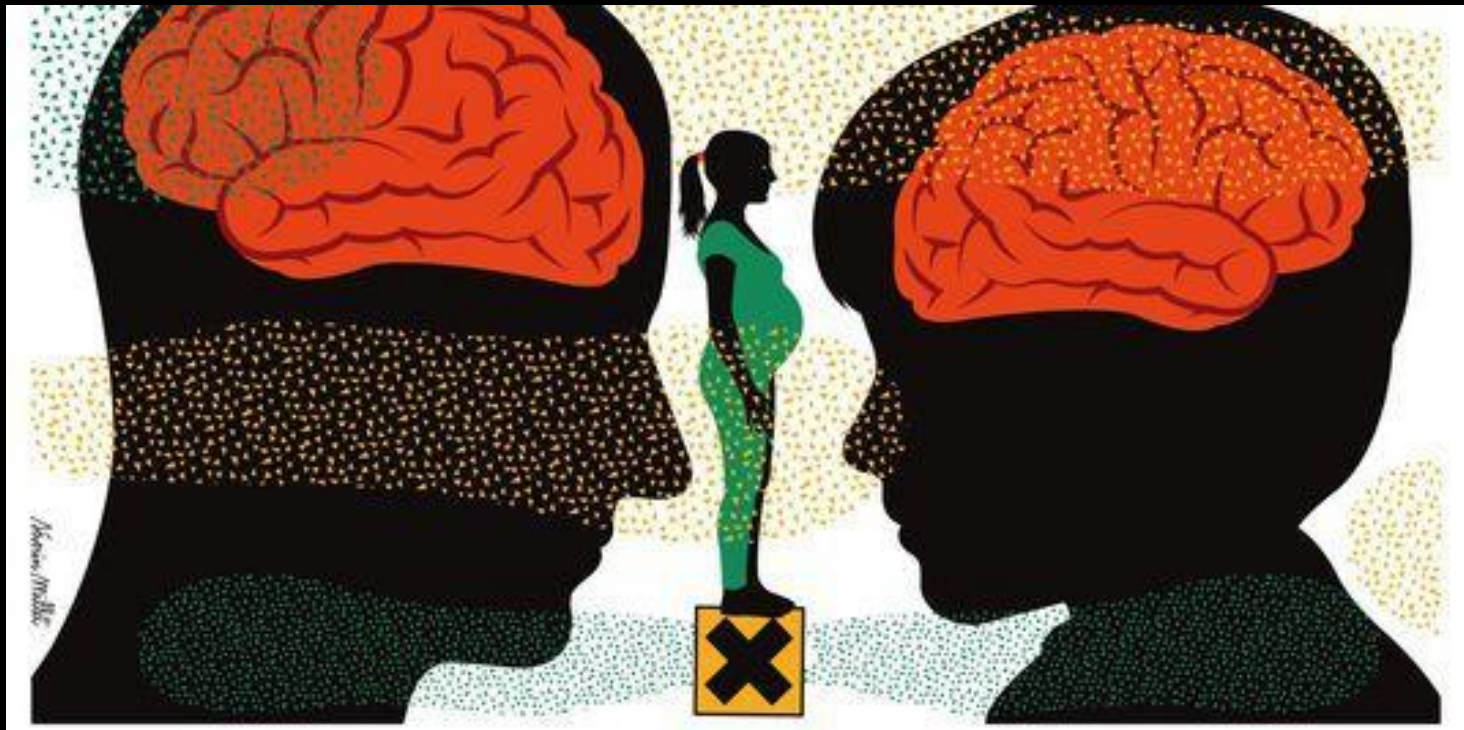


# Toxic Cocktail: How environmental pollution is poisoning our brains

Professor Barbara Demeneix  
MNHN / Sorbonne Universities, Paris  
CHE\_HEAL June 2017



# TOXIC COCKTAIL



How Chemical Pollution Is  
Poisoning Our Brains

BARBARA DEMENEIX

**OXFORD**  
UNIVERSITY PRESS

[> Testing of chemicals](#)[> Assessment of chemicals](#)[> Risk management of chemicals](#)[> Chemical accident prevention, preparedness and response](#)[> Pollutant release and transfer register](#)[> Safety of manufactured nanomaterials](#)[> Agricultural pesticides and biocides](#)[> Biosafety - BioTrack](#)

## OECD Guidelines for the Testing of Chemicals

The [OECD Guidelines](#) are a unique tool for assessing the potential effects of chemicals on human health and the environment. Accepted internationally as standard methods for safety testing, the Guidelines are used by professionals in industry, academia and government involved in the testing and assessment of chemicals (industrial chemicals, pesticides, personal care products, etc.). These Guidelines are regularly updated with the assistance of thousands of national experts from OECD member countries. OECD Test Guidelines are covered by the Mutual Acceptance of Data, implying that data generated in the testing of chemicals in an OECD member country, or a partner country having adhered to the Decision, in accordance with OECD Test Guidelines and Principles of Good Laboratory Practice (GLP), be accepted in other OECD countries and partner countries having adhered to the Decision, for the purposes of assessment and other uses relating to the protection of human health and the environment.

[> More about OECD Test Guidelines](#)[> Section 1: Physical Chemical Properties](#)[> Section 2: Effects on Biotic Systems \(Software for TG 223\)](#)[> Section 3: Degradation and Accumulation](#)[> Section 4: Health Effects \(Software for TG 455, TG 432 and TG 425\)](#)[> Section 5: Other Test Guidelines](#)[> List of Adopted Test Guidelines Including Dates of Revisions](#)[> List of TG Addenda adopted by Council](#)[> Draft Test Guidelines and public commenting rounds](#)

