

ENVS 427: Environmental and Ecological Monitoring

Winter 2018 Syllabus

I. Summary Information

A. Instructors

- Peg Boulay, Instructor, 541-346-5945, boulay@uoregon.edu
Office: 244 COL; Office Hour: 3:30 – 4:30 p.m. Wed and by appointment
- Alejandro Brambila, GE, abrambil@uoregon.edu
Office: 47B COL (ELP Lab); Office Hour: 11:00 a.m. – 12:00 p.m. Fri and by appointment

B. Meeting Times and Locations

Lecture: Wednesday 2:00-3:20 p.m.; 142 COL

Lab: Friday 1:00 – 4:50 p.m.; McArthur Court entrance (for off-campus field trips) or 189 PLC

C. Required Readings and Materials

- There is no textbook for this course. Required readings will be available online and/or Canvas.
- 4.5" x 7" Rite in the Rain[®] notebook (mandatory; available at UO bookstore). Do not use a smaller notebook (e.g., 3" x 4.5") – it won't be big enough.

D. Course Website

We will be using Canvas as a means of communication and coordination. Visit our Canvas site regularly throughout the term for announcements, assignments, handouts, worksheets, pdfs of lecture Powerpoint presentations, and other information.

II. Course Overview and Objectives

Environmental scientists collect, analyze and share information for a variety of reasons. Your specific objectives will shape your questions, which in turn, will drive your project design and methods. In the Environmental Leadership Program's (ELP) "Conservation Science in Action" projects, students collect and use information to assist our community partners with ecological research, habitat restoration, management planning, species conservation and other needs. This course is designed to prepare you for your spring ELP projects by introducing you to your team, community partners, project background and protocols. We will also examine the entire process of designing and implementing a monitoring or research program. We will investigate several local case studies and gain hands-on experience using common techniques to collect, manage, summarize and present data. ELP projects all use common techniques to address current conservation issues, so these case studies are relevant to our course work regardless of your affiliation with a particular ELP project. In addition, we will practice some fundamental skills that all field-based environmental scientists should know.

Learning Outcomes (see appendix for more details)

Through active engagement in the course materials and activities, students will be able to:

- Using specific examples, describe how monitoring programs are used to address questions in management of populations, habitats and ecosystems; restoration ecology; environmental remediation; and other fields.
- Outline a process for designing an effective monitoring program that is grounded in clear objectives.

- Compare and contrast local case studies to discover common themes of sampling design, sources of bias, data management, and more.
- Demonstrate how to use common monitoring tools and techniques and describe the circumstances where they are best applied.
- Identify 13-15 native plants.
- Collect and summarize accurate and useful monitoring data by implementing “best practices” for Quality Assurance/Quality Control (QA/QC).
- Search for, read, interpret, and summarize scientific literature. Utilize scientific writing to communicate results.
- Apply listening, communicating, collaborating and other interpersonal skills essential to working within team settings.

Ecological monitoring is highly quantitative and relies on models for predicting outcomes and statistics for analyzing data. Because I emphasize field methods, we do not have time to adequately address statistical design. Please be aware of that you must thoughtfully consider variation, sample size, power and the assumptions of specific statistical tests **before** you collect any data! We will discuss some sampling design considerations during weeks 6-9. Students with limited statistics background often find this content challenging but not overly difficult. I encourage you to engage fully with the readings and ask questions.

III. Class Activities, Evaluation and Grading

Note: We will post assignment grades on our Canvas website. If you believe that we made a data entry error or that you deserve more points on an assignment or exam question, submit a brief explanation of the situation in writing within one week of the scores being posted.

