SHC Output 10.2: Characterize Select Interrelationships Between Environmental Stressors to Address Cumulative Impacts on Community Health

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Agency Problem

Understand how the interactions of environmental exposures, stressors from the built and degraded natural environments, and social determinants contribute to disproportionate impacts of vulnerable groups

Examples of Identified Partner Needs

- What are the **chemical stressors and potential health impacts** from contaminants impacted by natural events (e.g., floods, drought, fire)?
- What **interactions between chemical exposures, social/built/natural environmental systems**/conditions/policies result in unequal adverse environmental health conditions among diverse overburdened population groups?
- How do we **translate data and information** for use by communities?
- How do we integrate ecosystem goods and services with health data to evaluate community health?

Output Description

- Understand the myriad chemical and non-chemical stressors found in the total environment (built, natural, social)
- Identify linkages between built and natural environmental conditions, social determinants of health, and adverse impacts on health and well-being
- Identify environmental disparities to enable EPA, states, tribes, and communities to incorporate considerations of disproportionately impacted groups into risk assessments and epidemiological investigations
- Develop and apply these methods and approaches for assessing cumulative health impacts by incorporating a health endpoint, measure or marker

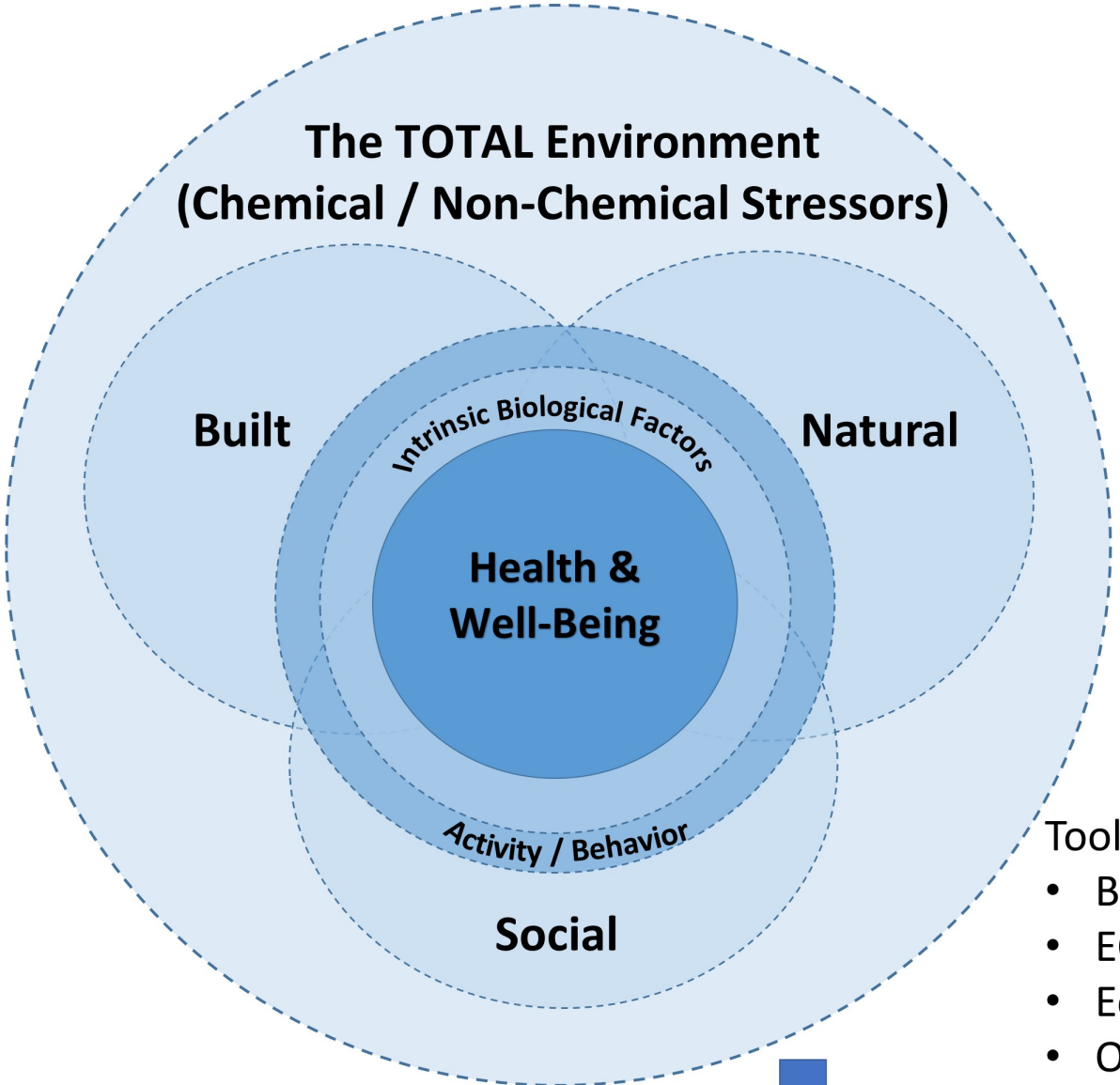
Scientific Approach

- Research projects focused on better understanding stressors from the built and social environments
- Integration and translation of research projects

Figure Depicting Integrated Research Activities in SHC RA 10, Output 2

Research activities focused on chemical and non-chemical stressors from the built and social environments

- Asthma triggers
- Cumulative health effects
- Tribal child care centers
- Post-ingestion bioaccessibility models
- Workshop