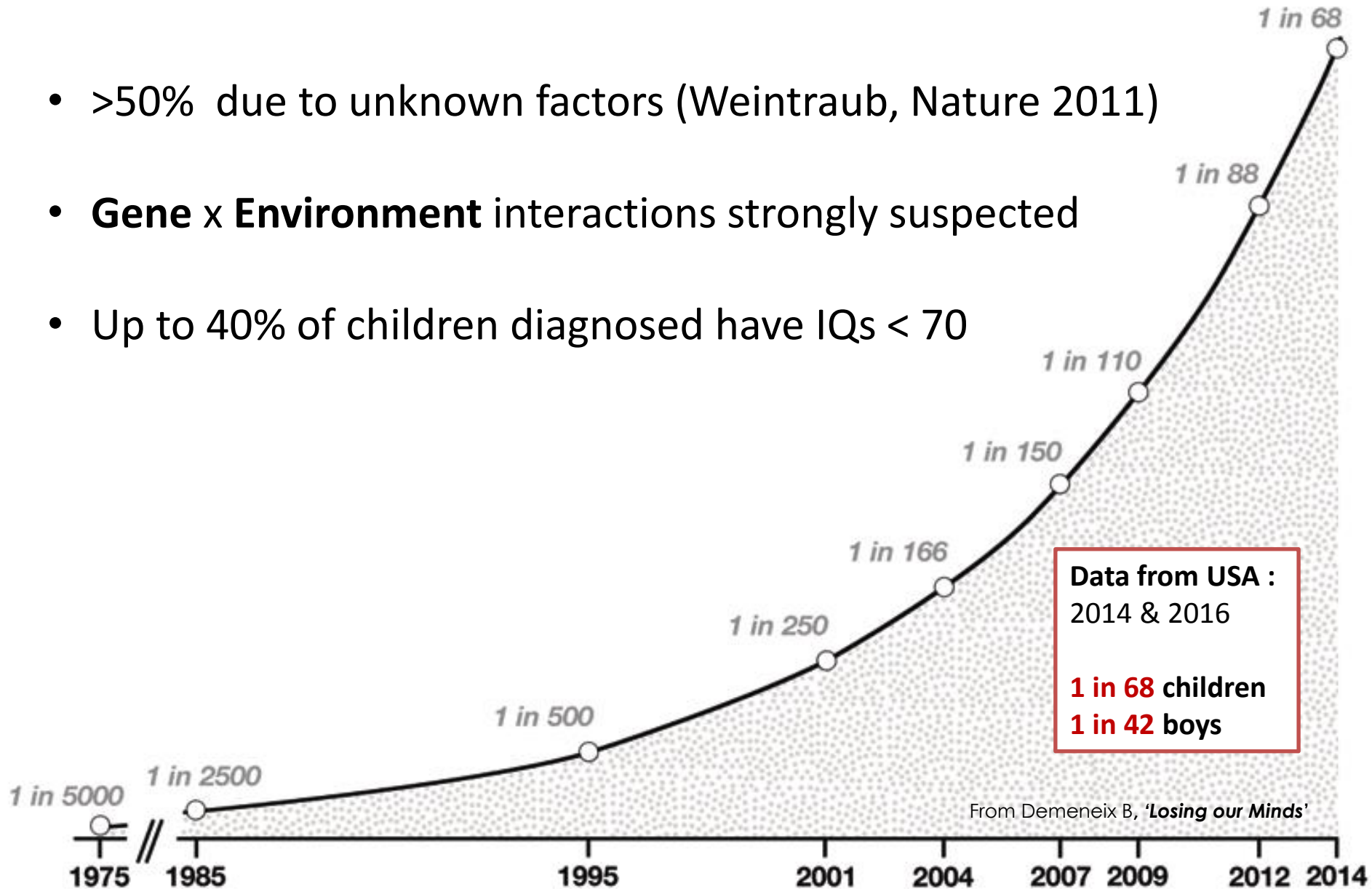
# Disclosure

I am a co-founder of WatchFrog - but receive no financial compensation.

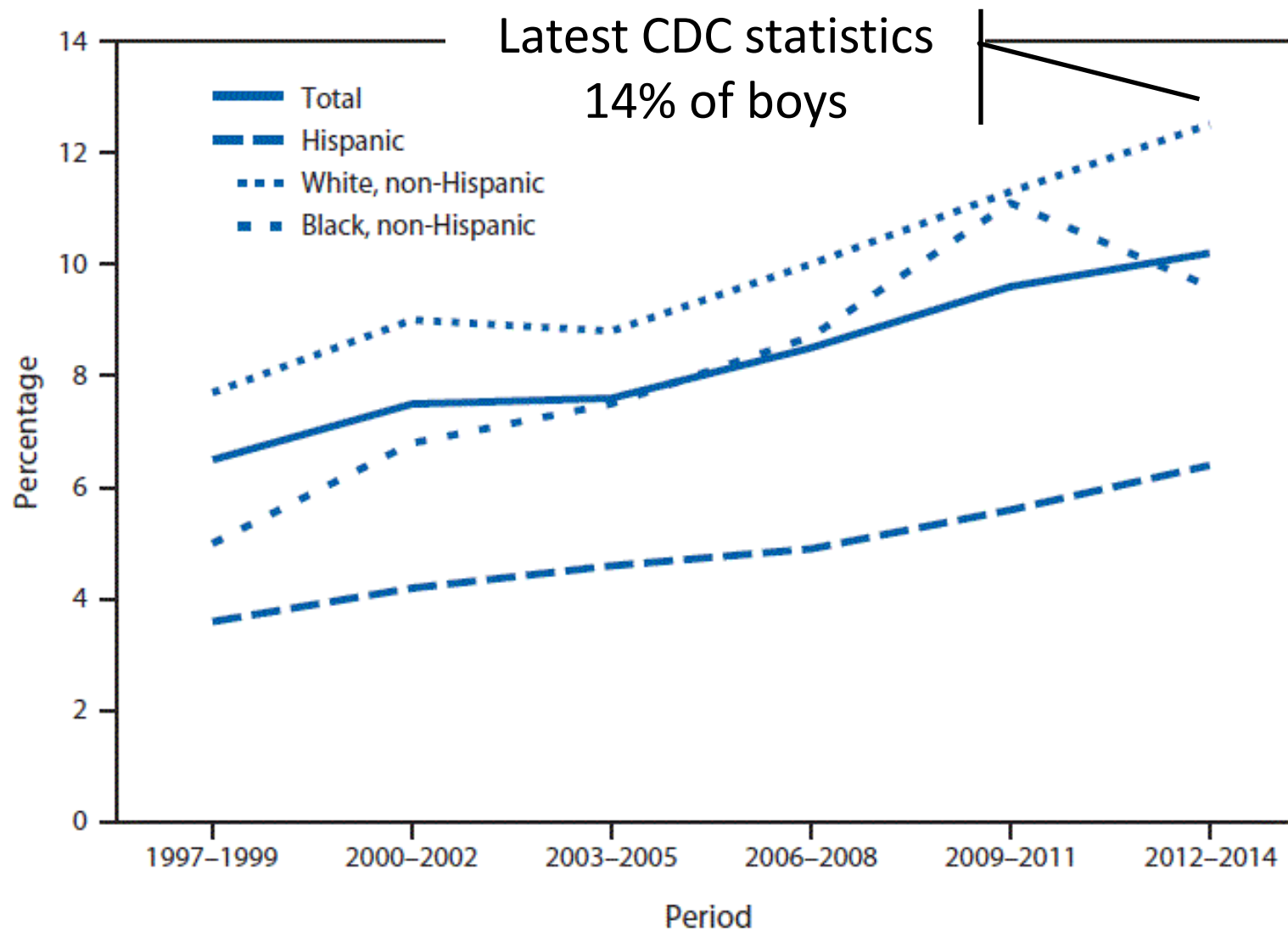


# Unexplained increase in neurodevelopmental disease

- >50% due to unknown factors (Weintraub, Nature 2011)
- **Gene x Environment** interactions strongly suspected
- Up to 40% of children diagnosed have IQs < 70

