PORTFOLIO of TEACHING

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College of Earth, Ocean, & Atmospheric Sciences

Oregon State University

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CONTENTS page #

I. Statement of Teaching Philosophy 2

II. Curriculum Vitae 5

III. Description of Teaching Materials 10

IV. Teaching Improvement Activities 14

V. Student Evaluations of Teaching 18

VI. Appendices 23

 Appendix I. SMILE Spring Challenge Event 2019

 Appendix II. Lesson Plan for Proposed Course Entitled “Global Change, Natural Resources, & Environmental Injustice”

 Appendix III. OC 460 (499) Lesson Plan: Fluvial Sediment Fluxes

 Appendix IV. Analytic Rubric

Welcome to my teaching portfolio. Below I will discuss in detail my teaching goals; my experiences towards achieving and exemplifying these goals in my teaching; and my reflections of how I continue growing as a learner and educator. But first, I would like to briefly outline my graduate teaching experiences.

I pursued a Graduate Teaching Certificate in College and University Teaching (GCCUT) from Oregon State University (OSU). This investment in my training has taught me valuable theories and methods related to adult teaching and learning; enlightened me to issues of difference, power, and discrimination within the classroom; and has instilled in me the tools needed to progress to excellence in teaching, including the especially important tool of self-assessment. Additional to the knowledge I gained through GCCUT, I also gained a variety of formal teaching experiences during my graduate education. As a graduate teaching assistant (GTA), I taught at both undergraduate and graduate levels; online and in-person courses; field, laboratory, and lecture environments. Moreover, I am keenly interested in communication of my science to audiences outside of academia and engagement of coastal community members in my research. As an active member of the OSU College of Earth, Ocean, & Atmospheric Sciences’ Science Communication (CEOAS SciComm) group, I have helped organize and participated in workshops related to communicating research to non-scientific audiences. As an Oregon Sea Grant (OSG) Robert E. Malouf Marine Science Scholar, I designed multiple outreach products and activities for members of the Oregon community. Throughout my portfolio I will elaborate on these experiences.

SECTION I:

Statement of Teaching Philosophy

As a lifelong learner, I am motivated to acquire and create new knowledge, and to share these gains through my commitment to lifelong teaching. This desire to learn and teach propels me towards a career that combines my enthusiasm for researching coastal geomorphologic change, for communicating my science, and for inspiring others – namely college students – to pursue a life of inquiry and interest in the natural world. As a professor, I envision myself teaching a wide diversity of courses including undergraduate and graduate level; in-person, field, and online; and large- and small-enrollment. As an earth scientist, studying the societally-relevant topic of coastal geomorphic change, I seek a career that allows me to continue my outreach and engagement with the public.

Higher education should seek to provide knowledge, skills, and experiences for students related to their chosen career path, but more importantly teach students how to acquire new knowledge, skills, and experiences for themselves. Higher education must also provide students with life experiences that allow them to be informed and engaged citizens. Further, higher education must afford students with tools to improve their lives and those of others. These goals should be universal to higher education; thus, I will focus on my personal goals as I strive for excellence in teaching. (1) Perhaps most importantly, I strive to create equitable teaching and learning environments for my students pursuing earth science degrees and careers. (2) I also seek to be a teacher that provides students with transformational learning experiences. (3) Lastly, through incorporation of best teaching practices including careful, frequent evaluation and revision of my teaching, I hope to constantly improve my teaching.

(1) I seek to create equitable learning environments. Implicit bias, though sometimes subtle and difficult to measure scientifically, is pervasive; it hinders the success of those it targets throughout their entire academic careers. As a woman in science, I have experienced and witnessed this first-hand. As a White scientist, I feel I must use my privilege to dismantle socially unjust systems. There unfortunately exists no simple solution that will eliminate implicit bias and the issues it poses. However, teachers must recognize the social hierarchies, even those that are implicit, and those that students may be unaware of, and mitigate inequity as much as possible. The focus of higher educational institutions must shift from recruitment and retention to attracting and producing a thriving diversity of students. The learning environments should be equitable, meaning that students should feel safe, validated, supported, and challenged.

My participation in seminars and workshops has enlightened me towards the importance of teaching within a diversity of contexts (see Section IV for detail). Changing contexts change how we see ourselves and our students, and how our students see themselves and us. The importance placed on different aspects of our identities will change with time, location, etc, which may refer to interpersonal, community, structural, and/or domestic/international contexts. The workshops I have attended taught me practical strategies for teaching within different contexts. These included learning to communicate within the context of other cultures, using student-centered and culturally mediated instruction, and viewing oneself as a facilitator of education.

Moreover, towards applying this knowledge, my work with the Oregon State University (OSU) Science & Math Investigative Learning Experiences (SMILE) program aimed to increase participation of low-socioeconomic children in earth sciences (see Section III.I for detail). SMILE provides underrepresented Oregon K-12 students with pathway programs to degrees and careers in STEM. My hands-on activities guided high school students, elementary school students, and K-12 teachers in the SMILE program through an experiment investigating organic carbon burial in salt marsh cores at the OSU Marine Geology Repository. This experience not only exposed the SMILE students to earth science content, often lacking in current K-12 curricula, but also engaged them as scientists in exciting, societally-relevant research happening in their region.

(2) I seek never to suffer from “narration sickness”, wherein teachers are tasked with depositing their information into students [1]. I have witnessed this phenomenon often as a student in my STEM courses. Too frequently earth science professors approach difficult, societally-relevant issues, such as those related to climate change, from only the scientific perspective. By not incorporating students’ experiences, the significance of the issue is often lost in this method of teaching. Higher education, when viewed as a process of critical inquiry performed by students and teachers as equals can be transformative and lead to social change. I therefore intend to teach content centered around discussions on complicated and controversial issues related to earth system processes that draw upon the students’ experiences. This form of progressive, problem-solving education provides a means of empowerment for and increases participation by under-represented groups in lifelong learning.

As a GTA for an advanced oceanography course – geological oceanography – I worked to narrow the perceived intellectual gap between myself and my students through careful redirection of questions. Additionally, supplemental to my GCCUT curriculum, I elected to learn about difference, power, and discrimination through inclusive classroom coursework (OSU GRAD 542). In association with this class, I designed a proposed course investigating the intersection of global change, natural resources, and socio-economic inequality. As an example lesson plan, I devised a discussion exploring environmental injustice surrounding preparation, mitigation, and perception of large storm events, with a focus on Hurricane Katrina (see Section III.II for detail). I am eager to deliver this and similar content in my future position.

(3) I additionally strive to incorporate best teaching practices in my classrooms. For instance, despite the challenges associated with connecting students with their natural environment, especially in online and large-enrollment courses, we as educators must incorporate more of these experiences into our lesson plans to combat poor retention of students in the earth sciences. Authentic experiences are especially crucial in introductory earth science courses, as these experiences tend to be the most impactful. Towards accumulating transformative teaching experiences during my graduate degree, I developed and implemented authentic learning activities that enhance how my students view, value, and interact with their natural environment.

As an example, I helped develop laboratory assignments for a newly offered laboratory-based course for undergraduate students. All activities and laboratory assignments were developed by me (as a graduate teaching assistant) and the primary instructor to provide students with authentic learning opportunities that emulate real, scientific data analysis. For instance, I helped develop a laboratory activity for students to analyze real-world stream gauge data maintained by the US Geological Survey (see Section III.III for detail). The project asks students to analyze stream discharge and suspended sediment time series data, develop a research narrative that integrates the peer-reviewed literature, and present their findings in a report format. Each student was assigned a unique river and was given freedom to investigate any aspect of interest related to the record of sediment discharge. This authentic learning experience provides students the opportunity to work with real-world data and to communicate a final research product.

Virtual learning is becoming increasingly more prevalent in today’s academic environments. Online learning provides the opportunity for students from around the world to acquire a low-cost, flexible, convenient education. Large enrollment courses are becoming more popular as online courses become more common. Though these courses are efficient and cost-effective, students are often placed in a passive role. Because it is unlikely that large institutions will reduce class sizes, we as educators must find instructional techniques to increase active and cooperative learning. I have therefore sought opportunities to gain practical strategies to facilitate engaged learning in large-enrollment, online courses. As a graduate teaching assistant, I have assisted in teaching a number of high-enrollment, introductory courses, introductory online courses, and writing intensive, online courses (see Section II.VIII For detail). These experiences taught me valuable, practical knowledge applicable to future courses I will teach. To further my knowledge of instructional strategies important in maintaining an active learning environment within large-enrollment and online courses, I participated in workshops, seminars, and short-courses during my graduate degree (see Section IV for detail). In an effort to continue improving my teaching skills within the virtual environment, I have also paid careful attention to assessments I receive from my online students (see Section V for detail).

To achieve excellence in teaching, we must constantly evaluate our pedagogy. The importance of self-evaluation cannot be over-stated – simply put, it allows us to understand what has been working and what needs revision to ensure our students’ success towards becoming individual thinkers and learners. As an example of my thoughtfulness related to evaluation, as a GTA for an introductory geology course for graduate students I evaluated end-of-term student evaluations of my teaching (see Section V.IV for detail) and created a detailed, analytic rubric to incorporate into laboratory exercises (see Section III.IV for detail). Not only does this rubric make grading more efficient and less biased, it more clearly states the expectations for the students, who in response rose to my expectations and improved their performance.

Through my teaching, I strive to provide students with the skills and experience to be independent learners once they have graduated. My ultimate goal is to be a teacher who provides her students with experiential learning that is transformative to their world-views. I want to be the type of educator that inspires students to become teachers themselves.

[1] Freire, P. (1970). *Pedagogy of the Oppressed*. New York, Continuum.

