Climate Justice in Your Classroom

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WEAVING CLIMATE, ENVIRONMENTAL JUSTICE AND CIVIC ENGAGEMENT INTO YOUR COURSES

AFFILIATES OF THE UW PROGRAM ON CLIMATE CHANGE

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Contents

About the Editors and Contributors

Contributors

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    - Dr. Anderson-Frey is an atmospheric scientist who focuses on mesoscale meteorology and the study of severe storms. Her course focuses on the intersection between severe storms, climate change, and societal vulnerability.
- **Dr. Brittany Johnson**
    - Dr. Johnson is a soil scientist and plant ecologist interested in the interactions between climate and ecosystem function. Her work focuses on restorative soil management, and moving towards sustainable systems and communities for the future.
- **Dr. Mikelle Nuwer**
    - Dr. Nuwer is currently the co-chair of the Diversity, Equity and Inclusion (DEI) committee for the School of Oceanography, and discusses the importance of shellfish aquaculture in the

Pacific Northwest and how changing ocean conditions are threatening the success of the industry and the communities that rely on them as a resource.

- **Dr. Luanne Thompson**
    - Dr. Thompson uses oceanic dynamics to understand climate variability and change. She uses climate models and satellite observations to untangle the role the ocean plays in moving and storing heat and chemicals in the climate system, and has been involved in interdisciplinary collaborations that address the challenges climate change will bring to natural and human systems.
- **Dr. Alex Turner**
    - Dr. Turner is an atmospheric scientist focusing on climate and air quality, and specifically, greenhouse gases. He is particularly interested in problems at the intersection of atmospheric chemistry and the carbon cycle, such as understanding how changes in the chemical composition of our atmosphere affect the cycling of carbon from greenhouse gases.

Editors

- **Dr. Miriam Bertram**
    - Miriam is the Assistant Director for the University of Washington Program on Climate Change (UW PCC). Miriam joined the UW PCC in 2001 armed with a PhD in Oceanography and an interest in what an interdisciplinary approach to thinking

about climate could accomplish. She is deeply committed to moving society forward to meet the challenges of a changing climate.

- **Madeline Brooks**
    - Madeline is an undergraduate student at the University of Washington, studying Marine Biology, Aquatic and Fisheries science, and Public Policy, focusing on how conservation and management policy can positively impact both the environment and the folks who call it home. As a changing climate is sure to shape our future, she hopes to use the lens of Environmental Justice to ensure an equitable path to a sustainable future.
- **Isaac Olson**
    - Isaac is an undergraduate student at the University of Washington studying Oceanography and Environmental Studies, focusing on how climate change affects the ocean, how it impacts our lives, and what can be done about it. As a person of color doing environmental work, Climate and Environmental Justice are close to his heart, and he is ecstatic that such a brilliant resource is being put together to increase the visibility and understanding of these issues.
- **Dr. Heather Price**
    - Dr. Price teaches general chemistry and GOB chemistry, and leads the Climate Justice Across the Curriculum project at North Seattle College. Her current National Science Foundation research project, Climate Justice in Undergraduate STEM Incorporating Civic

Engagement, focuses on improving undergraduate STEM education (NSF-IUSE) through the integration of climate justice, equity, and civic engagement across the college STEM curriculum.

- **Dr. Alex Turner**
    - Dr. Turner is an atmospheric scientist focusing on climate and air quality, and specifically, greenhouse gases. He is particularly interested in problems at the intersection of atmospheric chemistry and the carbon cycle, such as understanding how changes in the chemical composition of our atmosphere affect the cycling of carbon from greenhouse gases.

Introduction

DR. HEATHER PRICE, NORTH SEATTLE COLLEGE

Our students learn about climate change in many of our classes and then they are hungry for what to do with that knowledge and how to connect it within their careers and communities. Climate touches and belongs in every subject we teach, and it's not enough for us to only teach the issues and facts. That's like a doctor giving a patient test results, but not the tools to heal and repair. This is where civic and community engagement comes in.

Climate Justice Across the Curriculum workshops seek to build bridges between disciplines and faculty as they incorporate climate justice and civic engagement into their courses in ways that empower students. During these workshops faculty come together to support each other as they weave climate justice and civic engagement into one or more of their classes.

Each chapter of this book contains curriculum developed by an instructor in one of the Climate Justice Across the Curriculum workshops at the University of Washington Seattle held in the winter of 2021 and 2022. These winter workshops at UW Seattle are adaptations of the well-established Climate Justice curriculum workshops at Bellevue College and North Seattle College which grew from the Curriculum for the Bioregion at Western Washington University.

The following section is adapted from a book chapter by Sonya

Remmington-Doucette and Heather Price in, An Existential Toolkit for Climate Justice Educators (2022).

Why weave climate justice and civic engagement into our courses?

Civic and community engagement involves collaboration with others to improve your community and can be done through political or non-political means and by anyone no matter age or citizenship status. It can involve a wide range of actions such as posting on social media, talking with a friend about a climate justice issue, volunteering with a community climate justice organization, testifying before city council, or organizing a protest. In our classrooms, civic and community engagement can also mean instilling in our students the knowledge, skill, responsibility, efficacy, commitment, and values which are all important qualities of engaged citizens (Wang and Jackson, 2005).

There is no one definition for climate justice. A working definition is that it is centered on taking action for a just transition to a sustainable future by recognizing the disproportionate effects of climate disruption on marginalized groups and future generations. It is concerned with inequities that arise from climate disruption that occur between generations (inter-generational equity) and those that occur among people living today (intra-generational equity). Viewing climate change through a justice "lens" means asking questions such as: Who has power and access to resources, and who doesn't? As a result, who feels the disproportionate effects of things like climate change, and who will weather climate changes better as a result of their privileged position in society? It also means taking action to address these inequities and disrupt systems of oppression through community and civic engagement.

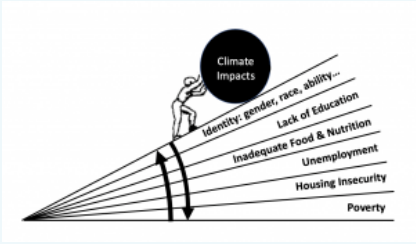

Figure 1: Intra-generational climate justice wedges. Wedges represent factors affecting an individual or community's capacity to mitigate or adapt to climate impacts represented by the boulder. Adapted from Making Partners: Intersectoral Action for Health 1988 Proceedings and outcomes of a WHO Joint Working Group on Intersectoral Action for Health. The Netherlands.

Climate justice includes both intergenerational and intragenerational aspects (Kanbur, 2015; Stapleton et al., 2018). Intergenerational climate justice refers to the impact of one generation on another. For instance, the impact of each generation's resource use on future generations who are not yet here, and do not yet have a voice. Intragenerational climate justice refers to impacts within a generation.

Everyone living today plays a role in intragenerational climate justice. For instance, the lifestyles of the richest 0.54% of global population, about 42 million people, emit more greenhouse gas emissions – due to flying, driving, big homes, and consumption – than the poorest half of the global population, which is over 3.6 billion people (Otto et al., 2019). Various factors such as education, gender, race, ability, employment, food & nutrition, healthcare, and housing, all impact a person or a community's ability to contend with climate impacts that are happening right now (Figure 1). Because of historical oppression and colonization from rich countries and peoples, those most affected by intra-generational climate injustice are people in the global south, and communities of color, particularly Indigenous, Black, and Latinx, living in rich countries.

