

Disrupting the Symphony of Life

生命の交響曲をかく乱する

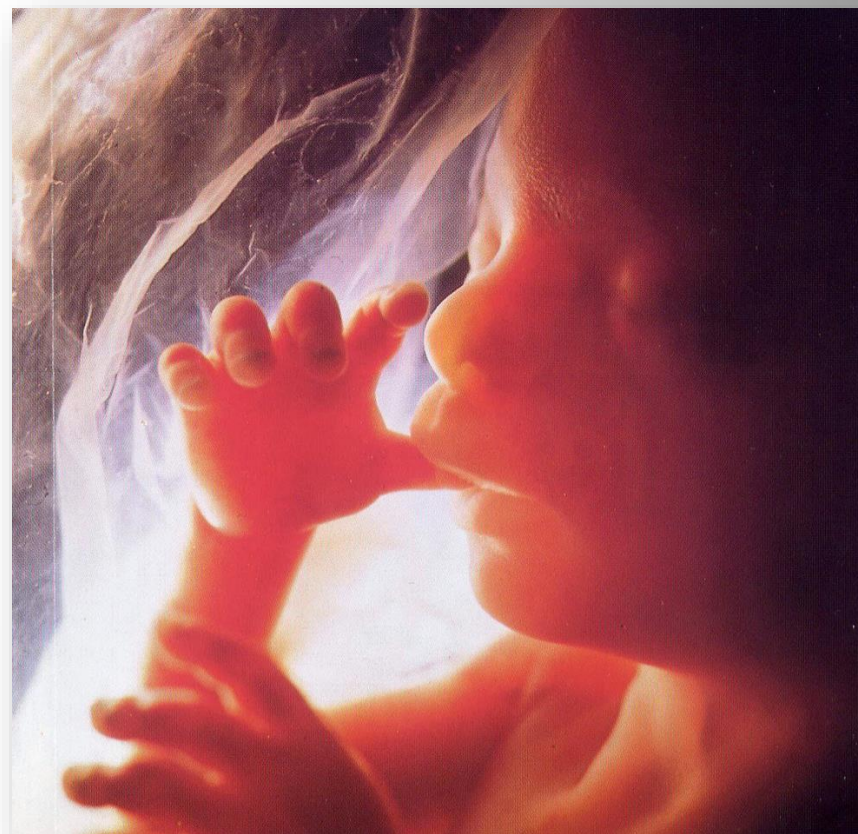
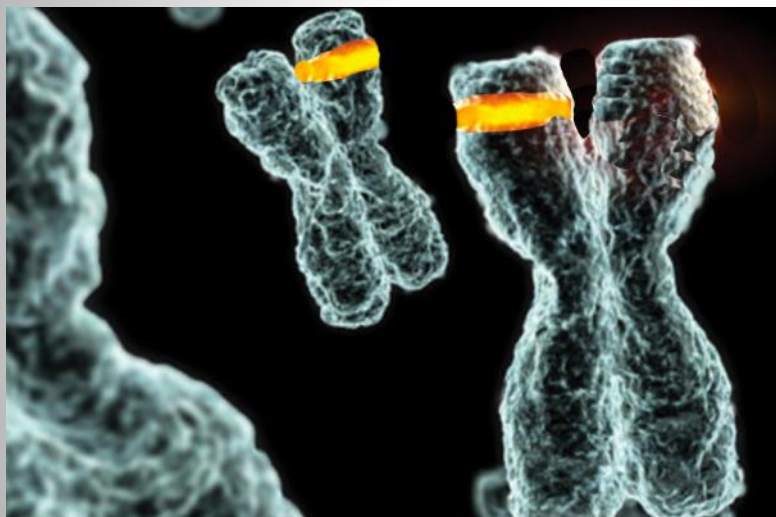
ピート・マイヤーズ博士
環境健康科学
カーネギーメロン大学

Pete Myers, Ph.D.

Environmental Health Sciences
and Carnegie Mellon University

ホルモンは生命の交響曲を奏でる EDC(内分泌かく乱化学物質)はシステムをハックする

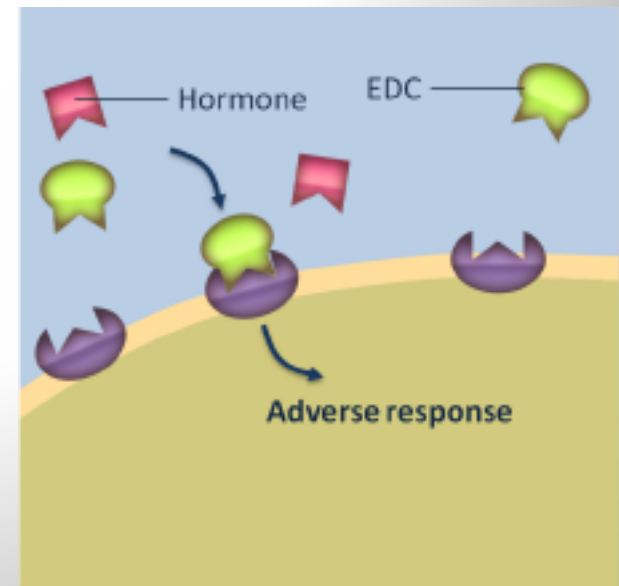
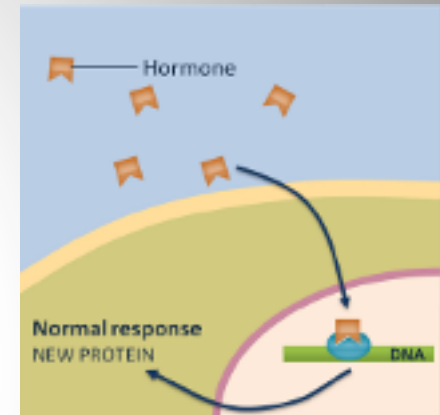
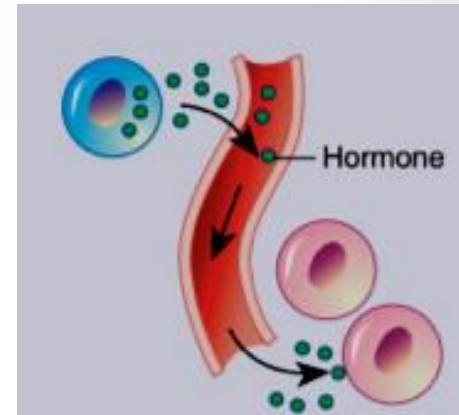
Hormones conduct the symphony of life
EDCs hack the system



