

CONTROLLING TOXIC CHEMICAL EXPOSURES TO SAFEGUARD CHILDREN'S HEALTH

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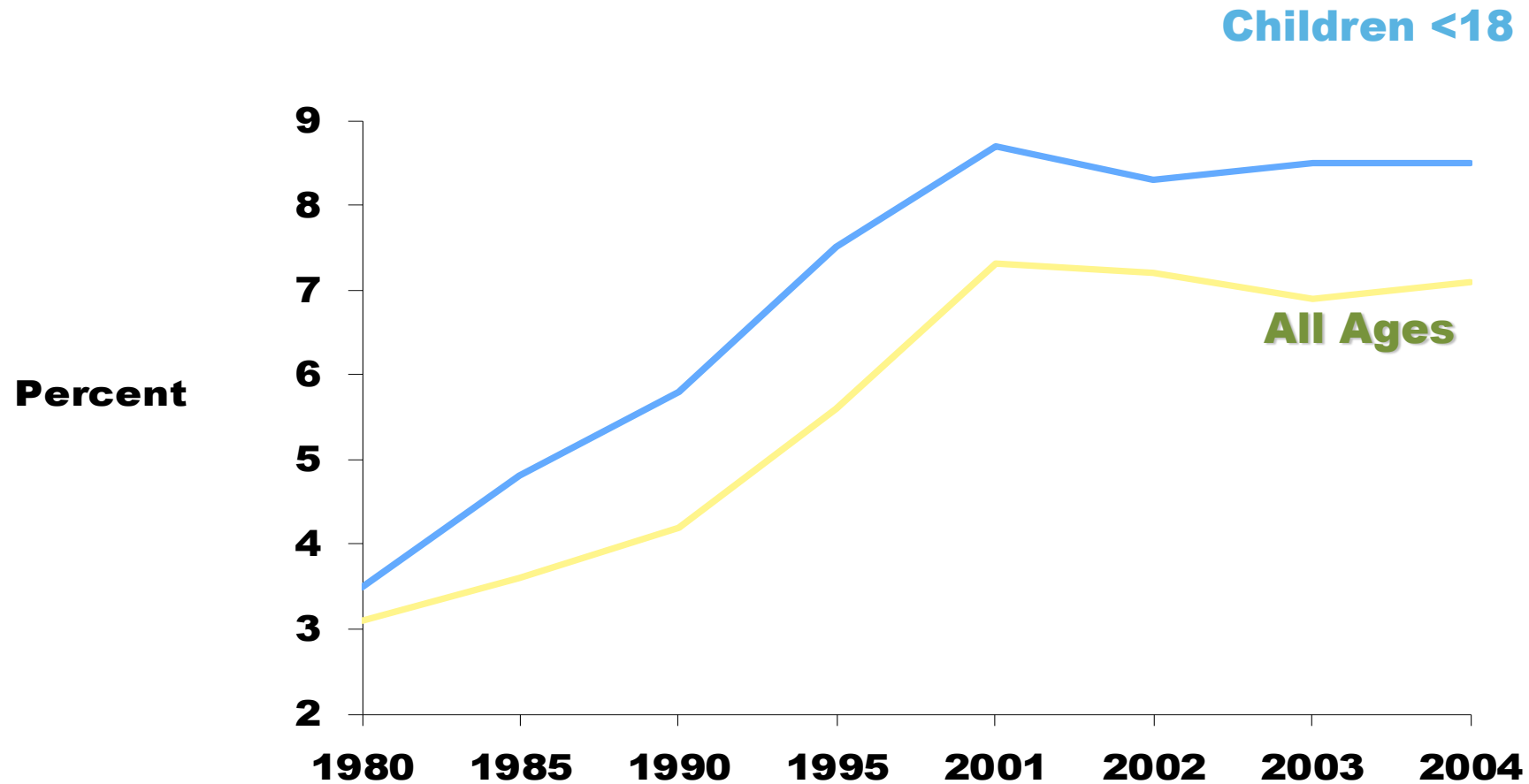


OVER THE PAST CENTURY, PATTERNS OF DISEASE IN CHILDREN HAVE CHANGED PROFOUNDLY IN THE SAME TIME, CHILDREN'S ENVIRONMENTS HAVE CHANGED EQUALLY REMARKABLY

- Infectious diseases have declined in frequency (COVID-19, AIDS, malaria and tuberculosis notwithstanding)
- Infant mortality has declined by over 90%
- Life expectancy has nearly doubled
- Chronic, non-communicable diseases have become increasingly prevalent
- And in the same time, children have been exposed for the first time in all of human history to thousands of new chemicals and plastics never before seen on the face of the earth

- **What are the connections between these two trends?**

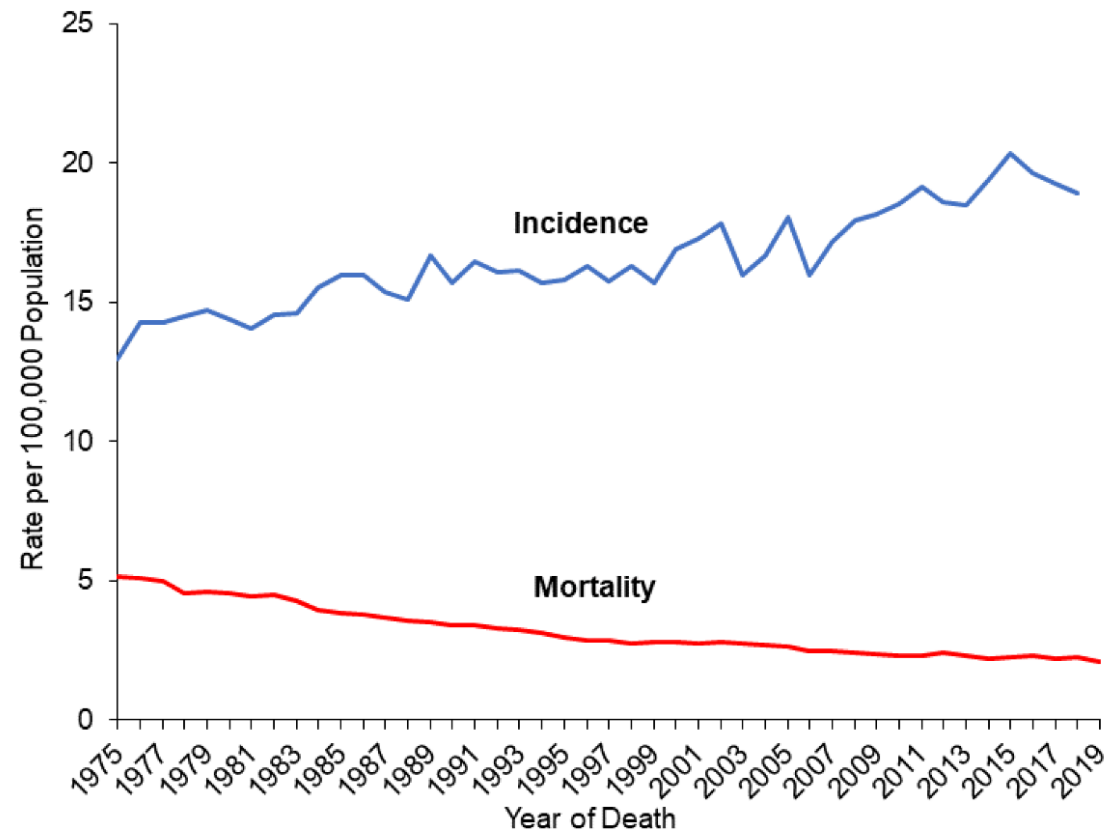
INCREASING PREVALENCE OF ASTHMA, USA, 1980-2004



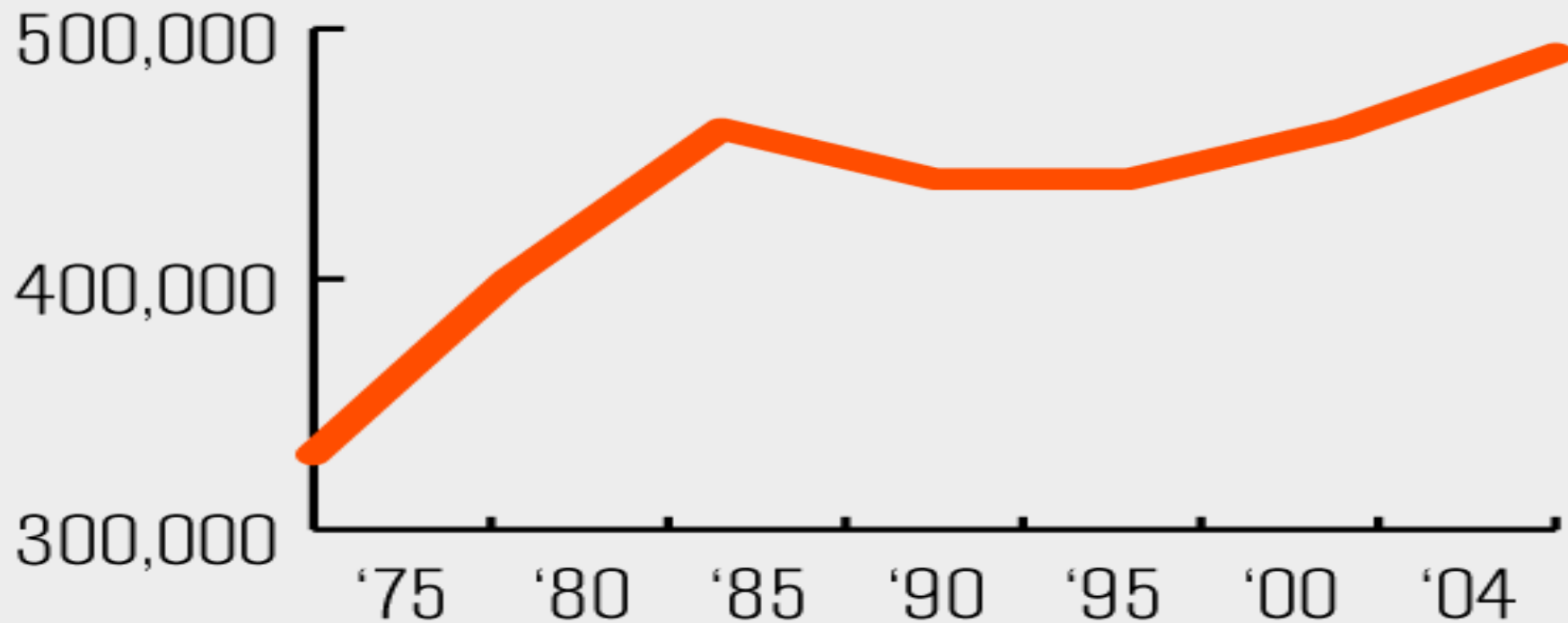
Source: CDC MMWR, October 19, 2007 / 56(SS08);1-14;18-54

CHILDHOOD CANCER, INCIDENCE AND MORTALITY, USA, 1975-1996

Trends in Cancer Incidence* and Death Rates in Children and Adolescents (0-19 Years), 1975-2019