SECTION II:

Curriculum Vitae

Erin K. Peck

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**Website:** http://blogs.oregonstate.edu/erinkpeck/ • **Twitter:** https://twitter.com/peck\_erin\_k

**I. RESEARCH INTERESTS**

I am interested in determining the factors controlling salt marsh growth and resilience to drowning under sea level rise. Currently, I am comparing the relative importance of sea level rise and suspended sediment supply in driving salt marsh areal growth and vertical sediment accretion along the Oregon Coast. I am additionally interested in quantifying carbon burial rates in these systems.

**II. EDUCATION**

**Ph.D., Oregon State University, Corvallis, OR Enrolled June 2017**

College of Earth, Ocean, & Atmospheric Sciences (CEOAS)

Major: Ocean, Earth, & Atmospheric Sciences

Discipline: Ocean Ecology & Biogeochemistry

Minor: Risk & Uncertainty Quantification in Earth Systems (Summer 2020)

Advisor: Dr. Robert A. Wheatcroft

GPA: 3.95

**Graduate Certificate in College & University Teaching September 2019**

Graduate School, Oregon State University, Corvallis, OR

GPA: 4.0

**Coursework:**

GRAD 607: Capstone (Teaching Portfolio Development) *Summer 2019*

GRAD 610: Internship (Peer-Observation of Teaching) *Spring 2019*

GRAD 542: Difference, Power, & Discrimination, Inclusive Classroom *Spring 2019*

GRAD 513: Professional Development in College & University Teaching *Fall 2018*

GRAD 561: Course Design & Methods for College & University Teaching *Spring 2018*

GRAD 560: Theories & Practice in College & University Teaching *Fall 2017*

**M.S., Oregon State University, Corvallis, OR June 2017**

CEOAS

Major: Ocean, Earth, & Atmospheric Sciences

Discipline: Ocean Ecology & Biogeochemistry

Advisor: Dr. Robert A. Wheatcroft

GPA: 3.95

**B.A., Franklin & Marshall College, Lancaster, PA May 2014**

Major: Environmental Science Minor: Geoscience

Magna Cum Laude

Cumulative GPA: 3.85; Major GPA: 3.86

**III. HONORS, AWARDS, & FELLOWSHIPS**

* National Science Foundation Research Traineeship Program Fellow at OSU (2019); 1-year stipend ($34,000), tuition, & fees
* The Geological Society of America Award for Geochronology Student Reserach2 (AGeS2) (2019); $9,447
* State of the Coast Runner-Up Student Poster Award (2018)
* Oregon Sea Grant Scholars Travel Award (2018); $500
* Oregon Sea Grant Robert E. Malouf Marine Studies Scholarship (2018-2019); $10,800
* Achievement Rewards for College Scientists (ARCS) Scholar Award (2014 – 2017); $18,000
* Murray Levine Memorial Fund for Teaching Assistant Excellence (2016); $500
* Phi Beta Kappa Society (2014 - Present)
* Franklin & Marshall Environmental Science Award (2014); $500
* Lloyd S. Yeakel Memorial Award in Geology for outstanding performance in the field of sedimentology (2013); $500

**IV. PUBLICATIONS**

**Peck, E.K.**, R.A. Wheatcroft, & L.S. Brophy. (in prep). Controls on sediment accretion and blue carbon burial in salt marshes: Insights from the Oregon coast.

de Wet, C.B., A. Moser, K. Oxman, & **E.** **Peck.** (2015). Semi-arid and cyclic carbonates; deposition and diagenesis of the Middle Cambrain Buffalo Springs Formation, Morgantown, Pennsylvania, USA. *PA Geology*.

**V. CONFERENCES**

*AGU Fall Meeting, Washington, DC December 2018*

eLightning Presentation – Controls on sediment accretion and blue carbon burial in salt marshes: Insights from the Oregon coast (Abstract ID: 441159)

*State of the Coast, Coos Bay, OR October 2018*

Poster – Changing sediment and blue carbon accumulation recorded in Oregon salt marshes

*AGU Fall Meeting, San Francisco, CA December 2016*

Poster - Influence of sea level rise on tidal wetland sediment and carbon accumulation under differing fluvial sediment supply in the Pacific Northwest (Abstract ID: 180433)

*ARCS Annual Luncheon October 2016*

Poster – Influence of sea level rise on tidal wetland carbon and sediment accumulation under differing sediment supplies

*CERF 23rd Biennial Conference, Portland, OR November 2015*

Poster - Quantifying sediment and carbon accumulation in Oregon tidal wetlands (Abstract ID: 0480-000886)

**VI. INVITED SEMINARS**

*USGS Brownbag Seminar Series October 2018*

“Controls on sediment accretion and blue carbon burial in salt marshes: Insights from the Oregon coast.”

**VII. RESEARCH EXPERIENCE**

**Oregon State University**, Corvallis, OR

*Ph.D. Dissertation (Dr. Robert Wheatcroft) Fall 2014 - Present*

* Impacts of relative sea-level rise and fluvial inputs on carbon and sediment accumulation in Oregon estuaries

*Collaborator – Institute for Applied Ecology (Laura Brophy) Jan. 2015 - Mar. 2016*

* Goals: (1) quantify carbon accumulation rates at tidal wetland restoration sites and nearby least-disturbed reference sites in Tillamook Bay and Youngs Bay estuaries of Oregon through carbon stock and sediment accumulation analysis on sediment cores, (2) estimate the carbon losses that occurred when the restoration sites were diked and drained, and (3) predict the post-restoration carbon sequestration capacity of the restoration sites

*Research Assistant – South Slough NERR (Craig Cornu) Nov. 2014 - Feb. 2015*

* Assisted PNW coastal blue carbon researchers to develop a collaborative research framework and subsequent research proposals

**Franklin & Marshall College**, Lancaster, PA
*Research Student – Earth & Env. Dept. (Dr. Robert Walter) Fall 2013 – Spring 2014*

* Completion of sediment fingerprinting through the use of Bayesian statistics on compositionally adjusted data

*Hackman Summer Research Scholar – Earth & Env. Dept. (Dr. Robert Walter) Summer 2013*

* Worked to identify the sources of sediment runoff into streams through geochemical sediment fingerprinting with the ultimate goal of aiding in the mitigation of fine-grain, suspended sediment polluting the Chesapeake Bay
* Determined element compositions of source soils and suspended sediment by partial acid digestion and ICP-OES

*Research Student - Chemistry Dept. (Dr. Jennifer Morford) Spring 2013*

* Refined a method for identifying thiols through sample preparation in a glove box and analysis using HPLC with fluorescence detection and ESMS that can be used to determine thiols in sulfidic salt marsh pore water

*Hackman Summer Research Scholar - Chemistry Dept. (Dr. Jennifer Morford) Summer 2012*

* Identified various thiols and trace metals in sulfidic salt marsh pore water from Great Bay (NH) using HPLC with fluorescence detection, and ICP-OES with the ultimate goal of understanding the role of trace metals in the mobilization of thiols within coastal marine sediments

*Laboratory Assistant - Biology Dept. (Dr. Carl Pike) Spring 2012*

* Studied the physiological responses of various plant species grown under elevated carbon dioxide through the analysis of leaf C:N through CHN Analyzer and measurement of root biomass

**VIII. TEACHING EXPERIENCE**

*Graduate Teaching Assistant – Oregon State University, Corvallis, OR Fall 2014 – Present*

OC 103: Exploring the Deep/Geography of the World’s Oceans (undergraduate)

* + Summer 2019 & Fall 2014 (online)
		- Duties included: graded laboratory assignments, quizzes, and exams; responded by email to student concerns
	+ Spring 2016
		- Duties included: lectured and assisted students in the laboratory section; graded laboratory assignments; assisted in fieldtrip; held office-hours

OC 499/460: Geological Oceanography (undergraduate)

* + Spring 2019
	+ Duties included: assisted in course development; lectured and assisted students in the laboratory section; lead in-class literature discussions; graded assignments and exams; held office-hours by appointment

OEAS 520: The Solid Earth (graduate)

* + Winter 2019, Winter 2018, & Fall 2016
	+ Duties included: assisted in course development; lectured and assisted students in the laboratory section; lectured in class sessions; lead in-class literature discussions; graded assignments; held office-hours by appointment

OEAS 500: Cascadia Field Trip (graduate)

* + Fall 2016 & Fall 2015
	+ Duties included: assisted in guiding first-year graduate students around Pacific Northwest ecoregions of interest

OC 201: Oceanography (undergraduate)

* + Winter 2016 (lead TA), Spring 2015 (lead TA), & Winter 2015
	+ Duties included: lectured and assisted students in the laboratory section; lectured in class sessions; graded laboratory assignments, quizzes, and exams; assisted in fieldtrips; held office-hours; as lead TA, organized other GTAs and laboratory materials

GEO 300: Sustainability for the Common Good (undergraduate)

* + Fall 2014 (online)
	+ Duties included: graded written essay assignments; held office-hours; responded by email to student concerns

*Tutor* – *Franklin & Marshall College, Lancaster, PA Spring 2014*

* Course – Sedimentology & Stratigraphy
* Duties included group and individual tutoring sessions, lab preparation and instrumentation (ICP-OES)

**IX. OUTREACH EXPERIENCE**

*Corvallis da Vinci Days Summer 2019*

Designed and will deliver a booth with the goal of communicating to Corvallis community members how Oregon’s salt marshes record the history of Cascadia Subduction Zone earthquakes and tsunami

*OSU’s SMILE Spring Challenge Event Spring 2019*

Designed and implemented a series of hands-on learning activities for K-12 students organized by OSU’s Science & Math Investigative Learning Experiences (SMILE) program. SMILE seeks to provide underrepresented Oregon K-12 students with pathway programs to degrees and careers in STEM. My activities guided ~60 high school students, ~100 elementary school students, and ~25 K-12 teachers in the SMILE program through an activity investigating organic carbon burial in salt marsh cores at the OSU Marine Geology Repository.

