Summary Report

May 24-25, 2005
Ann Arbor, Michigan

Hosted by:

U.S. EPA Office of Children's Health Protection

U.S. EPA Office of Research and Development –
National Health and Environmental Effects Research Laboratory

U.S. EPA Office of Environmental Justice

National Institute of Environmental Health Sciences

University of Michigan School of Public Health's
Department of Health Behavior and Health Education

Center for Research on Ethnicity, Culture and Health
at the University of Michigan School of Public Health

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1. Abstract

A technical workshop was held on the campus of University of Michigan in Ann Arbor on May-24-25, 2005 on the topic of connecting social and environmental factors to measure and track environmental health disparities. This workshop was sponsored by U.S. EPA's Office of Children's Health Protection (OCHP), Office of Research and Development, National Health and Environmental Effects Research Laboratory (NHEERL), and Office of Environmental Justice; The National Institute of Environmental Health Sciences (NIEHS); and the Department of Health Behavior and Health Education and the Center for Research on Ethnicity, Culture and Health (CRECH) at the University of Michigan School of Public Health. The workshop was designed to develop a scientific foundation to explore the conceptual issues, data needs, and policy applications with regard to the social and environmental factors used to measure and track racial, ethnic, and class disparities in environmental health. Presentations focused on the use of multilevel analysis to study environmental health disparities, developing an organizing framework for evaluating health disparities, the development of indicators, group exercises to identify preliminary lists of priority health outcomes and potential indicators, and discussions about policy implications.

In December 2004, Gee and Payne-Sturges authored a paper that became the foundation for this workshop. Their manuscript presented a conceptual framework from which to understand how social and physical environmental factors may create disparities, as well as describing how indicators may aid in the measurement and tracking of these disparities. Three additional papers were then commissioned by the EPA to address some of the themes raised in their paper. To give the participants a mutual knowledge base, all of these papers were sent to participants prior to the workshop and summarized in brief presentations at the workshop. These papers (authors include Russell Lopez, Rachel Morello-Frosch, Devon Payne-Sturges, Gilbert C. Gee, Catherine Cubbin and Mah-J Soobader) covered such diverse topics as the relationship between racial residential segregation and exposure to air particulates, the selection of indicators for environmental health disparities and methodologies for examining environmental health disparities. Additional presentations were given by Tracey Woodruff and Kirstin Crowder on EPA's "America's Children and the Environment" reports and international criteria for environmental health indicators respectively. The workshop also featured breakout sessions in which groups of 10-12 participants collaborated to create lists of priority environmental health outcomes, indicators, and data sources to inform the proposed indicators.

Some of the most inspiring presentations, however, were by leaders of environmental justice community organizations from Detroit, Michigan and Oakland, California: Donele Wilkins, Detroiters Working for Environmental Justice, Bhavna Shamasunder, Environmental Health and Justice Program, Urban Habitat, and Azibuike Akaba, Coalition for West Oakland Revitalization. These organizations use environmental health indicators to monitor conditions in their neighborhoods, gather evidence for advocacy,

and measure the progress of their programs. To close the workshop, Bunyan Bryant, a pioneer scientist, professor, and advocate in the environmental justice movement, led a discussion on the policy implications of what had been discussed at the workshop.

The workshop featured candid and spirited discussions among participants from a wide range of disciplines. Participants were enthusiastic about the meeting and expressed strong interest in convening additional workshops to explore theoretical frameworks and the state of the science on connections between social and physical environments and public health.

The closing exercise, in which participants were asked to recommend their highest-priority next steps for moving forward on the issue of environmental health disparities, revealed several recurring themes:

- Develop a set of indicators that can be used to assess environmental health disparities.
- Improve our understanding of the relationships between health outcomes and the underlying factors behind environmental health disparities.
- Improve the availability and quality of data.
- Engage communities in participatory research projects.
- Enhance the political influence and power of communities and minority racial groups.
- Engage federal, state, and local agencies more proactively in the issue of environmental health disparities.

2. Workshop Rationale and Overview

This workshop titled, "Connecting Social and Environmental Factors to Measure and Track Environmental Health Disparities" was held at the University of Michigan, Ann Arbor, on May 24-25, 2005. A primary goal of the workshop was to develop a scientific foundation to explore conceptual issues, data needs, and policy applications with regard to the social and environmental factors used to measure and track racial, ethnic, and class disparities in environmental health. The invitational workshop included presentations, discussions, and group exercises. There were 35 participants from diverse backgrounds, including advocates, biostatisticians, environmental scientists, epidemiologists, health educators, policy makers and social scientists.

The workshop was sponsored by U.S. EPA's Office of Children's Health Protection (OCHP), Office of Research and Development, National Health and Environmental Effects Research Laboratory (NHEERL), and Office of Environmental Justice; the National Institute of Environmental Health Sciences (NIEHS); and the University of Michigan School of Public Health's Department of Health Behavior and Health Education and the Center for Research on Ethnicity, Culture and Health (CRECH). (See Appendix 5 for more information on the sponsors.) The workshop was organized by a planning committee led by Drs. Devon Payne-Sturges, U.S. EPA Office of Children's

Health Protection and Gilbert Gee, University Michigan School of Public Health. (See Appendix 6 for members of planning committee.)

Environmental Health: A Definition

"Environmental health comprises of those aspects of human health, including quality of life, that are determined by physical, chemical, biological, social, and psychosocial factors in the environment. It also refers to the theory and practice of assessing, correcting, controlling, and preventing those factors in the environment that can potentially affect adversely the health of future generations."

—World Health Organization, 1993

Workshop Objectives

The workshop was designed to begin exploring the following questions:

1. Theoretical Frameworks - How do existing theoretical or conceptual frameworks integrate social and environmental conditions to address disparities in environmental health?
2. Current Knowledge - What is the current state of scientific knowledge on the connections/interactions between social factors, environmental conditions/exposures and health?
3. Factor Identification - What are the key social and environmental factors to evaluate in considering environmentally produced health disparities?
4. Data and Methodology Needs - What data and methods are needed to assess the impact of social and environmental factors on health at the national and local levels?
5. Policy Applications - How can we develop indicators and methods that could guide regulations and policies at regulatory agencies, and that also serve as useful tools for public health practitioners and communities in their efforts to develop policies and programs that reduce health disparities?

The workshop was envisioned as a first step toward developing a process to better characterize the state of environmental health for disadvantaged populations in the United States. Ultimately, the workshop sponsors aim to work with participants and other researchers to develop a methodology that can be used to show, at a national level, how well the United States has been doing in addressing environmental health disparities and where it needs to do better.

Background on Environmental Health Disparities

Health disparities are defined as the inequities in morbidity and mortality between social groups (e.g., racial/ethnic minorities and low-income populations). The federal Healthy People 2010 initiative has made the elimination of health disparities a top national priority.

Current research suggests that health disparities are produced by both environmental (e.g., physical, chemical, biological agents to which individuals are exposed in a multitude of settings, including home, school and workplace) and social forces (e.g., individual and community level characteristics such as socio-economic status, education, psychosocial stress, coping resources and support systems, residential factors, cultural variables, and institutional and political forces such as racism and classism) (Institute of Medicine 1999). Moreover, environmental justice advocates have encouraged scientists

and regulators to view the "environment" holistically, by considering the effects that socio-economic and other social factors have on exposure to environmental hazards and resulting health outcomes. Achieving this national health goal will require interventions that address both social and environmental factors, as social factors often shape distributions of environmental hazards among diverse communities.

A wide range of activities from various sectors of U.S. society have attempted to address inequality in exposures to environmental hazards and resulting health outcomes, including: federally funded research programs on environmental hazards; initiatives to increase citizen involvement in environmental decisions; and community-based efforts to address local concerns about environmental hazards. However, it is difficult to evaluate the success of these efforts, especially with regards to eliminating the disparities between minority/disadvantaged and majority communities. This is because the tools from which to understand and assess disparities have not been fully developed.

> "It has become evident that the issues of environmental health, public health, and health care are inextricably tied together. As we try to expand the lexicon, the natural home for this is in looking at environmental health disparities."
>
> *—Hal Zenick*
> Associate Director for Health,
> National Health and Environmental Health Effects Research Laboratory

Researchers in the fields of environmental health science, epidemiology, and the social sciences have advanced their methods and the technology to improve assessments of environmental exposures and the measurement social processes that shape health disparities. However, these diverse methodological traditions are seldom integrated in a way that elucidates the complex relationships between the socioeconomic and environmental factors that drive racial and social inequalities in health. By convening a diverse group of environmental health scientists, epidemiologists, social scientists, and public health practitioners, this workshop sought to initiate such transdisciplinary theoretical and methodological thinking on the question of environmental health disparities.

> "Environmental health research and education includes a broader array of biological, social, and psychosocial inputs. We believe that bringing together these different approaches in partnership and unison is fundamental to being able to reduce the extent of health disparities in this country."
>
> *—Allen Dearry*
> Associate Director for Research Coordination, Planning, and Translation,
> National Institute of Environmental Health Sciences

Workshop Preparation and Structure

The workshop organizers commissioned three papers that were mailed to all participants in advance of the workshop, along with other relevant studies (see Appendix 1 for abstracts of these papers) to give participants a mutual knowledge base and a point of departure for discussion. For additional background reading and review, participants received a draft paper on Integrated Assessment of Environment and Health by Amy Kyle, Tracey Woodruff, and Daniel Axelrad, as well as a copy of the 2003 America's Children and the Environment report.

The workshop began with introductions and short welcoming messages from the sponsors (see Appendix 5 for full details on workshop sponsors). Harold Neighbors

welcomed participants on behalf of the Center for Research on Ethnicity, Culture and Health at the University of Michigan, followed by William Saunders, acting director of EPA's Office of Children's Health Protection. Harold Zenick of EPA's National Health and Environmental Health Effects Research Laboratory spoke next, followed by Charles Lee of EPA's Office of Environmental Justice and Allen Dearry of the National Institute of Environmental Health Sciences. Several of the sponsors recalled the groundbreaking conference on Race and the Incidence of Environmental Hazards, which took place at the University of Michigan in 1990 and was co-organized by Bunyan Bryant (one of the speakers at the current workshop). Several sponsors also observed that the social environment was not considered a factor in environmental health disparities 15 years ago; today researchers have come to understand that cultural, social, and economic influence set the stage for differential exposures and responses.

The introductions were followed by background presentations on environmental health disparities, which in turn were followed by breakout sessions to identify health outcomes that are related to disparities and indicators that could be used at a national level to track them over time.

The second day began with a recap and discussion of the workshop's purpose and outcomes, followed by a discussion on frameworks and theories. Representatives of local community organizations then gave presentations on indicators of environmental health disparities and their applicability at the local level, followed by a presentation and discussion on policy implications. In a closing exercise, participants were asked to identify two priority next steps that should be taken toward understanding and addressing environmental health disparities.

3. Presentations

Introduction to Concept of Environmental Health Indicators

The concept of health indicators or measures is not new to public health. Health indicators are basic tools used by public health practitioners to characterize community health and assess trends in risk factors, mortality and morbidity (Thacker and Berkelman 1988; Thacker et al. 1996). Recent applications of environmental health indicators, based on available data at a mainly national level, include EPA's report *America's Children and the Environment: A First View of Available Measures* (Woodruff et al. 2000) and the second edition, *America's Children and the Environment: Measures of Contaminants, Body Burdens, and Illnesses* (Woodruff et al. 2003). The *America's Children and the Environment* reports can serve as our inspiration and model for the development of new social environment and environmental health indicators relevant to racial minorities and low socioeconomic groups.

Tracey Woodruff, senior scientist, National Center for Environmental Economics, U.S. EPA gave a presentation on the concept and characteristics of environmental health indicators, the process of identifying and developing indicators, and some thoughts on how indicators might be developed for environmental health disparities.

Woodruff explained that the role or purpose of indicators is to condense data and science into an understandable form. Indicators can be used to:

- monitor trends in important environmental health factors;
- identify policy successes and priorities;
- identify potential populations at risk; and
- show relationships between different indicators.

Woodruff then gave an overview of the indicators in EPA's *America's Children and the Environment* reports, which provide measures that are easily viewed and understood by policy makers, the public, and stakeholders. The indicators in these reports were developed based on the following criteria:

- must be relevant to children's environmental health;
- must have available data;
- must have nationally representative data; and
- data must be of sufficient quality.

According to Woodruff, identifying the best available data for indicators is an iterative process, and researchers may end up having to rely on proxy data if the exact data they want are not available. For pesticides, for example, national data on pesticide exposure are not available, but data are available for pesticide residues on foods.

To incorporate race/ethnicity and SES into children's environmental health indicators, Woodruff recommended that researchers begin by deciding on the categories of

race/ethnicity and SES, then developing each indicator for these aspects. The *America's Children and the Environment* reports use income as a measure of SES and the standard federal definitions for race and ethnicity.

Woodruff emphasized that determining how to incorporate SES and race/ethnicity information into indicators is not always a straightforward process. Some national data do not record all variables of interest, and the available data can be inconsistent. In some cases, data on race/ethnicity or SES can be estimated through indirect means.

In response to questions from the audience, Woodruff confirmed that *America's Children and the Environment* is currently being updated, and that EPA plans to add new indicators for childhood diseases, including attention-deficit hyperactivity disorder (ADHD) and autism, and possibly a new indicator for the built environment.

Introduction to Issues in Segregation and Environmental Health Disparities

Environmental Justice, Regional Equity, and Residential Race Segregation
Understanding racial segregation is key to understanding environmental health disparities. The workshop organizers commissioned a paper to summarize the findings of the segregation literature, describe approaches to measuring segregation, and provide a framework for understanding the relationships between segregation and environmental health.

Rachel Morello-Frosch, assistant professor of Environmental Studies and the Department of Community Health, Brown University; and *Russell Lopez,* research assistant professor, Boston University School of Public Health, presented their paper at the workshop, describing the links between segregation and environmental health. Morello-Frosch and Lopez defined racial segregation as the patterns in which people are distributed across a landscape because of their race. They noted that segregation leads to disproportionate exposure to environmental problems for groups that tend to end up in poorer-quality areas. An analysis of cancer risk allocated by sources of air toxics and segregation level shows that pollution burdens are lower in areas of low to moderate segregation, increasing as the segregation level increases. Pollution burdens also show persistent stratification across income levels, but not as dramatically as with race.