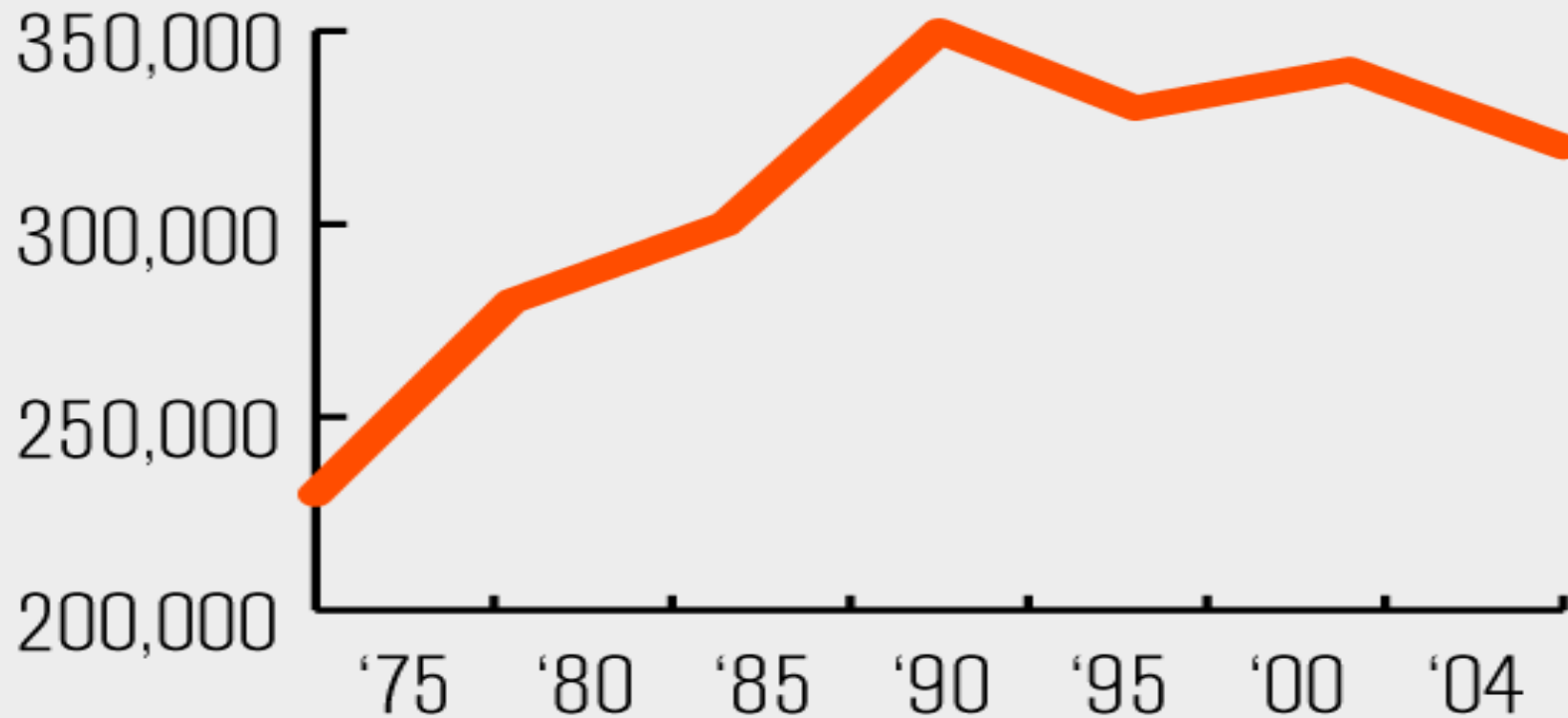


Incidence of Childhood Leukemia 1975-2004



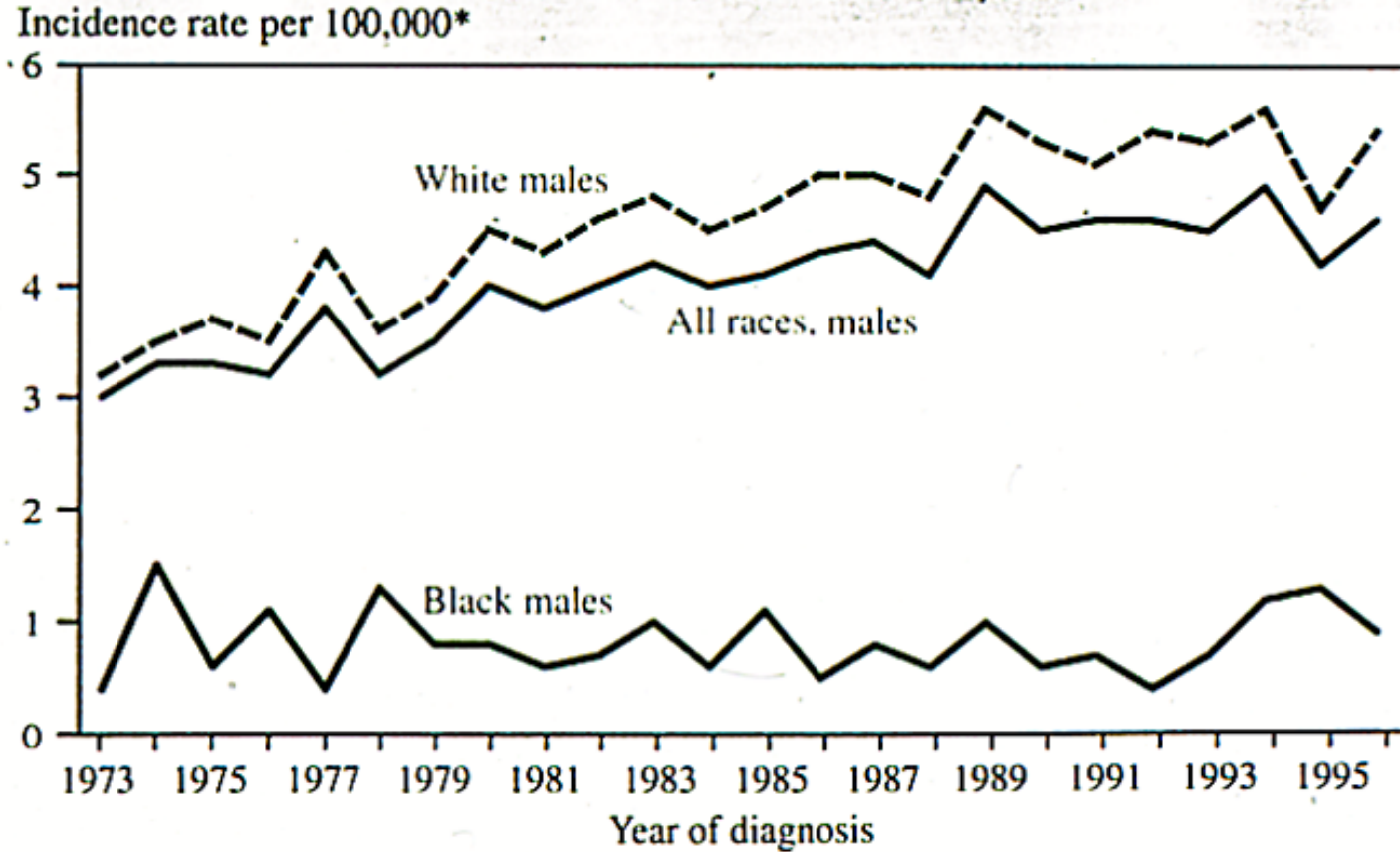
Source: National Cancer Institute

Incidence of Childhood Brain Cancer 1975-2004



Source: National Cancer Institute

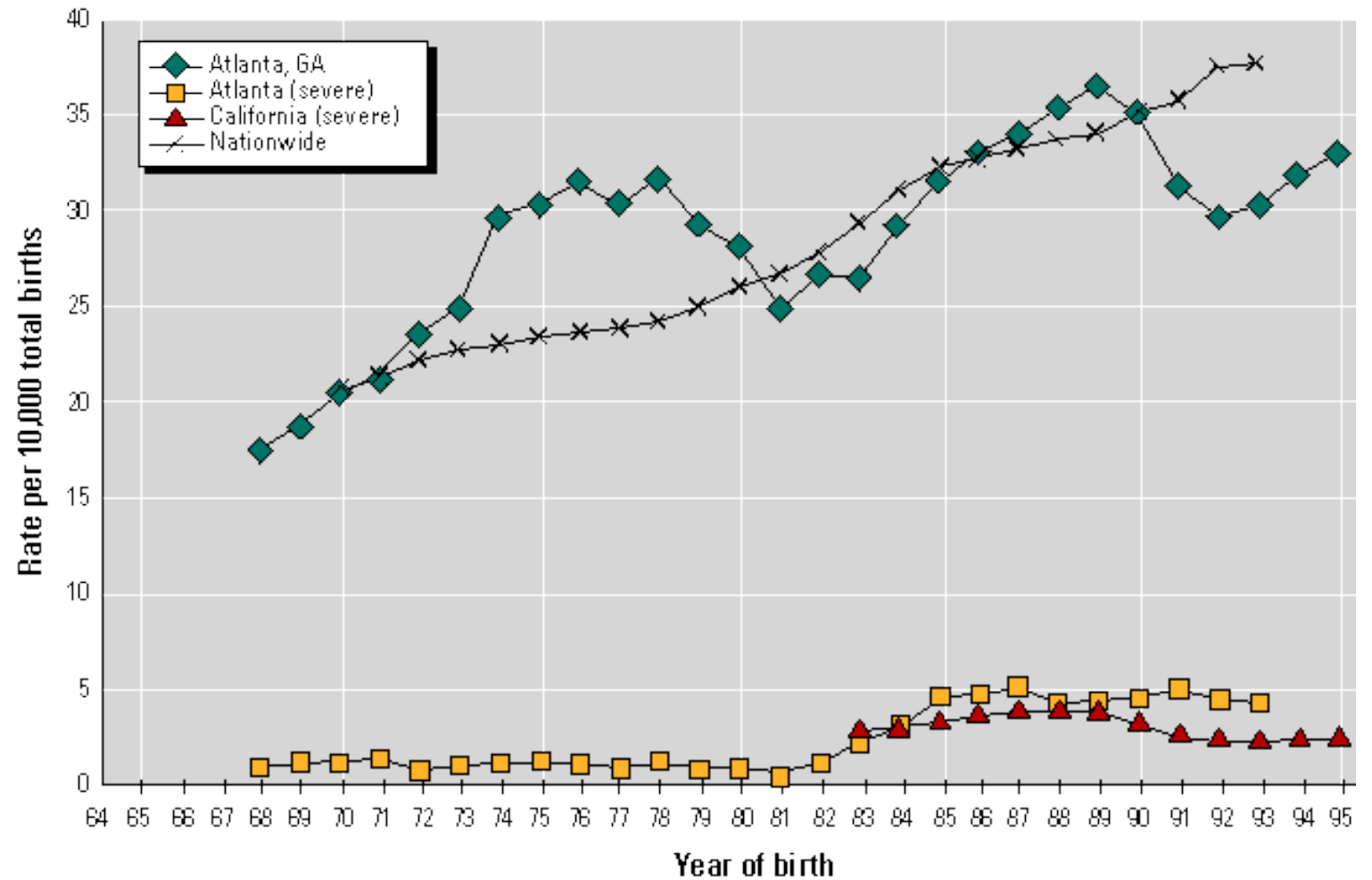
**INCREASING
INCIDENCE
OF
TESTICULAR
CANCER, USA**



*Age-adjusted to the 1970 U.S. standard population.

