



Northeastern

TO: Senate Agenda Committee

FROM: Climate Justice Action Planning Committee

DATE: March 27th, 2024

SUBJECT: Final report for the Academic Years 2023-2024

This 2023-2024 academic year marked the third time that the Climate Justice Action Committee was a standing committee of the Faculty Senate. The committee was created in response to a specific recommendation of the 2020-2021 ad-hoc Climate Justice Action Committee and stood for the first time during the 2021-2022 academic year.

The committee met regularly from September through March to review charges and information, discuss challenges and opportunities for climate justice action and gain insights from meetings with key constituents. The committee met with members from the Climate Justice and Sustainability Hub (Planning Real Estate & Facilities). The committee also conducted two surveys among faculty and other forms of research to support its findings and recommendations.

Committee Members:

1. Rachel F Rodgers, Department of Applied Psychology, Boston campus, Co-Chair
2. Mikhail Oet, College of Professional Studies, Boston campus, Co-Chair
3. Umit Coskun, Department of Mechanical & Industrial Engineering, Boston campus
4. Kristina Faul, Chemistry and Environmental Science, Mills College, Oakland Campus
5. Tamara Bonaci, Khoury College of Computer Sciences, Seattle Campus

2023-2024 Charges:

1. In coordination with the Climate Justice and Sustainability Hub and the Diversity, Equity, and Inclusion office, carry out data collection required to measure progress toward this committee's previous strategic plan and to increase ratings in the STARS and Times Higher Education Impact rankings, including inventorying existing coursework/curricula and community engagement efforts related to climate justice and environmental sustainability.
2. Investigate the feasibility of adding a NUPath Core Category in the area of climate justice and environmental sustainability, with reference to comparable core requirements at other institutions, existing or needed courses across the Northeastern global network, and the process for phasing in such a requirement if adopted.
3. Conduct activities for and with Northeastern faculty, staff, and students and/or surrounding communities to promote progress toward this committee's previous strategic plan.

Summary of committee recommendations:

1. Improving the **signaling and identification of academic offerings** related to climate justice and sustainability (e.g. searchable keywords).
2. Developing **centralized searchable systems** of academic offerings and research activities for students, faculty, and staff.

3. Increasing the **profile of sustainability and climate justice scholarship** and activities through curricular means (NUPath) and university research events (RISE)
4. **Coordinating** key partners and stakeholder events across the global campus to increase the **visibility and number of climate justice related events**.

Climate Justice Action Committee - Report to the Faculty Senate: March 8th, 2024

A. Definition and role of climate justice action in education

Climate justice is an approach to climate action that addresses the injustices and inequalities that have led to varying levels of vulnerability to climate risks locally and globally (Saraswat & Kumar, 2016). Taking action for climate justice necessitates changing at a level incorporating diverse forms of knowledge that connect technology and social progress while prioritizing fairness regarding social, racial, and economic aspects (Newell et al., 2021).

Within higher education, climate justice action includes centering climate justice as a university priority within all educational and training activities, in their content and their practice, as well as committing to a more equitable, inclusive, diverse, and accessible university community and ending fossil fuel reliance within our communities and our global network of campuses. Climate justice also involves expanding our commitment to partnering with and centering the needs of under-invested-in communities and communities of color who continue to be more vulnerable to increasingly frequent and intense climate disruptions and whose health and well-being are disproportionately harmed by fossil fuel use. As a global campus, Northeastern has the potential and the responsibility to be a global leader and to ensure that our priorities, strategies, and actions are aligned with and respond to the needs and priorities of broader networks of non-academic communities. Prioritizing climate justice is both an opportunity and a responsibility for any university committed to advancing racial justice, sustaining collaborative community relations, and restoring ecosystems.

B. Summary of Key Findings and recommendations from the 2022-2023 committee

Summary: The 2022-2023 committee acknowledged the legacy of the previous committee and reaffirms the priorities outlined by that group. The current committee calls for more urgent and visible action around the identified priorities and activities and notes an overall need for more visible advancement toward the identified goals.

The committee reaffirmed and expanded the priorities articulated by the previous committee. In addition, the current committee highlights the increased urgency, responsibility, and potential for Northeastern University to become a global leader in Climate Justice Action, given its Global Campus.

Table 1: 2022-2023 Identified Climate Action Priorities
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| <ol style="list-style-type: none">1. Situate Climate Justice Action as a presidential priority and provide the structures and incentives to facilitate synergistic work across research, educational experiences, and services and facilities throughout the Global Campus.2. Communicate vocally and transparently regarding the university's commitment to Climate Justice Action through a visible strategic plan, ambitious goals, and available indices of its commitment to and accountable progress towards Climate Justice Action.3. Engage in and facilitate inclusive community engagement, critical stakeholder participation, and partner collaboration towards aligning priorities on Climate Justice and Social Justice, as envisaged by the first Climate Justice Action Committee. |
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- C. **Charge 1: Carry out data collection required to measure progress toward this committee's previous strategic plan and to increase ratings in the STARS and Times Higher Education Impact rankings, including inventorying existing coursework/curricula and community engagement efforts related to climate justice and environmental sustainability.**

1.1 Progress

The Committee collaborated with the NEU Climate Justice and Sustainability Hub in sponsoring a Charge 1 Experiential Project to create a detailed database reflecting Northeastern University's commitment to sustainability and climate justice through its educational and research activities. This initiative was led by Mikhail Oet (Co-Chair, CJAP Committee) and Megan Curtis-Murphy (Director of Campus Sustainability and Engagement), with significant contributions from a dedicated student team from the College of Professional Studies Master of Professional Studies in Informatics program, guided by Xiaomu Zhou (Associate Teaching Professor).

- **Data Collection:** The team employed web scraping techniques to extract data from faculty webpages, Google Scholar profiles, the Northeastern course catalog, and the course syllabi (currently limited to the College of Professional Studies). This comprehensive approach collected 4861 faculty webpages across nine colleges/schools and over 5000 Google Scholar profiles associated with the University.
- **Data Analysis:** The study pinpointed classes and faculty studies connected to sustainability and climate justice. Classes were sorted based on their relevance to these subjects, and faculty research was assessed for its concentration on sustainability-related topics. This procedure included reviewing more than 2000 course syllabi and over 300 course catalog pages.
- **Database and Dashboard Creation:** The team created a data storage framework to organize the gathered information efficiently. Additionally, they developed a user dashboard to represent the University's sustainability and climate justice efforts, making it easier for people to explore and comprehend these initiatives.

Appendix 1 displays the process and main findings from this innovative and successful project.

In the Fall 2023, the committee included questions in the survey to the faculty regarding content related to climate justice and sustainability in their scholarship and activities. Overall, the findings are informative but unrepresentative. In addition, the survey rendered notably less complete results regarding the inclusion of these topics in academic offerings as compared to the database project. The answers to these questions are summarized in Appendix 2.