Morello-Frosch and Lopez noted that while segregation is mostly residential, it can apply to occupations and educational outcomes as well. Segregation appears to lead to increased adult and infant mortality, increased morbidity and mortality due to infectious diseases, and increased exposure to violence and homicides. In metropolitan areas, segregation is related to exposure to hazardous waste, air pollution, and proximity to landfills; it is more difficult for segregated groups to avoid risks that other groups can avoid. Morello-Frosch and Lopez emphasized the need to investigate the history of why people live where they do, and to investigate how segregation affects exposure and response to pollution. Unequal exposures may be related to land use and zoning decisions that often are related to race.

The researchers emphasized that Hispanic and Black children are as segregated today as they were in 1954. Despite small progress on reducing residential segregation, they said, there has been virtually no progress in alleviating educational segregation.

Morello-Frosch and Lopez described a range of measures of segregation, including the dissimilarity index (the percentage of people who would have to move to achieve uniformity) and isolation/exposure indices that characterize the average exposure of a particular racial/group to other groups. They went on to describe spatial measures of segregation, such as concentration (the density of a racial group in metropolitan areas); clustering in "ethnic enclaves," and centralization (the extent to which a racial group is found in city centers).

Morello-Frosch and Lopez proposed a framework (see presentation in Appendix 3) for understanding the relationships between segregation and environmental health.

"The greater disability burden to minorities is of grave concern to the public health, and it has very real consequences. Ethnic and racial minorities do not yet completely share in the hope afforded by remarkable scientific advances…"

—David Satcher, M.D., Ph.D. (2001)

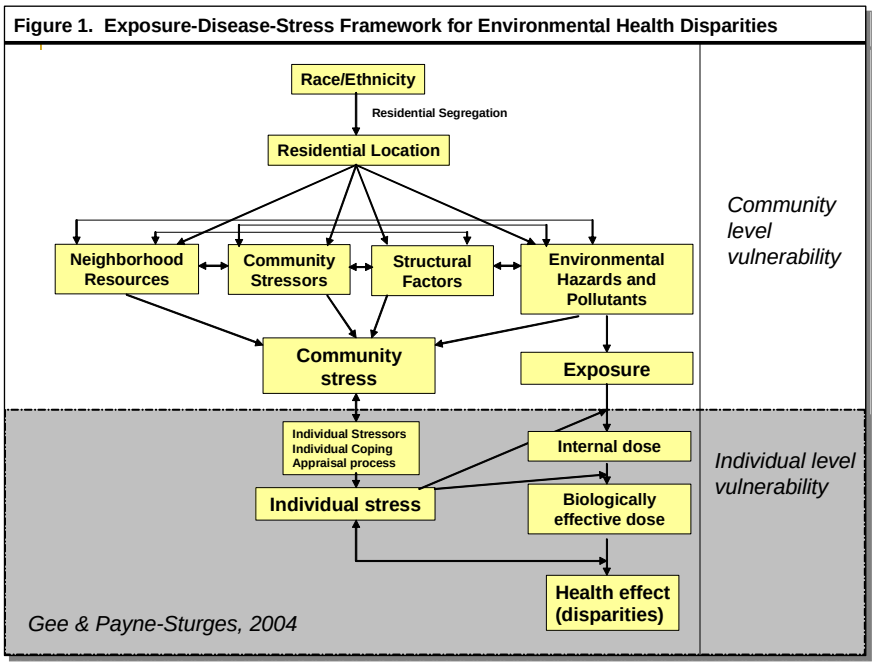
Key methodological challenges cited by the researchers include determining how to measure multiple exposures or cumulative risks in a way that is meaningful for communities, and how segregation interacts with community social factors and individual factors that could influence vulnerability.

In response to a question regarding which indicators could be used to capture the "donut" effect, in which low-income families are driven out to places with no municipal infrastructure, Lopez advised that isolation or dissimilarity indices would be best suited, although he warned that metropolitan area definitions are updated only every 10 years. In response to a participant who questioned whether the map showing areas in the United States with low segregation simply represents those cities with very low proportions of minorities to begin with, Morello-Frosch replied that the dissimilarity index measure is not affected by the composition of the metropolitan area. She also noted that many cities in the western United States tend to be more diverse than one would initially think, due to the high rates of immigration.

Organizing Framework for Evaluating Environmental Health Disparities
A multidisciplinary organizing framework offers a starting place for discussions about environmental health disparities. This presentation was based on the paper "Environmental Health Disparities: A Framework Integrating Psychosocial and Environmental Concepts" (Gee and Payne-Sturges 2004), which was distributed to participants prior to the workshop.

Gilbert C. Gee, assistant professor, University of Michigan; and *Devon Payne-Sturges,* environmental scientist, Office of Children's Health Protection, U.S. EPA, provided background on environmental health disparities and presented key points from their paper. Gee began by pointing out that the United States spends more on health care than

any other country (both in terms of spending per capita and spending as a percentage of Gross Domestic Product), and yet ranks 28th in terms of life expectancy. Furthermore, there is a gap in life expectancy by race, with Whites having longer life expectancy than Blacks. The gap has closed considerably since the 1930s, but in 1999 there was still a difference of nearly 6 years.



Gee said that there is a need to improve health for all but also to identify what is causing the gap and how to reduce it.

Gee noted that there are multiple levels of factors that contribute to health: health has a genetic component, but also is affected by access to health care, health behaviors, social networks, stratification, national and state policies, community, occupations, and the broader political-economic system.

Regarding the racial gap in life expectancy, Gee pointed to two key factors: racial segregation and psychosocial stress. Gee cited an exposure and disease paradigm (see http://www.niehs.nih.gov/envgenom/egp4.htm) in which dose-response relationship may change depending on social stressors. He noted that White and minority communities exhibit different responses to stressors.

The exposure-disease-stress framework proposed by Gee and Payne-Sturges is shown in Figure 1.

In response to a question about how to address the issue of scale in multilevel analysis (in the sense that causes, exposures, and interventions can have scale; things that are measured at an individual scale may have components at other scales, such as institutional or local), Gee replied that these are some of the conceptual and empirical challenges that researchers are starting to grapple with in multilevel analysis.

Methodologies for Indicators and the Study of Environmental Health Disparities

Moving on from the overviews of environmental indicators and environmental health disparities, the workshop shifted its focus to the details of how to approach analysis of health disparities and how to develop indicators. These presentations set the stage for group exercises in which participants identified preliminary lists of priority environmental health outcomes, indicators, and data sources to inform the proposed indicators.

Levels of Analysis for the Study of Environmental Health Disparities
Individual health is produced through multiple pathways. Individuals within groups, and groups within a local context, may share similar characteristics. Multilevel modeling allows researchers to identify the correlations and variability between these different levels. It can be used in the study of environmental health disparities to investigate the effects of context and cross-level interactions.

The workshop organizers commissioned a paper on multilevel analysis, which was distributed to participants prior to the meeting and presented during the workshop by *Mah-Jabeen Soobader*, Statworks; and *Catherine Cubbin*, assistant research scientist, Center on Social Disparities in Health, University of California, San Francisco.

Soobader and Cubbin explained that in its simplest form, multilevel analysis has a two-level structure: level 1 is the *individual*, level 2 is *place*. Multilevel analysis involves recognizing everything that is known at the micro level, and then building on that by adding the local level, the context within which micro-level effects occur. The micro level includes factors such as individual body burdens, unfair treatment, and socioeconomic position. The local level is represented by factors such as neighborhood housing quality, residential segregation, and housing market. The macro level consists of factors such as environmental policies, housing policies, and institutionalized racism.

Soobader and Cubbin noted that data linkages—information that can be used to link individual data to the larger context, such as geocoding, GIS mapping, and secondary sources of data—facilitate multilevel analysis. Multilevel analysis can be used as a goal in designing the collection of primary data: researchers need to think about data sources that provide a multilevel structure.

After the presentation, one participant observed that ecological assessment takes a similar multi-stress, multi-level approach, and perhaps researchers could learn from ecological assessments in developing a multilevel approach to analyzing environmental health disparities. The participant also observed that we have never clearly articulated what is meant by "eliminating health disparities." Soobader agreed that this is an important point. Another participant suggested that the goal should be to bring everyone up to the same level of health enjoyed by privileged groups.

In response to a question about how income is addressed in multilevel analysis, Soobader said that the goal is to know whether people have an adequate amount (of money) to afford the things they need, such as adequate housing. This can be ascertained by using income categories supplemented with additional information.

Criteria to Consider in Selecting Environmental Health Indicators
Environmental health indicators are used to track changes in a system over time, give information on a phenomenon of interest, signal policymakers and the public to react, and measure program effectiveness. When linked with other measures or indicators, an indicator can show associations between system components. This predictive potential is what people really want, and as such, indicators have to be selected with certain criteria in mind. In this presentation, *Kirstin Crowder*, ASPH Fellow, U.S. EPA, described the process of selecting criteria for environmental health indicators.

Crowder began by defining an environmental health indicator as an expression of the probable link between environment and health, based on prior scientific knowledge. It is targeted at an issue of specific public policy or management concern, and is presented in a form that facilitates interpretation for effective decision-making. Crowder defined indicator criteria as the characteristics of the indicator that make it achieve what you intend it to do. Indicator criteria ensure quality control for data collection and management, and the utility and purposefulness of collected information.

According to Crowder, the process of selecting criteria includes:

- Selecting indicators by first thinking about what you want to accomplish and who is the ultimate recipient of the information;
- Selecting your pertinent factors and deciding how to measure them;
- Reviewing your methodology to determine whether your methods will really generate indicators; and
- Identifying criteria to create an indicator that meets your purposes.

Crowder noted that this process reflects the program objectives and reveals the expectations of the stakeholders and program planners. With that in mind, Crowder concluded, the question facing us now is, "What characteristics should indicators have for a program that examines the social and environmental factors that produce health disparities?"

After the presentation, one participant observed that theories are also needed to inform indicators and show how the data connect. Another participant observed that indicators are about creating meaning out of data. There is a tension between making the indicator too simple and making it too complex. Another participant noted that program purposes can change over time, and criteria may need to be updated to reflect those changes.

Indicators of Environmental Health Disparities and Their Applicability at the Local Level

This session explored how community organizations use environmental health data for advocacy and social change. Since these organizations are working on the ground to address health disparities, researchers can benefit from a clear understanding of their data needs and the ways in which they use data. In preparation for the meeting, the workshop

organizers sent the following questions to the speakers and asked them to address these questions during their presentations:

- How often are environmental health data used by community organizations for advocacy and social change? How is the data used?
- What characteristics of the data are important so they are useful and relevant for communities?
- Are data representative of the local community important, or are data at larger scale (county/state/region/national) also important to have?
- Are there environmental health issues that communities are concerned about for which data/indicators do not exist currently?

Donele Wilkins, executive director, Detroiters Working for Environmental Justice in Detroit, Michigan, launched the discussion by giving a presentation on how her organization has used environmental health data to further its mission. According to Wilkins, Detroit is the "poster child for environmental justice," with 40,000 to 60,000 parcels of contaminated land. The entire city has been designated a Brownfield site. Detroit has twice the national rate and three times the state rate of asthma. Wilkins said that Detroit is the most segregated city in the country, in the most segregated state in the country. Detroiters Working for Environmental Justice focuses on how to change this situation and its effects on health and quality of life.

Wilkins said that her organization began collaborating with the University of Michigan in 1998 to develop a community-based participatory research project on asthma. Community members helped design the project, which included an intervention component in neighborhoods and homes.

According to Wilkins, environmental health data are useful to community organizations only to the extent that they can be used for advocacy and to promote social change. Data need to be relevant and credible. The data have to be broken down in simplistic ways so they can be shared with the community, and they have to be accurate. Community groups need data that are representative of the local community as well as larger-scale data. Wilkins noted that there are many environmental health issues that communities are concerned about for which data do not exist. She also stressed the need to understand more about synergy and cumulative impacts.

Wilkins cited the example of the Action Against Asthma project, which documented peaks in exposure to airborne particulate matter and elemental carbon in predominantly Latino and African American neighborhoods. These peaks were found near the Ambassador Bridge between Detroit and Windsor, Ontario, and appeared to be related to the idling of diesel trucks delayed at the border for security reasons after September 11, 2001. The group presented their findings to the city council to begin discussions for change.

Wilkins concluded by emphasizing that community public health suffers when environmental protection is traded off for economic development. In response to a

question about whether community groups also work with regional agencies, Wilkins replied that Detroiters Working for Environmental Justice has built relationships with regional organizations that are like-minded and have influence, and has begun working more formally at the state level in recent years.

Bhavna Shamasunder from the Environmental Health and Justice Program at Urban Habitat in Oakland, California, described her organization's approach to using environmental health data. Urban Habitat acts on a regional level to aid local communities on the philosophy that communities should have the power to influence decisions that affect their own lives.

Shamasunder noted that communities think of problems and situations, not data, and that a trainer/organizer needs to act as an interpreter or translator of the data, because data are not meaningful to communities in and of themselves. Urban Habitat uses data to support a community's organizing process, a community's goals, or to validate a community's struggle. The organization also spends a lot of time looking at historical information to see how things got to be the way they are now.

According to Shamasunder, the most useful local data are based on individual and community experiences, reflect the problem and community-defined goals, are supported by a trainer/organizer; and are echoed or strengthened by state and/or national data. For example, a community technical advisor (TA) can analyze transportation subsidies to examine potential disparities in transportation access. Community members can then use this information to seek funding and advocate for policy change. Further, TA's can build community capacity by training community residents to find and analyze this information themselves.

Azibuike Akaba, community technical assistance coordinator, Coalition for West Oakland Revitalization, spoke next about the West Oakland Environmental Indicators Project, which developed 17 indicators to create a picture of the "State of the Hood" in West Oakland. Akaba explained that indicators raise awareness among residents about issues in their community, and are a way of democratizing access to information. He said that indicators also amplify the community's voice in policy debates and provide benchmarks against which to measure change efforts.

Akaba described the key environmental health issues for Oakland, which include ambient air quality, indoor air quality, and cumulative air pollution impacts. Diesel emissions from traffic are a particular problem: currently 10,000 trucks pass through Oakland each day, a number that is expected to double by 2007. Health effects of segregated neighborhoods in Oakland include poorer air quality, less nutritious food, isolation from jobs, increased crime and violence, frequent chronic disease hospitalizations, and poorer mental health.

