Oregon TECH

2021-22
Environmental Sciences Assessment Report
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for Natural Science Department Chair Nate Bickford

Contents

Section 1 – Program Mission and Educational Objectives

Program Mission

The Bachelor of Science program in Environmental Sciences (BES) 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, and the Nature Conservancy.

Mission Alignment

The BES program mission closely aligns with the Oregon Tech mission: *Oregon Institute of Technology (Oregon Tech), Oregon's public polytechnic university, offers innovative, professionally-focused undergraduate and graduate degree programs in the areas of engineering, health, business, technology, and applied arts and sciences. To foster student and graduate success, the university provides a hands-on, project-based learning environment and emphasizes innovation, scholarship, and applied research. With a commitment to diversity and leadership development, Oregon Tech offers statewide educational opportunities and technical expertise to meet current and emerging needs of Oregonians as well as other national and international constituents.*

Our students experience active and applied learning in natural environments. They develop the collaboration and communication skills necessary to work on diverse teams to address environmental issues. Many students participate in research with faculty and agency partners (Table 1). Further, BES faculty and students engage with professional communities through publications and conference presentations (Table 2). These research and scholarly activities are in direct alignment with Pillars II & III of Oregon Tech's strategic plan which state:

> Pillar II COMMITMENT TO INNOVATION: Oregon Tech strives to be entrepreneurial and on the leading edge of student engagement, innovative teaching, and collaborative research.
>
> Pillar III COMMITMENT TO COMMUNITY: Oregon Tech is an active member of the communities that it serves. Students, faculty, and staff are encouraged to contribute to their physical, professional, scholarly, and social communities via leadership and active participation through their academic and professional expertise.

Table 1: Environmental Science faculty and student research projects 2021-2022.

Project	PIs	Agency Partners	Grants or gifts in kind	Number of OT students
Carnivore Study – tracking large and meso carnivores around campus	Jherime Kellerman – NSC	Forest Service	10 game cameras with new rechargeable batteries and SD cards from the Forest Service	3
Halictidae Study – monitoring native bees and Apis mellifera on campus. Students are curating an entomological collection and contributing to the Oregon Bee Atlas project. Pollen collection for Bee O Diversity projects.	Christy VanRooyen - NSC Terri Torres - MATH	Bee O Diversity Oregon State University Department of agriculture Klamath Basin Beekeeping Association Oregon State Beekeeping Association	Pollen traps from Bee O Diversity Field entomological collection boxes from Oregon State Provost Innovation Grant $11,000 Bee Packages and use of honey spinner from Klamath Basin Beekeeping Association	4
Forest Fire Air Quality Research – this study is examining increased hospital burden with smoke from forest fires. Current research will be expanded from the Rouge Valley to include the Klamath Basin and examine the chemical composition of particulate matter in 2022. Additionally, this grant will fund the initial establishment of the Center for Advancing Interdisciplinary Research on the Environment and Health (AIRE Center) here at Oregon Tech.	Addie Clark - NSC Kyle Chapman - PHM Kerry Farris - NSC	U.S. Health Resources and Services Administration (HRSA) Rogue Valley Hospitals	$1,000,000 HRSA allocation of funds. Provost Creativity Grant $27,000	5

Project	PIs	Agency Partners	Grants or gifts in kind	Number of OT students involved
Air Quality Monitoring - examining air quality changes in the Klamath Basin related to woodstove change outs, COVID 19, and forest fire activity.	Addie Clark - NSC	Department of Environmental Quality Klamath County Public Health	Provost Creativity grant $8,800	4
Klamath Falls City Parks Department- established a system of permanent vegetation monitoring plots in Moore Park. Provide the city with vegetation metrics that can help inform their management, in particular with fuels reduction.	Kerry Farris - NSC	Klamath Falls City Parks Department	Summer Creativity Grant	2
Western Yellow Rail migration using stable isotopes.	Jherime Kellerman - NSC	US Fish and Wildlife Service Bureau of Land Management	$3000	1
Avian response to riparian restoration, Cascade-Siskiyou National Monument.	Jherime Kellerman - NSC	Bureau of Land Management	4-year Cooperative agreement - $12,000 in year 1	1

Table 2: Environmental Science faculty and student publications and conference proceedings.

BES Publications and Conference Proceedings

Environmental Science faculty names in bold and *identifies student name.

- Chapman, K.; **Clark, A.E.**; **Farris, K**. and Sarah Fitzpatrick. *In Press. Fires, Respiratory Hospitalizations, and Capacity Issues.* Pp. xx-xx in Dalton, M., and E. Fleishman, editors. 2023. Sixth Oregon Climate Assessment. Oregon Climate Change Research Institute, Oregon State University, Corvallis, Oregon.

- **Clark, A. E.;** O'Malley, K. *; Ossowski, C. * *Effects of COVID-19 Related "Stay-At-Home" Orders on Rural Atmopsheric Particulate Matter (Presentation)* • Spring National Meeting of the American Chemical Society (ACS) 2022, Mar. 20-24
    - ***Also given as a poster at *Sci-Mix***
- **Clark, A. E.;** Ossowski, C. * *Effect of Woodstove Changeouts on PM2.5 in Rural Southern Oregon (Presentation)* • Spring National Meeting of the American Chemistry Society (ACS) 2022, Mar. 20-24
    - Also given as a poster at *Sci-Mix*
- Chapman, K.; **Clark, A. E.; Farris, K.**; Fitzpatrick, S. *Helping Hospitals Predict Capacity Issues: Using State Agency Data to Examine the Relationship Between PM2.5 and Respiratory Hospitalizations in Southern Oregon (eLightning)* • American Geophysical Union (AGU) 54th Annual Fall Meeting, Dec 12–16
- Chapman, K.; **Farris,K.** and **Clark, A. E.** *Drought, wildfires, air quality, and respiratory hospitalizations in Southern Oregon (Presentation).* Pacific Northwest Drought and Public Health Workshop. Portland, OR 2022, Oct 19-20.
- **Clark, A. E.;** O'Malley, K. *; Ossowski, C. * *Effects of COVID-19 Related "Stay-At-Home" Orders on Rural Atmopsheric Particulate Matter (Poster)* • American Geophysical Union (AGU) 54th Annual Fall Meeting, Dec 12–16
- **Kellermann, J. L**. 2021. *The knowledge of rails and waterthrush: Observer value and information content in Oregon's rare bird populations.* Oregon Birds 47(2), 107-110
- **VanRooyen, C**. editor. *OIT: CHE 101 - Introduction to General Chemistry*. 2021. Open educational text for introductory chemistry.
- **VanRooyen, C.** *Improved Teaching a Symptom of COVID 19 (Presentation).* • American Chemistry Society (ACS) Biennial Conference on Chemical Education 2022, Jul. 31 - Aug. 4.
- Corzatt, L.; **VanRooyen, C.;** Schmerbach, D. *Bee School – an introduction to bee keeping (presentation)* • Klamath Basin Beekeeping Association class. 2022, March 18th-19th.

Section 2 – Program Student Learning Outcomes

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

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

PSLOs are reviewed annually to maintain relevance in a rapidly evolving job market. Our agency partners advise on essential skills and desired qualifications to ensure that our graduates are successful on the job.

Section 3 – Curriculum Map

Table 3: Mapping of ISLOs and PSLOs to the environmental science curriculum. Level of application: F – Foundational P – Practicing C - Capstone

University	**ISLO 1 - Communication**	**ISLO 2 – Inquiry & Analysis**	**ISLO 3 – Ethical Reasoning**	**ISLO 4 – Quantitative Literacy**	**ISLO 5 - Teamwork**	**ISLO 6 – Diverse Perspectives**		
Program	**PSLO 6**	**PSLO 4**	**PSLO 3**	**PSLO 4**	**PSLO 2**	**PSLO 2**	**PSLO 1**	**PSLO 5**
COURSE								
BIO 211							F	
ENV 111						F	F	
GIS 103								F
GEOG 105								F, P
ENV 108					F, P			
BIO 212					P		F	
GIS 134							F	F
GIS 205							P	P
MATH 111				F, P				
WRI 121	F							
BIO 213							F	
MATH 112				F, P				
CHE 221-223		F		P				
ENV 217			F			F		
MATH 251				F				
SPE 111	F							
SPE 321					F, P			

University	ISLO 1 - Communication	ISLO 2 – Inquiry & Analysis	ISLO 3 – Ethical Reasoning	ISLO 4 – Quantitative Literacy	ISLO 5 - Teamwork	ISLO 6 – Diverse Perspectives		
Program	**PSLO 6**	**PSLO 4**	**PSLO 3**	**PSLO 4**	**PSLO 2**	**PSLO 2**	**PSLO 1**	**PSLO 5**
COURSE								
ENV 224		F	P				P	
ECO 201 or 202				F				
ENV 226	P	P					P	
ENV 355			P			P	C	
MATH 361		P						
ENV 314			P					
CHE 315		P		P				
ENV 434		C						
PHY 201							F	
CHE 465		P		P				
Plant elective					C		P	
Wildlife elective								C
WRI 227	P							
ENV 484			C		P			
ENV 485		C						
ENV 495	C	C						C
Writing elective	P							

Section 4 – Assessment Cycle

The assessment cycle was revised this year to better align program specific learning outcome assessment with institutional learning outcome assessment.

