Generations at Risk? Environmental Contaminants and Reproductive Health

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Public Health Implications of 1990 Air Toxics Concentrations across the United States

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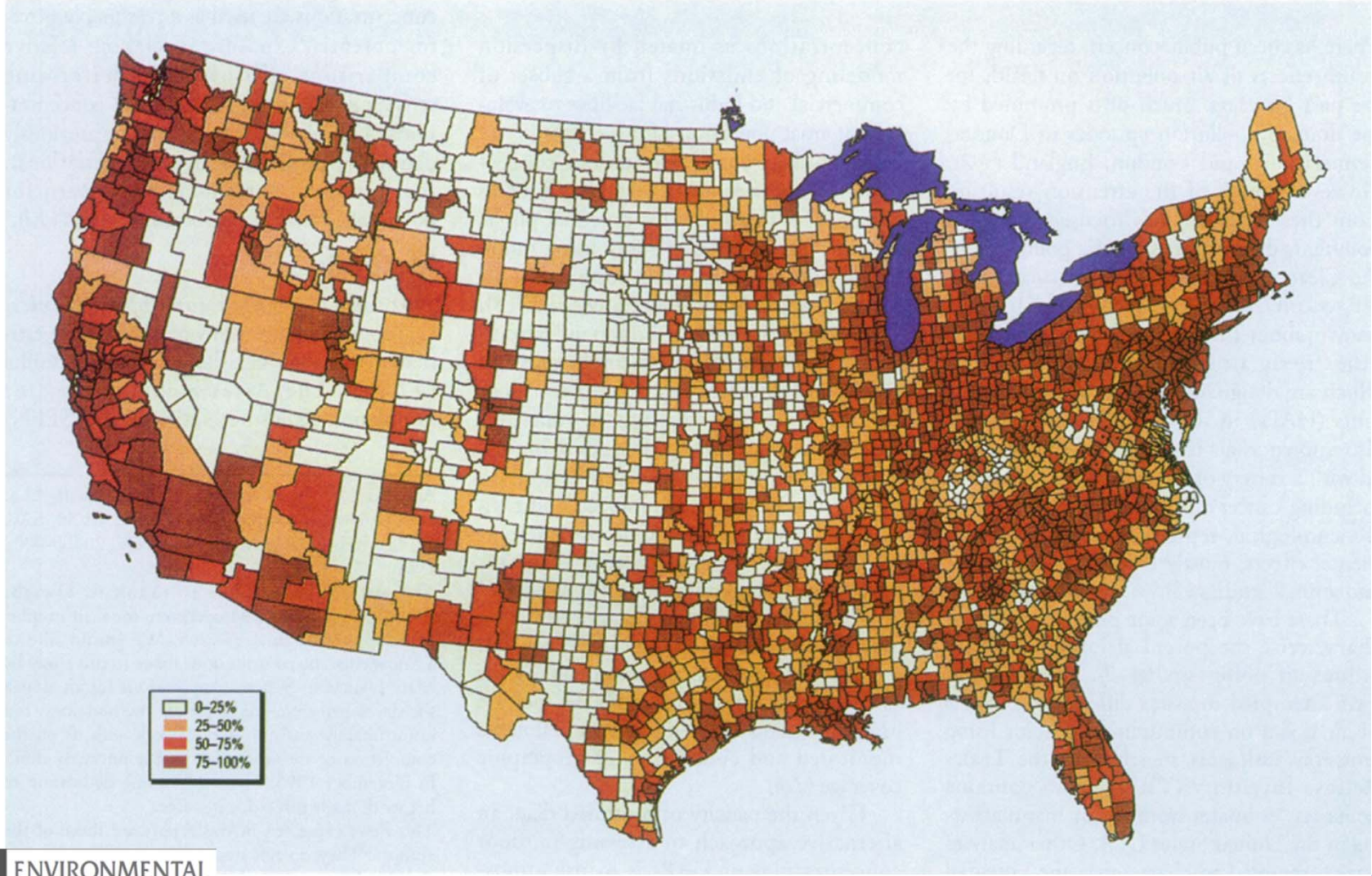
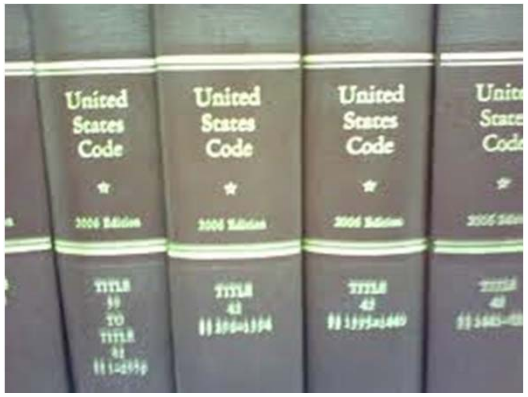
[1]U.S. Environmental Protection Agency, Washington, DC 20460 USA; [2]School of Public Health, University of California, Berkeley, Berkeley, CA 94720 USA; [3]ICF Kaiser, Systems Applications International Division, San Rafael, CA 94903 USA



1990 US Clean Air Act Amendments



S.1630

To amend the Clean Air Act to provide for attainment and maintenance of health (Enrolled Bill [Final as Passed Both House and Senate] - ENR)

--S.1630--

S.1630

One Hundred First Congress of the United States of America

AT THE SECOND SESSION

Begun and held at the City of Washington on Tuesday, the twenty-third day of January,

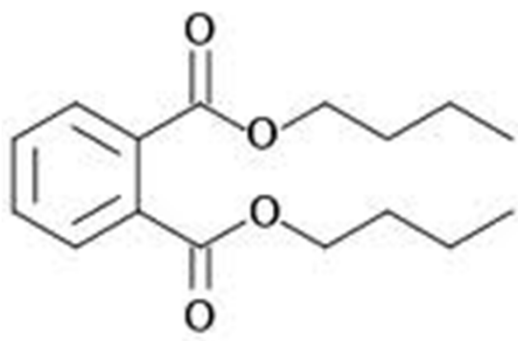
one thousand nine hundred and ninety

An Act

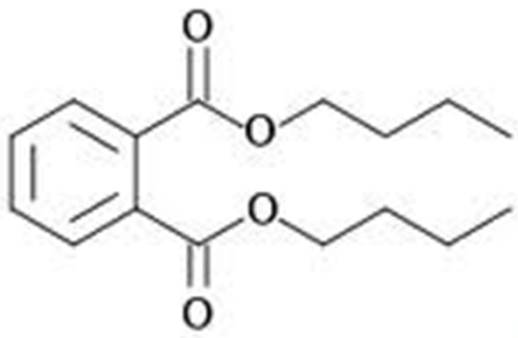
To amend the Clean Air Act to provide for attainment and maintenance of health

protective national ambient air quality standards, and for other purposes.

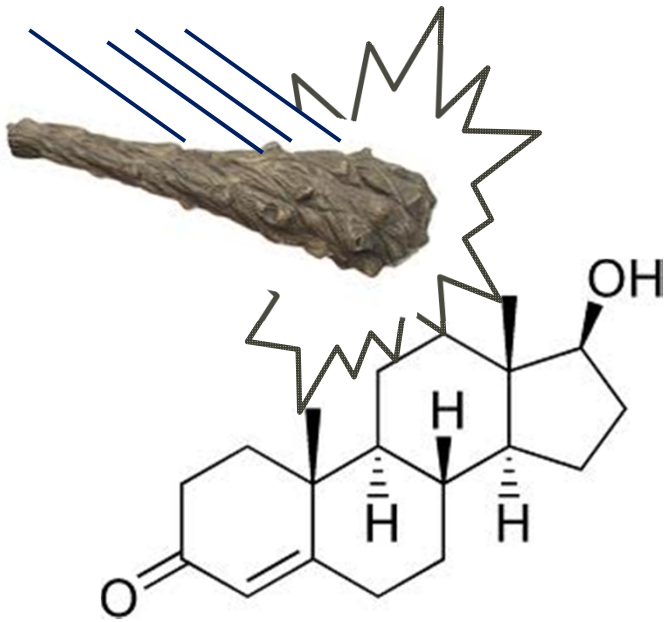
Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,