Akaba noted that the indicators project made use of community-based participatory research; for example, residents helped document diesel truck traffic. Project leaders held monthly meetings with community groups, and created fact sheets for every indicator to

educate people about trends and risks. The community made policy recommendations based on the project's findings.

Policy Implications

Eliminating environmental health disparities involves more than just research; it requires political action and decision making. To provide a policy perspective and launch a discussion on policy issues, Bunyan Bryant, director of the Environmental Justice Initiative at the University of Michigan School of Natural Resources and Environment, spoke on how to integrate environmental health disparities research into policy. Bryant has long been involved in the environmental justice movement, and co-organized the 1990 Conference on Race and the Incidence of Environmental Hazards, which was held at the University of Michigan. That meeting and those that followed helped build EPA's commitment to environmental justice issues and the creation of EPA's Office on Environmental Justice.

Bryant began by recommending that researchers review existing policy frameworks for environmental justice to see if their collective work can be incorporated in some way, or whether new policies are needed. Before moving forward, he said, a small group of conferees should pull together information into a format that would lend itself to policy briefs.

Bryant questioned the extent to which research has been useful in facilitating meaningful change in terms of eliminating environmental health disparities. To date, he said, most research has focused on the end-of-the-pipeline problems, rather than their underlying causes. He called on participants to stretch their commitments to address the root causes of environmental and social justice problems.

He talked about how segregation is associated with infant and adult mortality, life expectancy, homicide, tuberculosis, toxic exposures, poverty, and more. It's important to reverse racial segregation to reduce these social problems.

Group Discussion on Policy Issues

Bunyan Bryant challenged participants to offer ideas for policies that could be developed to address issues identified in this workshop. Participants spoke of policies to address cumulative risks, the application of the precautionary principle, and social stresses and vulnerability. Other observations included:

- The importance of maintaining the momentum of environmental justice grants to communities. NIH is turning more toward bench science, and we should encourage them to maintain the action component of their mission.

- The need for a vehicle to translate research into policy. Every day, research is being translated into policy, but that research tends to be industrial. Pharmaceuticals can influence policy more than we can.

- The need to reverse the burden on proof from communities to chemical manufacturers, and the need for clear-cut policy rules about pollutants with clearly established links to health effects.

- The importance of looking at sound scientific alternatives to quantitative risk assessment.

- The need to promote life cycle responsibility (cradle to grave).

- The importance of recognizing risk assessment as just one part of the discussion, not the only thing that matters.

- The need to create an infrastructure to support foundations that are driven by people of color, indigenously driven.

Bryant asked if there should be some sort of policy to disseminate research findings more quickly when public health is at stake. Answers and observations included the following:

- There is the issue of lack of trust if research hasn't been peer-reviewed.

- NIH has issued a directive to expedite the availability of results of projects funded by NIH. Also, in OMB's final revised peer review guidelines for the federal government, agencies have the option to open up technical analyses for public comment before they are peer-reviewed.

- Even the participatory process can be used to delay action. In all of our models and policy, there needs to be a time component; a goal to protect public health in a timely fashion.

4. Group Exercises

Overview

The workshop included two group exercises: 1) to develop a preliminary list of the top 10 health outcomes for health disparities, to be used as the first step toward identifying priority health outcomes for measurement and tracking; and 2) to develop a preliminary list of indicators that could be used to track the "top 10" health outcomes identified in the first exercise.

The goal of these exercises was not to come up with definitive lists, but rather to begin exploring the issues. EPA ultimately wants to produce indicators of health disparity to help describe areas of concern for environmental justice, and to identify areas that should be targeted for action. The group exercises were a first step in that direction.

First Group Exercise

The purpose of this exercise was to begin the process of identifying the 10 most "important" health outcomes related health disparities, based on the participants' experience and expert opinions.

The outcomes would include:

- Diseases or conditions that may be related to exposure to an environmental hazard or environmental pollutants;
- Disease or conditions for which there may be racial/ethnic and economic disparities; and
- Disease or conditions that might render a population/community more vulnerable to exposure to an environmental hazard or environmental pollutants.

The conference organizers came up with an initial list of 24 outcomes (see the "Potential Health Outcomes to Consider for the Study of Environmental Health Disparities" handout in Appendix 4). The goal of this exercise was to prioritize and add to this list.

Participants were split into four groups, each with its own facilitator, and were asked to come up with a list of top 10 health outcomes.

The top 10 outcomes identified for each group were:

Green Team

- Lead poisoning
- Functional disability
- Cancers
- Multiple chemical sensitivity
- Neurological outcomes

- Obesity
- Diabetes
- Birth defects
- Quality of Life
- All-Causes Mortality
- Cardiovascular
- Respiratory (lung function, asthma)
- Mental health

Red Team:

- Asthma
- Cardiovascular
- Lung cancer
- Breast cancer
- Neurological (blood lead, ADHD)
- Injuries
- Diabetes
- Obesity
- Adverse reproductive outcomes (low birth weight, malformations)
- Other respiratory
- Depression

Yellow Team:

- Chronic respiratory disease
- Developmental outcomes
- Asthma
- Depression
- Obesity
- Occupational illness
- Childhood cancer
- Adult cancer
- Transportation injuries
- Neurological disease
- Cardiovascular disease

Blue Team:

- Diabetes
- Low birth weight/infant mortality
- Cancer
- Heart disease
- Asthma

- Respiratory diseases
- Birth defects
- Quality of life
- Neurodevelopmental outcomes
- Lead poisoning
- Alzheimer's

After identifying their top 10 outcomes, the groups reconvened. The lists from the four groups were placed on poster sheets around the room. Individual participants then voted for the outcomes on any sheet except the one developed by their group, in order to avoid double-voting and to ensure a broader consensus on what the overall group thought was important. Members of the Green group, for example, could vote for any outcome listed by the Red, Yellow or Blue groups. For example, two of the outcomes listed by the Green group were asthma and multiple chemical sensitivity. Because asthma was listed by at least one other group (e.g. Red), a Green group member could vote for asthma on the Red list. However, because multiple chemical sensitivity was not listed by another group, a Green team member could not vote for this outcome during the full group discussion.

The results from this multi-group voting process are shown in Table 1.

Table 1. Voting Results

Outcome	**Number of votes**
Quality of life	17
Cardiovascular disease	17
Asthma	15
Neurological outcomes	13
Cancer	11
Obesity	10
Birth outcomes	9
Diabetes	8
Respiratory disease	7
Neurodevelopmental	7
LBW/IM	5
Injuries	5
Depression	5
Lead poisoning	4
Mental health	4
All cause mortality	3
Developmental outcome	3
Transportation injuries	3
Functional disability	2
Occupational illness	2

Multiple chemical sensitivity	1
Childhood cancer	1
Breast cancer	1
Adverse reproductive outcomes	1
Adult cancer	1
Lung cancer	0

Second Group Exercise

This exercise aimed to identify potential indicators that could be developed for the top 10 health outcomes identified in the previous exercise. Participants were given a list of outcomes, and for each outcome they were asked to address the following questions:

- Can you measure this outcome directly, and if yes, how?
- What indicators could be used to measure this outcome?
- For each indicator, what are the potential data sources? Rate the quality of data from 1=bad to 5=excellent.
- What are the upstream factors (physical/environmental and social) that could contribute to this outcome?

The Blue team was assigned the outcomes of *obesity*, *cardiovascular effects*, and *asthma*; the Yellow team was assigned *neurodevelopmental* and *neurological* effects; the Red team was assigned *cancer* and *birth outcomes*; and the Green team was assigned *quality of life* and *diabetes*.

The results of this exercise are shown in the following tables. Note that not all teams followed the guidelines exactly. Some groups did not rank the data quality or list data sources for all upstream factors; in those cases the upstream factors are listed in bullets below the table.

Blue team

Obesity

Indicator	**Quality of Data**	**Data Source**
Body Mass Index	5	NHANES
Limited physical activity	4	NHIS
Upstream social and physical environment factors that may contribute to this outcome		
Upstream Factor	**Quality of Data**	**Data Source**
Poverty	5	Census
Access to transportation	*	Local/region MPOs
Access to affordable/nutritious food	*	State-based business license
Food policy	*	*
Crime rate/safety	5	FBI/DOJ
Access to exercise facilities	*	State-based departments of education
School funding	*	Fed Department of Education
Electronic media	*	*

Cardiovascular Effects

Indicator	**Quality of Data**	**Data source**
Death	5	Vital statistics
Hospitalization	5	State-based departments of health/CDC National Hospital Discharge Survey
Hypertension	5	NHANES
Upstream social and physical environment factors that may contribute to this outcome		
Upstream Factor	**Quality of Data**	**Data Source**
Obesity	*	*
Smoking	5	NHANES
Particulate AP	5	EPA-AIRS
Smoking regulations	*	*
Poverty	5	Census
Segregation	*	*

*Not reported by group.

Other upstream social and physical environmental factors, for which data quality and sources were not identified:

- Zoning regulations
- Grocery store access
- Industry regulation
    - Waste handling
    - Industry siting
    - Occupational health guidelines
- World trade
- Larger market forces
- Farming practices
- Government subsidies
- Agrochemical production, application, distribution
- Water quality/quantity
- Climatological factors/weather
- Antibiotic disposal/resistance, sub-therapeutic use
- Unregulated pharmaceuticals/personal care products

Asthma

Indicator	**Quality of Data**	**Data Source**
Death	5	Vital statistics
Hospitalization	5	State-based DO health, CDC National Hospital Discharge Survey
ER/Doctor's Visit	5	National Hospital Ambulatory Care, Medical Care Survey
Prevalence	4/5	NHIS/NHANES
Medication/Treatment Access	*	Commercial DB-pharmacy
School/work absence related to asthma	4/ *	NHIS/state-based
Physical activity limitation related to asthma	4	NHIS
Upstream social and physical environment factors that may contribute to this outcome		
Upstream Factor	**Quality of Data**	**Data source**
Segregation	*	*
Poverty	5	Census
Health insurance	4	NHIS
Proximity to major roadways	5	EPA-OTAQ
Housing/indoor air quality	3	HUD/NIEHS lead survey
Air pollution	5/4	EPA-AIRS & NATA
Low birth weight	5	Vital statistics
Safety concerns/crime	5	FBI/DOJ
Crowding/population density	5	Census
Municipal services	*	*
Availability of health providers	5	Area resource file – national DB at county-level
Residential ETS	4	NHIS
Smoking regulations	*	*

*Not reported by group.

Yellow team

Neurodevelopmental Effects

Indicator	Quality of Data	Data Source
Prevalence of:		
Autism	Inconsistent quality	Some state registries, NHIS (3), BRFSS (2)
Learning disabilities	"	"
Mental retardation	"	"
ADHD		"
Children's behavioral difficulties	"	"
Cerebral palsy	"	"

Upstream social and physical environmental factors, for which data source and quality were not identified:

- Substandard housing
- Nutrition
- Lack of access to healthcare
- Pesticide drift
- Prenatal care
- Lack of information
- Cultural practices
- Take-home exposure (parents' occupations)
- Maternal health status
- Pesticide exposure/toxin exposure

Neurological Effects

Indicator	Quality of Data	Data Source
Prevalence of:	*	
Stroke	*	Administrative records (2), Medicare (2), NHIS (3) death records (3)
Alzheimer's	*	occupational epidemiology studies (inconsistent), advocacy organizations (1)
Parkinson's	*	Same as above
Mercury poisoning, heavy metals poisoning	4	NHANES, ATSDR, biomonitoring
Depression	2	BRFSS
Stress	2	BRFSS

*Not reported by group.

Upstream social and physical environmental factors, for which data sources and quality were not identified:

- Access to healthcare (diagnosis, hypertensives)
- Pesticide exposure/toxin exposure
- Fish consumption/traditional lifestyle
- Early life viral infections
- Head injury
- Health behaviors
- Neighborhood characteristics

Red Team:

Key to Quality of Data numbers used by this team: 5 = measures everything, includes resolution. 3: measures what it purports to measure, does not include resolution. Note that the Red Team did not have time to address the topic of cancer, so only results for birth outcomes are presented here.

Birth Outcomes

Indicator	**Quality of Data**	**Data source**
Infant mortality	3	National mortality records
Birth weight	3	Natality records
Pre-term (gestational age)	3	Natality records
Birth defects	3	State registries for birth defects

Second-tier outcomes (surrogates), for which data sources and quality were not identified:

- Biomonitoring/body burdens
- c-section
- breast milk

Upstream social and physical environmental factors, for which data sources and quality were not identified:

- Stress
- Access to transportation
- Medicare/Medicaid
- Pre-conceptual health of parents
- Environmental exposures
- Prenatal health
- Neonatal health

- Poverty
- Public health infrastructure
- Structure of health insurance
- Discrimination
- Occupational exposures
- Stratification of health care facilities
- Maternal age
- Maternal education
- Birth space
- Family and non-family violence
- Family size
- Housing conditions
    - Density
    - structure
- Food security
- Access to food (quality)
- STDs/STIs

Green team

Diabetes

Indicator	Quality of Data	Data source
Individual occurrence	5	NHANES/NHIS
Self-reporting	5	NHANES/NHIS/HIS
BMI (risk factor)	3 (measurement) 5 (data)	NHANES/NHIS/HIS
Waist-hip ratio	3 (measurement) 5 (data)	NHANES/NHIS/HIS
Age at onset	*	*
Hemoglobin A1C	*	*
Family history	*	NHANES? NHIS?
Census-level aggregates of the above	*	*
Disaggregate by race and SES	*	*
Diet/lifestyle, e.g. exercise	*	*

*Not reported by group.

Upstream social and physical environmental factors, for which data sources and quality were not identified:

- Access to greenspace, recreation centers
- Access to healthy food
- Targeted marketing, TV
- Health care access
- Race-based segregation
- SES
- Voter turnout
- Political “juice” index
- Land use, zoning, industrial, residential
- Regional integration and governance
- Collective efficacy
- Access to preventive care and relevant culturally appropriate info
- Exposure to endocrine disruptors
- Exposure to stress
- Built environment
- Neighborhood quality

Quality of Life

Potential data sources identified by the group: Self-rated health: individual (NHANES); Life satisfaction, functional abilities: SF-36, UTMB, Duke, New Haven.