An example of an intra-generational climate justice issue is particulate matter (PM 2.5) air pollution that comes from climate-exacerbated wildfires and smoke in the Western U.S. and from the burning and extraction of fossil fuels like methane (so-called natural) gas, oil, and coal. Burning fossil fuels is now recognized to be responsible for an estimated 1 in 5 deaths worldwide, and over 950 deaths each day in the US (Vohra et al., 2021). A person or community's ability to contend with PM2.5 air pollution depends on many factors listed in Figure 1. This is also where the benefits of community engagement are apparent. For instance, in Seattle, a BIPOC led community organization, Got Green, set up a trading space for people in the community to donate or pick up air filters and box fans during the 2020 smoke season, at a local coffee house, the Station Cafe. The organization utilized the power of social media to advertise this to the community on Instagram. In this way, community engagement, in the form of mutual aid, can help individuals or a community to overcome some of these disparities. This local example has also been used as an example of civic engagement and climate justice in the authors' STEM major college-level chemistry classes.

Description of Climate Justice Faculty Curriculum

The Climate Justice with Civic Engagement Across the Curriculum project for faculty development was adapted from a well-established local sustainability curriculum infusion model developed by the Curriculum for the Bioregion Initiative under the leadership of Jean McGregor (Washington Center for Improving the Quality of Undergraduate Education, 2020). This program at UW, NSC, and BC came about from grassroots efforts of faculty and staff presenting a proposal to administrators for funding, and included support from the offices of Instruction, Sustainability, Equity, Diversity, and Inclusion, and Student Leadership. At UW and NSC, a student TA was also employed to provide a student perspective and voice. The curriculum offers in-person and online learning communities, summer institutes, workshops, and other modalities that provide interdisciplinary faculty cohorts with the financial support and time to co-create and weave climate justice and civic engagement into their courses. Financial support, paying faculty for their time in lesson development and implementation, is important especially for community college faculty who are tethered to very high teaching loads with little time "to ponder, rethink, relearn, and redesign courses" (Hiser, 2020, p.1).

It's also important to protect meeting times for collaborative work and discussion so that most lesson creation happens in-community. Three to four online workshop meeting days, 1.5 to 2 hours each, take place with one to two weeks between each meeting day. This spacing allows time for faculty to reflect on their readings and discussions, and to design their curriculum. It's also important to keep these faculty institutes and

workshops relatively small, or to allow for online or in person breakout spaces where faculty feel comfortable discussing the challenges of incorporating issues of justice, equity, and community action into their courses. This is especially important for STEM faculty for whom incorporating such issues is often a new skill, and is also why it's important to pair STEM faculty with humanities and arts faculty for whom this way of teaching is the norm. Faculty benefit from working with small groups of 8-16 colleagues at the same institution, learning from each other and building bridges across disciplines.

An online learning system, in our case Canvas, is used to organize faculty into quarterly learning community groups of 8-16 faculty, where they can find and share resources on climate justice case studies and civic and community engagement. A public facing website is also available to point passersby to the curriculum repositories and upcoming opportunities to participate.

Table 1. Brief overview of the five components of the existing CJC interdisciplinary faculty PD model

Components	Description of Activities: Activities can occur in a one day (2 hour) Workshop, or over a 3-4 day (1.5-2 hour/day) Faculty Institute
1. Introduction to Climate Justice, and Community and Civic Engagement (C&CE)	Getting participants into the "mindset" to create lessons that integrate climate justice and C&CE requires baseline knowledge of climate justice and C&CE. Therefore, the first step is for faculty to learn about and discuss climate justice and C&CE. Through readings and group discussions they learn how climate justice and C&CE are different from, but related to, climate science and service learning, respectively.
2. Interdisciplinary Faculty Group Brainstorm to Create a Draft Module.	The next step is for faculty to work together in an interdisciplinary group brainstorm to come up with an outline for a module (lesson, assignment, lab, and/or activity) for their chosen class. Faculty first identify basic disciplinary concepts and skills specific to their discipline and chosen class. Next, they connect these concepts and skills to climate justice and C&CE. Faculty create and share their draft lessons using a visual that triangulates their disciplinary concepts and skills with the climate justice issue(s) and the C&CE they will weave into their courses. Throughout the brainstorm exercise, faculty give and receive feedback as they share-out their lesson ideas and drafts.
3. Experience a Climate Justice Lesson and Collaborative Reflection	The facilitator walks through or shares an example lesson that includes a climate justice issue and C&CE, and illustrates a variety of pedagogical elements (lectures, activities, videos, discussion). Participants continue to brainstorm and work on their lesson drafts in small interdisciplinary groups as they reflect on the pedagogical elements they may adopt, determine resources and information still required, and how to situate the lesson in their course based on students' prior knowledge.
4. Faculty Present Draft Module with Feedback and Reflection	Each faculty presents a short overview of their lesson to the interdisciplinary faculty group, including an overview of all lesson materials (i.e. learning outcomes, Powerpoint presentations, videos, grading rubrics, activity sheets, assignments). After each presentation, the group offers feedback. Faculty are also asked to offer their reflections and insights on how different disciplines connect climate justice and C&CE to their disciplinary content.
5. Faculty Submit their Module to a Curriculum Repository	Faculty implement their Climate Justice Lessons. One other faculty person from the interdisciplinary group observes their lesson. After lesson implementation, faculty and students complete surveys. Faculty make final lesson revisions and create a lesson plan. Finally, lessons are uploaded to a public Curriculum Repository.

Some Additional Resources

The Curriculum for the Bioregion initiative's Sustainability Courses Faculty Learning Community spent several meetings in 2012 brainstorming big ideas in sustainability that would be relevant to college and university learners. Robert Turner, a faculty member at University of Washington Bothell, created this website to collect our work; there are some excellent resources here: http://faculty.washington.edu/rturner1/Sustainability/Big_Ideas01.htm

Teaching-and-learning activity ideas can be found in the Curriculum for the Bioregion Curriculum Collection, which is housed at the Science Education Resource Center (SERC) at Carleton College. Visit the Curriculum for the Bioregion website (http://bioregion.evergreen.edu) and click on Curriculum Collection.

More details and information about the Climate Justice Across the Curriculum projects at Bellevue College and North Seattle College can be found at http://www.bellevue.edu/climatejustice and https://northseattle.edu/climate-justice

"Curriculum for the Bioregion" Initiative, Washington Center for Improving the Quality of Undergraduate Education, The Evergreen State College. http://bioregion.evergreen.edu

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Media Attributions

- CJPressbookFig1

About the Author

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PART I

MAIN BODY

DR. ALEX TURNER, UW ATMOSPHERIC SCIENCES

EXAMINING AIR QUALITY INEQUITY IN MAJOR US CITIES DURING THE COVID-19 PANDEMIC

This module is taught as part of ATM S 358: Fundamentals of Atmospheric Chemistry at the University of Washington-Seattle. ATMS 358 is an introduction to the chemical and physical processes that determine the composition of the atmosphere and how these connect to climate, ecosystems, and human welfare. Topics include the nitrogen, oxygen, carbon, sulfur cycles, the chemical forcing of climate change, stratospheric ozone, the oxidizing power of the atmosphere, air pollution, and acid rain.