*Hatfield Marine Science Day Spring 2019*

Designed and delivered a booth with the goal of communicating to Oregon coastal community members how Oregon’s salt marshes record the history of Cascadia Subduction Zone earthquakes and tsunami

**X. SERVICES TO CEOAS**

*Member:*

Promotion & Tenure Graduate Student Evaluation Committee *Fall 2018*

Academic Mentoring Program *Winter 2018*

CEOAS Communication Group *Fall 2017 - present*

*Organizer:*

Ocean Ecology & Biogeochemistry Grad Night *Fall 2017 - present*

**XI. SERVICES TO OREGON SEA GRANT (OSG)**

Reviewer for the 2019 OSG Summer Scholars Program *Spring 2019*

Reviewer for the 2018 Oregon Applied Sustainability Experience *Spring 2018*

**XII. PROFESSIONAL MEMBERSHIPS**

The Geological Society of America *2019*

American Geophysical Union *2018*

American Geophysical Union *2016*

SECTION III:

Description of Teaching Materials

*I. Increasing Access to Geosciences for Under-Served Youth*

 *SMILE 2019 Spring Challenge Event (Materials in Appendix I)*

1. *Description*

Every spring, Oregon State University’s SMILE (Science & Math Investigative Learning Experiences) program, which is part of the Office of Precollege Programs, hosts Challenge events for high school, middle school, and elementary school students. These K-12 students are involved in SMILE clubs all over the state of Oregon. SMILE’s mission is to “increase underrepresented students’ success in STEM degree programs and careers and deliver high-quality teacher professional development”.

To engage the public with my work in Oregon salt marshes, I developed and delivered hands-on demonstrations at OSU’s Marine Geology Repository (MGR) utilizing sediment cores that teach K-12 students about Oregon’s estuaries. The study of estuaries provides abundant opportunities for students to learn about complex ecological and societal topics because they sit at the land and sea boundary; are influenced by ecology, biogeochemistry, and hydrology; provide ecosystem services that are utilized by local and global communities; and can be threatened by changing climate and anthropogenic activities. The best way to extract data from salt marshes to investigate these topics over time is via sediment cores.

As take-aways from the MGR demonstrations, I intended for learners to have an enduring understanding of estuarine habitats so they can rationally use and advocate for conservation of coastal resources. The specific learning goals of these demonstrations, which dictated my design of the learning activities, were that students would be able to (1) describe how sediment cores are collected in marine environments and how these samples are stored and processed at the MGR, (2) discuss the unique features of Oregon’s estuaries, the services they provide, and the threats they face, (3) visually analyze salt marsh stratigraphy, (4) compare sediment cores with differing anthropogenic histories (e.g., of sea level rise, timber harvest, diking), and (5) identify tsunami sand layers and place them within the context of Cascadia seismic history.

1. *Insights*

Though an example of my non-formal teaching, the micro-curriculum I designed for the SMILE 2019 Spring Challenge Event illustrates a number of my teaching goals. Foremost, my participation in the SMILE program exemplifies my commitment to empowerment through education. I chose to work with the SMILE program because it seeks social justice through provision of STEM opportunities to under-served Oregon K-12 students, especially those from low-socio-economic backgrounds. In addition to hopefully inspiring some of my students to pursue future careers in STEM (especially geosciences!), this experience was certainly one of growth for myself. The experience challenged me to assess the paths that led me to science and the privileges I have been afforded as a White person from a financially secure family. Moreover, though I felt that my prior training through the OSU GCCUT program served me well while designing my activity, I was required to expand my knowledge both to outreach as a form of teaching and to working with K-12 students and the Next Generation Science Standards. This experience provided me with better insight into the educational backgrounds of Oregon public school students and I feel that I can better contextualize many of my local students’ experiences.

Also related to my goals of transformative teaching, I strove to design activities that would be authentic and relate to the students’ experiences. Thus, I designed the activities to rely on scientific model of inquiry using real-world examples (sediment samples) collected from coastal Oregon. By asking students to formulate hypotheses, backup their reasoning, and draw from previous knowledge, I therefore set expectations for students to act as equals in the scientific discovery process. All students rose to these expectations with an infectious enthusiasm.

*II. Holistic Approach to Teaching About the Environment*

 *Lesson Plan for Proposed Course Entitled “Global Change, Natural Resources, & Environmental Injustice” (Materials in Appendix II)*

1. *Design*

In association with a course in which I elected to enroll, GRAD 542: The Inclusive Classroom: Difference, Power, & Discrimination (DPD), I designed a course entitled “Global Change, Natural Resources, & Environmental Injustice.”

The earth is currently undergoing rapid change as a result of anthropogenic activities. Climate change impacts the availability and quality of natural resources, including access to livable and arable land and clean drinking water. Access to these resources are limited to those with social privilege and financial resources, while the burdens of rising global temperature, sea level, and pollution have been forced upon those with less privilege. Students in this class will explore the impacts of climate change on natural resources with a focus on environmental injustice in the U.S. The learning objectives of this course are that students will, (1) understand the social, political, and economic impacts of climate and land-use change to societies with a focus on the U.S, and (2) critically assess how difference, power, and discrimination have altered the study of global change; the assessment of risk associated with natural disasters; and the proposed and implemented mitigation strategies.

For this proposed course, I developed a syllabus and example discussion activity. The discussion activity explores the impacts of climate change on intensifying tropical storm intensities and thus the resulting outcomes for coastal communities. As a case study, the discussion focuses specifically on the victims of Hurricane Katrina. As the learning objectives of this discussion, students will (1) understand the link between rising sea surface temperature due to increased global temperatures and sea surface stratification and increased storm intensities, (2) critically evaluate preparation (e.g., levees and dikes, evacuation plans, and city zoning) of U.S. coastal communities for storm-induced flooding, and (3) assess these preparation strategies within the context of DPD.

1. Insights

Though I have not yet had the opportunity to teach this course, it exemplifies many of my teaching goals in action. First, the course I developed draws upon what I have learned during GRAD 542 and my teaching improvement activities (discussed in Section IV) related to creating an inclusive classroom. Not only would I develop a diverse and inclusive classroom environment, but the content challenges common modes by which we approach science – objectively without critical analysis of social consequence. Moreover, because the activity I designed provides students with the ability to analyze primary literature, a required skill for all scientists, it exemplifies my commitment to authentic learning. As the in-class lesson is also primarily discussion based, it builds students’ interpersonal skills and allows them to experience differing viewpoints and opinions. Indeed, communication skills, information literacy, and interpersonal skills are amongst the most valued skills currently. Thus, drawing on students’ experiences in discussing topics of climate change and natural resources though the critical lenses of the people most impacted will hopefully be transformational.

*III. Authentic Learning Experience*

 *OC 460 (499) Fluvial Sediment Fluxes Laboratory Activity (Materials in Appendix III)*

1. *Description*

OSU’s 4-credit class OC 460 (499): Geological Oceanography is a required course for undergraduate students seeking a BS degree in ocean science and is an elective course for undergraduate students seeking a BS degree in geology or climate science. The course explores sedimentary processes in the ocean and their stratigraphic significance. Specific topics include the structure of the ocean basins; processes controlling sediment delivery to and production within the ocean; sediment redistribution by waves, currents, and gravity; and dynamic sediment accumulation rates in various depositional environments to form the stratigraphic record. The techniques and challenges of deciphering sedimentary archives to better understand Earth history on time scales of events to millions of years are explored, as well.

As a GTA for this course, part of my responsibilities included preparing activities for the laboratory section. Because I was the assistant for this course during the first term that it was offered, I was responsible for designing and editing many of the learning activities. One such activity required students to download stream gauge data from the US Geological Survey’s online repository and calculate annual sediment loads. Each student was assigned a different US river that drains into the ocean and was tasked with analyzing the timeseries data, placing their findings in the context of landscape change.

This exercise relates to the learning outcomes of the course because rivers dominate the supply of particulate matter (e.g., sediment, particulate organic matter, nutrients, pollutants) to the ocean, therefore a firm understanding of the magnitude of fluvial supply and how it varies in time and space is an important starting point for many topics in sedimentary geology. The specific learning objectives of this activity were that students will be able to (1) navigate the USGS stream gauge data site for the U.S., download this data into a data processing program (e.g., Microsoft Excel), (2) understand the meaning of and be able to calculate empirical relationships, (3) calculate values of sediment load and yield, (4) analyze timeseries data, (5) assess errors and inaccuracies associated with sediment discharge data, and (6) use both their data analysis and watershed information (gathered from government websites, peer reviewed literature, etc.) to draw conclusions about landscape processes affecting sediment discharge records.

1. *Insights*

For all laboratory assignments, including the Fluvial Sediment Flux assignment, I chose to develop learning exercises that are authentic. Authentic performance tasks are realistic, inspire innovative thinking, draw upon knowledge and skills, and provide opportunities to practice, reflect, and get feedback. Because students were able to choose how to analyze their data and use the broader literature to assess changes observed in their sediment discharge over time, this authentic performance task also provided students with the opportunity to make many of their own scientific choices. Furthermore, because a final project in this course required analysis of timeseries data, which could include stream gauge data, this assignment allowed students to build skills that eventually can be demonstrated during a complex assignment.

*IV. Assessment in Action*

 *OEAS 520 and OC 460 (499) Analytic Rubric (Materials in Appendix IV)*

1. *Design*

Evaluations from OEAS 520 in Winter 2018 indicated that students were particularly dissatisfied with their performance evaluations throughout the course (rating = 4.6; Table II). For instance, one student said, “It would have been nice to know the expectations of labs and write ups before being graded…” (OEAS 520, Comment 8). Another student responded, “While Erin was very available to assist with assignments, she was inconsistent as a grader and blatantly misinformed the class about how she would grade and what she wanted for the lab format, especially for the first lab assignment” (OEAS 520, Comment 9). In response, I developed an analytic rubric that would provide students with detailed expectations for their laboratory reports.

