

CUMULATIVE IMPACTS: VULNERABILITY, RISK, AND HEALTH

Gina Solomon, M.D., M.P.H.



ENVIRONMENTAL JUSTICE: SCIENCE AND HISTORY

General Accounting Office

Siting Of Hazardous Waste Landfills And Their Correlation With Racial And Economic Status Of Surrounding Communities

This report provides information on the racial and economic characteristics of communities surrounding four hazardous waste landfills in three southeastern States. It also describes Federal criteria for siting landfills and provides data on public participation and how the Environmental Protection Agency's (EPA's) proposed hazardous waste facility permit changes will affect it.

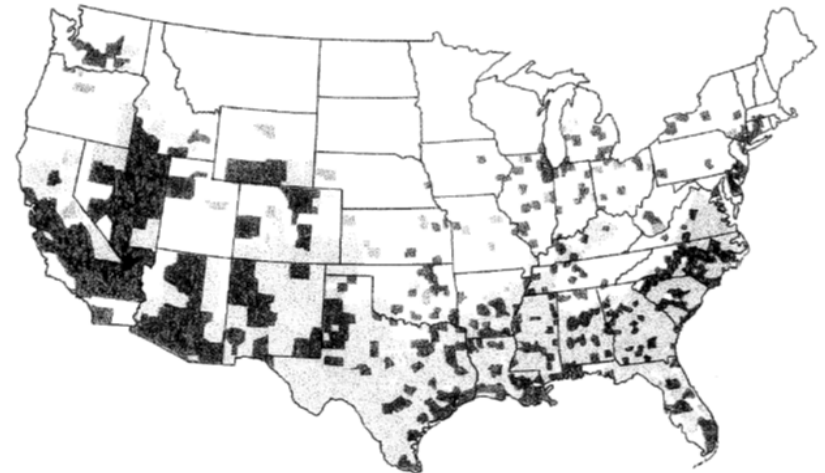


GAO/RCED-83-168
JUNE 1, 1983

1983

TOXIC WASTES AND RACE In The United States

A National Report on the Racial and Socio-Economic
Characteristics of Communities
with Hazardous Waste Sites



COMMISSION FOR RACIAL JUSTICE
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1987

The Drinking Water Disparities Framework: On the Origins and Persistence of Inequities in Exposure

Carolina L. Balazs, PhD, and Isha Ray, PhD

With this article, we develop the Drinking Water Disparities Framework to explain environmental injustice in the context of drinking water in the United States. The framework builds on the social epidemiology and environmental justice literatures, and is populated with 5 years of field data (2005–2010) from California's San Joaquin Valley. We trace the mechanisms through which natural, built, and sociopolitical factors work through state, county, community, and household actors to constrain access to safe water and to financial resources for communities. These constraints and regulatory failures produce social disparities in exposure to drinking water contaminants. Water system and household coping capacities lead, at best, to partial protection against exposure. This composite burden explains the origins and persistence of social disparities in exposure to drinking water contaminants. (*Am J Public Health*. 2014;104:603–611. doi:10.2105/AJPH.2013.301664)

Gray et al. *Environmental Health* 2014, 13:4
http://www.ehjournal.net/content/13/1/4



RESEARCH Open Access

Assessing the impact of race, social factors and air pollution on birth outcomes: a population-based study

Simone C. Gray^{1*}, Sharon E. Edwards², Bradley D. Schultz¹ and Marie Lynn Miranda^{2,3}

Sociology of Health & Illness Vol. 36 No. 2 2014 ISSN 0141-9889, pp. 199–212
doi: 10.1111/1467-9566.12126

Environmental justice and health practices: understanding how health inequities arise at the local level

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systems are vulnerable to inadequate regulatory protection,¹² and to uneven monitoring and reporting.^{13,14}

Studies on equity and the built environment have discussed how historical and structural conditions shape lack of access to safe drinking water. These conditions include selective enforcement of drinking water regulations,¹⁵ noncompliance with federal standards,^{16,17} inequities in access to funding,¹⁸ and (the absence of) a community safe water system that cost of service charges in

An Index for Assessing Demographic Inequalities in Cumulative Environmental Hazards with Application to Los Angeles, California

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RESEARCH Open Access

Being overburdened and medically underserved: assessment of this double disparity for populations in the state of Maryland

