:59 pm on 21 or 23 Jan (depending on your assigned lab day) on canvas – ***group submission***
What to Include: the completed exercises from the library lab with Alla Powers.

Week 4: Research Hypothesis, Timeline for Completing Project, and Task List
Due: 11:59 pm 28 or 30 Jan (depending on your assigned lab day) on Canvas - ***group submission***
What to Include: Please include all of the following components for an effective start to your project and full credit:

1. a statement of your research hypothesis
2. your independent variable and dependent variable
3. timeline of **when** you will:
    a) perform your field or lab research
    b) summarize/analyze your data
    c) create your presentation
    d) write your paper
4. a list of tasks that need to be completed in order for your group to remain on schedule and who will accomplish those tasks (e.g., need to research how other scientists have measured these variables and decide if those methods will work for us; need to look into equipment and lab availability, etc).

Note that some of these activities will likely take place over more than one day. Also, if you plan to divide some of the tasks among group members, make sure to be clear about who is responsible for each component.

Week 5: Study Design, Data Collection Sheet, and Needed Equipment
Due: 11:59 pm 4 or 6 Feb (depending on your assigned lab day) on Canvas – ***group submission***
What to Include: 1) Explain *how* you plan to collect your data. For example, with the leaf color project used throughout this handout, you might write, "We are going to observe the leaf color of 5 maple trees on the Oregon Tech campus. We will visit each tree once per week and record on the enclosed data sheet the dominant color (e.g., color comprises >50% of tree's leaves) of each tree's foliage. We will acquire the photoperiod of each observation day from known day lengths for Klamath Falls posted on www.noaa.com."; 2) provide a list of the variables you plan to record; 3) a list of any equipment you plan to use during the data collection process

Week 6: Draft of the Introduction Section of Your Paper
Due: 11:59 pm 11 or 13 Feb (depending on your assigned lab day) on Canvas – **INDIVIDUAL SUBMISSION**
What to Include: 1) a brief, two paragraph maximum, draft of your introduction section; 2) a list of any sources you cited in your introduction formatted according to the instructions outlined in this document.

Begin by reexamining "Step 6 – Communicate Your Results" beginning on page 4 of this document to refresh your memory on what constitutes an effective introduction to a scientific paper. Pay particular attention to the hourglass figure noting that introductions begin by describing the broad ecological concept you are studying and end with your hypothesis statement. Be sure to cite your sources as described in the "literature cited" portion of step 6 in this document.

Week 7: Raw Data and Preliminary Data Analysis
Due: 11:59pm 18 or 20 Feb (depending on your assigned lab day) on Canvas - ***group submission***
What to Include: 1) a digital copy of your data entered into an excel spreadsheet; 2) at least one summary figure or table of your data. This could be a histogram, scatterplot graph, etc. The table should NOT be your raw data!

Week 8: Preliminary Presentation Slides
Due: 11:59 pm 25 or 27 Feb (depending on your assigned lab day) on Canvas - ***group submission***
What to Include: A preliminary copy of your PowerPoint slides, saved as a pdf and submitted on blackboard (one per group). This does not need to be a fully complete presentation. However, we recommend that you at least have an outline of what content each slide will cover, for example which slides will be introduction, methods, results, and conclusions. The more complete your presentation is, the better feedback you will receive. Your presentation will follow a similar format as your paper but can include additional images such as photographs of your research, figures from other studies, or even videos or audio recordings.