A. Logistics and Standards

- **Submitting Assignments.** To save paper, we will use Canvas (for submitting and returning assignments) and the editing function in Word (for feedback). Unless otherwise instructed, submit all assignments via Canvas. Please complete your assignments in Microsoft Word or a compatible word processing program (generally, open access software works fine). Please don't submit PDFs. Name your file with your first name and assignment title (e.g., Boulay_Search-Synthesis.docx). All assignments are due at the beginning of class on the specified date.
- **Late assignments.** Late assignments will be penalized 5% if turned in late on the due date, then 5% every calendar day, up to one week after the original due date. To submit a late assignment, simply use Canvas. If you need to submit a hard copy (e.g., your Field Notebook), take it to the Environmental Studies office (144 Columbia Hall), ask a Student Adviser to record the date/time and sign it, and place it in my mailbox. Except for emergencies, no assignments will be accepted after one week.
- **Determination of course grade.** Grading will be based on points rather than a curve: A = 450 – 500 pts (90–100%), B = 400 – 459 pts (80–89.9%), C = 350 – 399 pts (70–79.9%), D = 300 – 349 pts (60–69.9%), F = ≤ 299 pts (< 60%).

B. Summary of class activities and grading.

For all major assignments, you will be given a handout with more information.

| Activity | Type of Activity | Total Points | Percent of Grade |
|--|------------------|--------------|------------------|
| Participation & Field Trip Attendance | Individual | 25 | 5% |
| Community Partner-Project Planning Worksheet | | | |
| <i>Section 1 of Worksheet</i> | Individual | 20 | 4% |
| <i>Final Worksheet</i> | Team | 40 | 8% |
| Field Notebook | Individual | 50 | 10% |
| Illustrated Field Guide | Individual | 75 | 15% |
| Project: Monitoring Proposal | | | |
| <i>Literature Search & Synthesis</i> | Individual | 100 | 20% |
| <i>Monitoring Proposal & UO Symposium Abstract</i> | Team | 100 | 20% |
| Final Exam | Individual | 90 | 18% |
| Total Points | | 500 | 100% |

1. Participation: class meetings, Friday labs/field trips. Class meetings give us an opportunity to explore concepts in depth, place them in context, relate them to broader ecological principles or policy considerations, and apply them to environmental issues. We will use class time for exercises, demonstrations, discussion, and problem solving. Your attendance and active participation in class activities will provide you with a greater understanding of the material than can be gained by doing the reading on your own, by talking to someone who attended class, or by reading lecture materials on the class website. The readings will provide you with important background for understanding the material in class, and I will expect that you have done the readings before coming to class.

Factors that contribute to a high participation grade include: completing the assigned readings, being prepared and fully engaged during class activities, sharing your insights on the class material, asking questions when you do not understand a concept, respectfully listening to others' viewpoints, and doing your part to keep exercises and discussions focused and on track. Poor participation in team assignments will affect both the assignment grade and your class participation grade.

Lastly, the Friday labs/field trips are an important part of this course and are designed to give you hands-on practice (plus, they are fun!). Your attendance is required and will factor into your participation grade. If an illness or unforeseeable emergency forces you to miss a field trip, let me know as soon as possible and we will work out an alternate approach. You are required to make up missed field trips.

Dress for success! ("There is no bad weather, only inappropriate clothing." – anonymous). Unless otherwise indicated, the Wednesday lectures will be indoors. The Friday labs will almost always involve at least some time outside, even on days when we don't have off-campus field trips. Since this is Oregon, we can expect to get cold and/or wet. Please dress appropriately to keep yourself warm and dry. Dress in layers and bring raingear, gloves, hat and appropriate footwear. What else to bring on field trips: your Rite in the Rain[®] field notebook, 2 pencils (not pens), and water bottle. *Optional*: umbrella, sunglasses, binoculars, magnifying hand lens, snacks, and personal field plant or animal identification guides.

A note on safety: As part of our field trips, we will hike off trail, cross a small shallow stream, carry lightweight equipment, and use landscaping tools such as shovels, hoes and clippers. We will go over safety procedures in class but we cannot eliminate all risk. Please contribute to safe field trips by following instructions, using equipment with care, watching your footing, being careful around water, and not wandering off. Thanks!