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Environmental Research

journal homepage: www.elsevier.com/locate/envres

Race, socioeconomic status, and air pollution exposure in North Carolina

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Risk-Based Targeting: Identifying Disproportionalities in the Sources and Effects of Industrial Pollution

RESEARCH Open Access

Environmental justice implications of arsenic contamination in California's San Joaquin Valley: a cross-sectional, cluster-design examining exposure and compliance in community drinking water systems

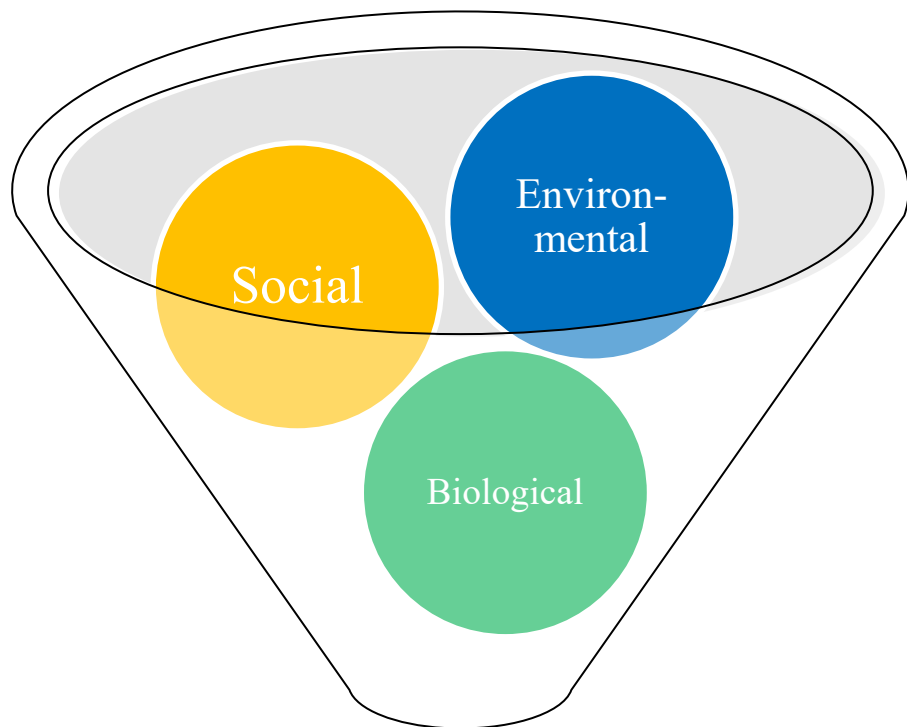
Carolina L. Balazs^{1*}, Rachel Morello-Frosch^{2,3}, Alan E. Hubbard² and Isha Ray¹

Environmental Justice and Regional Inequality in Southern California: Implications for Future Research

Rachel Morello-Frosch,¹ Manuel Pastor Jr.,² Carlos Porras,³ and James Sadd⁴

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Key concepts:



Health Outcomes

- Exposures to environmental hazards are unequal
- Biological and social vulnerabilities modify environmental hazards