Dibutyl Phthalate

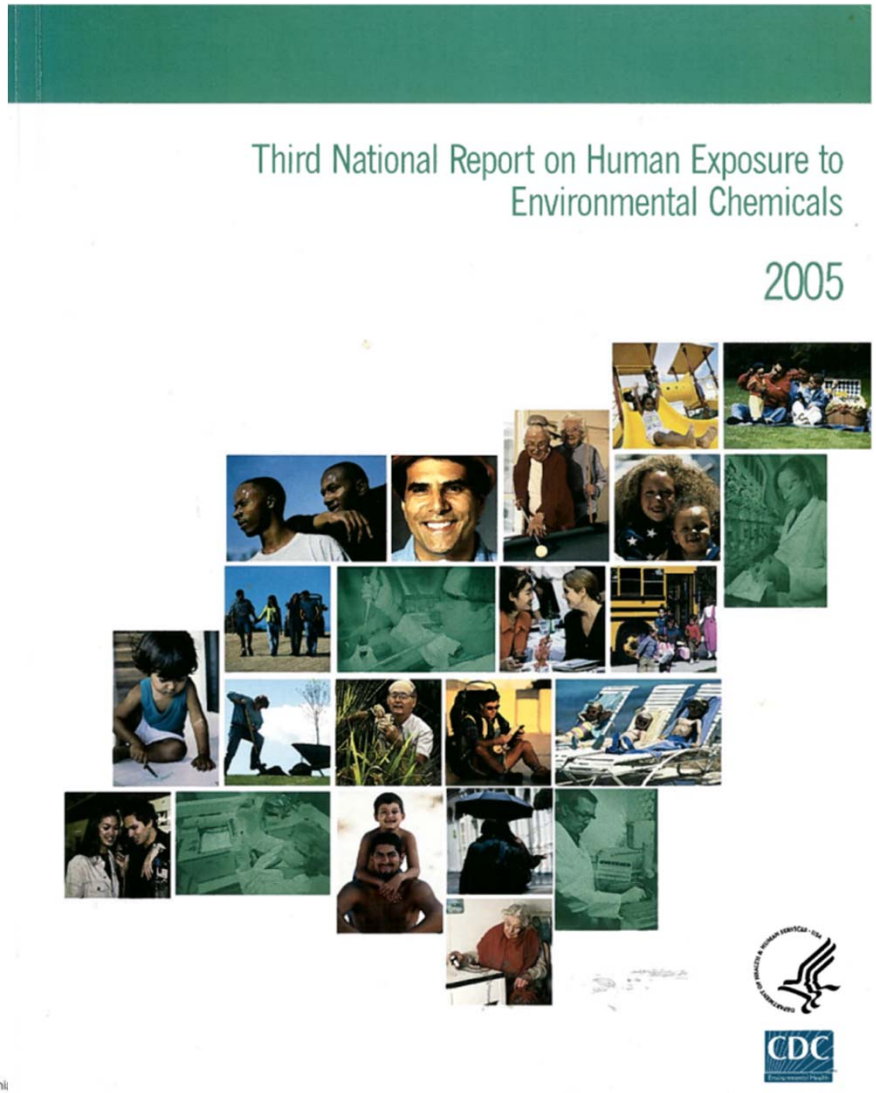


Dibutyl Phthalate



Testosterone

Endocrine Disrupting Compound



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And dibutyl pthalate is in all of us Virtually all the US population has detectable dibutyl phthalate

And it's higher in women

Why?

Blount et al. EHP 2000

Not Too Pretty

Phthalates, Beauty Products & the FDA

Jane Houlihan
Charlotte Brody
Bryony Schwan

July 8, 2002

Environmental Working Group™

Coming Clean

Health Care Without Harm

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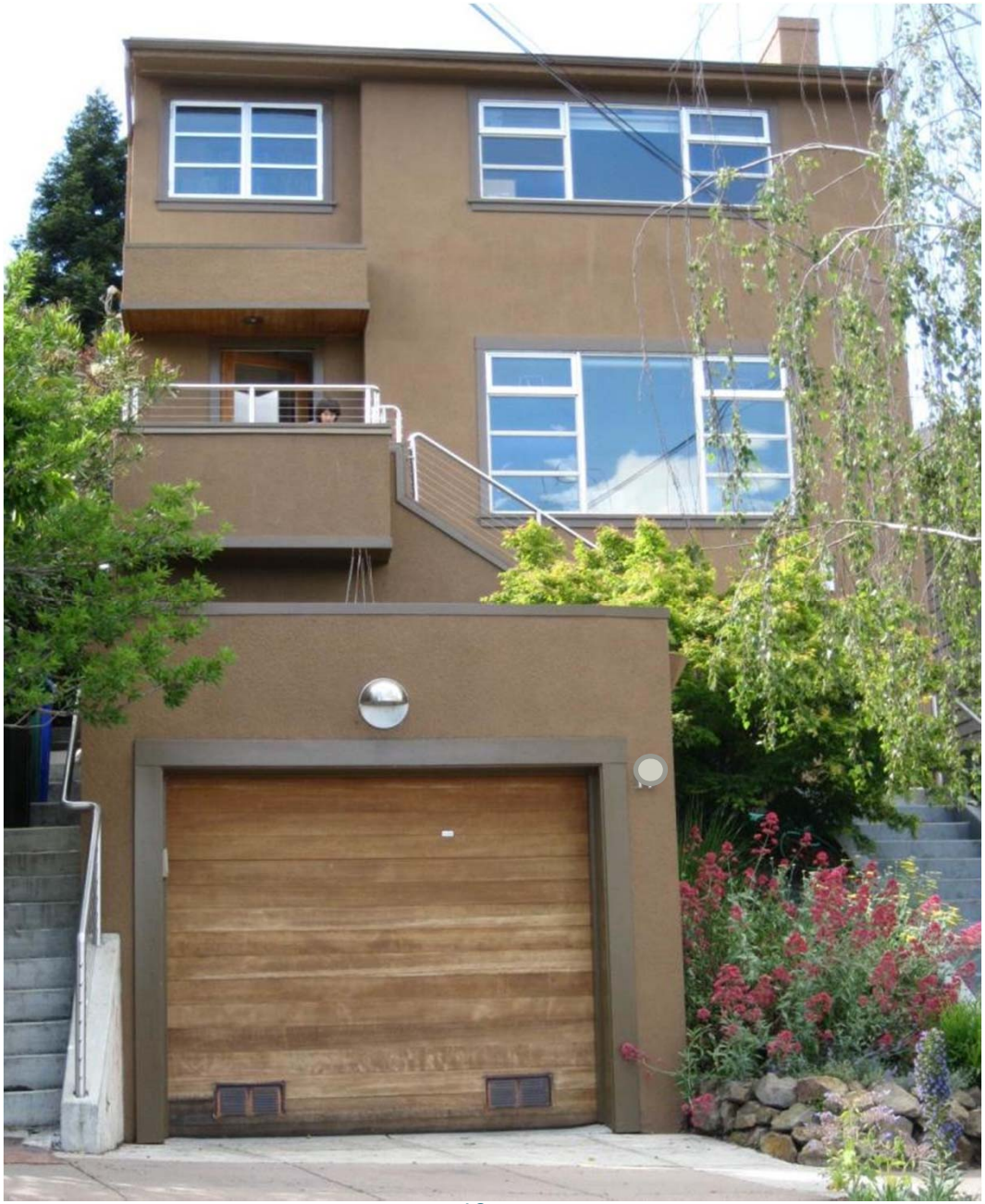
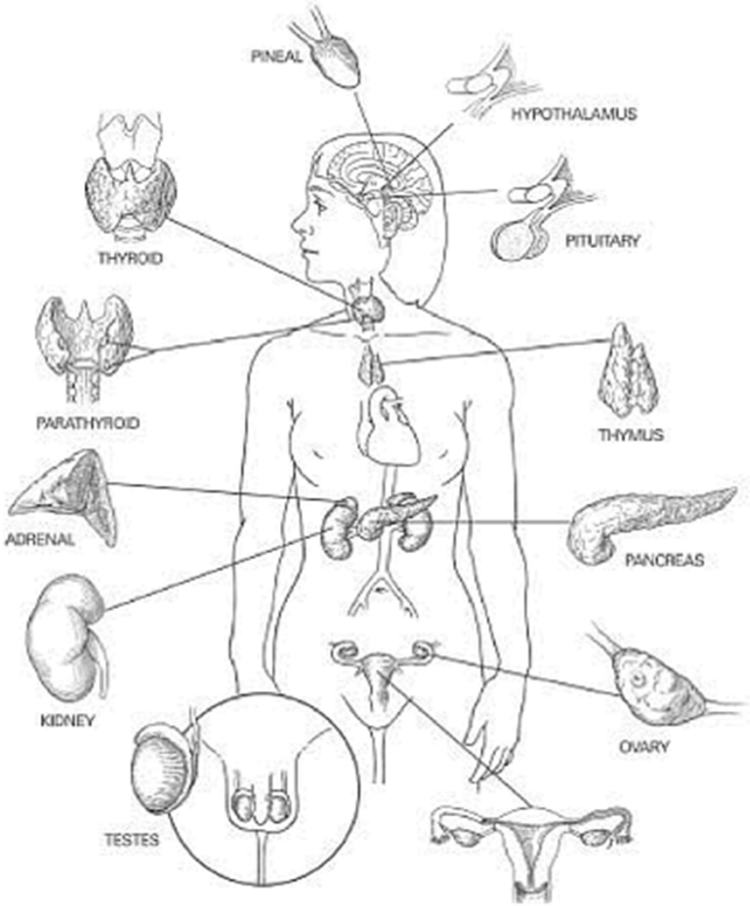
Suave

?