Indicator	**Quality of Data**	**Data Source**
Mobility, leaving your home	*	NHIS, CDC
Leisure time (or lack thereof	*	Current population survey
Occupational stress/free time with family	*	State, no data source
Neighborhood perception: safety, crime, social cohesion, social K	*	L.A. F.A.N., National survey of children's health, general social survey, panel survey of income dynamics, national survey of black Americans

*Not reported by group.

Upstream social and physical environmental factors, for which data sources and quality were not identified:

- Exclusion of certain groups in political process, political process to be responsive to the needs/concerns of "minority" groups
- Economic side of equation…draining of resources
- Cultural cohesiveness that can empower.
- Segregation and spatial mismatch
- Jobs
- Transportation
- Policing, services
- Community weathering from so many simultaneous stressors.

The Green team also raised several overarching issues:

- We need a theoretical framework to be able to do this sort of analysis.
- We should not be restricted to secondary data sources, and should be able to use studies to supplement secondary data.
- National data sets often exclude small groups (e.g., Native Americans)
- Quality of life perceptions are culturally rooted.
- Consult with affected groups about relevant indicators. National data sets may not have measures that are relevant to certain minorities.

5. Discussion on Frameworks and Theories

During the second day of the workshop, in response to questions and concerns raised by participants, the organizers held a discussion session on theories and frameworks for evaluating environmental health disparities.

To launch the discussion, Gilbert Gee put forth the question of whether a theory or framework was really needed, along with four hypothetical answers:

- Yes: If we don't have a framework for thinking about indicators, we are just collecting a lot of data to no clear end.
- Yes: Several frameworks were put forward to us yesterday.
- No: We don't need a single theory…it would be hard to come up with a single theory that cuts across so many disciplines.
- Not yet: It is too early for theories; we need to examine the data to help us build theories.

Points raised during the ensuing discussion are summarized below.

Frameworks
One participant said it was important to draw a distinction between frameworks and theory. A conceptual framework is useful to show how the variables fit together. Another participant noted that any framework needs to be flexible. Another emphasized that frameworks can use both quantitative and qualitative information.

Theories
One participant suggested that there might be multiple theories and frameworks that can help us understand how all the pieces fit together. Another warned that theories can bound your perception.

Other Ways of Knowing
One participant noted that research is always informed by implicit theories. In this case, part of it is very quantitative; it involves developing indicators that are quantifiable. But, the participant argued, there are other ways of knowing that are not quantifiable. Some important things don't get captured in these indicators. What counts as "science" versus other ways of knowing about the world? It's very important for us to be thinking about that as this project moves forward. Another participant emphasized that what we do ultimately has to include the passion of people and communities who are being affected by these disparities. "We have to keep human emotions in the picture even as we discuss things in dry quantitative terms."
.
Another participant questioned the basic assumption that in order to have a health outcome, you need an exposure. In Native American communities, some of the most extreme outcomes are coming from *avoidance* of exposure. People stop fishing and stop hunting to avoid traditional foods that once sustained us but are now contaminated. This

avoidance leads to a change in diet that then leads to health problems like diabetes and obesity. When it comes to measuring success, the community has to help define success. Also, researchers need to understand that perceptions are different; they have to find out what the community wants; how it defines "better quality of life," because the community's definition may be different from theirs.

Environmental Justice and Health Disparities Resources at NIH

Environmental Justice: Partnerships for Communication - http://www.niehs.nih.gov/translat/envjust/envjust.htm

Centers for Population Health and Health Disparities - http://obssr.od.nih.gov/CPHHD/Index.htm

Health Disparities Research - http://www.niehs.nih.gov/translat/hd/healthdis.htm

Community-Based Participatory Research Program - http://www.niehs.nih.gov/translat/cbpr/cbpr.htm

Another participant noted that many cultures have their own way of knowing. The theories emerge from discussions when we work with the communities. The community is a critical part of the participatory process. If you're working on health disparities, you're working with the communities. Having taken part in the process builds the community's capacity.

One participant noted that EPA has launched a new program called Community Action for Renewing Environments (CARE), which gives communities money to diagnose and prioritize their environmental issues, and then provides funds to address them. The intent is to have a **multi-disciplinary and interagency agency** team approach to community health issues.

6. Summary and Next Steps

The workshop featured candid and spirited discussions among participants from a wide range of disciplines. Participants were enthusiastic about the meeting and expressed strong interest in convening additional workshops to explore theoretical frameworks and the state of the science on connections between social and physical environments and public health.

This workshop was convened to begin the process of identifying indicators to understand and assess environmental health disparities. It was also intended as a way to launch a discussion within EPA about the role of social factors in exposures to environmental contaminants/hazards and environmentally mediated health outcomes.

Currently at EPA, there is interest in developing guidelines on cumulative risk assessment. Social factors are an important part of the equation, affecting exposures and vulnerability. There also is work underway to revise EPA's guidelines on conducting exposure assessment to treat social factors as exposures, which would be collected along with traditional exposure data.

In addition, EPA plans to highlight disparities in future editions of the *America's Children and the Environment Report* and the *Report on the Environment*. The outcomes from this workshop will help inform those efforts.

In the near term, the workshop will result in a meeting summary report (this document) that will be reviewed by all participants before publication. In addition, EPA wants to publish the three technical papers and highlights from the workshop summary report in a scientific peer-reviewed journal.

In the longer term, EPA hopes to produce an indicators report for environmental health disparities. This would be a long-term process and would require a series of workshops to build the foundation. EPA would like the participants at this workshop to remain as a standing advisory workgroup to help guide future activities.

Questions and Observations from Participants

Participants raised a number of questions and comments during the closing session. Several participants said that researchers should talk openly about racism and avoid terminology such as "health disparities" that doesn't explicitly mention race. Another participant noted that transdisciplinary thinking is key to gaining a better understanding of the role of social inequalities and how they relate to exposure. Another pointed out that researchers sometimes get caught up in studying the problem and forget the goal of the community is to have a problem solved. Researchers should keep the community's needs in mind.

At the end of the workshop, participants were asked to complete the following sentence:

As we move forward to take the next steps on the issue of environmental health disparities, the two things I believe we have to focus on are:

The responses revealed several recurring themes:

- Develop a set of indicators that can be used to assess environmental health disparities.
- Improve our understanding of the relationships between health outcomes and the underlying factors behind environmental health disparities.
- Improve the availability and quality of data.
- Engage communities in participatory research projects.
- Work to give communities and minority racial groups more political influence and power.
- Engage federal, state, and local agencies more proactively on the issue of environmental health disparities.

Individual responses are provided below.

Respondent 1:

1. Changing the culture at EPA to recognize the importance of social science in informing our work and encourage collaboration between environmental scientists and social scientists
2. Measurement tools, so we can track changes and progress and public health impacts as they relate to environmental health disparities.

Respondent 2:
Political, research, and financial support to address health disparities.

Respondent 3:
1. How to employ existing data in creating advocacy strategy
2. Establish policy guidelines for federal environmental and public health agencies to develop and collect data on relevant social and other indicators relevant to health disparities.

Respondent 4:
Constructing a policy to protect people in dire need and from overexposure to environmental toxins.

Respondent 5:
1. valid, reliable data
2. the integration of various analyses from transdisciplinary researchers.

Respondent 6:
1. Understanding how to describe the reality of people's lives as experienced

2. communicating the meaning of this reality to communities and policy makers.

Respondent 7:
1. Defining a limited set of informative measures to represent the environmentally related disparities/EJ issues.
2. Figuring out the social science aspects of this: still very undefined to me.

Respondent 8:
1. Develop a set of measures that can be used to assess disparities/environment
2. Develop/synthesize the underlying knowledge base to inform relationships between environment/health/disparity for policy purposes.

Respondent 9:
1. Framing our research topics (exposures) in a way that leads to direct policy action (e.g. traffic vs. “air pollution.”)
2. changing philosophy of research design within EPA to include community input early on.

Respondent 10:
1. Settle on a framework to spring off of, starting with the Gee/Payne-Sturges diagram
2. Set some limited next steps/priorities

Respondent 11:
1. Develop an ACE report on environmental health disparities
2. Develop a road map to look at environmental health disparities from both quantitative and qualitative community upstream perspectives.

Respondent 12:
1. Better define the scope, goals, and endpoints so that we can organize to tackle the larger problem in these smaller pieces.
2. Engage the various agencies on different levels to collaborate and open the research and action on a more holistic landscape.

Respondent 13:
Understanding processes that connect factors/outcomes and theorize the relations between process and factors/outcomes.

Respondent 14:
1. Data availability, factor identification, new ways to get the data we need.
2. Community research partnerships.

Respondent 15:
Race and class power analysis, leading to people who have the power to change things.

Respondent 16:

Creating ways communities can make decisions over their lives and shifting balance of power towards communities.

Respondent 17:

1. Identify upstream factors and social indicators that can be useful in cumulative risk assessment.
2. Use multilevel analysis for community-based participatory research strategy development.

Respondent 18:
Attaining equitable economic and political influence across racial groups and communities.

Respondent 19:

1. Linking data needs with community knowledge base
2. Disseminate our vision and framework for environmental health disparities to other agencies that could productively collaborate with us.

Respondent 20:

1. Community-based action-oriented research and empowerment to address issues.
2. Using research as a framework to promote human/ecological restoration and health

Respondent 21:

1. Developing the science base for tracking social indicators over time.
2. Establishing an infrastructure for continued dialogue.

Respondent 22:

1. Revising the environmental assessment process (at federal, state, and local levels) to reflect lower levels of significance. No baseline increment and the inclusion of health impact analysis, health disparities, environmental justice, and community impacts.
2. Data

Respondent 23:

1. Data availability issues: protection of confidentially restricting research.
2. Equity-related policies.

Appendix 1: Abstracts of Papers Distributed to Participants

The Riskscape and the Color Line: Examining the Role of Segregation in Environmental Health Disparities, by Rachel Morello-Frosch and Russ Lopez

Environmental health researchers, sociologists, policy-makers, and activists concerned about environmental justice argue that communities of color who are segregated in neighborhoods with high levels of poverty and material deprivation are also disproportionately exposed to physical environments that adversely affect their health and well-being. Examining these issues through the lens of racial residential segregation can offer new insights into the junctures of the political economy of social inequality with discrimination, environmental degradation, and health. More importantly, this line of inquiry may highlight whether observed pollution – health outcome relationships are mediated by segregation and whether segregation patterns impact diverse communities differently.

Although elements for understanding the relationship between residential segregation and community environmental health can be found separately in both the sociology literature and the environmental justice literature, only one previous investigation has attempted to combine these two lines of inquiry to analyze the relationship between outdoor air pollution exposure and segregation(Lopez 2002). Some researchers have recently argued that residential segregation is a crucial place to start for understanding the origins and persistence of environmental health disparities. This paper, commissioned for a workshop on developing measures to research and track environmental health disparities, examines theoretical and methodological questions related to racial residential segregation and environmental health. We seek to address the following questions: 1) Which metrics for measuring segregation are appropriate for the study of environmental health disparities? Are the metrics universally applicable across the range of environmental health issues and ethnic groups? 2) Can the methods applied to assess the relationship between segregation and air pollution be used for other exposures and health issues? 3) Given that most measures of segregation consider only dyads, to what extent are existing measures of segregation valid for multi-ethnic regions?

There are five primary dimensions of segregation, (evenness, isolation/exposure, clustering, concentration and centralization), all of which have varying conceptual implications for environmental health research and assessing disparities in exposures and health outcomes that may be environmentally mediated. Evenness is the measure that has been most frequently used in the sociology and public health literature and applied to various contexts (e.g. schools, the workplace, and neighborhoods). This measure estimates the degree to which the proportion of a particular racial or ethnic group living in residential areas (e.g. census tracts) approximates that group's relative percentage of an entire metropolitan area. The isolation or exposure indices are perhaps the best measure for reflecting how members of racial groups actually experience residential segregation in their neighborhoods but, unlike evenness, these measures are composition dependent. (Farley 1984)The other three dimensions of residential segregation, which tend to

characterize the spatial dimensions of segregation within metro areas (such as concentration, centralization, clustering) have been used less frequently. However these measures may be particularly useful when examining environmental health questions, particularly when focusing on a small number of MSAs that may be similar compositionally and in overall size. These latter measures may help researchers better grasp how the spatial form of segregation may disproportionately expose certain groups to specific environmental stressors that ultimately degrade community health.

Nearly all of the segregation measures focus on dyadic racial/ethnic comparisons with Non-Hispanic Whites generally serving as the referent group. However, generalized measures can also be used to assess patterns of segregation in a context of diversity where multiple racial/ethnic groups are simultaneously segregated from one another. Here we demonstrate how dyadic and generalized measures of segregation can be applied to examine racial disparities in air pollution burdens in major metropolitan areas of the United States. Based on these results we suggest ways in which segregation measures can be applied to track and research disparities related to other environmental hazards and health outcomes, such as childhood lead exposure and urban pesticide use, the location of mobile and stationary pollution sources, infant mortality and other birth outcomes, and asthma. We also propose a conceptual framework for understanding how segregation may shape the distribution of environmental health disparities and enhance the vulnerability of segregated communities to the adverse health effects of hazardous physical and social environments. We suggest that a regional equity perspective helps elucidate how segregation patterns can create and amplify environmental health disparities. The rationale for taking a regional perspective are twofold: First, previous research strongly suggests that it is more fruitful to assess potential drivers of environmental health disparities at the regional level because economic trends, transportation planning, and industrial clusters tend to be regional in nature, and zoning, siting, and urban planning decisions tend to be local. Second, research that examines how health inequities play out regionally could lead to interventions and policy initiatives that better bridge the divide between the city core and suburbs and more effectively ameliorate fundamental drivers of environmental health and disease among diverse communities.

Questions to Consider:

1) What are the various contexts researchers should consider when examining relationships between segregation and environmental health disparities?

2) What are the implications of segregation in the context of different individual risk factors for health outcomes that may be socially and environmentally mediated?

3) Should we consider segregation as a potential mediator between environmental hazard exposure and health outcome relationships, or should it be conceptualized as a risk factor in and of itself?

4) How should we track and measure segregation in relationship to other key variables that measure socioeconomic status?

National Environmental Health Measures for Minority and Low Income Populations: Tracking Social Disparities in Environmental Health, by Devon Payne-Sturges and Gilbert C. Gee

Healthy People 2010 (USDHHS, 2004) has established as a top priority the elimination of health disparities. Current research suggests that characteristics of the social, physical and built environment contributes to these disparities. In order to track progress and to assess the potential contributions of the various components of the "environment," tools specific to environmental health disparities are required.