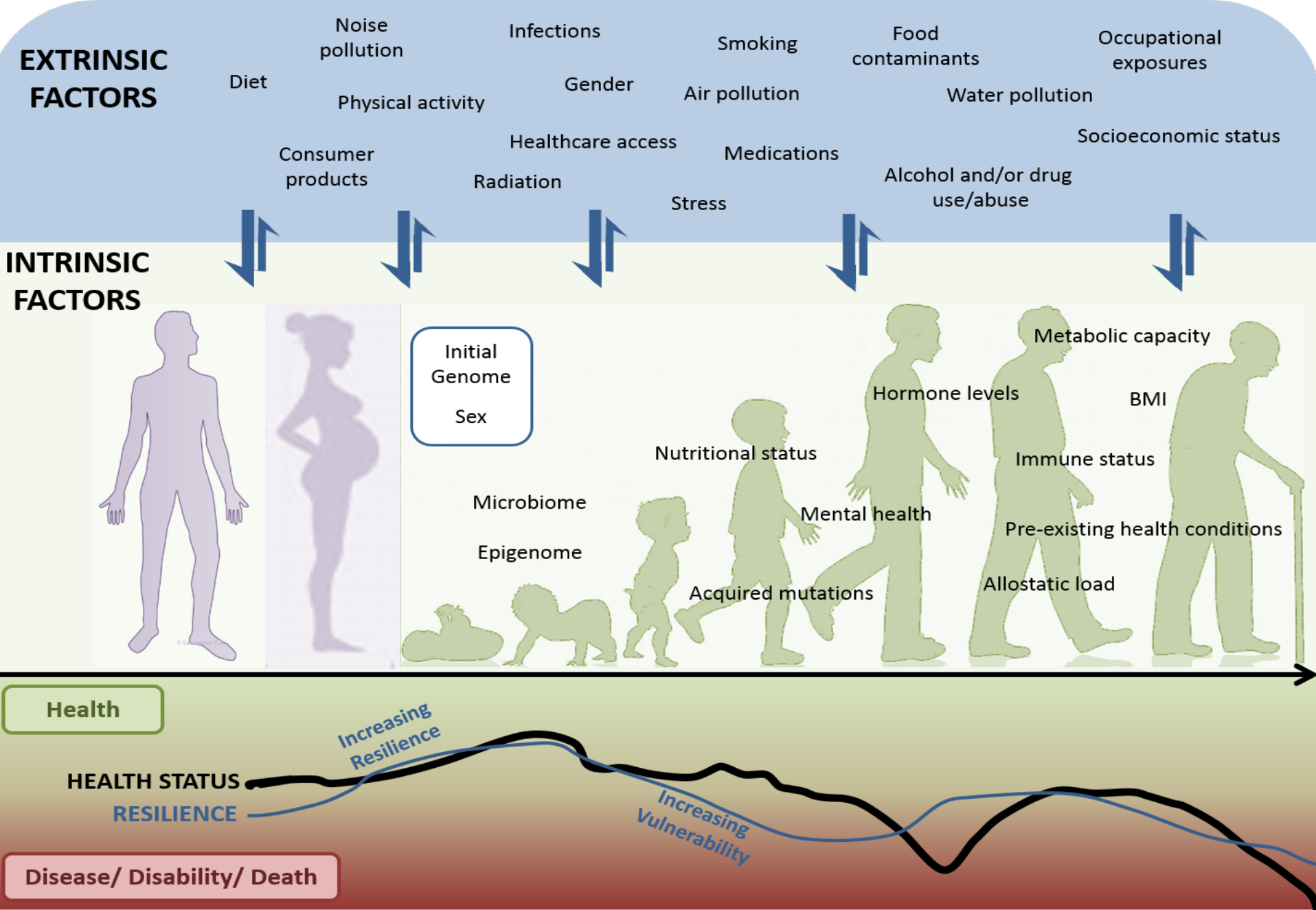
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Home / Annual Review of Public Health / Volume 37, 2016 / Solomon, pp 83-96

Cumulative Environmental Impacts: Science and Policy to Protect Communities

Annual Review of Public Health
Vol. 37:83-96 (Volume publication date March 2016)
First published online as a Review in Advance on January 6, 2016
<https://doi.org/10.1146/annurev-publhealth-032315-021807>

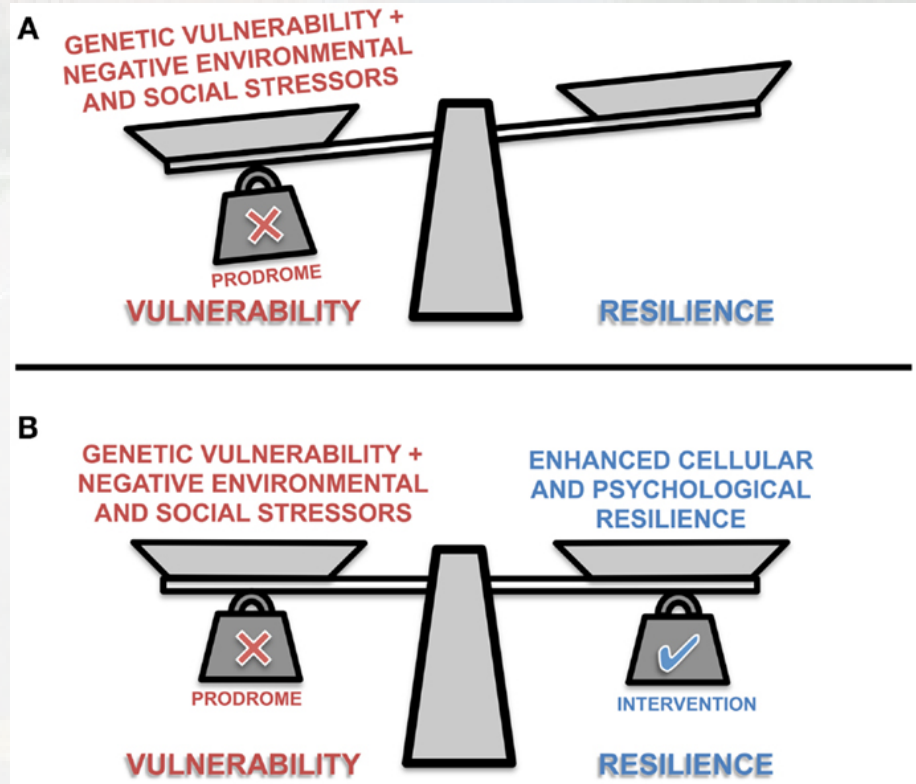
Gina M. Solomon,¹ Rachel Morello-Frosch,² Lauren Zeise,³ and John B. Faust³
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McHale CM, et al. Assessing health risks from multiple environmental stressors: Moving from G×E to I×E. *Mutat Res*, 2018.