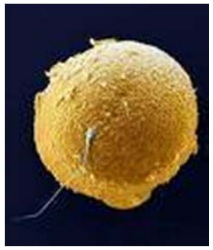


Two Ways to Make Hormones



Timing Matters

Development and Periods of Susceptibility



Fertilized Egg → Embryo Fetus → Infant → Child Teenager

No increased risk of breast cancer

5 fold increased risk of breast cancer

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* From Cohn et al. EHP 2007

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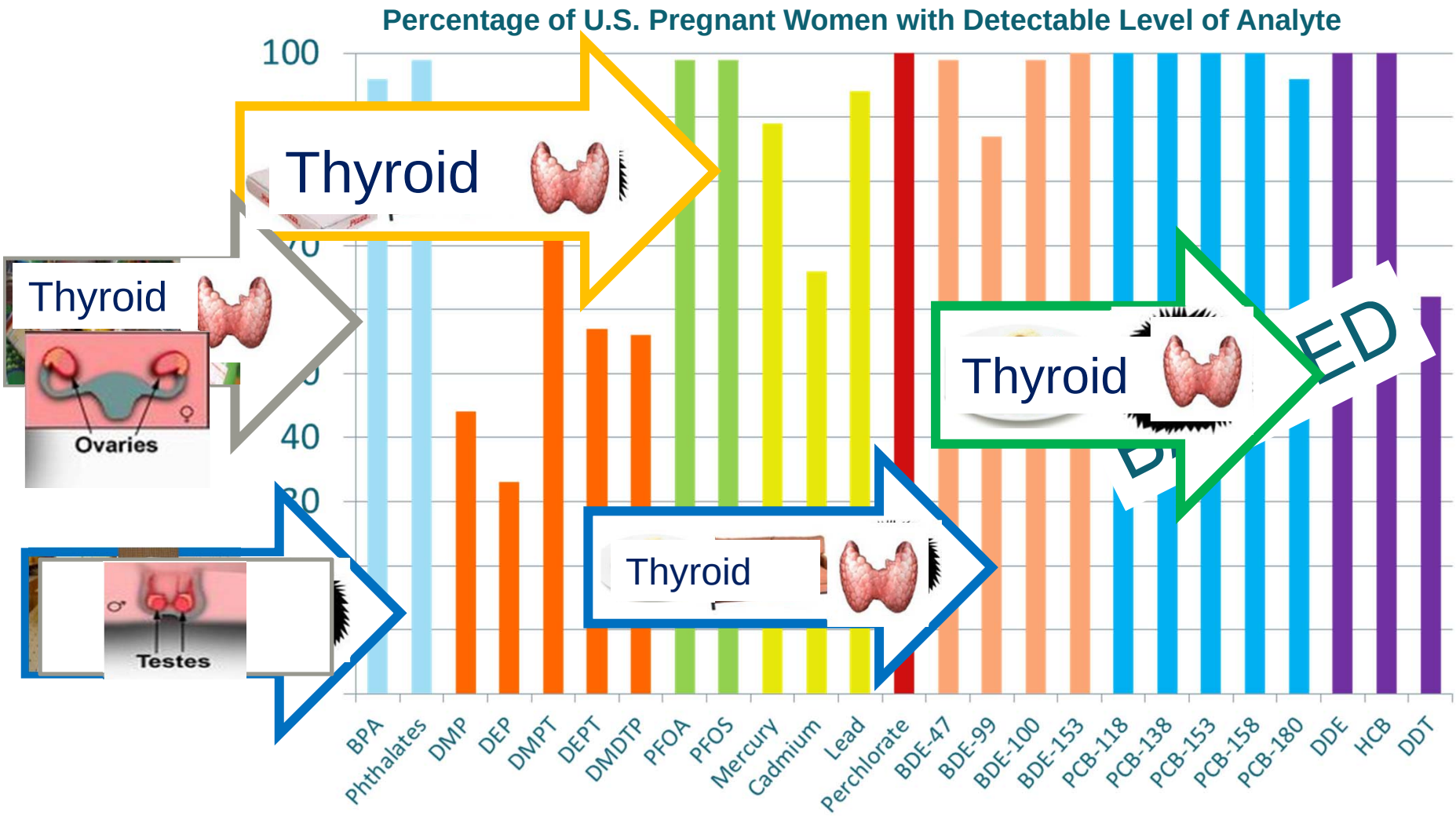
Contemporary Prenatal Exposure to Endocrine Disrupting Chemicals



Woodruff, Zota, Schwartz EHP 2011

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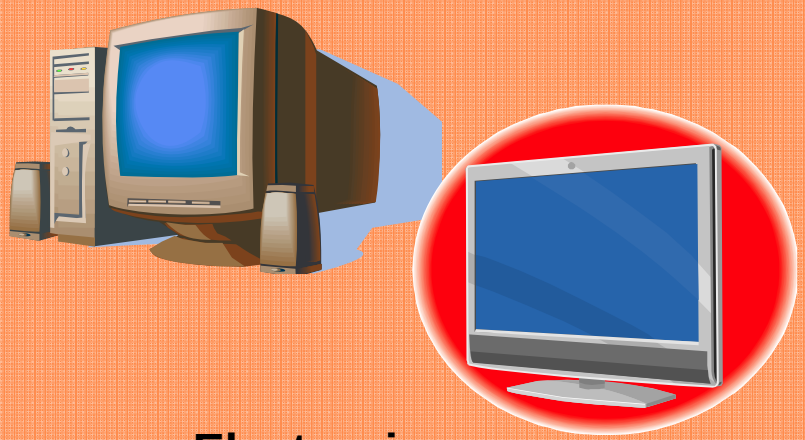
PBDEs *are ubiquitous in our environment*

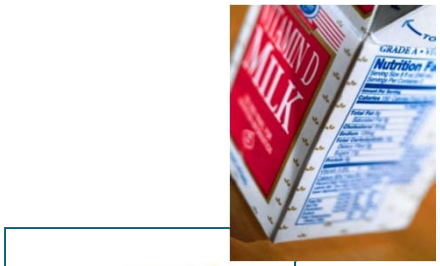
© Leona Kanaskie

Upholstered Furniture



Electronics

Domestic and Wild Animals



Food Supply

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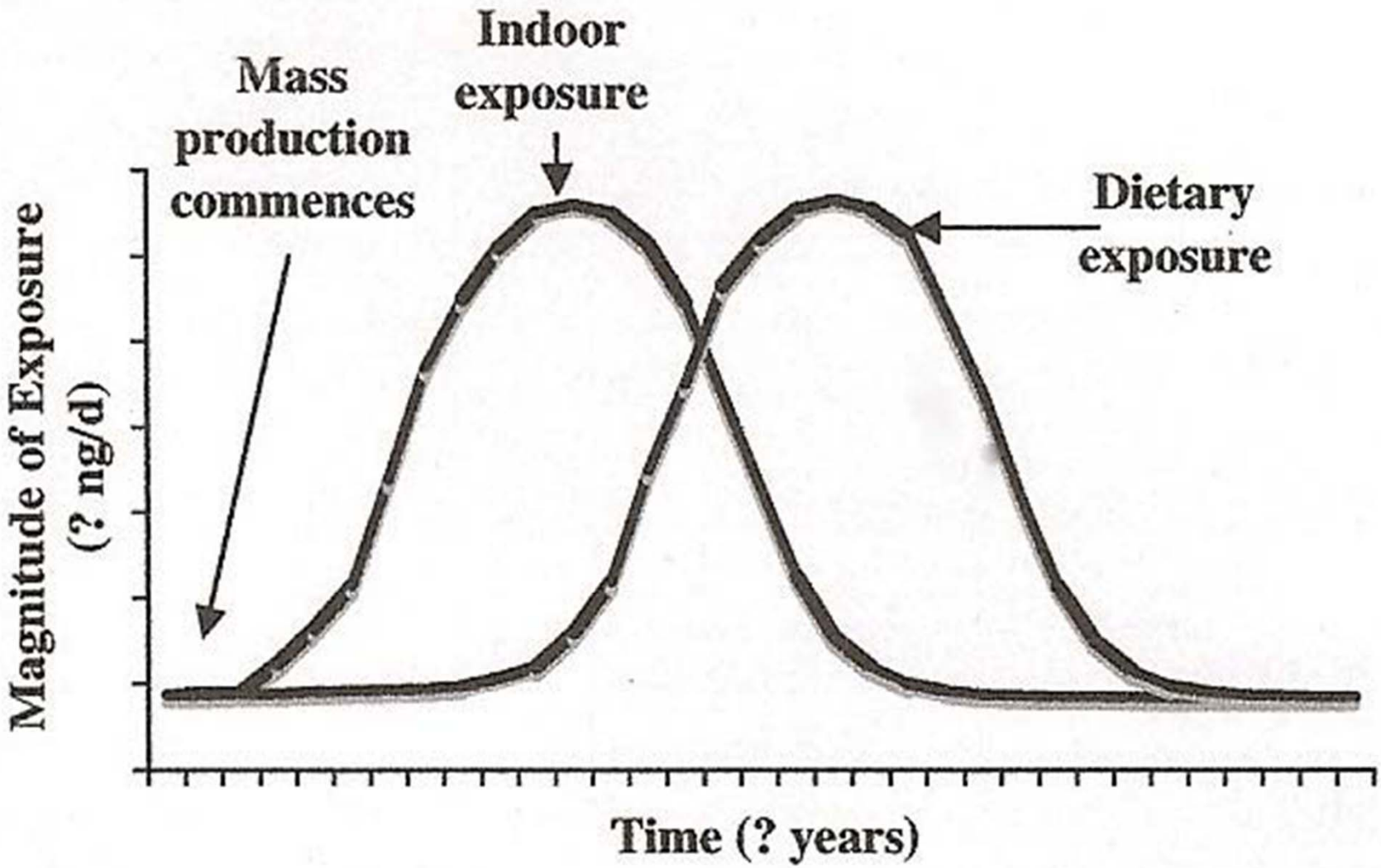