In this paper, we discuss one potential tool, a set of candidate indicators that may be used to track disparities in outcomes, as well as indicators that may be used analytically to assess potential causal pathways. Several other reports on health and environmental indicators have been produced, including EPA's *America's Children and the Environment*. However, there has not been a comprehensive discussion about environmental indicators that focus on racial, ethnic and socioeconomic disparities in health. Therefore, we focus on indicators specific to historically disadvantaged populations.

Based on a conceptual framework that views health disparities as partially driven by differential access to resources and exposures to hazards, we group the indicators into four categories: social processes, environmental contaminants/exposures, bodyburdens of environmental contaminants, and health outcomes. We provide a few examples to illustrate each category, including residential segregation, $PM_{2.5}$ exposures, blood lead and blood mercury exposures, and asthma mortality. These indicators and categories are derived from a review of environmental health disparities from several disciplines. As a next step in a long-term effort to better understand the relationship between social disadvantage, environment, and health disparities, we hope that the proposed indicators and literature review serve as a foundation for EPA to create a databook on environmental health disparities. These efforts may aid community organizations, local agencies, scientists and policy makers in allocating resources and developing interventions.

Questions to Consider:

1. What environmentally mediated health outcomes should EPA track in order to assess health disparities and potential progress?

2. What are some of the key markers of environmental toxicants and hazards that can should be tracked over time?

3. What are some of the key markers of the social environment that can be tracked over time?

Levels of Analysis for the Study of Environmental Health Disparities, by Mah-Jabeen Soobader, Catherine Cubbin, Gilbert Gee, Arlene Rosenbaum, James Laurenson, Devon Payne-Sturges

We present a fundamental approach for achieving health promotion and sustainability by using multilevel techniques to quantify and monitor socioeconomic and racial/ethnic disparities in environmental health. Reducing racial/ethnic and socioeconomic environmental health disparities requires a comprehensive multilevel conceptual and quantitative approach that recognizes the various levels through which environmental health disparities are produced and perpetuated. Multilevel typically refers to the concept of lower- level units contained within higher-level units; e.g., of individuals nested within groups nested within neighborhoods, or industrial facilities nested within communities. Individuals within groups, groups within local contexts, and local contexts within macro contexts may share similar characteristics. Multilevel techniques explicitly model these correlated data where the assumption of independence between observations is violated and conventional OLS techniques are not appropriate. This is in contrast to procedures that attempt to correct for the correlated structure of the data, such as those used in SUDAAN.

We propose a conceptual framework that incorporates the micro level, contained within the local level, which in turn is contained within the macro level, to inform the present discussion. Using lead exposure as an illustrative example, the *micro level* refers to the most proximate level factors, such as individual body burdens of lead. The *local level* refers to the immediate context that surrounds the individual, such as the concentrations of lead in the surrounding soil. The *macro level* refers to both the larger geospatial region that encapsulates the local level (e.g., states) and/or the broader social context (e.g., political climate and laws regarding lead-based paint in housing). Such a conceptual approach underlies multilevel techniques that allows for the consideration of numerous levels simultaneously; that is, factors that affect health are simultaneously considered as operating at the level of the individual and the level of contexts. We contend that recent research increasingly places primary emphasis on investigating the micro or individual levels, often to the exclusion of the macro level. And while the micro level is indeed important, a major limitation of focusing only on micro-level processes is that the environmental context itself is removed from the line of inquiry. Inattention to the complex interactions between individuals and their environments may lead to inappropriate science, and thus incomplete interventions and policies.

We discuss the utility of multilevel techniques to examine physical and social environmental and individual-level factors to appropriately quantify and improve our understanding of environmental health disparities.

Multilevel modeling approaches can potentially contribute to environmental health research by providing a mathematical modeling approach for:

- Informing environmental policies and examining the impact of existing policies on local contexts and individual exposures.

- Examining a single environmental exposure that may occur through multiple media operating at different levels simultaneously and interacting at different levels.

- Examining multiple exposures operating at different levels simultaneously, potentially accumulating over time, and interacting with each other.

- Examining exposures differentially affecting subgroups of the population and/or geographic areas.

- Examining the fundamental role of social and economic factors and the need to account for all levels through which these mechanisms influence individual exposures, either directly or through their effect on local environments.

We discuss the reasoning and the methodological approach behind multilevel modeling, including differentiating individual and contextual influences on individual outcomes. Environmental studies are typically conducted at a single level, either at the aggregate/ecologic level or the micro/individual level. These studies have been critiqued due to the incorrect inference of the study results. Multilevel models provide the advantage of identifying and differentiating sources of variation at multiple levels, thus assigning variability to the appropriate level. For example, when the same exposure is measured at multiple levels these models allow us to evaluate the relative importance of the exposure at each level. An important feature of multilevel models is that the data need not be hierarchical. That is, contexts do not need to be neatly nested within each other. This is important as exposures commonly occur in contexts that are not hierarchical, but different contexts may occur at the same level. For example, children may be exposed to lead in the neighborhood but also within the school environment, and neighborhoods may not be nested within school districts.

In addition, multilevel models allow us to examine individual and contextual interactions as well as interactions between different levels of context. Modeling an interaction between the individual and the context provides information about the differential effect of context for individual groups. Interactions may also be examined between different levels of context, e.g., providing information on the effect of city expenditure on different types of neighborhoods. Such observations are important for policy development and resource allocation for preventing environmental exposures. Multilevel models also enable us to examine changes over time, including repeated measures of individuals as in panel studies and repeated measures of contexts as in annual statewide surveys. Longitudinal multilevel models are an important component in monitoring environmental health disparities.

Next we address the questions and principles that guide the choice of levels or geographic units in multilevel studies, with worked examples of air pollution and water quality that tackle these issues included as appendices. These include the research question being addressed, the theoretical pathways linking the micro, local, and macro levels, health outcomes and exposures under consideration, data availability, and the administrative or intervention application of the research. Direct policies, synergistic policy effects,

sensitivity periods, and mediating mechanisms also influence the definition of the relevant levels.

Finally, the ways in which different data sources can be combined to produce suitable data for multilevel analyses are addressed. Data requirements for multilevel models require, at a minimum, that observations have identifiers that differentiate the contextual setting(s) of each observation. National survey data are now being geocoded and linked to census data to facilitate multilevel analyses. In addition, because of how data are collected, as for environmental exposures, or because of the sampling strategy of national surveys, geographic identifiers are sometimes readily available on some datasets. Note that the appropriateness of the level at which geographic identifiers are available should be evaluated. We provide some examples of how different data sources can be linked to create multilevel data structures, including census data linked to survey data, census and tax assessor data linked to state health department data, and national health survey data linked to environmental exposure data.

Appendices include a review of the social theories of place and provide a description of commonly used census geographic units. Although numerous challenges in multilevel research remain, we call attention to the emerging conceptual and quantitative approaches for assessing the convergence of social, economic, racial/ethnic, and environmental factors in generating and sustaining environmental health disparities.

Questions to Consider

1. What is the disparity research question or monitoring objective to be addressed?

2. What is the exposure or health(s) outcome?

3. What are the relevant levels to be considered?

4. What are the units at the micro, local, and/ macro level?

5. What are relevant variables to address the research question or monitoring objective, including racial/ethnic, social, economic, and policy variables?

6. What is the multilevel design?

7. What data source(s) can be used to address the research question or monitoring objective?

8. Are the units, and variables you require available on the data source? If not, how can this be rectified?

9. What are the challenges involved in generating the data?

10. What other issues need to be considered to address the research question or monitoring objective?

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Appendix 3: Presentations

The presentations given at the workshop are available for downloading at:

http://www.sph.umich.edu/crech/whatsnew/wn_HDW_2005.htm

Appendix 4: Handouts

Potential Health Outcomes to Consider for the Study of Environmental Health Disparities

Life expectancy
Mortality
- All cause mortality
- Cancer mortality
- Asthma mortality
- Infant mortality

Cancer
- Lung cancer
- Bladder cancer
- Leukemia
- Breast cancer

Respiratory Illnesses
Hospitalization rates for respiratory illnesses (e.g. acute bronchitis/bronchiolitis, pneumonia, chronic obstructive pulmonary disorder and asthma)
- Sarcordosis
- Asthma

Other Chronic Diseases
- Heart disease
- Kidney disease
- Liver disease
- Hypertension
- Diabetes
- Neurological diseases
- Lupus

Children's Health
- Cancer in children
- Low birth weight
- Birth defects
- Childhood asthma

Infectious Diseases
- Foodborne and waterborne illnesses

Proposed Criteria for Environmental Health Disparities Indicators

Scientific

- Accurate (tested and validated)
- Reliable, produces consistent results, reproducible
- Representative of phenomenon of interest
- Responsive to changes in the system
- Able to track over time
- Simple

Policy Orientation

- Relevant to an identified need
- Meets users' needs (understandable by the public)
- Informative to policy-makers
- Actionable – linked to current actions or catalyzes action
- Accessible at different political levels

Data

- Easy and relatively inexpensive to collect
- Available and accessible
- Appropriate spatial and temporal scales
- Able to aggregate and disaggregate by race
- Limited number of indicators
- Baseline exists (or can be set)

Ideally, data for a particular indicator would be compatible with that indicator's data from other systems (e.g., other cities, state-level, national level), so that comparisons can be made.

Candidate Indicators/Measures

Social Processes

Residential segregation
- Dissimilarity
- Isolation
- Minority composition
- Ethnic churning

Community stressors
- Crowding & density
- Crime
- Noise
- Lack of control
- Household poverty
- Stigma
- Family income
- Employment opportunities
- Housing quality
- Living standards
- Income inequality

Neighborhood resources
- Social capital
- Voter participation
- Neighborhood quality
- Faith-based institutions
- Recreational facilities: parks, etc.
- Greenways
- Neighborhood associations
- Schools, libraries
- Cultural institutions

Structural factors
- Zoning policies
- Governance structure
- Taxation system
- Regulatory environment
- Physical constraints: temperature, elevation, humidity

Physical Environmental Hazards/Exposures

Outdoor air pollution
- Exposure to Criteria air pollutants
- Estimated noncancer risks from air pollutant exposures
- Estimated cumulative cancer risk from air pollutant exposure

Indoor air pollution
- Smoking
- ETS exposure

Radon
Lead hazards
Substandard quality housing
Jurisdictions with anti-smoking ordinances for public spaces

Drinking water and ambient water quality

Population served by public water systems not meeting standards
Migrant worker camps water systems not meeting standards
U.S.-Mexico Border community water systems
Access to recreational waters meeting standards
Populations in areas with high quality watersheds
Populations with in states with fish advisories
Fish consumption patterns

Pesticides

Foods with detectable pesticide residues
Pesticide related illnesses among agricultural workers
Reported pesticide use by farmers
Estimated pesticide exposure through fish consumption/subsistence fishing
Reports of indoor pesticide use

Land contaminants and waste sites

Population living within 1 and 3 mile radii of hazardous waste sites and landfills
Population living within 1 and 3 mile radii of Superfund sites designated as public health hazard

Body Burden

Lead (in children and adult workers)
Cadmium
Mercury (in women of childbearing age)
Arsenic
Cotinine
OP pesticides
Pyrethroid pesticides
PCBs
DDT/DDE
Estimated pesticide doses based on body burden measures

Categories of Environmental Health Disparities Indicators

Health Outcome Indicators: Diseases or conditions that may be related to exposure to an environmental hazard (or environmental pollutant).

Social Environment/Processes Indicators or Measures: Psychosocial factors that may directly or indirectly lead to illness. These include factors operating at the interpersonal (e.g. socioeconomic position) as well as societal level (e.g. residential racial segregation).

Physical Environmental Hazards/Exposure Indicators: Condition or activities that identify the potential for or occurrence of exposure to an environmental contaminant or hazardous condition (e.g. toxic chemical agents, physical agents, biomechanical stressors, as well as biological agents).

Bodyburden Indicators: Biological markers in tissue or fluid that identify the presence of a substance or combination of substances that could impact human health.

Environment and Environmental Health Indicator Criteria Matrix

Criteria Type	Criterion	Source
Scientific	Valid (accurate)	3, 4, 5, 6, 7, 8, 9, 10, 12, 14, 15, 17
	Reliable; produces consistent results; reproducible	3, 4, 5, 6, 8, 9, 10, 11, 12, 14, 15, 17
	Representative of phenomenon of interest (does it capture the necessary information?)	1, 2, 3, 6, 7, 8, 10, 12, 14, 16, 17
	Based on sound scientific knowledge	1, 2, 4, 7, 8, 10, 11, 13, 14
	Transformable (intelligent) [if = "responsive" or "sensitive to change"]	1, 2, 4, 6, 7, 8, 12, 17
	Specific for object of study; precise; directly measures result of interest	1, 5, 8, 12, 13, 16, 17
	Trackable over time	4, 7, 8, 10, 11, 17
	Measurable	4, 5, 8, 10, 13, 17
	Simple	5, 7, 8, 12, 13
	Predictive (anticipatory)	1, 3, 8, 10, 16
	Integrates exposures (if = causes) and effects; identifies causal links	6, 8, 11, 13
	Robust	1, 2, 9, 17
	Clearly defined	1, 4, 14
	Based on demonstrated links between the environment and health	4, 13, 17
	Stable	1, 13
	Unbiased	9, 14
	Clarity in design	11, 14
	Describes systemic changes/reflects trends over time	1, 14
	Has specified uncertainties	1
	Testable	2
	Developed within a conceptual and operational framework	1
	Built incrementally (simple to complex)	6
	Timely – up-to-date	17
Policy Orientation	Relevant, applicable to issues of significance (does it answer a worthwhile question?)	2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 17
	Easy to understand by public	1, 4, 5, 7, 9, 10, 12, 13, 14, 17
	Meets users' needs	1, 2, 3, 4, 8, 10, 11, 14
	Informative to policy-makers	4, 8, 9, 10, 13, 16
	Catalyzes action (linked to existing action)	3, 4, 12, 13, 14, 17