OVERVIEW

- **Climate Justice Issue:** The stark disparities in air pollution based on race, ethnicity, etc
- **Target Audience:** 300-level students
- **Lesson Length:** 1 class period (50 minutes) with prior preparation
- **Learning Objectives:**
    - Quantify the magnitude of the inequity in air quality
    - Understand how to approach the scientific literature
- **Topic Overview:**
    - *This lesson is centered around the paper "COVID-19 pandemic reveals persistent disparities in nitrogen dioxide pollution" by Kerr, Goldberg, and Anenberg.*
        - *DOI: 10.1073/pnas.2022409118*
    - Even before the COVID-19 pandemic, there was evidence of stark disparities in air pollution linked to increased levels of traffic that leads to higher exposure for minority and low socioeconomic communities. For example, NO_2levels in the least White census tracts of the United States were nearly

triple the levels in the most White tracts. Because of the prevalence of highways and interstates in racially and ethnically diverse areas, the decrease in passenger traffic as a result of the lockdowns associated with the COVID-19 pandemic resulted in the largest reductions in NO_2 being linked to areas with 2.0 times more non-White residents and 2.1 times more Hispanic residents than the neighborhoods that experienced the smallest reductions. However, despite the largest reductions occurring in marginalized areas, non-White neighborhoods still had worse air quality during the lockdown than White neighborhoods before lockdown. Policies that aim to eliminate pollution disparities will need to address much more than simply reducing emissions from passenger traffic, but also consider other collocated sources of emissions, including heavy-duty vehicles.

- **Chapter Components:**
  - Lesson Overview
  - Instructor Guide
    - Description of lesson preparation and lesson content as a ***Powerpoint***
  - Attribution

INSTRUCTOR GUIDE

Lesson Plan

- Prior to class, each student should:
    - Read the paper (5 pages long)
    - Watch a short video from the author
    - Post 2 discussion questions the night before
        - If you have never used Canvas, *here* is how to create a discussion board
- During class, form breakout groups to discuss the posted questions
    - Assign each group 2 discussion questions for ~15 min
    - Have groups report back on one question
- As a class, discuss a couple of the figures in more detail
- Instruct students to speak to one person about the topic after the class

Attribution: Turner, A. "Examining Air Quality Inequity in Major US Cities During the COVID-19 Pandemic". *Climate Justice in Your Classroom,* edited by Bertram, Brooks, and Olson, 2023. https://uw.pressbooks.pub/climatejustice/chapter/air-quality-inequity/ Date of Access.

About the Author

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DR. BRITTANY JOHNSON, UW ENVIRONMENTAL AND FOREST SCIENCES

EXPLORING LINKS BETWEEN AGROFORESTRY, FOOD SECURITY, AND LAND SOVEREIGNTY

This module was originally used in the courses ESRM 210: Introductory Soils and SEFS 510: Fundamentals of Plant-Soil Interactions and promotes big picture thinking about land management and soil health. This content is formulated to be adapted for a wide range of audiences, from graduate to high school students. If will be helpful for students to have a basic familiarity with concepts such as eutrophication, soil health, over-fertilization, and land degradation prior to starting this lesson. Some additional background in conventional agriculture methods and soil processes (decomposition, gas exchange, nutrient cycling, etc.) may also be helpful.

OVERVIEW

- **Climate Justice Issue:** Focusing on restorative soil

management, consciously thinking about how communities/ systems can work in harmony with the natural towards sustainability for the future and justice for the planet.

- **Target Audience:** University level/ Mature High school level
- **Lesson Length:** 1 50+ minutes class period with prior preparation
- **Learning Objectives:**
    - Become familiar with common terms in agriculture
    - Understand the impacts of agricultural practices
    - Discuss the impact and importance of changing the dialogue around food production and sustainability
    - Apply these ideas in a civically-minded exercise (Think, Pair, Share)
- **Topic Overview:** This lesson promotes big picture thinking about land management and soil health. The focus is on increasing the awareness of our absolute dependence on the beautiful substance below our feet as well as the connections between food systems, human health, and environmental processes. Learners are engaged through a "Think-pair-share" style activity about challenges and solutions to agricultural issues and then taking this a step further to think about solution obstacles and incentives (template provided). This will likely bring up many questions about food security, food sovereignty, and sustainability which you may choose to tackle

in more detail during subsequent lessons. Provided are options to utilize this lecture during both synchronous and asynchronous classes.

- **Chapter Components:**
    - Lesson Overview
    - Instructor Guide: Instructions on preparing the content for this lecture, templates, and assigning student groups.
    - Pre-class Work for Students: A short article and common terms students should know going into lecture. Option to add short quiz to check learning objectives.
    - Lecture Content: How to structure the course time and flow of the lecture period.
    - Additional Links and Resources: More information on many topics and some resources I find helpful.
    - Attribution

INSTRUCTOR GUIDE

Estimated preparation time: 1 hour
Before the start of class, the instructor should do the following:

SYNCHRONOUS OPTION

1) Assign the "Pre-class Work for Students" which contains reading and gets students familiar with common terms. Consider adding more definitions and a short Canvas quiz to reinforce learning objectives important to your course.

- Never made a Canvas quiz? See here for a how-to!

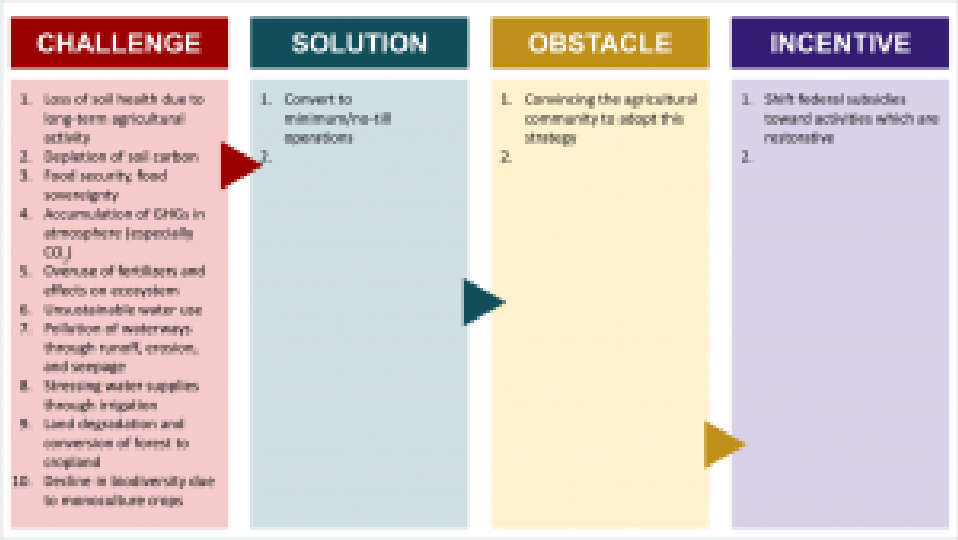
2) Create a short lecture (<20 minutes) on current and future challenges facing food production. I encourage you to begin with the land acknowledgment appropriate to your location. Some ideas and resources:

- Consider having students calculate their water footprint before class begins (add to the pre-class work). Illustrate the idea of visible and invisible water usage and how that could influence perceived water use. You could also use a figure like this one from Future Food 2050 to demonstrate the actual cost of common items like coffee and beef in class. In class, have students name one thing they could do in their household to conserve water.
- This article by Jennifer Morris, the CEO of The Nature Conservancy, has all the building blocks for a brief summary of food production challenges and lots of statistics.
- Discuss the food-water-energy nexus and how population growth stresses each of these components. Also be sure to mention that soil is at the literal foundation of all factors within the nexus, so changes to soil

health will feed back into the overall balance. I have found this figure from Future Earth describing the interactions among components and this one from CNA about stressors on the nexus from population growth to be useful illustrations.

