

FOUNDATIONAL MODULE

Mapping Environmental Justice



What's in this module?

Contents

Graduate students or advanced undergraduates with prior exposure to GIS or environmental justice concepts.

Contents

Part I focuses on how environmental data is collected and structured to build indices: what gets counted, and what's left out? Part II examines how index design and mapping choices shape accessibility, legibility, and narrative. Part III explores the limits of these tools, and provides an activity that brings students either in conversation with each other, or outside, to talk about how they experience place.

Activities

3 parts

3 activities

Photo by darmau on Unsplash.



Learning Objectives

01

Describe the lifecycle of environmental justice data and how decisions at each stage shape decision making.

02

Critically evaluate the design and construction of environmental justice multi-criteria weighted indices.

03

Create your own environmental justice index, recognizing its limitations and exploring other participatory mapping methods.

04

Explore how environmental justice indices are used in policy, planning, and advocacy

Introduction

“Examining power means naming and explaining the forces of oppression that are so baked into our daily lives—and into our datasets, our databases, and our algorithms—that we often don’t even see them.”

– *DATA FEMINISM (D’IGNAZIO & KLEIN, 2020)*

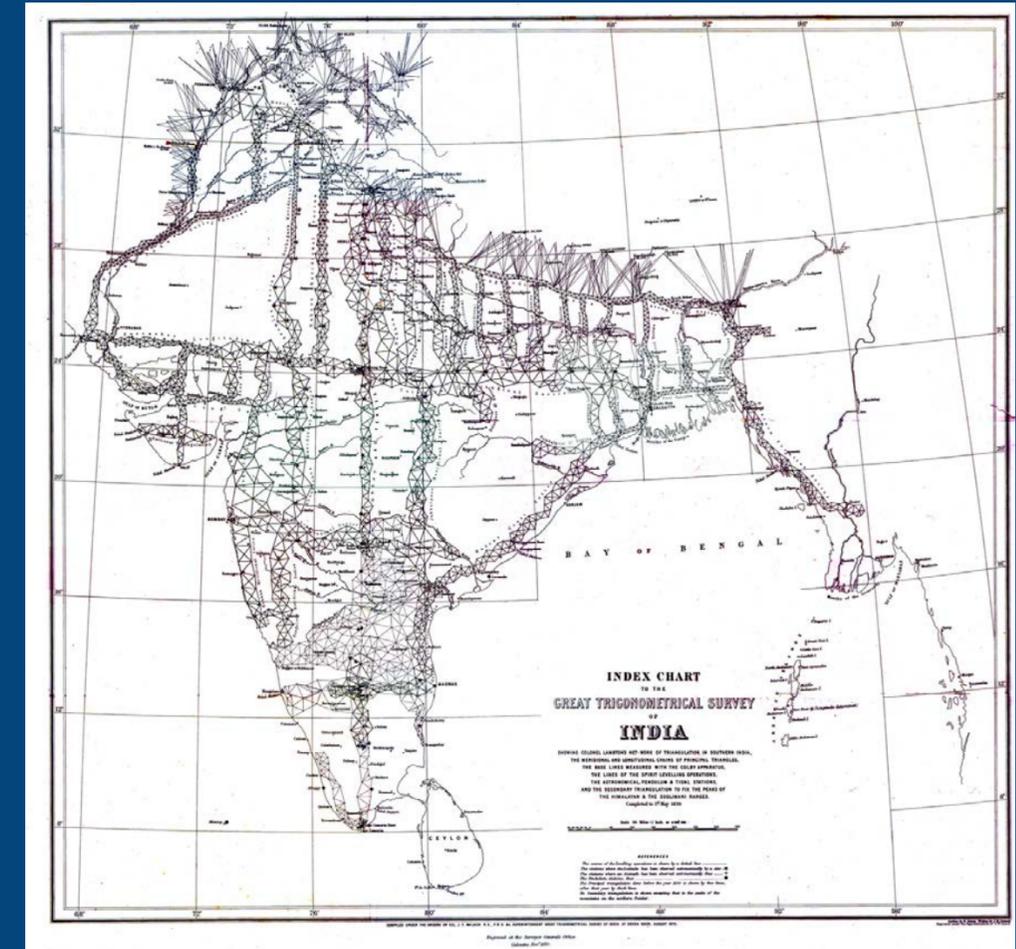
Mapping and Power

Critical Cartography is a field that recognizes how maps are not neutral documents. As a term used both to describe mapping practices and theoretical critique, it “...challenges academic cartography by linking geographic knowledge with power, and thus is political.” (Crampton & Krygier, 2015)

When reading a map, a critical cartographer may ask:

- What gets measured?
- How is it measured?
- What data is included (and excluded)?
- How is data visualized?
- How are places named?
- Who uses the map – and for what reasons?
- Did communities have a say in how data was collected or used?

Example: The Great Trigonometrical Survey of India



This map is in the public domain.

