2020-21
Environmental Sciences Assessment Report
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Section 1 – Program Mission

The Bachelor of Science program in Environmental Sciences prepares students for immediate employment and graduate studies in the assessment and monitoring of environmental conditions and problems, including research, mitigation and restoration. The BES program focuses on interdisciplinary scientific study of ecology, natural resources, and sustainability with emphases on management, research, and communication. The curriculum is comprised of four integrated core areas in ecology & natural resources; data analysis & statistics; geographic information systems (GIS); and social sciences.

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

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

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

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

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

Section 2 – Program Educational Objectives

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

- A strong applied foundational knowledge of environmental systems including physical and biogeography, aquatic and terrestrial ecology, and environmental chemistry.
- An understanding of the complex relationships between natural and human systems.
- The application of mathematical and statistical concepts to field and laboratory data to study natural phenomena.
- Use of GIS to solve geospatial problems.
- Design, execute, and communicate a scientific project. While all graduates will have gone through the scientific process of study design and implementation, they will not be expected to have a complete mastery of this objective. We hope that being exposed to research as an undergrad will better prepare them for graduate school and/or advancement in their careers.

Section 3 – Program Description and History

Program History

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

Based on exit surveys and advising interviews, 90-95% of students in the ENV major are taking seasonal and permanent positions during summer breaks and following graduation in fields of natural resource management and ecology, primarily forestry, wildland fire, and wildlife and fisheries. This work experience is a driving force behind our amazing BES graduate success rate which was 94% from 2018-20.

Improved enrollment and retention continues to be the primary goal for Environmental Sciences with a target fall enrollment of 60 students within the next 2-3 years. Central to achieving this goal are the strong relationships with community partners that are being built and the development of mentorship within the program. One of the changes made to our curriculum in the last two years was to offer a fall term Mentorship and Teambuilding class which is taken by the majority of the students in the program and counts toward technical elective. In this course students are grouped into teams with both upper and lower classman which we hope fosters better connections throughout the entire program. In fall of 2019, the mentorship class included an overnight camp trip to the Lava Beds National Monument, where teams got to take a variety of mini lessons on things like land navigation, astronomy, mammal skull identification, and natural resource management. The students also got to build relationships through social activities like hiking, yoga, and dining together (Figure 1). In fall of 2020 a modified version of the mentorship course was offered due to COVID where students attended a virtual workshop focused on developing student portfolios in Portfolium. These portfolios provide a platform for students to share examples of their amazing work at OIT and will be used for assessment within the program. With changing COVID guidelines we were able to offer a day long field trip for this course is fall of 2021.

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

In the past two years, the Environmental Science faculty have done an outstanding job adapting to various online, hybridized, and modified in person teaching modalities due to COVID. In a program that is lab intensive, it has been challenging to simulate the types of outdoor and project based learning experiences we have done in the past. Faculty rose to this challenge by offering unique alternatives to former lab experiences such as mailing students lab kits allowing them to conduct experiments and collect samples from home.

Students were sent outdoors using virtually guided field trips to help them gather data on their local environments and then analyze and report on this data. These experiences continue to prepare BES students for employment and graduate school.

While many environmental programs across the United States saw a significant decreases in enrollment related to COVID-19 in the fall of 2020, the Oregon Tech ENV program remained relatively unchanged (Table 1).

Program Location: Klamath Falls Campus only.

Program Enrollment:

Table 1: BES Enrollment 2015-19

Fall 2016	Fall 2017	Fall 2018	Fall 2019	Fall 2020	5 Year Difference	5 Year % Change
42	41	42	37	36	6	-14.2%

Program Graduates:

Table 2: BES Number of Graduates 2013-19

2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
5	11	14	3	8	9	5

Employment Rates and Salaries:

Employment rate and salary data is based on the 2018-2020 graduates of the BES program, and was collected via exit surveys, career services surveys, and Linkedln. It is important to note that not all students necessarily replied to these surveys.

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

Employed	Continuing Education	Looking for Work	Not Seeking	Median Salary	Success Rate
16	0	1	0	$39,280	94%

Industry Relationships:

Table 4: Current relationships between BES and local agencies.