ホルモンはどこから来るのか？

Where do hormones come from?

内分泌系 The Endocrine System



ホルモンは体内の分泌腺から来るとして

And if hormones come from glands

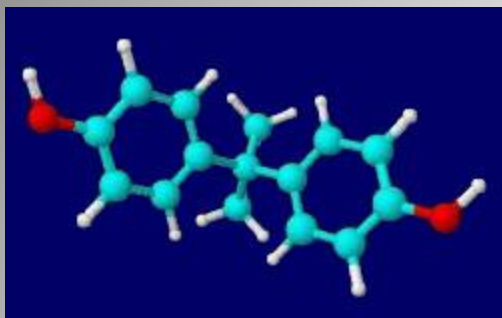
EDCはどこから来るのか？ Where do EDCs come from?

内分泌システム The Endocrine System



石油化学システム The Petrochemical System





ビスフェノールA

Bisphenol A

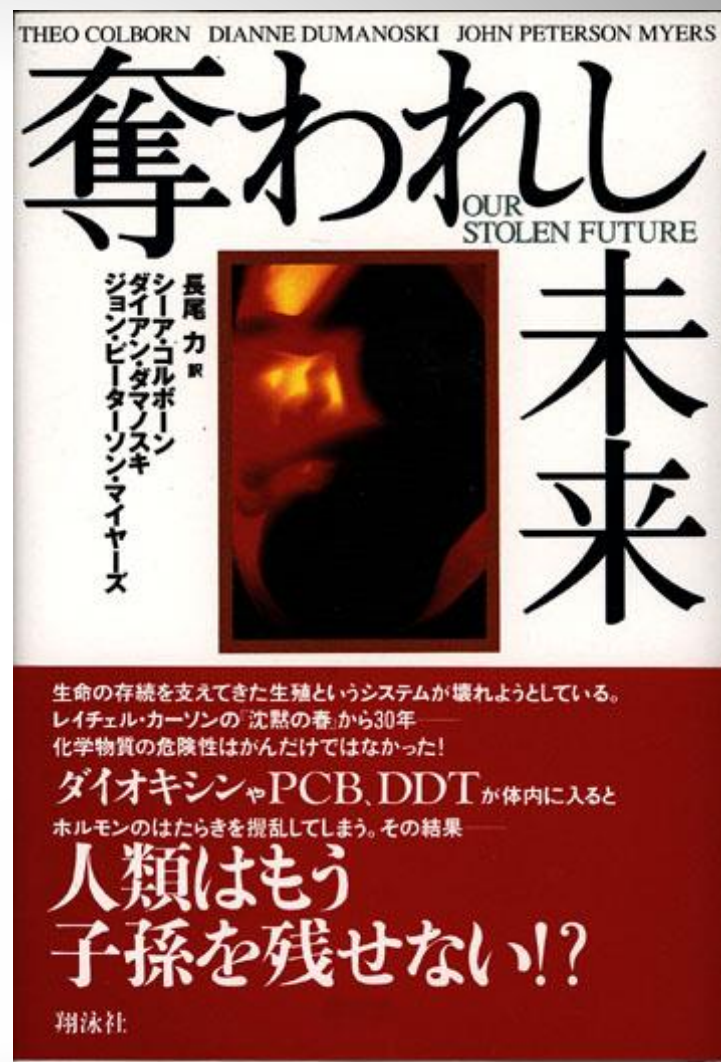
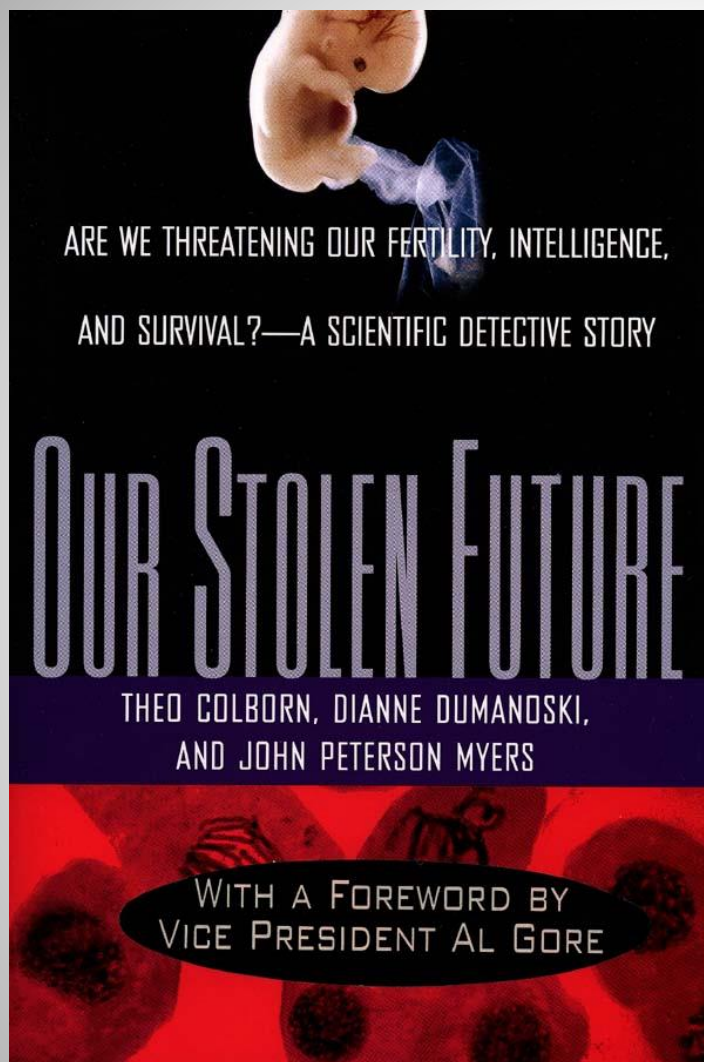