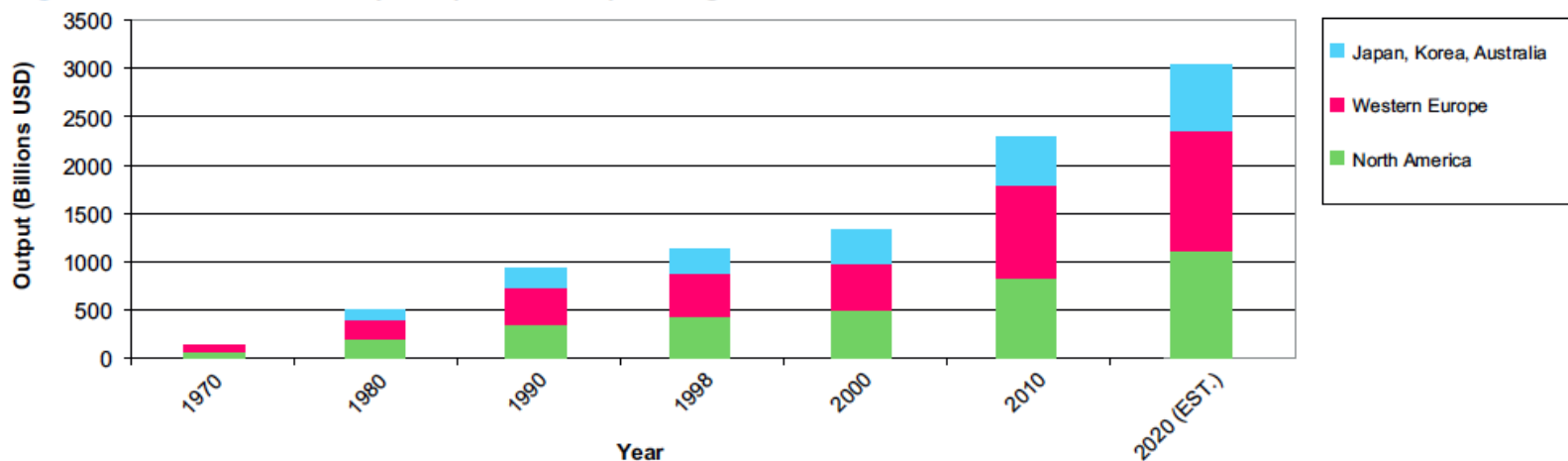


# Attention Deficit/ Hyperactivity Disorder increase USA

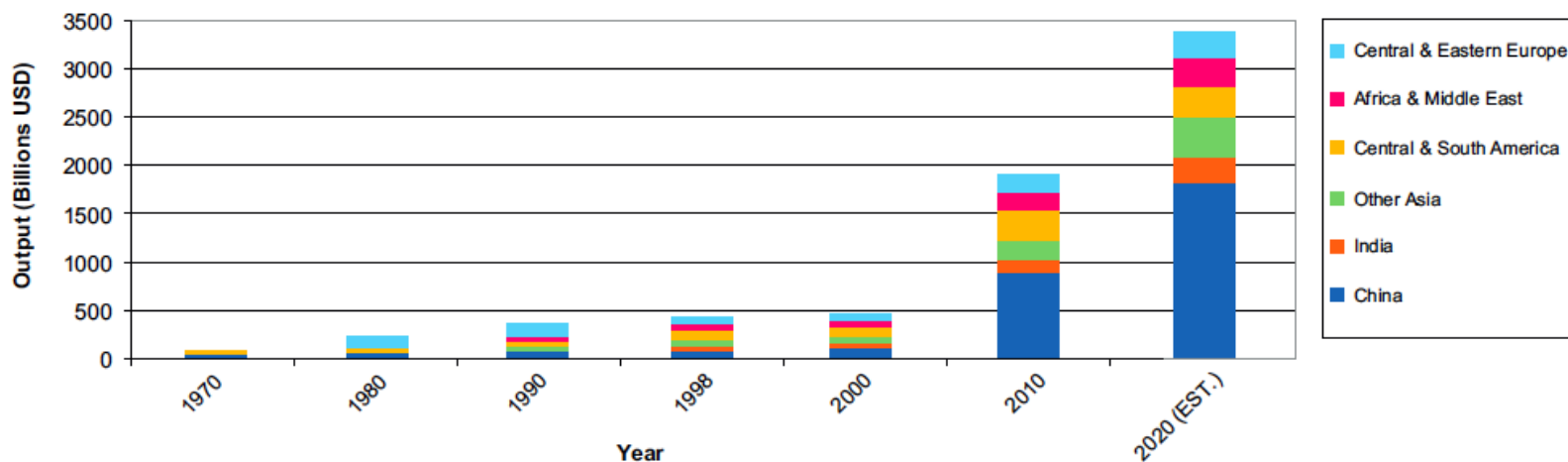


# Production by the Chemical industry set to increase 300 fold between 1970 - 2020

**Figure 1.** Chemical Industry Output: Developed Regions\*



**Figure 2.** Chemical Industry Output: Developing Regions\* & Countries with Economies in Transition



\*As categorized by UN Statistics Division, <http://unstats.un.org/unsd/methods/m49/m49regin.htm>, accessed 24 November, 2011, with the exception of the Republic of Korea. **1970-1990 Source:** U.S. Chemical Manufacturers Association (1998). *U.S. Chemical Industry Statistical Handbook*. Chemical Manufacturers Association, Inc. **2000-2010 Source:** American Chemistry Council (2011). "Global Business of Chemistry: Global Chemical Shipments by Country/Region (billions of dollars)." Retrieved from: <http://www.americanchemistry.com/Jobs/EconomicStatistics/Industry-Profile/Global-Business-of-Chemistry>. Accessed: 11 August, 2011. **2020 Estimation Source:** American Chemistry Council, *Mid-Year 2011 Situation & Outlook*, June 2011.







**Linda Birnbaum** Director NIEHS

**Exposure to multiple chemicals is inevitable ... we live in a chemical soup...**

**Many** of these industrial chemicals contain bromine, fluorine or chlorine and can interfere with **thyroid hormone signalling** - act as **endocrine disruptors**.