The Great Trigonometrical Survey was undertaken by the British East India Company starting in 1802, with the aim of mapping the Indian subcontinent using “objective” scientific precision. However, both its production and its impacts were deeply political—designed to serve colonial aims by enabling land taxation, consolidating territorial control, and erasing Indigenous systems of knowledge and land use. (Xaxa 2024; Edney 1997)

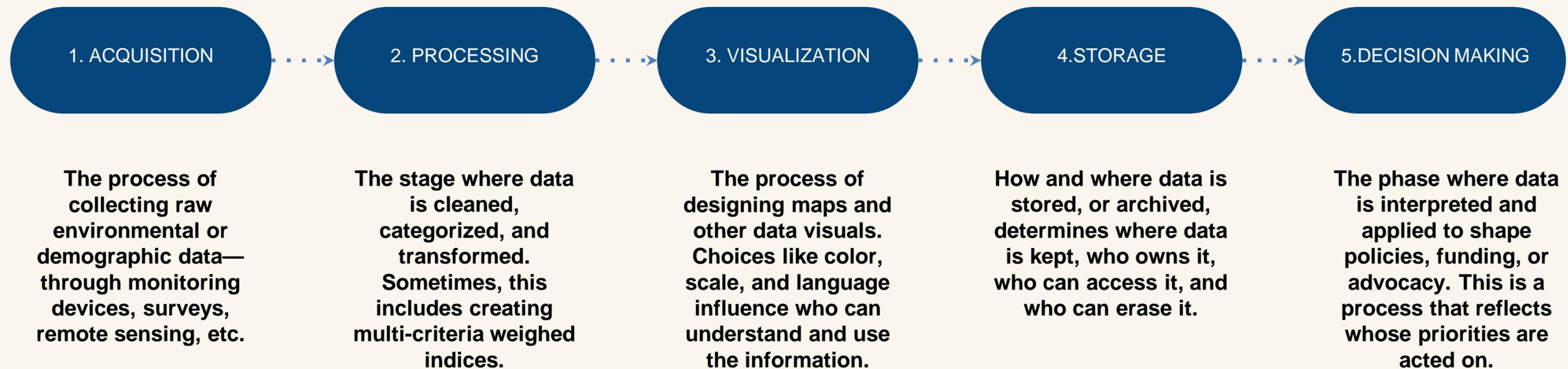
The Lifecycle of Spatial Data

PART 1

Spatial Data Lifecycle

Understanding the lifecycle of environmental justice data means asking critical questions about **power** at every stage—who collects the data, how it's structured, where it's stored, and how it's ultimately used. Each phase shapes what environmental harms are made visible, whose experiences are centered, and what kinds of action are possible.

Simplified Data Lifecycle:



Data Lifecycle Steps Adapted From:

Roth, Silke, and Markus Luczak-Roesch. 2018. "Deconstructing the Data Life-Cycle in Digital Humanitarianism." *Information, Communication & Society* 23 (4): 555–71. doi:10.1080/1369118X.2018.1521457.

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Simplified Data Lifecycle:



The process of collecting raw environmental or demographic data—through devices, surveys, remote sensing, etc.

The stage where data is cleaned, categorized, and transformed.
multi-criteria weighed indices.

The process of designing maps and other data visuals. Choices like color, understand and use the information.

How and where data is stored, or archived, determines where data is kept, who owns it,

The phase where data is interpreted and applied to shape policies, funding, or whose priorities are acted on.

What questions should we ask at each stage?

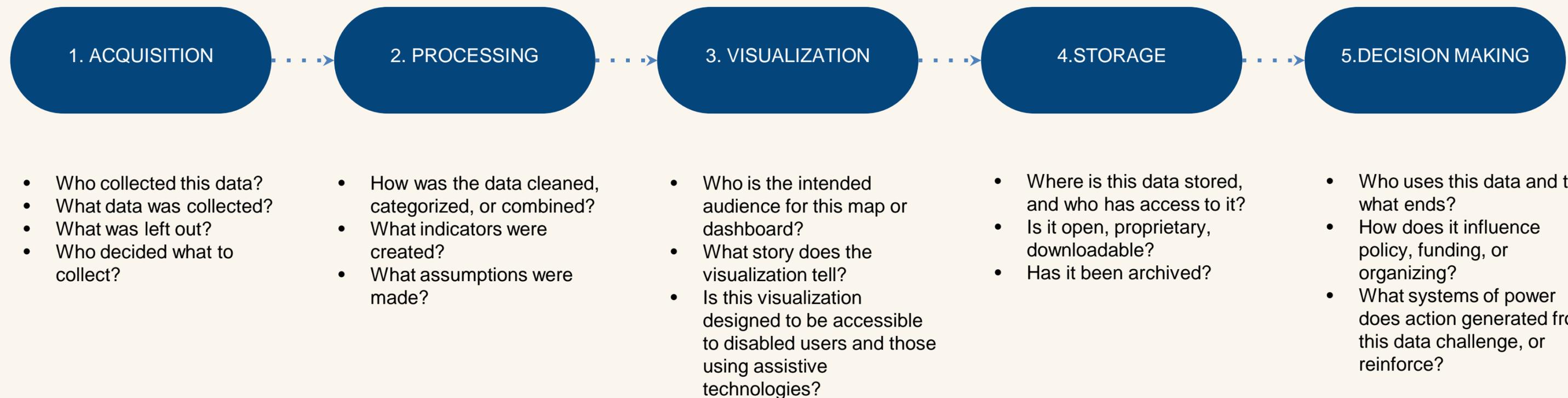
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ACTIVITY #1

MAPPING THE DATA LIFECYCLE OF EJ TOOLS

Goal

Analyze how power operates across the data lifecycle of the **Massachusetts Environmental Justice Populations tool** using the five-stage framework: Acquisition → Processing → Visualization → Storage → Decision Making

Step 1:

Split into 5 groups, and assign each group one stage of the spatial data lifecycle.

