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Planetary Health and Pollution

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Image from <https://uk.pinterest.com/pin/484671005179850>

Pollution defined...

'any material introduced into the environment as the result of human activity that endangers human health or harms living resources or ecosystems'

Global Commission on Pollution and Health

- Ambient air pollution: fine particulate ($PM_{2.5}$) pollution and tropospheric ozone pollution
- Household air pollution
- Water pollution: unsafe water sources and inadequate sanitation
- Occupational exposures to hazardous chemicals
- Soil pollution, e.g. contaminated industrial and mining sites
- Radiation, ultraviolet and ionising
- Heavy metals
- Plastics and microplastics
- Chemicals of emerging concern, e.g. endocrine disruptors

Global Commission on Pollution + Health

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Major drivers of pollution

- Urbanization
- Increasing use of motor vehicles
- Globalization: relocation of industries to developing countries
- Increasing industrialization
- Increasing chemical production



Presentations Title

Global chemical production

15 June 2017

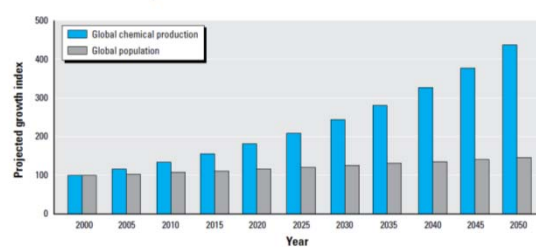


Figure 2. Global chemical production is projected to grow at a rate of 3% per year, rapidly outpacing the rate of global population growth, estimated at 0.77% per year. On this trajectory, chemical production will double by 2024, indexed to 2000 (American Chemistry Council 2003; OECD 2001; United Nations 2004).

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Wilson and Schwarzman, 2009 • Environmental Health Perspectives

4

Planetary boundaries and chemical pollution: not yet quantified...

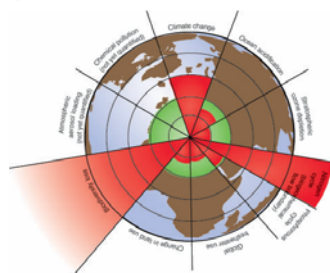


Image from The Stockholm Resilience Centre, Stockholm University, <http://www.stockholmresilience.org/>
Rockström et al. 2009, Ecology and Society 14(2): 32

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5

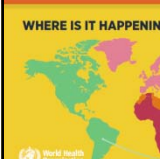
ENVIRONMENTAL IMPACTS ON HEALTH: WHAT IS THE BIG PICTURE?

17 Jan 2017

FACT: 23% of all global deaths are attributable to environmental factors.

GCPH: 'Pollution is the world's largest environmental cause of death'

WHERE IS IT HAPPENING?



AIR POLLUTION (including indoors and outdoors)

CLIMATE CHANGE

BUILT ENVIRONMENTS (including housing and roads)

AGRICULTURAL PRACTICES (including pesticide use, waste-water reuse)

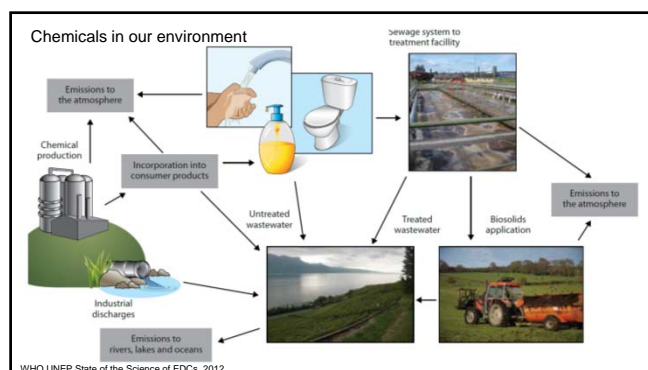
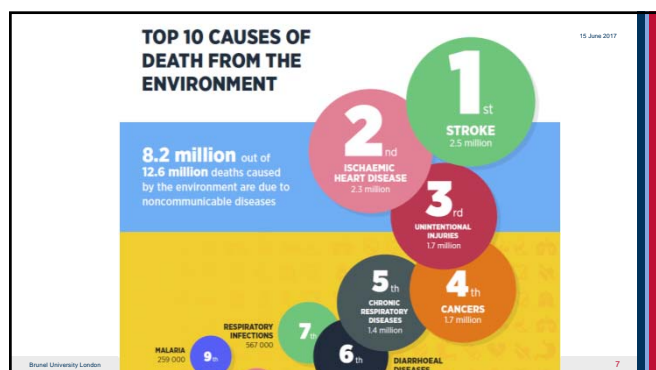
CHEMICALS (and biological agents)