Harrad and Diamond, 2006 Atmospheric Environment

Highly Exposed Subpopulations

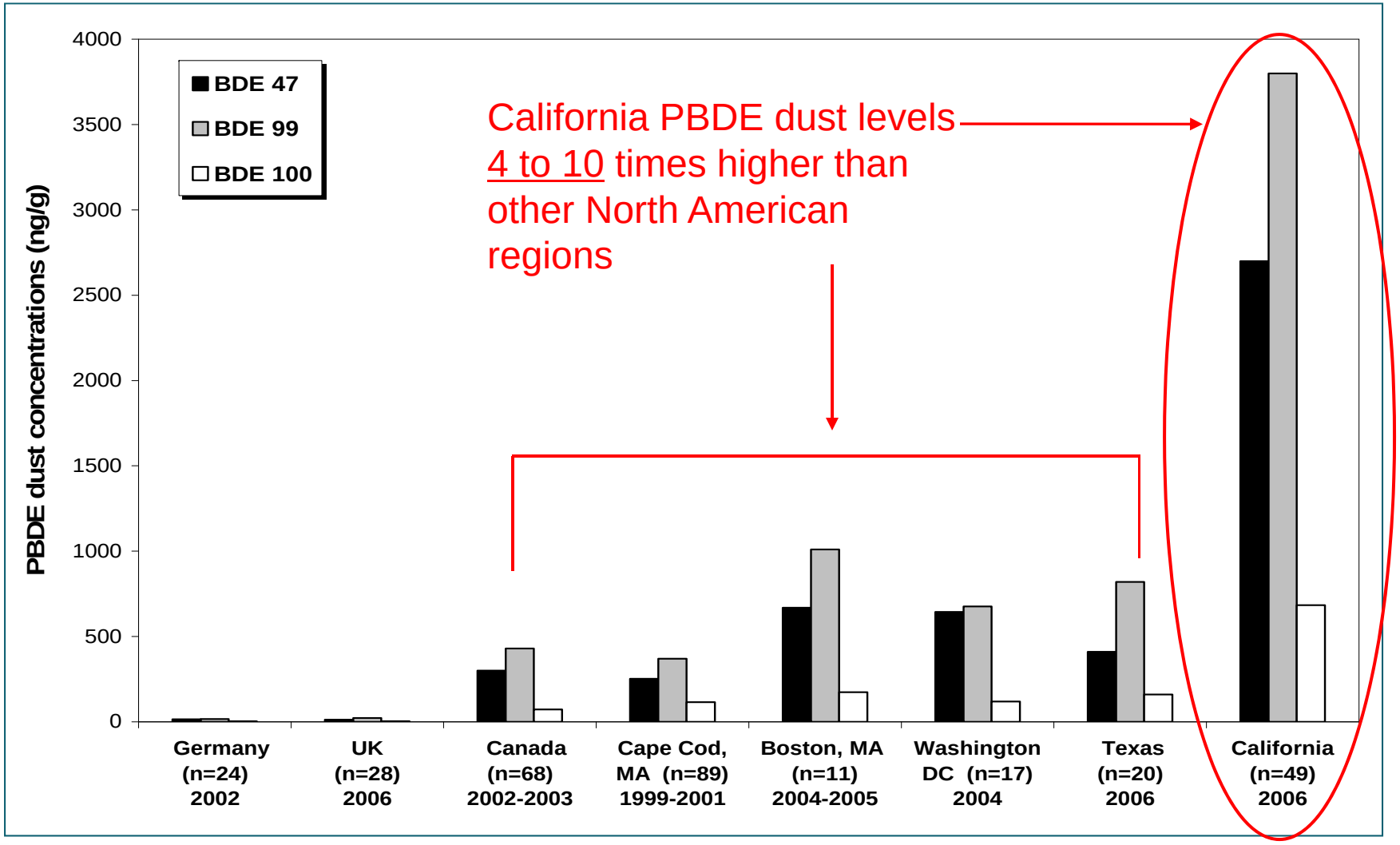
- PBDE exposures are not uniform across the US population
- Subpopulations with potentially higher exposures:
  - Californians
  - Socially vulnerable/ Low SES

Chicago tribune

California Technical Bulletin 117 (TB 117)

- 1975 standard
- Performance-based standard
- Foam in furniture must withstand open flame for 12 seconds
- Unique standard; no other state has a parallel standard

California residents: highly exposed to penta-BDEs



Zota A, Rudel RA, Morello-Frosch RA, Brody JB. 2008. Environ Science &Technology

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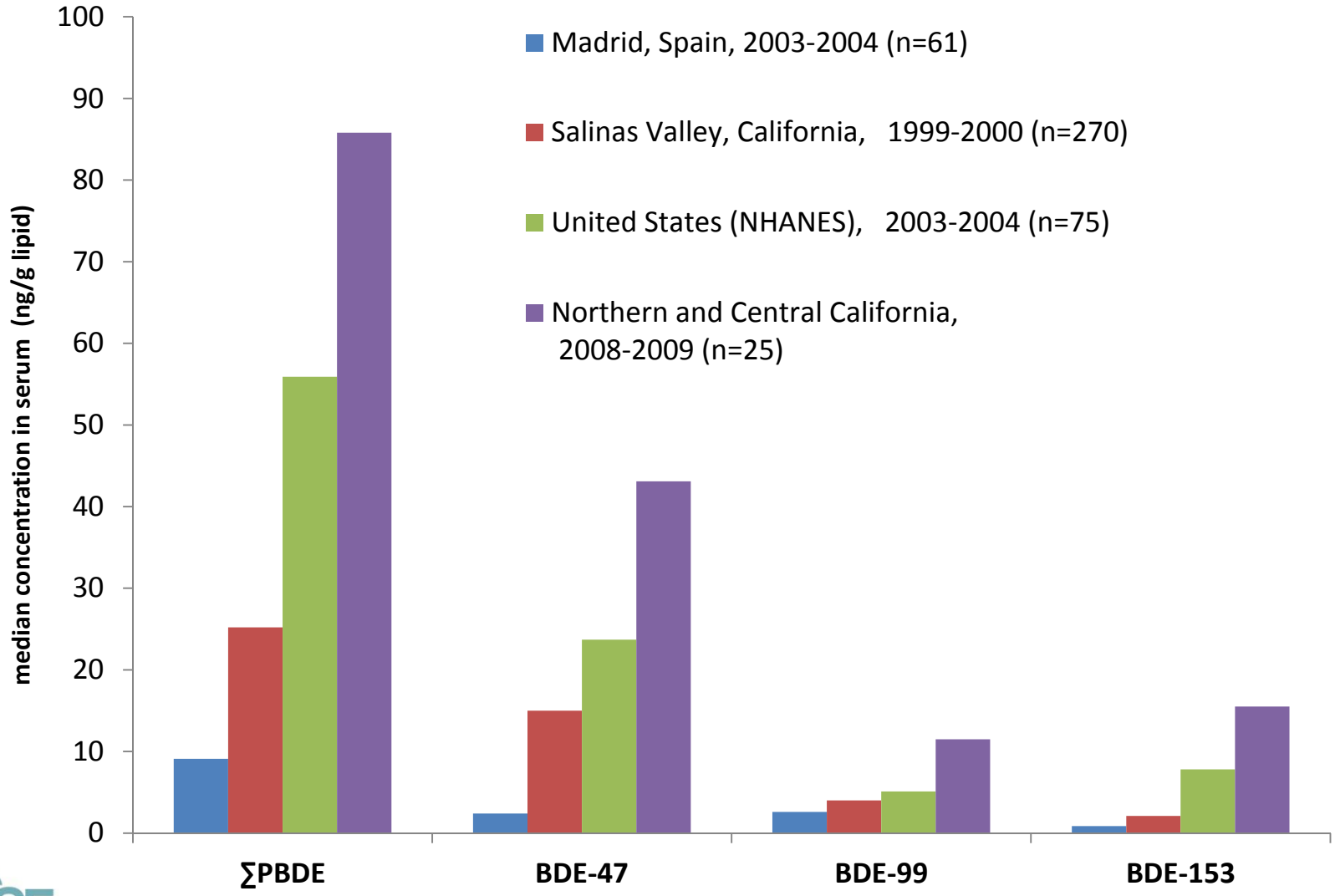
Penta-PBDEs in California pregnant women are highest reported to date among pregnant women worldwide



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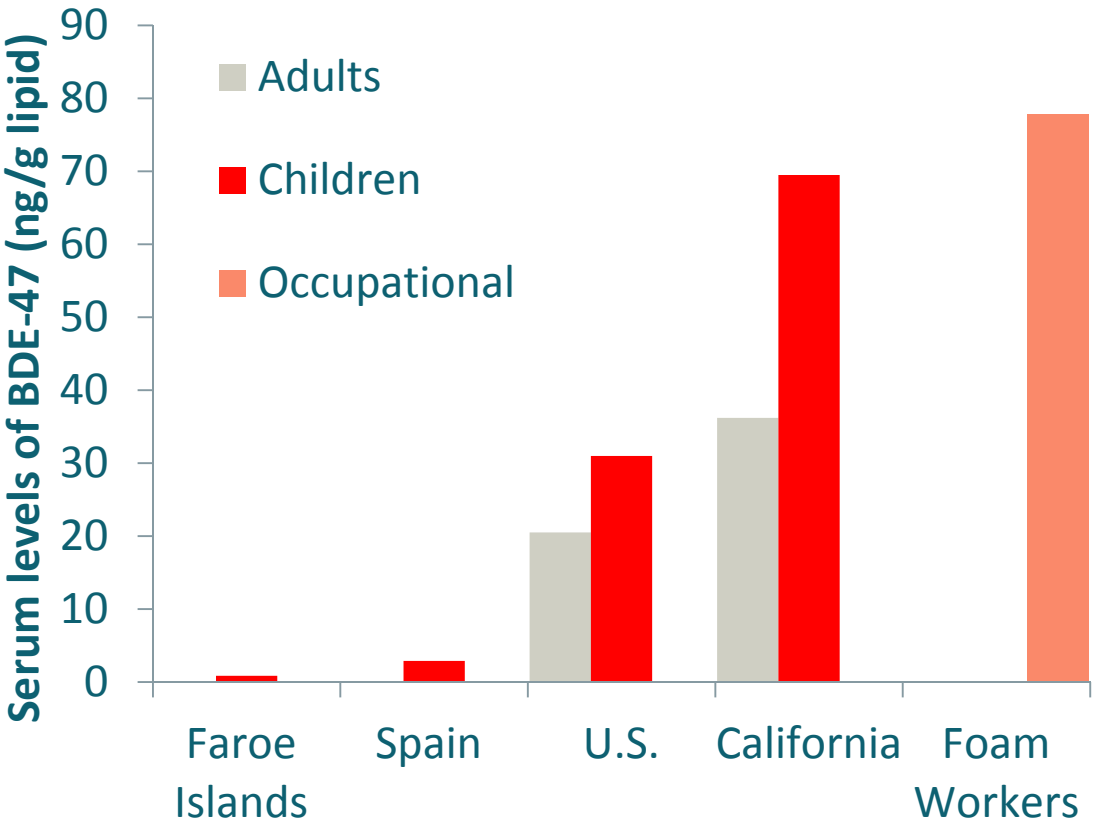
Zota AR, Park JS, Wang Y, Petreas M, Zoeller RT, Woodruff TJ. 2011. Polybrominated Diphenyl Ethers, Hydroxylated Polybrominated Diphenyl Ethers, and Measures of Thyroid Function in Second Trimester Pregnant Women in California. Environ Sci Technol 45(18): 7896-7905.