Tipping Points

- Factors that enhance health and resilience:
 - Parks, green spaces
 - Safe communities
 - Access to healthy foods
 - Access to health care
 - Financial resources
 - Social support
 - Power and agency



Reducing GHGs Can Produce Major Health Co-benefits

Some examples:

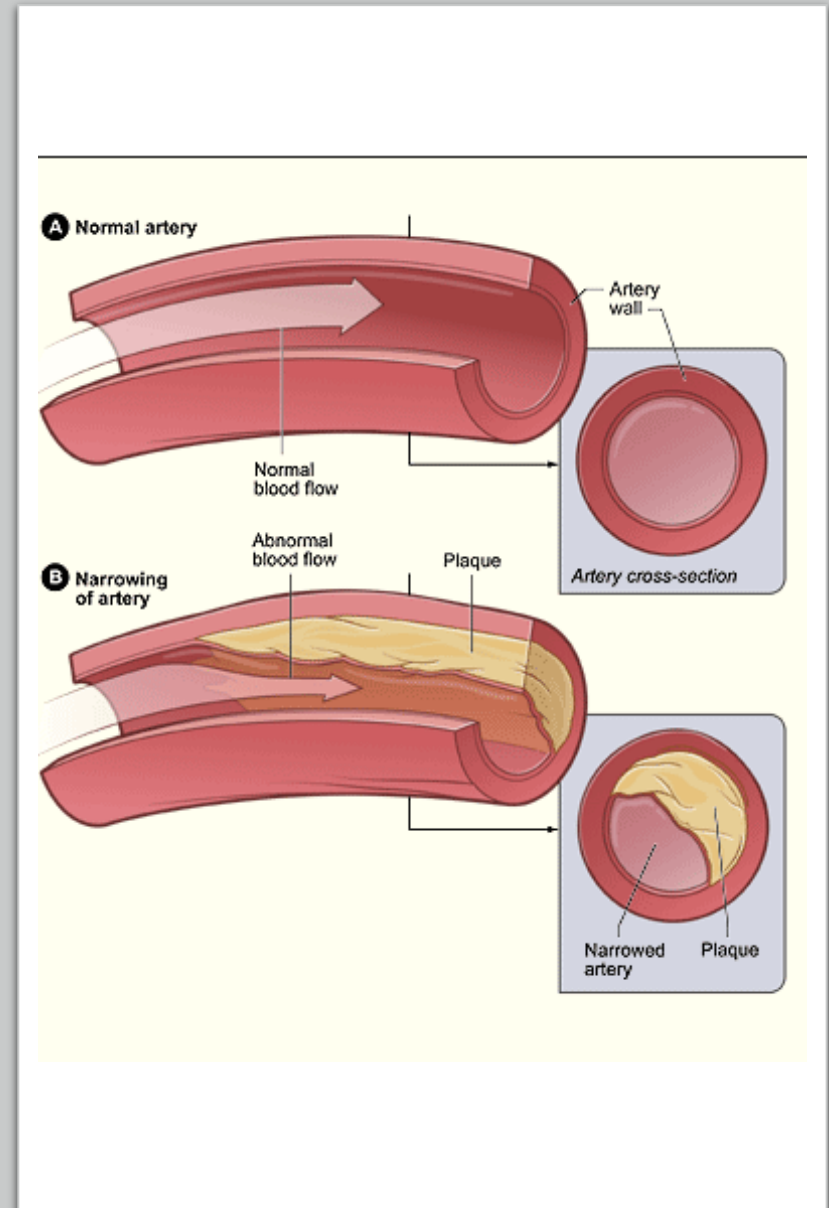
- Reductions in multiple air pollutants
- Reduced noise
- Increased physical activity
- More green spaces
- Reduced traffic congestion
- Fewer odors