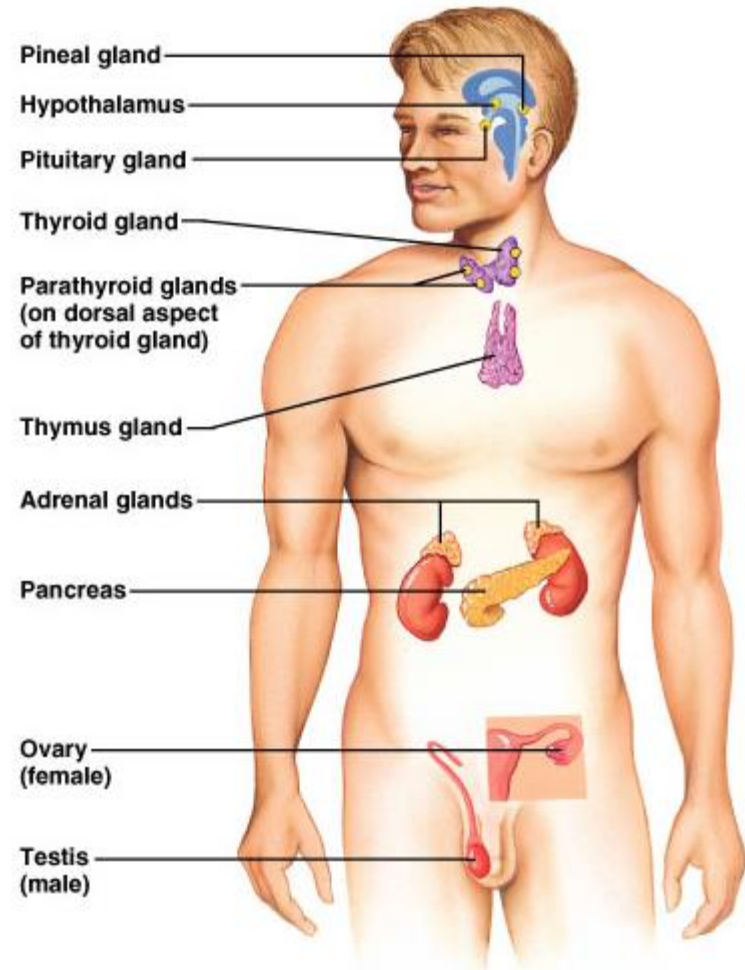
Thyroid hormone contains **iodine**, both **iodine and thyroid hormone** are essential for **brain development**.

**Exceedingly vulnerable to endocrine disruption.**



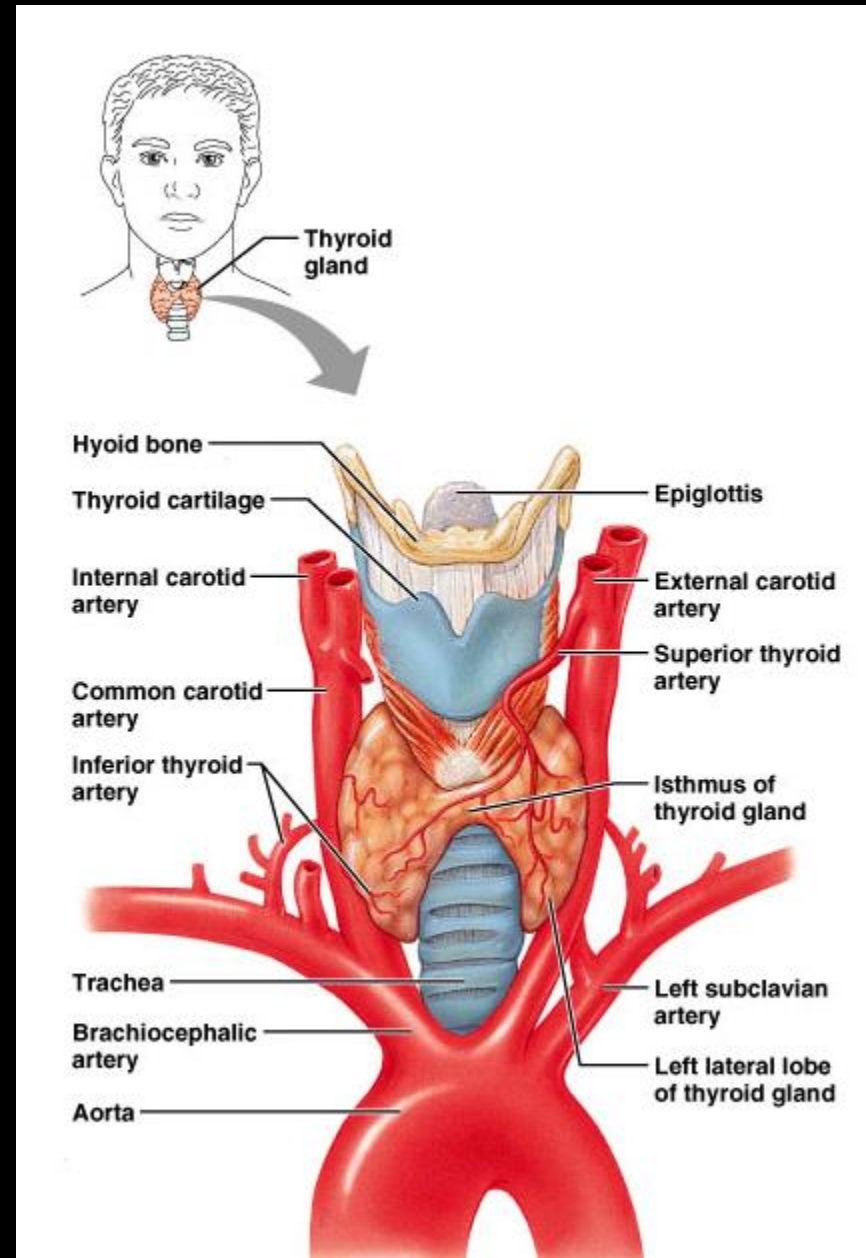
# Endocrine Organs

- Purely endocrine organs
  - Pituitary gland
  - Pineal gland
  - Thyroid gland
  - Parathyroid glands
  - Adrenal: 2 glands
    - Cortex
    - Medulla
- Endocrine cells in other organs
  - Pancreas
  - Thymus
  - Gonads
  - Hypothalamus



# The Thyroid Gland

- Anterior neck on trachea just inferior to larynx
- Produces two **Thyroid hormones:**
  - **T4** (thyroxine) and **T3**
  - **4 or 3 iodine molecules**