Industry Relationships
Klamath County Public Health Students will be monitoring air quality changes in the Klamath Basin related to Woodstove change outs over the next two years. PI Addie Clark Washington Department of Natural Resources PI Jherime Kellerman Three River Misquito and Vector Contorl PI Jherime Kellerman US Fish and Wildlife PI Jherime Kellerman Natural Resource Conservation Service PIs Christy VanRooyen and Jherime Kellerman Klamath Basin Beekeeping Association & Oregon State Beekeeping Association Students and faculty participating in a variety of pollinator research and educational outreach projects including the potential to use bees as sampling agents for chemical contaminants in an environment, developing a native bee reference collection, designing and building a prototype hive monitoring station, and leading community talks on the importance of pollinators. PI Christy VanRooyen and Terri Torres Department of Environmental Quality & Klamath County Environmental Health OIT recently purchased an air quality monitor to track particulate matter. Data from this monitor will be shared with the DEQ. PI Addie Clark Klamath Falls City Parks Vegetation type inventory at Moore Park. Students taking plant ecology and forest ecology participate in these surveys annually. PI Kerry Ferris Lake County Resource Initiative Students acting as field assistants collecting data as part of a larger crew examining the effects of alternative silvicultural treatments on ponderosa pine recruitment. PI Kerry Farris

Table 5: Recent BES publications and conference proceedings.

Showcase Learning Experiences
These recent publications/conference proceedings included student researchers. *identifies student name. • O'Leary*, D., J.L. Kellermann, & C. Wayne. 2018. Snowmelt, spring phenology, and extended growing season in Crater Lake National Park. International Journal of Biometeorology. DOI 10.1007/s00484-017-1449-3 • Gunning, A.* & J.L. Kellermann. 2017. Black-backed Woodpecker and Wood-boring Beetle Associations with post-fire burn severity following the National Creek Fire. Northwest Scientific Association Annual Meeting, Ashland, OR. • Kellermann, J.L., J. Lajoie*, S. Mohren, & A. Robatcek*. 2014. Black-backed woodpecker occupancy and Mountain Pine Beetle disturbance at multiple scales: Crater Lake National Park, Oregon. American Ornithologist's Union, Cooper Ornithological Society, Society of Canadian Ornithologists 2014 Joint Meeting, Estes Park, Colorado. • VanRooyen, C. & Bennet, J*. 2019. "Geospatial Analysis of Apis mellifera Colonies". Presented at the Western Apicultural Society Conference. July, 2019.

Section 4 – Program Student Learning Outcomes

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

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

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

Section 5 – Curriculum Map

BES curriculum map shown on the following page includes the changes that were approved by CPC in Spring of 2020 (Table 7) and were implemented for the first time in 2020-2021. The new curriculum was specifically designed to better address our PSLOs. For instance, students now focus on analytical and statistical techniques through the following sequence of courses: Scientific Reasoning and Methodology (ENV 224), Environmental Data Analysis (ENV 226), Statistical Methods I (MATH 361), and Advanced Data Analysis (ENV 434) in addition to GIS classes. Students will be expected to apply these analysis skills in their upper division ENV and BIO courses. The new curriculum allows for more customization through technical electives after a broad foundational knowledge in biology, chemistry, physical geography and general physics.

Table 6: BES curriculum map by term

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

Section 6 – Assessment Cycle

Table 7: BES PSLO and ESLO assessment cycle.

Environmental Science BS PSLO and ESLO Assessment Cycle

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

Section 7 – Methods for Assessment

PSLO Assessment 2020-21

In 2020 the following PSLO was assessed: Apply appropriate analytical and statistical techniques to answer data driven scientific questions. Direct measures were collected in ENV 226 and ENV 434 where students complete an extensive data analysis project as part of their lab. Project assignments can be viewed in Appendix A. BES students uploaded examples of their data analysis work to their portfolios which were then evaluated using the ENV Data Analysis Rubric (Appendix B) by the assessment coordinator. If students failed to upload their work to Portfolium, their work was not assessed.