Environmental Health Sciences







EDCに関する慢性疾患

Chronic diseases linked to EDCs

ホルモンが関与するガン

Hormone-related cancers

ADHD

学習障害

Learning disabilities

早産 Pre-term birth

アレルギー
Allergies

子宮内膜症

Endometriosis

不妊症 Infertility

心臓疾患 Heart disease

糖尿病

Diabetes

自閉症 Autism

変性疾患

Degenerative diseases

子宮筋腫 Fibroids

肥満 Obesity

喘息
Asthma

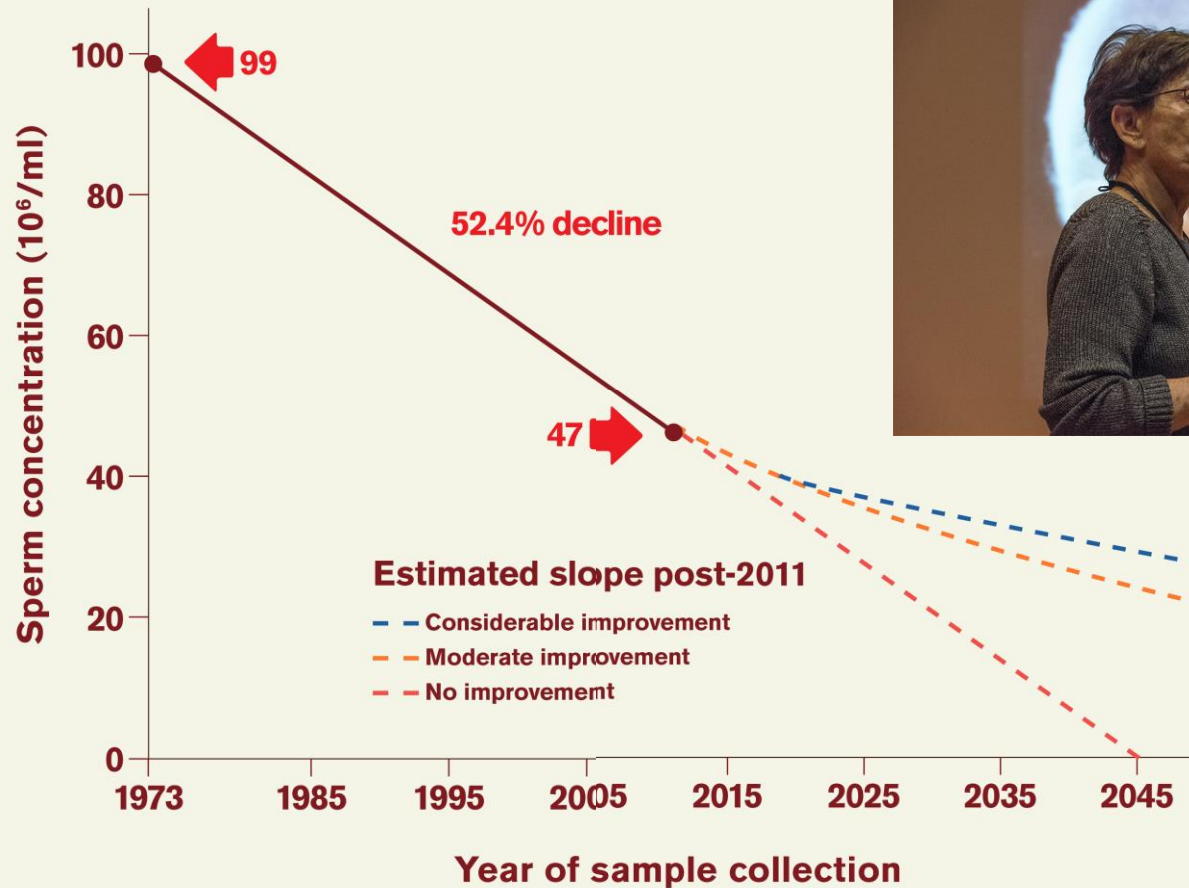
多嚢胞性卵巣
polycystic ovaries

自己免疫疾患
Autoimmunity

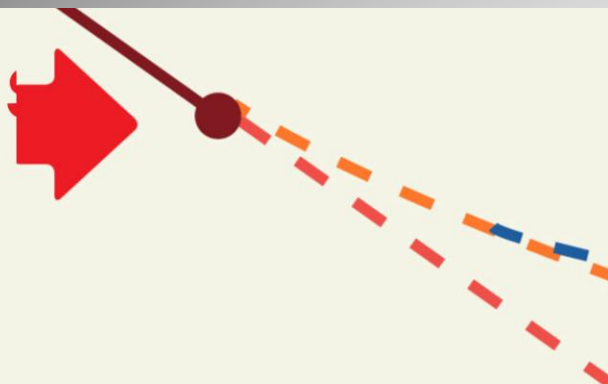


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西洋諸国では精子が減少 Sperm Decline in Western Countries