**Iodine discovered in 1813**

**BUT** iodine deficiency still a major cause of preventable intellectual retardation

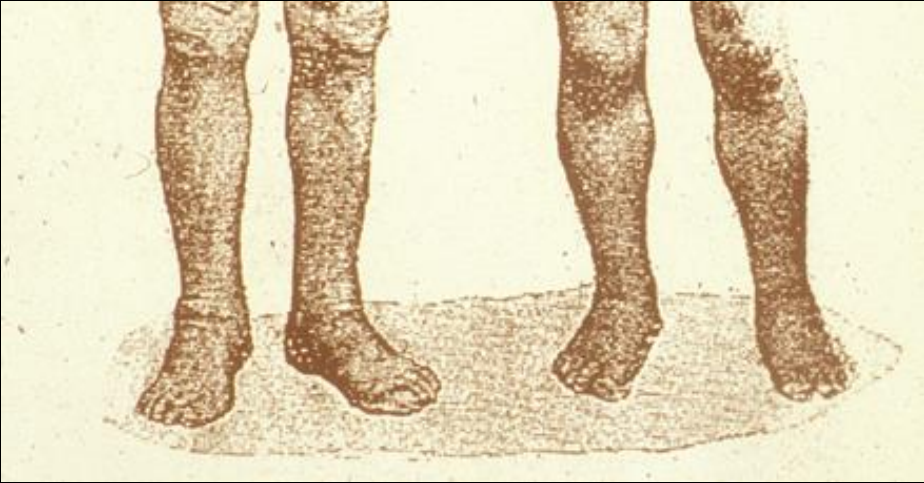


**Thyroid hormone isolated in 1912**

Cretinism virtually eradicated worldwide due to postnatal T4 therapy 1970s

Without a minimum of thyroid hormone, at the right time, a tadpole fails to become a frog and a human baby becomes a cretin.

*Jacques Legrand 1976*



**BUT**

In the last twenty years we have witnessed a revolution in understanding thyroid hormone signalling

- **Need for tight control of maternal levels of thyroid hormone in early pregnancy**

**Environment Special:**  
The oceans—why 70%  
of our planet is in danger

**The Facebook Movie:**  
The secret history of  
social networking

# TIME

**How the  
first nine  
months  
shape  
the rest  
of your life**

The new science  
of fetal origins  
BY ANNIE MURPHY PAUL

THREE

**Mothers' thyroid  
hormone levels  
modify children IQ  
and brain structure**

*Tim Korevaar ...Robin Peters,  
Lancet Diabetes Endocrinology  
2016 4, 35-43*



# Endocrine disruptors present in maternal blood are also found in amniotic fluid

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Pesticide metabolites

BPA

Benzophenone-3

4-4' -DDE

Triclosan

Diethyl hexyl phtalate (DEHP)