Within the four categories on the rubric, BES students scored an average score of 4.3 of 5.0 possible for Question/Hypothesis, 3.4 of 5.0 for Interpretation, 4.5 of 5.0 for Data Representations, and 3.6 of 5.0 possible for communication of results. It is important to note that with a sample size of thirteen individuals, these results may not be statistically significant. If the data is divided by graduating class, the average score for interpretation of data for Juniors/Seniors is higher, 4.5, than for Freshman/Sophomores, 3.2 indicating improvement in this category as a student progresses within the program. A similar improvement can be noted for communication results: Juniors/Seniors received an average score of 4.8 where Freshman/Sophomores received an average score of 3.3.

In addition to direct measures for Data Analysis we are also using the indirect measure of self-reported efficacy from exit interviews. According to our exit interviews, 100% of our students felt that they are highly proficient at applying appropriate analytical and statistical techniques to answer data driven scientific questions and that their experiences at Oregon Tech **very much** contributed to their ability to do this.

ESLO Assessment 2019-20

In 2019-20 we collected data on the Quantitative Literacy ESLO and Inquiry and Analysis ESLO for institutional assessment purposes. Direct assessment data was collected in ENV 434 and PHY 201. Results from this data are still pending.

Section 8 - Evidence of Improvement in Student Learning

PSLOs in the BES program were updated in 2019 and the PSLO on Data Analysis was edited at that time. While we cannot directly compare results from previous assessment reports about data analysis since the verbiage of the PSLO and how it is assessed has changed, our students overall appear to continue to score highly in the data analysis category. Further, the program continues to require a broad range of data analysis projects throughout its courses giving students many opportunities to develop these skills.

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

As a team of positive and forward-thinking individuals the BES faculty are pleased to be making progress on strategic plans for the program. The newly adopted BES curriculum is the direct result of revisions to the PSLOs. The PSLOs were revised in response to exit interview data and communication with industry partners which suggested the need for graduates with excellent communication skills who can analyze data to make science-based decisions related to environmental issues. Now that industry driven PSLOs are in place with appropriate curriculum, focus has shifted toward collecting valuable assessment data through the implementation of student portfolios. Further, changes in the assessment process as dictated by accrediting boards in higher education will allow for more flexibility in the gathering of assessment data.

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

Things we do well:

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

Opportunities for Improvement

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

Many of the opportunities for improvement listed above were addressed during the program curriculum revision. Approximately 33% of students reported on the 2018-19 exit surveys that the lower division courses did not provide the foundation necessary for upper division courses. In response to this, course work was redistributed in a more meaningful way by developing sequences of classes which are now required to be taken in order. Electives are better distributed with new elective offerings. PHY 201 which will be a more theoretical approach to physics with examples specifically related to environmental issues will be taught for the first time in Winter 2020. The math requirements have shifted more heavily toward data analysis which aligns with professional expectations for our students. Further, new courses will be offered in 2021-22 in soils and hydrology to address content deficiencies which were identified through exit interviews and contact with agency partners.

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

The BES faculty are making every effort to connect our students to regional scientific research. The many partnerships we have formed (Table 4) provide our students with professional experience and connect them to expertise and tools which we may be unable to provide here on campus given our small program size. Increasing student enrollment is of highest priority for the BES program. As mentioned in Section 3 of this report, we have set a target enrollment of 60 students by fall of 2024.

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

We will continue to utilize assessment data to drive decision making within the BES program. We believe that this will lead to a higher recruitment, retention, graduate success rates, and improve learning objective performance. Our use of assessment data will also act as a model for our students about making data driven decisions in the field of educational science which is one of the learning objectives for the program (PSLO 3)!

Appendix A: ENV 226 & ENV 434 Data Analysis Project Assignments

ENV 226 Practical 3 Designing a Project

- ✓ LO 9.1 Combine the principals you have learned in this class about data analysis and presentation to design your own research project based on available data from the Christmas Bird Count.
- ✓ LO 9.2 Present your findings in a PowerPoint presentation.
- ✓ LO 9.3 Critically evaluate the analysis done by your peers.

Part 1 – Due by end of Day on 6/11/20

Every December, the Audubon Society sponsors the Christmas Bird Count (CBC), the nation's longest-running citizen science bird project. From sun up to sun down on their selected day, bird enthusiasts gather to identify and count as many species as they can within their assigned region. Veteran participants compete for bragging rights (and possibly a cold beer) to see who gets the most birds or the most unusual find of the day. The data is submitted to Audubon where it is compiled into a current and historic records of bird species dating as far back as 1900.