Table 4: BES assessment cycle 2021-2024. Level of application: F – Foundational P – Practicing C - Capstone

ISLO	PSLO	2021-2022	2022-2023	2023-2024
Communication	**PSLO 6**	BIO 212L – general biology lab - F ENV 307 – water resources - P Surveys given at ENV Project Symposium Exit Interviews - C		
Inquiry & Analysis	**PSLO 4**			ENV 226 ENV 434 Exit Interviews
Ethical Reasoning	**PSLO 3**	ENV 355 - Careers in Environmental Sciences - P ENV 375 – forest ecology - C ENV 484 – sustainable human ecology - P Exit Interviews		
Quantitative Literacy	PSLO 4			CHE 315 ENV 434 Exit Interviews
Teamwork	**PSLO 2**	BIO 212 L – general biology lab - F ENV 375 - forest ecology - P Exit Interviews		
Diverse Perspectives	**PSLO 2**		ENV 314 – Environmental Law and Policy ENV 355 – Careers in Environmental Sciences Exit Interviews	
	PSLO 1	Assessed annually through curriculum completion. Exit Interviews	Assessed annually through curriculum completion. Exit Interviews	Assessed annually through curriculum completion. Exit Interviews
	PSLO 5		GEOG 105 – physical geography GIS 205 – GIS data integration BIO 307 – Fire Ecology Exit Interviews	

Section 5– Assessment Data Collection Processes

In 2021-22 data was collected on three of six ISLOs and four of six PSLOs:

- ISLO 1 – Communication- Oregon Tech students will communicate effectively orally and in writing.
- ISLO 3 – Ethical Reasoning - Oregon Tech students will make and defend reasonable ethical judgments.
- ISLO 5 – Teamwork - Oregon Tech students will collaborate effectively in teams or groups.
- PSLO 1 - Foundational knowledge - Attain applicable foundational knowledge, technical skills, information literacy, and experience in several core areas of natural resources & environmental sciences.
- PSLO 2 – Collaboration - Constructively work within and among diverse communities and perspectives.
- PSLO 3 - Science Advocacy - Make and advocate for science-based and sustainable solutions to local and global environmental issues.
- PSLO 6 - Communication - Effectively communicate science to a diverse range of community stakeholders.

Performance Target:
The overall standard of success established by BES faculty members was a minimum of 80% of students assessed would score 75% or higher on the chosen artifact.

Activity:

Annually, students demonstrate the attainment of foundational knowledge (PSLO 1) through the successful completion of curriculum. Data for the assessment of this PSLO includes enrollment and retention data. Each year the faculty review the curriculum to ensure that students are obtaining the skills necessary for job success. This year, new courses in Water Resources and Fire Ecology were added as technical electives to the curriculum.

Direct assessment data for the communication (ISLO 1 and PSLO 6) was taken in BIO 212L general biology lab and ENV 307 water resources. In BIO 212 Lab students completed a rapid ecological study that culminated in a presentation and paper. In ENV 307, students developed a restoration plan for a site that they determined was functional at risk and presented the plan in class. Additionally, a survey was given at the annual Environmental Research and Adventure Project Symposium to assess the six presentations given. 22 surveys were completed by attendees which included students, family members, government agency professionals, and Oregon Tech administrators. An indirect measure was provided through student exit interviews.

Ethical reasoning data (ISLO 3 and PSLO 3) was collected in ENV 355 – Careers and professionalism in environmental sciences, ENV 375 forest ecology, and ENV 484 – sustainable human ecology. In ENV 355 students complete an ethics assignment evaluating the environmental and social impacts of taking various actions to respond to a water quality case study. The students then are required to recommend one of the proposed actions. The final exam in ENV 375 forest ecology was chosen as the artifact related to ethics in that course. In ENV 484, select questions on ethical natural resource management from both the midterm and final were chosen for assessment.

Teamwork (ISLO 5 and PSLO 2) was assessed in BIO 212 L – general biology lab and ENV 367 plant ecology. The rapid ecological studies in BIO 212 L were completed in small groups (2-3 individuals). The final project was again used in ENV 375 as the students worked in small groups to complete this assignment.

The assignments for all of the project artifacts can be found in Appendix A.

Sample:
Here are the sample sizes for each of the courses where assessment data was collected. 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 usually statistically significant.

- Communication
  - BIO 212 Lab – 63 students
  - ENV 307 – 10 students

- Ethical reasoning
    - ENV 355 - 7 students
    - ENV 375 – 16 students
    - ENV 484 – 9 students

- Teamwork
    - BIO 212 Lab – 63 students
    - ENV 367– 10 students
- Exit Interviews – 4 of 7 graduating seniors
- First year retention rates – average class size 10 students
- ENV Research and Adventure Symposium assessment survey – 22 responses

Reliability: The instructor of record was responsible for assessing the artifacts for their classes. At the end of the term, each instructor recorded their data in the Course Learning Outcome worksheets. In the case of BIO 212L where three different instructors teach lab sections, a common assignment and rubric were utilized to ensure consistency. At least one course taught by each faculty member within the Environmental Science program was utilized for assessment to both fairly distribute the work associated with assessment and to provide a representative sample of teaching.

Rubric: Rubrics for the project artifacts from BIO 212L, ENV 375, and ENV 355 can be found in Appendix B.

Section 6– Assessment Data

Program Enrollment:

Table 5: BES Fall term week 4 headcounts 2017-2021.

Fall 2017	Fall 2018	Fall 2019	Fall 2020	Fall 2021
41	42	37	36	40

Enrollment within the environmental sciences program has remained relatively stable over the last five years. Unsurprisingly, we saw a small dip in enrollment during the height of the COVID 19 pandemic, but the fall 2021 data indicates that the program is making a recovery. We have been able to maintain this enrollment through an increase in transfer students to the program. Enrollment and retention continue to be of great concern for the environmental program and will be further addressed in our action plans.

1st Year Retention Rates

Table 6: First year retention rates with the BES program. Based on week 4 headcounts throughout the academic year.

2016-17	2017-18	2018-19	2019-20	2020-21
62%	70%	45%	50%	60%

Though the 60% is similar to the national average retention rate of 59% for public undergraduate institutions as given by the National Center for Education Statistics, our rate is lower than the Oregon Tech target of 75%. We have established a goal of increasing retention by 5% in the next year.

Employment Rates and Salaries:

100% of Oregon Tech Environmental Sciences graduates are either employed or seeking an advanced degree within six months of graduation with a median salary of **$33, 949.** Employment rate and salary data is based on the 2020 graduates of the BES program, and was collected via exit surveys, career services surveys, and Linkedln. The amazing success of our graduates should be attributed to the well-designed program curriculum and the many opportunities for our students to do research or hold intern positions during their education. These experiences give our students the outstanding professional and technical skills needed in the competitive post COVID job market.

ISLO and PSLO data:

Table 7: ISLO and PSLO data for 2021-2022.

Performance Criteria	Assessment Methods	Application Level	Performance Target	Results	Met?
ISLO 1 & PSLO 6 **Communication**	Rapid Ecological Assessment in BIO 212L	F	80% of students scoring a 75% or higher	**97%**	Yes
ISLO 1 & PSLO 6 Communication	Restoration Project Presentation – ENV 307 Water resources	P	80% of students scoring a 75% or higher	**90%**	Yes
ISLO 1 & PSLO 6 Communication	ENV Research and Adventure Project Symposium evaluations	C	80% of students scoring a 4 or 5 on survey.	**86%**	Yes
ISLO 1 & PSLO 6 Communication	Exit Interviews		80% of students rate themselves as proficient or highly proficient	**100%**	Yes
ISLO 3 & PSLO 3 Ethics & Advocacy	Environmental Ethics Assignment – ENV 355	P	80% of students scoring a 75% or higher	**100%**	Yes
ISLO 3 & PSLO 3 Ethics & Advocacy	Forest Ecology Final Exam – ENV 375	C	80% of students scoring a 75% or higher	**100%**	Yes
ISLO 3 & PSLO 3 Ethics & Advocacy	ENV 484 – Midterm and Final Exam	P	80% of students scoring a 90% or higher	**90%**	Yes
ISLO 3 & PSLO 3 Ethics & Advocacy	Exit Interview		80% of students rate themselves as proficient or highly proficient	**100%**	Yes
ISLO 5 & PSLO 2 Teamwork	Rapid Ecological Assessment in BIO 212L	F	80% of students scoring a 75% or higher	**97%**	Yes
ISLO 5 & PSLO 2 Teamwork	Plant Ecology Project – ENV 367	C	80% of students scoring a 75% or higher	**100%**	Yes

Performance Criteria	Assessment Methods	Application Level	Performance Target	Results	Met?
ISLO 5 & PSLO 2 Teamwork	Exit Interviews		80% of students rate themselves as proficient or highly proficient	**100%**	Yes
BES Graduation Rate	University Dashboard		6-year rate >50%	**50.8%**	Yes
BES Retention	University Dashboard		1-year rate >75%	**60%**	No
DFWI	University Dashboard		All program <12%	**4%**	Yes

Equity Gaps:

No equity gaps were identified in the courses chosen for the 2021-22 assessment process mostly due to insufficient data. Faculty were advised by the assessment executive committee to record a response of insufficient data if the class had fewer than five students within a specific demographic subcategory.

History of Results:

In 2017-18, the Environmental Science Program underwent significant changes. Under the leadership of a new program director, BES faculty adopted different PSLOs to better align with current industry needs. The faculty then revised curriculum to support the PSLOs. This means that we do not have much historical data and look forward to filling in this table over time. The assessment process has also changed significantly over this time with the introduction of Course Learning Outcome worksheets for reporting assessment data and more clearly defined performance targets.

Table 7: History of results for BES assessment data.

Performance Criteria	Previous Action Plan	2017-18	2018-19	2019-20	2020-21	Current data	Interpretation
ISLO 1 & PSLO 6 Communication	None Given					**97%**	Need more data.
ISLO 1 & PSLO 6 Communication	None Given					**90%**	Need more data.
ISLO 1 & PSLO 6 Communication	None Given					**86%**	Fewer students meet the standard at the capstone level.
ISLO 3 & PSLO 3 Ethics & Advocacy	None Given					**100%**	Need more data.
ISLO 3 & PSLO 3 Ethics & Advocacy	None Given					**92%**	Need more data.
ISLO 3 & PSLO 3 Ethics & Advocacy	None Given					**90%**	Need more data.
ISLO 5 & PSLO 2 Teamwork	None Given			3.4/4 average score		**97%**	Students continue to perform well in teams.