1.2 Recommendations

The Committee suggests the following actions:

1. Strengthen Database Capabilities: Broaden the database by integrating more real-time data sources and including course syllabi from all colleges and schools at Northeastern University. This initiative should involve an examination of faculty research

paths and creating courses centered on sustainability and climate justice. In addition, this would be facilitated by university wide recommendations for faculty to:

- (a) include specific mention of sustainability as a brief rubric in syllabi and;
- (b) include keywords that can be rendered searchable.

2. Enhance Dashboard Features: Update the dashboard to offer navigation and deeper insights into the data. This enhancement could introduce functions that enable users to refine information based on interests or departments, making it more straightforward to access and comprehend Northeastern contributions to sustainability and climate justice.

3. Involve the University Community: Use the database and dashboard to engage with the Northeastern community. Raising awareness and understanding of the University's endeavors in these areas can inspire involvement and cooperation among students, faculty, and staff.

D. Charge 2: Investigate the feasibility of adding a NUPath Core Category in the area of climate justice and environmental sustainability.

2.1. Progress

- The process for developing an NUPath Core Category was explored with the help of Mike Jackson, Vice Provost - Curriculum & Programs. To date, no policies exist for the revisions of the NUPath Core Categories although a committee is to be formed.
- Comparable or useful course labeling systems at other universities were investigated (see Appendix 2), including the sustainability micro-credential at the University of Colorado, and the climate action badge at the Santa Clara University.
- Undergraduate and professional program offerings at Boston-area institutions were also reviewed (Appendix 3).
- Based upon these, the committee has put forth a proposal for the wording of a potential NUPath Core Category (Table 4).
- Potential courses include, but are not limited to, ENVR 1110 Global Climate Change, which has had success in both Boston and Oakland in the First Year Foundational Course (FYFC) program in the Global Scholars Program, as a first-year experience for students from a range of majors. This course includes an acti place-based final project.

2.2. Recommendation

The committee recommends connecting with the Senate Agenda Committee for further information regarding the working group focusing on this topic. In addition, the committee has outlined proposed criteria for the related NUPath requirement (Table 4).

Table 2: Proposed NUPath criteria
Climate justice and sustainability
Students study and practice methods for understanding and increasing climate justice and sustainability across global, local and organizational contexts. They learn theories and perspectives on sustainability, systems, and how socially constructed categories

have shaped the ways in which groups have benefited from the unsustainable practices or are affected by lack of sustainable systems.

Learning Goals: By the end of the course, students should be able to

- A. Discuss ways in which different fields of knowledge are related to questions of sustainability and the relationships among multiple systems
- B. Discuss the value in recognizing how socially constructed categories modulate the effects of climate change and unsustainable systems
- C. Evaluate the usefulness of technological, policy, psychosocial or other interventions for increasing sustainability and climate justice.
- D. Engage in change-action through advocacy, solution creation, or other change-oriented activities

In addition, the Committee recommends:

- 1. Clearer listing and identification of courses related to climate justice and sustainability. This could be achieved, for example, by a university wide recommendation for all syllabi to clearly mention how sustainability and social justice are addressed. In addition, recommending that all syllabi include keywords, including but not limited to those pertaining to this topic, would enhance the searchability of our academic offerings.
- 2. The development of important courses to bridge gaps in the existing NEU course offerings such as community leadership and grant writing related to climate justice, as well as courses in specific areas such as arts, and experiential offerings.
- 3. Increasing and clearly identifying coop opportunities related to climate justice and sustainability

E. Charge 3: Conduct activities for and with Northeastern faculty, staff, and students and/or surrounding communities to promote progress toward this committee's previous strategic plan.

3.1. Progress

The committee has engaged in numerous outreach activities to address this charge including:

- 1. Outreach for linking DEI and climate justice
 - a. Lisa Susser, Manager of Network Diversity on the Boston campus
 - b. The Bouvé DEI leads (Elizabeth Glowacki and Sean Mohammed)
 - c. The Mills College DEI co-lead (Darcelle Lahr)
 - d. The Institute for Health Equity and Social Justice Research (Directors Alisa Lincoln and Idia Thurston)
- 2. Outreach for highlighting the relevance of sustainability and climate change research
 - a. The committee reached out to C2C Impact Engine to gather information about projects already happening on and off campus regarding climate justice action.

- b. The committee reached out to the RISE expo organizers to investigate the possibility of including a recognition of climate-justice focused research at that event

3.2. Recommendations

Based on the activities and information gathered by the committee the following recommendations were formulated:

1. Leverage existing University events and initiatives to elevate the work being done related to climate justice and sustainability including the annual RISE event.
2. Increased coordination across the multiple different groups and units involved in the organization of student, faculty, and staff facing events related to climate justice and sustainability.

Other activities:

List any other activities or work the committee did this past year.

The committee presented ongoing and new work on the Oakland Campus at the Nov 16, 2023, meeting of the Staff and Faculty Sustainability Meeting Series sponsored by the Climate Justice and Sustainability Hub.

Respectfully submitted,

Tamara Bonaci, Umit Coskun, Kristina Faul, Mikhail Oet, Rachel F. Rodgers

Appendixes

Appendix 1: Charge 1 Experiential Project



Research team and sponsors

Student Team: Yashkumar Niteshbhai Navadiya, Manohara Naga Perala, Buket Dede, Jiayue Liu, Shruti Sham Kotwal, Jui Yung Lee, Parth Raghuvanshi, Naman Chaudhry, Rahheb Al Shaikh, Nsikak-Abasi Una, Bhavana Deshetty
Master of Professional Studies in Informatics, College of Professional Studies



Mentor: Dr. Xiaomu Zhou, Informatics Faculty Lead

Sponsors: Dr. Mikhail Oet, Megan Curtis-Murphy
Northeastern University Climate Justice and Sustainability Hub



Objectives



BACKGROUND

- Northeastern University is dedicated to addressing sustainability and climate justice challenges through its Climate Justice and Sustainability Hub. Recognizing the importance of data in driving progress, the university seeks to consolidate and showcase its efforts in these areas. Currently holding a Silver level ranking in the Sustainability Tracking, Assessment & Rating System (STARS), Northeastern aims to elevate its position by demonstrating its commitment to sustainability practices.



MOTIVATION

- The motivation behind this project lies in the necessity to create a comprehensive and accessible representation of Northeastern University's endeavors in sustainability and climate justice. By compiling data on courses, faculty research, and projects related to these topics, the university aims to highlight its contributions to global sustainability efforts and inspire further action within the community.



GOALS

- Develop a web crawler to gather data from various sources, including the university's course catalog, course syllabi, faculty profiles, and external databases, such as Google Scholar pages associated with Northeastern.
- Analyze the course catalog to identify the total number of available courses and categorize those relevant to sustainability and climate justice.
- Analyze course syllabi to gain deeper understanding regarding the interested topics
- Analyze NU Faculty's teaching and research engagement in sustainability and climate justice
- Establish a database or data warehousing architecture to organize and manage the collected data effectively.
- Design a user-friendly dashboard for visualizing and exploring the university's sustainability and climate justice initiatives.
- Quantify the prevalence of sustainability and climate justice-focused courses within the catalog, providing insights into the university's educational offerings in these areas.