Integration and translation

Tools:

- Biomarker-based health metrics
- EQI
- Eco-Health Relationship Browser
- Opportunity Atlas (environmental stressors)
- Children's Health App

Integration and translation

Chemical and Non-Chemical Stressors

- Chemical Stressors
  - Metals
  - Pesticides
  - PFAS
  - Ozone
  - Criteria air pollutants

Quote from user: "*I used the [Eco-Health Relationship Browser] to research evidence associated with heat events, as we were developing a brief HIA for use by the City of Cincinnati Office of Environment and Sustainability.*" Camille A. Jones MD, MPH, Assistant Health Commissioner, Division Director, Community Health and Environmental Health Services

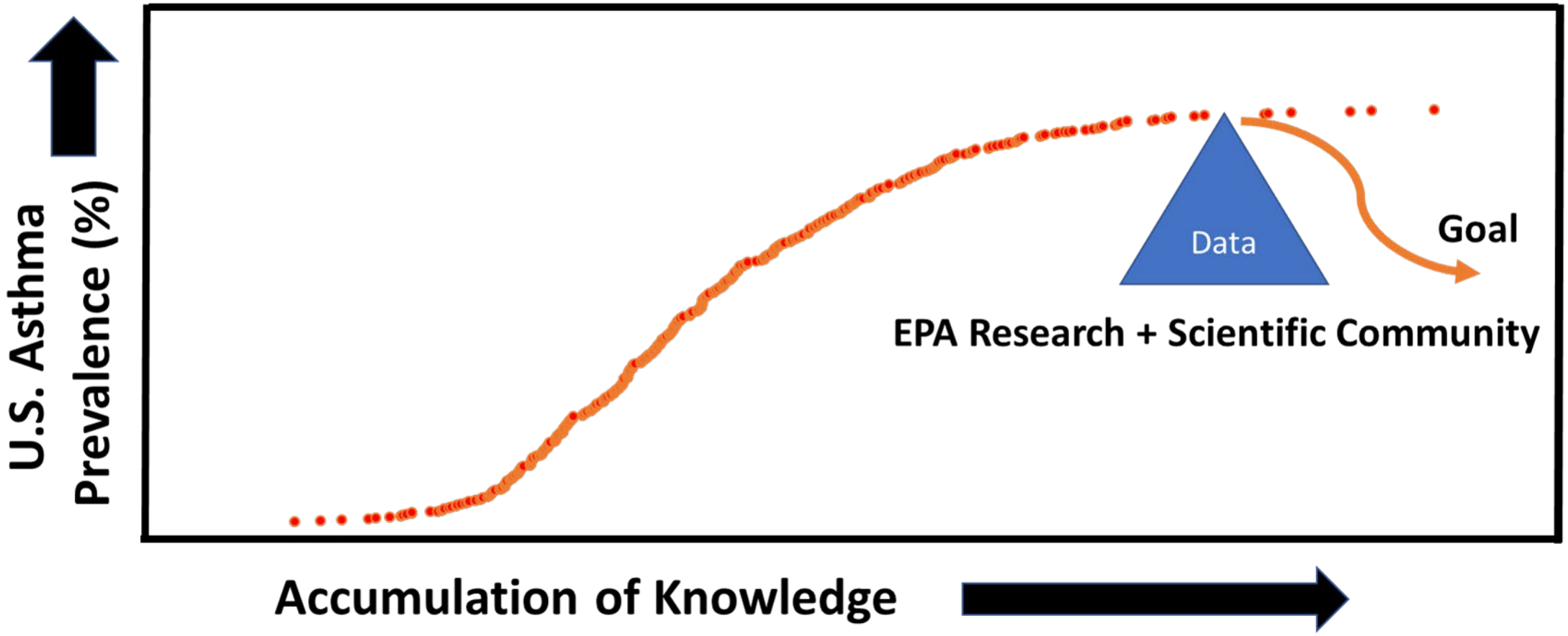
- Non-Chemical Stressors
  - High fat diet
  - Maternal psychosocial stress
  - Lack of access to and suboptimal contacts with the natural environment
  - Residential proximity to brownfields, contaminated sites, and busy road
  - Socioeconomic deprivation and social stress
  - Soil-borne chronic infections and community-acquired chronic infections

Chemical and Non-Chemical Stressors (cont'd)