Today's assignment will focus on using this data. Take a look at the available data on the CBC website. http://netapp.audubon.org/cbcobservation/

In a Word document, answer the questions below.

1. Current and historical data can be displayed by two possible variables. What are they?

2. While CBCs are generally guided by expert birders, any interested person is welcome to participate. What are some potential limitations to citizen science data? What are the advantages to collecting data this way?

From the Christmas Bird Count website, "The data collected by Christmas Bird Count participants over the years provide a wealth of information to researchers interested in the long-term study of early winter bird populations across North America. *To date over 200 peer-reviewed articles have resulted from analysis done with Christmas Bird Count data. Beyond the items listed here, CBC data has been used by U.S. federal agencies as an important basis for making decisions about birds."*

The Audubon Society provides a CBC bibliography for all of the research based on the data at:

http://www.audubon.org/christmas-bird-count-bibliography

Using the OIT Library database (or Google Scholar), see if you can access one of these studies.

3. Provide the bibliography information and a brief summary of the research.

4. What type of statistical analysis did they use? Comment on the strength/reliability of their analysis based on the information they provide.

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Now that you have examined the available data, come up with a question you could answer using the data? With any project design, it is important to consider the data you will need and the type of analysis you might use to answer the question you pose. Think about the various types of analysis we have used in this class.

5. What is your question?

6. Make a null and alternative hypothesis related to your question.

Part 2 – Due 6/11/20

Download the data sets needed to answer your question. If using current data, you may need to do some cutting and pasting as they only list a certain number of results per page. Historical data can be exported as an excel file. Run an appropriate analysis of the data.

Record a video of your findings in a 5-10 minute presentation in class on 6/11/20. Be sure to include the following:

- What was your question?

- What were the null and alternative hypothesis?

- What type of analysis did you run, and why did you choose this particular method?

- What are your results? Please include any graphs, charts, or tables which help to display the results of your analysis. Don’t forget to mention things like P value and correlation coefficients where appropriate. APA formatting of the presentation.

- Do you accept or reject the null and alternative hypothesis? Why?

ENV 226 Project Paper

Write a scientific paper describing your data analysis project. Your paper should only be **500 words** (not including captions or references) and should contain all the typical aspects of a scientific article including: introduction, methods, results, discussion, plus one or two figures or tables. See descriptions of each section below.

1. *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 one other peer reviewed paper on the topic.
    - An explanation of how your specific research question fills an existing gap in knowledge or contributes 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.

2. *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 – "I ran a Fisher Exact test". Be sure to give credit to the Audubon Society for use of their data. See their Bibliography page which explains how they want people to cite their data.
    https://www.audubon.org/christmas-bird-count-bibliography

3. *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.

Figures and/or Tables: You must include at least one figure and one table in your paper. Figures and tables should ***summarize*** your data and emphasize your key results. 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

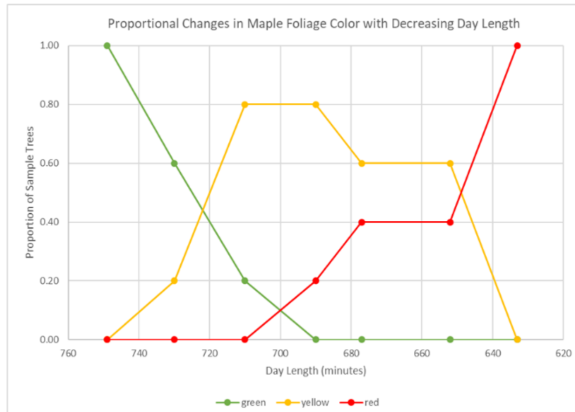

Figure 1. Changes in the proportion of sampled maple trees within three foliage-color categories as day length decreases on the campus of Oregon Tech.

4. *Discussion*: This section reiterates your key results using brief, summarizing statements. It does not report hard numbers or statistics. Did your analysis 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. 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?