LEVINE ET AL 2017, GRAPH: GRANTHAM FOUNDATION



ope post-2011

Improvement
ovement
nt



Sperm count

2023 22 years count down to 0

05 2015 2025 2035 2045

FOUNDATIO

科学の革命

Revolution in science

1. 低用量が重要

Low doses matter a lot

2. 子宮内の出来事は子宮内に留まらない

Events in the womb don't stay in the womb

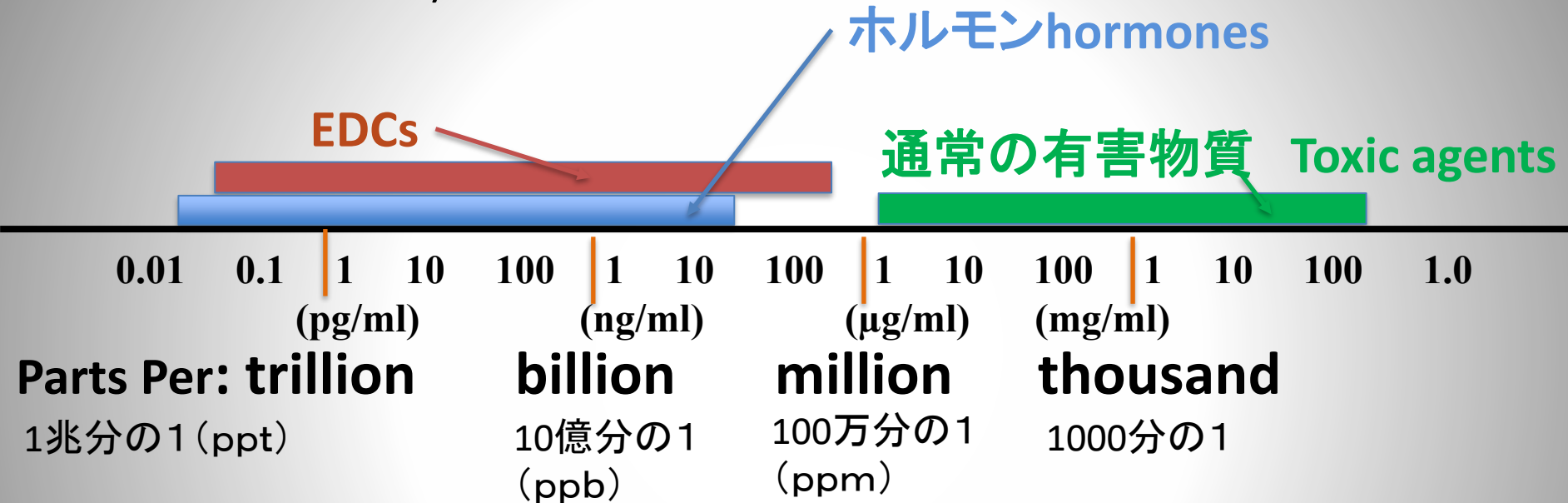
3. 試験方法に深い欠陥

Testing methods are deeply flawed



EDCsは非常に低濃度で有効

EDCs effective at very low concentrations



Hormone and EDC effects amplified

Intracellular machinery amplifies hormone and EDC signaling

Cell membrane receptors via cyclic AMP

Nuclear receptors via mRNA and ribosomes

The diagram illustrates a signal transduction pathway with multiple points of amplification. At the top, a red 'Hormone' molecule binds to a blue 'G-Protein Coupled Receptor' embedded in a yellow cell membrane. This activates the receptor, which then triggers the activation of G-proteins. The first amplification step is labeled 'AMPLIFICATION' with arrows pointing to three activated G-proteins. Each activated G-protein consists of a purple 'G-Protein Active α Subunit' and a green 'Adenyl cyclase' subunit. The activated α subunits then activate 'Adenyl cyclase', which converts 'GTP' into 'cAMP'. This second amplification step is also labeled 'AMPLIFICATION' with arrows pointing to four cAMP molecules. The cAMP molecules then activate 'Protein Kinase A' (PKA), shown as red spheres. This third amplification step is labeled 'AMPLIFICATION' with arrows pointing to four PKA molecules. Each PKA molecule then activates a cluster of 'Protein' molecules, shown as groups of red spheres. This fourth amplification step is labeled 'AMPLIFICATION' with arrows pointing to four clusters of protein molecules. Finally, each cluster of protein molecules produces a 'Final Product', shown as a large, dense cloud of red dots.

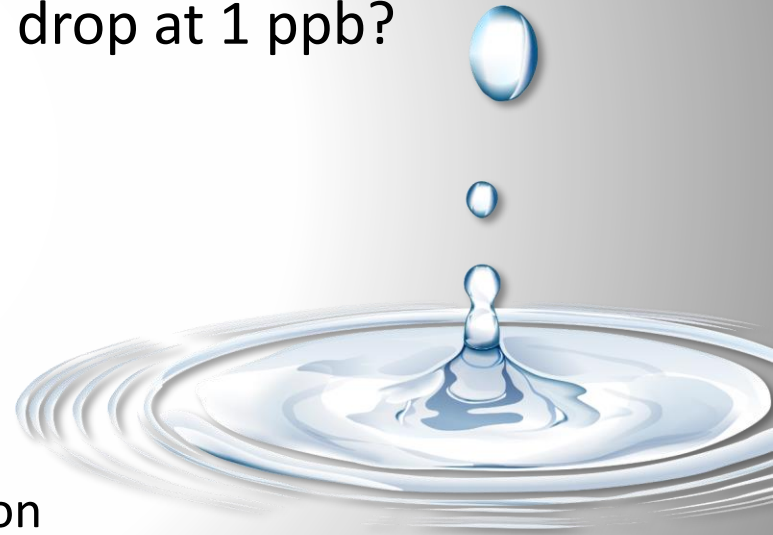
10億分の1 (ppb) とは？

What's a part per billion?