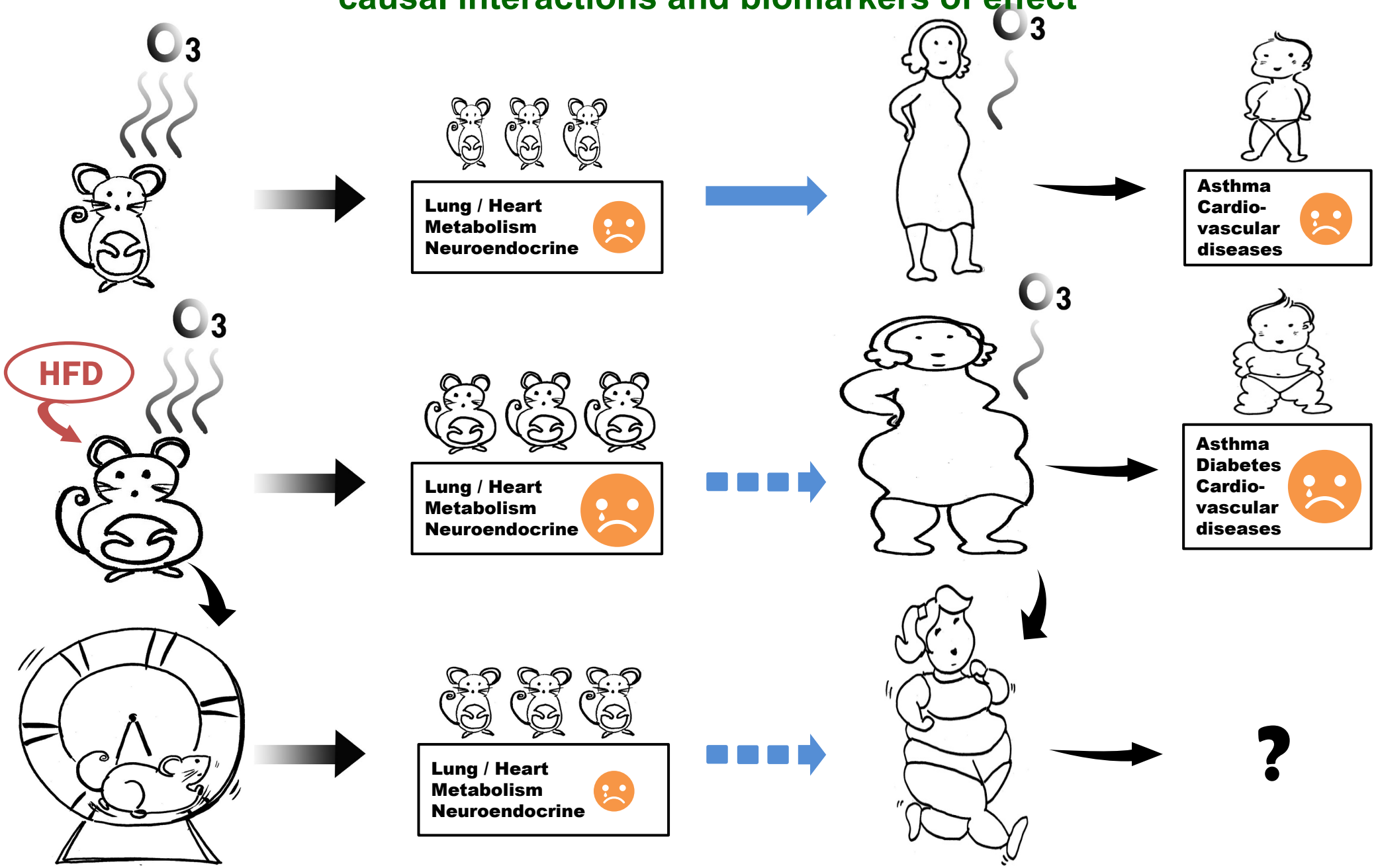
- Non-Chemical Stressors
  - Water borne pathogens
  - Nutrients
  - Floods
  - Heat
  - Nature deprivation/neighborhood blight
  - Social isolation

Quote from user: "*This project [Tribal Child Care Center Study] is a high priority for the EPA Region 10 Children's Environmental Health and Integrated Pest Management programs, and it could not have been completed without ORD's active engagement. The results from this project [Tribal Child Care Center Study] will help the Indian Health Service and the Northwest Indian Health Board prioritize services for tribal daycare centers in the Pacific Northwest.*" Bethany Plewe, EPA, Region 10, Enforcement and Compliance Assurance Division, Air and Toxics Enforcement Section

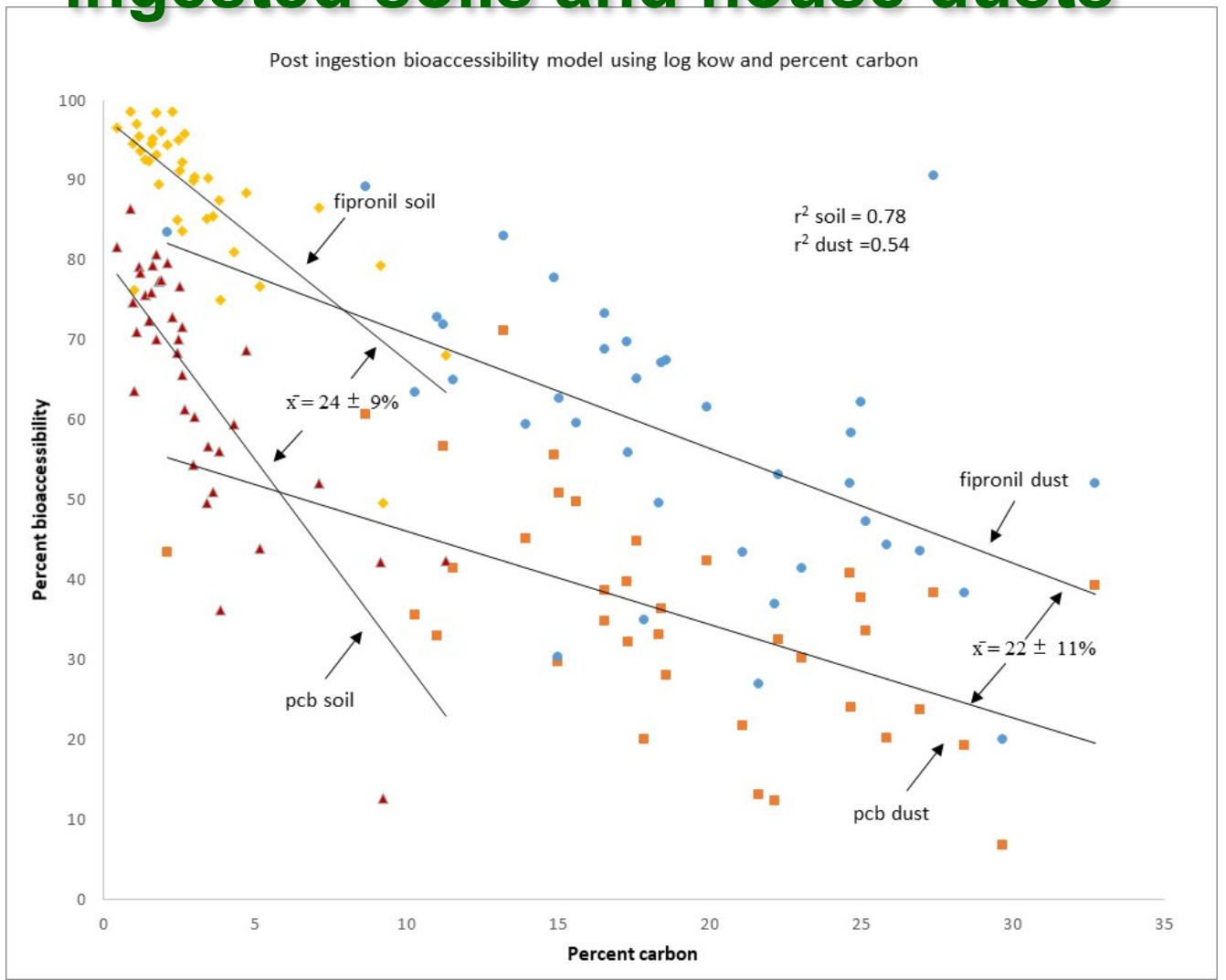
Understanding environmental asthma triggers and ways to manage it in community settings through research, education, and outreach