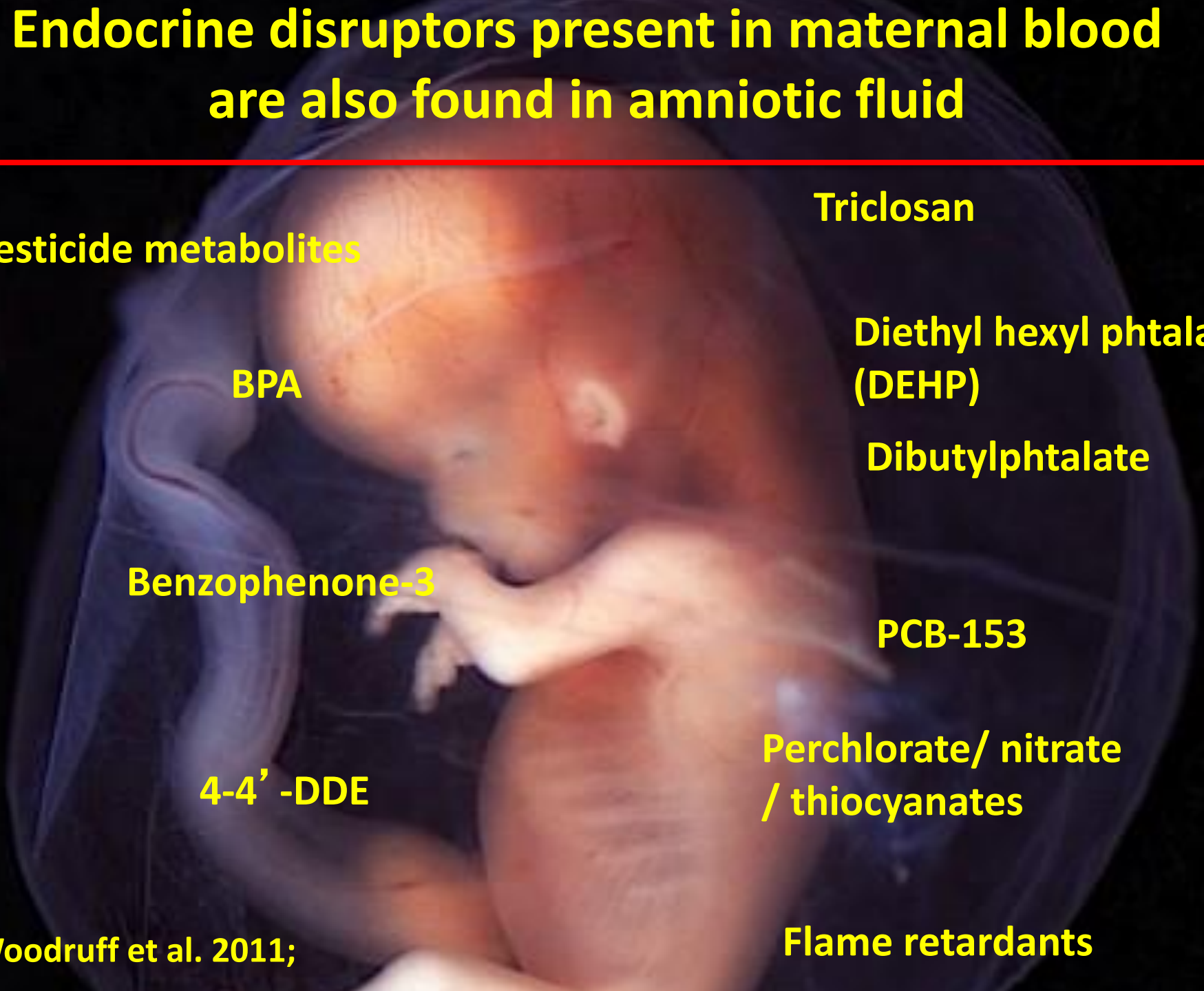
Dibutylphtalate

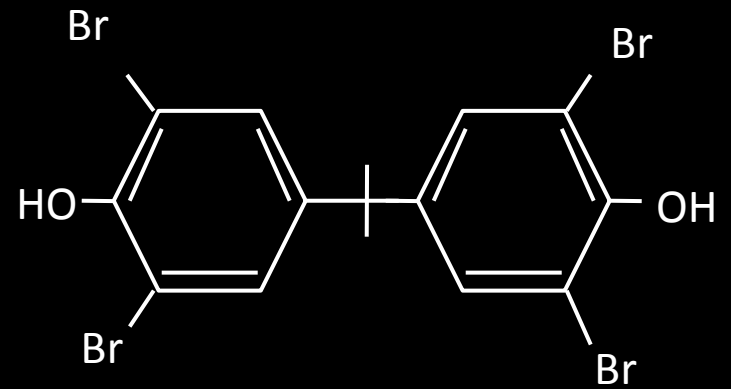
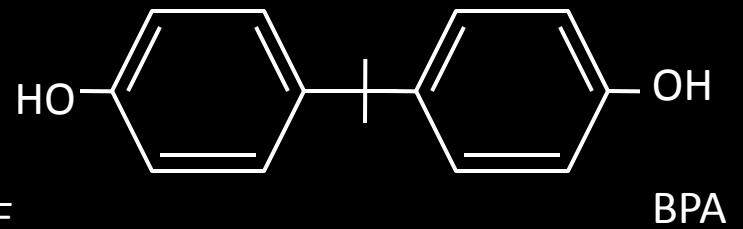
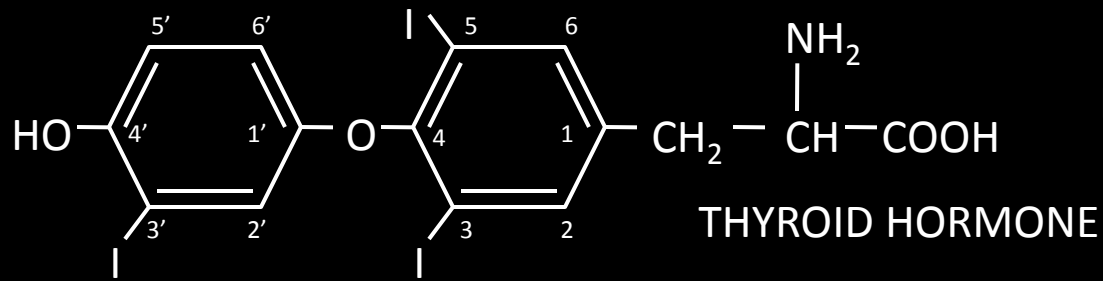
PCB-153

Perchlorate/ nitrate / thiocyanates

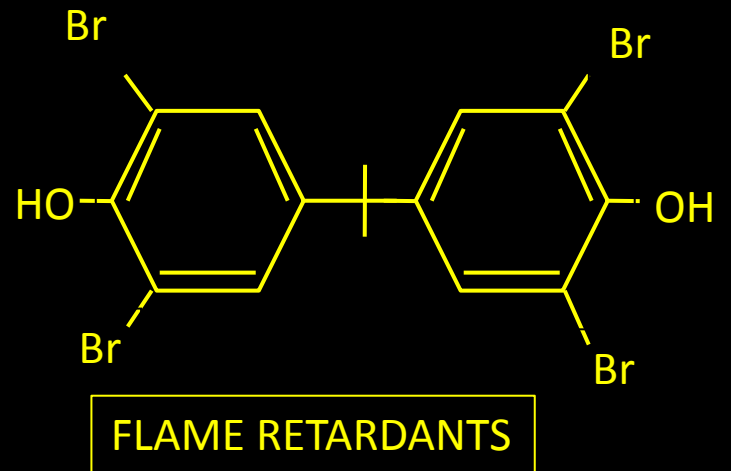
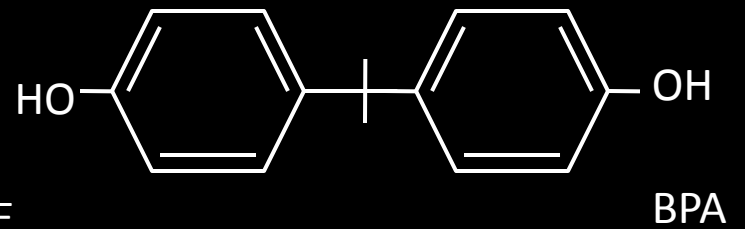
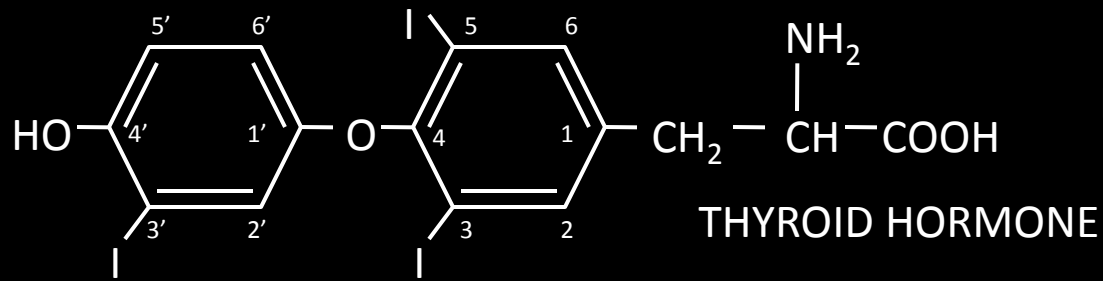
Flame retardants

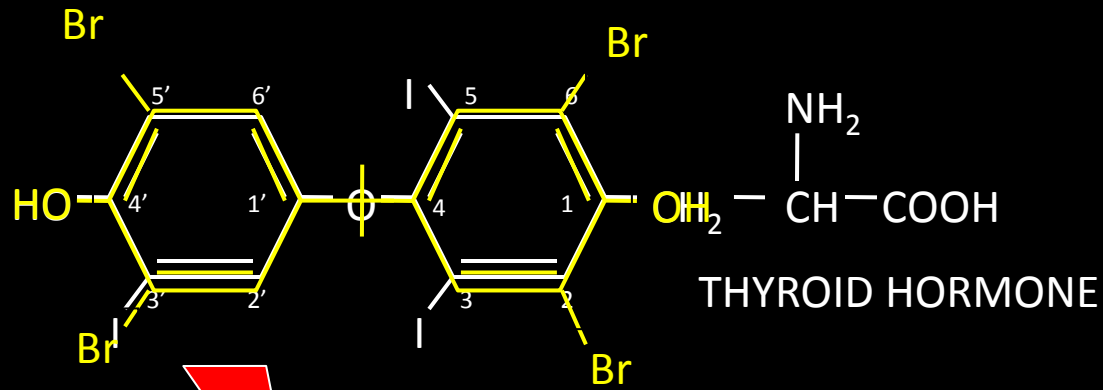
Woodruff et al. 2011;











FLAME RETARDANTS



# Levels of the 15 common contaminants found in human amniotic fluid

## Phenolic compounds

- Bisphenol A (BPA)  $0.2 \cdot 10^{-8}$  M
- Triclosan  $0.7 \cdot 10^{-7}$  M
- Benzophenone-3  $0.9 \cdot 10^{-7}$  M