1ppbの濃度には何個のBPA分子が含まれているのか？

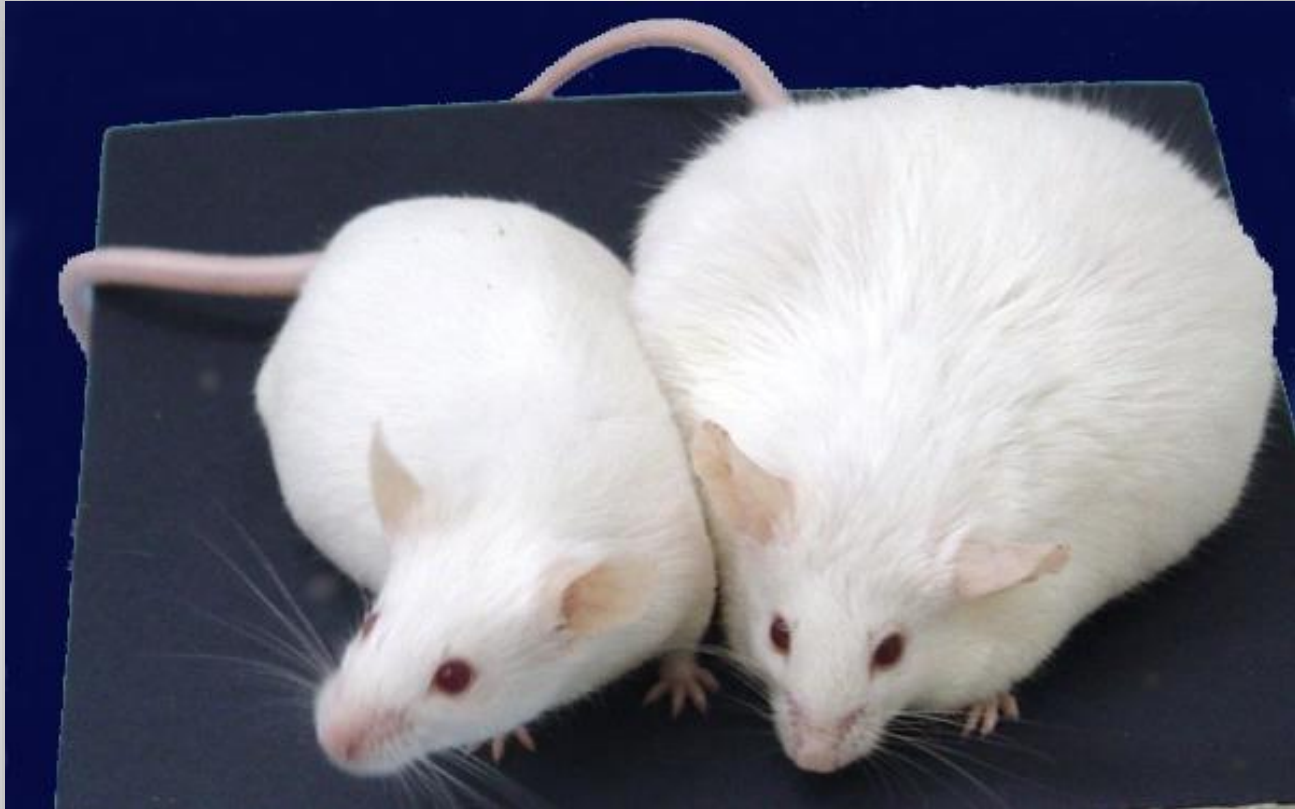
How many molecules of BPA are in this drop at 1 ppb?