Data Sources: Faculty NU Webpages

- Faculty webpages include their names, positions, email addresses, and descriptions.
- The description contains details about their educational background, research interests, publications, and projects.
- We have collected **4861** Faculty webpages from **9 colleges /schools** for our analysis.

The screenshot shows a faculty profile for Gregory D. Abowd. At the top, his name is displayed in a large, bold font. Below the name, his titles and affiliations are listed: Dean of the College of Engineering, Office of the Dean, Professor - Electrical and Computer Engineering, Affiliated Faculty, Health Sciences, and Affiliated Faculty, Khoury College of Computer Sciences. To the right of the text is a portrait photograph of Gregory D. Abowd. Below the text and photo, there is a 'CONTACT' section with an email address (dean@coe.northeastern.edu) and a physical address (230 SN, 360 Huntington Ave, Boston, MA 02115). A 'SOCIAL MEDIA' section is also present with a circular icon. Further down, a 'Research Focus' section lists 'Human-Computer Interaction, Ubiquitous Computing, Software Engineering'. Below that, there are navigation tabs for 'BIOGRAPHY', 'RESEARCH', 'PUBLICATIONS', and 'RELATED NEWS'. At the bottom, an 'About' section provides a detailed biography of Gregory D. Abowd, mentioning his previous roles at Northeastern University and Georgia Institute of Technology, and his research interests in Human-Computer Interaction (HCI) and ubiquitous computing.

Data Sources: Northeastern Catalogs

Northeastern University
Academic Catalog 2023-2024

Home > Course Descriptions

Course Descriptions

2023-2024 EDITION

Undergraduate

College of Professional Studies Undergraduate

Graduate

Course Descriptions

Accounting (ACCT)

Accounting - CPS (ACCT)

Advanced Manufacturing Systems - CPS (AMM)

African American Studies (AAS)

African Studies (AFCS)

African Studies (AFES)

American Sign Language (AMSL)

Analytics - CPS (ANL)

Anthropology (ANTH)

Anthropology - CPS (ANT)

Applied Logistics - CPS (APL)

Accounting (ACCT)

2023-2024 EDITION

Undergraduate

College of Professional Studies Undergraduate

Graduate

Course Descriptions

Accounting (ACCT)

Accounting - CPS (ACCT)

Advanced Manufacturing Systems - CPS (AMM)

African American Studies (AAS)

African Studies (AFCS)

African Studies (AFES)

American Sign Language (AMSL)

Analytics - CPS (ANL)

Anthropology (ANTH)

Anthropology - CPS (ANT)

Applied Logistics - CPS (APL)

COURSES

ACCT 1201 Financial Accounting and Reporting (4 Hours)
Covers the basic concepts and theory of financial accounting and the accounting cycle. Includes financial statements of the balance sheet, income statement, and cash flow statement. Includes an overview of the accounting cycle and the accounting cycle. Includes an overview of the accounting cycle and the accounting cycle. Includes an overview of the accounting cycle and the accounting cycle.

ACCT 1202 Financial Accounting and Reporting (4 Hours)
Does not cover the accounting cycle. Covers the accounting cycle. Includes an overview of the accounting cycle and the accounting cycle. Includes an overview of the accounting cycle and the accounting cycle.

ACCT 1203 Management Accounting (4 Hours)
Covers the basic concepts and theory of management accounting. Includes an overview of the accounting cycle and the accounting cycle. Includes an overview of the accounting cycle and the accounting cycle.

Northeastern University
Academic Catalog 2023-2024

Home > Catalog Archives

Catalog Archives

2016-2017 Catalog | Web-Version | Graduate PDF | Undergraduate PDF | CPS Undergraduate PDF | Course Descriptions

2017-2018 Catalog | Web-Version | Graduate PDF | Undergraduate PDF | CPS Undergraduate PDF | Course Descriptions

2018-2019 Catalog | Web-Version | Graduate PDF | Undergraduate PDF | CPS Undergraduate PDF | Course Descriptions

2019-2020 Catalog | Web-Version | Graduate PDF | Undergraduate PDF | CPS Undergraduate PDF | Course Descriptions

2020-2021 Catalog | Web-Version | Graduate PDF | Undergraduate PDF | CPS Undergraduate PDF | Course Descriptions

2021-2022 Catalog | Web-Version | Graduate PDF | Undergraduate PDF | CPS Undergraduate PDF | Course Descriptions

2022-2023 Catalog | Web-Version | Graduate PDF | Undergraduate PDF | CPS Undergraduate PDF | Course Descriptions | Academic Calendar

Previous Catalogs

PDF Files, thousand pages of each file

Northeastern Course Catalog

- Northeastern Registrar office has archived all course catalogs.
- Some courses are web-based descriptions, while others are PDF files
- We processed about 300+ course catalog pages.

Web-based descriptions

Keywords used to match and technical tools

KEYWORDS

- Climate
- Ecologic
- Ecological
- Environment
- Environmental
- Environmentalism
- Fossil Fuel
- Global Warming
- Natural
- Nature
- Resilience
- Resilient
- Sustainability
- Sustainable
- Energy
- Renewable
- Solar
- Wind
- Alternative Transportation
- Biodiversity
- Conservation
- Consumption
- Contamination
- Deforestation

- Eco-conscious
- Ecoliteracy
- Ecosystem
- Green building
- Greenhouse
- Land management
- Marine
- Native species
- Pollution
- Preservation
- Recycling
- Waste
- Water
- Wildlife
- Land Use
- Disparities
- Equality
- Equitable
- Food security
- Food system
- Food waste
- Human rights
- Hunger
- Inequalities
- Inequity

- Poverty
- Racial
- Racism
- Reproductive rights
- Social change
- Justice

Data Scrapping Tools

- Python
- BeautifulSoap
- Selenium
- Scholarly
- Concurrent
- Requests
- Tableau (Data Visualization)

Process and Methods: NU Faculty Profiles

Data Scrapping

- We employed web scraping techniques to gather information from Northeastern University's faculty webpages and Google Scholar profiles.
- Using Python libraries like BeautifulSoup and Selenium, we extracted data on faculty members' names, positions, email addresses, research interests, publications, and citation counts.
- After cleaning and integrating the scraped data, we automated the process for scalability and periodic updates.
- These efforts provided valuable insights into faculty research activities related to sustainability and climate justice, enhancing our understanding of Northeastern University's contributions in these areas.