Vulnerable Populations: Children



PBDE levels in California children aged 2-5 years are similar to levels in occupationally exposed adults

Adapted from Rose et al., Environmental Science & Technology, 2010

Low Doses Matters

Flame Retardant	Median Cord Blood in NYC (ng/g lipid)	Median Level US Pregnant Women (ng/g lipid)
PBDE-47	11	24
PBDE-99	3	5
PBDE-100	1	7

Herbstman 2010 EHP

Low Doses Matters

Children with higher concentrations of flame retardants (BDEs 47, 99, or 100) "scored lower on tests of mental and physical development" (including IQ)

Herbstman 2010 EHP

Cumulative Exposures Matter

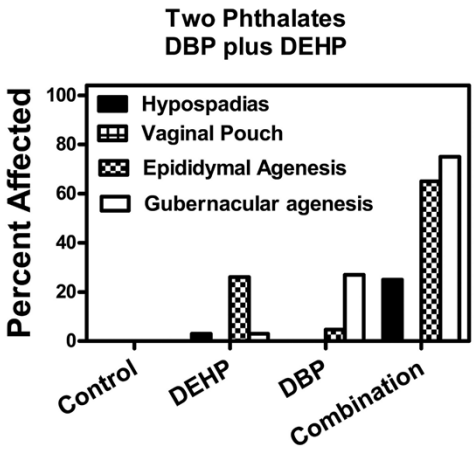
Toxicologic Pathology, 37: 100-113, 2009
Copyright © 2009 by Society of Toxicologic Pathology
ISSN: 0192-6233 print / 1533-1601 online
DOI: 10.1177/0192623308329478

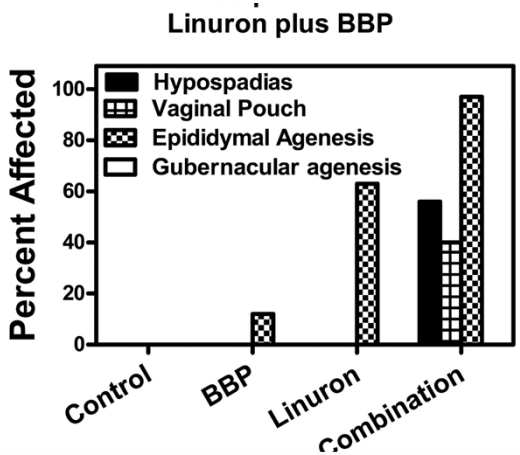
Cumulative Effects of In Utero Administration of Mixtures of "Antiandrogens" on Male Rat Reproductive Development

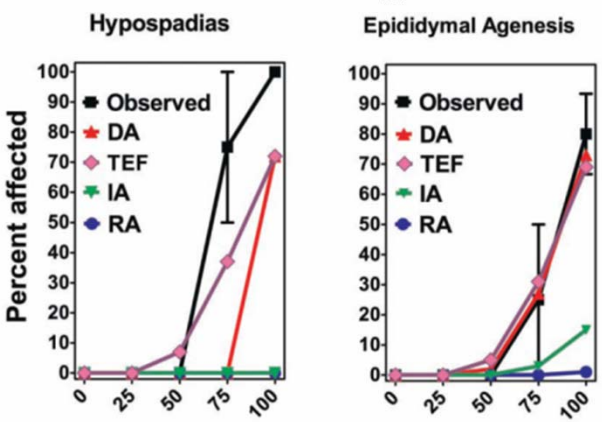
CYNTHIA V. RIDER,[1,2] VICKIE S. WILSON,[1] KEMBRA L. HOWDESHELL,[1] ANDREW K. HOTCHKISS,[1,2,3]
JOHNATHAN R. FURR,[1] CHRISTY R. LAMBRIGHT,[1] AND L. EARL GRAY JR[1]

Exposure to multiple chemicals can display cumulative dose-additive effects when chemicals act by different mechanisms of toxicity

Our results indicate that compounds that act by disparate mechanisms of toxicity display cumulative dose-additive effects when present in combination.







7 Antiandrogens together

Rider C V et al. Toxicol Pathol 2009;37:100-113

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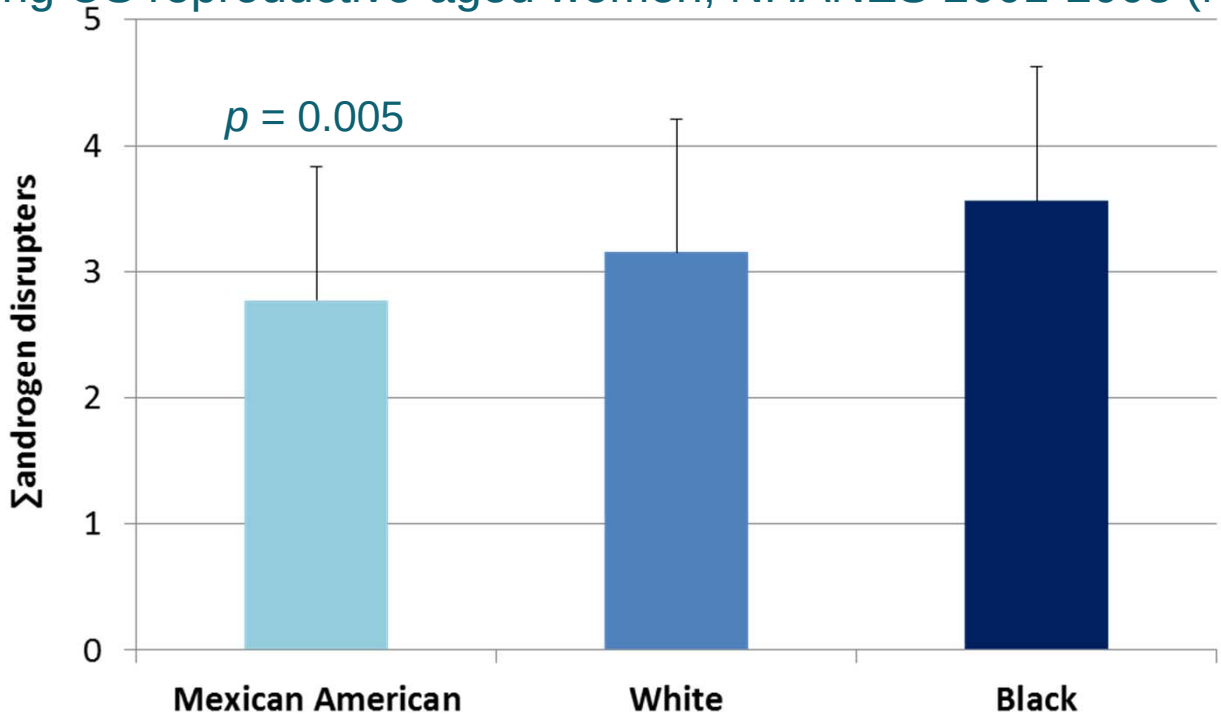
Black women have higher cumulative exposures to androgen-disrupting phthalates

Potency-weighted score of androgen-disrupting urinary phthalates among US reproductive-aged women, NHANES 2001-2008 (N=1495)



Adjusted for urinary creatinine, age, BMI, education, and income

Zota and Woodruff, *manscript in prep*

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Socioeconomic disparities in the indoor environment

Fine particulate matter (PM2.5)

Nitrogen dioxide

Secondhand tobacco smoke

1,4 dichlorobenzene

BTEX

Chloroform

Lead

Pesticides

PBDE flame retardants

Cockroach allergens

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Adamkiewicz G, Zota AR, et al. 2011. Moving Environmental Justice Indoors: Understanding Structural Influences on Residential Exposure Patterns in Low-Income Communities. Am J Public Health.

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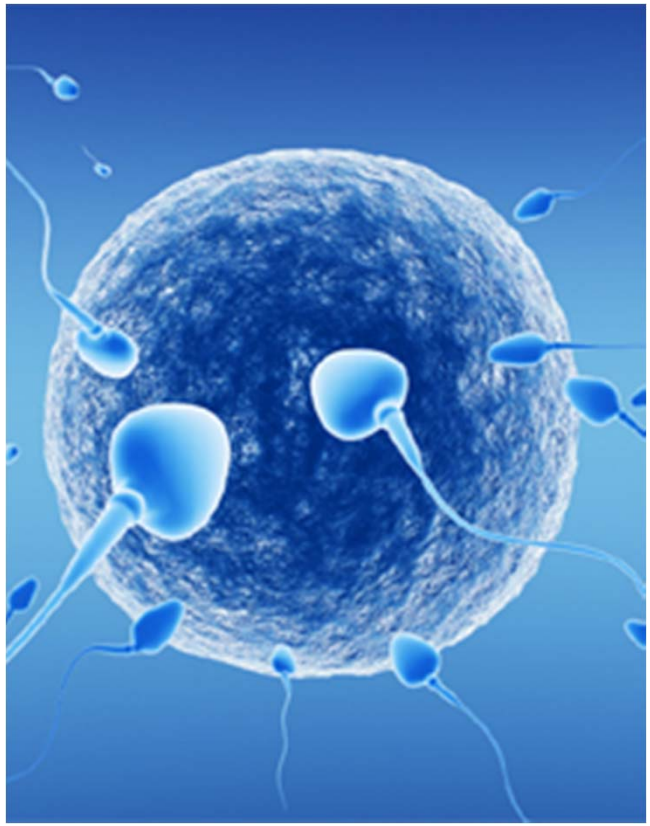
Our Reproductive Capacity - Under Strain?