Step 2:

Read the summary of the Urban Institute's report on EJ screening tools: [Screening for Environmental Justice](#)

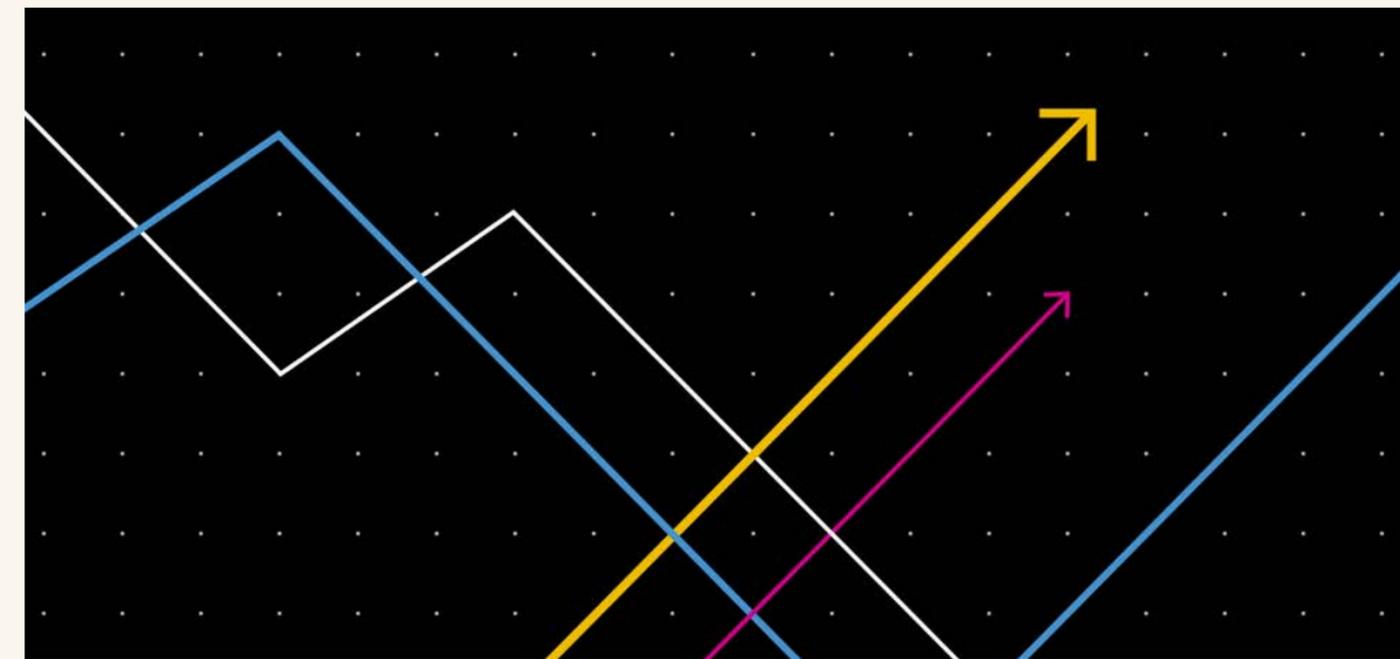
Step 3:

Focus on the [Massachusetts Environmental Justice Populations tool](#) and, in your groups, ask the questions relevant to you group's stage that are on Slide 9.

Step 4:

Come together as a full class or share in cross-group pairs to share back:

1. Key observations about power and design choices
2. Gaps, limitations, or missing voices
3. One recommendation to improve the tool



RESEARCH REPORT

Screening for Environmental Justice

A Framework for Comparing National, State, and Local Data Tools

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November 2022

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Scale and EJ Mapping

Scale	Examples	Strengths	Limitations
Federal	<u>CEJST</u> , <u>EJScreen</u> (Both archived)		
State	<u>CalEnviroScreen</u> , <u>Massachusetts EJ Populations</u>		
Local / City	<u>EJNYC Mapping Tool</u>		

Scale and EJ Mapping

Scale	Examples	Strengths	Limitations
Federal	<u>CEJST</u> , <u>EJScreen</u> (Both archived)	(+) Consistent coverage across U.S. (+) Often tied to major, federal funding programs (Ex: Justice40)	(-) Relies on broad-scale indicators (Ex: census data) and generic weighting
State	<u>CalEnviroScreen</u> , <u>Massachusetts EJ Populations</u>	(+) Can include state-specific hazards (Ex: oil wells, wildfires) (+) More timely updates	(-) Varies by state; some states lack tools entirely (-) Still may rely on generalized proxies
Local / City	<u>EJNYC Mapping Tool</u>	(+) May better reflect local conditions (+) Can integrate higher quality data collected at a city level	(-) Often underfunded (-) Harder to compare across regions or advocate for state/federal action

Scale and EJ Mapping

For each of these scenarios – which scale of environmental justice tool (federal, state, or local) is most appropriate? What else (besides a mapping tool) would you need to make an informed and just decision?