Performance Criteria	Previous Action Plan	2017-18	2018-19	2019-20	2020-21	Current data	Interpretation
ISLO 5 & PSLO 2 Teamwork	None Given			3.4/4 average score		**100%**	Students continue to perform well in teams.
BES Graduation Rate	None Given					**50.8%** Most current data is from 2015-16	More current data is needed for analysis.
BES first year retention rate	None Given	62%	70%	45%	50%	**60%**	Covid had a significant impact on retention in BES
DFWI rate in BES specific courses.	None Given	2%	3%	1%	3%	**4%**	Continues to be much lower than campus average.

Student Success Stories:

We continue to have amazing students within the BES program. Below is a snippet from the Environmental Science Project and Adventure Symposium program to give readers an idea of the outstanding work our students have been doing. For the full symposium program see Appendix C.

Eleanor Kenyon

During the SARP NASA Program Eleanor Kenyon and other interns attended lectures from renowned scientists, learned how to code and use satellite imagery processing software, collected aerosol data, and ultimately came up with an independent research project to pursue over the 8-week program. Eleanor used Geographic Information Systems to model debris flow risk following a wildfire, based on factors such as slope, geology, vegetation cover, and fire severity. Eleanor was the 2021 Oregon Tech Senior cup award recipient for the significant impact that she on the campus community while at Oregon Tech.

Elijah Hayes

In 2020 **Elijah Hayes** set out to break the Klamath County big year record of 259 species. A *big year* is an informal competition among birders who attempt to identify as many species of birds as possible by sight or sound. Elijah achieved this goal and is the county record holder for most bird species identified in Klamath county in a single year.

Section 7– Action Plans

Reflecting on the assessment data, the one area where Environmental Sciences did not meet the performance target was retention. The BES first year retention rate was 60% with a target of 75%. The low DFWI rates within BES courses indicate that our retention issues are not associated with program specific curriculum. This means that students are either facing attrition in their general educational requirements or are leaving Oregon Tech for reasons other than failing their classes. The graduation rate barely met the 50% target with 50.8% of BES students graduating in six years. Our action plans for the coming year will center on first year retention and graduation rates.

Action Plans for 2022-2023

Goal 1: Increase enrollment in the program so that the retention rates are not dramatically influenced by the loss of a few individuals.

- Meet with admissions/marketing to discuss how to better advertise the BES degree.
- Meet with university advisors to highlight the potential for BES to be an excellent alternative choice if they have students who want to switch majors.
- Update the ENV website.
- Visit local schools.

Goal 2: Write a retention plan for BES.

Goal 3: Add a project to ENV 108 – mentorship and teambuilding that requires first year students to partner with upper classman to better foster relationships among students. This course will also return to having an overnight field experience for students.

Goal 4: Continue to increase opportunities for students to conduct research or connect with internships.

- Formalize a process for tracking faculty workload related to research or partnership activities.

Goal 5: Develop tracks within the Environmental Sciences curriculum.

Goal 6: Schedule specific meeting times to discuss assessment.

ISLO Diverse Perspectives data will be collected in ENV 314 – Law and Policy and ENV 355 – Careers & Professionalism in Environmental sciences. PSLO Geospatial Literacy data will be collected in GEOG 105, GIS 205, and BIO 307 – fire ecology.

The following areas were identified as areas for improvement on last year's assessment report.

- Add diversity to our staff and student body
- Better distribute electives throughout the year
- Making science and math requirements more relevant for our students
- Update lab equipment.
- Reduce scheduling conflicts.

We have made progress on many of these items. We have been working to better distribute electives throughout the year giving our students more options for technical electives. We hired an adjunct instructor in fall of 2021 who taught a soils course for BES. This is an area we have been lacking in the program over the last few years, and students who took the class reported highly of their experience. Further, we moved a wildlife elective that is commonly taught in spring to the fall freeing up room to add a new Water Resources class.

We added a PHY 201 course to the curriculum which will be taught on an every other year basis. This course meets the physics requirement of a bachelor of science degree, but was specifically focused on physics in natural environments

making it more relevant for our students. We are looking at submitting a CPC curriculum change in 2022-23 which will give students the option to take either MATH 251 or MATH 362 depending on their area of focus within the program. For example, students wanting to study hydrologic measurements might be better served with the calculus while students studying wildlife might learn more valuable skills in the advanced statistics course.

Our department has been able to update a variety of lab equipment in the last year. We have a new wet lab within the CEET building with a variety of new chemistry equipment including a classroom set of Vernier Spectrovis spectrophotometers, new burettes for titrations, a new ice machine, and better functioning hoods. We are looking forward to the completion of Boivin Hall renovation which will include three new chemistry labs and dedicated chemical research space. In the watershed lab we purchased some HACH kits for field testing water quality samples, a secchi disk, a clinometer, two handheld multiprobes, and two spherical densiometers.

We have carefully scheduled courses within the program to reduce conflicts where possible so that students can take multiple courses as needed. For example, we moved a biology lab last spring to remove a conflict with the new Water Resources class. We plan to add a section of GEOG 105 lab giving students more options for when they take the lab.

While we did not specifically address the need to increase diversity in the program last year, we hope that by increasing enrollment we will see an increase in diversity as well.

In 2022-23 need to hire an environmental chemistry faculty member as our search for this type of chemist failed in 2021-22. This person would expand our capacity to do water and air quality research within the Klamath Basin and would teach a number of key required and elective courses within the BES program.

Section 8– Closing the Loop: Reflection on previous work

The assessment process within BES continues to evolve. While we had hoped to move toward a portfolio based system for assessment the university opted to change the software options available for this. Because of this, we decided to utilize the new Course Learning Outcome worksheets which are available through Tech Web. These sheets allow faculty to collect the data as they teach their courses each term and submit that information to the department of institutional research. The worksheets allow scaffolding of learning objectives so that it is easy to see the alignment of ISLOs with PSLOs and even course specific learning outcomes. This more standardized approach will be easier to implement and increase the faculty involvement with data collection. As we gather more PSLO data in the coming years, we will be better able to monitor student learning over time and close the loop on our action plans.

On May 19, 2022, faculty within the BES program received training on using the new Course Learning Outcome worksheets. On September 21, 2022 BES faculty attended a convocation session on new requirements for programmatic assessment reports. Our program will be meeting on Nov. 10th, 2022 to discuss the results from this assessment report and to strategically plan a better closing the loop process.

Overall, the data indicates that BES students are excellent communicators and work well in teams, skills which are integral to environmental work. The students can reach ethical decisions related to natural resource management and then advocate for these science-based solutions. It was noted that not all the assignments related to ethics specifically addressed the different ethical theories which is part of the ethics ISLO. BES does not have a course that includes this content at a foundational level. There is an assumption that students would be developing this skill through their social science/ humanities electives.. We will be reaching out to our colleagues in social sciences/humanities to discover where ethical theories are introduced in their curriculum and will consider revising our assessment approach as needed.

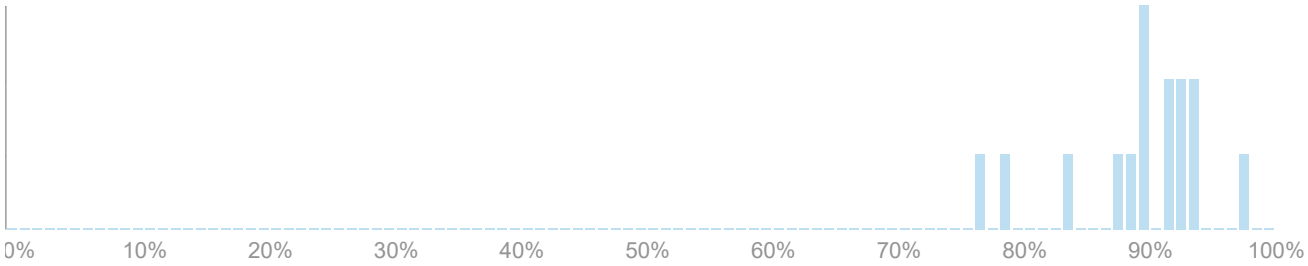
As a team, we have identified a variety of retention and graduation goals for the coming 2022-23 academic year. Our faculty remain committed to excellence in teaching through applied learning techniques. We have had a phenomenal year building partnerships and research experiences for our students. There is great potential for the BES degree to grow, and we look forward to increased programmatic success in the coming year.

Appendix A– Assessment Artifacts

Quiz Summary

Section Filter ▾ | Student Analysis | Item Analysis

Average Score	High Score	Low Score	Standard Deviation	Average Time
90%	98%	77%	5.48	01:12:94



Question Breakdown

Attempts: 15 out of 15

Explain the difference between traditional silviculture and ecological forestry.

Answers which scored in the top 27%	5 respondents	**33 %**	✓
Answers which scored in the middle 46%	10 respondents	67 %	

variable density harvest	14 respondents	93 %

7%
answered
correctly

Attempts: 15 out of 15

One of the primary principles of ecological forestry at the stand level is to *maintain continuity in forest structure, function, and biota between pre- and post-harvest systems*. Which of the following harvest regimes best meets this principle?

-0.02

Discrimination
Index ⓘ

variable retention harvest	14 respondents	**93 %**	✓
variable density harvest	1 respondent	7 %	

93%
answered
correctly

Attempts: 15 out of 15

Developing silvicultural prescriptions is a complex process, but can be broken down into three major steps: 1) gaining knowledge of the system; 2) setting

View in SpeedGrader (https://oit.instructure.com/courses/14840/gradeb assignment_id=255721)

Attempts: 15 out of 15

The principles of ecological forestry operate at three different levels - stand, landscape, and social. For each principle below, select the level at which it would be ***best*** applied in a forest initiated by episodic, severe fire.

Maintenance of the entire sere to sustain full array of conditions, functions, and biota

Continuity in forest structure, function, and biota between pre- and post-harvest systems

Reduce risks of to important forest values and increase future options for management

Silvicultural activities are timed at intervals that reflect ecological processes

social		0 %	100% answered correctly
stand		0 %	
landscape	15 respondents	**100 %**	✓

Attempts: 15 out of 15

One of the primary principles of ecological forestry at the stand level is the *creation and maintenance of structural complexity and biological richness, including spatial heterogeneity at multiple spatial scales*. Which of the following harvest regimes best meets this principle?