ID	Name	Role	Link	Description
1	Amrout Aamer	Associate Teaching Professor	https://nu.northeastern.edu/faculty/amrout-aamer/	About Dr. Aamer has over 23 years of industry...
2	Reneshkumar Rajeev Unnikrishnan	Part Time Lecturer	https://nu.northeastern.edu/faculty/reneshkumar-rajeev-unnikrishnan/	Description not found
3	Mahmoud Abdalrhman	Lecturer	https://nu.northeastern.edu/faculty/mahmoud-abdalrhman/	Description not found
4	Almehdi Alkhatib	Part Time Lecturer	https://nu.northeastern.edu/faculty/almehdi-alkhatib/	Description not found
5	Riad Alkhatib	Part Time Lecturer	https://nu.northeastern.edu/faculty/riad-alkhatib/	About Dr. Riad Alkhatib earned the PhD...
6	Chingping Anagnostis	Part Time Lecturer	https://nu.northeastern.edu/faculty/chingping-anagnostis/	Description not found
7	Dafar Aghajani	Part Time Lecturer	https://nu.northeastern.edu/faculty/dafar-aghajani/	Description not found
8	Jason Ajami	Part Time Lecturer	https://nu.northeastern.edu/faculty/jason-ajami/	Description not found
9	Renery Aquino	Part Time Lecturer	https://nu.northeastern.edu/faculty/renery-aquino/	Description not found
10	Mehrez Arnaiz	Lecturer	https://nu.northeastern.edu/faculty/mehrez-arnaiz/	Description not found
11	Hadi Arshadi	Part Time Lecturer	https://nu.northeastern.edu/faculty/hadi-arshadi/	Description not found
12	Fatouh Arshad Alkhatib	Part Time Lecturer	https://nu.northeastern.edu/faculty/fatouh-alkhatib/	Description not found
13	Samuel Arsenau	Lecturer	https://nu.northeastern.edu/faculty/samuel-arsenau/	Description not found
14	Adelwale Ayo	Part Time Lecturer	https://nu.northeastern.edu/faculty/adelwale-ayo/	Description not found
15	Caroline Babin	Part Time Lecturer	https://nu.northeastern.edu/faculty/caroline-babin/	Description not found
16	Zeynep Akavut	Lecturer	https://nu.northeastern.edu/faculty/zeynep-akavut/	Description not found
17	Sydney Allen	Lecturer	https://nu.northeastern.edu/faculty/sydney-allen/	Description not found
18	Christina Alvarado	Part Time Lecturer	https://nu.northeastern.edu/faculty/christina-alvarado/	About Dr. Alvarado received her PhD in theater...
19	Justus Alvarado	Associate Teaching Professor	https://nu.northeastern.edu/faculty/justus-alvarado/	About Justus Alvarado is a scholar and author...

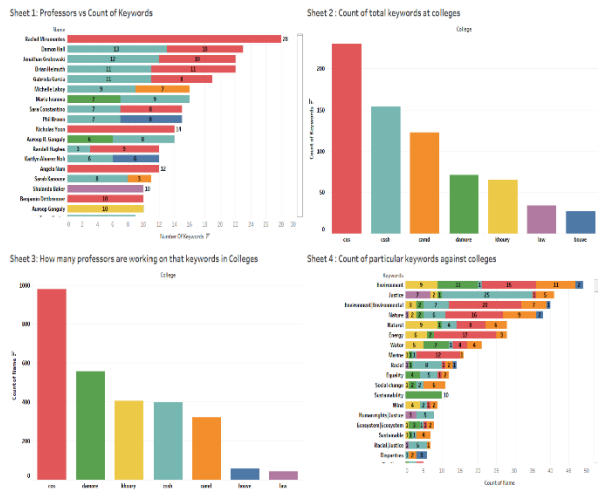
ID	Name	Role	Title	Description
1	Amrout Aamer	Associate	Researcher	Researcher working on water use efficiency and terrestrial drought recovery across the contiguous United States
2	Amrout Aamer	Lecturer	Professor	Biophysical drought resilience and recovery over the CONUS: A multi-stage framework considering water scarcity and quality
3	Amrout Aamer	Associate	Associate	Development of agricultural planning models in a watershed considering climate change impacts
4	Amrout Aamer	Associate	Associate	Development of a framework in the design of achieving the sustainable development goals
5	Amrout Aamer	Associate	Associate	Development of a framework for assessing the impact of climate change on water resources in a watershed
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Process and Methods: NU Course Catalog and CPS Syllabi

- Thorough Analysis of PDF Syllabi and Course Catalogue:** Detailed review of course descriptions, prerequisites, and institutional goals ensures a comprehensive understanding.
- Text Extraction with pdf plumber:** Utilizing pdf plumber for extracting vital information like course titles, descriptions, and program details.
- Keyword Analysis for Themes:** Focused on sustainability, social justice, and environmental impact, using regular expressions to identify relevant keywords.
- Data Structuring for Organization:** Defining columns for effective organization including course title, code, program name, and level. Tableau employed for dynamic visualizations depicting keyword frequency, thematic clusters, and program trends.

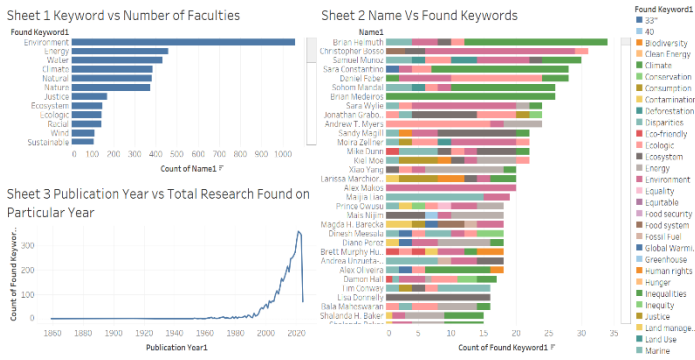
COURSE CODE	COURSE TITLE	INSTITUTION	INSTITUTION PREFIX	INSTITUTION
ENVS 1000	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1000
ENVS 1001	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1001
ENVS 1002	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1002
ENVS 1003	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1003
ENVS 1004	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1004
ENVS 1005	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1005
ENVS 1006	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1006
ENVS 1007	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1007
ENVS 1008	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1008
ENVS 1009	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1009
ENVS 1010	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1010
ENVS 1011	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1011
ENVS 1012	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1012
ENVS 1013	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1013
ENVS 1014	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1014
ENVS 1015	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1015
ENVS 1016	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1016
ENVS 1017	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1017
ENVS 1018	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1018
ENVS 1019	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1019
ENVS 1020	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1020
ENVS 1021	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1021
ENVS 1022	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1022
ENVS 1023	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1023
ENVS 1024	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1024
ENVS 1025	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1025
ENVS 1026	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1026
ENVS 1027	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1027
ENVS 1028	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1028
ENVS 1029	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1029
ENVS 1030	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1030
ENVS 1031	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1031
ENVS 1032	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1032
ENVS 1033	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1033
ENVS 1034	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1034
ENVS 1035	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1035
ENVS 1036	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1036
ENVS 1037	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1037
ENVS 1038	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1038
ENVS 1039	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1039
ENVS 1040	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1040
ENVS 1041	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1041
ENVS 1042	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1042
ENVS 1043	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1043
ENVS 1044	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1044
ENVS 1045	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1045
ENVS 1046	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1046
ENVS 1047	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1047
ENVS 1048	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1048
ENVS 1049	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1049
ENVS 1050	Introduction to Environmental Science	University of Massachusetts Lowell	ENVS	1050

➤ Preliminary findings: NU Faculty Webpages



- Sheet 1 illustrates the **professors** who are predominantly engaged in work pertaining to sustainability and energy-related subjects.
- Sheet 2 displays which **colleges/schools** are most actively involved in endeavors related to sustainability and energy topics.
- Sheet 3 provides insight into the **distribution of professors across colleges/schools** involved in research or teaching courses relevant to sustainability and energy-related subjects.
- Sheet 4 demonstrates the **frequency of professors mentioned** in research papers or other related content focusing on specific keywords, originating from various colleges/schools.