A community board in the your neighborhood asks for your help identifying a site for a new cooling center that will serve mothers with children. What scale of map or tool would be most suitable for this use case?



You're writing a national grant proposal to fund community air monitoring projects in the most climate-vulnerable census tracts. Which scale of mapping tool helps you decide where to target, and what are its tradeoffs?



You've been hired by your state's Department of Health to identify neighborhoods most at risk of heat-related illness to target for health interventions. You only have budget for 5 cities. What kind of index would help you decide which cities are a part of this project?

The Making of an Index

PART 2

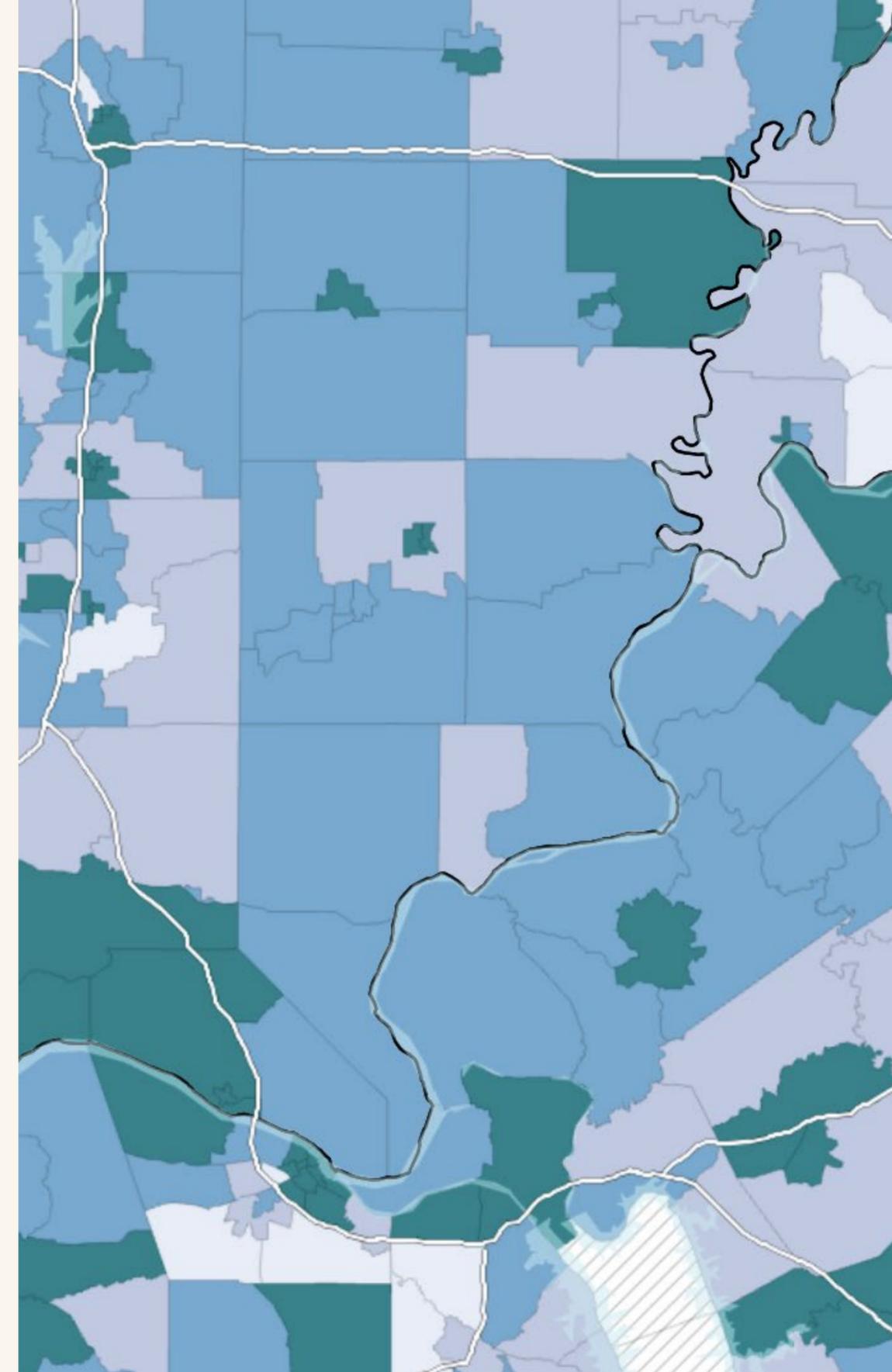


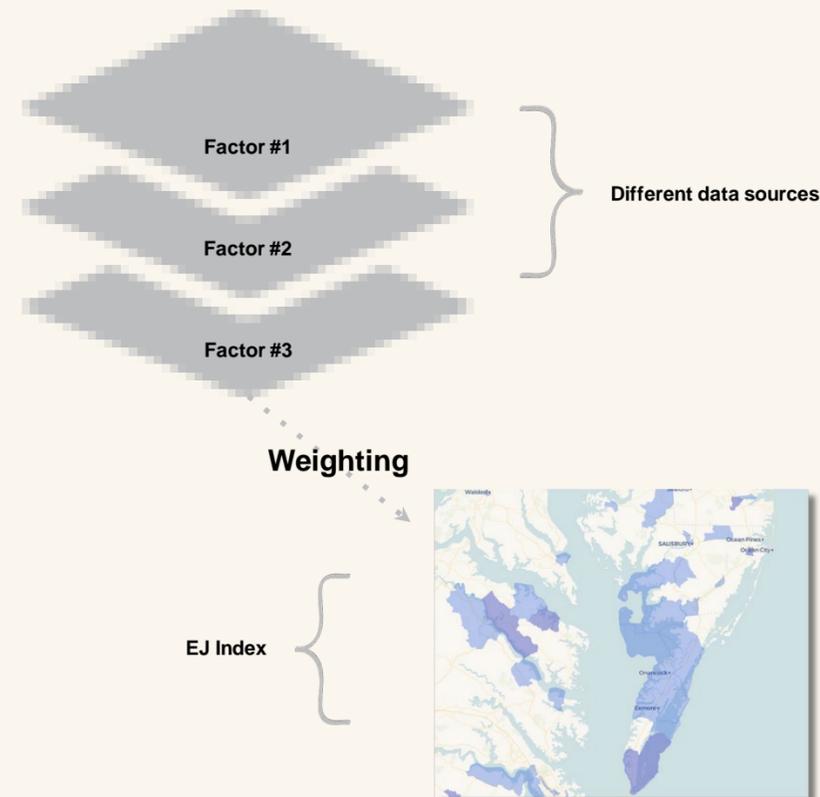