- Touch on land degradation and the effect of forest conversion on soil health and carbon storage. I recommend checking out Soils Revealed for some really amazing visuals on carbon loss and sequestration due to land use.

3) Create a template like the photo below in an appropriate shareable format (Google Slides recommended). Feel free to alter the challenges to suit your course material, these are just some examples.



- For example, Challenge #1, the solution could be to convert to minimum/no-till operations, obstacle is convincing the agricultural community to adopt this strategy, and the incentive is to redirect federal subsidies toward

sustainable agricultural practices

- When creating your Google Slides document, duplicate the template slide according to the number of small groups you plan to have for the activity (recommended group size is 4-5 students) and narrow the challenges to 1-3 per group depending on how much time you would like to allocate to the activity. Leave the example Challenge #1 on each slide for student reference
- Prefer to do this on paper? Simply do the step above and then print copies

4) Assign student groups (4-5 students/group)

- If you have term-long working groups, feel free to continue using them for this activity.
- If you would like to randomize groups, here are two fun ways to do it:
    - Print or write the group numbers 5 times, cut them out in squares, fold them in half, place them in a container, and have students pick one when they arrive for the day. Pre-label areas of the classroom for each group. They will then sit in the designated area for the number on the paper they selected.
    - Have mini-candy bars in a bowl (5 of each kind) and allow students to choose as they enter. Group them by what type of candy they selected.
    - Suggestion: If you choose to randomize groups and your students are not normally very social, consider building in a fun introductory step to the start of group work (e.g., instruct students to share their names and what they wish their superpower was).

ASYNCHRONOUS OPTION

Before the start of class, the instructor should follow steps 1-3 as above. Record your short lecture created in Step 2 and post to Canvas using the software of your choice- Panopto is nicely linked to Canvas, but you can also record in PowerPoint. Try adding captions for your students to improve accessibility; YouTube does an excellent job of adding auto-captions which do not require much editing. For Step 3, create this Slides document. For Step 4, create Discussion Groups and assign students before class (how-to here) so that students can interact with each other. Be sure to share the link to the Slides documents in the Discussion Group instructions.

PRE- CLASS WORK FOR STUDENTS

Reading

- These two articles barely scratch the surface, but highlight the importance of acknowledging, honoring, and incorporating Indigenous knowledge and practice into agricultural systems:
    - Heart of the Hopi (Levin, A. 2019. American Indian Magazine 20(3).)
    - Meet the Three Sisters Who Sustain Native America (Murphy, A. 2018. PBS: Native Voices)

Introduction to Concepts and Common terms

Have your students review the following terms and watch the videos. Add, subtract, or modify as suits your course. As mentioned in the instructor work page, consider reinforcing the key takeaways that are important for your class using a short Canvas quiz!

- **Agroforestry:** The intentional integration of trees and shrubs into crop and animal farming systems to create environmental, economic, and social benefits. It has been practiced in the United States and around the world for centuries (USDA).
- **Conventional Farming (Industrial Agriculture):** Farming systems which include the use of synthetic chemical fertilizers, pesticides, herbicides and other continual inputs, genetically modified organisms, Concentrated Animal Feeding Operations, heavy irrigation, intensive tillage, or concentrated monoculture production. Thus conventional agriculture is typically highly resource and energy intensive, but also highly productive (Wikipedia). See "Tillage" below for a video example of the effects of mechanical disturbance.
- **Community Forestry:** A participatory approach to forest management that strengthens communities' capacity to build vibrant local economies, while protecting and enhancing their local forest ecosystems. By integrating ecological, social, and economic components into cohesive approaches to forestry issues, community-based approaches give local residents both the opportunity and the responsibility to manage their natural resources effectively and to enjoy the benefits of that responsibility (Aspen Institute).
- Food Security: Ensuring that all people at all times have both physical and economic access to the basic food that they need (FAO).
- **Food Sovereignty:** A food system in which the people who produce, distribute, and consume food also control the mechanisms and policies of food production and distribution (Wikipedia).
- **Forest Garden:** A garden modeled on the structure of young natural woodland, utilizing plants of direct and indirect benefit to people – often edible plants. It may contain large trees, small trees, shrubs, herbaceous perennials, herbs, annuals, root crops and climbers, all planted in such a way as to maximize positive interactions and minimize negative interactions, with fertility maintained largely or wholly by the plants themselves (Agroforestry.org). To visualize this, check out the video below:

- https://youtu.be/Q_m_0UPOzuI

- **Precision Agriculture (Site-Specific Crop Management):** The practice of using precise global positioning combined with location-specific measurements—either in-field data collection (such as soil variables or pest occurrence) or remotely sensed data (such as from aircraft or satellites)—to quantify spatially variable field conditions and target treatments (herbicide, pesticides, fertilizers, water) (USDA).
    - https://youtu.be/tbkTi3zNN9s
- **Permaculture:** The conscious design and maintenance of agriculturally productive ecosystems which have the diversity, stability, and resilience of natural ecosystems. It is the harmonious integration of landscape and people — providing their food, energy, shelter, and other material and non-material needs in a sustainable way (Permaculture News).
- **Regenerative Agriculture:** A holistic land management practice that leverages the power of photosynthesis in plants to close the carbon cycle, and build soil health, crop resilience and nutrient density. Regenerative agriculture improves soil health, primarily through the practices that increase soil organic matter at small (first video) and large (second video) scales (Regeneration International). It is important to understand that the techniques at the heart of regenerative agriculture are not new, they are rooted in traditional Indigenous methods which have been passed down through generations that promote crop diversification and a deep reverence of the landscape:
    - https://youtu.be/FJ7BSML0lUQ
    - https://youtu.be/nSp7SuuP1R0
- **Tillage**: The mechanical manipulation of the soil for the purpose of crop production affecting significantly the soil characteristics such as soil water conservation, soil temperature, infiltration and evapotranspiration processes (Busari et al., 2015).

- https://youtu.be/1YNr6lwFbsw

- **Traditional Ecological Knowledge (TEK):** Describes Indigenous and other traditional knowledge of local resources. As a field of study in anthropology, TEK refers to "a cumulative body of knowledge, belief, and practice, evolving by accumulation of TEK and handed down through generations through traditional songs, stories and beliefs. It is concerned with the relationship of living beings (including humans) with their traditional groups and with their environment." Such knowledge is used in natural resource management as a substitute for baseline environmental data in cases where there is little recorded scientific data and shapes other scientific methods of ecological management (Wikipedia). It is important to note that many techniques which are considered "regenerative agriculture" in mainstream media have been practiced by Indigenous peoples since time immemorial

LECTURE CONTENT

For a SYNCHRONOUS class:

Setting Up the Discussion (15-20 minutes)

Begin this class period by presenting the short lecture you prepared (Instructor Guide, item 2) discussing issues of population growth and food production.

Learner Engagement and Activity (20-25 minutes)

In order to have students think critically about the potential of sustainable growing methods to be implemented as a long-term treatment for ecological and soil health, they

will work in small groups to discuss the challenges currently faced by the agricultural industry and potential solutions. This lesson then takes it one step further by incorporating in additional sections on obstacles and incentives (because there is no plan universally accepted!).

(5 minutes) Example challenge: To facilitate this activity, use your shared Slides document created during preparation for this lesson. Walk through the completed Challenge #1 to provide a working example of how to use the flow chart. Go into more detail in each section (e.g., how is soil health quantified, formation of tillage pans, where federal subsidies are currently allocated, etc.) to demonstrate the path of thinking. Remind the students to think about the pre-class reading while completing this task.