## Phthalates

- DBP  $0.24 \cdot 10^{-6}$  M
- DEHP  $10^{-7} - 10^{-6}$  M



## Organochlorine pesticides

- HCB  $10^{-11}$  M
- 4-4' DDE  $10^{-9}$  M



FLAME  
RETARDANT

## Polyaromatic hydrocarbons

- 2-Naphthol  $0.5 \cdot 10^{-8}$  M

## Perfluorinated compounds

- PFOS  $0.8 \cdot 10^{-8}$  M
- PFOA  $0.4 \cdot 10^{-8}$  M



## Halogenated compounds

- PCB-153  $0.2 \cdot 10^{-8}$  M
- BDE-209  $0.6 \cdot 10^{-9}$  M
- Sodium perchlorate  $10^{-8}$  M

## Heavy metals


- Methyl Mercury  $10^{-7}$  M
- Lead  $0.2 \cdot 10^{-9}$  M



Many of these compounds individually have been shown to act as thyroid hormone disruptors and to cause IQ loss



# What might be the consequences of these exposures?



14 IQ  
point loss

**Were the Victorians cleverer than us?**

The **decline in general intelligence** estimated from a meta-analysis of the slowing of simple reaction time

M. A. Woodley, J. Nijenhuis, R. Murphy

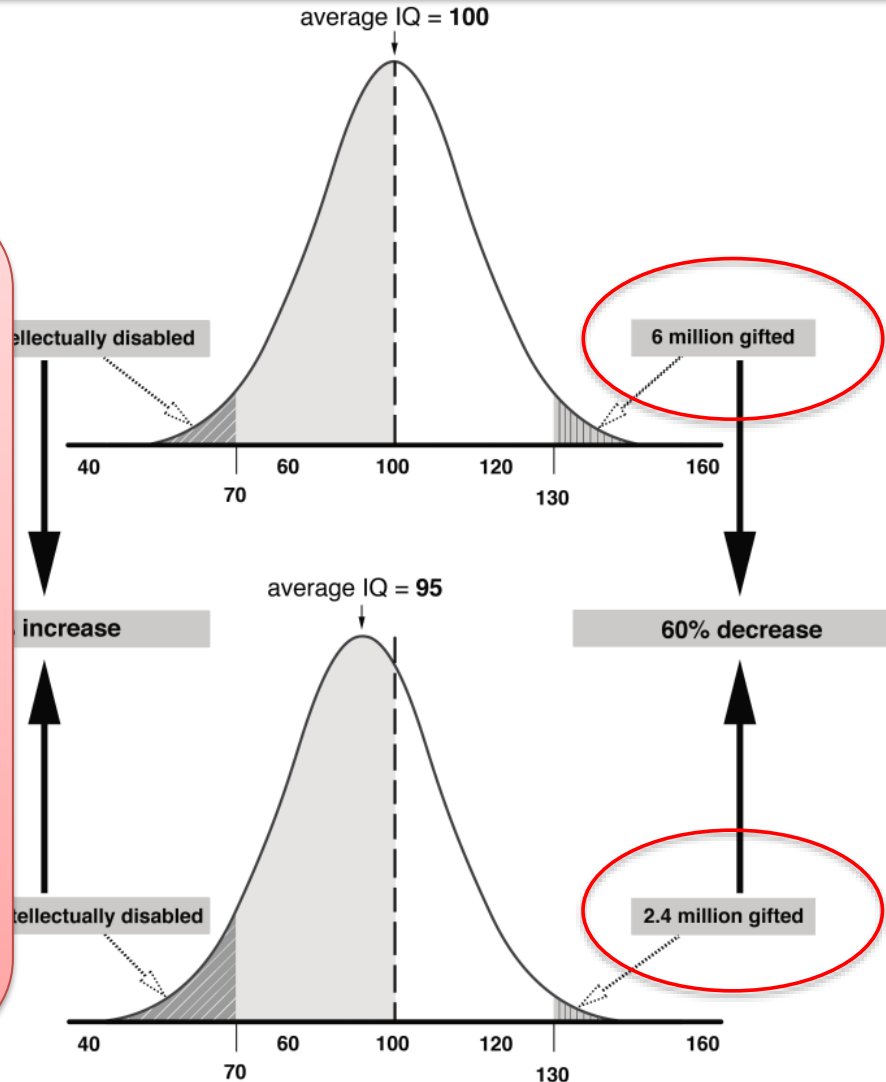
Intelligence 2013

# A 5 point IQ loss results in 60% less gifted individuals

Well documented for:

- Iodine deficiency
- Maternal hypothyroidism
- PCBs
- Lead/ mercury
- Organophosphate pesticides
- PBDEs (flame retardants)

**Additive effects?**



**Socio-economic costs?**

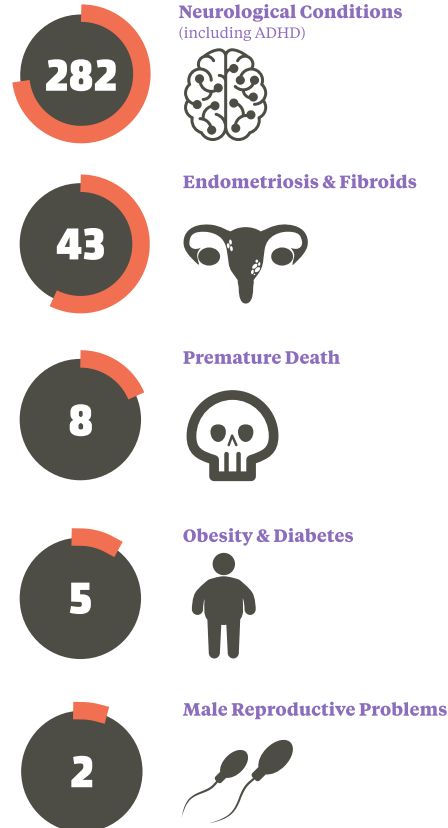


## Health Effects From Endocrine Disrupting Chemicals Cost The U.S.

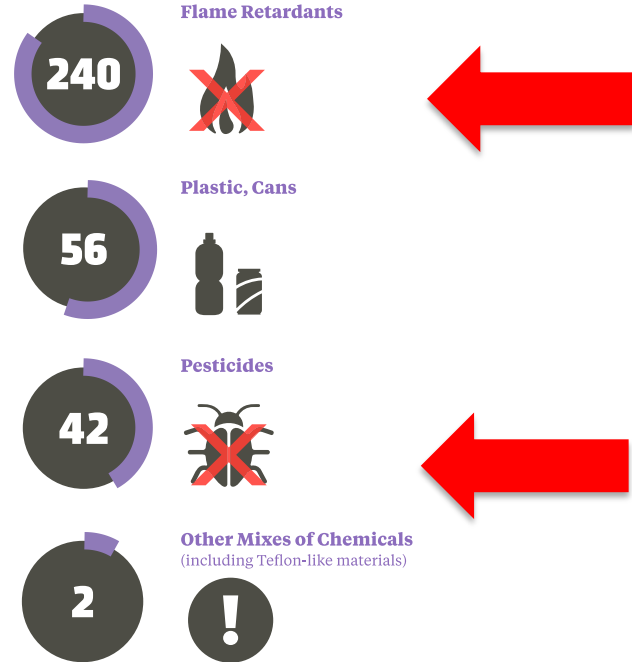
# \$340 Billion Annually

Endocrine Disrupting Chemicals (EDCs) interfere with hormone action to cause adverse health effects in people.