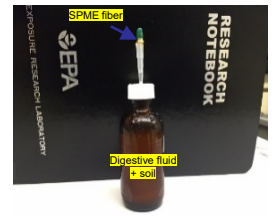


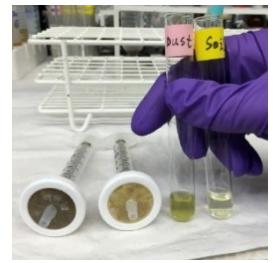
Cumulative health effects of exposure to contaminated sites and non-chemical stressors: causal interactions and biomarkers of effect

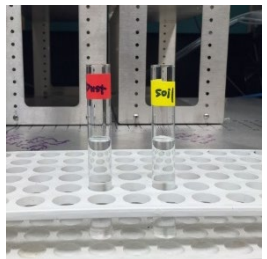


Bioaccessibility model for organic compounds sorbed to ingested soils and house dusts





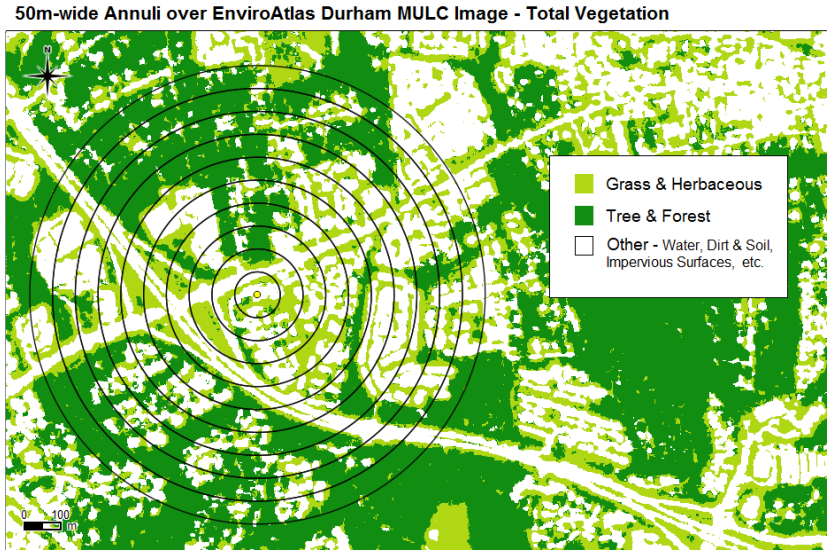


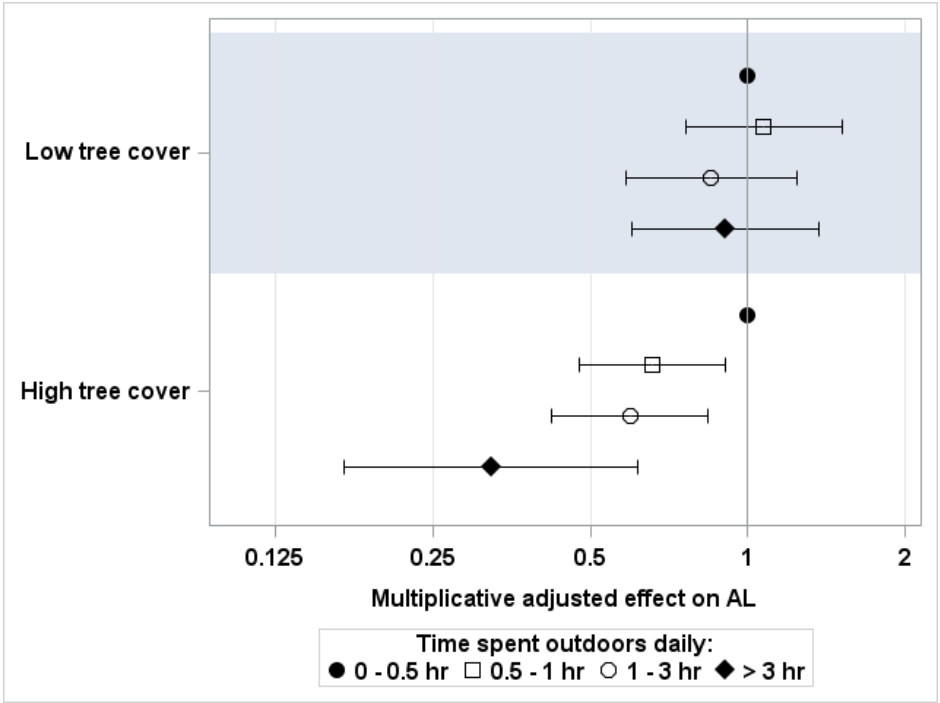


Novel and improved biomarker-based health metrics to evaluate cumulative health impacts of contaminated sites and blighted communities

- Allostatic Load (AL) is a composite biomarker-based measure of physiological dysregulation that is strongly predictive of morbidity and mortality
- Demonstrated that individuals who live in green areas and spend more than 30 min per day outdoors have reduced chronic inflammation index based on 18 biomarkers after adjusting for socio-demographic factors, chronic infections, sleep problems, and daily screen time

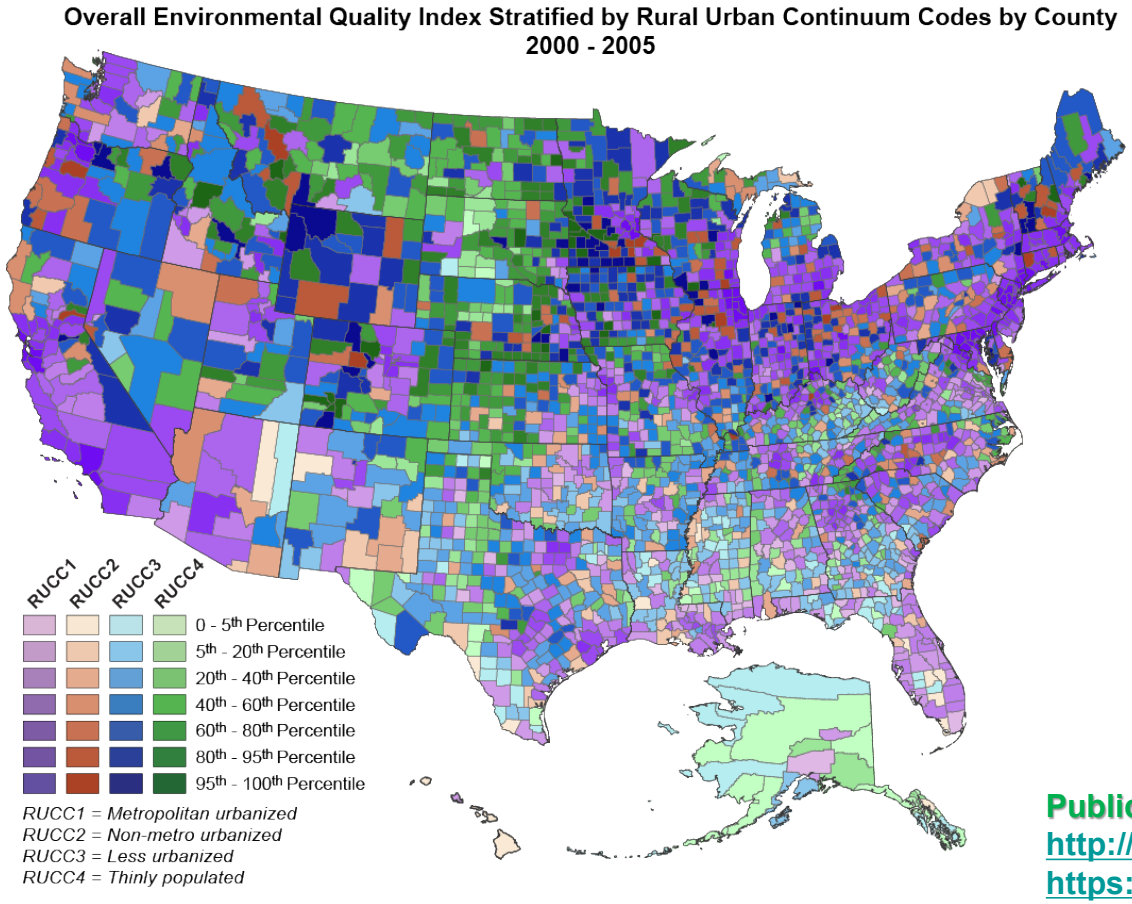
GIS analysis of residential greenness using EnviroAtlas landcover data