1. Insights

Analytic rubrics are ideal for assessing laboratory reports because they allow for detailed assessment of individual criteria. Moreover, incorporation of the grading rubric reduced my work load, and still allowed me to provide quality feedback in a structured format. To assess whether the rubric was a valuable tool to students, I posed a specific question in their Student Evaluations of Teaching: To what extent did the rubrics help frame your lab assignments? (e.g., did you consult the rubric before beginning the assignment, after writing to check your work, and/or after receiving your graded assignment?) See Section V.IV for responses. These comments, combined with the “evaluation of student performance” rating of 5.6 (Table II), indicate that the analytic rubric was extremely helpful to students.

SECTION IV:

Teaching Improvement Activities

I have participated in a number of professional development workshops and webinars. In particular I have focused on gaining skills to create an inclusive classroom and to facilitate active learning in large enrollment and online courses. I have detailed this programing (Table I) and below is a description of how I applied and plan to incorporate this knowledge into my teaching strategies.

Table I. List of teaching improvement activities.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Date & Time Commitment** | **Workshop/Seminar Name** | **Location** | **Presenter** | **Brief Description** |
| 6/28/19; 2 h | CEOAS Science Communication Group’s Brown Bag Seminar: SciComm using Twitter | OSU Campus | Sarah Seabrook | Discussed effective communication of science using Twitter |
| 2/15/19; 1.5 h | CEOAS Science Communication Group’s Interview Master Class | OSU Campus | Jane Greenhalgh & Alice Winkler | Dynamic exploration of how to give compelling interviews about our science |
| 10/19/18; 3 h | Oregon Sea Grant Scholars Day Professional Development Training | OSU Campus | Deanna Caracciolo & Catherine Dayger Forbes | Maintaining mentor/mentee relationships and reflective evaluation |
| 4/27/18; 4 h | 2018 CEOAS Science Communication Group’s Workshop: Distilling Research into a Story | OSU Campus | Abby Metzger, Nancy Steinberg, & Jennessa Duncombe | Introduction to different tools and frameworks to help identify and distill science into a storyWorked to translate our research into a hook, elevator pitch, headline, or pithy summary |
| 11/6/18; 2 h | CTL Tuesday Teaching Talks, “Class Time” Lectures & Active Learning | OSU Campus | Devon Quick | Learned approaches to combining student-centered activities and presentation-style instruction |
| 10/29/18; 1 h | CIRTLCast, How can we interrupt and mitigate implicit bias when we witness it? | Online - CIRTL | Eva Pietri | Discussed recommendations for interrupting and mitigating implicit bias |
| 10/23/18; 2 h | CTL Tuesday Teaching Talks, Student Feedback & Responsive Teaching | OSU Campus | Katy Williams | Learned strategies for collecting, analyzing, and responding to mid-course feedback from students |
| 10/22/18; 1 h | SERC, InTeGrate, Webinar: Beyond Teaching: Using Context Diversity to help students thrive while broadening diversity in the geosciences | Online - SERC | Gary Weissmann & Roberto Ibarra | Introduction to Multicontext Theory and Context DiversityDiscussed how Context Diversity may influence my teaching, research, and academic careerLearned examples of how to activate Context Diversity concepts in the classroom |
| 10/22/18; 1 h | CIRTLCast, How can we minimize implicit bias in our academic communities? | Online - CIRTL | Wayne Hilson, Jr. | Discussed minimizing implicit bias in STEM classrooms, higher education institutions, and beyond |
| 10/9/18; 2 h | CTL Tuesday Teaching Talks, Supporting Diverse Learners through Culturally Responsive Teaching | OSU Campus | Jeff Kenney | Explored the theory and practice of culturally responsive teaching |
| 10/8/18 | CIRTLCast, How can we identify implicit biases in ourselves and others? | Online - CIRTL | Sarah Eddy | Discussed reactions to implicit bias in STEM as well as reflected on my own biases |
| 10/2/18; 2 h | CTL Tuesday Teaching Talks, Creating Equitable & Culturally Inclusive Environments | OSU Campus | Jane Waite | - Explored the questions: Why do students experience same classes differently? How does who we are impact the ways we teach and learn? What constitutes an equitable environment? |
| 10/1/18; 1 h | CIRTLCast, How pervasive is implicit bias in STEM? | Online - CIRTL | Leslie Ashburn-Nardo | Discussed the impact of diversity on student learning, in particular how diversity can enhance learning, and how inequities can negatively impact learning if not addressedDiscussed how instructors’ beliefs and biases can influence student learning |
| 9/25/18; 2 h | CTL Tuesday Teaching Talks, Teaching Philosophies & Portfolios | OSU Campus | Brooke Hawland & Tasha Biesinger | Learned how to use philosophies and portfolios to capture the evolution of your teaching, ideology, and accomplishments |
| 8 h | Ecampus Online Teaching Workshops, Teaching an Online Course | Online - Canvas | Self-paced course | Learned practical skills for using Canvas to teach an online course through OSU |
| 1/26/28; 8 h | 2018 Oregon Women in Higher Education Annual Conference | Sunriver Resort, OR | OWHE, various  | Networked with women leaders in the state of Oregon Participated in opportunities for professional growthDiscussed how to be a part of shaping the future of higher education |
| 6/6/17; 4 h | CEOAS Science Communication Group’s Workshop: COMPASS Message Box | OSU Campus | Abby Metzger, Mark Floyd, & Nick Houtman | Introduction to COMPASS and the Message Box strategy for communicating science  |

*I. Creating an Inclusive Classroom*

As I mentioned above, I have focused much of my professional development towards learning more about the topics of creating an inclusive and diverse classroom through reducing implicit bias. I have learned the following and have worked towards incorporating this knowledge into my teaching.

The CIRTLCast Implicit Bias series I participated in provided information related to realizing implicit bias, creating equity in the classroom, and interrupting microaggressions. From this series it has become apparent to me that implicit bias, though sometimes subtle and difficult to measure scientifically, is pervasive. It hinders the success of those it targets throughout their careers. Though it hurts people of color, those from low income households, those who identify as LGBTQ, the differently abled, etc., most research has been conducted on the impacts of implicit biases based on gender. Though there is additionally no simple fix to reducing implicit bias and the issues it poses, the CIRTLCast Implicit Bias webinars provided tools to recognize and interrupt it.

The SERC InTeGrate Webinar: “Beyond Teaching, Using Context Diversity to Help Students Thrive While Broadening Diversity in the Geosciences” delved into the issues associated with increasing diversity in higher education. The webinar speakers noted that the traditional methods for increasing diversity amongst undergraduates were scholarships for minoritized students, affirmative action, multicultural studies, and college prep courses. However, these actions only addressed the symptoms of low diversity and poor academic performance by minorities and not the underlying problem. Increased context diversity and balance between contextual elements is thus necessary. The focus of higher educational institutions should shift from recruitment and retention to attracting and producing a thriving diversity of students.

According to Jane Waite, who delivered the Tuesday Teaching Talk (TTT) entitled “Creating Equitable Teaching and Learning Environments”, the learning environments should be equitable, meaning that students should feel safe, validated, supported, and challenged. Why is this so difficult to achieve? When considering the impact of a student’s culture, Jane Waite stated that we must think about the different learning domains: instruction, which are our lenses through which we see the world, curriculum including the materials, content, exercises, projects, etc.; discourse between peers and instructors; common knowledge and what is assumed to be understood by all; and physical setting which impacts access, messaging, and cultural norms. We must understand that in a diverse society, the dominant culture is a group with social, economic, and political power. Non-dominant cultures thus can feel alienation, isolation, and estrangement in the learning environment. Equitable teaching is one where no cultural world view is valued over another. Teachers must recognize the social hierarchies, even those that are implicit, and those that students may be unaware of, and mitigate inequity as much as possible. Waite provided a number of strategies, tips, and good practice examples, such as engaging in positive interactions with students, using appropriate modes of address, eliminating classroom incivilities, and encouraging open and inclusive classroom discussions.

During his TTT, Jeff Kenney spoke about “Supporting Diverse Learners Through Culturally Responsive Teaching”. Throughout his presentation, Jeff Kenney stressed the importance of context and how it may change how we see ourselves and our students, and how our students see themselves and us. The importance placed on different aspects of our identities will change with time, location, and context, which may refer to interpersonal, community, structural, and/or domestic/international contexts. Similar to those provided by Jane Waite, Jeff Kenney provided participants with pedagogical possibilities, which included learning to communicate within the context of other cultures, using student-centered and culturally mediated instruction, and viewing oneself as a facilitator of education.

*II. Teaching Large-Enrollment & Online Classes*

I have also been interested in gaining practical strategies to facilitate engaged learning in online and large-enrollment courses when I am afforded such an opportunity. For instance, some of the many possibilities for instruction on Canvas were covered by the Ecampus Online Teaching Workshop: Teaching an Online Course. For instance, quizzes with a variety of different question types (e.g., True/False, multiple choice, multiple correct answers, fill in the blank, word matching, etc.) can be administered in and graded directly by Canvas. Additionally, students in large-enrollment courses can be broken up into groups to discuss open-ended questions.

During my professional development training, small group discussions were also advocated as a means for engaging students in much of my other programming related to instructional strategies for large-enrollment courses. For instance, to inspire students to speak during class discussions, Devon Quick during the Nov. 6 Tuesday Teaching Talk (“Class Time” Lectures & Active Learning) suggested teachers ask divergent questions rather than convergent questions. Divergent questions are those that are open ended and often have multiple correct answers (e.g., discussion or evaluation questions), whereas convergent questions are those that have only one correct answer (e.g., true or false statements, or multiple-choice questions). Devon Quick provided many other examples of techniques that motivate students to answer questions in class such as “Think-Pair-Share” (or “Think-Write-Pair-Share”), waiting for responses though the silence may grow awkward, reframing the question, writing multiple answers down on the board, and using clickers or the application “Top Hat”.