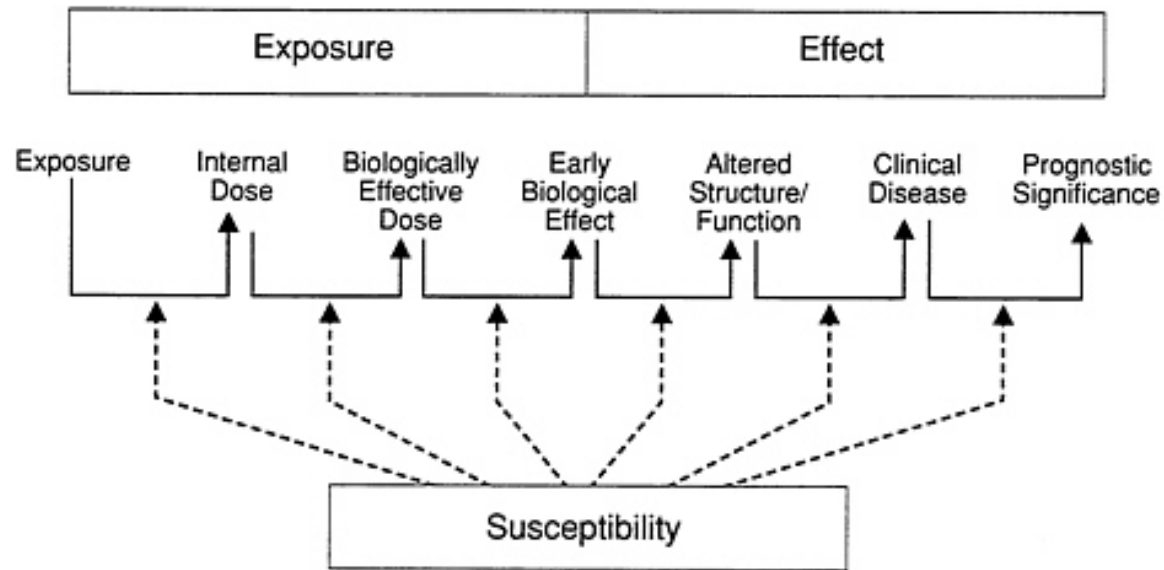
Some of these are hard to quantify

Toxic Stress

Responses to Chronic Stress:

- Short-term: Stress hormones (cortisol, epinephrine, etc.)
- Longer term: Inflammation, high blood pressure, heart rate, blood sugar, cholesterol
- Ultimately: Cardiovascular disease, neurodegenerative disease, cancer, etc.





Measuring Toxic Stress?

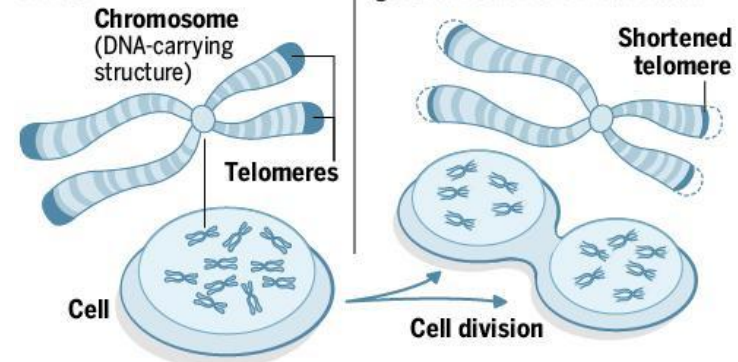
Example: Telomere Shortening

- Age
- Genetics
- Socioeconomic status
- Stress
- Exercise
- Smoking
- Diet
- Anti-oxidants
- Occupational exposures
- Environmental exposures (especially air pollution)

Clue to longevity

Telomeres are caplike features at the ends of chromosomes that help protect them when cells divide.