5. *Literature Cited*: Here you will list, in alphabetical order by author, all the papers you cited within your report including the Audubon citation. Citations on the reference page and in text citations should be in APA format. If you need more info about APA formatting, check out this link: https://apastyle.apa.org/

Term Project

The main goal of the final project is to help you become confident using the statistical tools covered during this quarter in a real-world data analysis setting. You may draw from any existing environmental data set of your choice. I also have several datasets (outlined below) that you may use if you don't already have one in mind. Your final report (accounting for 30% of your grade) will be **due by Thursday, March 21st** @ **8:00am.** *Successful reports will address **all** the sections outlined below and contain well-organized, fully-formed paragraphs consisting of complete sentences and justification for conclusions including appropriate plots, tables and statistics*.

1. Introduction of the Dataset
    a. How many variables are you examining?
    b. What is/are your explanatory variables?
        i. what type of variables are they?
    c. What is/are your response variable(s)?
        i. what type of variables are they?
2. Hypotheses
    a. What is/are the research hypothesis you want to test with this dataset?
3. Data Exploration
    a. Use the procedures outlined this quarter that are ***appropriate for your question***, ***variables***, and choice of ***test***.
4. Selection of Statistical Analysis Technique
    a. How and why is your selected analysis technique appropriate for your data and your question?
    b. Justify, justify, justify….
    c. What are the assumptions associated with your selected technique? Did you meet them? If not, which ones did your data set fail? What steps did you take in response?
5. Conduct Analysis
6. Interpret and Discuss Results
    a. Did you analysis support or refute your original hypothesis?
    b. What evidence do you have to back up this statement (plots, tables, statistics, etc.)
    c. What was the effect of your independent variable on your dependent variable?
    d. What conclusions can you draw from your result that addresses the real-world question at hand?

Data Sets Currently Available (hopefully 2-3 more available soon)

1. Fire size (ha) and suppression costs in Sierra Nevada
2. Effects of fire severity on mortality of lodgepole pine in Crater Lake NP
3. Effects of scarification on decommissioned roads on the Fremont-Winema NF
    - Understory species diversity
    - Soil Compaction
4. Effects of hazard fuel reduction on the Fremont-Winema NF
    - Shift in tree diameter distribution?
5. Woodpecker foraging habitat selection in relation to fire severity and beetle activity on the Blacks Mountain Experimental Forest (Lassen NF)

Appendix B: ENV Data Analysis Rubric

ENV Data Analysis Rubric: PSLO Apply appropriate analytical and statistical techniques to answer data driven scientific questions.

Performance Criteria	In Progress (1)	Adequate (3)	Exemplary (5)
Question & Hypothesis	Appropriate scientific question and hypothesis, but variables are incorrectly identified.	Appropriate scientific question with clear and correctly defined variables. Hypothesis clearly identifies the variables, but fails to provide the expected trend beyond just that it is different from the null.	Appropriate scientific question with clearly and correctly defined variables. Hypothesis clearly identifies the variables and provides the expected trend in the data beyond just that it is different from the null.
Interpretation	Accurately interprets specific data points on graphs and or interpret results of computations literally.	Accurately interprets specific data points on graphs and or interpret results of computations literally and identifies overall patterns and trends in graphical information.	Accurately interprets specific data points on graphs and or interpret results of computations literally and identifies overall patterns and trends in graphical information. Applies to these interpretations within the broader ecological context.
Representations of Data	Construct graphical models of statistical information in response to specific instructor prompting.	Construct appropriate, complex, and clearly labeled analytical and/or graphical models with instructor prompting or guidance.	Construct appropriate, complex, and clearly labeled analytical and/or graphical models with little to no instructor prompting or guidance.
Communication of Results	Accurately integrate quantitative evidence into basic arguments. However, quantitative evidence is conveyed and explained in such a way that it is difficult to follow or requires expertise in the subject area.	Accurately integrate quantitative evidence into basic arguments. Student uses quantitative evidence to identify, explain, and/or solve a problem. Quantitative evidence is conveyed and explained in such a way that a competent non-expert reader can follow along.	Accurately integrate quantitative evidence into an extended argument in response to a broad prompt. Student uses quantitative evidence to identify, explain, and/or solve a problem. Quantitative evidence is conveyed and explained in such a way that a competent non-expert reader can follow along.