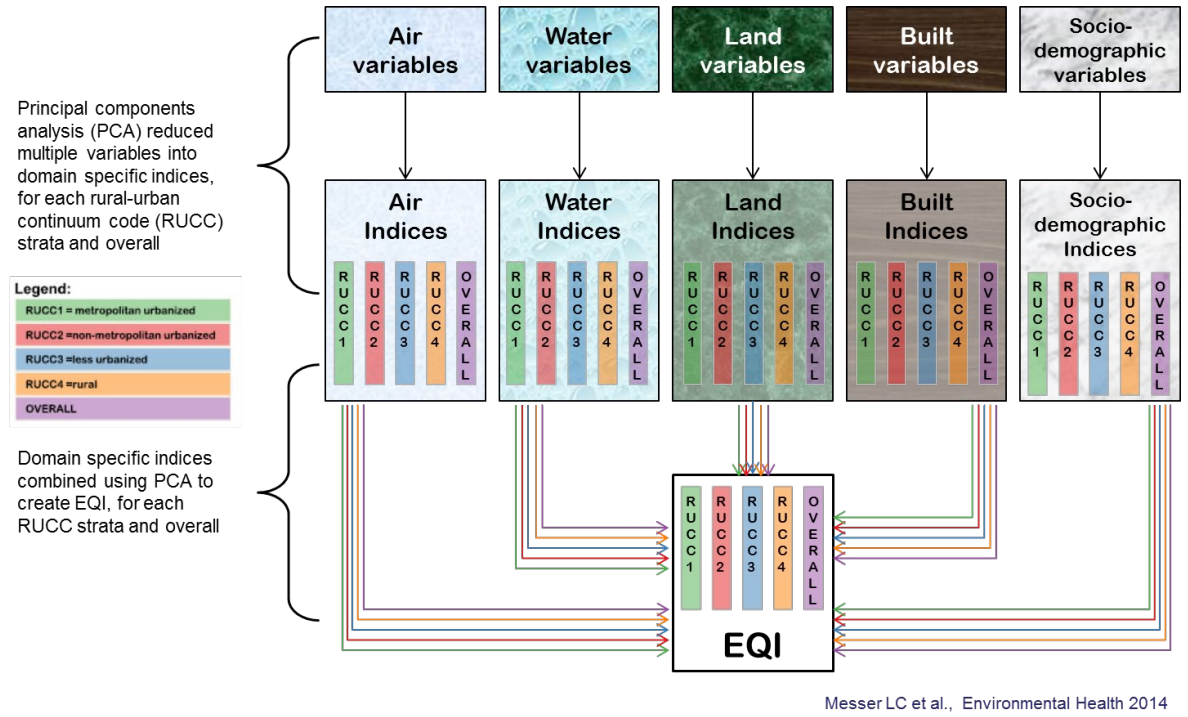




Environmental Quality Index (EQI) – development of census tract, community, rural, Tribal and examine cumulative health impacts for vulnerable groups

An environmental quality index (EQI) for all counties in the U.S. taking into account multiple domains that influence exposure and health