2. Homework: Community Partner Worksheet. This assignment is designed to familiarize you with your ELP Community Partner, project goals, and your teammates. It will also allow you to begin planning your project as a team. Lack of participation in ENV5 427 team assignments will result in a "0" for the assignment.

3. Field Notebook. The purpose of this assignment is to encourage you to take good notes during field trips, to allow you to create your own personal system of recording field notes, and to create a reference for your spring field work. For the Field Notebook assignment, you are required to have a 4.5" x 7" (or similar size) Rite in the Rain[®] notebook.

4. Illustrated Field Guide. This assignment will help you learn the plant species that you will need to know to complete your spring project. The act of sketching will allow you to learn and remember the plants in a more complete way. Your illustrated field guide will also serve as a helpful reference during spring term.

5. Project: Monitoring Proposal. Often practitioners must write a monitoring proposal to communicate project goals/methods and/or secure funding. You will write a streamlined proposal for your ELP project, modeled after federal funding proposals. This assignment will allow you to hone your synthesis and writing skills as you prepare for your project by becoming familiar with relevant literature, completing critical background reading, thinking carefully about your protocols, becoming familiar with your site(s), practicing data analysis, and creating content that can be used during spring term. This project will be completed in two stages: Literature Search-Synthesis and Monitoring plan. This assignment includes submitting an abstract to the UO Undergraduate Symposium. Lack of participation in ENV5 427 group assignments will result in a "0" for the assignment.

6. Final Exam. There will be a comprehensive final exam. The exam will emphasize applying concepts rather than remembering details. Exam questions will be in a variety of formats (short essay, problem-solving, fill-in-the-blank, and other approaches). You will be given a study guide.

7. Optional opportunity: attend Willamette Valley Habitat Management and Restoration meeting. Each year, professionals share discuss land management successes and failures through short presentations. And, each year, I take a few students. I will provide more details in class. Note: this is a professional development opportunity and not for extra credit.

V. Classroom Conduct, Attendance and Special Arrangements

This syllabus describes the roles and expectations for each of us during the course. If you have questions or concerns about any of the course requirements, please let me know as soon as possible.

I support the use of computers to take notes and phones for class activities. However, please show respect to your instructors and fellow students by not checking email/social media, texting, or playing games.

A few words on cheating, plagiarism and other academic misconduct issues: I expect everyone to strictly adhere to the University Student Conduct Code (available at conduct.uoregon.edu) and University policies regarding academic misconduct. All work submitted for this course must be your own and be written exclusively for this course. I will treat any cases of academic dishonesty seriously. If there is any question about whether an act constitutes academic misconduct, it is your obligation to clarify the question with me before carrying out or attempting to carry out the act. Additional information about a common form of academic misconduct, plagiarism, is available at www.libweb.uoregon.edu/guides/plagiarism/students.

A common (and often unintentional) form of academic misconduct is “cutting and pasting” content from sources (including the internet). You must properly acknowledge and document all sources of information (e.g., quotations, paraphrases, ideas). In this course, we will discuss proper methods for evaluating, using and citing reference material.

Your attendance is expected and part of your grade. However, please tell me if you are having significant problems that interfere with your ability to attend or do work in this class. Depending on the situation, I am willing to give you an incomplete or to make special arrangements to allow you to complete your work. However, an “Incomplete” grade in this class may preclude your participation in your spring ELP project. Please ensure that your need is real and unavoidable, that you have done your best to deal with the situation, and that you inform me about it as soon as is practically possible.

Also, the University of Oregon strives to create inclusive learning environments. If there are aspects of the instruction or design of this course that result in disability-related barriers to your participation, please notify me during the first week of class. You may also wish to contact the Accessible Education Center in 164 Oregon Hall at 541-346-1155 or uoaec@uoregon.edu.