Over time, due to ongoing cell division, telomeres become shorter. Telomere length appears to be an indication of age and the general health of an individual.



Source: The Nobel Committee for Physiology

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Associated with early onset of coronary heart disease, heart failure, diabetes, cancer, and osteoporosis.

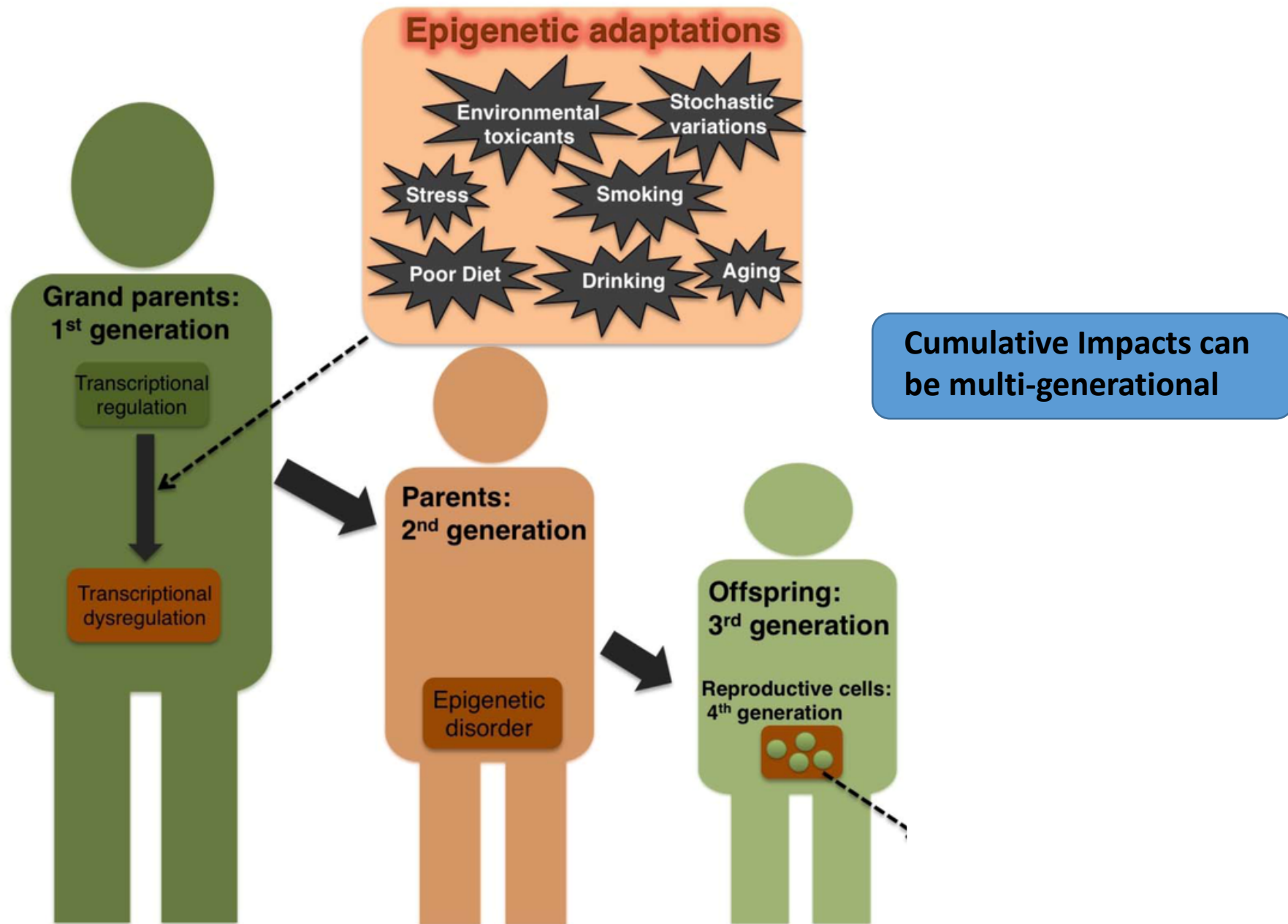
Example: Epigenetics

Changes caused by modification of gene expression rather than alteration of the genes themselves.