➤ Preliminary Findings: Google Scholar Pages



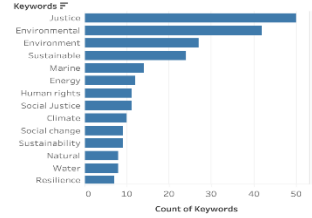
- In Sheet 1, you can discern the areas within **sustainability and energy-related** topics where research activity is likely to be concentrated, indicating potential focuses for further investigation.
- Conversely, Sheet 2 not only highlights the **professors leading in research** output but also sheds light on the specific topics they are inclined to explore in their research papers.
- Sheet 3 delineates the **annual distribution of research efforts by faculty members**. For instance, it illuminates how the global pandemic influenced researchers to dedicate more attention to sustainability and energy-related topics.

➔ Preliminary Findings: Northeastern Catalog 2022

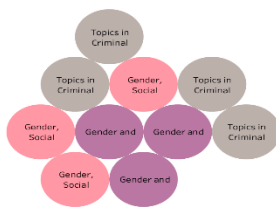
Most Relevant Courses in NEU



Top 10 Keywords present



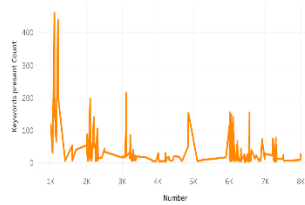
Top 3 courses and course code that have Keywords



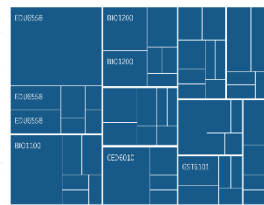
- Most Relevant Courses : This sheet projects the 10 most relevant courses to Sustainability aspect in the Course Catalogue where **Topics in Criminal Justice and Criminology** stands first. This gives an idea of which course is most inclusive in this aspect.
- Keywords that have maximum occurrence gives an understanding of which topic of Sustainability is being focused. The word that occurs maximum number of times in the Course Catalogue is **Justice**.
- Among the top 3 courses that have maximum keywords, **Topics in Criminal Justice and Criminology** was offered multiple times followed by **Gender Social Justice and Transnational activism** along with **Gender and reproductive Justice**.

➔ Preliminary Finding 4: CPS Syllabi (2020-2023)

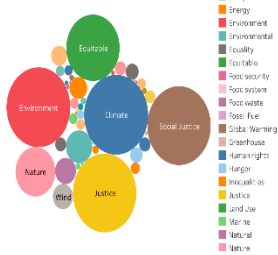
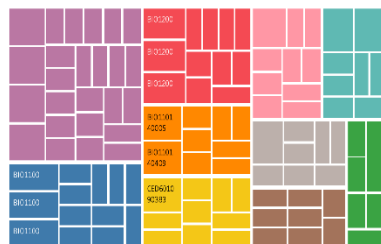
Keywords present VS Course



Top 10 courses with keywords present



Multiple CRNs VS Keywords Present



- "Keywords present VS Course," illustrates the course code that have maximum keyword in syllabi replicating how **Undergraduate level** courses have higher relevance with sustainability topics.
- The Top courses with maximum keywords projects courses that have most keywords. Though undergrad courses have more occurrence of keywords interestingly it's grad level course which has highest keyword **EDU 6558. Issues in Education** followed by **BIO 1200. Principles of Biology**
- The word cloud is an insight of the most relevant topic that is talked about in sustainability aspect. **Environment** is the maximum occurring amongst all the syllabi followed by **Climate** and **Justice**.

→ Moving forward

- Construct a better data repository for any future teams to continue the analysis
- Conduct more and deeper analysis, including clustering the keywords to reflect the topic pertaining to sustainability and climate justice
- Refine our dashboard to be more intuitive, enabling more descriptions and interpretations

→ Thanks and Be Green!



MORE VALUE THAN JUST
SUSTAINABILITY

Made of high-density polyethylene (or HDPE) material, our compostable grocery bags are safer for the environment than traditional plastic bags.

Appendix 2: DIGEST OF 2023-2024 AY SURVEY QUESTIONS

Distribution of Survey Respondents

There are 603 responses (about 64% reported by fulltime non tenure track, 34% by Fulltime tenure track or tenured faculty, and 1% by parttime faculty). Responses are approximately equally distributed among the rank of the faculty (27.4% assistant, 36.5% associate, and 36.2% full professor level).

The majority of respondents are from the College of Science (20%). About 1.4% of respondents are from School of Law, about 4.8% are from Mills College at Northeastern, about 6.5% are from College of Professional Studies, the rest of respondents are from other Colleges (Bouvé College of Health Sciences, College of Arts, Media and Design, Khoury College of Computer Sciences, College of Engineering, College of Science, College of Social Sciences and Humanities, D'Amore-McKim School of Business) each contributing from 9.5% to 10% of all total.

Most respondents are from Boston Campus (86%) followed by Oakland Campus (7%). There are no respondents from London, Miami, and San Francisco. The other seven campuses contributed the remaining 7% of the responses.

Involvement in Sustainability Related Activities

Gross majority (91.9%) of the respondents reported involvement in Sustainability Related Activities.

- 159 (26.4% of respondents) related to class teaching,
- 133 (22.0%) related to student mentoring or supervising,
- 125 (20.7%) related to research,
- 113 (18.7%) related to community activities,
- 24 (4.0%) indicated other related activities; however, responses indicated a variety of understandings of the question as illustrated by the following list of other activities reported
 - research addressing climate change disinformation,
 - teaching a course on energy production to the Roxbury Youth Club,
 - producing a movie "Powering Puerto Rico" related to solar energy in Puerto Rico,
 - beach cleaning activities,
 - composting and recycling,
 - drive to recycle and awareness,
 - participating in the NYC climate solution proposal,
 - reflection assignment to raise awareness of lab sustainability,
 - organizing focusing on DEIR programing and sustainability,
 - being board member of nonprofit climate.org,
 - participating in administrative and committee work.

The way University Can Support

This question got about 80 responses. However, many of them include seemingly unrelated answers or indicators of confusion about the intent of the question. Following are the responses that are addressing the intend of the survey question:

- Encouraging/subsidizing the public transport, encouraging biking, Free/discounted Electric Vehicle Parking;
- Paper recycling bins to offices;

- Need for better transparency related to recycling efforts (Comment was: The students who are passionate about sustainability feel disheartened when they see that everything in the black bins (recycling and trash) all getting dumped into one big bin when the operations team collects the waste and recycling);
- Internal funding for sustainability-related initiatives;
- Small grants for teaching innovation in integrating climate justice themes into existing classes;
- Research hub connecting faculty and students interested in climate-related research.