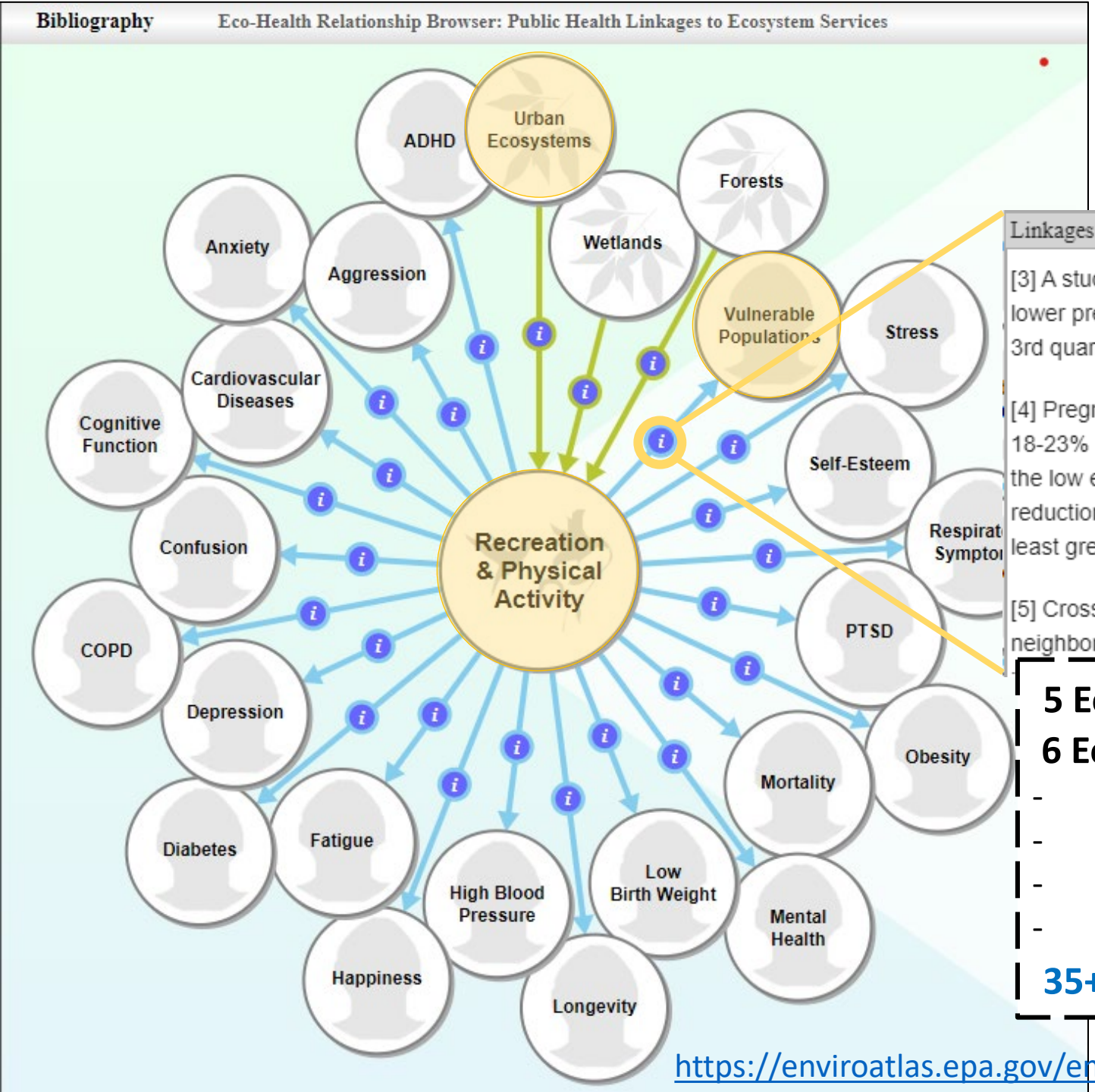
EQI Construction Conceptual Diagram

Public Access To EQI

http://epa.maps.arcgis.com/home/item.html?id=90ab3f8d668c4a4e88144d586ea34141

https://edg.epa.gov/data/Public/ORD/NHEERL/EQI

Advancing translation of eco-health science through EnviroAtlas and the Eco-Health Relationship Browser



Linkages

[3] A study exploring the density of street trees in relation to body weight reported 12% lower prevalence of obesity in low-income children aged 3-5 yrs. between the 1st and 3rd quartiles of street tree density (Lovasi et al., 2013; n=11,562, New York City).