2兆6500個 2.65 trillion



10億分の1

1 part per billion



同じ系統のマウス Same strain of mice

同じカロリー摂取 Same caloric intake

同じ活動レベル Same activity levels



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3. テスト方法に深い欠陥

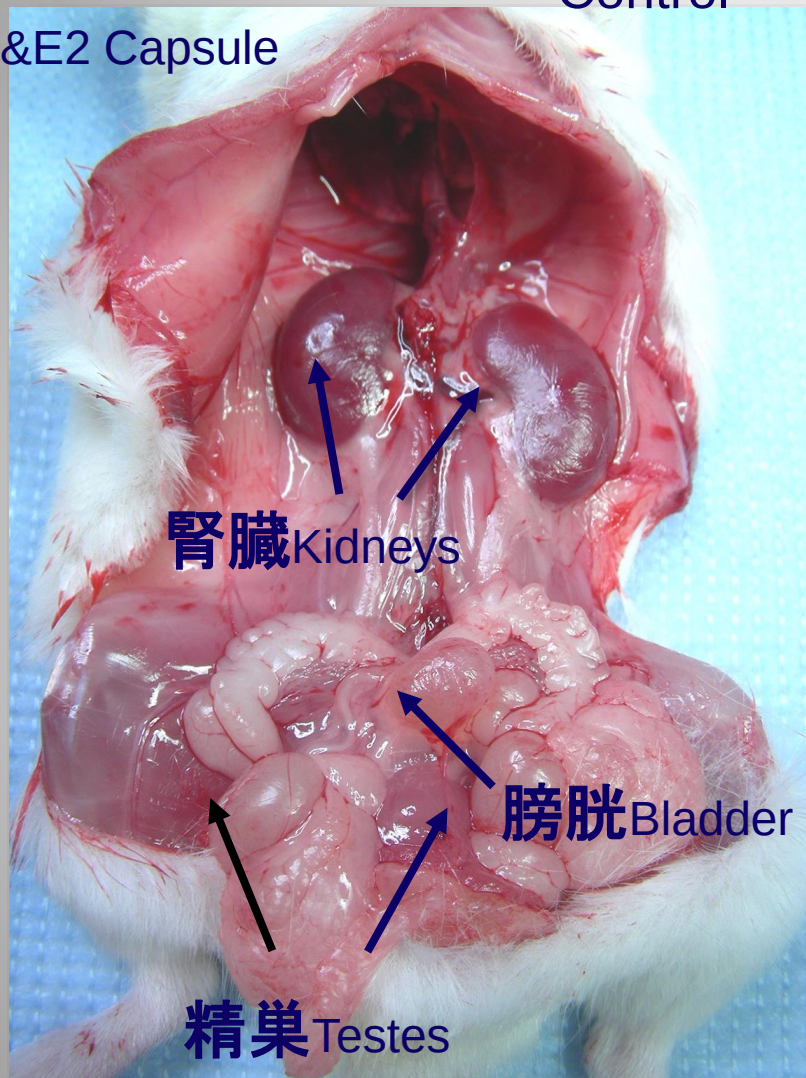
Testing methods are deeply flawed



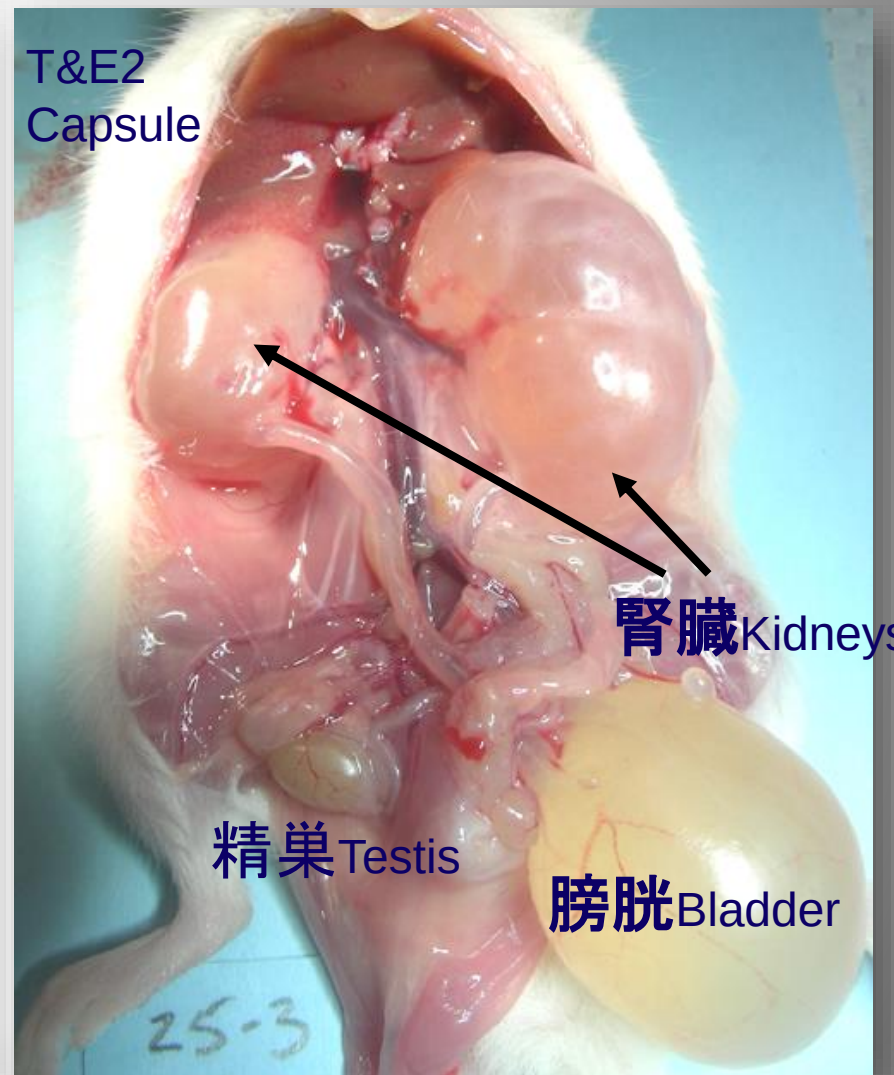
コントロール Control

BPA

T&E2 Capsule



T&E2
Capsule





Environmental Health Sciences

科学の革命

Revolution in science

1. 低用量が重要

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私たちは安全について深く無知である

We are profoundly ignorant about safety

ほとんどの物質は試験されていない

Most have not been tested

試験法には欠陥があり、時代遅れである

The tests used are flawed and outdated

コアの仮説が間違っている

Core assumptions are wrong