Sources: *SEER Cancer Statistics Review, 1973-1996* (NCI 1999) and *Cancer Rates and Risks, 4th edition* (NCI 1996); access at <http://www-seer.ims.nci.nih.gov>

INCREASING INCIDENCE OF MALE REPRODUCTIVE BIRTH DEFECTS



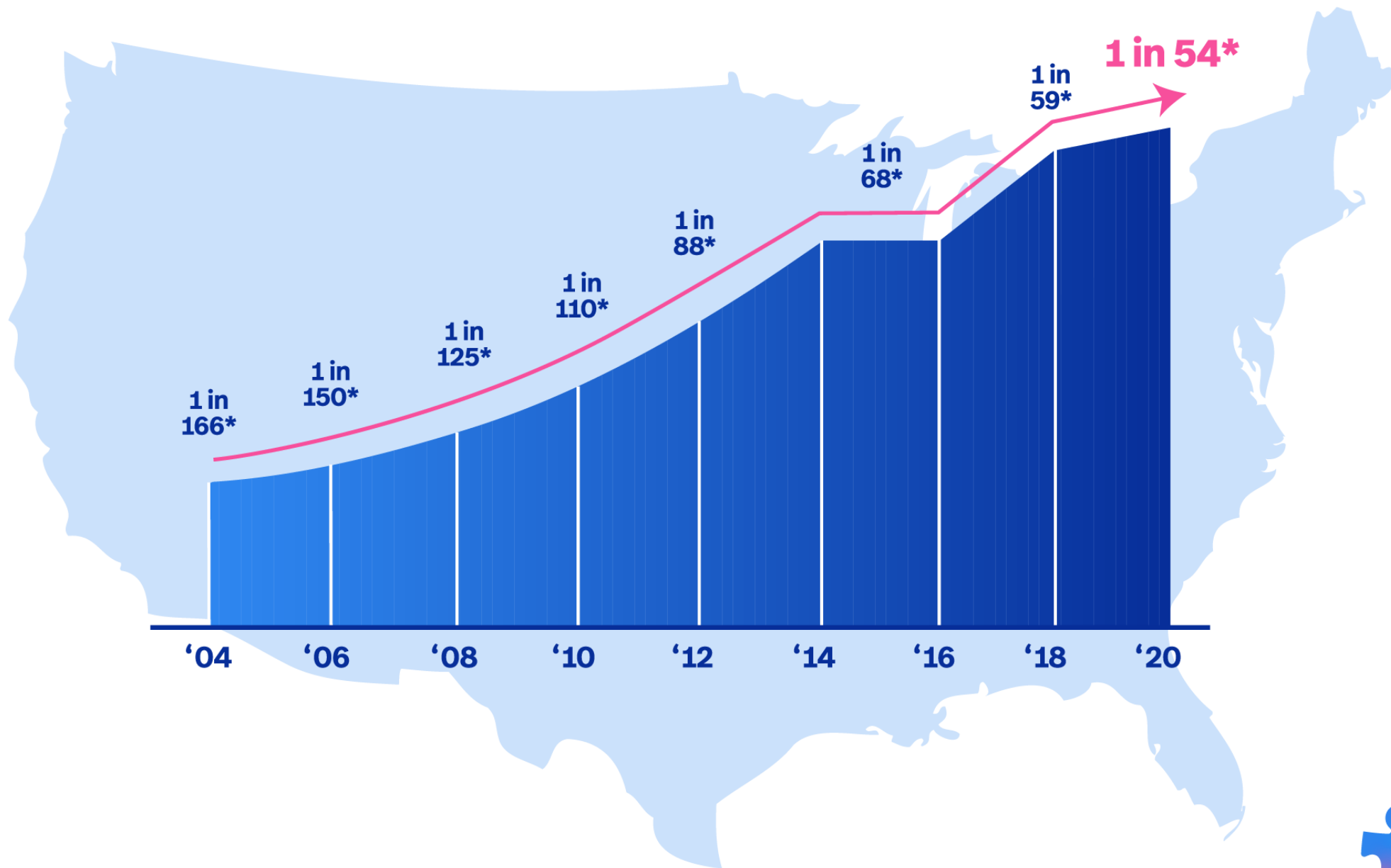
INCREASING INCIDENCE OF NEURODEVELOPMENTAL DISABILITIES

Affect 10-15% of all children

Include:

- Dyslexia
- ADHD
- Mental Retardation
- Autism

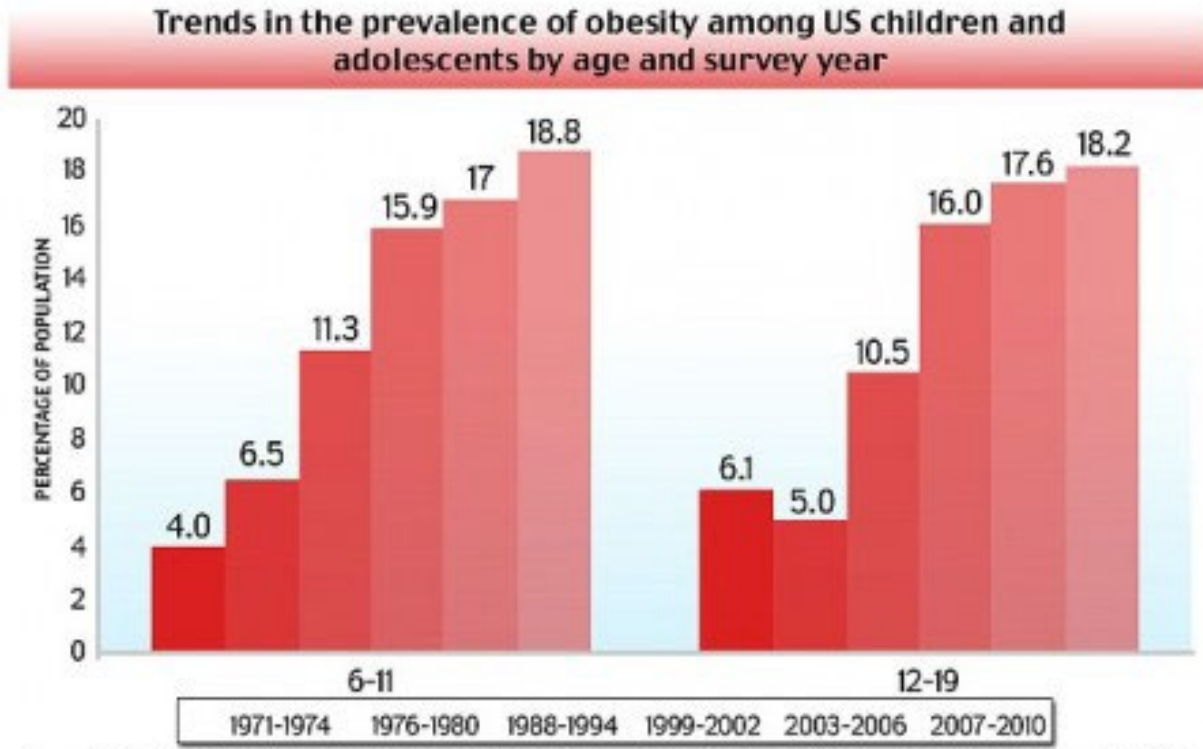
Reported incidence is increasing



* Centers for Disease Control and Prevention (CDC) prevalence estimates are for 4 years prior to the report date (e.g. 2020 figures are from 2016)

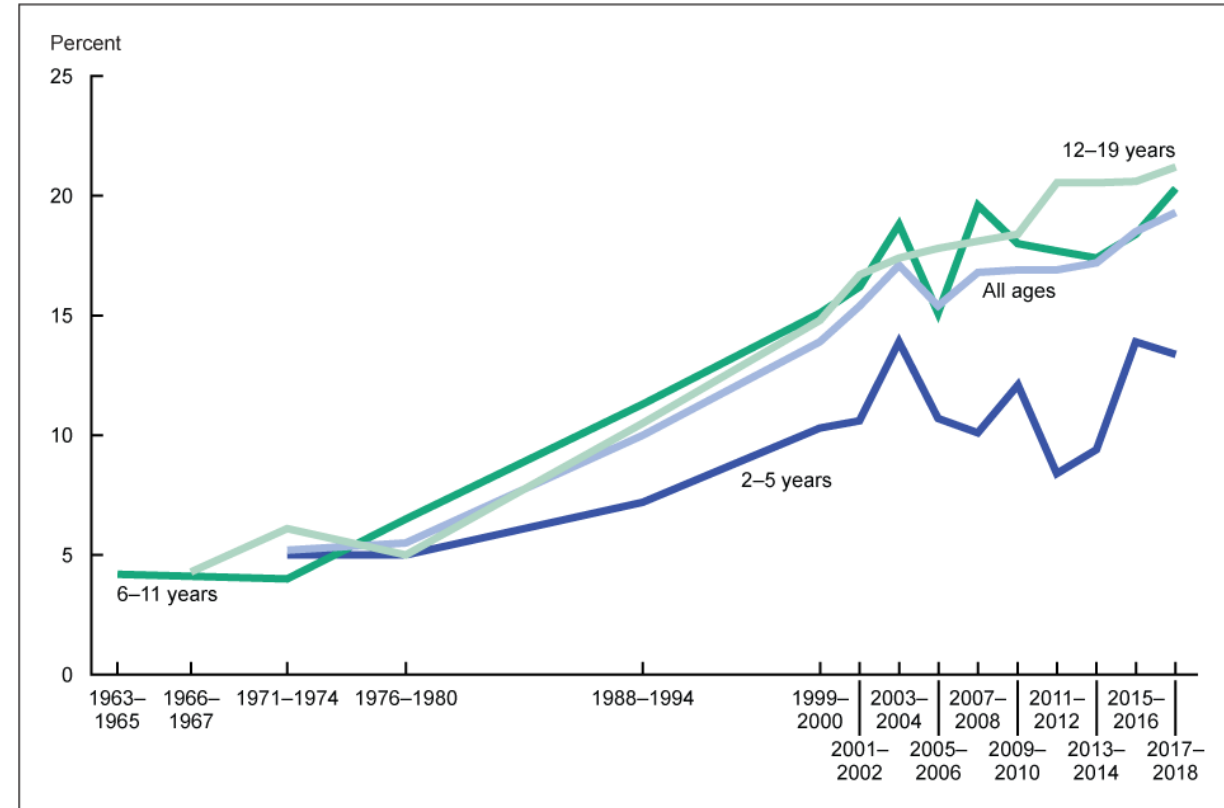


INCREASING PREVALENCE OF CHILDHOOD OBESITY



Source: NHANES: 1971-1974, 1976-1980, 1988-1994, 1999-2002, 2003-2006 and 2007-2010; Data derived from Health, United States, 2011 (NCHS)