	Endorsed by public (if = reflect community values)	3, 10, 12, 14, 17
	Linked to other measurements	1, 4, 6, 11
	Accessible at different political levels	4, 5, 10
	Indicates the progress of policy	1
	Transparent	2
	Owned by users	1
	Records changes in policy means or policy impact	1
	Attractive to local media	10
	Receive adequate funding over the long-term	13
	Easily communicated	14
Data	Cost-effective to compile and apply	2, 3, 6, 7, 8, 11, 12, 16, 17
	Data already available and accessible	3, 5, 6, 8, 10, 12, 15, 17
	Compatible with data of other users	1, 6, 7, 8, 10, 12, 13, 16
	Appropriate spatial and temporal scales	1, 6, 8, 11, 12, 14, 17
	Easy to collect	1, 3, 4, 6, 10, 12, 17
	Not too many indicators (manageable)	3, 5, 6, 11
	Baseline or threshold value available	1, 7, 11, 16
	Able to aggregate or disaggregate	3
	Source monitoring system linked to federal agencies	13

1. World Water Assessment Programme: Chapter 3 of WWDR "Signing Progress: Indicators Mark the Way"
http://www.unesco.org/water/wwap/wwdr/pdf/chap3.pdf (on page 45 of document; 17 of pdf file)

Scientific Criteria:

- Robust, well-founded basis in scientific knowledge
- Representativeness, describing the state or quality of an issue or subject, giving significant and precise information
- Clearly and consistently defined, so as to be unambiguous or lend themselves to various interpretations, or to give inconsistent results in different situations
- Be developed within an agreed-upon conceptual and operational framework quantitative expression
- Be sensitive insofar as a small change to be measured should result in a measurable change in the indicator
- Anticipatory, early warning, capable of indicating of degradation or risk before serious harm has occurred
- Stability, low natural variability in order to separate stress-caused effects from random fluctuations
- Specific for a certain stress or effect
- Broadly applicable to many stresses and sites, usable in different regions

- Uncertainties need to be specified
- Transformable (intelligent)

Political Criteria:

- Tailored to the needs of the primary users
- Have ownership by users
- Problem has to be manageable, thus cause-effect chain of indicator has to be known to enable tackling the problem
- Have a target or threshold against which to compare an explicit scale ranging from undesirable states to desirable states (along with specific weightings) in order to assess the significance of the information
- Record either changes in the means recommended by policy or changes in the development impact attributable to policy
- Lend themselves to be linked to models, forecasting and information systems
- Simple, easily-interpreted and appealing to society in order to ease communication between policy-makers and society
- Match with national and international policy plans and indicate the progress of policy
- Have historical data available to show trends over time
- Data is readily collectible, thereby lowering the technical and collection costs
- Normalized to provide a basis for regional, national, and international comparisons

2. World Health Organization: "Environmental Health Indicators: Framework and Methodologies"
http://whqlibdoc.who.int/hq/1999/WHO_SDE_OEH_99.10.pdf

General Criteria:

- Provide a relevant and meaningful summary of the conditions of interest
- Transparent
- Testable
- Scientifically sound
- Sensitive to real changes in the conditions they measure
- Robust
- Cost-effective to compile and apply
- Dynamic – able to be updated and changed as the conditions the indicators describe change, and as the availability of data, scientific knowledge, and needs of their users change

3. Pan American Health Organization: "Environmental Health Indicators for the US-Mexico Border – Concept Document"
http://www.fep.paho.org/english/env/Indicadores/Environmental%20Public%20Health%20Indicators.pdf
(page 15-17 of document; 24-26 of pdf file)

Scientific Criteria:

- Data availability and suitability
- Indicator validity

  - indicator is a reasonable measure as assessed by the users
  - accurately describes the dimensions of interest
  - predictive
  - produces consistent results
  - appropriate measure of object being observed
- Indicator representativeness
- Reliability – consistent over repetitions
- Ability to disaggregate

Use-based Criteria:

- Feasibility
  - Data is already collected or
  - Data is inexpensive in both time and money to collect
- Audience endorsement
- Manageability
- Balance between phenomena of interest
- Ability to serve as a catalyst of action

4. CDC/NCEH – "Environmental Public Health Indicators"
http://www.cdc.gov/nceh/indicators/EPHI.pdf (page 4 of document; 6 of pdf file)

Attributes of an Ideal Indicator:

- Measurable
- Trackable over time
- Based on demonstrated links between environment and health
- Useful and understood by diverse populations
- Informative to the public and to responsible agencies
- Tied to public health objectives
- Action-oriented
- Incorporated in clear-case definitions
- Feasible – in addition to measurable and trackable over time
  - Accessible at different political levels
  - Accurate (both reliable and valid)
  - Sensitive to changes in underlying factors
  - Timely

5. European Commission/Director General of Development – "Guidelines for Monitoring Progress in Health, AIDS and Population"
http://europa.eu.int/comm/development/body/theme/human_social/docs/health/03-02_monitoring_guidelines.pdf#zoom=100 (page 11 of document and pdf file)

General Criteria:

- Few in number, simple, and readily measurable
- Precise
- Relevant in relation to stated goals
- Valid and reliable

- Based upon routinely collected data (rather than requiring special surveys)
- Supportive of participatory and evidence-based decision making at all levels

6. Department of Environmental Affairs and Tourism of South Africa – "National Core Set of Environmental Indicators: for State of Environment Reporting in South Africa; Phase 1, Scoping Report"
http://www.environment.gov.za/soer/indicator/docs/local_level/EPI%20Final%20Report.pdf (page 19-20 of both document and pdf file)

General Criteria:

- Relevance to the environmental problem and its context
- Technical alignment between users of the information (indicator sets should be compatible with the sets of other users)
- Limited in number
- Regular refinement – indicator is able to respond to change
- Incremental approach – builds on past work, prioritizing performance indicators
- Availability and accessibility of data
- Feasible – must have practical, established methods of data collection at a reasonable cost
- Have clearly identified causal links to other indicators
- High quality and reliability
- Appropriate temporal and spatial scale (allowing for aggregation or disaggregation)

7. OECD – "Environmental Monographs: Nº 83: OECD Core Set of Indicators for Environmental Performance Reviews"
http://lead.virtualcentre.org/en/dec/toolbox/Refer/gd93179.pdf (page 7 of both document and pdf file)

Policy Relevance and Utility Criteria:

- Provides a representative picture of environmental conditions, pressures on the environment or society's responses
- Be simple, easy to interpret, and able to show trends over time
- Be responsive to changes in the environment and related human activities
- Provide a basis for international comparisons
- Be either national in scope or applicable to regional environmental issues of national significance
- Have a threshold or reference value against which to compare the indicator

Analytical Soundness Criteria:

- Be theoretically well founded in technical and scientific terms
- Be based on international standards and international consensus about its validity
- Lend itself to being linked to economic models, forecasting, and information systems

Measurability Criteria:

- data should be readily available or made available at a reasonable cost-benefit ratio
- data should be adequately documented and of known quality
- data should be updated at regular intervals in accordance with reliable procedures

8. Chemical and Pesticides Results Measures (EPA and Florida State University: Project Summary)
I can't find this document online. Here's the CAPRM website; please e-mail if you'd like a copy of the project summary. http://www.pepps.fsu.edu/CAPRM/ (p. 17 and 18 of pdf file)

Essential criteria:

- measurability
- data quality
- importance to region and states
- relevance to a desired, significant policy goal, issue, legal mandate, or agency mission
- representativeness: changes in the indicator correlate with trends in the other parameters or systems it was intended to represent
- appropriate scale (spatial and temporal)
- ability to show trends
- ability to support policy decisions

Preferable criteria:

- directly measures the result of interest
- ability to be understood
- sensitivity
- integration of exposures and effects
- data comparability
- data affordability/availability
- predictive/anticipatory

9. Children's Health and Environment Indicators in North America: Volume I
(p. 10 of doc. Please e-mail me for a copy of this report.)

- based on priority issues
- relevant to children's health and the environment
- useful to policy-makers
- useful to public
- unbiased
- reliable
- valid
- based on high-quality data
- robust data collection
- repeatable data collection

10. Sustainable Seattle, "Indicators of Sustainable Community"
(linked at http://www.sustainableseattle.org/pubs/publications/view?searchterm=indicators%20of%20sustainable%20community, however it doesn't seem to be on the website. Email me if you'd like a pdf copy. p. 12 of pdf)

- relevant – fit the purpose for measuring, tells you something about the system
- reflect community values
- attractive to local media
- statistically measurable (includes data availability and comparability)
- logically or scientifically defensible – understandable rationales for using the indicator exist
- reliable (includes consistent over time and accurate)
- leading (predictive)
- policy-relevant (for all stakeholders, including public)

11. The World Bank, "Indicators of Environment and Sustainable Development"
(Also can't find online. Here's a similar doc. http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2000/02/09/000094946_00012505400754/Rendered/PDF/multi_page.pdf pages 9-10 of doc, 21-22 of pdf. The criteria from the document I cited are on p. 12-15 of doc, and 24-27 of pdf.)

- Directly relevant to project objectives
- Directly relevant to target population (meets users' needs)
- Clearly designed
- Realistic collection or development costs of data
- High quality (from quality measurements)
- High reliability
- Appropriate spatial and temporal scale

12. USEPA and SEMARNAT (MX), The Border 2012 Program, "Strategy for Indicator Development"
(http://www.epa.gov/ehwg/strategy.pdf)

Core Criteria:

- Representative of what they are meant to describe.
- Relevant to policy
- Scientifically valid
- Produces consistent results
- Based on precise data
- Simple
- Sensitive to change
- Understood and accepted by the public

Preferred Criteria

- Available data
- Compatible, even across the border

Media-specific Criteria (esp. depends if environment or program indicator)

- Appropriate spatial and temporal scale
- Feasible data collection
- Cost-effective data collection

13. Institute of Medicine, "Environmental Health Indicators: Bridging the Chasm of Public Health and the Environment"
(available from the National Academies Press http://books.nap.edu/books/0309092655/html/R2.html. p. 25 and 28)

Monitoring system for indicator data should:

- Make sense to people in local health departments
- Be keyed to local public health actions
- Receive adequate funding over the long term
- Have a sense of stability
- Be based on sound science
- Be linked to other federal agencies

Indicator criteria:

- Simple – measure only one item
- Measurable – comparable and quantifiable
- Understandable – comprehensible to policy-makers and the public
- Defensible – support a relationship between environmental factors and health status

14. United States Environmental Protection Agency, for the 2006 Report on the Environment, "Indicator Selection Criteria for the Public Report: Draft of April 12, 2005"

Technical Document Criteria

- Answers a question in the technical document [listed in matrix as "relevant"]
- Clear, accurate, & objective (unbiased)
- Sound collection methodologies
- Describes changes and reflects trends
- Represents the target population and is comparable across time and space
- Transparent and reproducible

Public Report Criteria

- **Important to the public:** Indicator reflects an issue considered to be important or relevant to the public according to opinion polls, EPA surveys, and academic studies.*

* See Appendix 3 for lists of topics important to the public and scientists.

- **Understandable to the public:** Indicator is easily understood by members of the public, regardless of their age, education, or geographic location.

- **Easily communicated:** Indicator and indicator data can be described in terms that are clear to the public.

- **Able to effect behavioral change:** Indicator reflects an environmental issue that individuals or society can effectively influence through their actions or behaviors.

- **Important to scientists:** Indicator reflects an issue considered to be important to the scientific community according to recent surveys and polls.*

15. America's Children and the Environment
(www.epa.gov/envirohealth/children)

- importance to the health of children (relevant)
- availability of data for much or all of the United States
- sufficient quality of data to generate a reliable measure (valid & reliable)

16. CalEPA EPIC
(http://www.oehha.ca.gov/multimedia/epic/)

Primary Criteria

- Decision support: the indicator should provide information appropriate for making policy decisions.
- Representativeness: the indicator is designed to reflect the environmental issue it is selected to characterize.
- Data quality: data are/will be collected to yield measures that are scientifically acceptable and support sound conclusions about the state of the system being studied.
- Sensitivity: the indicator should be able to distinguish meaningful differences in environmental conditions with an acceptable degree of resolution.

Secondary Criteria

- Anticipatory: the indicator can provide an early warning of environmental change.
- Data comparability: the indicator can be compared to indicators in other state, regional, national, or international systems.
- Cost-effective: data collection efforts generate the type and amount of information needed to support the indicator, and can be carried out at a reasonable cost.
- Benchmark value: the indicator is based on, or can be compared to, a benchmark value or point of reference, so that users can assess its significance.

17. WHO Children's Environmental Health Indicators
(http://www.who.int/ceh/publications/ceh1590599/en/index.html)

Scientific Validity

- Credible – based on a known linkage between the environment and health
- Sensitive to changes in the conditions of interest
- Consistent and comparable over space and time
- Robust – unaffected by minor changes in methodology, scale, or data
- Representative of the conditions and area of concern
- Accurate – based on reliable data
- Scalable – capable of being used at different scales

Utility and Practicability

- Relevant to an issue of policy or practical concern
- Actionable – related to a condition which is amenable to influence or control
- Understandable by and acceptable to those at whom it is addressed
- Time – up-to-date
- Specific – targeted at an explicit phenomenon or issue
- Measurable – based on available data and manageable methods
- Cost-effective – capable of being constructed and used at an acceptable cost

Indicator Worksheet

Concept	Indicator	Data Source	• Risk factor • Proxy for heath outcome we cannot measure directly • Both
Circle one: social, body burden, physical environmental hazard/exposure, health outcome			
Socioeconomic position	% Households under poverty level Median household income Unemployment rate	Census, SFT 3 Files Census, SFT 3 Files Census, SFT 3 Files	risk factor
Circle one: social, body burden, physical environmental hazard/exposure, health outcome			

Indicator Worksheet

Concept	Indicator	Datasource	• Risk factor • Proxy for heath outcome we cannot measure directly • Both
Circle: social, bodyburden, physical environmental hazard/exposure, health outcome			
Circle: social, bodyburden, physical environmental hazard/exposure, health outcome			
Circle: social, bodyburden,physical environmental hazard/exposure, health outcome			

Concept	Indicator	Datasource	• Risk factor • Proxy for heath outcome we cannot measure directly • Both
Circle: social, bodyburden, physical environmental hazard/exposure, health outcome			
Circle: social, bodyburden, physical environmental hazard/exposure, health outcome			
Circle: social, bodyburden, physical environmental hazard/exposure, health			

Appendix 5: Workshop Sponsors

U.S. EPA's Office of Children's Health Protection (OCHP) promotes environmental health protection of children and older adults in the United States and around the world. Children in socioeconomically disadvantaged communities may be disproportionately affected by environmental hazards. For example, children of lower income families are more likely to have asthma attacks and elevated blood lead levels. To reach these disproportionately affected children, OCHP is working with the National Urban League through a Memorandum of Understanding to facilitate better communication between U.S. EPA and the National Urban League, resulting in more collaborative protection of the environment and greater awareness of health issues that impact children. Also, as part of its over mission, OCHP supports the development and use indicators to track progress in protecting the environmental health of children and older adults. Since 2000 OCHP in partnership with EPA's Office of Policy Economics and Innovation, has published two reports on children's environmental health indicators, *America's Children and the Environment: A first View of Available Measures* and *America's Children and the Environment: Measures of Contaminants, Body Burdens, and Illnesses*. OCHP now wishes to further the science of developing indicators by including measures of the interaction between social and physical environment that may lead to ill health and health disparities. For more information on OCHP, see http://yosemite.epa.gov/ochp/ochpweb.nsf/homepage and to access *America's Children and the Environment* indicators report see http://www.epa.gov/envirohealth/children/index.htm.