問題を隠すために分析が操作されている

Analyses manipulated to hide problems

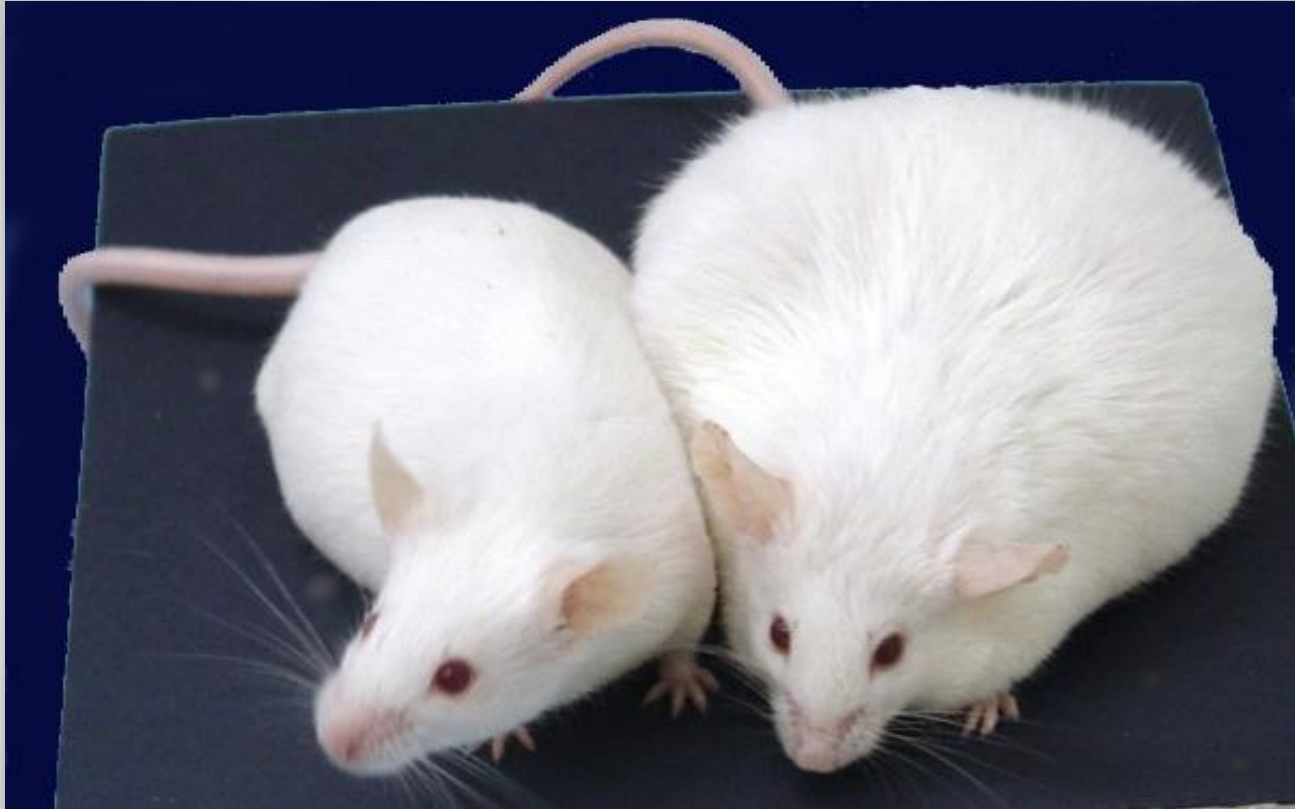


10億分の1

1 part per billion

1000ppbではどうか？

What about 1000 ppb?



同じ系統のマウス Same strain of mice

同じカロリー摂取 Same caloric intake

同じ活動レベル Same activity levels



非単調性が鍵 Non-monotonicity is key

内分泌学の非単調性を理解していなければ、EDCの安全性をテストする資格はない

If you don't understand the endocrinology of non-monotonicity, you have no business testing for safety of EDCs.

あなたは間違えるだろう You will get it wrong.

ロケット科学ではない。内分泌学入門コースで習う基本的な内分泌学だ

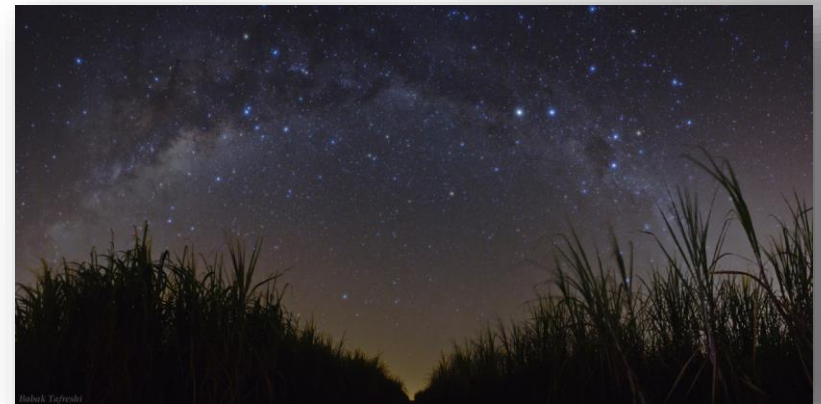
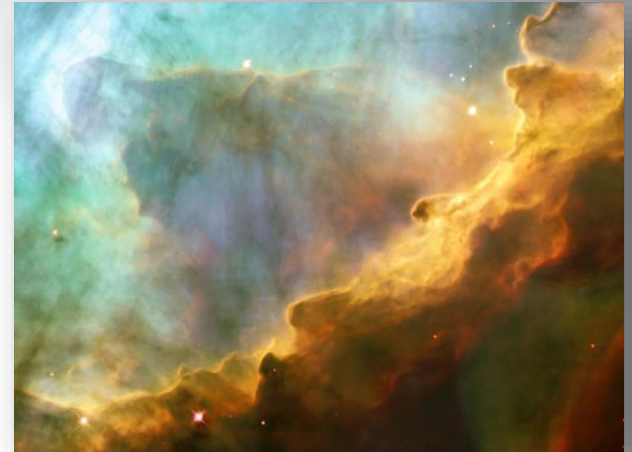
It's not rocket science. It's basic endocrinology, taught in introductory endocrinology courses.