Scientific indicators of declining reproductive function and increasing rates of reproductive illnesses since the mid-20th century



↑ Difficulty conceiving & maintaining pregnancy

↑ Rates testicular cancer

↓ Sperm counts

Woodruff TJ, Carlson A, Schwartz JM, et al. Proceedings of the Summit on Environmental Challenges to Reproductive Health and Fertility: Executive summary. Fertil Steril 2008;89:e1-e20; Schettler T, Solomon G, Valenti M, et al. Generations at Risk. Reproductive Health and the Environment. Cambridge, MA: MIT Press 1999; Crain DA, Janssen SJ, Edwards TM, et al. Female reproductive disorders: the roles of endocrine-disrupting compounds and developmental timing. Fertil Steril 2008;90:911-40; Colborn T, Dumanoski D, Myers JP. Our Stolen Future: Penguin Books USA, Inc. 1996.

Prevalence of chronic conditions among children and youth increased from 1988 to 2006

JAMA®

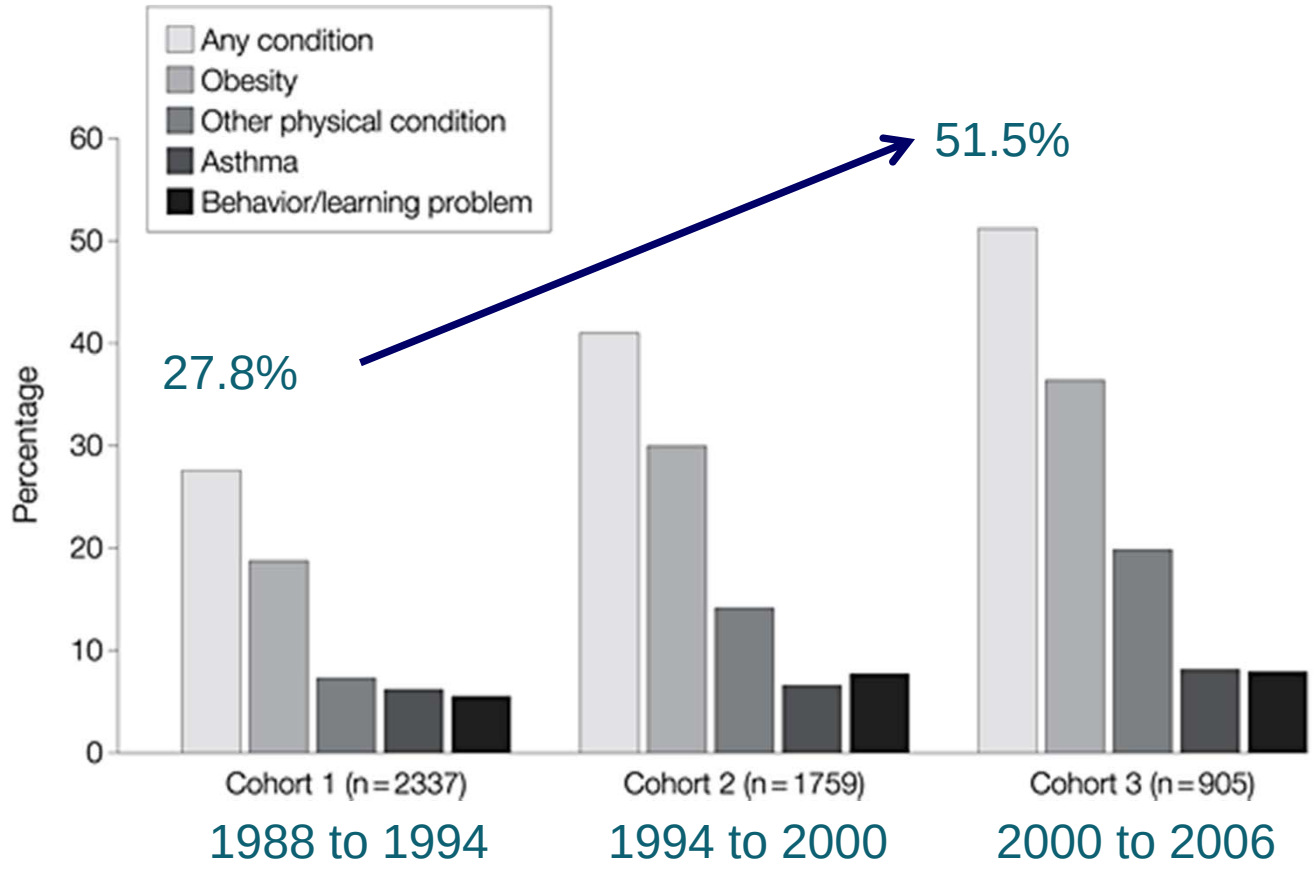
Online article and related content current as of February 17, 2010.

Dynamics of Obesity and Chronic Health Conditions Among Children and Youth

Jeanne Van Cleave; Steven L. Gortmaker; James M. Perrin

JAMA. 2010;303(7):623-630 (doi:10.1001/jama.2010.104)

http://jama.ama-assn.org/cgi/content/full/303/7/623



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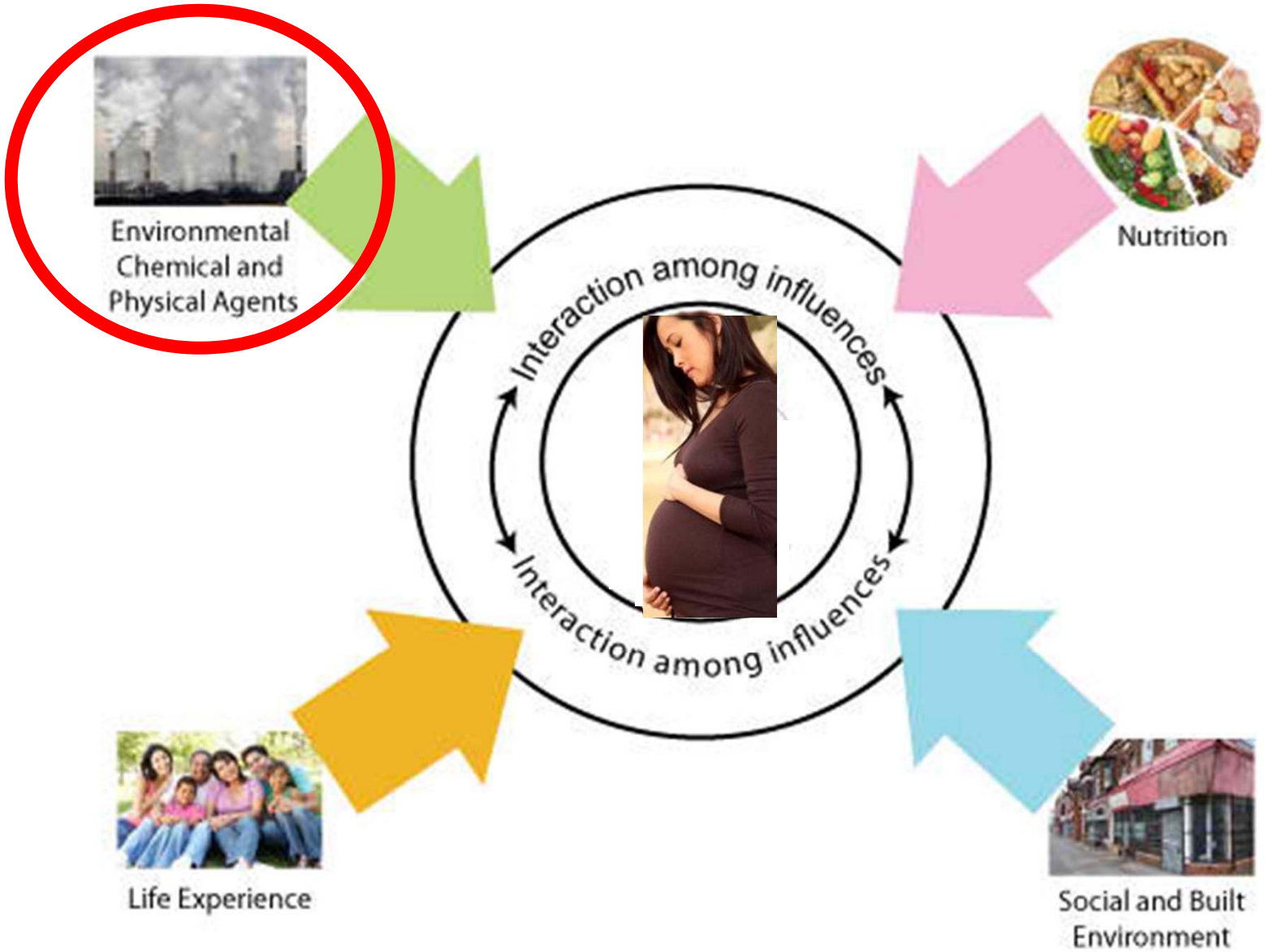
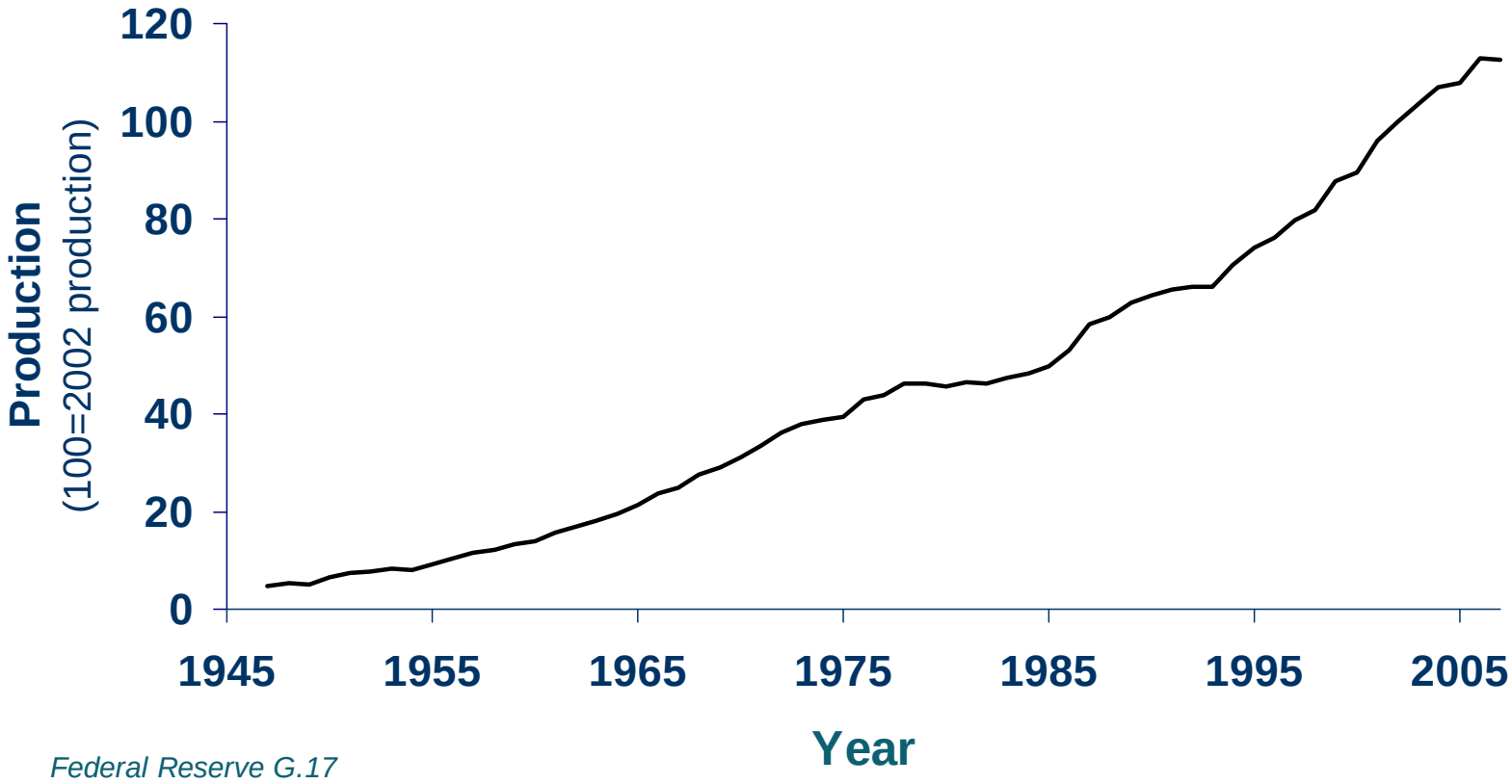

