Unit 2 - Environmental Justice: Geographic Patterns, Inequitable Exposure to Hazards, and Historical Roots

What are the origins of environmental justice? What are examples of environmental justice communities, and how is underrepresentation in science connected?

NGSS connections: ***Practices:*** *Asking Questions and Defining Problems; Developing and Using Models; Planning and Carrying Out Investigations; Analyzing and Interpreting Data; Obtaining, Evaluating, and Communicating Information; Engaging in Argument from Evidence; Constructing Explanations and Designing Solutions;* ***CCCs:*** *Patterns; Cause and Effect; Systems and System Models;* ***DCI:*** *HS-ETS1-1.*

Starting point for instructors

- Do Unit 0 - Setting the Stage before this lesson, and review norms if needed.
- We strongly recommend teaching all of **Unit 1, especially** "Why Does Representation Matter?", "Learning about Scientists' Lives", "Subjectivity and Objectivity in Science and **Unit 2 -** Systemic Racism, before teaching this lesson to establish an understanding of representation in science and systemic inequalities.
- This lesson uses the example of toxic waste and industrial facilities and their disproportionate effect on communities of color. Instructors can use this example, or adjust the lesson to use examples from other sciences (e.g., access/barriers to clean energy sources or energy use & pollution for adding data centers or electric utility environmental justice actions for physics/engineering classes)

Pre-Lesson Student Exploration / Bell-Ringer

Before coming to class/at the start of class, students need to read "The Father of Environmental Justice Exposes the Geography of Inequity," in which Dr. Robert Bullard looks back on his four decades of activism and the work ahead.

Optional writing: Based on Dr. Bullard's experiences, what patterns were uncovered about where environmental hazards are located and who is affected? What was Dr. Bullard's relationship to the communities mentioned?

In-Class Investigations

Write-Pair-Share: Discussion about the Pre-Lesson Article *[20-30 minutes]*

For last night's homework (or in class), students read an article on Dr. Bullard's work that provides evidence of geographical concentrations of environmental issues.

- *Write:* Dr. Bullard found that toxic waste facilities were disproportionately located in Black communities. Based on what we learned in **Unit 2 -** Systemic Racism, does his data fit your definition of racism? Why or why not?
- *Pair:* Pair up and share your answer with a partner. What did you agree on? What were your

differences?
- *Share:* Ask pairs or small groups to volunteer to share with the whole class.

Debrief: Most of you identified that the geographical concentration of environmental issues in NC communities of color is due to policies and systems, not just individual prejudice. When systemic racism shows up specifically in environmental issues - like where pollution is located, who gets clean water, whose neighborhoods have toxic facilities- we use a specific term for this. The EPA defines environmental justice as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies." This means that environmental justice fits many experts' definitions of systemic racism. Dr. Bullard's work in the 1970's - 1980's provided the data for this pattern, essentially launching what became the environmental justice movement.

- *Reflection:* Ask students to reflect on the above discussion and what they learned in **Unit 1 -** "Why Does Representation Matter?" They can answer the following questions in small groups or repeat the *Write, Pair, Share activity.*
    - Does Dr. Bullard's work align with the recent EPA definition of environmental justice? If yes, how and if no, why not?
    - Dr. Bullard was trained as a social scientist. How did he collect data to draw conclusions about geographical location, race, and environmental issues? What unique perspectives did his professional background offer to these issues?
    - In **Unit 1 -** "Why Does Representation Matter?", we explored the question "What unique perspective does a minority student bring to a physics class?" How does that question relate here? What unique perspective(s) did Dr. Bullard bring as a researcher studying communities affected by environmental racism?

Instructor Note:
As you can see, this lesson builds on Unit 2 - Systemic Racism by applying that framework to environmental issues. Students use their prior understanding of systemic racism to analyze Dr. Bullard's data, and then the specific term "environmental justice" is introduced. If students haven't completed Unit 2 - Systemic Racism, you may consider revising the *Write* prompt to: "Dr. Bullard found that toxic waste facilities were disproportionately located in Black communities. Do you think that this pattern is accidental, or was there a systematic reason? Explain your thinking."

In-Class Investigations

How does data collection and representation look different since Dr. Bullard's research in the 1970s and 1980s? ProPublica's interactive digital map showing industrial pollution and cancer risk levels across different U.S. census tracts is an illustrative example. Students can explore the relationship among geographical location, race, and environmental harm in a single area.

Introduction: "Cancer Alley" in Louisiana is an 85-mile-long stretch along the Mississippi that is home to over 200 petrochemical processing facilities. In this activity, we'll use research and data analysis to do a mini-investigation of environmental justice.