*III. Science Communication*

My programming has also focused on honing my science communication skills. A goal of mine is to increase my experience interacting with and educating those outside of the university environment. Through participation in CEOAS SciComm workshops, I have learned skills, such as the COMPASS Message Box, that help to distill and communicate my science effectively to a wide diversity of non-scientific audiences. I have used these skills when giving interviews for news articles and when developing and delivering outreach activities, such as those for the OSU SMILE Spring Challenge Events (Section III.I).

SECTION V:

Student Evaluation of Teaching

*I. Ratings*

The following quantitative evaluations were chosen for two primary reasons. First, I believe these questions most relate to my teaching philosophy. Second, as I was a graduate teaching assistant for these courses and was not tasked with course development or organization, I believe these questions best represent feedback specific to my role. Because there were no assignments related to OEAS 500, I did not include rating for “availability of extra help” or “evaluation of student performance” for this course.

*Table II.* Mean values of course ratings for selected questions. Students were able to respond on a scale of 1 to 6 or respond, “unable to rate”. Scores indicated: 1: Very Poor; 2: Poor; 3. Fair; 4: Good; 5. Very Good; 6: Excellent. The evaluation question did not apply where no rate was calculated (“-”).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Course** | **Total # Students** | **Response Rate** | **Availability of Extra Help** | **Interest in my Learning** | **Ability to Develop a Welcoming Classroom Environment** | **Evaluation of Student Performance** |
| OC 499/OC 460: Geological Oceanography |  |
| Spring 2019 | 25 | 36% | 5.7 | 5.7 | 5.7 | 5.4 |
|  |  |  |  |  |  |  |
| OEAS 520: The Solid Earth |  |
| Winter 2019 | 16 | 50% | 5.6 | 5.4 | 5.3 | 5.6 |
| Winter 2018 | 21 | 48% | 5.4 | 4.9 | 4.9 | 4.6 |
| Fall 2016 | 13 | 85% | 5.8 | 5.6 | 5.8 | 5.4 |
|  |  |  |  |  |  |  |
| OEAS 500: Cascadia Field Trip |  |
| Fall 2016 | 16 | 75% | - | 5.3 | 5.5 | - |
| Fall 2015 | 18 | 67% | - | 5.6 | 5.8 | - |
|  |  |  |  |  |  |  |
| OC 103: Exploring the Deep/Geography of the World’s Oceans |  |
| Spring 2016 | 50 | 54% | 4.6 | 4.5 | 4.7 | 4.6 |
| Fall 2014 (online) | 48 | 73% | 4.5 | 4.6 | 4.7 | 4.8 |
|  |  |  |  |  |  |  |
| OC 201: Oceanography |  |
| Winter 2016 | 24 | 75% | 5.0 | 5.1 | 5.0 | 5.1 |
| Spring 2015 | 17 | 71% | 5.6 | 5.5 | 5.4 | 5.4 |
| Winter 2015 | 48 | 75% | 5.0 | 4.7 | 4.8 | 4.6 |
|  |  |  |  |  |  |  |
| GEO 300: Sustainability for the Common Good |  |
| Fall 2014 (online) | 49 | 65% | 5.4 | 5.3 | 5.6 | 5.4 |

*II. Selected General Written Comments:*

**OC 499/460:**

1. “The core lab had some difficulties, but you were there for my group members. We didn't do as well as we wanted, but I think it had more to do with the people and their motivation for doing this project. The instructions weren't as clear as they could have been, even after we asked the questions that we wanted help with.” (2019)

**OEAS 520:**

1. “Erin was a helpful, clear instructor who was an excellent guide in the learning process.” (2019)
2. “Erin was fantastic at creating an environment that encouraged questions and stimulated conversation. She provided challenging but interesting assignments that kept the class engaging. She made herself available for questions throughout all times of the day and on the weekends.” (2019)
3. “The lab portion of this course was well run and Erin provided excellent guidance and insight into the labs that she led (several throughout the term).” (2019)
4. “Lab activities were helpful, and Erin did an excellent job providing quick feedback and responding to questions about the assignments. The final lab project was disorganized, and I often felt as though our time at the Nypro building could have been better utilized with more organization and clearer instructions for us.” (2019)
5. “I really enjoyed your contribution to the teaching of this class, and it really helped me get more out of the course than [the lead instructors] did. Your explanations of what was expected for us and the objectives for each assignment were very clear and you made it easy to complete assignments in a way that was helpful for our own learning. I think one critique might be that there could be a little more explanation about some of the confusing parts of the labs where students often run into difficulties. This would be things like issues with the tools we're using to gather data for the assignment or maybe even a more comprehensive overview of how to use different aspects of Excel that everyone might not be super familiar with yet. Overall, thank you for being so helpful and available during this course. It was nice to have at least one supportive instructor be a part of this class.” (2019)
6. “Gave very clear instructions for labs and what was expected of us. Helped with analysis tools for every lab, and helped to guide us in the right direction. Also helped us outside of lab, at almost any time. The questions on the labs made us think on our own and develop thoughtful responses. I learned very useful things in this course, things that I won't see in any other courses I have to take.” (2018)
7. “Great job making yourself available to us, and really helping us understand the material. Would recommend holding a recitation for this class would be useful to get all of the questions knocked out in one go rather than repeating yourself 30 times.” (2018)
8. “Erin was always available and willing to help which was awesome. It would have been nice to know the expectations of labs and write ups before being graded and failing the first two labs before getting any feedback. I think its important to remeber that students want to do a good job and will do a good job when they know what is expected of them.” (2018)
9. “While Erin was very available to assist with assignments, she was inconsistent as a grader and blatantly misinformed the class about how she would grade and what she wanted for the lab format, especially for the first lab assignment.” (2018)
10. “Erin was super helpful with the core lab and spent a considerable amount of time with each group making sure they understood everything. The only issue was that none of the groups ended up getting all of the data they needed, which was not her fault, but still difficult to work with.” (2017)
11. “Erin did a fantastic job. Our group wouldn't have been able to get anywhere without her help on the core lab. She did a great job making herself available for questions.” (2017)
12. “Erin's expertise on sediment cores allowed for a lot more in depth analysis and learning then the class would have otherwise done without her.” (2017)
13. “Erin was essential to our group's ability to complete the core lab. She helped us understand what we were looking at on the CT scan and gave us direction with how to interpret the images and further resources on land use changes in our study areas. She was very timely with responding to e-mail questions.” (2017)

**OEAS 500:**

1. “I thought the content and structure of the class was great. Because the nature of the class is to drive around and explore different aspects of Oregon's natural history and current research it would be difficult to improve on, but more structured lectures would be appreciated.” (2016)
2. “The best TA. Very knowledgeable, helpful, nice. Goes above and beyond” (2016)
3. “I LOVED THIS FIELD CLASS! Another necessary incoming graduate class! I attribute this class to my quick understanding and comfort with the school and my cohort” (2015)
4. “Such a wonderful course and great way for incoming graduate students to meet each other and become familiar with Cascadia. I wish more classes like this were available to incoming students.” (2015)

**OC 103:**

1. “Overall a good class that was well organized and put together. Helped me develop a foundation of knowledge and grow academically. Many of the poor ratings are due to it being an online class.” (2014)
2. “You seemed to do a great job. Only emailed you once and you fixed my issue in a timely manner. Cant think of anything to complain about.” (2014)

**OC 201:**

1. “Erin did a great job at being a TA this term. She was very good at answering any questions that came up and her review sessions were very helpful.” (2016)
2. “My experience with teachers assistants has usually been that they are MIA when I need help or are unaccommodating to students under special circumstances due to their busy schedule, which is understandable. Luckily this was not the case for this class. Erin answered my emails quickly and made sure to make a lab available to me when I was gone for a conference. All of the labs were graded fairly as well.” (2016)
3. “Erin was very helpful and a great TA and lecturer. Went through slides in lab a little fast but in lecture the pace was perfect.” (2016)
4. “Erin was an excellent TA. She was very approachable and didn't mind answering a lot of questions, which I appreciated. ” (2015)
5. “Erin is a great TA, always making herself available and going out of her way to explain concepts in a variety of ways and sometimes if necessary multiple times. ” (2015)
6. “Erin is a really awesome TA! I think she can be harsh when grading labs, for an entry level course, but other than that shes pretty badass.. ” (2015)
7. “I feel that the labs were graded too harshly. This was supposed to be a 200-level course, and the quality of work which was expected seemed to be more in line with a 400-level one. ” (2015)

**GEO 300:**

1. “I enjoyed the course and learned so much.” (2014)
2. “I don't know how hands on the TA Erin was but doesn't mean she didn't do a lot, so the best I can evaluate her instruction was overall this course great!” (2014)

*III. Observable Trends*

Of the four criteria I chose to include, my lowest rating is a 4.5 (Table II), which is half-way between good and very good, received in OC 103: Exploring the Deep during fall 2014. This was the first course I taught as a graduate teaching assistant. Since then, I have improved markedly in the other courses I have taught. I credit my improvement to both having had more experience and also to having learned effective teaching skills as a student in the GCCUT program. Additionally, this course was online. I have noticed, both in my ratings and in my comments that students feel disconnected from instructors in online courses. For instance, in GEO 300: Sustainability for the Common Good, one student commented, “I don't know how hands on the TA Erin was but doesn't mean she didn't do a lot …” (GEO 300, Comment 2). Though the student did not elaborate on why online courses would receive a worse rating, another student wrote, “Many of the poor ratings are due to it being an online class” (OC 103, Comment 1). These reviews reveal that when I teach online courses in the future, I must be extra cognizant to communicate with students and create an obvious presence in the online space.