(15 minutes) Group work: Send students into numbered small groups (4-5 students per group). Remind them to put their names in the slide comments section of their group slide so that they can be graded on their submission. Allow students to brainstorm potential answers to each challenge and point out that there can be multiple solutions/obstacles/incentives for each challenge so be creative!

Speak Out and Reach Out Session (10 minutes and beyond)

In this final step of the "Think-Pair-Share" activity, pair off the groups and have them present one of their challenges, solutions, obstacles, and incentives to each other and discuss. Ask students to provide other ideas, from new solutions to additional obstacles and incentives.

At the end of class, ask the students to keep thinking about these challenges. What does food security mean? How will we achieve it on local to global scales? How can we ensure resources are shared equitably? Encourage students to talk to one person about this issue whether it is a friend, roommate, classmate, family member, or stranger while keeping an open and curious mind. Enjoy!

For an ASYNCHRONOUS class:

Present your short recording on Canvas along with the optional quiz if you created one for the pre-class work. Have students in each small group work together remotely to fill out the Slides template and contribute to their discussion board. Try making multiple

discussion boards within your class so that each one has ~10 students in it (i.e. two groups) and students should review the Slide created by the other group and use the discussion board to complete the "Speak Out" portion of the lecture. Make this a graded discussion so that each student has incentive to participate.

ADDITIONAL LINKS AND RESOURCES

- LEAF Network: All about edible trees (care, types, planting planners, etc.). Developed for Arizona, but can be used widely.
- Communities Committee: Guides and step-by-step instructions for creating a community forest.
- Stewardship Contracting Overview: Federal partnership in forest management
- National Urban and Community Forestry Advisory Council (NUCFAC): Congressionally designated advisory council to the Secretary of Agriculture on urban forestry and related issues
- Regeneration International: Blog and resources focused on promoting regenerative agriculture
- Growing a Revolution: Book by UW faculty David Montgomery focused on the benefits, history, and data behind the movement toward regenerative agriculture
- Dirt to Soil: Gabe Brown's book on discovering regenerative agriculture benefits on his farm, check out his TEDx talk on YouTube as well!

Attribution: Johnson, B. “Exploring Links Between Agroforestry, Food Security, and Land Sovereignty”. *Climate Justice in Your Classroom*, edited by Bertram, Brooks, and Olson, 2023. https://uw.pressbooks.pub/climatejustice/chapter/agroforestry-food-security-land-sovereignty/ Date of Access.

Media Attributions

- Screen Shot 2021-03-08 at 11.38.11 AM (1)

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UNDERSTANDING THE IMAPCTS OF OCEAN ACIDIFICATION ON SHELLFISH AND THE COMMUNITIES THAT RELY ON THEM IN THE PACIFIC NORTHWEST

Students are invited to learn about the importance of shellfish aquaculture in the Pacific Northwest and how changing ocean conditions are threatening the success of the industry and the communities that rely on them as a resource. This exercise is a case study that, if used in full, takes students through the entire learning cycle from invitation to reflection. Pieces of the exercise can be used as appropriate for the instructor goals. Parts of this lesson are adapted from the OOI (Ocean Observatories Initiative) Data Labs Collection activity, "Impacts of Ocean Acidification on Shellfish in the Pacific Northwest." The environmental justice component is integrated into the Invitation and Reflection phases of the learning cycle and can be used as a hook to engage students in the case study.

OVERVIEW

- **Climate Justice Issue:** Threats to shellfish, like ocean acidification, not only reduce the prevalence of a key resource, but also endanger an important part of the heritage, culture, and economy of many communities in the Pacific Northwest
- **Target Audience:** 100-200 level students
    - This activity is applicable to lower and upper division courses. In lower division courses, this activity can be used to introduce basic concepts of ocean circulation and ocean acidification. For upper level courses, this activity could include a more in depth discussion of ocean circulation, climate, heat budgets, and how ocean acidification affects shellfish aquaculture industries.
- **Lesson Length:** 3+ class periods (50 minutes each) with prior preparation (if taught in its entirety)
- **Learning Objectives:**
    - Use OOI Data Explorations activities to describe and interpret patterns in individual OOI data sets and correlations between the different data types presented (Exploration in learning cycle)
        - Write a figure legend for the first pH graph seen

        - Write a figure legend for all four of the graphs together
    - Explain the relationship between wind direction and pH on the west coast, using data and relevant oceanographic concepts to support their conclusions. (Exploration in learning cycle)
        - Identify a time range in which upwelling is occurring
        - Explain what is happening, including how and why the pH changes.
    - Identify oceanographic conditions that negatively impact shellfish populations and determine when those conditions are occurring. (Application in learning cycle)
        - Identify a time when conditions will negatively impact shellfish populations
        - Draft an advisory to shellfish aquaculturists describing the problem, why it is occurring, and suggesting possible solutions.
    - Identify the communities that rely on shellfish as a resource and explain why. (Reflection to Invitation in learning cycle)

- Assess the value and economic contribution of shellfish farming and wild harvest in Washington. (Reflection to Invitation in learning cycle)
    - Translate research findings into infographic to share on course website and social media
- Increase the visibility and understanding of ocean acidification across the Pacific Northwest and the communities it is currently negatively impacting through targeted use of outreach education and social marketing. (Reflection to Invitation in learning cycle)

- **Topic Overview:**
    - Shellfish are a crucial aspect of life in the Pacific Northwest: they are a major piece of the economy, they have a lengthy history in the region, and most importantly, they serve as a vital cultural component to many groups that live in the region, especially within Indigenous communities and reliant groups. All of this storied heritage is threatened by ocean acidification, which the rise in the average of pH of the ocean as a result of increased CO_2 emissions. (Information on ocean acidification from NOAA is available *here*). As pH increases, $CaCO_3$ concentration in the water decreases, resulting in many shellfish

being unable to form structurally sound shells and endangering their population. These weaker shellfish are less healthy and are much more at risk to predation and sickness. Thus, as CO_2 emissions continue and pH rises, not only are shellfish threatened, but so are the livelihoods of the innumerable communities, that cherish and depend on them.

- **Prior knowledge:**
    - Before completing this activity, students should be familiar with pH, the dissolution of gases in water, and the basic concept of upwelling and Ekman transport. Preferably, students will have some background on buffers, shellfish life cycles, meroplanktonic vs. holoplanktonic life histories, and aquaculture, although this information can be provided during the activity as needed.
- **Technology requirement:**
    - Parts of this activity requires internet access on computers or tablets, preferably with no more than two students per device. If computer access is not available the graphs and activity questions may be printed ahead of time and students can use smart phones for internet research.

- **Chapter Components:**
  - Lesson Overview
    - *Also available as a PDF*
  - Instructor Guide
    - Instructions on preparing the content for this case with suggested activities and assessments.
    - *Also available as a PDF*
  - Environmental Justice Hook and Suggested Teaching Plan
    - How to structure the course time and flow of class sessions for environmental justice hook.
    - *Also available as a PDF*
  - Attribution

INSTRUCTOR GUIDE

Teaching Notes:

This exercise is a case study that, if used in full, takes students through the entire learning cycle from invitation to reflection. This exercise is adapted from the OOI Data Labs Collection activity, "Impacts of Ocean Acidification on Shellfish in the Pacific Northwest." Pieces of the exercise can be used as appropriate for the instructor goals.