Source: Willet et al., *New Eng J Med*, 1999

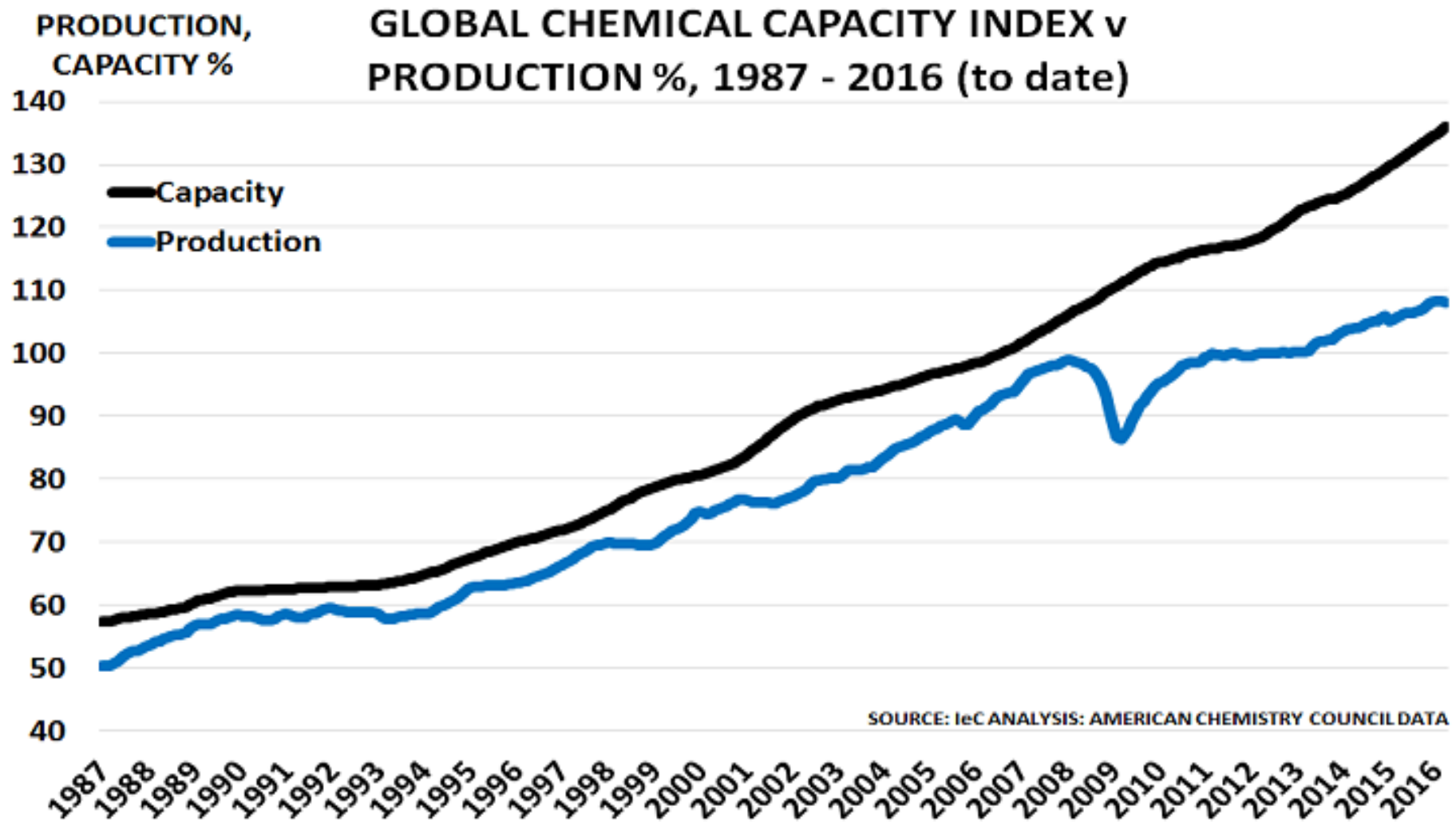


NOTE: Obesity is body mass index (BMI) at or above the 95th percentile from the sex-specific BMI-for-age 2000 CDC Growth Charts.
 SOURCES: National Center for Health Statistics, National Health Examination Surveys II (ages 6-11), III (ages 12-17); and National Health and Nutrition Examination Surveys (NHANES) I-III, and NHANES 1999-2000, 2001-2002, 2003-2004, 2005-2006, 2007-2008, 2009-2010, 2011-2012, 2013-2014, 2015-2016, and 2017-2018.

THE CHEMICAL REVOLUTION

SINCE THE 1950'S,
THOUSANDS OF NEW
CHEMICALS AND PLASTICS
HAVE BEEN MANUFACTURED AND
RELEASED TO THE ENVIRONMENT

GLOBAL CHEMICAL PRODUCTION, 1987- 2016



MANUFACTURED CHEMICALS TODAY

- There are currently 350,000 chemicals and chemical mixtures in commerce
- Mostly are new materials invented since 1950. Never before existed on earth
- Used in millions of consumer products
- Widely disseminated in the environment – from the high Arctic to the ocean depths.
- Nearly universal human exposure – including pregnant women and newborn infants
- Disproportionately heavy exposure of the poor and minorities – environmental injustice
- Global chemical production is increasing by 3.5% annually. Doubling time of 25-30 yrs
- **The great majority – 80-90% - of chemicals in commerce have never been tested for safety or toxicity**

NEW CHEMICALS ARE INTRODUCED WITH GREAT ENTHUSIASM AND LITTLE DUE DILIGENCE...



...AND THEN ARE BELATEDLY FOUND TIME AND AGAIN TO HAVE CAUSED GREAT HARM TO THE ENVIRONMENT AND TO CHILDREN'S HEALTH

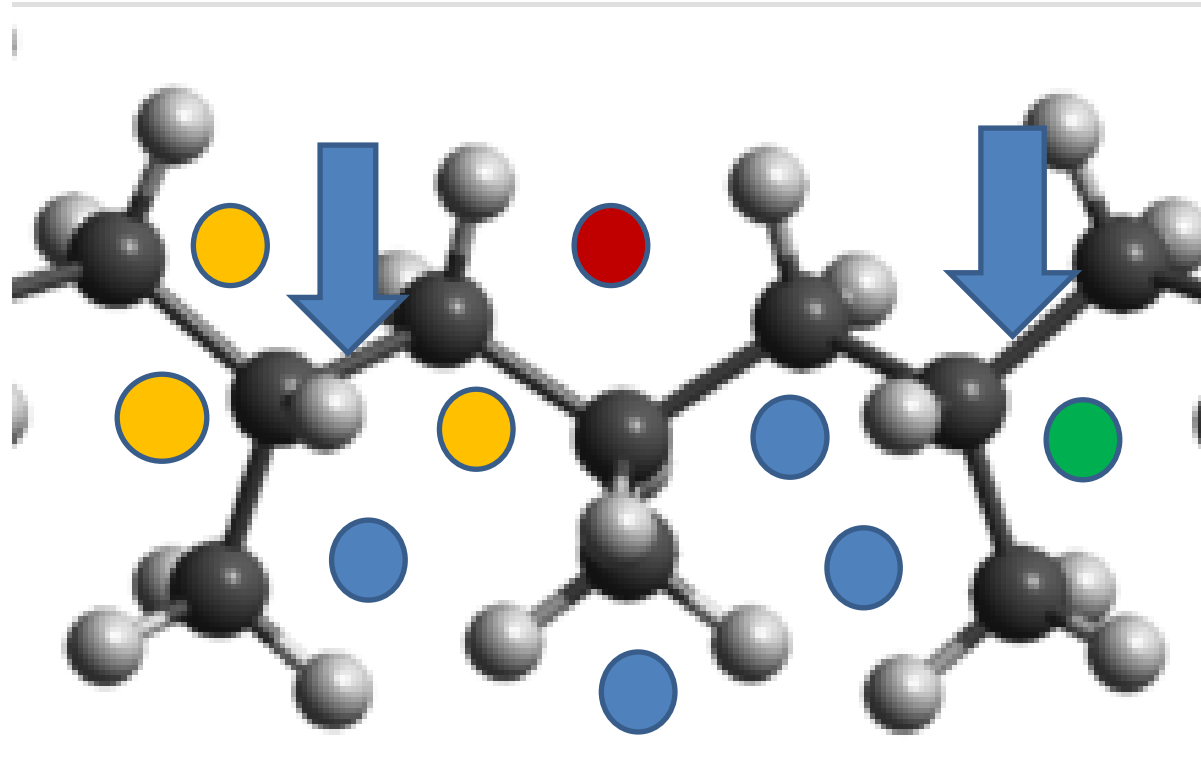


**PLASTIC -THE
SIGNATURE
MATERIAL OF
OUR AGE**

**THE AGE OF
DISPOSABLE LIVING**

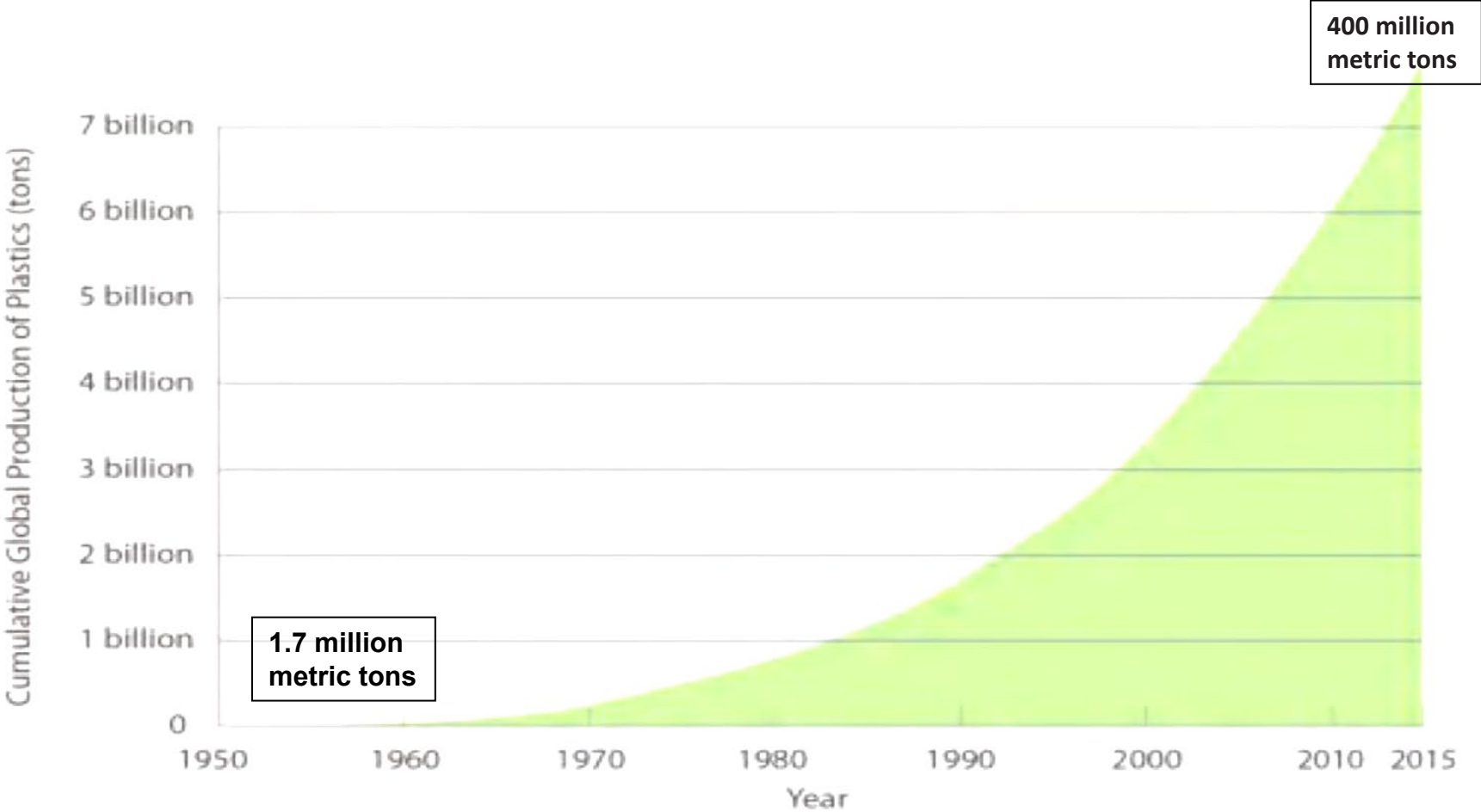
WHAT IS PLASTIC?