*IV. OEAS 520 Winter 2019 Specific Example of Incorporation of Feedback*

See Section III.IV for explanation. **To what extent did the rubrics help frame your lab assignments? (e.g., did you consult the rubric before beginning the assignment, after writing to check your work, and/or after receiving your graded assignment?)** These were their responses:

1. “The rubrics were very helpful to use as a guide in the assignments. I very much appreciated the clarity of having these available to reference.”
2. “I checked the rubric while writing the lab reports and after receiving the grades. I used the instructions and the questions that were asked on each assignment to frame my lab reports. The detailed instructions and specifying the questions that needed answering per assignment really helped.”
3. “The rubric aided in the grading of the assignment. For the initial lab I may have referenced the rubric to ensure I had all the required parts, but after that I had a good understanding of what was expected on the labs.”
4. “I used the rubric as a guide. It's very helpful to know what exactly the graders are looking for, and rather than simply checking off boxes, I used it to inform and posture the direction of my assignments.”
5. “I felt the lab rubric laid out clearly what I did well and where I might have missed the mark. I consulted the rubric at the beginning and then again after receiving back my graded assignment.”
6. “I personally felt the beginning labs were excellent for synthesizing knowledge learned in class. Mostly due to Erin's clear explanations while working one on one with her and good feedback via the rubric. I felt lost and confused during the core labs but that was in no way Erin's fault as she was not in charge at that period of time.”

SECTION VI:

Appendices

*Appendix I. SMILE Spring Challenge Event 2019*

Interactive Experiences with Oregon Salt Marsh Sediment

**Location:** Oregon State University’s Marine Geology Repository (MGR)

**Audience:** Oregon high and elementary school students in SMILE

**SMILE Mission Statement:** to increase underrepresented students’ success in STEM degree programs and careers, and deliver high-quality teacher professional development.

**Vision:** to provide a broad range of pathway programs to help underrepresented students succeed in STEM degrees and careers. We provide professional development resources that create better teachers.

**Learning Outcomes:**

1. Students will be able to describe how sediment cores are collected in marine environments and Students will be able to describe how these samples are stored and processed at the MGR
2. Students will be able to discuss the unique features of Oregon’s estuaries, the services they provide, and the threats they face
3. Students will be able to visually analyze salt marsh stratigraphy
4. Students will be able to compare sediment cores with differing anthropogenic histories (e.g., of sea level rise, timber harvest, diking)
5. Students will be able to identify tsunami sand layers and place them within the context of Cascadia seismic history.

Timeline:

5 min: Enter the building and get settled, welcome to the marine geology repository at Oregon State University, blurb about my path into science

10 min: Salt marsh presentation and video *\*available upon request\**

* why do you think carbon is important?
* Where does carbon in the atmosphere come from?
* How does it leave the atmosphere?
* Where does it get stored?
* **Why we care about salt marshes**
	+ **What salt marshes are, where they are found, how they fit into the carbon cycle**
* Play video of how we collect the cores

30 min: Table activity and discussion (see below)

10 min: Tour of the MGR

5 min: final questions, goodbyes

Activity Run-through (20 min):

**Questions for students are in bold.** Safety is highlighted.

* Explain the sediment core and table set up in a little detail:
	+ This core is collected from X (show the map)
		- YB = Youngs Bay is located on the northern portion of the state and is part of the Columbia River Estuary
		- NT = Netarts Bay is just south of Tillamook Estuary and is in the northern portion of the coast
		- AB = Alsea Bay is located in the middle portion of the Oregon coast, just south of Yaquina Bay
	+ This timeline shows the last ~100 years, which is what we are able to measure
		- If we assume that this timeline extends back down the core without changing this core is about X years old
			* YB = ~700 y
			* NT = ~950 y
			* AB = ~730 y
	+ This is a CT scan of the sediment core. We scan the sediment cores at a veterinary hospital. It lets us look at the inside of the cores that we can’t see with our eyes, similar to the CT or X-ray scans you get of your body.
		- The lighter areas are more dense, like the PVC pipe or the sandy deposits. The darker areas are less dense, like the air or the plant parts.
	+ In the microscopes we have three samples taken from these different stars on the sediment core so you can look at them.
* **What stands out to you in the sediment core?**
	+ They might jump the gun on the earthquake tsunami deposit but hopefully they have more insights
* **If we know that the last earthquake in Oregon happened ~300 years ago in 1700, where in the core do you think you’d see an earthquake and tsunami deposit? Why there?**
	+ Lead the students through the evidence you have:
		- Visually you see a change in the sediment: buried, organic rich salt marsh that looks similar to the surface, sandy deposit with a sharp contact is an indication of a rapid change, gradual change from sandy sediment back to organic rich sediment = regrowth of the salt marsh
		- Texturally you can feel the difference in the sand and mud – get students to gently touch the mud
		- CT scan shows this trend more obviously
		- Microscope slides show that the mud below the tsunami deposit and the mud at the surface is similar, the tsunami deposit is very different and clearly sand
* **What other evidence would allow us to tell that the deposit is different and maybe an earthquake/tsunami deposit?**
	+ When this happens, this huge wave comes in and buries things in the bay – what would you expect to see buried in the core?
	+ Get the students to spitball ideas. Some answers I can think of are age dating the deposit (radiocarbon/14C), relating the core to other cores collected in the same estuary or along the entire coast, testing the chemistry of the sediment, looking for woody debris in the tsunami deposit, measure change in grain/sand size.
* Explain the hydrogen peroxide procedure: We are going to set up an experiment to measure organic matter in the sediment. Organic matter is made up of plants and other things that were once living and have now decomposed to form this carbon-rich mud. We can pour very strong bleach (hydrogen peroxide) on the sediment. The more plant material is in the mud, the more it will bubble as the bleach dissolves the plants.
	+ For the elementary students – compare the experiment to what happens in our stomachs – digestion = bubbling, gurgling
	+ 30% hydrogen peroxide will burn a little if it gets on your skin and might bleach skin or clothing. If it gets on hands, wash them immediately. If it is a larger spill, use the chemical shower or eyewash station.
	+ Put on gloves and have students put on goggles
	+ Plug the hotplate in and warn students not to touch it. Note: they heat up fast and don’t have to be very hot for the demonstration to work!
* **Where do we think the highest organic matter content is in the core? Where do we think the lowest organic matter content is?**
	+ Highest = surface and also below tsunami (because it was once a salt marsh that got buried quickly during the earthquake and tsunami and didn’t have time to decompose)
	+ Lowest = tsunami sand deposit
* **Where should we take the sediment samples in the core?**
	+ Lead them to choose the top of the core, from the tsunami deposit, and below the tsunami deposit. An additional sample could be from above the tsunami deposit.
* Have different students take a small sample of mud using the spatula and place it in separate beakers. Pour a little water and hydrogen peroxide over the sediment and place them on the hotplates.
	+ Hopefully the organic rich sediment will bubble (but not explode!) while the sandy material wont bubble as much
	+ If this doesn’t happen, add more hydrogen peroxide, slowly.
	+ Once the bubbling starts, don’t let it sit too long on the hotplate or it might start to burn. You can take it off the hotplate to show the students and if the bubbling stops you can place it back on the hotplate temporarily.
* **What do we see?**

Discussion (10 min):

* Ok everyone come back together. **What did we see?**
	+ An earthquake/tsunami deposit
* **How do we know?**
	+ It’s at a depth we expect
	+ We can see it
	+ We can feel it
	+ It shows up in the CT scan
	+ We see a difference in the microscopes
	+ We measured different amounts of organic matter
* **What are some other ways that we could confirm our hypothesis?**
	+ Some answers I can think of are age dating the deposit (radiocarbon/14C), relating the core to other cores collected in the same estuary or along the entire coast, testing the chemistry of the sediment, looking for woody debris in the tsunami deposit, measure change in grain/sand size.
		- Does anyone know what it means to be radioactive?
		- Back when we were using atomic bombs …,
* Great! **Any questions?**

*Appendix IV. Syllabus & Lesson Plan for Proposed Course*

**Syllabus:**

OC 4xx: Global Change, Natural Resources, & Environmental Injustice

**Course Description:** The earth is currently undergoing rapid change as a result of anthropogenic activities. Climate change impacts the availability and quality of natural resources, including access to livable and arable land and clean drinking water. Access to these resources have and will be limited to those with social privilege and financial resources, while the burdens of rising global temperature, sea level, and pollution have been forced upon those with less privilege. Students will explore the impacts of climate change on natural resources with a focus on environmental injustice in the U.S.

**Prerequisites:** OC201, GEO 201, and ATS 201 (Grades of C- or better).

**Credits:** This course is 3 credits, which combines approximately 90 h of instruction, online activities, and assignments.

**Course Meetings:** 9:00 – 10:20 Tu &Th, Burt 193

**Instructor:** Erin Peck

 Email: peckerin@oregonstate.edu

 Office: Burt 126

 Office Hours: open door or by email appointment

**Course Martials:** There is no suitable textbook for the course. Instead we will depend on readings from various book chapters and the primary literature. The readings will be posted on Canvas as .pdf files. It is imperative that you do the readings before or soon after lectures and before discussions.

**Learning Outcomes:**

* Students will understand the social, political, and economic impacts of climate and land-use change to societies with a focus on the U.S.
* Students will critically assess how difference, power, and discrimination have altered the study of global change; the assessment of risk associated with natural disasters; and the proposed and implemented mitigation strategies.

**Baccalaureate Core Learning Outcomes:** This course fulfills the Baccalaureate Core requirements for the Difference, Power, and Discrimination category. It does this by providing student with opportunities to (the following is taken directly from https://dpd.oregonstate.edu/):

* Explain how difference is socially constructed,
* Use historical and contemporary examples, describe how perceived differences, combined with unequal distribution of power across economic, social, and political institutions, result in discrimination, and
* Analyze ways in which the interactions of social categories, such as race, ethnicity, social class, gender, religion, sexual orientation, disability, and age, are related to difference, power, and discrimination in the United States.