RADIATION (ultraviolet and ionizing)

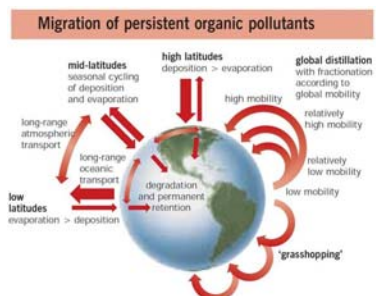
COMMUNITY NOISE

OCCUPATIONAL RISKS

World Health Organization
#EnvironmentalHealth



Chemicals reach every corner of the planet



Exposures during sensitive periods of life



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WHO UNEP State of the Science of EDCs, 2012

Chemicals of concern: endocrine disrupting chemicals

15 June 2017

"An endocrine disruptor is an exogenous **substance or mixture** that alters function(s) of the **endocrine system** and consequently causes **adverse health effects in an intact organism**, or its progeny, or (sub)populations" (IPCS, 2002)

Endocrine system controls:

- Development and growth
- Energy regulation and metabolism
- Internal homeostasis
- Reproduction (sex, pregnancy, lactation)
- Physiology via **chemical signals (hormones)** from one part of the body to another

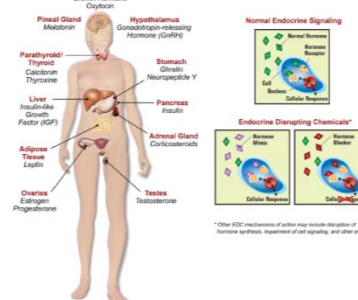


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11

Hormones produced by the endocrine system

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12

Endocrine Disrupting Chemicals

15 June 2017

| HERBICIDES | INSECTICIDES | INDUSTRIAL CHEMICALS |
|-------------|------------------------|--------------------------|
| 2,4-D | Aldicarb | Bisphenol - A |
| 2,4,5-T | beta-HCH | Polycarbonates |
| Alachlor | Carbaryl | Burphydroxanisole |
| Amitro | Chlordane | Cadmium |
| Atrazine | Chlordecone | Chloro- & Bromo-diphenyl |
| Linuron | DBCP | Dioxins |
| Metribuzin | Discolol | Furans |
| Nitrofen | Dieldrin | Lead |
| Trifluralin | DDT and metabolites | Manganese |
| | Endosulfan | Methyl mercury |
| | Heptachlor / H-epoxide | Nonylphenol |
| | Lindane (gamma-HCH) | Octylphenol |
| | Malathion | PCBs |
| | Metomyl | Pentachlorophenol |
| | Hexachlorobenzene | Penta- to Nonylphenols |
| | Mancozeb | Perchlorate |
| | Maneb | PFOA |
| | Metiram - complex | p-tert-Pentylphenol |
| | Tri-butyl-tin | Phthalates |
| | Vinclozolin | Styrene |
| | Zineb | |

EU priority list:
over 560 suspected
endocrine disruptors

Testosterone synthesis inhibitor
Thyroid hormone disruptor

Estrogen receptor agonist
Androgen receptor antagonist

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Effects of endocrine disruptors in wildlife - examples

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- egg shell thinning and feminisation of males in **birds** by DDT and other pesticides (North America, Europe)
- impairment of reproduction and immune function in **seals** by PCB/DDT metabolites, dioxins (Baltic and North Sea)
- masculinization of female marine **snails** by TBT from antifoulings (world-wide)
- feminisation of male **fish** by natural estrogens and xeno-estrogens (world-wide)

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CHEMICAL RESEARCH CHANGES POLICY

THE QUEEN'S ANNIVERSARY PRIZES
For Science and Research

2011

Professor John Sumpter, O.B.E., July 2016

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EDCs and humans: associations with endocrine-related and other diseases

- Reproductive/endocrine**
 - Breast/prostate cancer
 - Endometriosis
 - Infertility
 - Diabetes/metabolic syndrome
 - Early puberty
 - Obesity
- Immune/autoimmune**
 - Susceptibility to infections
 - Autoimmune disease
- Cardiopulmonary**
 - Asthma
 - Heart disease/hypertension
 - Stroke
- Brain/nervous system**
 - Alzheimer disease
 - Parkinson disease
 - ADHD/learning disabilities

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Obesity, planetary health, and pollution

15 June 2017

Image from The Economist, 2014, Special issue on Planetary Health,
<http://www.visionariesunbound.com/static/pdf/>

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Overweight and obesity in males: 1975