Image Source: Screenshot from the [CDC's Environmental Justice Index](#). This map is in the public domain.

What is an Index?

An index is a type of dataset that combines multiple indicators, such as pollution levels, income, and health data, into a single score or classification.

Environmental Justice indices are used to identify EJ communities and reveal patterns of vulnerability or risk. Often times, they are created to aid in the distribution of resources.

(Osakwe et. al. 2024; Huynh et. al. 2024)



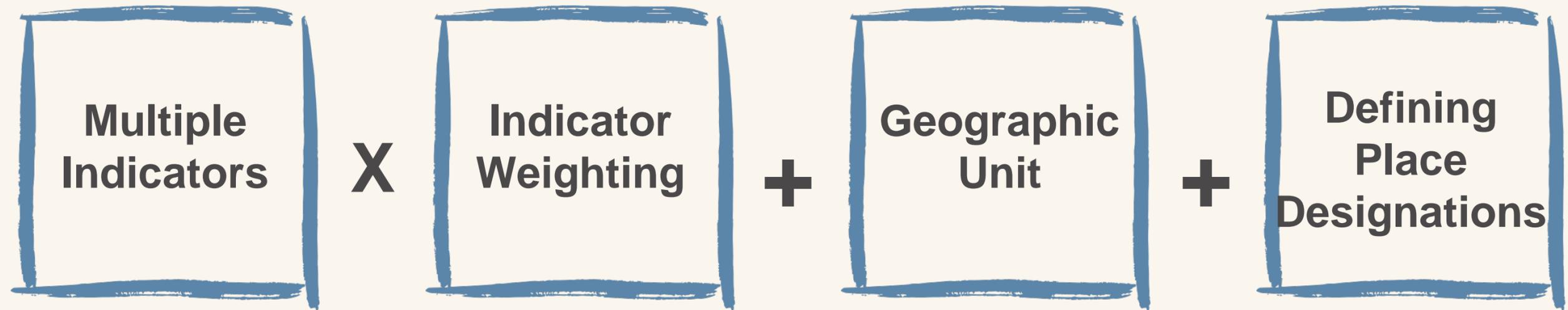
What Makes an Index?

- Multiple indicators (e.g., air pollution, asthma rates, poverty)
- Weighting (some factors count more than others)
- Aggregation (indicators combined into a score or rank)
- Geographic unit (e.g., census tract, ZIP code, block group)

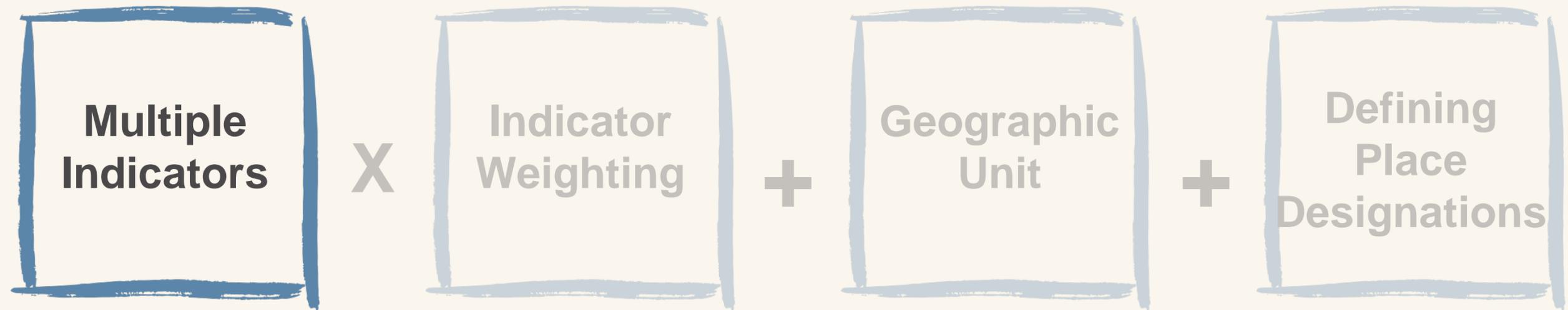
Important Distinction:

Not all environmental justice maps are indices. Some maps show single datasets (e.g., heat risk, flood zones) or use narrative, participatory, or visual methods. Indices are composite tools, one kind of EJ mapping, but not the only kind.

What Goes Into an EJ Index?



What Goes Into an EJ Index?



Possible Indicators May Include:

Environmental

- Air quality
- Water quality
- Access to green space
- Heat vulnerability

Social

- Income
- Race / Ethnicity
- Education
- Age

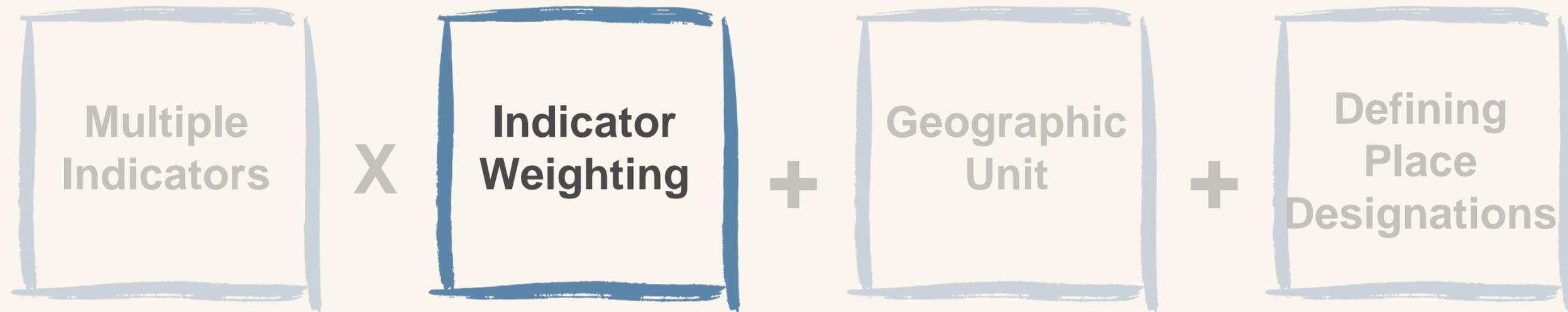
Health

- Asthma rates
- Heart disease
- Low birth weight rates
- Life expectancy

Infrastructure

- Housing quality
- AC access
- Transit access
- Flood control infrastructure

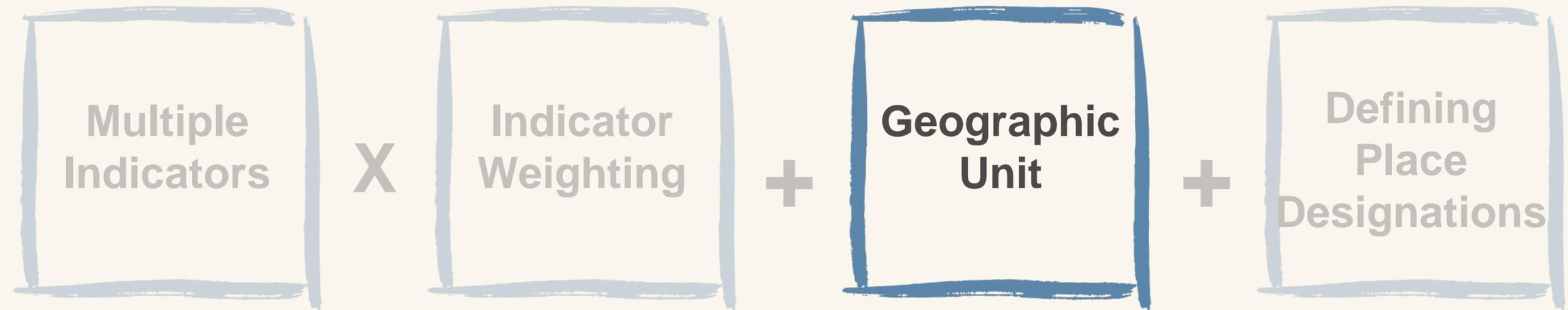
What Goes Into an EJ Index?



Indicator weighting refers to how much each indicator affects the final EJ score. Not all indicators may be equally as relevant to a community's vulnerability, therefore, it is important for an index to reflect local priorities. There are different weighting approaches ([Dean 2022](#)), which generally fall within two categories:

- **Participatory Multi-Criteria Analysis:** Stakeholders define indicator weights through a participatory process.
- **Analyst-Led Multi-Criteria Analysis:** A non-participatory approach whereby a specialist, or team of specialists, undertakes the analysis and determines, amongst other things, indicator weights.