**Course Format:** Each class period, we will discuss a specific topic related to global change, natural resources, and environmental injustice. For the first ~10 - 20 minutes of class I will introduce the topic with some background. For the final ~ 70 – 60 minutes, we will discuss the topic and assigned readings. These readings are posted on Canvas.

**Course Assessment (see rubrics):**

Class/Discussion Participation: 50%

Research Proposal: 50%

5% 5 min presentation to the class proposing paper topic

10% peer review 1

10% peer review 2

25% final paper

**Course Content:**

* Environmental racism and environmental injustice
	+ Difference as a social construct
	+ Risk assessment of environmental hazards
	+ Access to nature
* Impacts of climate change and human activities to natural resources
	+ Rising global sea level & destruction of coastal barriers with impacts on livable & arable land
	+ Rising global temperatures and the impact on livable & arable land
		- Increased aridity and drought with impacts on fresh water supply, crop productivity, and wildfire
	+ Pollution of drinking water, air, and soil
		- DDT
		- Lead in the environment
		- BPA
		- Oil Spills
		- Smog
	+ Synergistic impacts
		- Increased hurricane intensity with examples of Hurricane Katrina, Superstorm Sandy, Hurricane Maria, etc.
			* This is the topic I will develop into a lesson plan with supporting material for my final portfolio.
		- Combined impacts of ocean acidification and eutrophication on fisheries (and tragedy of the commons)
* Solutions?

**Statement regarding students with disabilities:** Accommodations for students with disabilities are determined and approved by Disability Access Services (DAS). If you believe you are eligible for accommodations but have not obtained approval please contact DAS (541-737-4098 or http://ds.oregonstate.edu). DAS notifies students and faculty members of approved academic accommodations and coordinates implementation of those accommodations. While not required, students and faculty members are encouraged to discuss details of the implementation of individual accommodations.

Please speak to me about other special accommodations including religious observations.

**Academic Dishonesty and OSU Expectations for Student Conduct:**

Students are expected to be honest and ethical in their academic work. Academic dishonesty is defined as an intentional act of deception in cheating, plagiarism, falsification, assisting, tampering, multiple submissions of work, and unauthorized recording and use. For more information visit http://studentlife.oregonstate.edu/studentconduct/academicmisconduct.

**Course Ground Rules:**

These have been adapted from Jessica Beck and Annie Popkin, OSU instructors and from Weber Canon, L. (1990). Fostering positive race, class, and gender dynamics in the classroom. *Women’s Studies Quarterly, 18,* 125 - 134. **During the first class we will discuss these ground rules and students will have a chance to add to this list.**

* Assume and expect the best of others in class and of yourself.
* Recognize and value the experiences, abilities, and knowledge each person brings to the class. Honor and celebrate the diversity of the class. Teach and learn from others.
* Avoid making sexist, racist, homophobic, classist, anti-creed, ageist, transphobic, or other similar remarks that may have marginalizing effects on your classmates. Do not assume that people are experts on certain topics because of their gender, race, sexual orientation, religion affiliation, age or other identities. Still, accept that mistakes may be made as part of the educational process as we learn and grow together. If you experience situations that are hurtful or offensive, seek to address issues so you can be heard and others can learn from the process. If you need support in doing so, reach out to the instructor or classmates for support.
* Listen actively. This involves paying close attention to what others are saying without thinking of a response while the person is still speaking. It may also involve asking clarifying questions, which are integral to a community of scholars and are meant to expand our thinking, not to devalue another’s perspective.
* Be conscious of your contributions to class and the course. Actively seek ways to share your perspectives but also avoid dominating or monopolizing the class with your questions or ideas. Help to ensure that everyone has the opportunity to speak and add to the discussion. A healthy learning community relies upon the rich, diverse perspectives of all its participants.
* Help create an atmosphere of respect and professionalism. If you share ideas from class with others outside of class or if you share experiences from your own teaching in class, use your professional discretion and be careful not to breach confidentiality.
* Come to class prepared, having carefully completed reading and assignments. Share questions, areas of confusion, or additional resources that you think can further our learning as a community.
* Be willing and open to change. Allow yourself to consider new and diverse perspectives and reconsider currently held ideas and beliefs.
* Be present. As much as possible avoid bringing or engaging in distractions during class such as unrelated work or technology.

**Reading List:**

*Environmental Racism:*

Bailar III, J. C., & Bailer, A. J. (2001). Environment and health: 9. The science of risk assessment. *CMAJ: Canadian Medical Association Journal*, *164*(4), 503.

Bullard, R. D. (1993). Anatomy of environmental racism and the environmental justice movement. *Confronting environmental racism: Voices from the grassroots*, *15*, 23.

Bullard, R. D., & Lewis, J. (1996). Environmental justice and communities of color. *San Francisco*.

Hamilton, J. T. (1995). Testing for environmental racism: Prejudice, profits, political power?. *Journal of Policy Analysis and Management*, *14*(1), 107-132.

Holifield, R. (2001). Defining environmental justice and environmental racism. *Urban geography*, *22*(1), 78-90.

Powell, D. L., & Stewart, V. (2001). Children: the unwitting target of environmental injustices. *Pediatric Clinics of North America*, *48*(5), 1291-1305.

Pulido, L. (1996). A critical review of the methodology of environmental racism research. *Antipode*, *28*(2), 142-159.

Whitehead, M. (2009). The wood for the trees: Ordinary environmental injustice and the everyday right to urban nature. *International Journal of Urban and Regional Research*, *33*(3), 662-681.

Whyte, K. (2017). The Dakota access pipeline, environmental injustice, and US colonialism.

*Rising Sea Level & Coastal Flooding:*

Byravan, S., & Rajan, S. C. (2010). The ethical implications of sea-level rise due to climate change. *Ethics & International Affairs*, *24*(3), 239-260.

Hardy, R. D., Milligan, R. A., & Heynen, N. (2017). Racial coastal formation: The environmental injustice of colorblind adaptation planning for sea-level rise. *Geoforum*, *87*, 62-72.

*Rising Air Temperature:*

Patrick, M. J. (2014). The cycles and spirals of justice in water-allocation decision making. *Water International*, *39*(1), 63-80.

Westerling, A. L., Hidalgo, H. G., Cayan, D. R., & Swetnam, T. W. (2006). Warming and earlier spring increase western US forest wildfire activity. *science*, *313*(5789), 940-943.

*Lead:*

Campbell, C., Greenberg, R., Mankikar, D., & Ross, R. (2016). A case study of environmental injustice: The failure in Flint. *International journal of environmental research and public health*, *13*(10), 951.

Dilworth‐Bart, J. E., & Moore, C. F. (2006). Mercy mercy me: Social injustice and the prevention of environmental pollutant exposures among ethnic minority and poor children. *Child Development*, *77*(2), 247-265.

*Oil Spills:*

Bradshaw, E. A. (2014). State-corporate environmental cover-up: The response to the 2010 Gulf of Mexico oil spill. *State Crime Journal*, *3*(2), 163-181.

Widener, P., & Gunter, V. J. (2007). Oil spill recovery in the media: Missing an Alaska Native perspective. *Society and Natural Resources*, *20*(9), 767-783.

*Air Quality:*

Drury, R. T., Belliveau, M. E., Kuhn, J. S., & Bansal, S. (1998). Pollution trading and environmental injustice: Los Angeles' failed experiment in air quality policy. *Duke Envtl. L. & Pol'y F.*, *9*, 231.

Gugliotta, A. (2000). Class, Gender, and Coal Smoke: Gender Ideology and Environmental Injustice in Pittsburgh, 1868-1914. *Environmental History*, 165-193.
*DDT:*

Kabasenche, W. P., & Skinner, M. K. (2014). DDT, epigenetic harm, and transgenerational environmental justice. *Environmental Health*, *13*(1), 62.

*Hurricanes:*

Kurtz, H. E. (2007). Environmental justice, citizen participation and Hurricane Katrina. *Southeastern Geographer*, *47*(1), 111-113.

McDougall, H. A. (2007). Hurricane Katrina: A Story of Race, Poverty, and Environmental Injustice. *Howard LJ*, *51*, 533.

*Impacts on Fishing:*

Burkholder, J., Libra, B., Weyer, P., Heathcote, S., Kolpin, D., Thorne, P. S., & Wichman, M. (2006). Impacts of waste from concentrated animal feeding operations on water quality. *Environmental health perspectives*, *115*(2), 308-312.

Lloret, J., Rätz, H. J., Lleonart, J., & Demestre, M. (2016). Challenging the links between seafood and human health in the context of global change. *Journal of the Marine Biological Association of the United Kingdom*, *96*(1), 29-42.

Longo, S. B., & Clark, B. (2016). An Ocean of troubles: advancing marine sociology. *Social Problems*, *63*(4), 463-479.

*Additional Reading:*

Eichstaedt, P. H. (1994). If you poison us: Uranium and Native Americans.

Nash, L. (2006). *Inescapable ecologies: A history of environment, disease, and knowledge*. University of California Press.

Sze, J. (2006). *Noxious New York: The racial politics of urban health and environmental justice*. MIT press.

Taylor, D. (2014). *Toxic communities: Environmental racism, industrial pollution, and residential mobility*. NYU Press.

Washington, S. H. (2004). *Packing them in: An archaeology of environmental racism in Chicago, 1865-1954*. Lexington Books.