Environmental Chemical and Physical Agents
Nutrition
Interaction among influences
Interaction among influences
Life Experience
Social and Built Environment

U.S. Chemical Production

Chemical production has increased **20-fold** between 1947 and 2007



Federal Reserve G.17

43

Chemicals found in Virtually Every Pregnant Woman in the US

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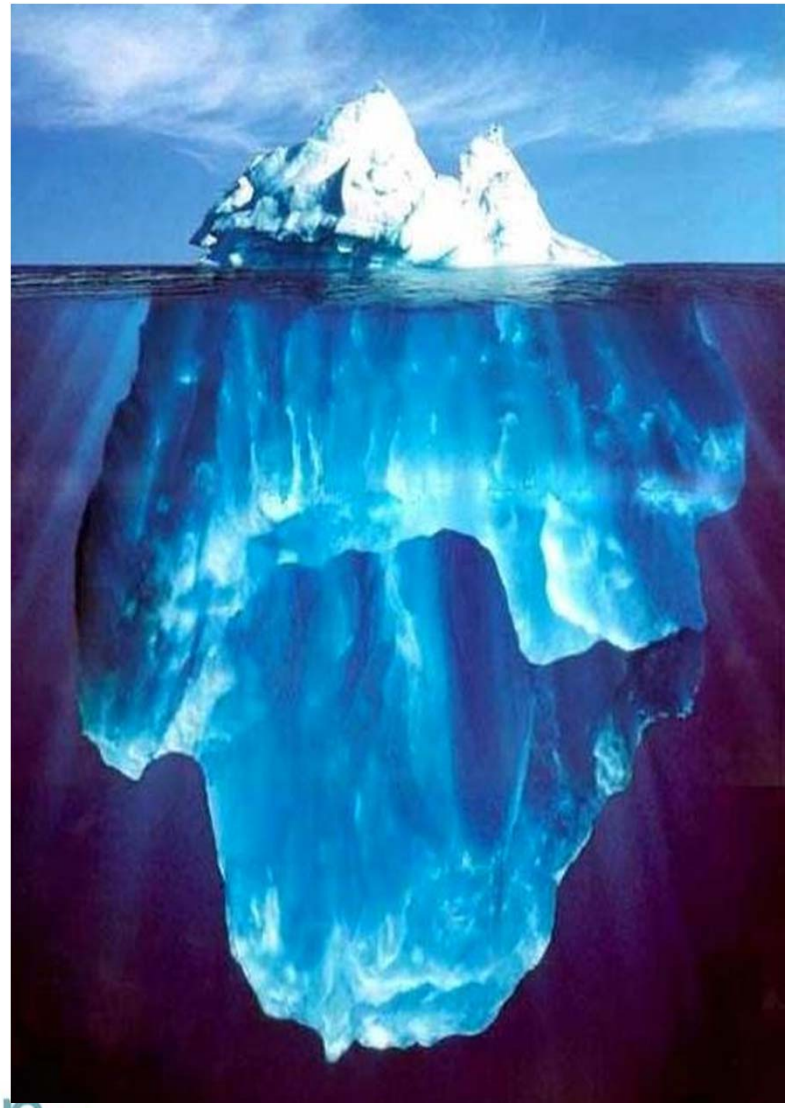
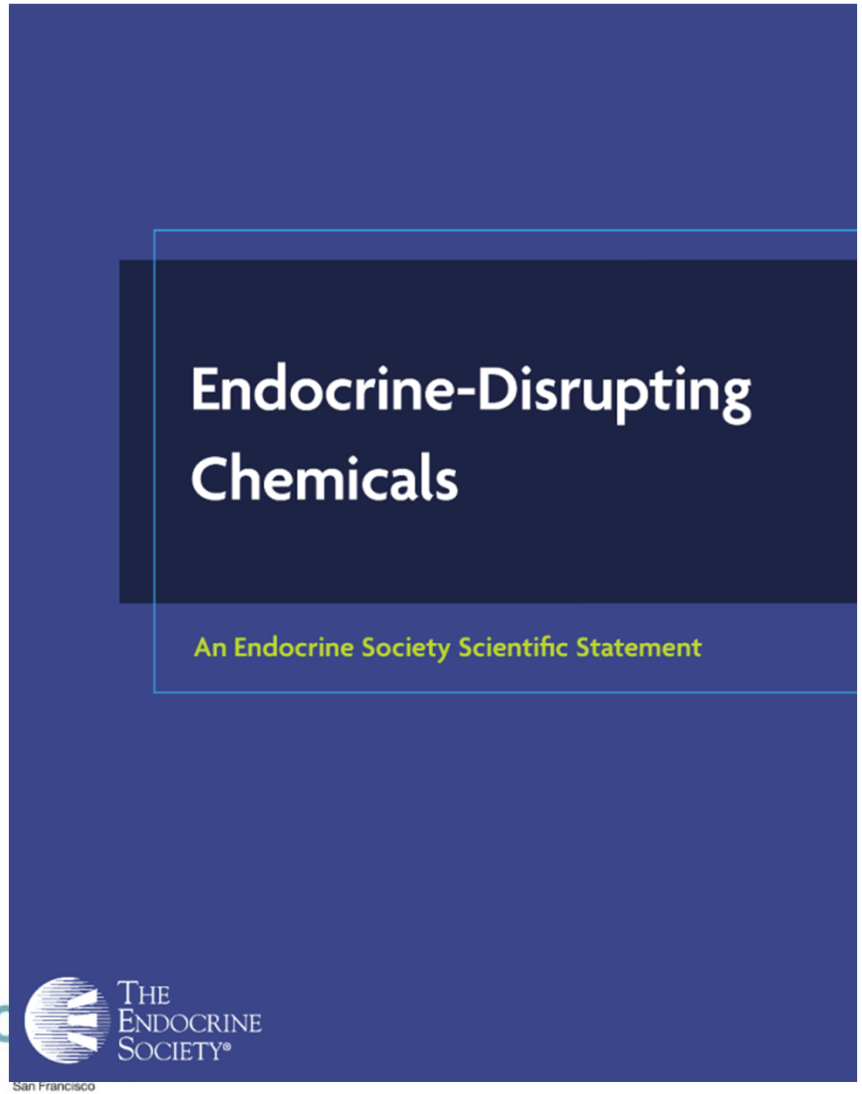
By 2006 …