ENVS 427: Environmental and Ecological Monitoring

Winter 2018 Class Schedule

If specific pages aren't given, you are expected to read the entire article, chapter or document. This schedule is subject to adjustments: the assignment dates will not change, but topics covered in each class may shift. I will announce any changes in class and on Canvas.

| Wk | Date | Topics | Reading | Assignment Due |
|----|-----------|--|--|--|
| 1 | C1 – 1/10 | - ELP/course overview - Planning a monitoring program (steps) - Why monitor?: Step 1: goals, types | 1. Roni, P., M. Liermann, S. Muhar, and S. Schmutz. 2013. Monitoring and evaluation of restoration actions. <i>Read pp. 254-257 (Sections 8.1-8.3.1 in Ch 8).</i> | |
| | C2 – 1/12 | <u>MEET AT MAC COURT</u> Field Trip: Mt. Pisgah Arboretum - Silvicultural methods: tree dbh & height; canopy closure; distance - Field notebooks | 1. Kershaw, J.A. Jr., M. J. Ducey, T.W. Beers, and B. Husch. 2017. Forest Mensuration, 5 th Edition. <i>Read these pages in Ch 5 Individual Tree Parameters: pp. 92-99, 101 (5.1 Age and part of 5.2 Tree Diameters); pp. 108-120 (5.3 Height); and pp. 125-127 (5.5 part of Crown Parameters). Note: focus on the methods/equipment and don't worry about the mathematical formulas.</i> 2. Field Notebook assignment description 3. <i>Optional: For an example of field notes in ecological restoration, see https://prairieecologist.com/2012/04/17/the-value-of-field-notebooks/.</i> | |
| 2 | C3 – 1/17 | - Field notebooks cont. - Step 2: Questions, scale | 1. Feinsinger, P. 2001. Designing field studies for biodiversity conservation. <i>Read Ch 3 So what's the question? (pp 21-28).</i> 2. Roni et al. 2013. Monitoring and evaluation of restoration actions. <i>Read pp. 257-260 (Section 8.3.2).</i> 3. White, M. A. et al. 2017. Two scales are better than one: Monitoring multiple-use northern temperate forests. <i>Read pp. 44-48 (Introduction and Methods).</i> 4. <i>Think about discussion questions (no write-up required)</i> | |
| | C4 – 1/19 | <u>MEET IN 189 PLC</u> - ELP community partners and project overview - Group norms - Interpreting maps | 1. Community Partner websites (see Homework). 2. Princeton University's Outdoor Action Program's "The OA Guide to Map and Compass" (Ch 6 of <i>The Backpacker's Field Manual</i> by Rick Curtis [1998]). <i>Only read "Maps and Map Reading" section, http://www.princeton.edu/~oa/manual/mapcompass.shtml.</i> 3. USGS. 2001. The Universal Transverse Mercator (UTM) Grid, http://pubs.usgs.gov/fs/2001/0077/report.pdf . | Homework - Partner/ Planning Worksheet (section I) |
| 3 | C5 – 1/24 | - Step 3: Monitoring design - rigor | 1. Elzinga, C. L., D. Salzer, J. W. Willoughby, and J. P. Gibbs. 2001. Monitoring plant and animal populations. <i>Read pp. 2-5 (part of Ch 1 Introduction to Monitoring).</i> 2. Roni et al. 2013. Monitoring and evaluation of restoration actions. <i>Read pp. 260-264 (Section 8.3.3).</i> 3. Muller, I., M. Delisle, M. Ollittraut, and I. Bernez. 2015. Responses of riparian plant communities and water quality after 8 years of passive ecological restoration using a BACI design. <i>Hydrobiologia, https://link.springer.com/article/10.1007/s10750-015-2349-3.</i> 4. <i>Think about discussion questions (no write-up required)</i> | |