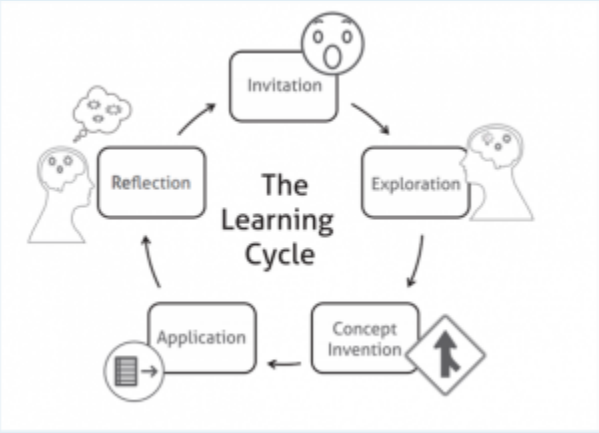
- Students are invited to learn about the importance of shellfish aquaculture in the Pacific Northwest and how changing ocean conditions are threatening the success of the industry and impacting the community groups who value shellfish as a resource.
- The Challenge Questions in the OOI Data Explorations should be used to invite students to explore data and make predictions. (Invitation)
- Several types of data are presented, some as time series data with the interactive widgets, and students are asked to speculate on the relationships between the wind and different water properties (Exploration in learning cycle).
- This guide provides background on important concepts, and several ideas are given for having students access their previous learning on pH, carbonate chemistry, and surface ocean circulation (Concept Invention in learning cycle).
- After coming to a conclusion of the cause of the low pH surface waters, students are challenged to apply what they have learned to a longer data set (Application in learning cycle).
- This case requires students to reflect on the interaction between wind, circulation, water properties, biology, and the societal impact of changing ocean conditions so at the conclusion students are asked to think about what they have learned about this complexity and identify concepts/topics they would like to learn more about (Reflection in learning cycle).

Learning Goals and Assessments:

Students will be able to:

- Describe and interpret patterns in individual data sets and correlations between the different data types presented (Exploration)
    - Write a figure legend for the first pH graph seen
    - Write a figure legend for all four of the graphs together
- Explain the relationship between wind direction and pH on the Oregon coast, using data and relevant oceanographic concepts to support their conclusions. (Exploration)
    - Identify a time range in which upwelling is occurring
    - Explain what is happening, including how and why the pH changes.
- Identify oceanographic conditions that negatively impact shellfish populations, and determine when those conditions are occurring. (Application)
    - Identify a time when conditions will negatively impact shellfish populations
    - Draft an advisory to shellfish aquaculturists describing the problem, why it is occurring, and suggesting possible solutions.
- Identify the communities that rely on shellfish as a resource and explain why. (Invitation to Reflection)
- Assess the value and economic contribution of shellfish farming and wild harvest in Washington. (Invitation to Reflection)
    - Translate research findings into infographic to share on course website and social media

The Learning Cycle (PDF)



from Lawrence Hall of Science

1. Invitation: Students are invited into the activity by sharing their personal experience with shellfish consumption or harvest.

- Activity Type: Class discussion
- Time: 1 class session (30-50 mins)
- Additional Time: 15 mins of student preparation before class
    - As an introductory activity, assign students to watch Supporting communities through ocean acidification research and respond to the following prompt:
        - What is your prior experience with shellfish, consumption and/or harvesting?
    - At the beginning of class, students are asked to free write for one minute on the prompt above. The instructor then randomly calls on student volunteers to share their prior experience with shellfish

consumption and/or harvesting and then discuss shellfish aquaculture. If aquaculture has not been previously discussed, a brief introduction could be added, with mention of locally aquacultured species.

- Suggested class activity questions: Think/pair/share or clicker questions (free response/word cloud) or brainstorm, write on board. Below are some potential questions to engage students and facilitate class discussion:
  - What kind of shellfish have students eaten (relatives or seen others eat if allergic)?
  - Where did their shellfish come from?
  - Do they know the shellfish source?
  - Pros and cons of aquacultured shellfish?
    - Ecological/environmental, cultural, health (HAB contamination)
    - Economic impacts

2. Exploration: Students use interactive data widgets to explore how changing weather conditions and ocean circulation patterns affect ocean pH.

- Activity Type: Online data lab
- Time: 1 class session (50 mins)
  - Give students 3-5 minutes to free write on what they know about ocean acidification. Students will use their free writes at the end of class to reflect on their learning.
  - Complete the Exploration data lab activity. Have students complete the activity questions, then discuss as a group.

3. Concept Invention: Students work together to identify and explain the link between CO_2 and pH of a solution

- Activity Type: In-class activity or lab
- Time: 1 class session (50 mins)
    - **NOTE:** When discussing ocean acidification with students, it is important to be discuss the following:
    - Why is it called ocean acidification when the pH of the ocean is basic?
        - Why is it difficult for shell building organisms to build those shells?
            - Concept of relative concentration of carbonate species and saturation (threshold) should be made clear to students
    - Show students the image of pH found in *Background* section and remind students of the definition of pH, what it is a measure of, and that it is on a log scale.
        - *Pacific Marine Environmental Laboratories primer on pH*
    - Have students identify and explain the link between pCO_2 and pH.
        - Lab activities that allow students to explore the link between CO_2 gas and the pH of a solution
            - *Ocean Acidification in a Cup Activity*
            - *Blowing Bubbles Activity*
        - Show CO_2 Time Series in North Pacific plot and ask students to describe trends of atmospheric CO_2, seawater pCO_2 and seawater pH, and explain why pH in seawater

decreases as atmospheric and seawater CO_2 increases.

- Have students create a list of the physical and biological factors that influence the pH of solution or seawater
- Ask students to explain why pH is important and how it influences life in the ocean
- Use the widget to examine and explain the relationship between wind direction and water temperature. Discuss correlations between these variables.
    - Refer to NASA Ocean Motion website for description and images of surface ocean circulation
    - This video of Ekman transport generated upwelling may also be useful
    - Show diagram of coastal upwelling and plot of Coastal Upwelling Index found on the Northwest Fisheries Science Center website
    - Show the students the vertical profile of pH with depth off the OR coast found in the *Background* section and have a discussion with them about the source of the low pH on the shelf.
    - With the combination of data, ask students to explain how a change in the wind direction results in change in

pH of surface water along coastal Oregon.

4. Application: Students use interactive data widgets to predict when coastal waters would be harmful to shellfish.

- Activity Type: Online data lab
- Time: 1 class session (50 mins)
    - Complete the Application section data lab. Have students answer the questions and discuss as a group.
        - Group discussion questions:
            - Would you expect this same pattern on the east coast? Why or why not?
            - Draw your prediction of nitrate levels over the time frame displayed in the pH graph. Why would you expect this trend?
        - Writing prompt: You are in a conversation with someone who claims it is good that the ocean absorbs atmospheric CO_2 because it reduces greenhouse gases in the atmosphere. How could you convince them that they're wrong?

5. Refection: Students assess the value and economic contribution of shellfish farming and wild harvest in Washington and translate research findings into fact sheets to share on course website

- Activity Type: Jigsaw
    - What is Jigsaw? Learn about the teaching strategy *here*.
- Time: 3 class sessions (50 minutes)

- Additional Time: 15 mins of student preparation before the first Jigsaw & 3-4 hours of student time before second Jigsaw
    - Think of one part of this exercise that was confusing or challenging for you. Why was it challenging? What did you do to overcome this difficulty?
        - Revisit the free write you completed earlier in class. Discuss how your knowledge of ocean acidification has changed. What would you be interested in learning more about?
        - Ask the students to consider how they learned and how much they learned and applied their learning through one or more of the following:
            - What new skills did you learn that helped you to figure out what was causing the low pH in surface waters?
            - What concepts did you need to learn more about in order to figure out the connection between winds and the seawater properties?
            - What new connections between concepts did you make?
            - In what ways did these connections help you to understand the concepts better?
            - What was the most difficult part of this activity/unit/challenge for you? Why? What helped you to figure it out?