[4] Pregnant women who lived in the highest quintiles for green space within 100m were 18-23% less likely to report depressive symptoms than those in the lowest quintiles. For the low education group, being in the greenest quintile was associated with a 26% reduction (OR=0.74, 95% CI: 0.59 to 0.94) in depressive symptoms compared to the least green quintile (McEachan et al., 2015; n=7,547, Bradford, England).

[5] Cross-sectional study of middle-school aged children found that a 5% increase in neighborhood area covered by trees was associated with 5% higher frequency of

5 Ecosystems

6 Ecosystem Services

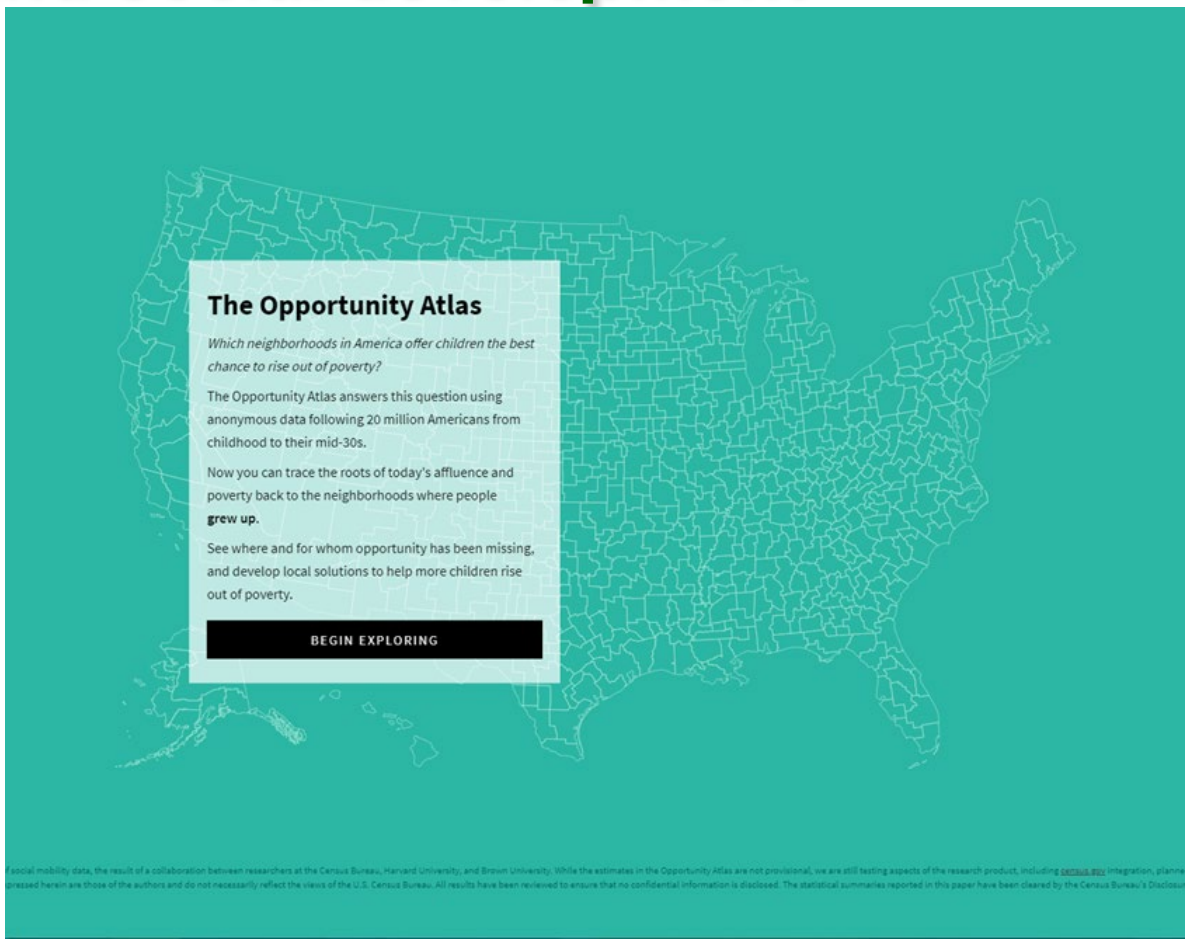
- **Air Quality; Water Quality**
- **Water Hazard Mitigation; Heat Hazard Mitigation**
- **Recreation & Physical Activity**
- **Aesthetics & Nature Engagement**