Respondents Message to Climate Justice Action Committee

There are common themes in the responses that can be summarized as 1) University should make our efforts more visible, 2) support/subsidize public transportation, 3) encourage bicycling or cleaner transportation alternatives, 4) fund initiatives. List of responses is as follows:

- *“making universities efforts to more public and visible”,*
- *“report how we compare other leading institutions, how our employees adopt sustainability-related practices”,*
- *“fund sustainability initiatives,”*
- *“encourage student involvement and feedback,”*
- *“adding to course curricula,”*
- *“subsidizing public transit,”*
- *“increase covered bike rack areas to further encourage the use of bikes by faculty, staff and students,”*
- *“encouraging every college and department to offer at least one course focused on applied sustainability within their various fields of study. Integrating sustainability into the curriculum across different disciplines would not only broaden the understanding of its importance but also foster a more comprehensive approach to addressing environmental and societal challenges.”*
- *“divest its [investment] portfolio from fossil fuel holdings sends a very clear message about NU’s commitment to the environment,”*
- *“retrofitting of old buildings to be less impactful/wasteful should be a priority,”*
- *“The University needs to get rid of single-use plastic and replace single-paned windows,”*
- *“More should be done to promote sustainability on campus especially with regard to food and beverage services and vendors. Adopt a policy similar to the governors' for state offices — banning single use plastic bottles on all campuses.”*
- *“Communicating honestly about the impact of single use plastic and eliminating it from campus needs to be an immediate goal, along with education on what state recyclables like paper and glass need to be in so that they ACTUALLY get recycled is critical.”*
- *“Stop leaf blowing. It is a needlessly large polluter.”*
- *“Change the name of the committee. Climate Action Committee fine. Sustainability Committee fine. Climate Justice Action Committee makes it appear to be another woke committee that claims to search for justice while backing programs and policies that disproportionately hurt the disadvantaged groups in society so the better off can virtue signal.”*
- *“Can we build solar powered EV charging stations?”*

- *“hand dryers in all the bathrooms to reduce paper waste.”*
- *“My minor pet vision for me is that of decolonizing the Oakland campus as far as vegetation is concerned. In my opinion, Northeastern could create a model plan by restoring native plant species on a campus in which introduced species are predominant. This could be a project that could involve students by providing community service while learning useful content and skills.”*

Teaching Sustainability Related Subjects

About 11% (65/603) of respondents stated teaching a climate/sustainability related course. A wide variety of courses covering are reported. Some of those courses are entirely dedicated to subject matter like CIVE 4566 Design for Sustainable Transportation, ENVR 1110 Global Climate Change, ENVR 2515 Sustainable Development, PPUA 5264 Energy Democracy and Climate Resilience: Technology, Policy, and Social Change. Many others are reported covering the subjects to some degree. List of courses reported by the respondents are as follows:

1. ARCH 3170 Architecture, Infrastructure, and the City
2. ARCH 5220 Integrated Building Systems
3. ARCH 5310 Design Tactics and Operations
4. ARTG 5000 Topics in Design
5. ARTG 6310 Design for Behavior and Experience
6. ARTH 5600 Landscape and Ecology in Visual Culture
7. BIOL 3411 Current Topics in Cell and Molecular Biology.
8. CHEM 1151 General Chemistry for Engineers
9. CHEM 1161 General Chemistry for Science Majors
10. CHEM 2161 Concepts in Chemistry
11. CHEM 5640 Biopolymeric Materials
12. CHEM 5670 Global Biogeochemistry
13. CIVE 3430 Engineering Microbiology and Ecology
14. CIVE 4566 Design for Sustainable Transportation: Netherlands
15. CIVE 4567 Planning and Policy for Sustainable Urban Transportation: Netherlands.
16. CIVE 5376 Traffic Engineering and Sustainable Urban Street Design
17. CIVE 5670 Global Biogeochemistry
18. CIVE 7385 Public Transportation
19. CS 7170 Human-centered AI
20. CLTR 1503 Info session for new Italian Culture Course with an embedded spring break trip
21. ECON 1116 Principles of Microeconomics. Sustainability
22. EEBA 6401 Experiential Business Decision Making
23. ENGL 2650 Science Writing: Origins, Ethics, and Emerging Genres
24. ENSY 5300 Electrochemical Energy Storage
25. ENTR 3306 Global Entrepreneurship
26. ENTR 4501 Integrated Studies in Entrepreneurial Startups
27. ENVR 1110 Global Climate Change
28. ENVR 2200 Earth's Changing Cycles
29. ENVR 2515 Sustainable Development
30. ENVR 5670 Global Biogeochemistry
31. GE 3300 Energy Systems: Science, Technology, and Sustainability
32. HIST 1150 East Asian Studies

33. INNO 2206 Global Social Enterprise: inclusive.
34. INNO 2301 Innovation
35. INNO 4506 Integrated Studies in Social Innovation and Entrepreneurship
36. INTB 2205 Business Decision Making in Developed Country Environments
37. INTB 4202 Executing Global Strategy
38. INTL 1101 Globalization and International Affairs
39. ITC 6040 Informatics Capstone
40. ME 5600 Materials Processing and Process Selection
41. MUSC 2336 The Festival Experience
42. MUSI 2234 Festivals
43. MUSI 3351 Music and Social Justice
44. PHYS 1132 Energy, Environment, and Society
45. POLS 2395 Environmental Politics and Policy
46. PPUA 5264 Energy Democracy and Climate Resilience: Technology, Policy, and Social Change
47. SOCL 1246 Environment & Society.

Research Recent Work that involves active and experiential learning and contributes to positive sustainability outcomes.

Following projects are reported by the respondents:

1. Somerson Sustainability Innovation Grant to create Rhode Island stakeholder and community engagement in the topic of pollution and remediation of Providence River.
2. Lifecycle mapping of their packaging designs, study of sustainable materials, visit to the Harvard GSD Materials Collection.
3. Wildfire prevention project, implemented partially with government of Canada.
4. Students led presentations at Malden public middle school on sustainability and the SDGs in collaboration with the UN Association of Greater Boston.
5. My students and I worked with colleagues at CERN on studying gases used in particle detection changes to see if suitable replacements could be found for gases with very high global warming potential. This work was done in collaboration with people from other institutions (Univ. of Florida, Univ. of Wisconsin) and was supported under grants to Northeastern from the NSF.
6. Students Co-ops at Mass Clean Energy Center having sustainability related positions.
7. Undergraduate core class including a debate session every term on sustainability efforts of a particular company, where teams do research on the company's efforts and then have to present assigned positions that the company should resist or embrace sustainability beyond the company's current efforts.
8. Most of my students have undertaken term projects that address issues of social, environmental and/or economic sustainability. A majority of the projects involve working with small business owners of color in the local community, public policy or related representatives, or local community-based organizations to support their work in the sustainability of the community
9. Seniors capstone projects proposals on sustainability; groundwater in Boston community, increasing permeable pavements in Boston alleys, making visible NU community's waste in effort to provoke action.
10. Projects for improving bike network planning (developing new methods and tools), as well as for bike network plans for specific locations. Likewise, projects for transit priority - general methods as well as plans for specific locations.