+0.02

Discrimination Index ⓘ

variable retention harvest	1 respondent	**7 %**	✓

goals; and 3) assessing conditions. *Explain two ways that you can gain knowledge of the system you are working in.*

Answers which scored in the top 27%	15 respondents	**100 %** ✓

View in SpeedGrader (https://oit.instructure.com/courses/14840/gradebook?assignment_id=255721)

Attempts: 15 out of 15

Consider a landscape consisting of forests initiated by a high-severity, episodic fire regime. The current condition of the landscape is that most of the area is comprised of previously harvested stands currently in the young forest stage. The management directives call for: 1) no harvest in mature and old forest stage stands; 2) harvest in young forest stage stands that focuses on creating horizontal structural complexity. Which of the following harvest regimes would best suit these goals?

-0.22

Discrimination Index (?)

variable retention harvest	14 respondents	**93 %** ✓
variable density harvest	1 respondent	7 %

93% answered correctly

Attempts: 15 out of 15

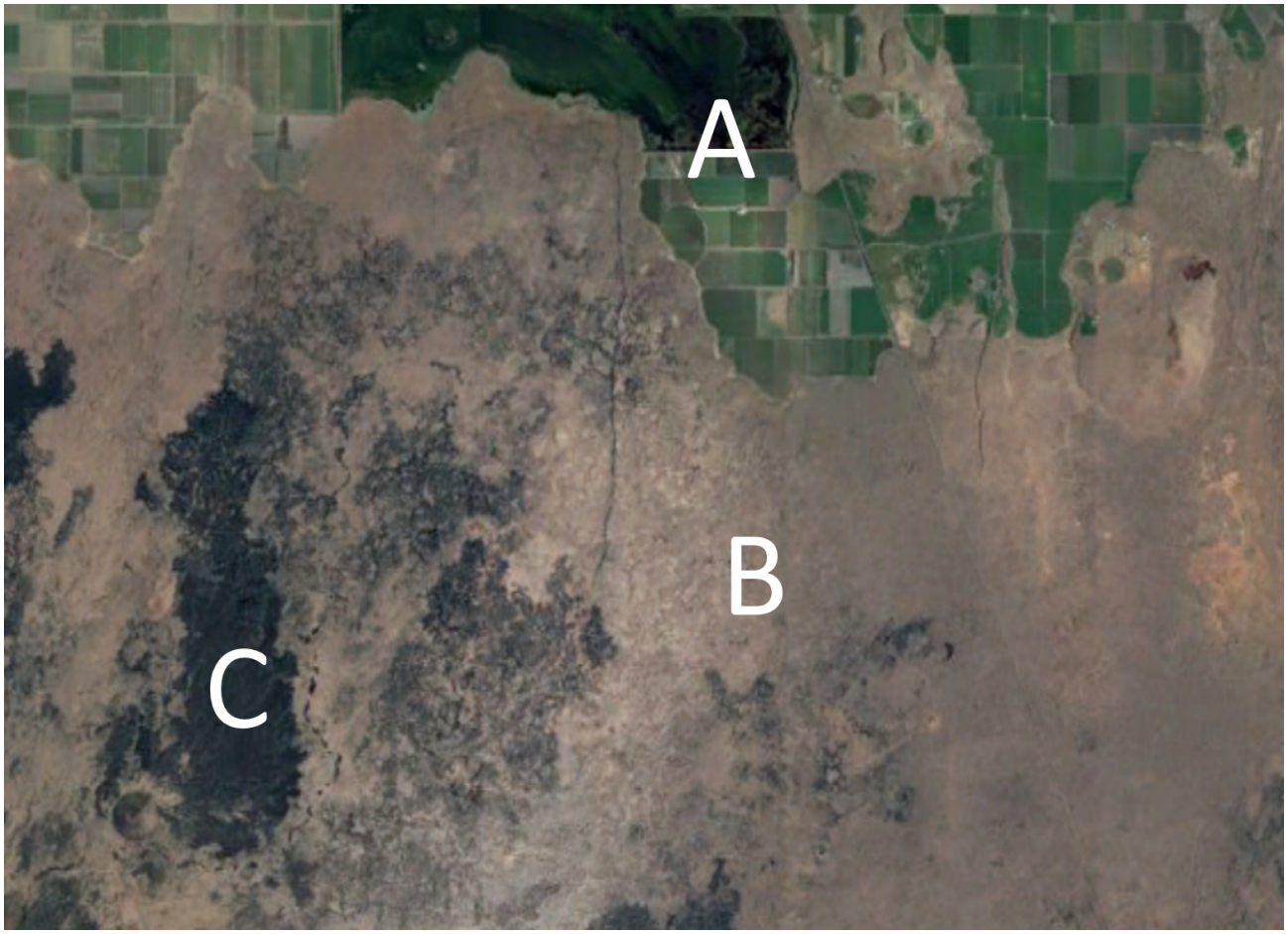
Consider a landscape consisting of forests initiated by a low-severity, chronic fire regime. The current condition of the landscape is that the entire area is comprised of overly dense stands consisting of multiple age classes and an abundance of shade-tolerant species. Which harvest regime (variable retention, or variable density) would be most appropriate? Would you combine any other management technique with your choice of harvest? *Explain your reasoning.*

Answers which scored in the top 27%	13 respondents	**87 %**
Answers which scored in the bottom 27%	2 respondents	13 %

View in SpeedGrader (https://oit.instructure.com/courses/14840/gradebassignment_id=255721)

Attempts: 15 out of 15

The figure below is an aerial view of the landscape around Tulelake, CA. Identify each letter as either a patch, a matrix, a corridor, or "not applicable".



A B C

patch	6 respondents	**40 %**	✓
matrix	1 respondent	7 %	
corridor	6 respondents	40 %	
not applicable	2 respondents	13 %	

40% answered correctly

Attempts: 15 out of 15

Of the 7 attributes of landscape patches, *size* and *shape* are of particular interest. Describe the importance of patch size and shape as it relates to *edge*

effects.

Answers which scored in the top 27%	11 respondents	**73 %** ✓
Answers which scored in the bottom 27%	4 respondents	27 %

View in SpeedGrader (https://oit.instructure.com/courses/14840/gradeb assignment_id=255721)

Attempts: 15 out of 15

Which of the following represents the largest and most universal category of meso- or mid-scale areas of concern in forested landscapes?

-0

Discrimination Index ⓘ

specialized habitats		0 %
corridors		0 %
refugia		0 %
aquatic and semi-aquatic ✓	15 respondents	**100 %**

100% answered correctly

Attempts: 15 out of 15

Compare and contrast the *philosophies* and practical *management actions* of the traditional, "black & white" system of forest landscape management with ecological forestry's "shades of green".

Answers which scored in the top 27%	10 respondents	**67 %**
Answers which scored in the middle 46%	4 respondents	27 %
Answers which scored in the bottom 27%	1 respondent	7 %

View in SpeedGrader (https://oit.instructure.com/courses/14840/gradeb assignment_id=255721)

Attempts: 15 out of 15

Most of the forested land in the United States is publicly owned.

-0.12

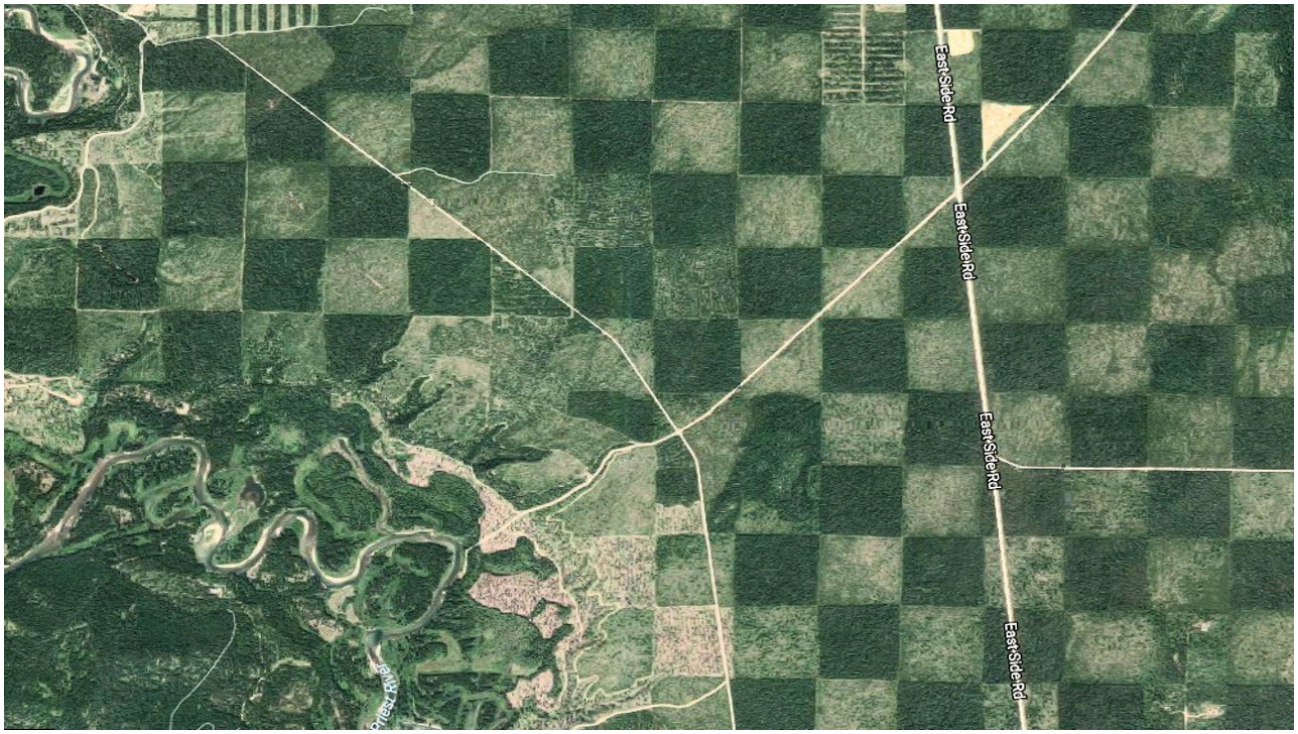
Discrimination Index

True	1 respondent	7 %
False	14 respondents	**93 %**

93% answered correctly

Attempts: 14 out of 15

Provide ***two*** reasons why the ownership pattern illustrated below presents a problem for a forester attempting to apply ecological forest management.