**Polymer Backbone:
Carbon-Carbon Bonds**



**Multiple Chemical Additives:
Phthalates, Bisphenols, PFAS,
Brominated Flame Retardants**

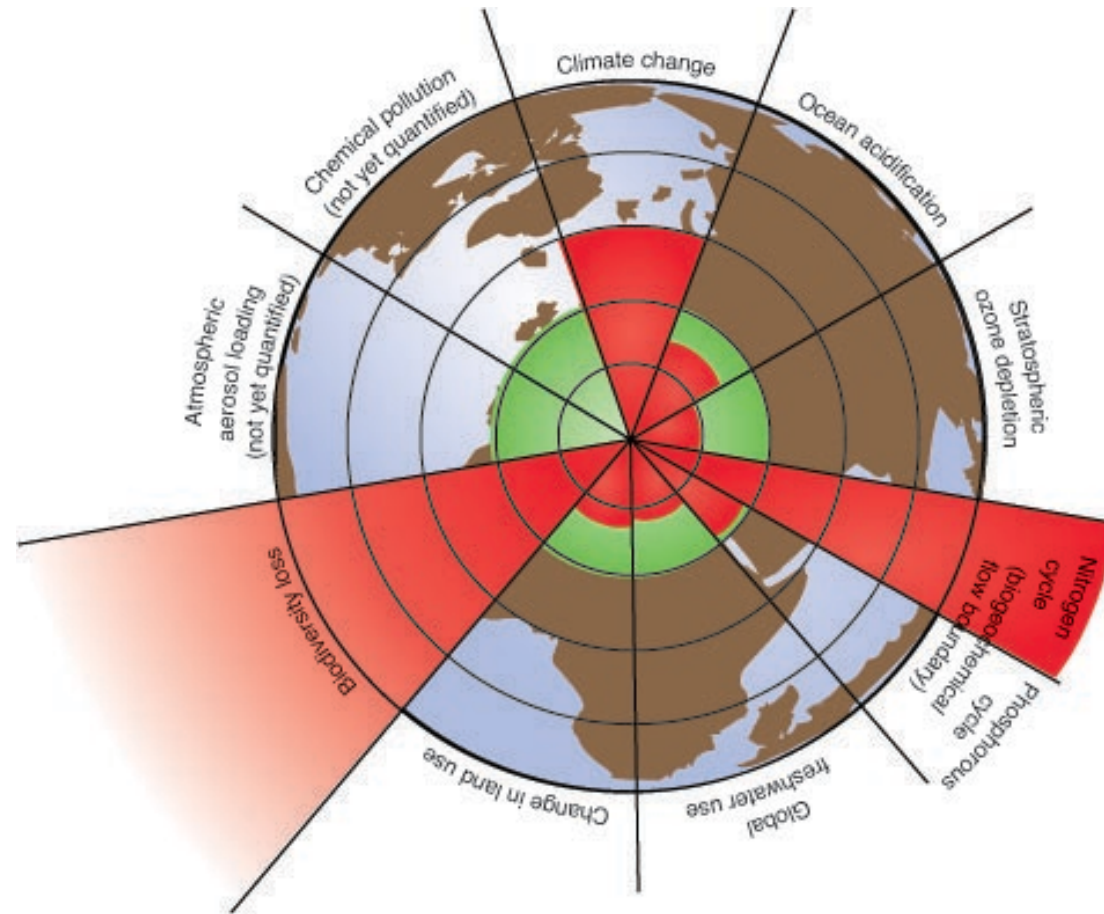
GLOBAL PLASTIC PRODUCTION, 1950 - 2015



PLASTICS TODAY AND TOMORROW

- More than 8,300 million metric tons (Mt) of plastic have been manufactured since 1950. One ton for every person on earth.
- More than 98% of plastic is made from oil and gas
- All plastic contains multiple chemical additives – many are highly toxic: carcinogens, neurotoxins, endocrine disruptors
- Production is on track to double by 2040 and treble by 2060 if current trends continue unchecked
- Plastic is responsible for 4-5% of current greenhouse gas emissions – more than Brazil. Projected to exceed 20% by 2050
- Single-use and short-lived plastics, which are made to be thrown away, account for about 40-50% of production
- About 20 Mt of plastic waste are released annually to the environment. Projected to double by 2060

THE PLANETARY BOUNDARIES CONCEPT



Planetary boundaries define the safe operating space for humanity

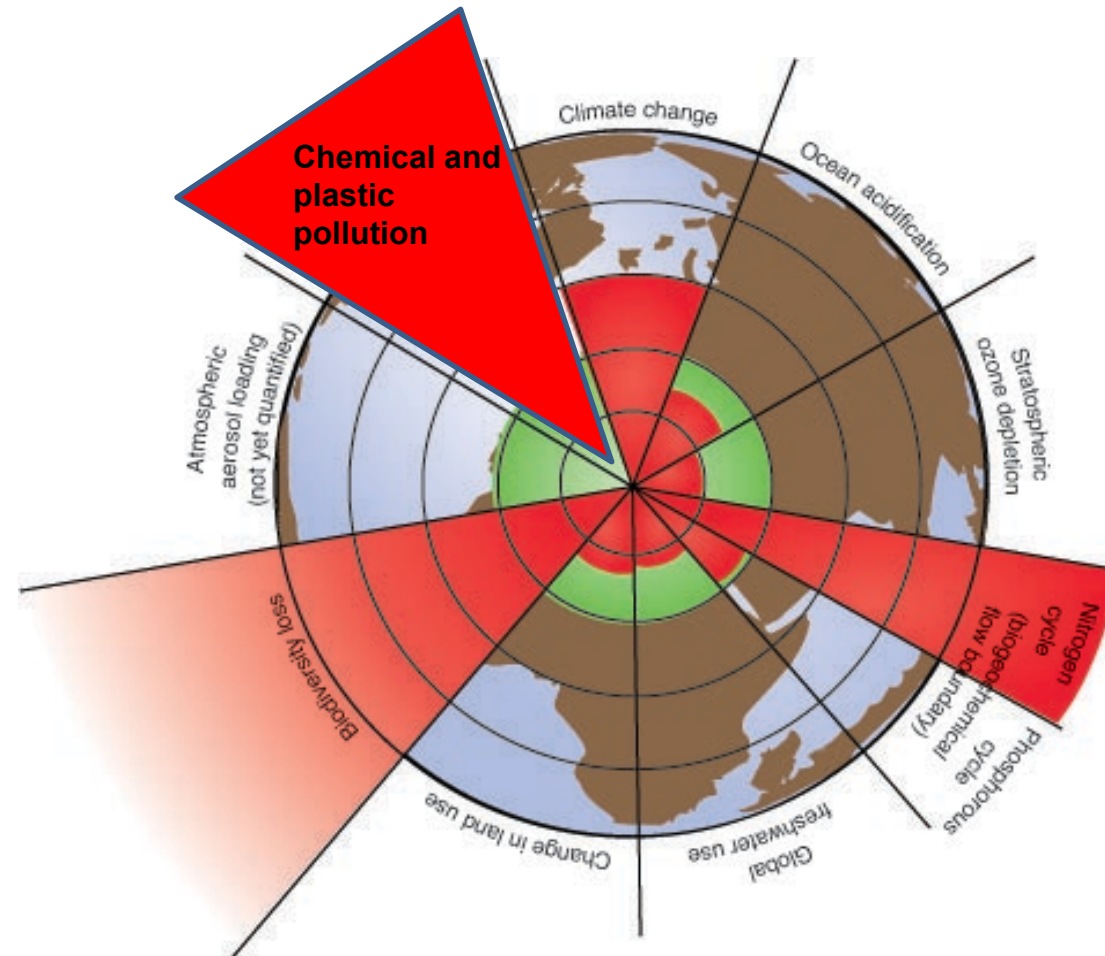
Johan Rockström , Stockholm Environmental Institute

PLASTICS, CHEMICALS AND PLANETARY BOUNDARIES

Concern has arisen that plastic and chemical pollution may have reached a tipping point—like climate change and biodiversity loss—where it could irreversibly damage the planet's support systems and threaten the survival of modern civilizations.

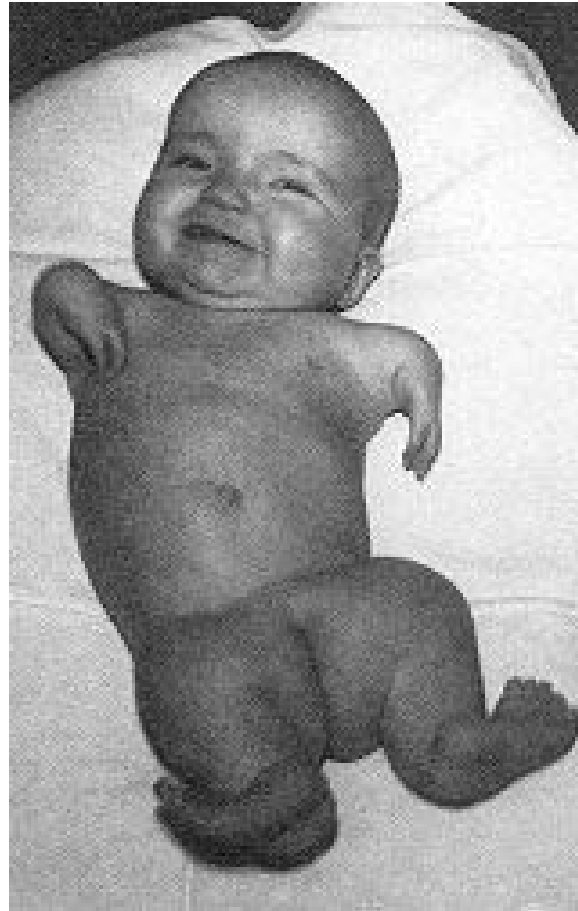
Persson et al. *Environ Sci Technol*. 2022; 56:1510-1521.
[doi: 10.1021/acs.est.1c04158](https://doi.org/10.1021/acs.est.1c04158)

CHEMICAL AND PLASTIC POLLUTION MAY ALREADY BE EXCEEDING ITS PLANETARY BOUNDARY



**EVIDENCE IS GREAT AND GROWING THAT
TOXIC CHEMICALS CAN CAUSE DISEASE
IN CHILDREN**

PHOCOMELIA FOLLOWING PRENATAL EXPOSURE TO THALIDOMIDE

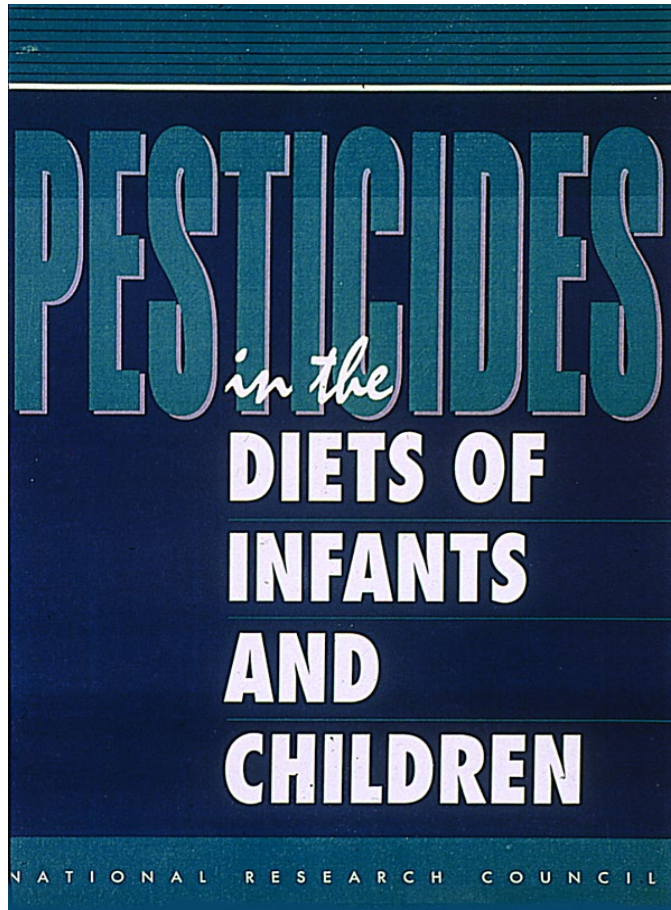


A CHILD MASSIVELY EXPOSED TO MERCURY IN THE WOMB – MINAMATA, JAPAN



No visible injury to the mother

CHILDREN ARE EXQUISITELY SENSITIVE TO TOXIC CHEMICALS IN THE ENVIRONMENT



- Greater exposure proportionate to body mass—
7 times more water per Kg per day;
Hand-to-mouth activity
- Diminished ability to detoxify many chemicals
- Heightened biological vulnerability –
thalidomide, DES, fetal alcohol syndrome
- More years of future life

CHILDREN ARE NOT LITTLE ADULTS

EVIDENCE OF LINKS BETWEEN ENVIRONMENT AND DISEASE - ASTHMA

Indoor triggers

- House dust
- Second-hand tobacco smoke
- Mold and mites
- Cockroach droppings
- Animal dander
- Certain pesticides

Outdoor triggers

- Ground-level ozone
- Fine particulates
- NO_x
- Diesel exhaust

Prevention is Achieved Through Reducing Exposures

EVIDENCE FOR ENVIRONMENTAL CAUSATION OF CHILDHOOD CANCER

- Radiation – post Hiroshima and Nagasaki
- DES and adenocarcinoma of vagina
- Solvents, especially benzene
- Pesticide exposure, especially prenatally
- Nitrosamine
- Aspartame
- Protective effects of folic acid and breast feeding

Upward Trend Still Unexplained

EVIDENCE FOR ENVIRONMENTAL CAUSATION OF MALE REPRODUCTIVE DISORDERS

Falling sperm counts – cause not known

Rising testicular cancer – cause not known

Increasing hypospadias – cause not known

Are Endocrine Disrupting Chemicals Responsible?