| Wk | Date | Topics | Reading | Assignment Due |
|----|------------|--|---|--|
| | C6 – 1/26 | <u>MEET IN 189 PLC</u> - Spatial data: aerial photo interpretation, MAP Library tour - Map and compass - GPS | 1. Paine, D. P., and J. D. Kiser. 2012. Aerial photography and image interpretation. <i>Read pp. 280-289, part of Ch 15 Principles and techniques of aerial image interpretation.</i> 2. “The OA Guide to Map and Compass” cont. <i>Read all pages.</i> http://www.princeton.edu/~oa/manual/mapcompass.shtml . 3. Garmin: What is GPS? http://www8.garmin.com/aboutGPS/ . | |
| 4 | C7 – 1/31 | - Step 3: Monitoring design – parameters - Finding, using and citing and evaluating scientific literature | 1. Elzinga, C. L., D. Salzer, J. W. Willoughby, and J. P. Gibbs. 2001. Monitoring plant and animal populations. <i>Read pp. 6-7 (part of Ch 1 Introduction to Monitoring).</i> 2. Roni et al. 2013. Monitoring and evaluation of restoration actions. <i>Read pp. 264-269 (Section 8.3.4, including table 8.6).</i> 3. Holl, K. D., and J. Cairns, Jr. 2002. Monitoring and appraisal. <i>Read pp 417-428, part of Ch 21 in Perrow, M. R., and A. J. Davy, editors. Handbook of ecological restoration, volume 1.</i> 4. Dean Walton’s Search Strategies for Environmental Studies, https://researchguides.uoregon.edu/Environmental-Studies and UO Libraries Checklist for Evaluating Sources, https://researchguides.uoregon.edu/fakenews/evaluating . | Homework - Partner/ Planning Worksheet (final) |
| | C8 – 2/2 | <u>MEET AT MAC COURT</u> Field trip: Whitewater Ranch #1 | 1. Withrow-Robinson, B., M. Bennett, and G. Ahrens. 2011. A guide to riparian tree and shrub planting in the Willamette Valley: steps to success. EM 9040, http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/24003/em9040.pdf?sequence=1 . <i>Read pp 1-10.</i> 2. Luna T., R. K. Dumroese and T. D. Landis. 2006. Collecting dormant hardwood cuttings for western riparian restoration projects, https://www.fs.fed.us/t-d/pubs/pdfpubs/pdf06242334/pdf06242334dpi300.pdf . | |
| 5 | C9 – 2/7 | - Step 3: Intensity, Qualitative Methods (with a focus on photopoints) | 1. Veblem et al. 2014. Monitoring of livestock grazing effects on Bureau of Land Management Land. <i>Rangeland Ecology and Management 67:68–77, doi: 10.2111/REM-D-12-00178.1.</i> 2. Hamilton, R. No date. Photopoint monitoring, http://www.fs.fed.us/eng/rsac/invasivespecies/documents/Photopoint_monitoring.pdf . 3. <i>Think about discussion questions (no write-up required)</i> | |
| | C10 – 2/9 | <u>MEET AT MAC COURT</u> Field Trip: Willow Cr #1 - Experimental design - Team meeting? | 1. Pfeifer-Meister, L. et al. 2013. Pushing the limit: experimental evidence of climate effects on plant range distributions. <i>Ecology 94:2131-2137. Read entire article.</i> 2. 2018 Climate and Phenology Research Protocol. | |
| 6 | 2/13 | <u>Optional opportunity</u> | <u>Willamette Valley Habitat Management and Restoration meeting</u> | |
| | C11 – 2/14 | - Step 3: Timing, Pilot Studies - Step 4 Sampling Scheme (basic principles of sampling) | 1. Roni et al. 2013. Monitoring and evaluation of restoration actions. <i>Read pp. 269-272 (Section 8.3.5).</i> 2. Elzinga et al. 2001. Monitoring plant and animal populations. <i>Read pp. 76 – 81 (only through “Sampling vs Non-Sampling Errors”; part of Ch 7 Basic Principles of Sampling).</i> | Literature Search and Synthesis |
| | C12 – 2/16 | NO CLASS | <i>Consider working on your Illustrated Field Guide!</i> | |