**Lesson Plan:**

Increased hurricane intensities and flooding of low-lying coastal communities: Focus on Hurricane Katrina

**Course: OC 4xx:** Global Change, Natural Resources, & Environmental Injustice

**Course Type:** In-class, discussion-focused with short lecture

**Number of Students:** ≤ 25 students

**Materials Needed:** reading materials

**Required Readings:**

* Adeola, F. O., & Picou, J. S. (2017). Hurricane Katrina‐linked environmental injustice: race, class, and place differentials in attitudes. *Disasters*, *41*(2), 228-257.
* Bouie, J. (2015). Where Black Lives Matter began: Hurricane Katrina exposed our nation’s amazing tolerance for black pain. *Slate.*
* Reardon, S. (2015). Hurricane Katrina’s psychological scars revealed. *Nature News*, *524*(7566), 395.
* Seidenberg, J. (2005). Cultural competency in disaster recovery: Lessons learned from the Hurricane Katrina experience for better serving marginalized communities.

**Optional Readings:**

* Andrews, T.M. (2017). Beyoncé controversially sampled New Orleans culture in ‘Lemonade.’ Now she’s being sued for it. *The Washington Post*.
* Cochrane, E. (2019). Impasse over aid for Puerto Rico stalls billions in federal disaster relief. *The New York Times*.
* Emanuel, K. (2005). Increasing destructiveness of tropical cyclones over the past 30 years. *Nature*, *436*(7051), 686.
* Knutson, T. R., McBride, J. L., Chan, J., Emanuel, K., Holland, G., Landsea, C., ... & Sugi, M. (2010). Tropical cyclones and climate change. *Nature geoscience*, *3*(3), 157.
* Margetta, R. (2015). Documenting the invisible damage of Karina: Anthropologist’s account of a family’s eight-year recovery after Hurricane Katarina yields lessons for future disasters. *NSF Research News.*
* Sommers, S.R., E.P. Apfelbaum, K.N. Dukes, N. Toosi, & E.J. Wang. (2006). Race and media coverage of Hurricane Katrina: Analysis, Implications, and Future Research Questions. *Analyses of Social Issues and Public Policy, 6*(1), 1-17.

**Objectives of Lesson:**

* Students will understand the link between rising sea surface temperature due to increased global temperatures and sea surface stratification and increased storm intensities
* Students will critically evaluation preparation (e.g., levees and dikes, evacuation plans, and city zoning) of U.S. coastal communities for storm-induced flooding
* Students will assess these preparation strategies within the context of DPD

**Relevance to Course:**

Scientists have observed increased tropical cyclone intensities and durations in the last half-century and have related this to rising atmospheric moisture content and sea surface temperatures are rising, both results of rising air temperature. Coastal communities live on low-lying areas that are at risk of flooding during large storm events. Protection of coastal communities and recovery efforts following flooding is biased towards affluent communities. In New Orleans, poor, mostly black, and elderly communities were hardest hit during Hurricane Katrina and have been the slowest to recover.

**Timeline of Lesson:**

1. Lecture with presentation slides (~15 min) *\*available upon request\**
	1. Climate change impacts on hurricane severity in the U.S.
	2. Influences to hurricane generation
		1. Rising sea surface temperatures
		2. Rising sea levels
	3. It appears that the number of large storms is increasing, especially in the Atlantic Ocean
	4. It appears that the intensity is increasing in both the Pacific and Atlantic Oceans
2. Discussion (~ 65 min)
	1. 5 min: Can someone tell us what happened during Hurricane Katrina?
	2. 10 min: What is the cost of large storms?
		1. Generally, the cost is quantified in terms of recovery cost from a monetary standpoint
		2. Lives lost is also important (though less stressed by researchers)
		3. What about lasting health and psychological tolls?
			1. Cover the results of **Adeola & Picou 2017** and **Reardon 2015**
		4. Cultural losses? Are there ever cultural gains?
	3. 20 min: Evaluate the following statement from the **Adeola & Picou 2017** reading:
		1. “Natural disasters have been characterized in the literature as non-hierarchical, egalitarian, or equal opportunity phenomena, affecting alike all communities in their path regardless of class, race, or any other social attributes (Fritz, 1961; Lieberman, 2006; Adeola, 2012).”
		2. Think, Pair, Share
		3. Who are the most vulnerable to natural disasters?
			1. Age, disability status, gender, minority status, and socioeconomic factors impact the severity of physical and psychological ramifications following a disaster.
	4. 10 min: How do we portray victims of hurricanes? Cover **Bouie 2015**
		1. Black people were portrayed as looters, while white people were said to be looking for food to feed themselves and their families
		2. George W. Bush’s controversial statements
	5. 15 min: How does race and social class play a role during recovery? Cover **Seidenberg 2005**
		1. How is disaster aid allocated?
			1. Disaster aid following Hurricane Maria
	6. 5 min: What can be done? Point students towards Katrina 10 to end on a slightly positive note

*Appendix II. OC 460 (499) Lesson Plan: Fluvial Sediment Fluxes*

**Course:** OC 460 (OC 499); Geological Oceanography

**Course Type:** Computer-based lab section

**Number of Students:** 25

**Date:** Friday, April 19, 2019

**Materials Needed:** computer/laptop, lab assignment, data processing program (e.g., Microsoft Excel)

**Additional Documentation:** rubric, example lab report, lab 3 presentation (including demonstration of how to use a pivot table in Excel)

**Observations of Interest:**

* Organization: statement of how session will be organized
* Interaction: instructor questioning/redirecting questioning
* Use of Media: movement between different (and no) media

Run through the entire lab first, hour long office hours ~ excel help and basic skills

Skills test – through canvas (mac and pc)

How many of you had issues with this?

Reward students for asking questions in addition to those responding or even just activity (up to a certain point)

**Objectives of Lesson:**

* Students will be able to navigate the USGS stream gauge data site for the U.S., download this data into a data processing program (e.g., Microsoft Excel)
* Students will understand the meaning of and be able to calculate empirical relationships
* Students will be able to calculate values of sediment load and yield
* Students will be able to analyze timeseries data in a data
* Students will be able to assess errors and inaccuracies associated with sediment discharge data
* Students will be able to use both their data analysis and watershed information (gathered from government websites, peer reviewed literature, etc.) to draw conclusions about landscape processes affecting sediment discharge records

**Relevance to Course:**

Rivers dominate the supply of particulate matter (e.g., sediment, particulate organic matter, nutrients, pollutants) to the ocean, therefore a firm understanding of the magnitude of fluvial supply and how it varies in time and space is an important starting point for many topics in sedimentary geology.

**General Timeline:**

1. Return graded lab 2
2. Welcome, words of encouragement, outline (~5 min)
3. Review lab 2: GeoMapApp & Ocean Bathymetry (~10 min)
	1. Question 1: roughness of Kansas vs. abyssal plain
	2. Question 2: spreading rate of Mid-Atlantic Ridge vs East Pacific Rise
	3. Question 3: comparison of margin bathymetries
4. Introduce lab 3: Source to Sink Sediment Dynamics (~10 min)
	1. Objective of the lab and how this relates to class material
	2. Demonstration of bringing data into Excel
	3. Demonstration of how to use a Pivot Table in Excel
5. Students work on lab assignment during class, GTA moves around the room answering questions

*Appendix IIV. Analytic Rubric*

|  |  |  |
| --- | --- | --- |
|  | **Quality** | **Rating** |
| **Criteria** | *No/Limited Proficiency*  | *Some Proficiency* | *Proficiency* | *High Proficiency* |
| *Content* | Student has not answered all elements of the prompt. **0 pt** | Student has not provided a background to the assignment.Student has not discussed the methods they have utilized. Student has answered all elements of the prompt.**8 pt** | Student has not provided a background to the assignment.orStudent has not discussed the methods they have utilized. Student has answered all elements of the prompt.**16 pt** | Student has provided a brief but complete background to the assignment.Student has discussed briefly the methods they have utilized. Student has answered all elements of the prompt. **24 pt** |  |
| *Figures* | Student has no figures. **0 pt** | Student has not included all necessary figures.Figures are unclear, missing necessary elements, and/or difficult to interpret.Figure captions are missing, incomplete, or unclear.**8 pt** | Student has included all necessary figures but also extraneous figures. Figures are mostly clear with all or most of the necessary elements. Figures may not be attractive.All figures have complete captions. **16 pt** | Student has included all necessary figures and no excessive figures. Figures are clear and attractive with all necessary elements. There are no excessive elements. All units are SI.All figures have clear, complete, and concise captions. **24 pt**  |  |
| *Data analysis and synthesis* | Student’s data analysis techniques are inaccurate and lacking.Student has not considered error in the analysis.Student has not utilized literature to explain data trends.Student has not provided an interpretation of their data. **0 pt** | Student’s data analysis techniques are not appropriate or complete.Student has not provided accurate sources of error in the analysis.Student utilized literature, but it was not enough to explain the trends, not an accurate interpretation, and not properly cited.Student has provided inaccurate interpretations of their data and literature.**14 pt** | Student has utilized some appropriate data analysis techniques.Student consideration, reporting, or discussion of sources of error in the analysis was incomplete.Student utilized literature, but it was not enough to explain the trends, not an accurate interpretation, or not properly cited.Student has provided interpretations in their report that were not fully supported by both their analysis of the data and primary literature. **28 pt** | Student has utilized multiple, proper data analysis techniques.Student has considered, reported, and discussed sources of error in the analysis.When appropriate, student has utilized primary literature (properly cited) to explain data trends.Student has provided accurate interpretations in their report supported by both their analysis of the data and primary literature. **42 pt** |  |
| *Grammar & clarity* | Student’s writing is difficult to understand. Student has clearly not proof read their report. **0 pt** | Student’s writing is not concise or structured logically. Grammar and use of terms are poor. **3 pt** | Student’s writing is mostly clear though sometimes not concise or structured logically. Grammar and use of terms are mostly correct. **6 pt** | Student’s scientific writing is clear, concise, and compelling. Grammar and use of terms are correct.**9 pt** |  |
| Name (1 pt): |  |  |  | **Total Points (100 pts)** |  |