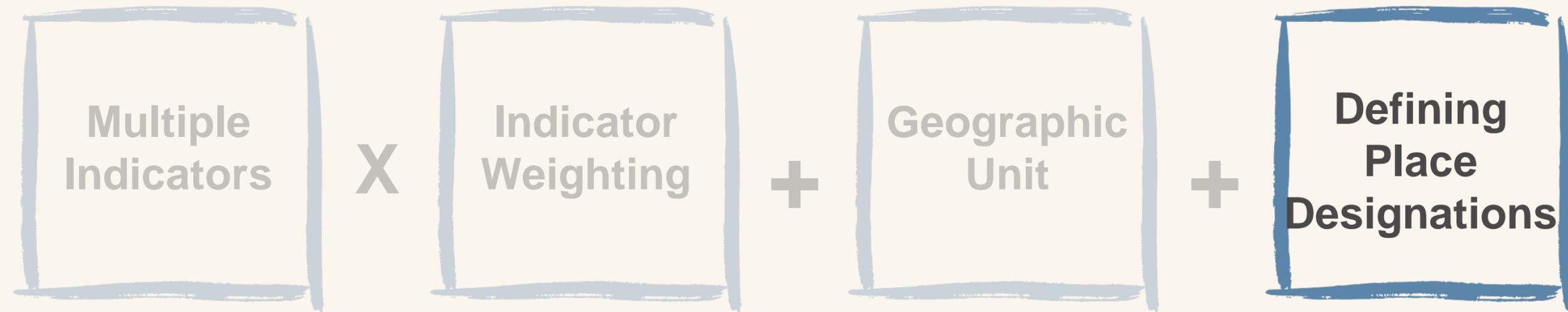
What Goes Into an EJ Index?



The geographic unit is the scale at which data is processed and communicated in the index. Depending on the intended end-user and use case, different scales may be more suitable.

- **Census Block Group** – Fine-scale, Suitable for neighborhood-level analysis, limited data availability.
- **Census Tract** – Common in EJ tools, balances detail with broad data coverage, aligned with other data reporting.
- **Neighborhood / Community District** – Useful in cities, may align with local governance.
- **County** – Broad view, may work for policy or funding decisions taking place at a state or national level, but can obscure local disparities.

What Goes Into an EJ Index?



Different EJ Indices take different approaches for making sense of the data: communicating which geographies are Environmental Justice communities, or experience some degree of vulnerability. These approaches, defined by the Urban Institute (Balakrishnan et. al. 2022), include:

- **Binary:** A place is either “disadvantaged” or not, based on a fixed threshold. This creates clear eligibility lines but can exclude communities just below the cutoff.
- **Tiered:** Places are ranked relative to others (ie, by percentile), better reflecting the spectrum of how risk and injustice are experienced, but possibly requiring more interpretation for policy and funding decisions to be made.

BUILD YOUR OWN SPATIAL DATA INDEX

Step 1: Situating Yourself (5 minutes)

Extreme heat is the deadliest climate disaster. Your task is to build a mini index to identify which neighborhoods in your city are most vulnerable. You are pretending to advise the City on where to prioritize funding for cooling interventions.

Step 2: Meet Your Partner + Select Your Neighborhood (5 minutes)

Find a partner and together, pick a real or imaginary neighborhood in your city. You will pretend to represent that neighborhood when assigning values to indicators later. For the purposes of this activity, each “neighborhood” will have the same value of 100 for each of the following indicators:

- % of Households Without AC Access
- % Energy-Burdened Households
- Surface Temperature / Lack of Tree Cover
- % of Population Over 65 Living Alone
- Percent of Neighborhood With Tree Canopy Coverage

Step 4: Assign Your Weights (10 minutes) Individually:

- You have 100 points to divide across the five indicators.
- Assign more points to indicators you think matter more for heat vulnerability. Reflect on what you know about heat, as well as social vulnerability in your city.
- Multiply each indicator value (100) by your assigned weight to calculate a score.

Step 5: Compare, Combine, Reflect (10 minutes)

Regroup with your partner and compare how you weighted the indicators, and how this affected the final weighted “Score”. Where did you align or differ? Why did you choose certain weights? What assumptions were baked into your decisions? Who might be helped or left out because of how you built your index? What data do you wish you had but couldn’t include?

Articles About Extreme Heat for Reference:

- [Who Is At Most Risk To Extreme Heat?](#) NIHHS
- [The Unequal Burden of Heat](#) American Scientist
- [41 million Americans are simmering on urban heat islands](#) Grist

BUILD YOUR OWN SPATIAL DATA INDEX

This version of the activity uses an ArcGIS Learn module and requires access to ArcGIS Pro. It is designed for students with some prior experience using GIS tools.

Step 1: Launch the Learn Module (5 minutes)

Go to the ArcGIS Learn project:

 [Create an Environmental Justice Index Map](#)

Sign in to ArcGIS Pro and download all of the listed datasets in the tutorial.