### \$340 Billion by Health Effect



### \$340 Billion by EDC Type





Chemical testing and regulatory decision making is not keeping pace with scientific knowledge.

Legislation is being delayed by lobbying from the chemical industry.

**What can we as individuals do?**

# 10 Ways To Protect Yourself from Toxic Chemicals:

A Guide for New and Expectant Mothers – and mothers of autistic patients

- 1. Avoid plastic in the kitchen.** Try not to consume food and drinks that have touched plastic packaging — use glass or ceramic containers to store food instead. Never drink coffee or other hot beverages from plastic-lined cups, and never microwave food in a plastic container.
- 2. Cook with stainless steel pans** instead of pans with a non-stick coating.
- 3. Buy organic.** Try to buy organic products, especially fruit and vegetables, and prepare food from scratch using fresh produce.
- 4. Limit your consumption of tuna, swordfish, and salmon** to no more than one serving a week, prefer sardines and mackerel for their high iodine and selenium and less toxins.
- 5. Increase your iodine intake.** Take mineral and vitamin supplements that contain 150 micrograms of iodine per daily dose, and **use iodized salt.**

# 10 Ways To Protect Yourself from Toxic Chemicals:

A Guide for New and Expectant Mothers – and mothers of autistic patients

**6. Limit your use of cosmetics**, especially those containing phthalates, triclosan and parabens. Instead of using sunscreen, cover up with a hat and T-shirt.

**7. Don't buy a new car or repaint your house** in the months before or during your pregnancy.

**8. Don't use insecticides or air fresheners** at home.

**9. Seek a doctor's advice before taking any medication.** Even use of acetaminophen should be limited while you are pregnant.

**10. Wash all new clothes** before wearing them, and avoid buying new furniture.

**AND**

# Salt!

Sea salt does not contain Iodine!



Use iodized salt – add to food after cooking







**Toxic Cocktail on Facebook: @ToxicCocktailOUP**



**@BDemeneix**



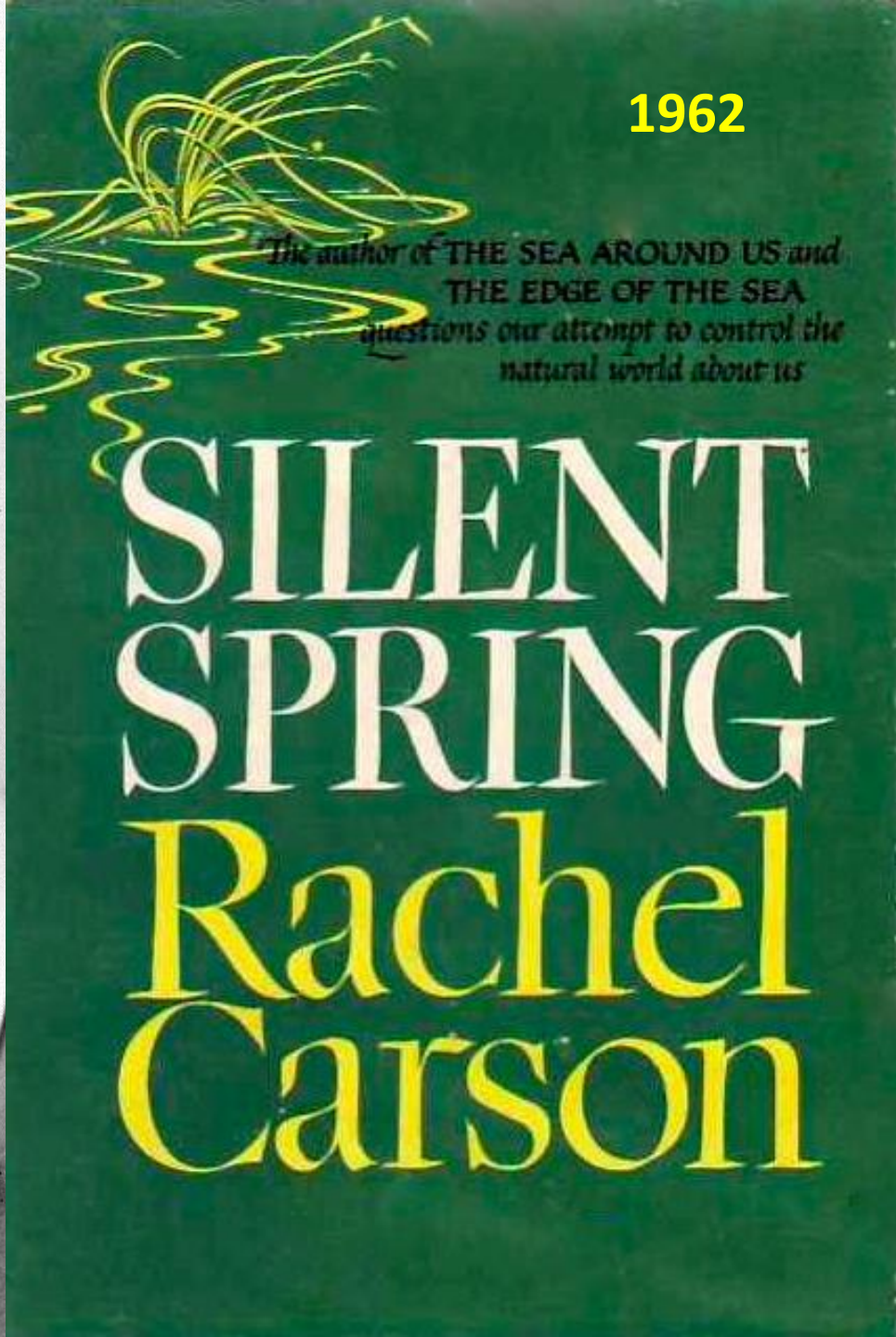
**My blog: [www.bdemeneix.wordpress.com](http://www.bdemeneix.wordpress.com)**





May 27, 1907 – April 14, 1964

1962



*The author of THE SEA AROUND US and  
THE EDGE OF THE SEA  
questions our attempt to control the  
natural world about us*

# SILENT SPRING

## Rachel Carson