- Students should create a data table with these columns:

    - A. Parish Name
    - B. % Population Non-White (Black, Hispanic, Other)
    - C. Average Excess Cancer Risk
    - D. Cancer Cases Per Million
    - E. Industrial Facilities/Notes
- They should then look at this list of parishes found within "Cancer Alley". Have students choose *three* parishes - one from each category - and write them in Column A of their table. It's OK, even encouraged, for students to choose different parishes from one another. [*Editors' Note: a "parish" is the Louisiana word for "county" and has no religious connotation.]*
- Students will use two online resources to complete their table:
    - Column B: Using the Census Reporter website, students can type the name of their parish directly into the search bar and scroll down to find Race and Ethnicity data
    - Columns C and E: Using ProPublica's Map, students can scroll down to see a map of Cancer Alley. By typing the parish name into the search bar towards the bottom of the page, they will find the average excess cancer risk across the parish. If they want to explore specific industrial facilities in any parish and the localized risk near those facilities, they can use the map to do so and enter it in Column E.
- Some students find risk ratios like 1/1600 difficult to understand; students may find it easier to compare "projected excess cancer deaths per million residents". To do this conversion in Column D, students should divide 1,000,000 by the denominator of the excess cancer risk. (See below for an example: 625 = 1000000 / 1600)
- Teachers, you can find a table showing the data for all parishes, and scatterplot visualizing the results, here. (Data accurate as of 5/22/26)

Cancer Alley Data Investigation - Example Table

A. Parish Name	B. % Pop Non-White	C. Average Excess Cancer Risk	D. Cancer Cases Per Million	E. Notes/Observations
St. John the Baptist Parish	70%	1 in 7,500	625	Denka Performance Elastomer emits 6 known carcinogens. Risk is x5 higher at that site.

Reflections and debrief of the data table. Ask students to answer the following questions.

- When you compare the racial makeup of the parish to the excess risk of cancer, what do you notice?
- Does this data support Dr. Bullard's conclusions about race and environmental issues from 40 years ago?
- Three data points are not enough to statistically establish a trend. How much more data would you need to feel confident in the trend you have identified?
- *Optional (if time/interest allows):* Look up your own community (or a nearby one) using the search bar on the map. How do the demographics of your community and the cancer risk levels compare to "Cancer Alley, Louisiana"?

Instructor Note:

We suggest that you become familiar with ProPublica's Map before your students use it. Read the introduction paragraph and click on areas of the map to see how it works. More information about the methodology of ProPublica's Map can be found here.

Students can examine more census tracts where particularly high-risk facilities are located and analyze the racial makeup of those tracts. If rigorous regression is desired, the data behind the project is available in the Data Store Archive. However, be aware that regressing census tracts within cities would be problematic because hotspots do not always correspond to the nearest city. Examining census tracts and analyzing their racial makeup is the best approach.

We've seen that environmental hazards have been concentrated in communities of color and low-income communities for 40+ years, as documented. Let's connect this to what we learned in Unit 1 about representation in science: what unique perspective does a scientist from an environmental justice community bring to addressing environmental issues? [5-10 minutes]

- Look back at **Unit 1** - Data Analysis & Representation (direct link to the pie charts) to answer the following questions in small groups or as a whole class.
    - Are non-white people underrepresented or overrepresented in the community of physicists/chemists/biologists,/etc?
    - Do you think that this trend is also present among environmental scientists?

Instructor Note:

According to 2018 Bureau of Labor Statistics data, only about 10-11% of environmental scientists are people of color (5% Black, 4.8% Latine, 0.7% Asian). Journal of Environmental Studies and Sciences (2018), making environmental science one of the least diverse STEM fields.

Lesson Wrap-Up: Case Study Jigsaw [15 minutes]

Divide the class into 3 groups. Give each group one scenario (handout or link):

Group 1: Gordon Plaza New Orleans

Group 2: RISE St. James

Group 3: Sandbranch, Texas - Freedman's Settlement

In small groups, or using Jigsaw, students can discuss their thoughts on the following questions:

- When communities face environmental problems, why might it be helpful to have scientists from those same communities working on solutions?
- How can science be a tool for community empowerment?
- Only 11% of environmental scientists are people of color, but communities of color experience disproportionate environmental hazards. How do you think under/over-representation in environmental science limits research priorities, environmental perspectives, and solutions?

Optional Emotional Check-In - Since URC lessons encourage students to wade into sensitive topics they may disagree with, we use the Emotional Check-In writing prompts to help students paraphrase what they're hearing, reflect on how it makes them feel, and consider whether there's an opportunity to learn from it. [10 minutes]

Post-Lesson Homework

Read and Reflect: Students may have questions about how these patterns developed. The article on Dr. Bullard touches on the history of redlining, but A brief history of redlining provides a more detailed history of redlining specifically in New York City, although the same federal Home Owners Loan Corporation (HOLC) policies were nationwide.

- Read Environment & Health Data Portal: A brief history of redlining and respond to the following reflection questions:
    - What criteria did HOLC use to classify neighborhoods?
    - Do you think that redlining was based on actual property conditions or on racism?
    - Think back to our investigation into Cancer Alley and Louisiana parishes. How might the 1930s HOLC maps have influenced where petrochemical plants were built in the 1940s - 1970s? (For more data, students can explore their own communities using the mapping tools: Mapping Inequality: Redlining in New Deal America)
    - How does understanding this history change how you think about solutions to environmental injustice and underrepresentation in science today?

Homework Debrief: We've now explored several facets of environmental justice: how environmental injustices are more pronounced in specific communities; how underrepresentation in science affects communities; and how historical policies like redlining created the geographic foundation for environmental injustice. [30 minutes]

Detail how to debrief.

- Write: Complete this sentence: Before reading the redlining article, I thought _____. Now, I understand _____.
- [*Optional*]: Use one of the Anonymous Poll methods listed here to help students share their sentences anonymously.
- Highlight any common themes in responses.
- See Lesson Plan Resources for links to community organizing success stories.

Resources

- Lesson Plan Resources