Activity Citation**:** Gerken, S., Greengrove, C., Nuwer, M., Smith, S., & Lichtenwalner, C. S. (2020). Impacts of Ocean Acidification on Shellfish in the Pacific Northwest. *OOI Data Labs Collection*.

ENVIRONMENTAL JUSTICE HOOK AND SUGGESTED TEACHING PLAN

Reflection to Invitation:

- In the Pacific Northwest shellfish is a way of life. Shellfish are an important resource and part of our heritage, culture and economy. Use this environmental justice connection as a hook to engage students and encourage them to integrate concepts and reflect on what was learned in this case study.

Suggested Teaching Plan:

Before 1st Class:

- Watch:
  - Sustainable Shellfish Aquaculture in WA
- Explore:
  - Nature Conservancy website (Shellfish & Aquaculture pages)

- Quiz Questions:
    - List at least 3 community groups that value shellfish as a resource .
    - Describe the economic and ecosystem value of shellfish as a resource to each community group you listed above.

1st Class – Jigsaw (Expert):

- Free Write (5 min.):
    - What can or does the term “value” mean? Do shellfish have different kinds of value to different groups?
- Short Class Discussion (10 min.):
    - Define what we mean by “value”
- Jigsaw Expert Group (30 min.):
    - Assign community group
    - Research history, cultural connection, ecosystem and economic value using template guide (Worksheet)

2nd Class – Jigsaw (Expert):

- Complete and submit template guide (same worksheet as before)
- Compose list of assessment questions that will be used to assess student knowledge on all community groups
- Write assessment questions for quiz
- Homework:
    - Create an Infographic to share on course site

3rd Class – Jigsaw (Collaborative):

- Group Work

    - Step 1: Meet briefly in Expert Group to plan how to best teacher other students about the value of shellfish to your assigned community group
    - Step 2: Jigsaw into Collaborative groups to learn about the value of shellfish to other community groups and the impact of OA on the groups
- Quiz:
    - Use expert group questions to assess understanding and identify knowledge gaps

Assignment Templates:

- Jigsaw Worksheet (Expert Groups)
- Infographic Description

Attribution: Nuwer, M. "Understanding the Impacts of Ocean Acidification on Shellfish and Reliant Communities in the Pacific Northwest". *Climate Justice in Your Classroom*, edited by Bertram, Brooks, and Olson, 2023. https://uw.pressbooks.pub/climatejustice/chapter/ocean-acidification-shellfish-PNW-communities/ Date of Access.

Media Attributions

- Nuwer_The Learning Cycle

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UNEQUAL IMPACTS: JUSTICE AT THE INTERSECTION OF RISK AND EXPOSURE TO SEVERE WEATHER THREAT

This module was originally used in the courses ATM S 103. This content is originally built as an asynchronous class, however it can also be adapted to a synchronous format, either in a traditional or flipped classroom set up.

OVERVIEW

- **Climate Justice Issue:** Focuses on the intersection between severe storms, climate change, and societal vulnerability.
- **Target Audience:** Undergraduates, 100 level course
- **Lesson Length:** 1 hour class period with prior preparation
- **Learning objectives:**

    - Provide students with the tools they need to recognize and describe the nuanced connections between severe storms (especially hurricanes), climate change, and societal vulnerability.
    - Give students an overview of how different demographics face unequal impacts of severe storms.
    - Have students establish their own solutions-based approaches to this problem and gain experience in presenting climate change and social justice to a broad audience.

- **Topic Overview:** As climate change continues to alter the natural systems and balance of the world, the effects of severe storms (especially hurricanes) have become exacerbated, disproportionally effecting vulnerable populations. Different demographics (those living in coastal cities for example) will disproportionately experience the impacts of more severe weather as climate change continues to increase the severity of these systems .
- **Chapter Components:**
    - Instructor Guide
        - *Also available as a PDF*
    - Unequal Impacts Assignment

        - *Also available as a PDF*
    - Grading Rubric
        - *Also available as a PDF*
    - Resources on Severe Storms, Climate Change, and Inequality
        - *Also available as a PDF*
    - Attribution

Instructor Guide

- **BEFORE CLASS:** Students are provided with the attached list of readings and videos ("Resources on Severe Storms, Climate Change, and Inequality").
- **DURING CLASS (IF SYNCHRONOUS):** Lead a brief discussion (including break-out rooms and think-pair-share) of materials read, optionally covering the following questions:
    - What did the readings teach you about climate change and hurricane that surprised you?
    - Which groups are likely to be most strongly impacted by severe storms?

    - Which of those inequities are likely to become more or less pronounced with climate change?

- **DURING CLASS (IF ASYNCHRONOUS):** Encourage students to consider the above questions while reflecting on the readings/videos.
- **AFTER CLASS (ASSIGNMENT):** Provide students with assignment details ("Unequal Impacts Assignment") and one week to complete assignment. Students should receive detailed feedback on each element of grading, using the attached grading rubric ("Grading Rubric").
- **FOLLOW-UP (IF SYNCHRONOUS):** In a small class, have each student report back a reading of their assignment and a 1-2 minute Q&A. In a larger class, break students into groups of 4-5 and have them do the same thing. Optionally, have students cycle into two or more groups.
- **FOLLOW-UP (IF ASYNCHRONOUS):** Students hand in copies of their assignments to the instructor. With students' permission, all assignment files are saved in a class-public repository, where a selection can be summarized by students for optional extra credit.

Unequal Impacts Assignment

In class (see "Resources on Severe Storms, Climate Change, and Inequality") we explored the complex connection between climate change and hurricane strength, and also discussed how vulnerability to storms is likely to expand over time. We also delved into how the impacts of hurricanes are already being felt unequally and that those unequal impacts are likely to expand over time.

Your goal is to create a brief Public Service Announcement-style description of at least one way in which unequal impacts due to severe storms could be reduced. Your PSA can

have different formats (an interview with a fictional expert, a letter to the editor, a social media post, a script for a YouTube video) but should be concise at around 250 words.

Your PSA can be guided by questions like the following:

- What can be done to decrease vulnerability to severe storms?
- What resources can be provided to help offset inequities?
- Are there specific policies or practices in place that should be reversed?
- In a future in which climate change is more pronounced than now, what should be done with urgency to reduce these unequal impacts?

Grading Rubric

Your PSA will be graded out of a maximum of 10 points based on the following categories:

- Creativity and Originality (3 pts):
  - Are the solutions suggested interesting and potentially feasible?
- Accuracy of Information (3 pts):
  - Does the scientific information being communicated accurately reflect our understanding of the situation?
- Persuasiveness (3 pts):
  - Do the arguments presented make a good case for change?
- Conciseness (1 pt):

- Are the provided arguments within 100 words of the 250-word suggested length?