PERFLUOROALKYL SUBSTANCES (PFAS)

- Non-stick compounds. Introduced in 1946.
- Used in non-stick cookware, stain-repellant carpets and furniture, water-repellent clothing, and firefighting foam.
- Widely disseminated in environment
- Main exposure is through drinking water
- Health effects:
 - Intrauterine growth retardation and decreased birth weight
 - Increased risk of ADHD
 - Hepatic and renal toxicity
 - Increases in serum lipid levels
 - Increased risk of thyroid disease
 - Suppression of immune function
 - Decreased fertility



THE DEVELOPING BRAIN IS EXQUISITELY SENSITIVE TO TOXIC CHEMICALS

- Much more sensitive than the adult brain
- Sensitivity is greatest during the 9 months of pregnancy and continues through childhood and adolescence
- Brain damage caused by toxic exposures in early life can be permanent, irreversible and untreatable
- The only effective treatment is prevention of exposure

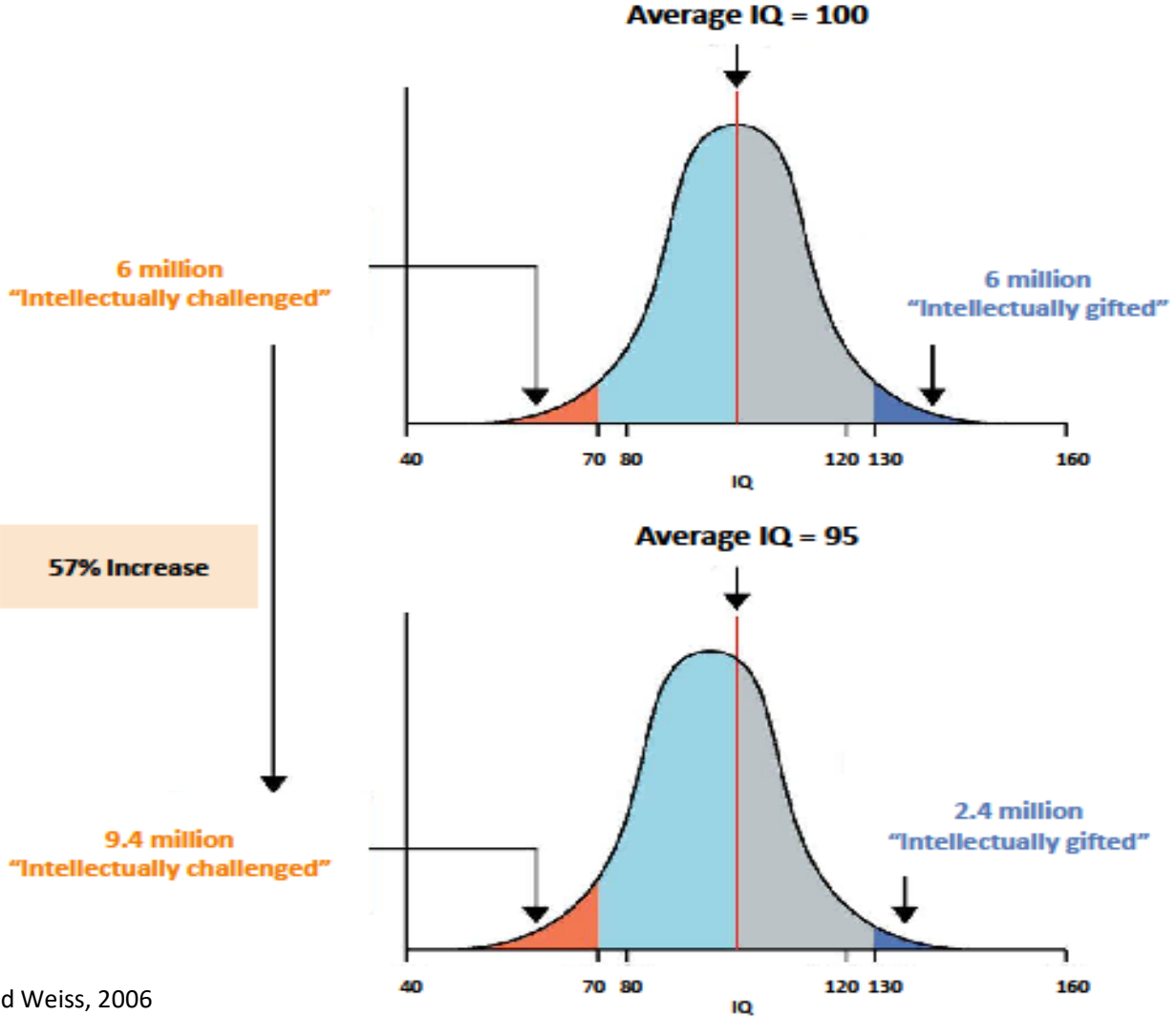
SUBCLINICAL NEUROTOXICITY

Subclinical toxicity was first recognized in the case of lead, but is now recognized to pertain to all chemicals that are toxic to the brain

The concept that relatively low dose exposure to neurotoxic chemicals... may cause harmful effects to health that are not evident on the standard clinical examination.

The underlying premise is that there exists a spectrum of toxicity, in which clinically apparent effects have their asymptomatic, subclinical counterparts.

SOCIETAL IMPACT OF A 5-POINT LOSS IN AVERAGE IQ POPULATION OF 100 MILLION CHILDREN



Gilbert and Weiss, 2006

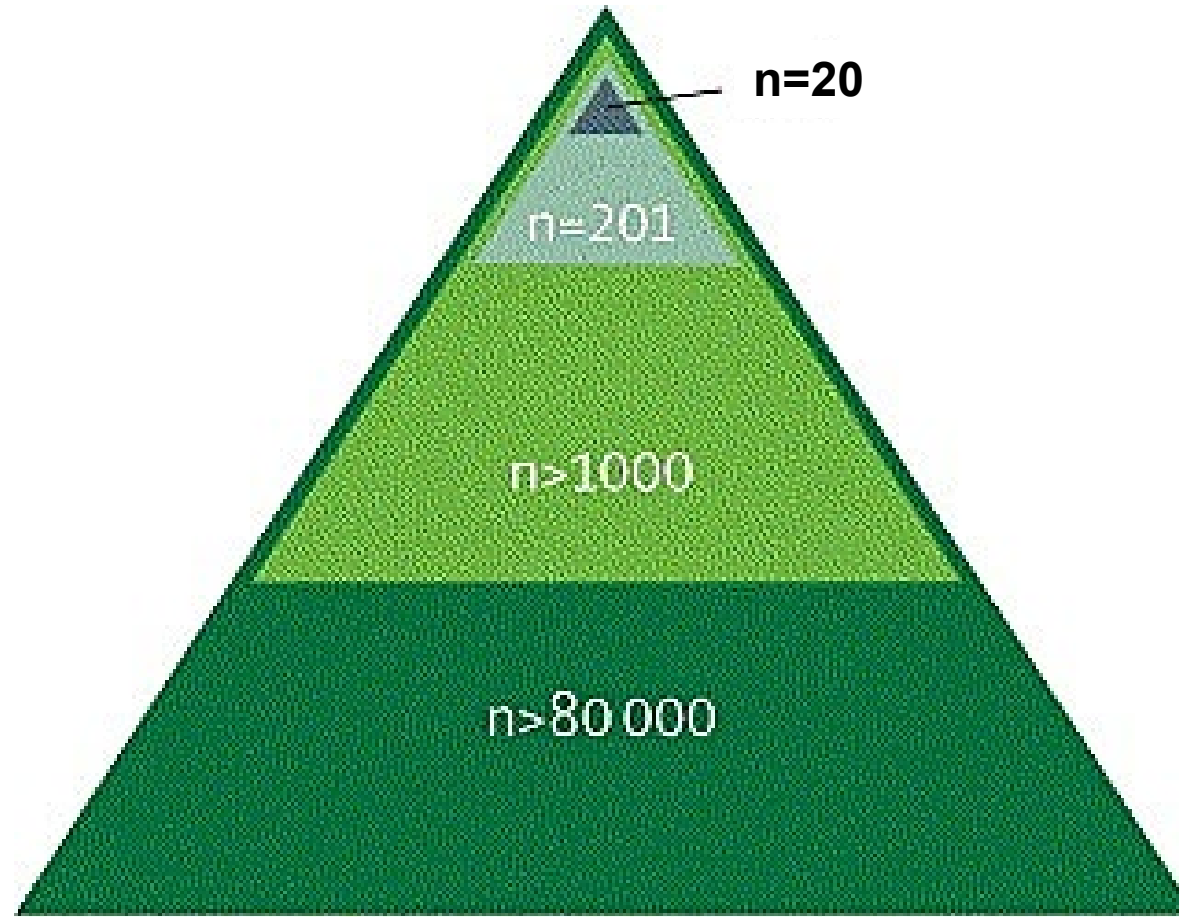
SUBCLINICAL TOXICITY – LEAD AND OTHER TOXIC CHEMICALS AFFECT DOMAINS BEYOND INTELLIGENCE


- At age 7, an association is evident between early-life lead levels and aggression, delinquency and social problems
- By age 11, increased delinquent and aggressive behavior are clearly evident in children with higher lead levels
- By age 18, young adults with higher lead levels at age 7 are more likely to be dyslexic and to have quit school
- Incarcerated young men have higher lead levels than young men from the same communities who are not in prison

CHEMICALS NOW KNOWN TO DAMAGE THE DEVELOPING HUMAN BRAIN


- Lead
- Methyl Mercury
- Polychlorinated Biphenyls (PCBs)
- Arsenic
- Manganese
- Organic solvents, e.g., Ethanol and Toluene
- Organophosphate pesticides - Chlorpyrifos
- Organochlorine pesticides
- Phthalates
- Bisphenol A
- Brominated flame retardants
- Polycyclic aromatic hydrocarbons

ARE THERE STILL OTHER NEUROTOXIC CHEMICALS NOT YET DISCOVERED?



 Chemicals known to be toxic to human neurodevelopment

 Chemicals known to be neurotoxic in human beings

 Chemicals known to be neurotoxic in experiments

 Chemical universe

David Rall on Developmental Neurotoxicity



Suppose that thalidomide, instead of causing the birth of children with missing limbs, had instead reduced their intellectual potential by 10%.

Would we be aware, even today, of its toxic potency?