| Wk | Date | Topics | Reading | Assignment Due |
|----|------------|--|---|--|
| 7 | C13 – 2/21 | Step 4 Sampling Scheme (basic principles of sampling cont.) | 1. Elzinga et al. 2001. Monitoring plant and animal populations. Read pp. 81 – 89 (<i>through “How to Achieve High Statistical Power”</i>). 2. Read about the Bullseye Glass air pollution case in Portland, https://www.opb.org/news/series/portland-oregon-air-pollution-glass/bullseye-glass-health-report-delay/ . | |
| | C14 – 2/23 | MEET AT MAC COURT - Field Trip: Whitewater Ranch #2 - Team meeting? (TBD) | 1. Withrow-Robinson, B., M. Bennett, and G. Ahrens. 2011. http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/24003/em9040.pdf?sequence=1 . Read pp 11-20. | Illustrated Field Guide |
| 8 | C15 – 2/28 | - Step 4 Sampling Scheme (sampling design) | 1. Elzinga et al. 2001. Monitoring plant and animal populations. Read pp. 102-110, <i>through Disturbance Effects</i> . 2. USDA Agricultural Research Service. The Landscape Toolbox – Sample Design, http://www.landscapetoolbox.org/monitoring-design/sample-design/ . | |
| | C16 – 3/2 | MEET AT MAC COURT Field Trip: BWCA - riparian monitoring - Team meeting? (TBD) | 1. 2015 Riparian Revegetation Monitoring Protocol – Plant Level. 2. 2016 Riparian Revegetation Monitoring Protocol – Community Level. Optional: check out the 2017 Riparian Restoration Team’s final report, https://envs.uoregon.edu/pastprojects/ . | |
| 9 | C17 - 3/7 | - Step 4 Sampling Scheme (sampling design cont.) - Step 5 Implement Monitoring (QA/QC) | 1. Elzinga et al. 2001. Monitoring plant and animal populations. Read: 1) pp. 134-140 (<i>part of Ch 8 Sampling Design</i> ; 2) pp. 55-59 (<i>part of Ch 5 General Field Techniques</i>). 2. Herrick et al. 2017. Monitoring manual for grassland, shrubland, and savanna ecosystems, 2nd edition. Read pp. 10-13. 3. Kosmala, M. et al. 2016. Assessing data quality in citizen science. <i>Frontiers in ecology and the environment</i> 14:551-560. doi: 10.1002/fee.1436/. 3. Think about discussion questions (<i>no write-up required</i>) | |
| | C18 – 3/9 | MEET AT MAC COURT - Field Trip: Willow Cr #2 - Vegetation monitoring: NVDI, phenology, percent cover, allometry | 1. Reread 2018 Climate and Phenology Research Protocol. 2. Elzinga et al. 2001. Ch 12 Field Techniques for Measuring Vegetation. Read pp. 206-212 and 218-226. Optional: check out the 2017 Climate & Phenology Team’s final report, https://envs.uoregon.edu/pastprojects/ . | 1) Monitoring Proposal (beginning); 2) Fld. Notebook (end) |
| 10 | C19 - 3/14 | - Monitoring animal populations (pollinators, aquatic invertebrates) | 1. Murdoch et al. 1999. Streamkeeper’s field guide. Read pp. 118-138 (<i>part of Ch 6 The Spineless Ones</i>). 2. Ullmann, K., M. Vaughn, C. Kremen, T. Shih, and M. Shepherd. 2010. California Pollinator Project: Citizen Scientist Pollinator Monitoring Guide. Read pp. 3-19, http://www.xerces.org/wp-content/uploads/2010/06/CA_CSM_guide.pdf . | |
| | C20 - 3/16 | MEETING LOCATION TBD - Field Trip: Alton Baker - Aquatic invertebrates - Synthesis and review | No assigned readings, but I recommend that you review Murdoch et al. (1999) and Roni et al. (2013) Ch 8 (pp 254-272). | |
| 11 | 3/19 | Final Exam | | Final Exam |