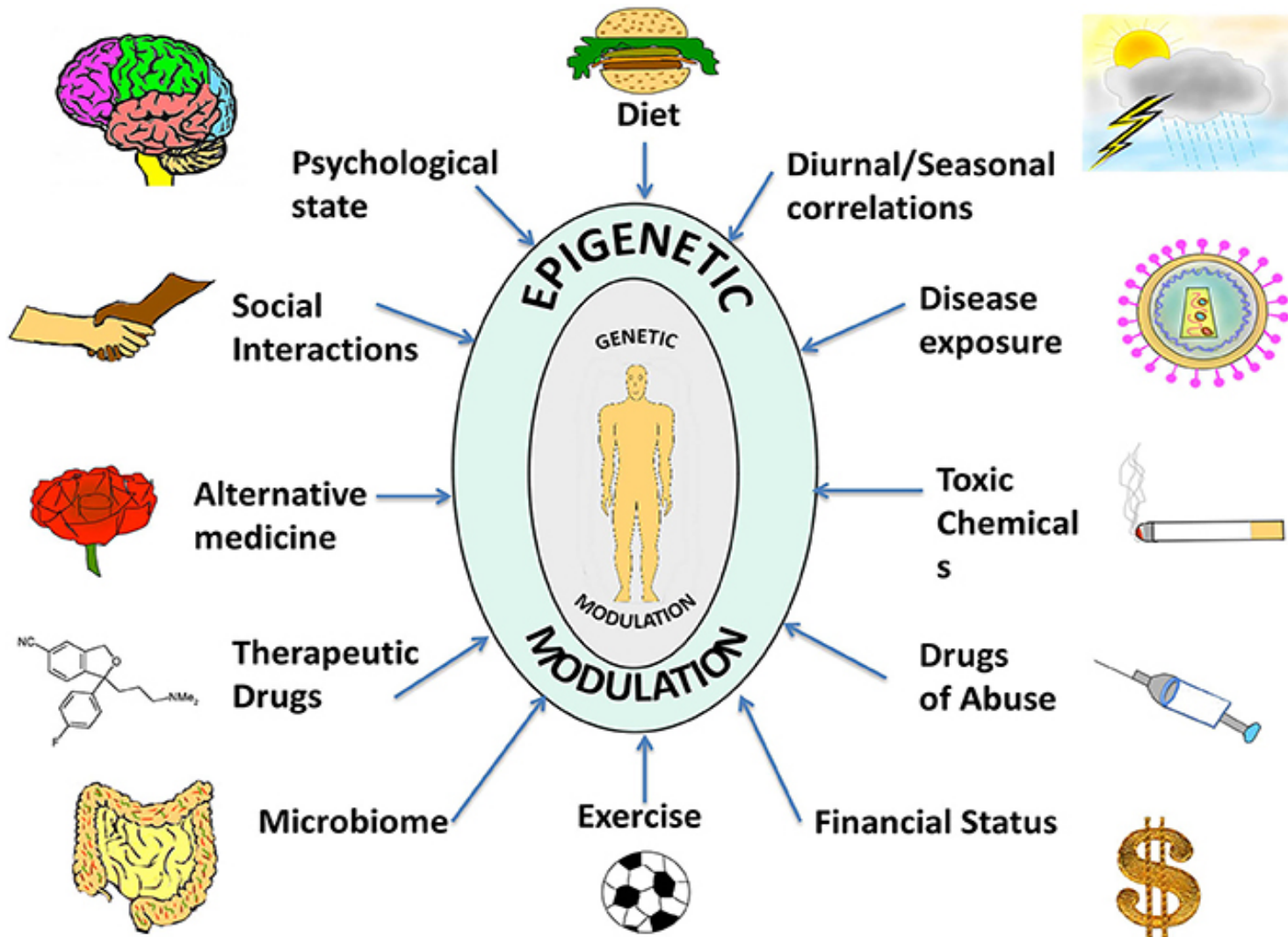


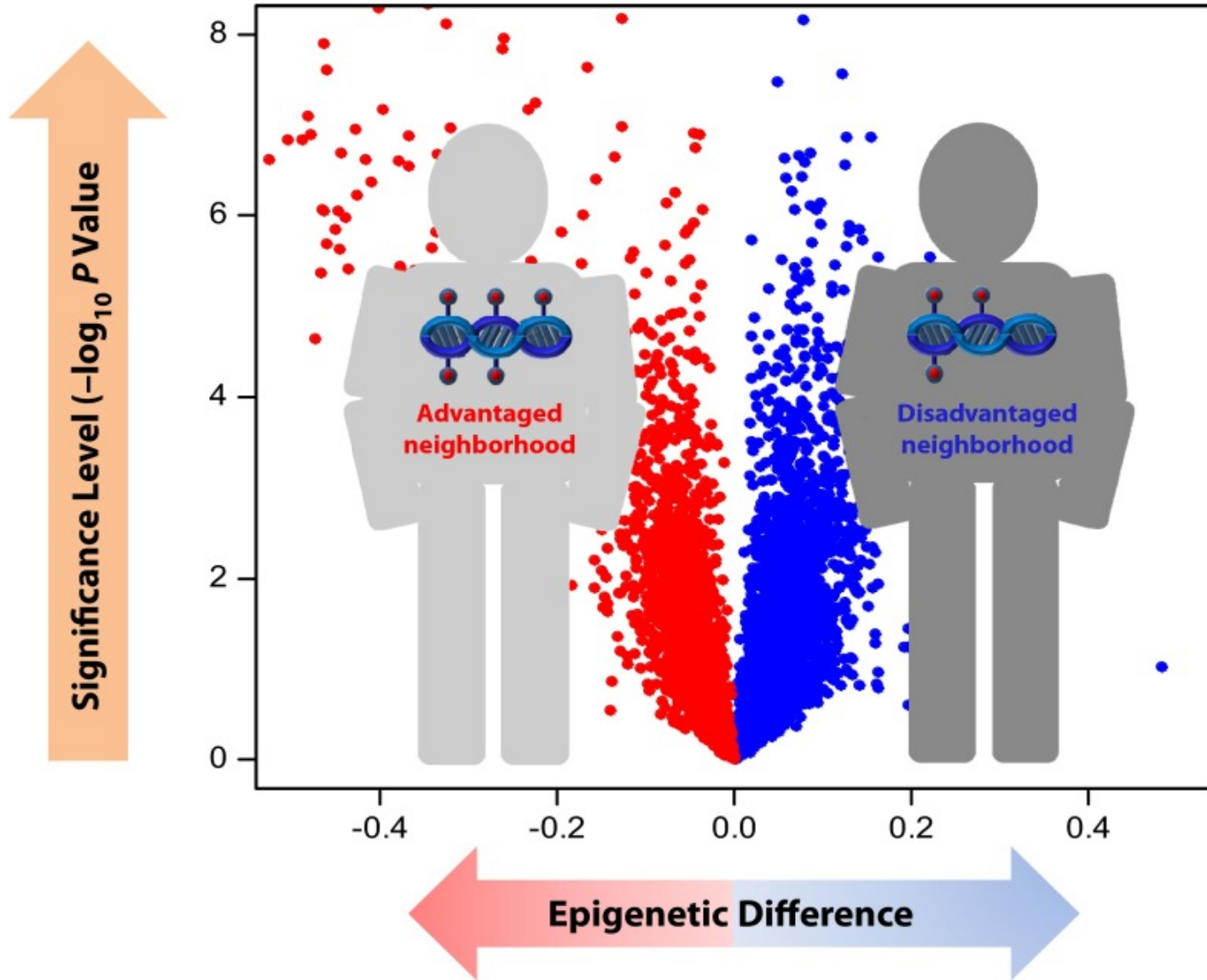
Genetically Identical Mice

Jirtle and Dolinoy.
<https://sites.duke.edu/ciphers/2019/06/06/part-2-what-is-epigenetics-and-what-does-it-mean-for-ciphers/>



Pandian and Sugiyama. Strategies To Modulate Heritable Epigenetic Defects in Cellular Machinery: Lessons from Nature. Pharmaceuticals, 2013.





Olden K, et al. Epigenome: Biosensor of Cumulative Exposure to Chemical and Nonchemical Stressors Related to Environmental Justice. *Am J Public Health*, 2014



Health outcomes have multiple causes
– Environmental, social, biological



Climate mitigation will affect multiple
health-related factors



Quantifying the health benefits is
challenging



Existing approaches to cumulative
impacts all have limitations



Newer approaches are emerging



Need to make decisions now and be
nimble as new tools emerge

Conclusions