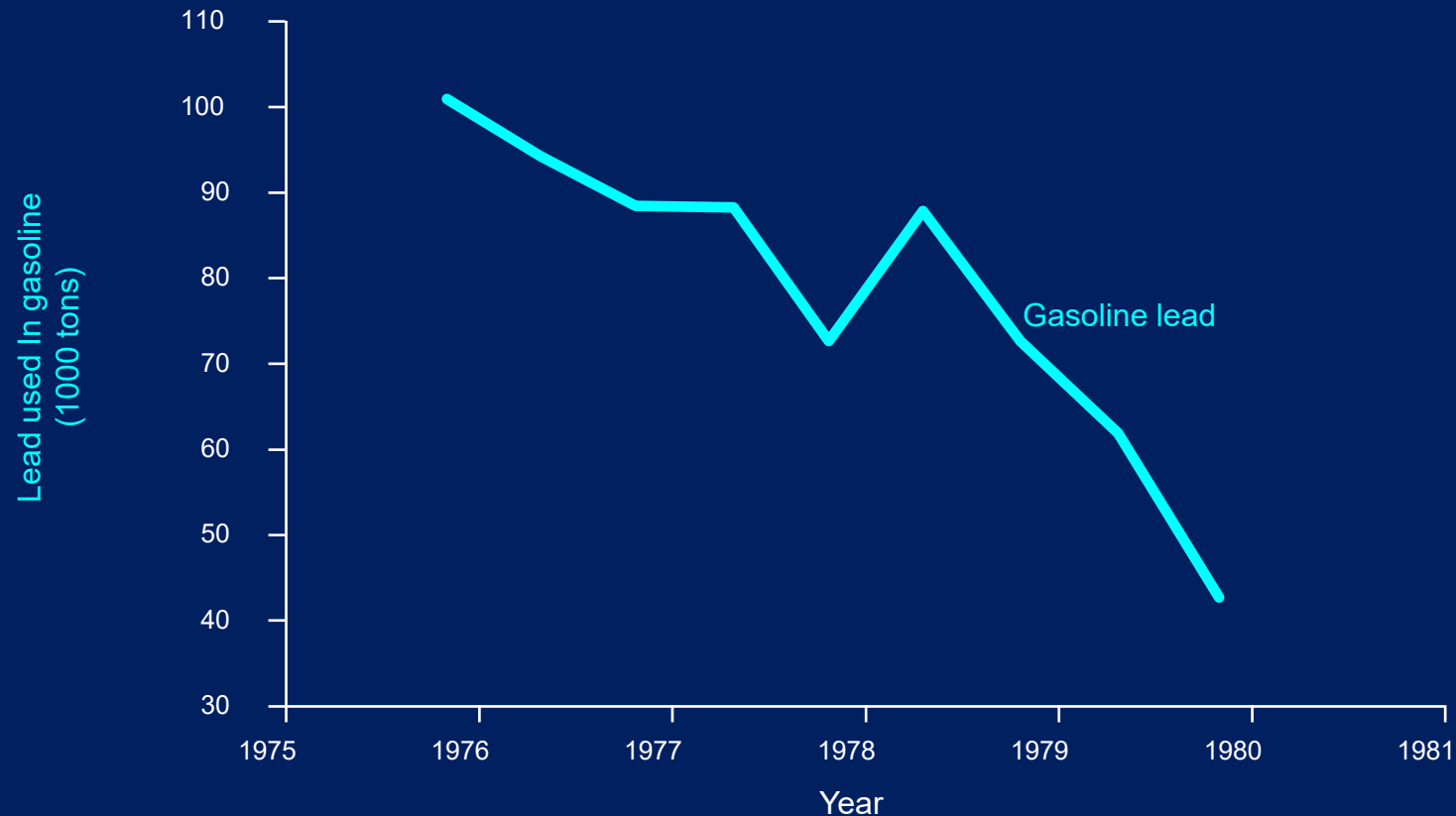
**THE GOOD NEWS:
DISEASE CAUSED BY TOXIC CHEMICALS
CAN BE PREVENTED**

THREE ESSENTIAL INGREDIENTS:

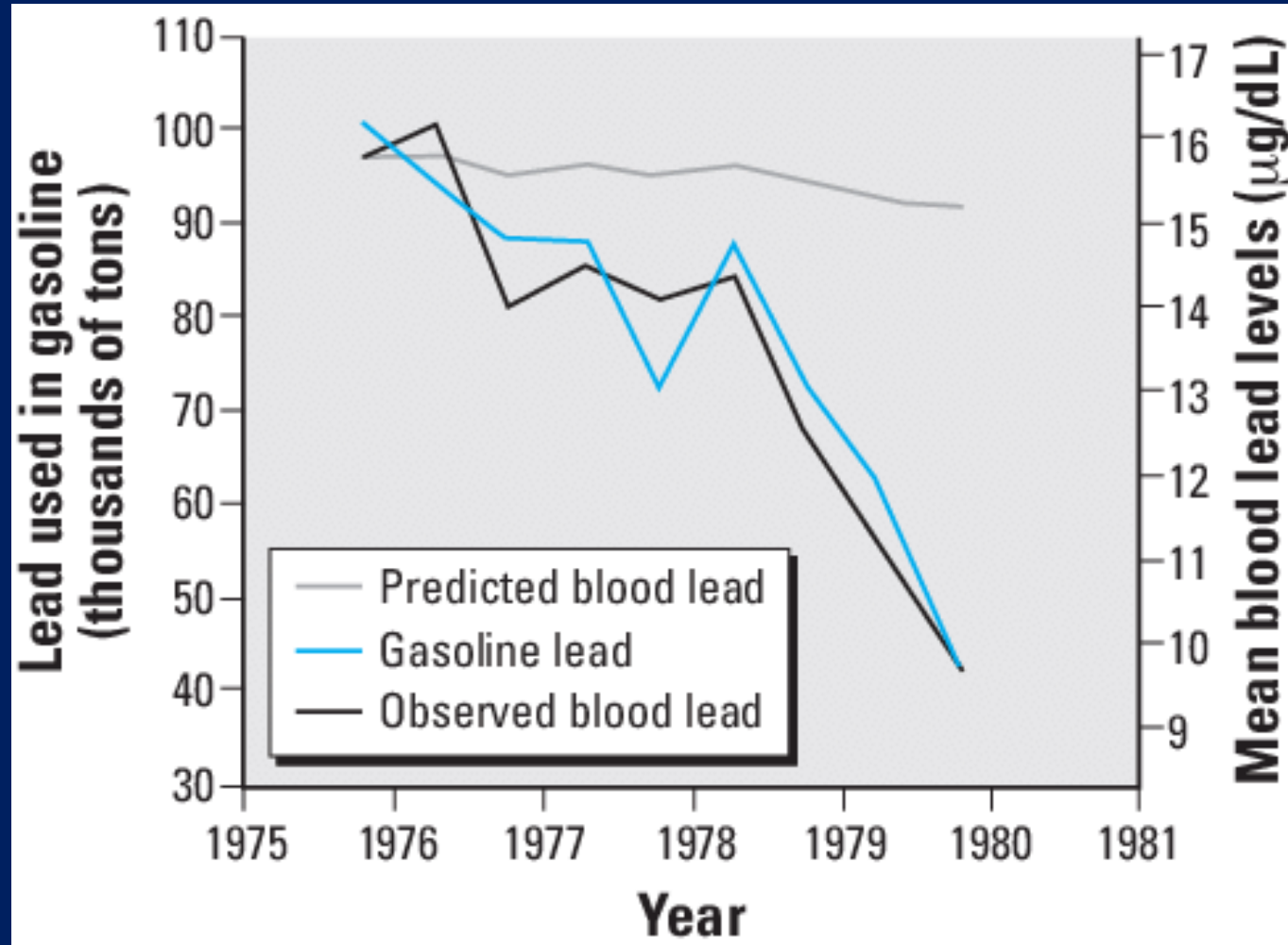
- Scientific discovery
- Willingness of scientists to translate science into policy
- Willingness of government officials and policy makers to act on and not ignore science and to confront powerful vested interests

The case of lead in gasoline

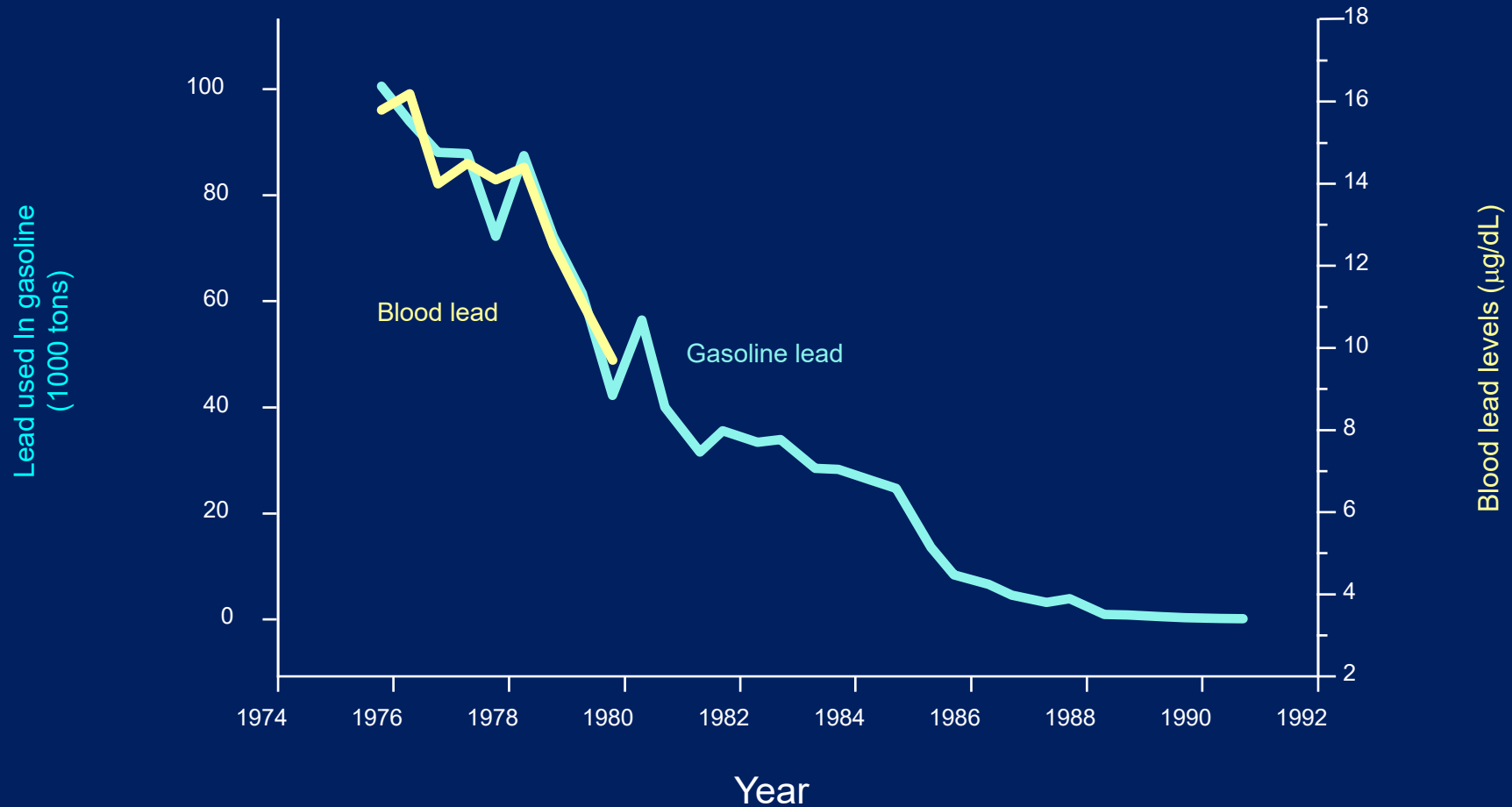
THE EPA DECISION ON LEAD IN GASOLINE: LEAD USE IN GASOLINE DECLINED FROM 1976 THROUGH 1980