Answers which scored in the top 27%	9 respondents	**60 %**
Answers which scored in the middle 46%	2 respondents	13 %
Answers which scored in the bottom 27%	4 respondents	27 %

View in SpeedGrader (https://oit.instructure.com/courses/14840/gradebassignment_id=255721)

Attempts: 15 out of 15

Most of the timber harvested in the United States comes from federal land.

-0.3

Discrimination Index

True	4 respondents	27 %

False	11 respondents	**73 %**	✓ 73% answered correctly

Attempts: 15 out of 15

Match the description of a *policy action* on the left side with the *policy process step* on the right.

ODF and USFS decide on stream buffers of 60-80' depending on the size of waterway.

Oregon Department of Forestry, and the U.S. Forest Service are responsible for meeting state and federal guidelines associated with the Clean Water Act and the Endangered Species Act.

ODF and USFS develop a series of stream management alternatives.

Over-harvesting of timber; especially on steep terrain causes significant runoff that degrades water quality in local streams.

ODF and USFS monitors stream quality for 5 years in all post harvest areas to determine effectiveness of new 60-80' buffer.

ODF and USFS monitor all timber harvests on both private and public land to ensure that the stream buffer requirements are being met.

Policy Formation and Analysis		0 %	
Problem Formulation		0 %	
Policy Adoption	11 respondents	**73 %**	✓
Policy Agenda		0 %	
Policy Implementation	4 respondents	27 %	
Policy Evaluation		0 %	

73% answered correctly

Attempts: 15 out of 15

Adoption of policy requires that the resource action not only be physically possible and economically feasible, but it must also be *socially acceptable*. This is often very difficult to achieve; however, studies show that if the public has 4 keys to acceptability, the odds of a policy being adopted are greater. List each key and explain how ***you***, as a resource manager, could provide for each.

Answers which scored in the top 27%	13 respondents	**87 %**
Answers which scored in the bottom 27%	2 respondents	13 %

View in SpeedGrader (https://oit.instructure.com/courses/14840/gradeb assignment_id=255721)

Attempts: 15 out of 15

Explain the difference between a stakeholder's *position* and a stakeholder's *interest(s)* and provide an example of each. Why is it important to distinguish between the two during a collaborative negotiation?

Answers which scored in the top 27%	12 respondents	**80 %**
Answers which scored in the bottom 27%	3 respondents	20 %

View in SpeedGrader (https://oit.instructure.com/courses/14840/gradeb assignment_id=255721)

Attempts: 15 out of 15

Compare and contrast the missions of private industry (e.g., Green Diamond), the state (e.g., Oregon Department of Forestry), and the federal government (e.g., U.S. Forest Service or Bureau of Land Management) in their management of forests. What pressures are placed on each organization that might contribute to how they decide to manage forests under their jurisdiction? What does this mean for implementing the principles of ecological forestry?

Answers which scored in the top 27%	13 respondents	**87 %**
Answers which scored in the bottom 27%	2 respondents	13 %

View in SpeedGrader (https://oit.instructure.com/courses/14840/gradeb assignment_id=255721)

Week

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 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 presentation AND an individual scientific paper

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

In addition to your scientific paper, you will present your project via an oral presentation, which will be evaluated by both your instructor and your peers – an essential aspect of science. Finally, you will play the role of critical reviewer, providing constructive feedback to your fellow lab students.

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 Examine the hypothetical topics below and construct a hypothesis 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 and/or measuring? Can you control or manipulate one or more of the variables in your 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. Air temperature is the *independent* variable.

Task 1.2 Return to the 3 topics from *Task 1.1.* 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. *Week 2 labs will be devoted to learning how to effectively search for reliable information using Oregon Tech 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. In addition to the core variables, is there other ancillary information that would help contextualize and organize your data? In the leaf color study, we would want to keep track of the date and 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 draft field data form for each of the three topics from Tasks 1.1-1.2. Be sure to include both the core variables and any ancillary information.

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? 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 from *Task 1.1*.

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 inclined to run 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, you will synthesize everything you have done into a brief, yet informative, *oral presentation* AND a *500-word scientific paper.*

Oral Presentation

You will create a concise 10-minute visual summary of your research project for presentation to your peers during the last two lab sessions of the quarter.

Scientific Paper

Your scientific paper will be a concise summary of your project and include 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 and includes the following:
    - A statement of the importance of the topic you are studying. Why should the reader care?
    - A brief summary on the current knowledge on your topic by citing at least 3 peer reviewed papers.
    - An explanation of how your specific research question will fill an existing gap in knowledge or contribute to the overall body of knowledge on your topic.
    - A clear statement of 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).

    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.

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. *Figures and/or Tables*: 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 (the full set of unanalyzed data) data. Figures and tables also require a caption. Captions should completely describe the figure or table such that they could stand alone, independent of your paper, and the reader would still have an idea of the question your study examined. Placement of captions differs between tables and figures. Table captions are placed above the table, while figure captions are placed below (see example).

Table 1. Changes in the proportion of sampled maple trees within three foliage-color categories as day length decreases on the campus of Oregon Tech.

daylight (min)	green	yellow	red
749	1.00	0.00	0.00
730	0.60	0.20	0.00
710	0.20	0.80	0.00
690	0.00	0.80	0.20
677	0.00	0.60	0.40
652	0.00	0.60	0.40
633	0.00	0.00	1.00

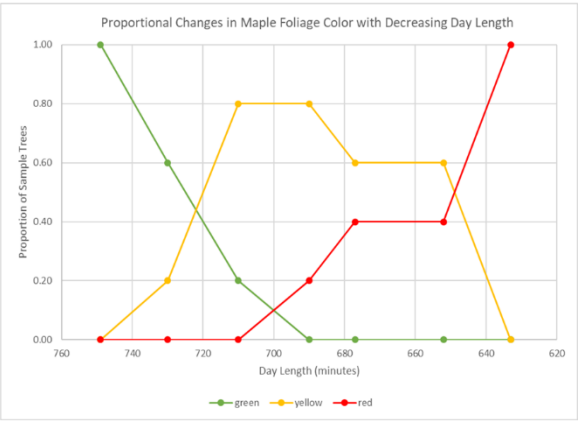


Figure 1. Changes in the proportion of sampled maple trees within three foliage-color categories as day length decreases on the campus of Oregon Tech.

6. *Results*: This section summarizes your results from the analysis of your data. It does *NOT* report raw data. This section will refer to your tables and/or figures that also *summarize* your data. For example, "The proportion of our sample trees within each foliage color category changed predictably with day length (Table 1 and Figure 1)." This lets the reader know they should refer to both Table 1 and Figure 1 in your paper for a visual representation of your findings.

7. *Discussion*: This section reiterates your key results using brief, summarizing statements. It does not report hard numbers or statistics. Did your observations support or refute your original hypothesis and prediction? If your results were not as you expected (did not support your hypothesis) speculate discuss why that may be. Was it your methods? Study sites? The time of year? A final critical element of a successful discussion is the interpretation of your results within the larger context of your field of study. How did your results compare with what is already known from the published literature?

8. *Literature Cited*: Here you will list, in alphabetical order by author, all the papers you cited within your RES report. 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:

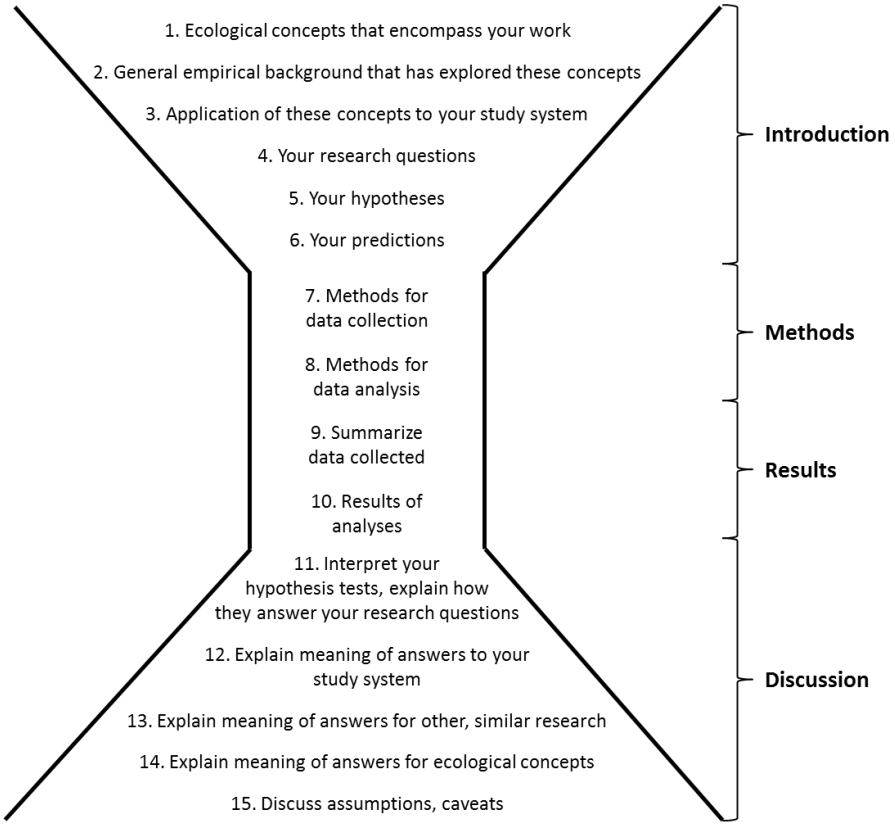
   Article in Peer-Reviewed **Print** Journal
   Last Name, First Initial. Second Initial. Year of publication. Title of article. Italicized Title of Journal. Volume number in bold: page or pages with no space between colon.