U.S. EPA's Office of Research and Development National Health and Environmental Effects Research Laboratory (NHEERL) serves as EPA's focal point for scientific research on the effects of contaminants and environmental stressors for both human health and ecosystem integrity. This research helps the Agency identify and understand the processes that affect our health and environment, and helps EPA evaluate the risks that pollution poses to humans and ecosystems. One of the NHEERL projects that focuses on health disparities is the Environmental Health Workgroup (EHWG) of the Border 2012 program, run by the US Environmental Protection Agency (EPA) and Mexico's Environmental Secretariat (SEMARNAT). The EHWG is a border-wide workgroup that focuses on problems that transcend the US-Mexico border and are shared by multiple communities. The EHWG has funded environmental health education and training projects in pesticide handling, lead exposure reduction, and drinking water safety. It also funds epidemiologic studies, predominantly on air contaminants and respiratory outcomes. As required by the Border 2012 Goal 4, the EHWG has most recently turned its attention to identifying and testing indicators of air and water exposures and their possible health effects. The workgroup expects that the development of environmental health indicators will serve as a tool to monitor changes in the health of people living along the border, as well as to predict health outcomes associated with the environment. To learn more about NHEERL see http://www.epa.gov/nheerl/.
To learn more about the EHWG, see http://www.epa.gov/ehwg.

U.S. EPA's Office of Environmental Justice is the entity within EPA with the primary responsibility for coordinating the Agency's efforts to integrate environmental justice into all policies, programs, and activities. EPA's environmental justice mandate encompasses the breadth of the Agency's work, including setting standards, permitting facilities, awarding grants, issuing licenses or regulations and reviewing proposed actions of the federal agencies. OEJ works with all stakeholders to constructively and collaboratively address environmental and public health issues and concerns. OEJ also provides information, technical and financial resources to assist and enable the Agency to meet its environmental justice goals and objectives. To learn more about OEJ see http://www.epa.gov/compliance/environmentaljustice/.

The National Institute of Environmental Health Sciences (NIEHS) is one of 27 Institutes and Centers of the National Institutes of Health(NIH), which is a component of the Department of Health and Human Services DHHS). The mission of the National Institute of Environmental Health Sciences (NIEHS) is to reduce the burden of human illness and dysfunction from environmental causes by understanding each of these elements and how they interrelate. The NIEHS achieves its mission through multidisciplinary biomedical research programs, prevention and intervention efforts, and communication strategies that encompass training, education, technology transfer, and community outreach. To learn more about NIEHS, see http://www.niehs.nih.gov/.

Department of Health Behavior and Health Education at the University of Michigan School of Public Health is concerned with factors associated with health-related behavior and health status, and develops and evaluates educational activities designed to improve individual and community health and quality of life. The aim of HBHE is to prepare students and conduct research that is relevant and acknowledges these trends. Our multidisciplinary faculty provide students with a broad choice of courses, including those which emphasize individual, family, group, social network, community, and policy approaches to health behavior and health education. Faculty aim in their courses to integrate theory, research, and practice-through, for example, the use of case studies, small group discussions, community-based fieldwork, and computer technology. For more information on the HBHE see http://www.sph.umich.edu/hbhe/.

The University of Michigan School of Public Health seeks to create and disseminate knowledge with the aim of preventing disease and promoting the health of populations in the United States and worldwide. We are especially concerned with poor, often minority populations, who suffer disproportionately from illness and disability. Among health science schools, we are unique in that we place a strong emphasis on disease prevention and health promotion, rather than on the treatment of existing illness. We aspire to be a crossroads of knowledge, where ideas and people from the biological, physical, social, and managerial sciences meet. The school employs integrated approaches to solving public health problems, and teaches and promotes the ethical practice of public health.

Center for Research on Ethnicity, Culture and Health (CRECH) was established in 1998 at the University of Michigan School of Public Health (UMSPH) to lead the School's response to dramatic changes in the racial and ethnic composition of the United

States. CRECH provides a forum for basic and applied public health research on relationships among ethnicity, culture, socioeconomic status and health. CRECH seeks to develop new transdisciplinary frameworks for understanding these relationships while promoting effective collaborations among public health academicians, health providers, and local communities. To learn more about CRECH see http://www.sph.umich.edu/crech/.

Appendix 6: Workshop Organizing Committee

Devon Payne-Sturges, DrPH
U.S. EPA, Office of Children's Health Protection

Gilbert C. Gee, PhD
Department of Health Behavior and Health Education
University of Michigan School of Public Health

Amy Schulz, PhD
Department of Health Behavior and Health Education
University of Michigan School of Public Health

Hal Zenick, PhD
U.S. EPA, Office of Research and Development National Health and Environmental Effects Research Laboratory

Rachel Morello-Frosch, PhD
Brown University

Kirstin Crowder
U.S. EPA, Office of Research and Development National Health and Environmental Effects Research Laboratory

Tracey Woodruff, PhD, MPH
U.S. EPA Office of Policy Economics and Innovation

Arlene Rosenbaum
ICF Consulting

Charles A. Wells, PhD
National Institute of Environmental Health Sciences

Charles Lee
U.S. EPA Office of Environmental Justice

Appendix 7: Speaker Biographies

Speakers are listed in the order in which they gave presentations during the workshop.

Devon Payne-Sturges, DrPH
Dr. Devon Payne-Sturges is an environmental health scientist with U.S. EPA's Office of Children's Health Protection. She works on critical regulatory and science policy issues at EPA that have an impact on children's health. She is currently serving on cross-agency workgroups developing agency strategy to reduce mercury emissions and human exposure to mercury, and identifying chemicals with emerging concerns for children's health. Her areas of research include use of exposure biomonitoring for policy analysis, risk assessment, environmental health indicator development, and environmental health of minority populations. Ms. Payne-Sturges was recently appointed to U.S. EPA's Risk Assessment Forum and is serving on the Cumulative Risk Assessment Tech Panel. She possesses a Master of Public Health and Doctor of Public Health degrees in environmental health sciences from Johns Hopkins Bloomberg School of Public health. Prior to joining U.S. EPA, Ms. Payne-Sturges served as Assistant Commissioner for Environmental Health with the Baltimore City Health Department.

SELECTED PUBLICATIONS:

Gee GC, Payne-Sturges D. 2004. Environmental Health Disparities: A Framework Integrating Psychosocial and Environmental Concepts. Environmental Health Perspectives 112(17): 1645-1653.

Payne-Sturges, D. C., T. A. Burke, et al. (2004). "Personal exposure meets risk assessment: a comparison of measured and modeled exposures and risks in an urban community." Environ Health Perspect 112(5): 589-98.

Payne-Sturges, D. C., M. Schwab, et al. (2004). "Closing the research loop: a risk-based approach for communicating results of air pollution exposure studies." Environ Health Perspect 112(1): 28-34.

Payne-Sturges, D. C. and J. G. Breugelmans (2001). "Local lead data are needed for local decision making." Am J Public Health 91(9): 1396-7.

Gilbert Gee, PhD
Dr. Gilbert C. Gee is an Assistant Professor of Health Behavior and Health Education at the School of Public Health at the University of Michigan. His research focuses on racial and ethnic health disparities, with particular emphasis on the roles of social stressors, neighborhood conditions, and racial discrimination. His work also examines the health of Asian Americans and Pacific Islanders and uses a multi-level approach. He has served as the Program Chair for the Asian and Pacific Islander Caucus of the American Public Health Association and is a board member of the Environmental Justice Initiative at the University of Michigan. He holds a bachelor's of arts in neuroscience from Oberlin

College, a doctorate in Social and Behavioral Sciences from the Johns Hopkins University School of Public Health and post-doctoral training in sociology from Indiana University.

SELECTED PUBLICATIONS:

Gee GC, Payne-Sturges D. 2004. Environmental Health Disparities: A Framework Integrating Psychosocial and Environmental Concepts. Environmental Health Perspectives 112(17): 1645-1653.

Gee GC and Takeuchi DT. 2004. Traffic Stress, Vehicular Burden and Well-Being: A Multilevel Analysis. Social Science and Medicine. 59(2):405-414

Gee GC. 2002. A Multilevel Analysis of the Relationship between Institutional and Individual Racial Discrimination and Health Status. American Journal of Public Health. 92: 615-623

Tracey J. Woodruff, PhD, MPH
Dr. Tracey J. Woodruff is a senior scientist and policy advisor in the National Center for Environmental Economics in the Office of Policy, Economics, and Innovation at the Unites States Environmental Protection Agency. She has done extensive research on environmental health issues, including health effects from air pollution, children's health risks, and environmental health indicators. She also works on critical science policy issues at EPA. She has served as an epidemiological expert for EPA in preparation of the regulatory standards for particulate matter and ozone, and co-led the project producing the first national characterization of air toxics across the US. Her most recent work focuses on environmental health indicators for children, including initiating and leading EPA's work developing measures to track children's environmental health. This has lead to two reports, the second, "America's Children and the Environment: Measures of Contaminants, Body Burdens, and Illnesses" was released in spring of 2003. She received her Ph.D. and M.P.H. in the environmental health sciences from the University of California, Berkeley. She completed a Pew Postdoctoral Fellowship at the University of California, San Francisco, Institute for Health Policy Studies.

Rachel Morello-Frosch, PhD
Ms. Morello-Frosch is an assistant professor at the Department of Community Health, School of Medicine and the Center for Environmental Studies at Brown University. Rachel completed her bachelor's degree in development economics, a master of public health degree in epidemiology and biostatistics, and her PhD in environmental health sciences at the University of California, Berkeley. She teaches methods courses on environmental health, risk assessment, and policy, epidemiology, and a seminar on the science and political economy of environmental health and justice.

Ms. Morello-Frosch's research examines race and class determinants of the distribution of health risks associated with air pollution among diverse communities in the United States. Her current work focuses on: comparative risk assessment and environmental

justice, developing models for community-based environmental health research, science and environmental health policy-making, children's environmental health, and the intersection between economic restructuring and community environmental health. Rachel is currently working on a research collaborative with colleagues in Southern California on "Air Pollution, Toxics and Environmental Justice." She is also collaborating with Silent Spring Institute in Massachusetts on a community-based household exposure study on endocrine-disrupting chemicals funded by the National Institute of Environmental Health Sciences.

SELECTED PUBLICATIONS:

Morello-Frosch R, Pastor M, Sadd J, Porras C, Prichard M. "Citizens, Science, and Data Judo: Leveraging Community-based Participatory Research to Build a Regional Collaborative for Environmental Justice in Southern California." In Methods for Conducting Community-Based Participatory Research in Public Health. Barbara Israel, Eugenia Eng, Amy Shultz, Edith Parker, eds. University of Michigan, Jossey-Bass Press (forthcoming 2004).

Morello-Frosch RA, Pastor M, Sadd J: "Integrating Environmental Justice and the Precautionary Principle in Research and Policy-Making: The Case of Ambient Air Toxics Exposures and Health Risks among School Children in Los Angeles." *Annals of the American Academy of Political and Social Science*, 2002, 584: 47-68.

Morello-Frosch RA: "The Political Economy of Environmental Discrimination." *Environment and Planning C, Government and Policy*, 2002, 20:477-496.

Morello-Frosch RA, Pastor M, Porras C, Sadd J: **"**Environmental Justice and Regional Inequality in Southern California: Implications for Future Research." *Environmental Health Perspectives*, 2002, 110 (Supplement 2): 149-154.

Morello-Frosch R, Zavestoski S, Brown P, McCormick S, Mayer B, Gasior R. "Social Movements in Health: Responses to and Shapers of a Changed Medical World." In The New Political Sociology of Science: Institutions, Networks, and Power. Kelly Moore and Scott Frickel, eds. Madison, WI: University of Wisconsin Press. (forthcoming 2004).

Pastor M, Morello-Frosch RA, Sadd J: "The Air is Always Cleaner on the Other Side: Race, Space, and Air Toxics Exposures in California." In Press, *Journal of Urban Affairs*, 2005.

Pastor M, Sadd J, Morello-Frosch RA: "Reading, Writing and Toxics: Children's Health, Academic Performance, and Environmental Justice in Los Angeles." *Environment and Planning C*, 2004, 2: 271-290.

Pastor M, Sadd J, Morello-Frosch RA: "Waiting to Inhale: The Demographics of Toxic Air Releases in 21st Century California." *Social Science Quarterly*, 2004, 85(2): 420-440.

Russ Lopez, PhD
Russ Lopez, a native of California, received his Bachelor of Science degree in Applied Earth Sciences from Stanford University and his Master of City and Regional Planning degree from the Kennedy School of Government at Harvard University. He has a doctorate in Environmental Health from the Boston University School of Public Health. Past employment includes working on urban and environmental issues for then Lt. Governor John Kerry. He also worked for ten years in various positions in for the City of Boston on housing, community development and environmental issues. Dr. Lopez was the first Executive Director of the Environmental Diversity Forum, a coalition of environmentalists and community activists advocating for environmental justice issues throughout New England. A longtime volunteer and member of several community based organizations, Dr. Lopez has also advised a number of local and national organizations including the Dorchester Community Collaborative, the Environmental Protection Agency and the US Department of the Interior. His interests include urban environmental health and the role of the cities and the structure of the built environment in public health outcomes.