THE EPA DECISION ON LEAD IN GASOLINE: DECLINE IN BLOOD LEAD LEVELS GREATLY EXCEEDED EXPECTATION

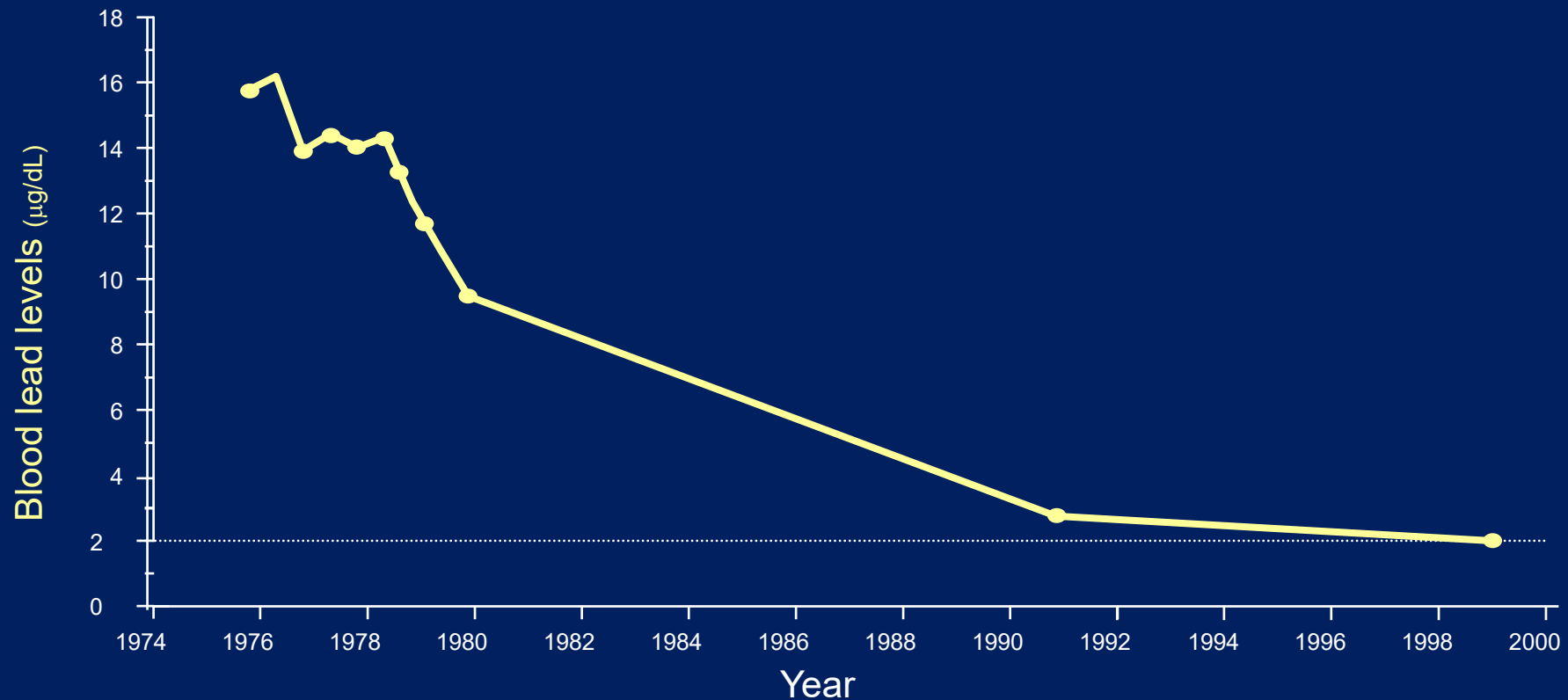


GASOLINE LEAD LEVELS DECLINED THROUGH 1991



Source: CDC. National Report on Human Exposure to Environmental Chemicals, March 2001

BLOOD LEAD LEVELS FOLLOWED THE DECLINE OF LEAD IN GASOLINE



Source: CDC. National Report on Human Exposure to Environmental Chemicals, March 2001

CONSEQUENCES OF REMOVING LEAD FROM GASOLINE

95% reduction in blood lead levels in US children

95% reduction in incidence of lead poisoning

2-5-point gain in population mean IQ

\$200 billion annual economic benefit to US each year since 1980 through increased economic productivity of more intelligent children

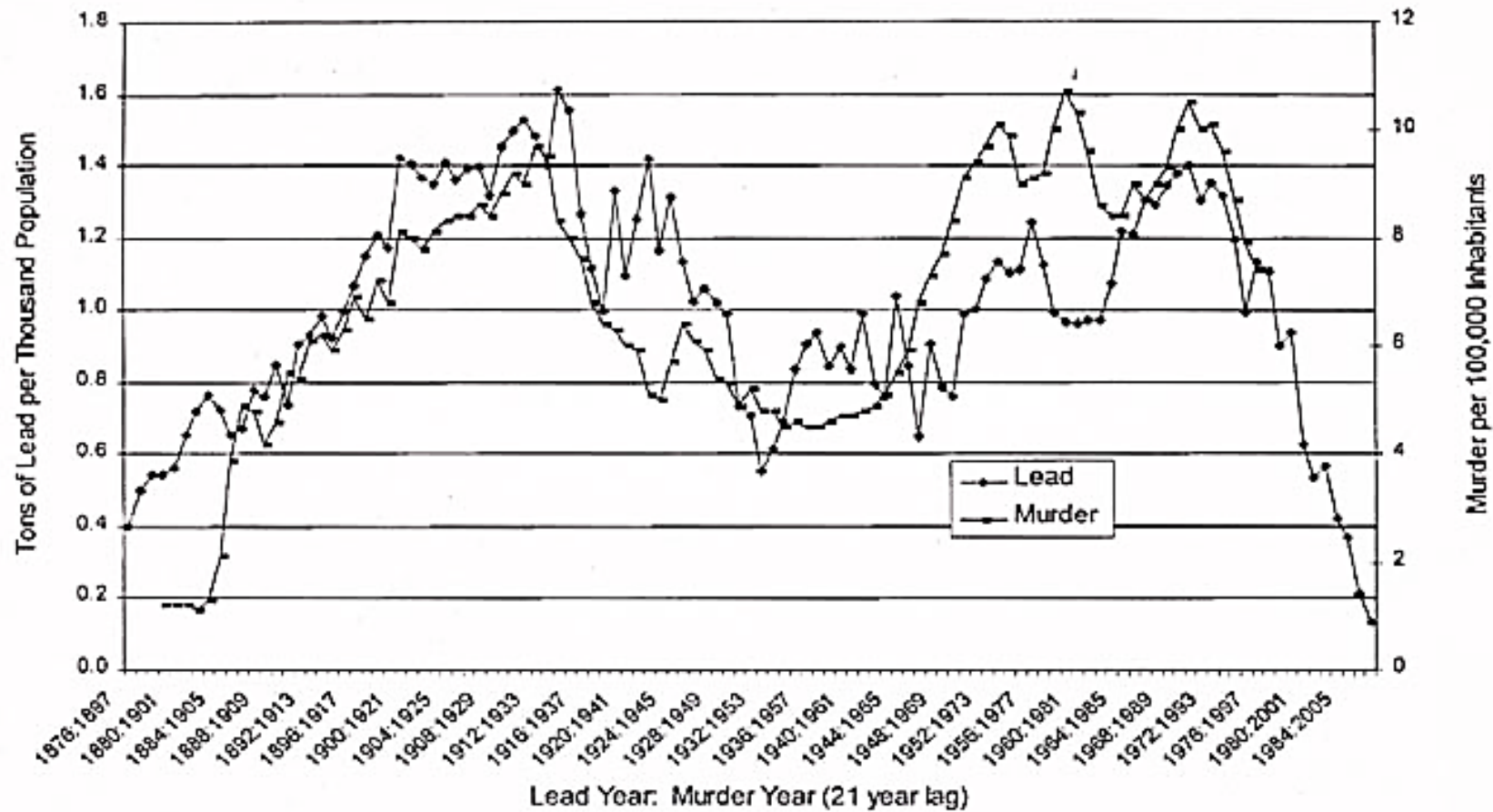
Aggregate economic benefit since 1980 = \$8 trillion

Between 1980 and 2020, more than 150 countries removed lead from gasoline

Algeria, the last country, removed lead in late 2021

DECLINING LEAD LEVELS AND FALL IN THE MURDER RATE

Is there a Connection?



**STRATEGIES
FOR CONTROLLING TOXIC CHEMICAL
EXPOSURES
TO
SAFEGUARD CHILDREN'S HEALTH**

SCIENCE-BASED LAWS AND POLICIES TO SLOW PLASTIC MANUFACTURE AND PREVENT PLASTIC POLLUTION

Interventions against plastic and plastic waste can use the same coordinated, multi-year strategies that countries, provinces, states, and cities have used to control air, water, soil and ocean pollution

These approaches are based on laws, policies and technology, backed by monitoring and enforcement, and encouraged by incentives.

They have proven highly cost-effective

They will prevent disease and save lives

MANDATED TESTING OF CHEMICALS

Goals

- Test new chemicals for toxicity before they come to market
- Prioritize testing of chemicals already in wide use

Current approach under TSCA is a dismal failure

- Chemicals are allowed to enter the market with little or no testing
- Only 5 chemicals have been removed from US markets since 1976

Our children and our grandchildren are the unwitting, unconsenting subjects in this vast toxicological experiment

European REACH program offers a model – “No Data, No Market”, but not always achieved in practice

Testing needs to be independent...industry should pay for toxicity testing, but not control it

MANDATED REVAMPING OF RISK ASSESSMENT

Chemicals and plastics are presumed innocent until proven harmful

They are allowed to remain on markets and human exposure is allowed to continue until danger is proven beyond any reasonable doubt

Need for fundamental revision of chemical policy to break through the failed risk assessment/risk management paradigm

Need for a new paradigm: Chemicals must be proven safe before they are allowed on markets

The Precautionary Principle needs to be incorporated into law

Need for a UN High Commission on Chemicals and Plastic Pollution analogous to the IPCC

GLOBAL INTERVENTIONS AGAINST PLASTIC

The world's nations must urgently develop and implement a strong, comprehensive, and legally binding **Global Plastics Treaty**, pursuant to the 2022 UNEA resolution

A **global cap on plastic production** must be a key component of the Global Plastic Treaty. A global cap will reduce plastics and plastic waste at root source.

A production cap is far more efficient and effective than any downstream solution

Implementation must be guided by targets, timetables and national commitments.

INTERVENTIONS AGAINST PLASTIC

Ban and charge user fees for all single use plastics

Ban microplastics in wash-off products like face scrubs and toothpaste

Compel plastic manufacturers to take financial responsibility for their products across their entire lifecycle – “**extended producer responsibility**”. Costs can no longer be externalized.

Require plastic manufacturers to pay into a fund dedicated to environmental clean-up of plastic waste

Incentivize development of safer, more sustainable materials to replace plastic

Monitoring: Support wide-scale human and environmental monitoring for plastic chemicals and microplastics

ULTIMATE SOLUTION: REINVENTION OF THE CHEMICAL INDUSTRY

Transition away from fossil fuels to renewable sources both for energy and for the production of sustainable feedstocks and platform chemicals

Develop a diverse new set of safer, more sustainable molecules and manufacturing processes

Reimagine product design, delivery, and consumption patterns so that products use safer chemicals, have lower adverse impacts through their life cycles, and at the end of their lives can become raw materials for new products



THANK YOU