   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 Peer-Reviewed **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.

Putting It All Together. 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 expand back out as we draw conclusions and relate our findings to the broader body of knowledge on the topic.

Part IV: 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 5, 6, or 9 Jan	Canvas Assignment	2-3 potential RES topics (5%)
2	8:00am 12, 13, or 14 Jan	Canvas Assignment	General Research Topic and Key Search Words (5%)
3	8:00am 19, 20 or 21 Jan	Canvas Assignment	Primary Literature Exercises and List of Sources (5%)
4	8:00am 26, 27, or 28 Jan	Canvas Assignment	First Draft of Introduction and Literature Cited Sections (5%)
5	11:59pm 2, 3, or 4 Feb	Canvas Assignment	Study Design, Data Collection, Equipment Needed, and Timeline (5%)
6	11:59pm 9, 10, or 11 Feb	Canvas Assignment	Second Draft of Introduction and Literature Cited Sections (5%)
7	11:59pm 16, 17, or 18 Feb	Canvas Assignment	Raw Data (5%)
8	11:59pm 23, 24, or 25 Feb	Canvas Assignment	Preliminary Data Analysis (5%)
9	during lab 2, 3, or 4 Mar	Presentation (half class)	Presentation (30%)
10	during lab 9, 10, or 11 Mar	Presentation (half class)	
10	11:59pm 12 Mar	Canvas Submission	Final Paper (30%)

Detail of Required Aspects of Each Project Submission

Week 1: Potential Topics for RES Project

Due: end of the lab period on 5, 6, or 9 Jan (depending on your assigned lab day) as a canvas assignment

***What to Include*:** A short description of 2-3 research topics you are considering for your RES project. If you need some inspiration, check out the document *RES Topic List* inside the *RES Resources* module on Canvas.

Week 2: General Research Topic and Key Search Words

Due: 8:00am on 12, 13, or 14 Jan (depending on your assigned lab day) to Canvas.
What to Include*:** In preparation for this week's lab you will have: 1) narrowed down your potential research to two to three topics (if you are having trouble thinking of research ideas, use the handout posted on Canvas titled, "RES Topic Ideas"); 2) constructed a list of 3-5 key words for ***each of your potential topics to use during our primary literature sources lab this week.

Week 3: Primary Literature Exercises and List of Sources
Due: 8:00 am on 19, 20, or 21 Jan (depending on your assigned lab day) on Canvas.
What to Include: the completed exercises from the "Primary Sources" lab.

Week 4: First Draft of Introduction and Literature Cited Sections
Due: 8:00 am 26, 27, or 28 Jan (depending on your assigned lab day) on Canvas.
What to Include: 1) a brief, 2-3 paragraph 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 5: Study Design, Data Collection, Equipment Needed, Project Timeline
Due: 8:00 am 2, 3, or 4 Feb (depending on your assigned lab day) on Canvas.
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 and dependent variables
3) An explanation of *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."
4) A list of equipment needed to collect your data
5) A timeline of **when** you will:
   a) gather field equipment
   b) perform your field or lab research
   c) summarize/analyze your data
   d) create your presentation
   e) write your paper
6) A list of tasks that need to be completed in order for you to remain on schedule and when those tasks will be completed (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).

Week 6: Second Draft of Introduction and Literature Cited Sections
Due: 8:00 am 9, 10, or 11 Feb (depending on your assigned lab day) on Canvas.
What to Include: You should have received feedback on the first draft of your *introduction and literature cited sections*. Please submit a second draft of your introduction where you have incorporated the suggestions made by your instructor.

Week 7: Raw Data
Due: 8:00 am 16, 17, or 18 Feb (depending on your assigned lab day) on Canvas.
What to Include: A digital copy of your raw data entered into a spreadsheet program such as Microsoft Excel or Google Sheets.

Week 8: Preliminary Data Analysis
Due: 8:00 am 23, 24, or 25 Feb (depending on your assigned lab day) on Canvas.
What to Include: One table and one figure that effectively summarize your data. Before getting started, review *step 6* of this document (*Presenting Your Results*) for guidelines how to successfully summarize your results using tables and figures. Do not submit raw data.

Weeks 9 or 10: Oral Presentation & Peer Reviews
Due: your assigned lab day during the presentation slot designated for you (either week 9 or 10).
What to Include: Your presentation is a visual representation of your research and you can use the paper you are writing as a guide. Begin your presentation by introducing your topic to the audience, explaining its importance to ecology and clearly stating your research hypothesis. Then, describe how you collected your data (methods) and conducted your analysis. Describe your results and discuss whether your hypothesis was supported or refuted. Finally, relate your results back to the overall body of knowledge on your topic.

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: 11:59 pm on 12 Mar (depending on your assigned lab day) on Canvas.
What to Include: The final draft of your RES paper containing ***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.

Analysis and Paper Preparation

The goals of today's lab are twofold: 1) analyze the final batch of vegetation and abiotic field data collected during week 6's lab; 2) begin construction a final report and presentation based on the research questions and hypotheses you proposed to the class during week 5's lab session.

Part 1. Data Analysis. All the vegetation and abiotic data has been summarized by transect in the excel file posted on Canvas. Use this data to construct figures and tables that summarize the data pertinent to your group's hypotheses. A quick review of the lab handout from week 3 might help you get started, as will your proposal, which outlined your independent and dependent variables. You should construct at least one figure for each of your hypotheses. These figures should clearly illustrate whether the associated hypotheses was supported or rejected. Feel free to use statistics if you are familiar enough with the method chosen. If not, see me and I can help you with this.

Part 2. Paper and Presentation Preparation. Your final report will follow the format of an article from the primary scientific literature and contain 7 separate sections. Your presentation will essentially be a visual display of your paper.

Part 2A. Paper Guidelines. A successful final research paper will contain all 7 elements listed below, will be well organized, and illustrate proper use of citations.

1. Title and Authors: Strive for a concise, yet informative title that lets the reader know what the paper is about. List authorship alphabetically.

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*. In my experience, it's easiest to write the abstract *last* and just glean a sentence or two from each section.

3. Introduction: This section establishes the context for your research and includes the following:

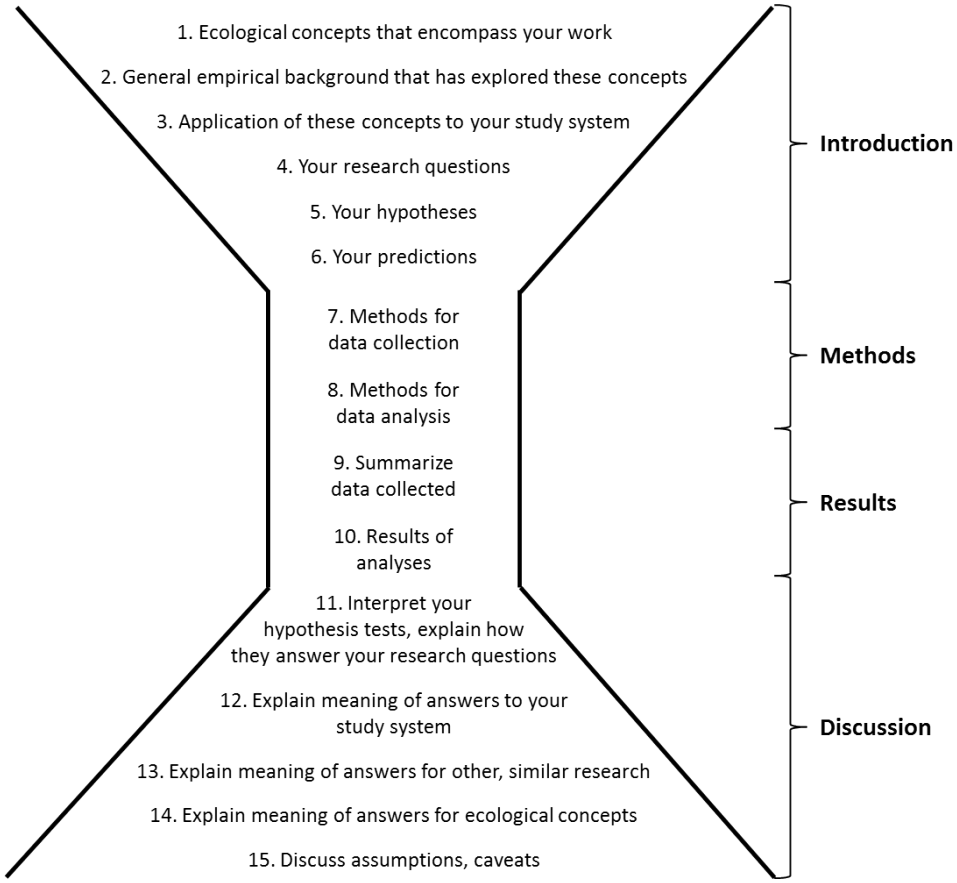
    a) A statement of the importance of the topic you are studying. Why should the reader care?
    b) A brief summary on the current knowledge on your topic using *internal citations*[1] of peer reviewed papers as appropriate.
    c) An explanation of how your specific research question will fill an existing gap in knowledge or contribute to the overall body of knowledge on your topic.
    d) A clear statement of your research question, associated hypotheses and predictions.

    Be sure that you use this section to justify (by citing other research) your hypotheses and predictions. For example, if you are hypothesizing that *Cercocarpus montanus* facilitates the establishment and growth of

[1] *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 are separated by "and" (Leu and Murray 2006). Citations of papers where more than two authors 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.

Ribes velutinum by using less soil moisture than other trees and shrubs on the study site, then you will need to cite evidence for why you may believe this. Even if you can't find direct evidence for this relationship between these specific species, there is likely evidence out there about soil moisture and facilitation in other species.