11. Went to Puerto Rico and built a solar energy system for a family in Utuado Puerto Rico. The film "Powering Puerto Rico" chronicles this work. I also started the Technology and Education Center for Renewable Energy in Puerto Rico www.tecre.org.

Research Projects

Some respondents answering this part note that information given may reveal identities of the respondents. Yet, there are a great variety of research projects reported including but not limited to conservation studies, forest fire monitoring and prevention, student recycling studies. Following is a list of responses.

- Hybrid CLT / Steel Structures for Zero Carbon Buildings.
- Green Infrastructure for Equity and Health using Sensors and Participatory Modeling.
- Green innovation in family firms.
- Assessing the meaning of corporate purpose in part to address responsibility towards the environment.
- City planning/improvement via design of bus stops in the presence of bike lanes, making BU Bridge better for bikes, pedestrians, and buses, and transit-friendly underlying traffic signal control.
- Integrating Regenerative Technologies into Urban Ecologies ‘Multi-scale modeling of bacterial plankton mediated nutrient cycling in the Narragansett Bay.
- Remembrance of Climate Futures A site-specific public art project landmarking local climate events projected by science that are expected to occur in the region in the 21st century.
- Conservation studies: Malden River Works which is a community-led project to create a climate resilient park on the Malden River; Charlesgate Park which is a multi-stakeholder community/public agency project to restore the connections between the Muddy River and the Charles through people-powered transportation; and Little Mystic Channel Park which is a community-led project to develop heat resilient public open space on the formerly industrial Little Mystic Channel.
- Wildfires prevention and detection using drones and computer vision.
- “My Electric Genealogy” multimedia show which uses the landscape infrastructure of Los Angeles to ask far-reaching questions about intergenerational environmental responsibility in the Anthropocene.
- Students created a booklet focusing on 4 different themes connected to Sustainability at Northeastern. The themes are 1) Materials/Recycling 2) Sustainable research and research on sustainability 3) Transportation 4) Energy Conservation.
- Climate change impacts on forestry and land resources in Northeast China.
- Stormwater pollutant removal, wastewater treatment process decarbonization, aquaculture pollutant reduction, understanding and improving air quality in urban environments.

Sustainability related publications

Some respondents decline to answer this part since the publications potentially uncover their identity. Nevertheless, reported limited publications cover a wide breath of

- applications of climate, climate justice, and sustainability including artwork representing environmental impacts, building constructions, city planning, transportation, energy solutions, corporate culture and education. Reported publications are as follows:
1. Laboy, Michelle M. "Reimagining Low-Carbon Futures: Architectural and Ecological Tradeoffs of Mass Timber for Durable Buildings." *Architecture, Structures and Construction*, May 31, 2022. <https://doi.org/10.1007/s44150-022-00048-7>.
 2. "Conditioned to Care: Gender Differences in Entrepreneurs' Socially Responsible Behaviors" Published in the *Journal of Small Business Management*
 3. The limits of the business case for sustainability: Don't count on 'Creating Shared Value' to extinguish corporate destruction Beyond the 'Win-Win': Creating Shared Value Requires Ethical Frameworks G de los Reyes, M Scholz, NC Smith
 4. Kinol, A., E. Miller, H. Axtell, I. Hirschfeld, S. Leggett, Y. Si and J. C. Stephens (2023). "Climate justice in higher education: a proposed paradigm shift towards a transformative role for colleges and universities." *Climatic Change* 176(2): 15.
 5. Furth, Peter G., Maaza C. Mekuria, and Hilary Nixon. "Network Connectivity for Low-Stress Bicycling." *Transportation Research Record* 2587: 41-49, 2016.
 6. Furth, P. G., P. Moser, and T.V.V.K. Putta. Measuring low-stress connectivity in terms of bike-accessible jobs and potential bike-to-work trips: A case study evaluating alternative bike route alignments in northern Delaware. *Journal of Transport and Land Use*, 11(1), 815–831, 2018. doi:10.5198/jtlu.2018.1159
 7. *Ecological Frictions and Borderless Futures: Art and Activism on a Sailing Ship* (in *At the Crossroads of Music and Social Justice*, 2023, IU Press).
 8. Mouchrek, N., Cullen, C., Ganino, A., Gliga, V., Kramer, P., Mahesh, R., ... & Shaikh, T. (2022). Investigating environmental values and psychological barriers to sustainable behaviors among college students. *Consilience*, (26), 1-18.
 9. Mouchrek, N. (2018). Engaging college students in the transition to sustainability through design-based approaches. *Consilience*, 20(20), 88-103.
 10. Ho, G., V. Kubušová, C. Irabien, V. Li, A. Weinstein, Sh. Chawla, D. Yeung, A. Mershin, K. Zolotovskiy, and L. Mogas-Soldevila. 2023. "Multiscale Design of Cell-Free Biologically Active Architectural Structures." *Frontiers in Bioengineering and Biotechnology* 11. <https://doi.org/10.3389/fbioe.2023.1125156>
 11. Velho A., Cruz P., Banks-Richardson D., Armin G., Zhang Y., Inomura K., Zolotovskiy K., Interactive Visualization of Plankton – Mediated Nutrient Cycling in the Narragansett Bay, IEEE Oceans Conference (accepted for publication).
 12. Zheng, S., Velho, A., Ross, K., Chen, H., Li, L., Zolotovskiy, K. Self-Cleaning Surface Architectures from Chitin Biomaterials - Computational and experimental methodology (pp 91-100), 50th Education and research in Computer Aided Design in Europe (eCAADe), v1, 2022. ISBN 978-94-91207-04-4.
 13. Kanouse, Sarah. "Over the Levee, Under the Plow: An Experimental Curriculum." In Sarah J. Ray and Jennifer Atkinson, eds. *Experiential Toolkit for Climate Justice Education*. Berkeley and Los Angeles: University of California Press. Expected 2024.
 14. Krupar, Shiloh and Sarah Kanouse. "Unmastering the Map, Federating People's Nuclear Atlases: Response to A People's Atlas of Nuclear Colorado Forum." *Society & Space* (online magazine).
 15. Kanouse, Sarah and Shiloh Krupar. "The National Toxic Land/Labor Conservation Service: Recovering an Atomic Commons." In Livia Monnet, ed. *Toxic Immanence* Montreal: McGill-Queen's University Press, 2022, 174-196.
 16. Krupar, Shiloh and Sarah Kanouse. "A People's Atlas of Nuclear Colorado." *Backchannels*, a blog of the Society for Social Studies of Science. March 21, 2022. <https://www.4sonline.org/a-peoples-atlas-of-nuclear-colorado>.