**Appendix: ENVS 427 Environmental and Ecological Monitoring
2018 Learning Outcomes**

| What do I want you to be able to do? (Learning Outcomes) | Why does it matter? | How will you know if you have achieved the outcome? (Assignments, Assessments) | How will you use the concepts and skills in your ELP project? (Application during Spring term) |
|--|--|---|---|
| Using specific examples, describe how monitoring programs are used to address questions in management of populations, habitats and ecosystems; restoration ecology; environmental remediation; and other fields. | We invest significant resources – financial and social capital – into regulatory and voluntary interventions to address environmental problems. How do you determine if these actions are working or how to adjust a less successful approach? | Field Notebook, Project Planning Worksheet, Final Exam | Communicate the context and purpose of your project (including in your final report). |
| Outline a process for designing an effective monitoring program that is grounded in clear objectives. | Your specific monitoring objectives will shape your questions, which in turn will drive your project design and methods. To be able answer your monitoring questions, you need to carefully consider issues such as metrics, scale and sampling design. What approaches are appropriate for your objectives? How do you need to adjust common approaches for your particular site and species characteristics? | Final Exam | Implement your project better and collect more useful data due to theoretical understanding. |
| Compare and contrast local case studies to discover common themes of sampling design, sources of bias, data management, and more. | When designing a monitoring program, it is useful to see how other field scientists have addressed common issues. What lessons can you apply to your project? | Field Notebook, Final Exam | Understand and communicate your methods to different audiences. |
| Demonstrate how to use common monitoring tools and techniques and describe the circumstances where they are best applied. | There are some frequently-used methods that any field scientist should know. You will learn how to properly use relevant equipment and implement the methods, as well as the inherent assumptions and limitations. How do you implement your methods? | Field Trips & Notebook, In-class Worksheets, Final Exam | 1. Implement protocols confidently and effectively due to practice. 2. Prevent, identify and solve problems in the field. |
| Identify 12-15 native plants. | Plants are often monitored to evaluate the success of ecological restoration or plant conservation efforts, to characterize ecological communities and as a surrogate for monitoring wildlife. What species will you be measuring? How can you tell? | Illustrated Field Guide | Identify plants correctly, which is critical for properly implementing your project. |

| What do I want you to be able to do? (Learning Outcomes) | Why does it matter? | How will you know if you have achieved the outcome? (Assignments, Assessments) | How will you use the concepts and skills in your ELP project? (Application during Spring term) |
|---|---|---|---|
| Collect and summarize accurate and useful monitoring data by implementing “best practices” for Quality Assurance/Quality Control (QA/QC). | Since the purpose of field work is to collect data that can actually be used to answer your questions, you need to practice paying precise attention to detail and following QA/QC protocols. What can contribute to inaccurate or unusable data? | Field Trips & Notebook, Monitoring Report | Effectively analyze and interpret your data because you have carefully collected and proofread your data. |
| Search for, read, interpret, and summarize scientific literature. Utilize scientific writing to communicate results. | Monitoring doesn’t occur within a vacuum. You must be familiar with the body of research relevant to your project and share your results to have the greatest impact. Why do your data matter? | Monitoring Report | 1. Again, have contextual understanding for your project, 2. Create a useful professional report for your community partner(s). |
| Apply listening, communicating, collaborating and other interpersonal skills essential to working within team settings. | All environmental work – including field work – involves working with other people. Effective teamwork requires thoughtful group processes as well as interpersonal skills. How can your team best work together to meet mutual goals? | Project Planning Worksheet, Monitoring Report | 1. Create group norms and processes to guide your work. 2. Work effectively as a team to implement a complex project. |