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: This section summarizes your results from the analysis of your data. It does *NOT* report raw data. The structure of this section should be organized around the hypotheses you tested and will refer to your figures and/or tables. For example, "Mean soil moisture content under the canopies of *C. montanus* was significantly greater than mean soil moisture contents under the canopies of *J. occidentalis*, *P. tridentata*, and *A. tridentata* (Figure 1 and Table 1)." This lets the reader know they should refer to both Figure 1 and Table 1 for a visual representation of your findings.

   You should include at least *one figure or table for each hypothesis tested*. The reader should be able to look at your figure and determine whether or not the results support or refute the associated hypothesis. Be sure to include captions for each table and figure you provide. Captions should completely describe the figure or table such that they could stand alone, independent of your paper, and the reader would still have an idea

of the question your study examined. Placement of captions differs between tables and figures. Table captions are placed *above* the table, while figure captions are placed *below*.

6. Discussion: This section reiterates your key results using brief, summarizing statements. It does not report hard numbers or statistics. Did your observations support or refute your original hypothesis and prediction? If your results were not as you expected (did not support your hypothesis) speculate why that may be. Was it your methods? Study sites? The time of year? A final critical element of a successful discussion is the interpretation of your results within the larger context of your field of study. How did your results compare with what is already known from the published literature? This is the bottom portion of the hourglass figure, where you move from your specific results back out to the broader knowledge on the subject.

7. References: Here you will list, in alphabetical order by author, all the papers you cited within your RES report. 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:

   Journal article with One author :

   FORMAT: Last name, First initial. Second initial. Date. Title. Journal title volume number: inclusive page numbers.

   EXAMPLE: Smith, V. H. 1986. Light and nutrient effects on the relative biomass of blue-green algae in lake phytoplankton. Canadian Journal of Fisheries and Aquatic Sciences 43:148–153.

   Journal article with two or more authors:

   FORMAT: Last name and initial(s) of author, followed by Initials and then Last name of additional authors. Year of publication. Title of article. Title of journal Volume number: Inclusive page numbers.

   EXAMPLE: Elser, J. J., and J. Urabe. 1999. The stoichiometry of consumer-driven nutrient recycling: theory, observations, and consequences. Ecology 80:735–751.

   Book

   FORMAT: Last name and Initial(s) of author, [followed by Initials and Last name of additional authors if any]. Year of publication. Title of book. Edition number if any. Name of publisher, City, State, Country of publisher.

   EXAMPLE: Sterner, R. W., and J. J. Elser. 2002. Ecological stoichiometry: the biology of elements from molecules to the biosphere. Princeton University Press, Princeton, New Jersey, USA.

   Article in Peer-Reviewed Online Journal (web only)

   FORMAT: 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.

   EXAMPLE: 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.

Notes on ESA Style

- Always list the author names in the order in which they appear on the paper. Researchers carefully determine the order of authorship on a paper, and you need to preserve it to ensure that the article is recognizable, findable, and fairly credited.
- Note that all author names are listed as first initials and last names. Even if you know the whole first name, the Ecology format dictates that using initials only in the Literature Cited list. Note also that the first name is given last name first, then intitials and any additional authors are listed intitials first, then last name.
- Note that there are spaces between the initials.
- Note that the journal name is written out completely. In older issues of Ecology, citations included bold font for volume number of journal articles. In recent issues, the volume number has not been bolded. Note that issue numbers for journal articles are not listed.
- Always italicize species names.

Part 2B. Presentation Guidelines. Oral presentations follow the same outline as written presentations. The advantage of an oral presentation is that you will find it easier to bring your enthusiasm for your work into your presentation and to have fun visuals. Most talks are delivered using either PowerPoint or Google Slides. A successful presentation will employ the following tips:

- Use your slides to emphasize important points, not to convey your entire script. Avoid using the templates that come with the PowerPoint or Google Slides and these often employ the use of lots of bulleted lists and tend to up with a less than interesting talk.
- You aren't stuck with only using the computer presentation. If appropriate, bring in props such as equipment, or other relevant materials so your audience can see what you actually worked with. If a picture is worth a thousand words, the actual physical items are worth ten thousand.
- Keep the slides visually simple, so that the viewer's eye is drawn to the key point you're trying to make. Use animations sparingly, as they are generally more distracting than helpful.
- Remember, above all, that the visuals are to support what you have to say, rather than the other way around.
- As a general rule of thumb, you shouldn't use more than one slide per minute. If you are allotted 15 minutes, then 15 slides is likely appropriate. If you have organism pictures that you can go through quickly, you might have a few more slides than this, but if you have a slide of a method that requires complicated explanation, you'll need to use fewer slides.

Environmental Ethics Assignment

Imagine you are a fisheries biologist working for the Oregon Department of Fish and Wildlife. Despite it being illegal to use live bait in Oregon lakes, fisherman have introduced an invasive nonnative fish species to one of the lakes in your region. In the five years since the invasive species was introduced, you have seen a dramatic reduction in water quality. pH is rising, dissolved oxygen and water clarity have been reduced, and during the summer you are now seeing large blooms of cyanobacteria. This poor water quality is leading to problems within the native populations of fish. Disease is on the rise, fish kills are more common, and sportsman report fewer large trout available. In addition to these negative ecological impacts, the poor water quality is having dire economic consequences as fewer people want to use the lake for summer recreational activities.

ODFW has tasked you with finding a solution to the water quality issues in the lake. You have been asked to create an environmental impact statement with a recommendation for a course of action out of these four possible choices.

1. Do nothing. This course of action will likely lead to continued degradation of water quality. This lake is heavily utilized for summer recreation.

2. Treat the lake with Rotenone to kill off the invasive species and then reintroduce only native fish species. Rotenone is a naturally occurring chemical found in the roots, seeds, and leaves of several subtropical plants and has been commonly used as a piscicide (fish killer). This piscicide is non-selective, meaning it has the potential to kill any fish exposed to it. (Sackett, 2012).

3. Introduce a GMO predator fish species which preferentially feeds upon the invasive fish. The predator fish would be modified to be sterile so that the number of these fish will remain stable at the amount you originally add until the predators eventually die off.

4. Reduce lake depth using the pre-existing dam and then manually remove the invasive species using netting and sorting techniques. Of the 4 options, this is by far the most expensive and labor intensive.

Your assignment for ENV 475:

Write a 2 page (double line space) report detailing which of the four options you feel is the most ethical approach to dealing with the water quality issue.

Begin the paper with a thesis statement which recommends the particular course of action that should be taken. For more info on thesis statements, check out this website: https://writingcenter.unc.edu/tips-and-tools/thesis-statements/

Support your decision with at least two outside sources of information on this topic. Use APA citations within the text when referencing the research and include a reference section at the end of your paper. References should not be counted as part of the 2 pages.

Appendix B– Project Rubrics

BIO212L RES Paper Grading Rubric (30pts) Winter 2021

Title (3%, or 1.0pts)

- Concise, yet effectively describes the project.

Abstract (5%, or 1.5pts)

- Should be concise review of *all components* of paper (e.g. 1-2 sentences from each section)

Introduction: (20%, or 6pts)

- Should cover general field of biology that their study addresses
- Summarize relevant literature
- Proper use of citations
- Statement of research question and hypotheses
- Well organized
- Well written

Methods (10%, or 3pts)

- Past tense, ***not*** a written like a recipe
- Clear and concise – could replicate the study from reading
- Includes all steps of methods used

Results (20%, or 6pts)

- Reports **summarized** data in narrative form, **not** raw data
- Describes findings in terms of total numbers, means, etc.
- Inclusion of table(s) and figure(s)
    - Figure clear and meaningful
    - Has detailed caption that can stand alone
    - Axes labeled
    - Units defined (e.g., mm, cm, g, etc.)

Discussion (20%, or 6pts)

- Clearly state key findings
- Discuss their implications in relation to other research
- Properly cite other work
- Draw reasonable conclusions

Lit Cited (5%, or 1.5pts)

- Contains *at least 3 peer-reviewed sources*
- Follows established format outlined in instructions

Overall presentation (10%, or 3pts)

- Proper length – not well over or under 500 words, keeping in mind there was no minimum
- Proper grammar & spelling
- Good flow and transition – e.g., doesn't feel like it was written carelessly and without review
- Ideas clearly communicated

In each row, circle the point value corresponding to the evaluation criteria earned by the presenter. Sum each column and then calculate a final score.

Area	Evaluation Criteria				
Content 30% (9pts)	Fully Complete (all 6 items) **(9pts)**	Mostly Complete (5/6 items) **(8pts)**	Somewhat Complete (4/6 items) **(7pts)**	Incomplete (3/6 items) **(6pts)**	Substantially Incomplete (1-2/6 items) **(4.5pts)**
Presentation 20% (6 pts)	Fully Complete (all 6 items) **(6pts)**	Mostly Complete (5/6 items) **(5.5pts)**	Somewhat Complete (4/6 items) **(5pts)**	Incomplete (3/6 items) **(4pts)**	Substantially Incomplete (1-2/6 items) **(3pts)**
Organization 20% (6 pts)	Excellent organization which enhances presentation **(6pts)**	Clearly organized **(5.5pts)**	Average organization; some areas a bit unorganized **(5pts)**	Disorganization leads to errors in content communication **(4pts)**	Chaotic; obviously detracts from presentation **(3pts)**
Creativity 20% (6 pts)	Highly enthusiastic; creative without detracting from objectives **(6pts)**	Creative; generates some enthusiasm **(5.5pts)**	Somewhat interesting and entertaining **(5pts)**	Dull; shows little creative effort **(4pts)**	Comatose; boring **(3pts)**
Time Management 10% (3 pts)	8-10 minutes, well-paced and thorough **(3pts)**	8-10 minutes, rushed at the end to finish **(2.5pts)**	8-10 minutes, drug out end to fill time **(2pts)**	<8 or >10 minutes, but well-paced and thorough **(1.5pts)**	<8 or >10 minutes and poorly paced &/or not thorough **(1pts)**
Column Totals					

CONTENT

A fully complete presentation will include:

1. A review of current research related to the topic
2. Justification for hypothesis
3. Methods used to collect data
4. Results with inclusion of figures
5. Interpretation and implication of results
6. Literature citations where necessary

PRESENTATION

A strong presentation will be:

1. Clear and concise
2. Evenly paced
3. Contain well-explained visuals that convey key concepts and results
4. Convey a strong level of preparedness and understanding of the topic
5. Well delivered - presenter(s) face the audience, speak clearly and audibly
6. Show equal involvement by all members of the group

TOTAL SCORE =

In each row, circle the point value corresponding to the evaluation criteria earned by the presenter. Sum each column and then calculate a final score.