低用量が強いということではなく、高用量(これも悪い場合もある)とは違った効果があるということだ

It's not that lower doses are stronger, it's that they have different effects than high doses (which can also be bad).

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EDCは現在、環境中に大量に存在している。

EDCs are now abundantly ubiquitous in the environment

最高峰の山々に On the highest mountains

北極の雪の中に In the Arctic snow

南極の深海 Antarctic deep

マリアナ海溝の底 Bottom of the Marianas Trench

人里離れた熱帯の河川と森林

Remote tropical rivers and forests

世界中の砂浜 Sandy beaches worldwide

いたるところの雨水 Rainwater everywhere



EDCはどうやってどこにでも行けるのか？

How do they get everywhere?

私たちが運んでいる We carry them

埋立地に廃棄しそこから溶出

We put them in landfills and they leach

揮発し、風に運ばれ、雨で落ちてくる

They volatilize, wind blows, rain falls

川と海の流が運ぶ Rivers and ocean currents carry

動物の移動 Animals migrate



科学はどこへ向かっているか？

Where is the science headed?

さらに多くのEDCが発見される Many more EDCs discovered

さらに多くのEDCメカニズムと健康影響が確認される

Many more EDC mechanisms and health effects identified

毒物学的試験法を21世紀へ

Bring toxicological testing into the 21st Century

本質的により安全な新世代の素材

A new generation of inherently safer materials

内分泌関連の疾病流行の負担を軽減する機会

Opportunities to reduce burden of endocrine-related epidemics.





Environmental Health Sciences



**Advancing
Green Chemistry**



Green Chemistry グリーンケミストリー

Dynamic Article Links 

Cite this: DOI: 10.1039/c2gc35055f 次世代の化学物質から内分泌かく乱物質を排除するデザイン

www.rsc.org/greenchem

PAPER

Designing endocrine disruption out of the next generation of chemicals†

T. T. Schug,^{*a} R. Abagyan,^b B. Blumberg,^c T. J. Collins,^d D. Crews,^e P. L. DeFur,^f S. M. Dickerson,^g T. M. Edwards,^h A. C. Gore,ⁱ L. J. Guillette,^j T. Hayes,^k J. J. Heindel,^a A. Moores,^l H. B. Patisaul,^m T. L. Tal,ⁿ K. A. Thayer,^o L. N. Vandenberg,^p J. C. Warner,^q C. S. Watson,^r F. S. vom Saal,^s R. T. Zoeller,^t K. P. O'Brien^{*g} and J. P. Myers^{*u}

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English 

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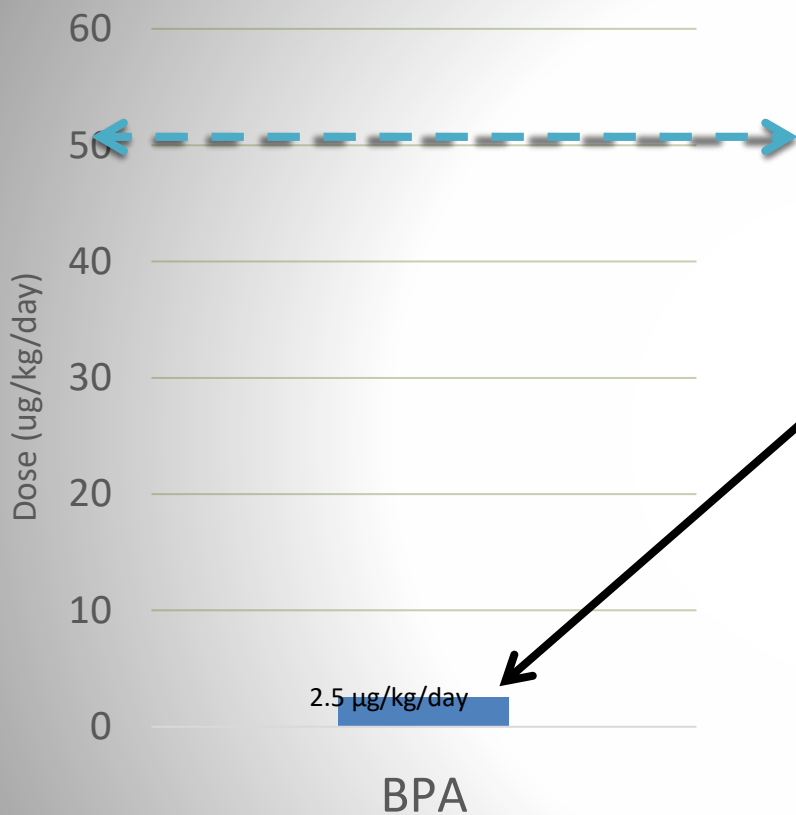


Available languages: English

Speech | 14 October 2020 | Brussels

Opening remarks by Executive Vice-President Timmermans at the press conference on the Chemicals Strategy for Sustainability





現在の耐容1日摂取量 ($50\mu\text{g}/\text{kg}/\text{日}$)

Current tolerable daily intake ($50\mu\text{g}/\text{kg}/\text{day}$)

低用量効果 Low dose effects

新しいLOAEL New LOAEL
(最小毒性量)

新たな耐容1日摂取量 ($0.0025\mu\text{g}/\text{kg}/\text{日}$)

New tolerable daily intake
($0.0025\mu\text{g}/\text{kg}/\text{day}$)

20,000分の1 以下に
20,000 times lower



再考Rethink

再設計
Redesign

改革
Reform