Don't worry,
I'm 11% tested.
Don't trust these odds?
Then you should know: only 11% of the 10,500 chemicals *in your cosmetics* have been screened for safety.
Most chemicals used in your cosmetics have never been evaluated for safety by the FDA or even by the industry-funded Cosmetics Industry Review panel. And some of the chemicals that have been tested—and used by companies such as Avon, L'Oréal (Maybelline) and Procter & Gamble (Cover Girl)—are suspected to cause cancer or birth defects.
We put these chemicals on our bodies every day when we use shampoo, nail polish and makeup.
We all expect and deserve safe and healthy beauty products. Help us give the cosmetics industry a makeover that keeps toxic chemicals out of our bodies!
Tell Avon, L'Oréal, and Procter & Gamble to join the nearly 200 cosmetics companies who have signed the Compact for Safe Cosmetics, a pledge to review their ingredients and implement a plan to ensure there are no dangerous and untested chemicals in their products.
And tell the FDA that chemicals should not be allowed in cosmetics products without first being assessed for health and safety.
Visit www.safecosmetics.org to learn more and take action.
Paid for by the Campaign for Safe Cosmetics
www.safecosmetics.org

Strength of the Evidence



Evidence for adverse reproductive outcomes (infertility, cancers, malformations) from exposure to endocrine disrupting chemicals **is strong**, and there is **mounting evidence** for effects on … thyroid, neuroendocrine, obesity and metabolism, and insulin and glucose homeostasis.

Diamanti-Kandarakis E et al. ***2009*** *Endocrine-Disrupting Chemicals: An Endocrine Society Scientific Statement. Endo Rev 30(4):293-342*

White House Task Force on Childhood Obesity Report to the President May 2010

"In addition to fetal "over-nutrition" or "under-nutrition," it is possible that **developmental exposure** to endocrine disrupting chemicals (EDCs) or other chemicals plays a role in the development of diabetes and childhood obesity" .(pg.17)

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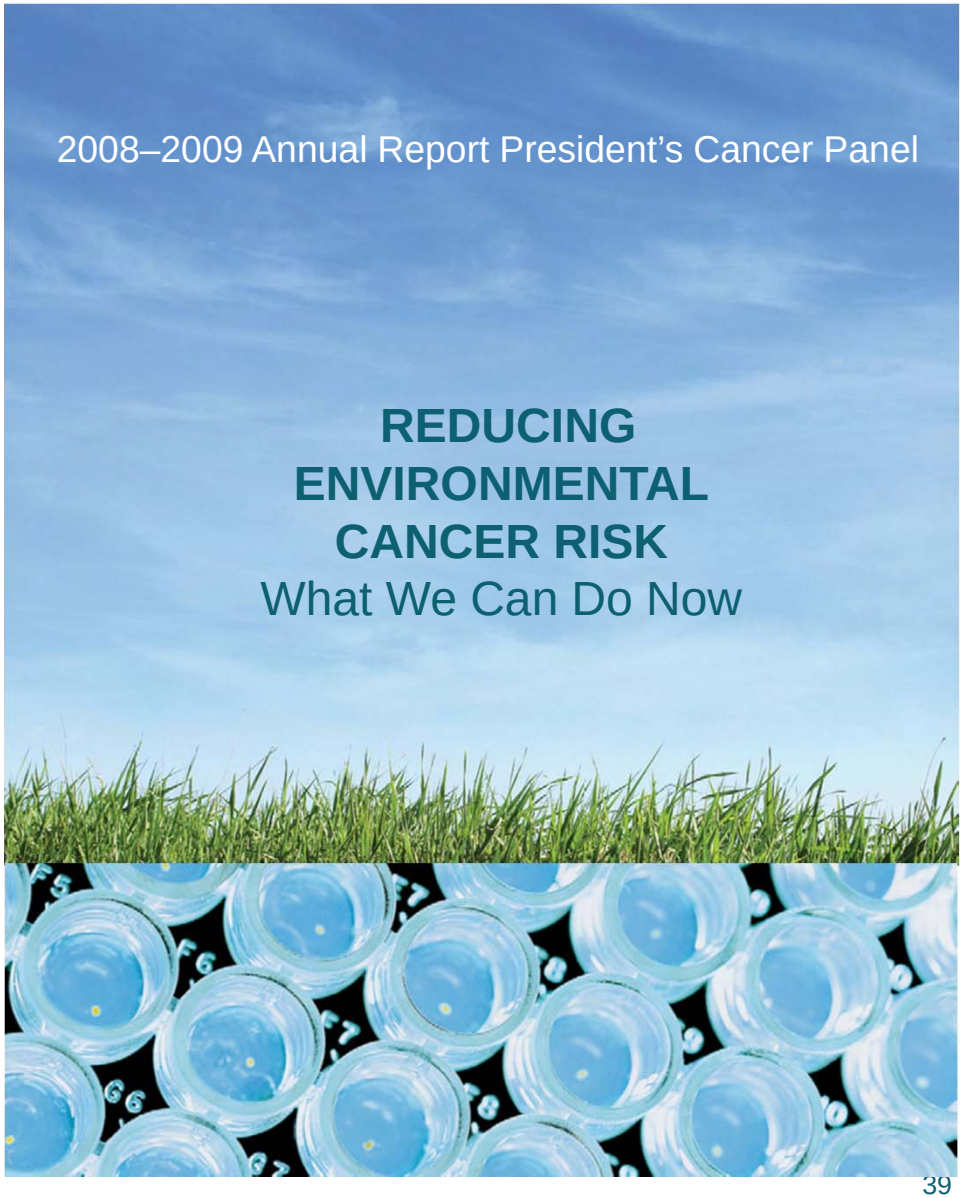
President's Cancer Panel



- **…the true burden of environmentally induced cancer has been grossly underestimated.**
- **Some chemicals indirectly increase cancer risk by contributing to immune and endocrine dysfunction …**
- **Increases in incidence of some childhood cancers,…, may implicate prenatal exposure to environmental carcinogens**

Interventions Matter

Going from this

To this

Can Reduce the BPA and Phthalates Found In You!

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Rudell EHP in press

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We Can’t Shop Our Way out the Problem

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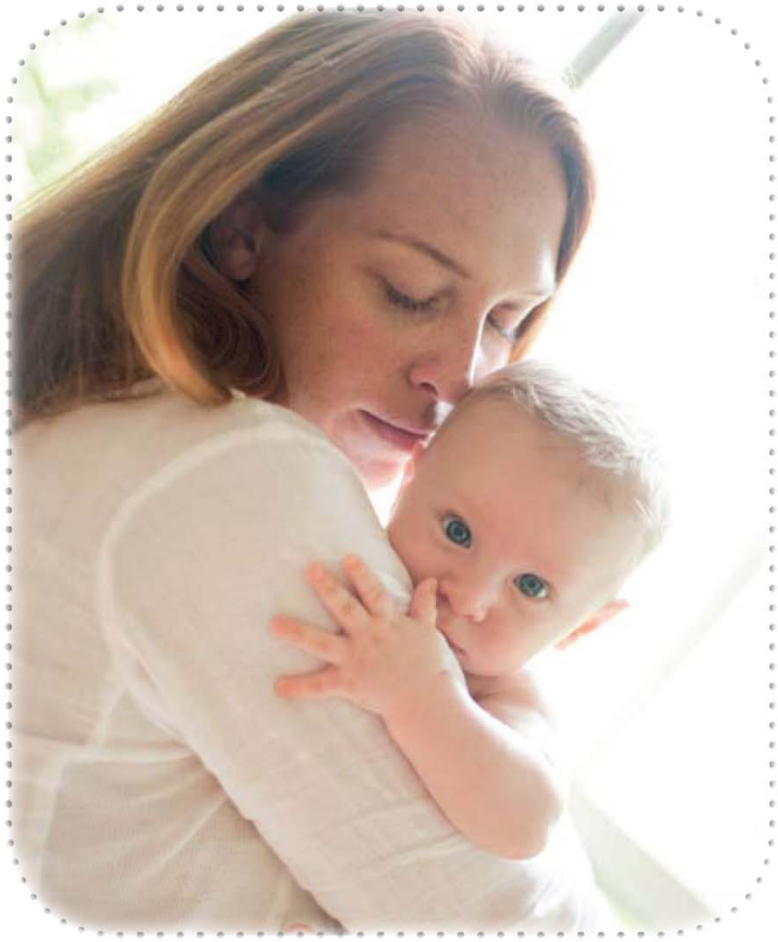
Reproductive
e Environment

MEET MOLLY GRAY.

Eats organic. Avoids BPA. Buys natural cleaners.
Loaded with toxic chemicals.



- Nine pregnant women tested from Washington, Oregon, and California, during the second trimester had **detectable**
  - Bisphenol A, mercury, at least four phthalates, at least two and up to 4 perfluorinated chemicals

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You Matter

Program on Reproductive Health and the Environment

Jackie Schwartz
Jason Harless
Ami Zota
Jessica Trowbridge
Carrie Dickenson

Dylan Atchley
Patrice Sutton
Joanne Perron
Janet Pan
Linda Giudice
(chair and founder)

Mission: To create a healthier environment for human reproduction and development by advancing scientific inquiry, clinical care, and health policies that prevent exposures to harmful chemicals in our environment

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