Step 2: Follow the Tutorial Instructions (35–45 minutes)

As you work through the steps, pause to reflect on:

- What indicators are being used?
- Who might have selected them?
- What indicators are left out?

Step 3. Customize the Weighting (10–15 minutes)

Using the Smart Map Search tool:

- Revisit the indicators and try adjusting the weights.
- Consider how shifting the weights changes which neighborhoods are classified as vulnerable. What are the real world implications of these decisions?

Step 4: Reflect + Discuss (10 minutes)

- What are the strengths and limitations of this tool?
- What data is missing?
- How does changing weights reflect different stakeholder priorities?
- How can this process be made more just, or equitable?

What the Data Misses

PART 3

What are the Limits of Digital EJ Maps and Indices?

- **Scale Misalignment:** Because many EJ indices report data at the Census Tract level, disparities between blocks may be missed.
- **Technical Barriers:** The creation and use of digital mapping tools, particularly indices, exclude people like the elderly who lack the necessary technical skill sets or communities without internet access.
- **Lack of Community Input:** While many indices, like CalEnviroScreen, are developed with input from the public, the scale at which these tools are developed (often at a city, state, or national level) precludes representative participation.
- **Quantification Limits:** Not all forms of harm can be easily measured. Things like emotional stress or cultural loss are not captured in typical data sets.



One example of how groundtruthing can complement mapping using aerial imagery, or data collected in a top-down manner, is in mapping access to fresh fruits and vegetables. Stores change often, and some vendors of fresh produce may be street vendors.

Conducting an on-the-ground survey can be an effective way to ensure that data is accurate and up to date (Dean et al., 2011). Conducting this type of fieldwork in partnership with communities may make it even more effective in understanding how people experience injustice on the ground.

FIELD PAPERS

This version of the activity is designed for a group to use online, suitable for in-person classrooms or online classrooms, where spending time outdoors in a neighborhood is not feasible.

Step 1. Pick a Place You Know (5 Minutes)

Based on your own lived experience, pick a neighborhood that you know well. This neighborhood can be anywhere in the world.

Step 2. Open Field Papers and Print Maps (15 Minutes)

Go to the Field Papers website:

[Field Papers](#)

This tool is an Open Source tool – meaning that it can freely be used, or modified. Under the “Make” tab, navigate to the neighborhood you want to spotlight, and then click “Make Atlas”. Download your map and print it.

Step 3. Find a Partner and Introduce Your Neighborhood (5 Minutes)

Locate a partner, and show them your neighborhood. Explain why you picked this place, and what your relationship to it is.

Step 4. Mark Up Your Map (10 Minutes)

With your partner, go through the following prompts and make marks on your map or a blank sheet of paper indicating the following:

- Where people gather
- Where you would take a friend who was visiting
- Places that are important to the people in this neighborhood

Step 5. Partner Sharing + Interview (10 Minutes)

Exchange maps with your partner. Each take five minutes to interview one another and ask the following prompts:

- Why did you choose to map this place?
- What stories do you associate with these spots?
- What does this map leave out?
- How has this place changed over time?

Step 6. Group Reflection (Optional: 5–10 minutes)

Regroup as a class and discuss:

- What kinds of knowledge came out through conversation that were not visible on the map?
- How does your partner's understanding of place differ from how it looks from above?
- How is this exercise relevant to mapping environmental justice issues in communities?

FIELD PAPERS

This version of the activity is designed for a group to use when they are able to go outdoors and walk around a small area – this could be a section of a campus, around a block, or a local park.

Step 1. Find a Partner and Distribute Field Papers (5 Minutes)

Students should find a partner for the activity, and each pair should receive one printed version of Field Papers corresponding to the area they will be exploring (ie, a part of a campus, a local park, a city block).

Step 2. Digital Exploration (15 Minutes)

Before going outside, students should explore the area from a digital perspective. Using the EDF's Climate Vulnerability Index, take 10 minutes to summarize what you learn from the census tract the area you will be walking based on data alone:

🔗 [The U.S. Climate Vulnerability Index](#) (EDF, Texas A&M)

Spend 5 minutes discussing what you find with your partner.

Step 3. Walking Observations (20-30 Minutes)

Pairs now spend between 20 and 30 minutes walking around the area mapped on Field Papers, and taking notes at things they observe on the Field Papers. These can include:

- Where people gather
- Places that look cared for
- Places that look like they require care
- Small businesses, community landmarks, or other forms of neighborhood infrastructure

Step 5. Partner Sharing + Reflections (10 Minutes)

Sitting with your partner, reflect on the following questions:

- What aspects of this neighborhood were invisible on the map but clear on the ground?
- What did the data or digital map suggest that wasn't apparent during your walk?
- How might your own perspective or lived experience shape what you noticed or overlooked?

Jot down a few shared insights to bring back to the group.

Step 6. Group Reflection (Optional: 5–10 minutes)

Regroup as a class and discuss:

- How does this kind of hands-on mapping help us better understand environmental justice issues?
- How should digital data and lived experience work together when it comes to documenting and addressing injustice?

For more resources on climate and environmental justice: **Please explore other modules in the Climate Justice Instructional Toolkit.**



Module References

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