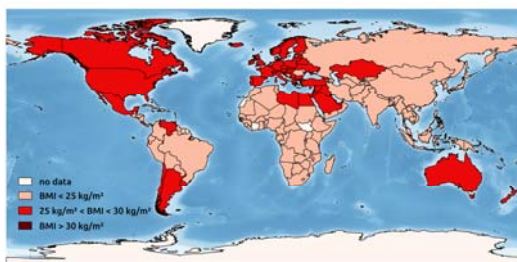
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Maps by Marta Plaza Hernandez, data from WHO/The Lancet

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Overweight and obesity in males: 1995

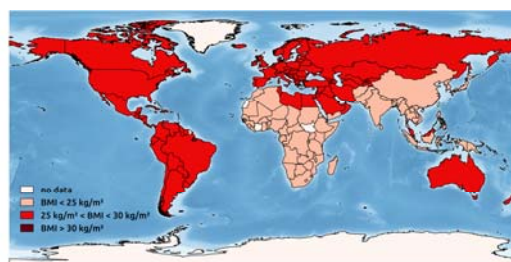
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Brunei University London Presentation Title Maps by Marta Plaza Hernandez, data from WHO/The Lancet 19

Overweight and obesity in males: 2014

15 June 2017

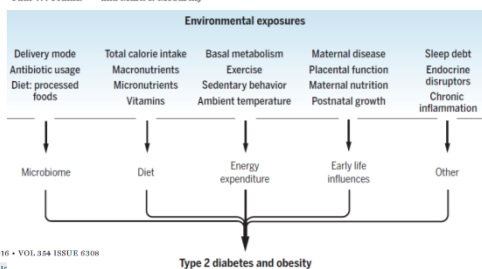


Brunei University London Presentation Title Maps by Marta Plaza Hernandez, data from WHO/The Lancet 20

Exposing the exposures responsible for type 2 diabetes and obesity

Paul W. Franks^{1,2,3} and Mark L. McCarthy^{4,5,6}

Science



7 OCTOBER 2016 • VOL 354 ISSUE 6308

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Type 2 diabetes and obesity

A role for chemical exposures in obesity?

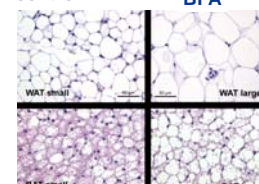
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Developmental exposure to synthetic estrogen (diethylstilbestrol - DES) (Newbold et al., 2007, Repro.Tox)

control

BPA

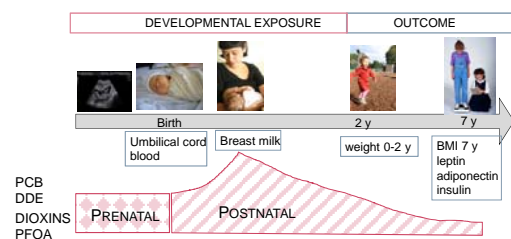


Developmental exposure to chemical in plastics packaging (Bisphenol A - BPA) (van Esterik et al., 2014, Toxicology)

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22

Human studies



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Contents lists available at ScienceDirect
Environment International
 (journal homepage: www.elsevier.com/locate/envint)

Perinatal exposure to dioxins and dioxin-like compounds and infant growth and body mass index at seven years: A pooled analysis of three European birth cohorts
 Nina Izatt^a, Hein Stigum^a, Eva Govarts^b, Lubica Palkovicova Murinova^c, Greet Schoeters^{b,d,e}, Tomas Trnovec^c, Juliette Legler^f, Cathrine Thomsen^g, Gudrun Koppen^h, Merete Eggesbo^{i,j}
 volume 123 | issues 7 | July 2015 • Environmental Health Perspectives

Prenatal and Postnatal Exposure to Persistent Organic Pollutants and Infant Growth: A Pooled Analysis of Seven European Birth Cohorts
 Nina Izatt^a, Hein Stigum^a, Marc-André Verner^{c,d}, Richard A. White^e, Eva Govarts^b, Lubica Palkovicova Murinova^c, Greet Schoeters^{b,d,e}, Tomas Trnovec^c, Juliette Legler^f, Cathrine Thomsen^g, Gudrun Koppen^h, Merete Eggesbo^{i,j}
 Int. J. Environ. Res. Public Health 2014, 11, 7001–7021; doi:10.3390/ijerph110707001

First Year Growth in Relation to Prenatal Exposure to Endocrine Disruptors — A Dutch Prospective Cohort Study
 Marijke de Cock^{1,2}, Michiel R. de Boer¹, Marja Lamoree¹, Juliette Legler¹ and Margot van de Bos¹