Resources on Severe Storms, Climate Change, and Inequality

Severe Storms Vulnerability

- Dr. Katherine Hayhoe discusses some of the complexities of climate change and causality when it comes to hurricanes:
  - Did Climate Change Cause This Hurricane?
  - https://www.youtube.com/watch?v=vUYHcjrlisw (3:47)
- David Roberts for Vox gets into nine things to keep in mind when discussing climate change and hurricanes:
  - Climate change did not "cause" Harvey or Irma, but it's a huge part of the story: 9 things
    we can say about hurricanes and climate
  - https://www.vox.com/energy-and-environment/2017/8/28/16213268/harvey-climatechange
    - Article, 15 min read
- Dr. Stephen Strader showcases the Expanding Bulls-Eye Effect of vulnerability to severe storms such as tornadoes in a Twitter thread:
  - Thread: Potential #DallasTornado built-environment exposure
  - https://twitter.com/stephenmstrader/status/1186300441916792833?lang=en
    - 5 Tweets, 5 min read

Unequal Impacts

- Gary Rivlin for Talk Poverty digs into the racial inequities that persisted eleven years after Hurricane Katrina:
    - White New Orleans Has Recovered from Hurricane Katrina. Black New Orleans Has Not.
    - https://talkpoverty.org/2016/08/26/people-poverty-work-paul-ryan-misunderstands-poverty/
        - Article, 15 min read
- Eleanor Krause and Richard V. Reeves for Brookings discuss economic inequities with Hurricane Harvey:
    - Hurricanes hit the poor the hardest
    - https://www.brookings.edu/blog/social-mobility-memos/2017/09/18/hurricanes-hit-the-poor-the-hardest/
        - Article, 5 min read

Attribution: Anderson-Frey, A. "Unequal Impacts: Justice at the Intersection of Risk and Exposure to Severe Weather Threat". *Climate Justice in Your Classroom*, edited by Bertram, Brooks, and Olson, 2021. https://uw.pressbooks.pub/climatejustice/chapter/unequal-impacts-justice-at-the-intersection-of-risk-and-exposure-to-severe-weather-threat/ Date of Access.

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EXPLORING ISSUES OF COASTAL CLIMATE JUSTICE THROUGH HAIKUS

This lesson was originally taught as part of OCEAN 320: Coastal Oceanography. By incorporating climate science, media literacy, and communication skills, the environmental justice issues associated with anthropogenic change and coastlines are highlighted in an educational and engaging way.

OVERVIEW

- **Climate Justice Issue:** This course explores the unique and disparate impacts of climate change on coastal environments, with particular emphasis on vulnerable regions and ecosystems.
- **Target Audience:** University-level undergraduates
- **Lesson Length:** 2 class periods

- **Learning objectives:**
    - Develop an understanding of the impacts of climate change on key aspects of coastal oceanography
    - Communicate their ideas precisely in both oral and written format
    - Translate those ideas for a general audience
- **Topic Overview:** Although climate change is a global phenomenon, its impacts are often felt more heavily in specific places. Coastlines are an example of such a region, as the unique processes, ecosystems, and communities, as well as the confluence of multiple climate change-driven threats, produce many unique threats to environmental justice. These threats come from the degradation of unique ecosystems that support reliant communities, including the destruction of tidal marshes, wetlands, and mangrove forests, the erosion of the Arctic, or damage caused by marine heatwaves. When these vital areas are endangered, certain people are unfairly impacted, whether through increased impact of disasters, loss of key aspects of economic stability or cultural heritage, or forced relocation due to rising environmental hazards.
- **Chapter Components:**
    - Lesson Overview
    - Instructor Guide

INSTRUCTOR GUIDE

Instructor Notes

- This assignment was written for a class of 24 and was assigned in week 9 of a 10 week quarter.
- The course is called Coastal Oceanography and is for Oceanography Majors. The class met on MWF for an hour.
- Part 1 of the activity was due on Wednesday evening of week 10, and Part 2 was an in-class Haiku activity done on Friday of the same week.

LESSON PLAN

Part 1: Critique of News Article

Writing Assignment: Coastal Oceanography and Climate Change (46 pts)

This assignment will prepare you for an in class small group discussion on the impacts of climate change on the coastal zone. I will assign you to one of 8 groups, with each group reading a different article on one of the following topics in the context of climate change:

- Mangroves
- Marine Heatwaves in the coastal zone
- Climate Change and erosion in the Arctic
- Wetlands

You will summarize the article that you are assigned as follows:

- Explain how is this article is related to a topic discussed in class. Be as specific as you can. Was there a lab question or class lecture that is related to this topic? How is it related? **(12 pts)**
- What quantitative aspect of the course is related to your article? Give an example calculation to estimate one quantitative aspect of the article using an equation from one of the labs or lectures. Write a short paragraph describing the implications of your calculation. This could be a comparison of the topic discussed in the article and a related topic discussed in class, an estimate of how big the effect might be, or an extrapolation of a magnitude or rate into the future, given realistic parameters.
  (Note: You will probably have to estimate values for some of the variables in your equation. If you're having trouble determining a realistic estimation for a variable, ask for help from one of the course instructors. Justify any estimations

you make in the write up). **8 pts for the calculation**
6 pts for the explanation and connection to class material

- Discuss how what is discussed in the article is important for people in the region of focus. You can also discuss the relevance for ecosystems and/or the economy. Be specific. What population of people are potentially impacted? Are these people particularly vulnerable? Are there solutions offered? How realistic are the solutions **(10 pts)**
- **Writing skill including Grammar and clarity (10 pts)**

Article reading Assignments

These articles are chosen from mainstream media (NY Times, Washington post) or scientific sources that are written for general audiences (i.e. EOS from the American Geophysical Union). Each person is assigned one article to read and summarize.

- Arctic and Sea Ice:
  - https://eos.org/articles/melting-arctic-sea-ice-strengthens-tides
  - https://www.washingtonpost.com/news/energy-environment/wp/2015/02/24/the-remote-alaskan-village-that-needs-to-be-relocated-due-to-climate-change/
- Tidal Marshes and wetlands:
  - https://eos.org/research-spotlights/half-of-u-s-tidal-marsh-areas-vulnerable-to-rising-seas
  - https://environment-review.yale.edu/making-way-coastal-wetlands-look-sea-level-rise-and-urban-development
- Mangroves:
  - https://eos.org/features/cameroons-mangrove-forests-are-choking-on-plastics
  - https://therevelator.org/mangroves-climate-change

- Marine heatwaves:
    - https://www.nationalgeographic.com/culture/article/space-map-pacific-blob
    - https://www.pugetsoundinstitute.org/2020/04/warm-water-blobs-significantly-diminish-salmon-other-fish-populations-study-says/

Part 2: Climate Change in the Coastal Zone Haiku Summaries (10 pts for submitted one or more Haiku's in the assignment)

- Divide into four topical groups of 6 students each to synthesize the information in the news articles that you analyzed by composing haikus. This exercise is based on the summary of a IPCC Working Group I report by Greg Johnson in 2013.
- First, read these Haiku's that can be found at
    - https://www.sightline.org/2018/12/05/climate-change-told-in-19-heartbreaking-haiku
- Use the haiku form of haiku three lines, five syllables in the first line, seven in the second line and 5 in the third line.
- Include reference to people and climate change in some way in at least one of the haiku's from your group.
- Students may submit a group of linked haikus.
- Haikus will be submitted on Canvas and a shared Google Doc, and may be shared with the class and the broader community.

Attribution: Thompson, L. "Exploring Issues of Coastal Climate Justice Through Haikus". *Climate Justice in Your Classroom*, edited by Bertram, Brooks, and Olson, 2021. https://uw.pressbooks.pub/climatejustice/chapter/exploring-issues-of-coastal-climate-justice-through-haikus/ Date of Access.

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