35+ Health Issues

https://enviroatlas.epa.gov/enviroatlas/Tools/EcoHealth_RelationshipBrowser/index.html

The role of environmental and public health factors in children's long-term health and social development

- Previous studies have established that the neighborhood where a child grows up can have substantial effects on their upward income mobility.
- A more comprehensive research program is needed to understand the relationship between a child's total environment (environmental, social, and building) and long-lasting health and social impacts.



https://www.opportunityatlas.org/

Short-Term Goals

- To generate chemical and non-chemical stressor information
- To synthesize and translate this stressor information for use by others

Long-Term Impact

With these anticipated results, the Agency will be able to demonstrate scientific leadership in promoting environmental health for vulnerable groups (including individuals, families, communities) by integrating and translating the complex interrelationships between chemical and non-chemical stressors found in the total environment (built, natural, social) and health and well-being

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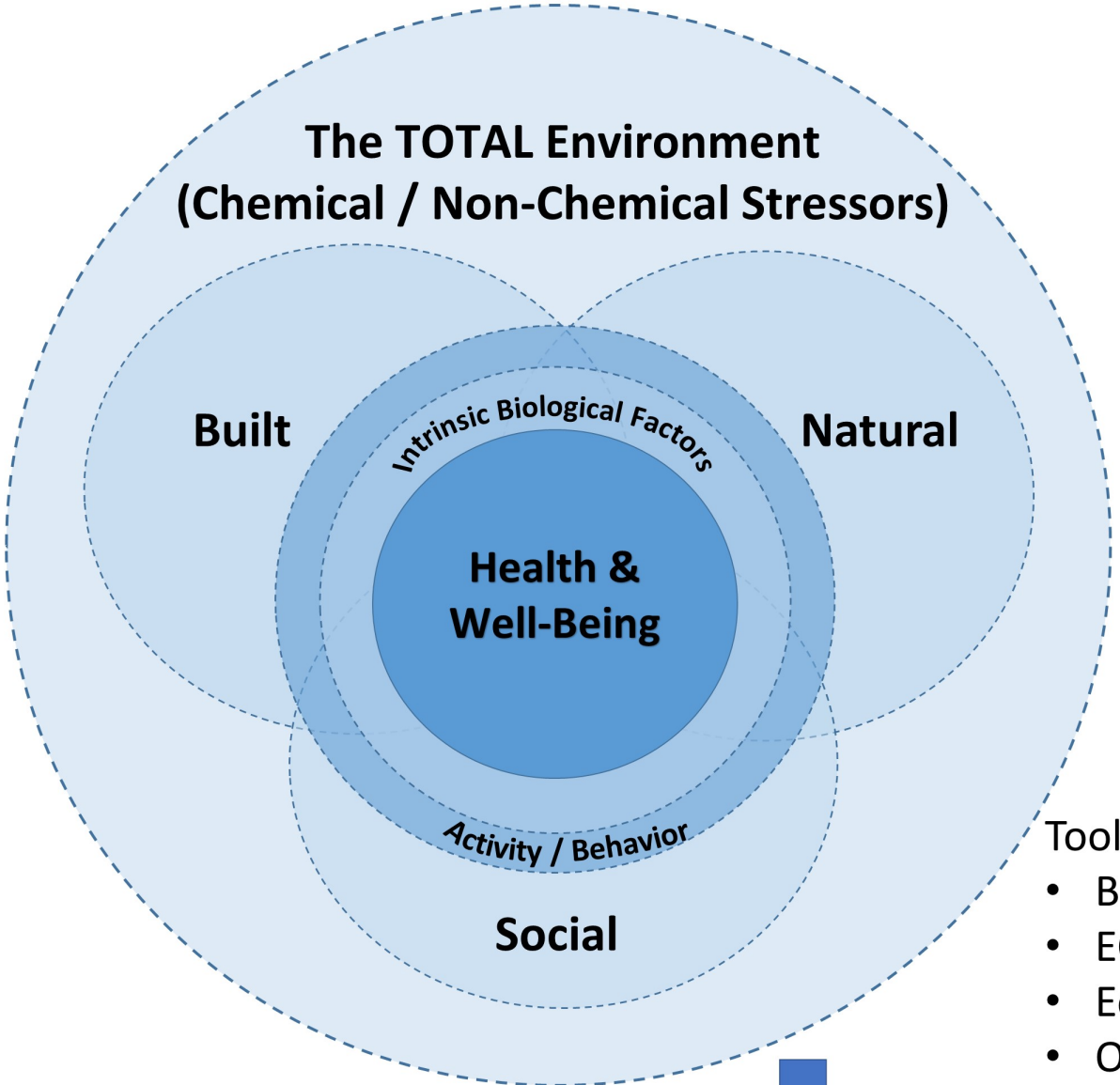

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