17. Kanouse, Sarah. "Staying with the Troubling, Performing in the Impasse." In Emily Eliza Scott, TJ Demos, and Subhankar Banerjee, eds. *The Routledge Companion to Contemporary Art, Visual Culture, and Climate Change*. New York: Routledge, 2021: 153-163.
18. Kanouse, Sarah. "Touching Power: White Womanhood, Colonial Spectacle and the 'Forces of Nature' at the Boulder Power Inaugural." *Arcadia: Explorations in Environmental History*. December 2021. <https://www.environmentandsociety.org/node/9369>.
19. Li, Bo, Binhui Liu, Mark Henderson, Wanying Zhou, and Mingyang Chen. "Expansion of Treeline in North China and Its Relationship with Altitude Sensitivity Gradient of *Larix Gmelinii*." *Forests* 14(10): 1960 (October 2023). <https://doi.org/10.3390/f14101960>.
20. Wang, Guibin, Binhui Liu, Mark Henderson, Yu Zhang, Zhi Zhang, Mingyang Chen, Haoxiang Guo, and Weiwei Huang, "Effect of Terracing on Soil Moisture of Slope Farmland in Northeast China's Black Soil Region." *Agriculture* 13(10): 1876 (October 2023). <https://doi.org/10.3390/agriculture13101876>.
21. Fengyuan Zhang, Binhui Liu, Mark Henderson, Xiangjin Shen, and Wanying Zhou, "Changing Spring Phenology of Northeast China Forests during Rapid Warming and Short-Term Slowdown Periods." *Forests* 13(12), 2173 (December 17, 2022). DOI:10.3390/f13122173.
22. Tongwei Kong, Binhui Liu, Mark Henderson, Wanying Zhou, Yuanhang Su, Shuai Wang, Ligang Wang, and Guibin Wang, "Effects of Shelterbelt Transformation on Soil Aggregates Characterization and Erodibility in China Black Soil Farmland." *Agriculture* 12(11), 1917 (November 14, 2022). DOI:10.3390/agriculture12111917.
23. Xiangjin Shen, Binhui Liu, Mark Henderson, Lei Wang, Ming Jiang, and Xianguo Lu, "Vegetation greening, extended growing seasons, and temperature feedbacks in warming temperate grasslands of China." *Journal of Climate* (April 22, 2022). DOI:10.1175/JCLI-D-21-0325.1.
24. Contrasts Inscribed on the former Great Swamp A visual essay examining the many traces found on interstitial land surrounding a small brook A story of many rivers and wetlands worldwide, polluted by industry and sewerage and straining infrastructure capabilities, now stressed by climate change and extreme rainfall events.

Appendix 3: Undergraduate interdisciplinary initiatives

Table 2: Undergraduate interdisciplinary initiatives	
Colorado University Sustainability Innovation Micro-Credential https://www.colorado.edu/ecenter/get-involved/micro-credentials	
-	Sustainability Innovation: The Sustainability Innovation micro-credential provides students with a foundational understanding of sustainability and an overview of projects and initiatives implemented at CU. Students will participate in workshops that will teach them creative problem-solving techniques, proposal development and how to engage stakeholders. They will receive a one-on-one mentoring session to get feedback and finish with a capstone implementing the newly learned skills in a project proposal or presentation.
To earn the Sustainability Innovation micro-credential in Spring 2024, students will need to:	

- Take the CU: Sustainability Skillsoft course
- Attend the Design Thinking for Sustainability Workshop on Feb. 22, 2024. Participants will learn how to use the design thinking process to explore problems, work in a team to come up with solutions and practice presenting them. Students will also learn circular design strategies and work together to use those strategies to re-design an everyday product to make them more sustainable.
- Attend a project development workshop in March. This workshop covers idea testing, proposal development, pitch formulation, stakeholder engagement and systems thinking. Students will gain feedback and tools to build out and identify support for project proposals.
- Complete a one-on-one mentoring session to test and validate project ideas.
- Capstone presentation. Participants will share their project in one or more of the following formats:
 - Applied-learning class project proposal/presentation
 - President's Sustainable Solutions Challenge presentation
 - Climate Action Expo presentation

Cal Poly Humboldt Climate Justice and Resilience Leadership Certificate of Study

https://catalog.humboldt.edu/preview_program.php?catoid=10&pooid=6134&returnto=1760

Required courses:

- Climate Justice and Sustainability Leadership
- Grant Writing for Social and Environmental Justice

Electives: Students must take one of several options in each of the areas below

- Racial, indigenous, and environmental Justice
- Regenerative design and art
- Systems change: Policy, law, economy

University of Colorado Boulder

<https://airtable.com/appfxXXTgwplcMebY/shrR8HmZ6IMP3sXhn>

CU Boulder has a "playbook" badge system.

To earn the Climate Action badge, students must complete three actions: one "learn" action, one "live" action, and one "lead" action in the respective badge category.

Columbia University

<https://www.climate.columbia.edu>

The Columbia climate school offers several collaborative undergraduate majors and concentrations:

- A major and concentration in sustainable development
- A major in environmental science, earth science, and climate science
- A climate system science major

Stanford University

<https://www.sustainability.stanford.edu>

The Doerr School of Sustainability at Stanford encompasses 8 departments and various research groups.

In terms of academic programs, it offers:

- Majors in environmental engineering, geophysics, earth & planetary sciences, earth systems science, energy science and engineering, oceans, and environmental social sciences
- A Change Leadership for Sustainability Program (both MS and executive education)

<https://www.college.stanford.edu/courses>

As part of the Civil, Liberal, and Global Education (COLLEGE) requirement for ALL Stanford students, students may choose a course that focuses on global climate change and/or sustainability. Recent courses include Environmental Sustainability: Global Predicaments and Possible Solutions as well as Preventing Human Extinction and The Ethical Challenges of the Global Climate Crisis

Appendix 4: Boston area programs and certificates

Table 3: Boston area programs and certificates
<p>MIT certificate in Sustainability https://professionalprograms.mit.edu/professional-certificate-program-in-sustainability</p> <ul style="list-style-type: none">- Sustainability strategies and opportunities for industry- Sustainable infrastructure systems- Life cycle assessment- Circular economy- Electives: cultural awareness, designing high impact solutions, persuasive communication, digital transformation, innovation and technology, clear energy solutions, women in leadership
<p>Boston University https://www.bu.edu/sustainability/academics-research/academics/</p> <ul style="list-style-type: none">- No formalized curricular program, but an accessible list of course from a variety of disciplines
<p>Boston College Environmental Studies https://www.bc.edu/bc-web/schools/mcas/sites/envstudies/major.html https://www.bc.edu/bc-web/schools/mcas/sites/envstudies.html</p> <ul style="list-style-type: none">- Major and minor in Environmental Studies (ENVS)- Interdisciplinary approach integrating natural sciences, social sciences, and humanities- Focus on addressing environmental challenges such as climate change, freshwater scarcity, food insecurity- Emphasis on transforming society for ecological regeneration, social justice, economic security- Fosters campus-wide dialogue on environmental issues through various events

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