Area	Evaluation Criteria				
Content 30% (9pts)	Fully Complete (all 6 items) **(9pts)**	Mostly Complete (5/6 items) **(8pts)**	Somewhat Complete (4/6 items) **(7pts)**	Incomplete (3/6 items) **(6pts)**	Substantially Incomplete (1-2/6 items) **(4.5pts)**
Presentation 20% (6 pts)	Fully Complete (all 6 items) **(6pts)**	Mostly Complete (5/6 items) **(5.5pts)**	Somewhat Complete (4/6 items) **(5pts)**	Incomplete (3/6 items) **(4pts)**	Substantially Incomplete (1-2/6 items) **(3pts)**
Organization 20% (6 pts)	Excellent organization which enhances presentation **(6pts)**	Clearly organized **(5.5pts)**	Average organization; some areas a bit unorganized **(5pts)**	Disorganization leads to errors in content communication **(4pts)**	Chaotic; obviously detracts from presentation **(3pts)**
Creativity 20% (6 pts)	Highly enthusiastic; creative without detracting from objectives **(6pts)**	Creative; generates some enthusiasm **(5.5pts)**	Somewhat interesting and entertaining **(5pts)**	Dull; shows little creative effort **(4pts)**	Comatose; boring **(3pts)**
Time Management 10% (3 pts)	8-10 minutes, well-paced and thorough **(3pts)**	8-10 minutes, rushed at the end to finish **(2.5pts)**	8-10 minutes, drug out end to fill time **(2pts)**	<8 or >10 minutes, but well-paced and thorough **(1.5pts)**	<8 or >10 minutes and poorly paced &/or not thorough **(1pts)**
Column Totals					

CONTENT

A fully complete presentation will include:

7. A review of current research related to the topic
8. Justification for hypothesis
9. Methods used to collect data
10. Results with inclusion of figures
11. Interpretation and implication of results
12. Literature citations where necessary

PRESENTATION

A strong presentation will be:

7. Clear and concise
8. Evenly paced
9. Contain well-explained visuals that convey key concepts and results
10. Convey a strong level of preparedness and understanding of the topic
11. Well delivered - presenter(s) face the audience, speak clearly and audibly
12. Show equal involvement by all members of the group

TOTAL SCORE =

Ethics Rubric				
Criteria	**Ratings**			**Pts**
Additional References	**10 pts** **Full Marks** Student provided references for two reputable sources and used the research as supporting evidence for their ethical decision.	**5 pts** **Partial Credit** Student made reference to two reputable sources in their paper but the information was loosely (or not at all) tied to their ethical decision.	**0 pts** **No Marks** Student failed to reference the addition sources in their paper and/or the cited information was from unreliable sources.	10 pts
Thesis Statement	**10 pts** **Full Marks** Strong thesis statement which clearly identifies the student's ethical choice and why that option was selected.	**5 pts** **Partial Credit** Thesis statement is weak and/or lacking reasoning behind the decision that was made.	**0 pts** **No Marks** Student failed to give a clear thesis statement.	10 pts
Writing	**10 pts** **Full Marks** Excellent grammar. Paper is clear, cohesive, and well documented in APA format.	**5 pts** **Partial Credit** Paper has a few grammatical errors but is still easily understood. Paper is clear or cohesive but not both. some APA formatting issues.	**0 pts** **No Marks** Paper lacks organization. Multiple grammatical errors which distract from the meaning of the paper. Failed to use APA citations.	10 pts
Ethical Reasoning	**10 pts** **Full Marks** Student arrived at a balanced decision taking into account perspectives of all stakeholders and the ethical principles that guide their actions.	**5 pts** **Partial Credit** Student arrived at a decision based on limited consideration of the various stakeholder perspectives. Logical sequence of ideas is loosely linked to the conclusion.	**0 pts** **No Marks** Student arrived at a decision based on personal opinion. Decision proposed in not feasible, acceptable, or ethically justified.	10 pts
				Total Points: 40

Appendix C– ENV Project Research and Adventure Symposium Program

SPECIAL THANKS

PROJECT MENTORS AND COLLABORATORS

Dar Roberts - University of California Santa Barbara

Clare Saiki - University of California Santa Barbara

The Land Group

Emily Schaller and Brenna Biggs

NASA Airborne Science Program

NASA Earth Science Division

NASA DEVELOP National Program

Science Systems and Applications Inc.

David Cohen – Anuenue Fisheries Research Center

Addie Clark – Oregon Institute of Technology

Jherime Kellermann - Oregon Institute of Technology

Josh Clark-Washington Department of Natural Resources

Kirk Davis-Washington Department of Natural Resources

ENVIRONMENTAL SCIENCE FACULTY

Addie Clark

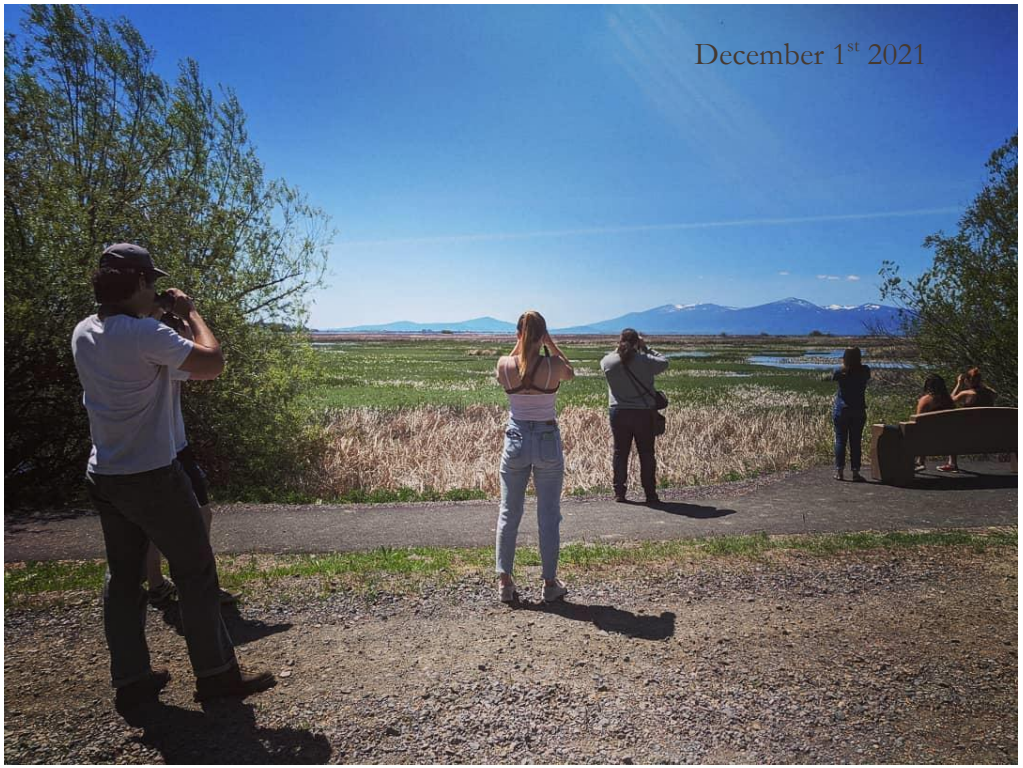
Kerry Farris

Lloyd Parratt

Christy VanRooyen

Jherime Kellerman

ENVIRONMENTAL SCIENCES STUDENT PROJECT & ADVENTURE SYMPOSIUM



ENV STUDENT SPEAKERS

McKenna Armantrout

McKenna Armantrout interned with the Washington Department of Natural Resources in 2019 as a Wildland Fire Analyst. She worked on various GIS projects, learned basic Python coding skills and began an aviation effectiveness research project which is ongoing this year.

Ethan Fujikami

For more than 30 years the State of Hawaii has been overtaken by invasive microalgae. The University of Hawaii and the State of Hawaii Division of Aquatic Resources developed a plan to hatch, raise, and release native sea urchins to control the invasive seaweed and **Ethan Fujikami** is helping with this research.

Jonathan VanDermark

As a participant in the NASA DEVELOP Fall 2021Term, **Jonathan VanDermark** was a member of the Southern California Health and Air Quality team. Their team created the Coastal Region Harmful Algal Bloom Tool, that uses different wavelengths of light to detect the presence of chlorophyll A and Lingulodinium polyedra.

Josh Walls

Josh Walls performed experiments involving nutrient cycling with an emphasis on biological protein production. He raised flocks of Coturnix japonica, studied Hermetia illucens, and researched invasive fish species across the US. Through this research he discovered a new potential method of combating aquatic invaders while minimizing government expenditure.

Elijah Hayes

This year **Elijah Hayes** set out to break the Klamath County big year record of 259 species. A big year is an informal competition among birders who attempt to identify as many species of birds as possible by sight or sound.

Eleanor Kenyon

During the SARP NASA Program **Eleanor Kenyon** and other interns attended lectures from renowned scientists, learned how to code and use satellite imagery processing software, collected aerosol data, and ultimately came up with an independent research project to pursue over the 8-week program. Eleanor used Geographic Information Systems to model debris flow risk following a wildfire, based on factors such as slope, geology, vegetation cover, and fire severity.