Current projects include the development of a curriculum for community groups on how to use information on the health effects of the built environment when considering new development proposals, a case study of the Boston Schoolyard Initiative for the Robert Wood Johnson Foundation's Active Living Research program, a study of the influence of neighborhood on the effectiveness of diet and exercise interventions, and a study on racial disparities in dental health. Currently holding the position of Research Assistant Professor in the Boston University School of Public Health, Department of Environmental Health, he teaches classes on Urban Environmental Health and Geographical Information Systems.

SELECTED PUBLICATIONS:

Lopez R. Segregation and Black/White Differences in Exposure to Air Toxics in 1990. *Environmental Health Perspectives* Supplements April 2002, Volume 110 (Supplement – 2):289-295.

Lopez R and Hynes HP. Sprawl in the 1990s: Measurement, Distribution and Trends. *Urban Affairs Review*. January 2003 Volume 38 (3): 325-355

Lopez R. Density and Health: Is Less More? *In Rediscovering the American Dream: Essays on Density*. Boston Society of Architects. Boston, MA December 2003

Lopez R. Urban Sprawl and Risk of Being Overweight or Obese. *American Public Health Association Journal.* September 2004. Volume 94: 1574-1579

Lopez R. Income Inequality and Self-Rated Health in U.S. Metropolitan Areas: A Multilevel Analysis. *Social Science and Medicine* December 2004. Volume 59 (12): 2409 – 2419

Mah-J Soobader, PhD
Dr. Soobader holds a PhD in Social Epidemiology from Boston University and is a well-recognized researcher in the field of Income Inequality. Dr. Soobader started her 12-year research career as a lecturer at the University of Durban-Westville in South Africa, where she supervised inter-disciplinary community-based research teams and played a key role in the development of an inter-disciplinary community-based research curriculum. During and following her doctoral dissertation, Dr. Soobader has made important contributions to research in Income Inequality, particularly, on health disparities, geographic differences in health disparities, and consequences of poverty on health. Related methodological research conducted by Dr. Soobader has examined economic inequality as a function of geographic aggregation and the use of geographic aggregates as proxies for individual measures. Her work extends to multilevel social inequalities, race differentials, and adult and child health. Dr. Soobader also maintains close ties to academia as an author and a reviewer of public health articles. Currently, as principal of STATWORKS, Dr. Soobader provides research expertise, guidance, and consulting services in the area of health disparities.

SELECTED PUBLICATIONS:

Dolores Acevedo-Garcia, Mah-J Soobader, and Lisa F. Berkman. The Differential Effect of Foreign-Born Status on Low Birth Weight by Race/Ethnicity and Education *Pediatrics* 2005 115: e20-30.

Elizabeth M. Barbeau, Nancy Krieger, Mah-J Soobader. Working Class Matters: Socioeconomic Disadvantage, Race/Ethnicity, Gender, and Smoking in NHIS 2000. *American Journal of Public Health*. 94(2):269-278. February 2004.

Soobader M., LeClere FB, Hadden WC, and Maury B., 2001. Examining the Validity of Using Aggregate Data to Proxy Individual Socio-economic Status: Does the Size of the Aggregate Matter? *American Journal of Public Health*, 91-632-636.

Soobader M and LeClere FB, 2000. Going Upstream: Social Inequality and Children's Health commissioned by *Critical Public Health*, 10 (2) 217-232.

Soobader M. and LeClere FB, 1999. Aggregation and the Measurement of Income Inequality, Effects on Morbidity, *Social Science and Medicine*, 48: 733-744.

Soobader M. and Sheik R., 1993. Transformation of Optometric Education. *South African Optometric Journal* 52 (2): 75-76.

Kirstin Crowder, MPH
Ms. Crowder is an Association of Schools of Public Health Fellow at the US Environmental Protection Agency, in the Office of Research and Development. Ms. Crowder graduated with her Master's of Public Health in Environmental and International Health from Emory University in 2004. Her thesis was entitled, "An Economic Analysis of Community-based Water Systems in Lempira, Honduras." Currently, she helps to

coordinate the actvities of the Environmental Health Workgroup (EHWG) of the Border 2012 program. In this capacity, she co-wrote the "Strategy for Indicator Development" produced by the Border Indicators Taskforce, and with partners at the Health Resources and Services Administration, is writing a cooperative agreement to develop evaluation methodology for community health worker training projects. She is also compiling a community-level data profile of communities selected as pilot study sites for the upcoming National Children's Study. Her professional interests include: community-based research and service provision, environmental epidemiology, economic evaluation of health services, and human rights and health.

Hal Zenick, PhD
Dr. Hal Zenick, Associate Director for Health, National Health and Environmental Effects Research Laboratory (NHEERL) in EPAs Office of Research and Development, has more than 20 years of experience in research in environmental health and risk assessment. Dr. Zenick received his Bachelor of Science degree in Psychology/Biology at the North Texas University in Denton, Texas in 1968 and his Post Doctoral degree in Physiological Psychology from the University of Missouri, Columbia, Missouri in 1972. Prior to joining NHEERL, he was a Branch Chief in EPAs Office of Health and Environmental Assessment, Office of Research and Development. Dr. Zenick serves as a U.S. Co-Chair of the Environmental Health Workgroup under the binational U.S.-Mexico Border 2012 Program and serves as EPAs representative to the U.S.-Mexico Critical Infrastructure Protection (CIP) Health Working Group. Within the Agency, he is Chair of the Agencys Heath Effects Institute Advisory Board and is ORDs senior executive lead for environmental justice matters. He has received numerous Agencys awards including the prestigious Presidential Meritorious Executive Rank Award, the ORD Statesmanship award. Recently, he has had a leading role in several emerging programs at EPA including efforts to develop better indicators of public health impact of environmental decisions. In this capacity, he has participated on a number of prominent National and Federal Projects. Dr. Zenick also has the lead for the Office of Research and Development for several cross-EPA/cross-Federal Agency initiatives including the impact of the environmental on the rapidly growing, aging population and the Futures of Toxicity Testing. Dr. Zenick is a member of the Advisory Board for the UNC Business Institute for Science, and the National Institute for Environmental Health Sciences (NIEHS) Board of Scientific Counselors. He is a past President of the Reproductive and Development Toxicology Specialty Section, Society of Toxicology, and a member of the March of Dimes Reproductive Hazards in the Workplace. He has also served on the editorial board of several prestigious journals.

SELECTED PUBLICATIONS AND PRESENTATIONS:

Applying an Environmental Public Health Paradigm to Assessing the Potential Impacts of Air Pollution on Older Citizens, Andrew M. Geller, Hal Zenick, Annual Meeting of the American Public Health Association, Nov. 2004.

EPA-ILSI International Biomonitoring Workshop Environmental Public Heath Continuum: Systems Biology Approach. September 2004.

NAS Committee on Toxicity Testing and Assessment of Environmental Agents, Sept. 2004.

2004 National Environmental Public Health Tracking Conference Assessing Public Health Impact of Environmental Decisions Through Information Technology and Research, March 2004.

CENR Update on NAS Project: Future of Toxicity Testing and Assessment, March 2004.

Presentation to the Board of Scientific Counselors, Accountability Initiative: Assessing Public Health Impact of Environmental Decisions, January 2004.

Zenick, H. Integrating U.S.-Mexico Border Environmental Health Data. Invited U.S.A. Keynote Address at Toxicology Has No Borders. The West Texas Regional Poison Center, El Paso, TX, June 23, 1995.

Zenick, H. Role of Research in Addressing Community Environmental Health Concerns: Experiences in the Lower Rio Grande Valley. Invited presentation for (1) The Environmental Equity Seminar Series, Duke University, Durham, NC, March 20, 1995; and (2) University of North Carolina, Chapel Hill, NC, April 17, 1995.

Zenick, H. An interagency research program to address environmental health issues along the U.S.-Mexico border. Second Annual Directors Symposium of the California Department of Toxic Substances Control. Sacramento, CA, December 16, 1993.

Donele Wilkins

Donele Wilkins has over two decades of experience in occupational and environmental health as an educator, consultant, trainer, administrator and advocate. In 1994, she co-founded and currently serves as the Executive Director of Detroiters Working for Environmental Justice, a non-profit organization addressing urban environmental issues in the City of Detroit. Ms. Wilkins is sought after as a public speaker addressing local and national audiences on topics of community driven sustainable development, environmental justice, and occupational and environmental health advocacy. She has coordinated and organized several conferences and gatherings to highlight the plight of her community. As a consultant, Ms. Wilkins has assisted several community organizations and put them on the correct path towards increasing their capacity to transform their communities. She is a mom of two - which motivates her to change conditions in her community so that they can have a brighter future. With her leadership, DWEJ was able to shut down the Henry Ford Hospital Medical Waste Incinerator.

Donele sits on The Detroit Brownfield Redevelopment Authority, Southeast Michigan Council of Governments-transportation advisory committee; Founder and Co-Chair of the National Black Environmental Justice Network, Colin Powel Academy board of education and many other committees and forums. She is the recipient of several awards,

fellowships and special recognition for her contribution on behalf of the community.

Azibuike Akaba
Azibuike Akaba is the Community Technical Assistance Coordinator for the Coalition for West Oakland Revitalization (CWOR). It is a Bay Area community based organization working Environmental Justice, economic development and civil rights. He is currently an environmental consultant and owns his own business: www.icbe.net. International Consultants for a Better Environment. He was the Coordinator of the National Technical Assistance Program (NTAP) for Communities for a Better Environment (CBE) from 1998 to 2003. He provides scientific and technical expertise to community groups addressing industrial pollution problems residential exposure and campaign planning. He had been a staff scientist at Communities for a Better Environment for 7 years. He has provided research for critical environmental campaigns such as: Ban MTBE, Dioxin, etc. He published several articles on Environmental Justice. He published a seminal MTBE report March 2000. He provided critical information for a victory on an international Methanex case in the NAFTA Counsel August 2002. He currently provides technical training on pollution monitoring and toxic site investigation to community groups and grassroots organizations. His particular area of expertise is Toxic Site Investigations. In addition to his work at CBE, Mr. Akaba has worked as Industrial Hygienist technologist, and served as an expert witness on ground water contamination and petrochemical accident related issues. He is a certified medical technologist and hazardous materials specialist.

Bhavna Shamasunder
Ms. Shamasunder is the coordinator of the Environmental Health and Justice Program (EHJ) at Urban Habitat. The EHJ Program addresses the systemic nature of environmental problems and poor health faced by poor communities and communities of color. Urban Habitat, a 16 year old environmental justice organization, works in partnership with low-income communities and communities of color to advance social, economic, and environmental justice in the Bay Area region and beyond. Through advocacy and the promotion of equitable policies, leadership development, research, and participation in strategic coalitions, Urban Habitat helps to build a truly democratic society in which all communities have the power to influence and benefit from the decisions impacting their neighborhoods. Ms. Shamasunder has a Masters degree in Environmental Studies from Yale University and undergraduate degrees in Ethnic Studies and Biology from the University of California, San Diego.

SELECTED PUBLICATIONS:

Shamasunder, Bhavna; *Precaution as Policy: How advocates are asserting a new standard to protect the environment;* in “Race, Poverty, and the Environment”; Fall 2003

Garzon, Catalina; Shamasunder, Bhavna; and Mason, Charles; *Brownfields Revitalization and Redevelopment: Policy Initiatives and Recommendations;* in proceeds of the Second People of Color Environmental Justice Summit; Urban Habitat; October 2002

Shamasunder, Bhavna and Bero, Lisa; "Financial Ties and Conflict of Interest Between Pharmaceutical and Tobacco Companies"*; Journal of the American Medical Association;* August 14, 2002; pp. 738-744

Bunyan Bryant, PhD
Bunyan Bryant, PhD is the Director of the Environmental Justice Initiative at the University of Michigan School of Natural Resources and Environment. He teaches two environmental justice courses and speaks at college campuses and professional conferences throughout the nation. He is a member of the League of Conservation Voters Education Fund and the United States Environmental Protection Agency Clean Air Act Advisory Committee.

Dr. Bryant's latest interest involves global climate change and environmental justice as he believes that no other issue threatens developing countries and low-income/people of color communities in developed nations more than global climate change. Other research interests include developing case studies on corporate, agency, and community responses to hazardous waste sites. He was co-principal investigator of the University of Michigan 1990 Detroit Area Study on Race and Toxic Waste. A more recent study undertaken with Dr. Elaine Hockman is determining the disproportionate impact of environmental hazards on people of color and low-income groups. They are in the midst of completing a book entitled Michigan: A State of Environmental Justice?

Dr. Bryant is currently updating his textbook Environmental Advocacy: Working for Economic and Environmental Justice. He has written the book Environmental Advocacy: Concepts, Issues and Dilemmas and a manual entitled "Social and Environmental Change: A Manual for Community Organizing and Action." He and Professor Paul Mohai edited the book Race and the Incidence of Environmental Hazards: A Time for Discourse, which has been used widely by lawyers, students, and advocates (Boulder: Westview Press, 1992). Professor Bryant also edited the book Environmental Justice: Issues, Policies, and Solutions (Island Press, 1995). He has written numerous articles for peer review journals.

Dr. Bryant and several of his students held a groundbreaking international Environmental Justice Global Climate Change conference in March of 2004. He organized an Environmental Justice/Philosophy conference for scholars in April 2002, and he co-organized a successful Latino Environmental Justice Symposium held November 2002. Dr. Bryant was the co-organizer of the University of Michigan 1990 Conference on Race and the Incidence of Environmental Hazards, which had considerable national impact and led to a series of high-level policy meetings with EPA Administrator William K. Reilly under President Bush's administration and later with EPA Administrator Carol Browner. These meetings paved the road for the EPA's commitment to environmental justice issues and to the creation of an EPA Office on Environmental Justice. Professor Bryant was a part of the movement responsible for President Clinton's signing of the Environmental Justice Executive Order, which has had a major impact on federal agencies and communities throughout the country.

Dr. Bryant has been a member of the EPA's National Environmental Justice Advisory Council for several years. In 1994 he co-facilitated the Symposium for Health Research and Needs to Ensure Environmental Justice, an event sponsored by major federal agencies. Over 1000 grassroots activists, government personnel, scientists, and community academic people participated.

In 2001 Dr. Bryant was awarded the prestigious honors of the Arthur Thurnau Professorship Award and the Harold Johnson Diversity Award. In 2000 he was selected as the School of Natural Resources and Environment Teacher of the Year Award. Dr. Bryant has been a consultant to a number of nonprofit environmental organizations and is continually in demand as an expert lecturer on environmental justice and organizational advocacy.

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