Weeks 9 and 10: Oral Presentation & Peer Reviews
Due: during your assigned lab day during the presentation slot your signed up for.
What to Include: Your presentation should use PowerPoint or google slides. All group members should participate in the oral presentation; you may switch back and forth among members during the presentation, or each person may take a different part of the talk to present. A general rule of thumb is to plan to cover one slide per minute during a presentation, except for slides that are merely transitional, or you are certain you will only spend a few seconds talking about. Your presentation will be evaluated by your instructor and your classmates. ***Everyone will provide individual peer-review of group oral presentations. Your instructor will provide you with a rubric in lab. It is important to give constructive comments. Reviews will be counted toward the grade of the student providing the review.***

Week 10: Final RES Report
Due: 11:00 am on 10 or 12 Mar (depending on your assigned lab day) on Canvas – **INDIVIDUAL SUBMISSION**
What to Include: 1) Each **individual** in the group will write their own paper. While you may work together and collaborate, your writing should be your own – do not simply copy and paste one of your group members writing, that is plagiarism. Your paper will contain the ***eight key parts of a scientific paper*** outlined in **Section II**; ***Step 6*** of this handout. Each section should have a heading on its own line. Your paper should be a maximum of 500 words, not including the title, names, figure or table legend, and literature cited. The goal here is to be as clear and concise as possible.

Appendix C: Teamwork Rubric

Essential Student Learning Outcome Rubric – Teamwork

ESLO 4 Teamwork:
Oregon Tech students will collaborate effectively in teams or groups.

Definition
Teamwork encompasses the ability to accomplish group tasks and resolve conflict within groups and teams while maintain and building positive relationships within these groups. Team members should participate in productive roles and provide leadership to enable an interdependent group to function effectively.

Performance Criteria	Capstone Level (4) The following are achieved *without prompting* from instructor:	Practice Level (3)	Foundation Level (2)	Pre-Foundation Level (1)	Pre-Foundation Level (0)
Identify and achieve goal/purpose	• When appropriate, realistic, prioritized and measurable goals are agreed upon and documented. • All team members share the common objectives/purpose. • Team achieves goal.	• When appropriate, realistic, prioritized and measurable goals are agreed upon and documented. • All team members share the common objectives/purpose. • Team achieves goal.	• Group shares common goals and purpose. • Few priorities are unrealistic or undocumented. • Group achieves goal.	• Individuals share some goals but a common purpose may be lacking. • Priorities may be unrealistic and documentation may be incomplete. • Group may not achieve goal.	• Clear goals are not formulated or documented; thus all members don't accept or understand the purpose/task of the group. • Group does not achieve goal.
Assume roles and responsibilities	• Members consistently and effectively fulfill roles and responsibilities. • Leadership roles are clearly defined and/or shared. • Members move team toward the goal by giving and seeking information or opinions, and assessing ideas and arguments critically. • Members are all self-motivated and complete assignments on time. • Most members attend all meetings. • Members reflect on group processes, provide feedback to other group members and make changes as necessary.	• Members consistently and effectively fulfill roles and responsibilities. • Leadership roles are clearly defined and/or shared. • Members move team toward the goal by giving and seeking information or opinions, and assessing ideas and arguments critically. • Members are all self-motivated and complete assignments on time. • Most members attend all meetings. • Members reflect on group processes, provide feedback to other group members and make changes as necessary.	• Members often fulfill roles and responsibilities. Leadership roles are generally defined and/or shared. • Generally, members are motivated and complete assignments in a timely manner. • Many members attend most meetings.	• Some members may not fulfill roles and responsibilities. • Leadership roles are not clearly defined and/or effectively shared. • Some members are not motivated and some assignments are not completed in a timely manner. • Meetings rarely include most members.	• Members do not fulfill roles and responsibilities. • Leadership roles are not defined and/or shared. • Members are not self-motivated and assignments are not completed on time. • Many members miss meetings. • Members continue processes that prove nonfunctional.

Oregon TECH

Essential Student Learning Outcome Rubric – Teamwork

Performance Criteria	Capstone Level (4) The following are achieved *without prompting* from instructor:	Practice Level (3)	Foundation Level (2)	Pre-Foundation Level (1)	Pre-Foundation Level (0)
Communicate effectively	• Members always communicate openly and respectfully. • Members listen to each other's ideas. • Members support and encourage each other. • Communication patterns foster a positive climate that motivates the team and builds cohesion and trust.	• Members always communicate openly and respectfully. • Members listen to each other's ideas. • Members support and encourage each other. • Communication patterns foster a positive climate that motivates the team and builds cohesion and trust.	• Members usually communicate openly and respectfully. • Members often listen to most ideas. • Members usually support and encourage each other.	• Members may not consistently communicate openly and respectfully. • Members may not listen to each other.	• Members do not communicate openly and respectfully. • Members do not listen to each other. • Communication patterns undermine teamwork
Reconcile disagreement	• All members welcome disagreement and use difference to improve decisions. • All members respect and accept disagreement and employ effective conflict resolution skills. • Subgroups absent.	• All members welcome disagreement and use difference to improve decisions. • All members respect and accept disagreement and employ effective conflict resolution skills. • Subgroups absent.	• Many members welcome disagreement and use difference to improve decisions. • Most members respect and accept disagreement and work to account for differences. • Subgroups rarely present.	• Few members welcome disagreement. Difference often results in voting. • Some members respect and accept disagreement and work to account for differences. • Subgroups may be present.	• Members do not welcome disagreement. • Difference often results in voting. Subgroups are present.
Share appropriately	• All members contribute significantly to discussions, decision making and work. • The work product is a collective effort; team members have both individual and mutual accountability for the successful completion of the work product.	• All members contribute significantly to discussions, decision making and work. • The work product is a collective effort; team members have both individual and mutual accountability for the successful completion of the work product.	• Many members contribute to discussions, decision-making and work. • Individuals focus on separate sections of the work product, but have a coordinator who ties the disparate parts together (they rely on the sum of each individual's work).	• Contributions are unequal although all members contribute something to discussions, decision making and work. • Coordination is sporadic so that the final work product is of uneven quality.	• Contributions are unequal. • Certain members dominate discussions, decision making, and work. • Some members may not contribute at all. • Individuals work on separate sections of the work product, but have no coordinating effort to tie parts together.

Oregon TECH

Essential Student Learning Outcome Rubric – Teamwork

Performance Criteria	Capstone Level (4) The following are achieved *without prompting* from instructor:	Practice Level (3)	Foundation Level (2)	Pre-Foundation Level (1)	Pre-Foundation Level (0)
Develop strategies for effective action	• Members use effective decision making processes to decide on action. • Group shares a clear set of norms and expectations for outcomes. • Group reaches consensus on decisions and produces detailed plans for action.	• Members use effective decision making processes to decide on action. • Group shares a clear set of norms and expectations for outcomes. • Group reaches consensus on decisions and produces detailed plans for action.	• Members usually use effective decision making processes to decide on action. • Most of the group shares norms and expectations for outcomes. • Group reaches consensus on most decisions and produces plans for action.	• Members sometimes use decision making processes to decide on action. Some of the members of the group do not share norms and expectations for outcomes. Group sometimes fails to reach consensus. Plans for action are informal and often arbitrarily assigned.	• Members seldom use decision making processes to decide on action. • Individuals often make decisions for the group. • The group does not share common norms and expectations for outcomes. • Group fails to reach consensus on most decisions. • Group does not produce plans for action.
Cultural Adaptation	• Members always recognize and adapt to differences in background and communication style.	• Members always recognize and adapt to differences in background and communication style.	• Members usually recognize and adapt to differences in background and communication style.	• Members may recognize, but do not adapt to differences in background and communication style	• Members do not recognize differences in background or communication style.

Essential Student Learning Outcome Rubric – Teamwork

Each color highlights the criteria that must be met for a particular level of achievement. For example, a Practicing course would require Proficiency in the Recognize, Know and Understand criteria.

<u>KEY</u>

Yellow – Foundation Level
Blue – Practice Level
Green = Capstone Level

If satisfies Level 2, 3 or 4
Y = Yes, N = No
If below Level 2 place checkmark where team/group resides