The Chemical Class Approach towards Healthier Products and People

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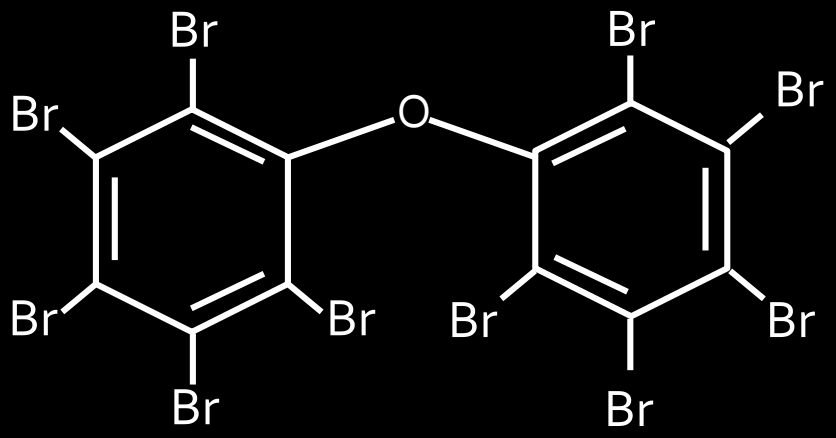
Founder, Green Science Policy Institute
Research Associate in Chemistry, UC Berkeley

January 2018

U.S. Toxic Substances Control Act (1976)

- 62,000 previous chemicals "grandfathered"
- 23,000 new chemicals
  - 85% have no health data
  - 67% have no data at all

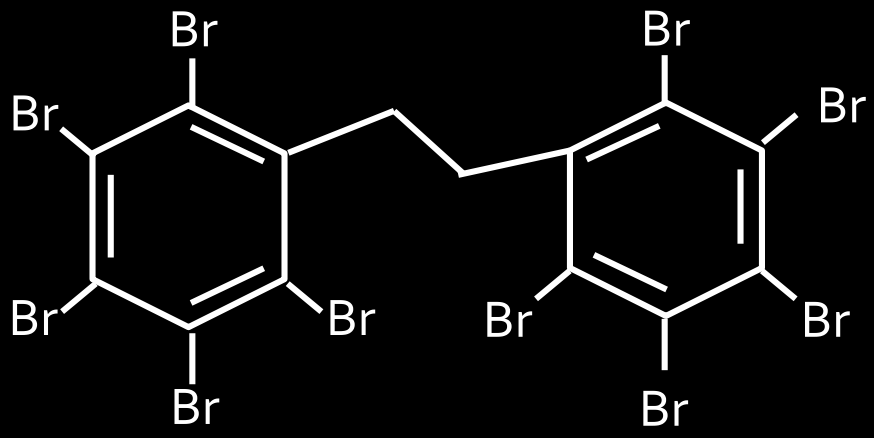
Regrettable Substitution



Decabromodiphenyl ether

Concerns:

- Persistence
- Bioaccumulation
- Toxicity



Decabromodiphenyl ethane

Concerns:

- Persistence
- Bioaccumulation
- Toxicity

GREEN SCIENCE POLICY INSTITUTE

Education

Research

Retreats

Policy & Purchasing Change

Six Classes Videos

An innovative approach to reducing toxics

VIEW and SHARE: www.SixClasses.org

Healthier products, healthier people in four minutes!

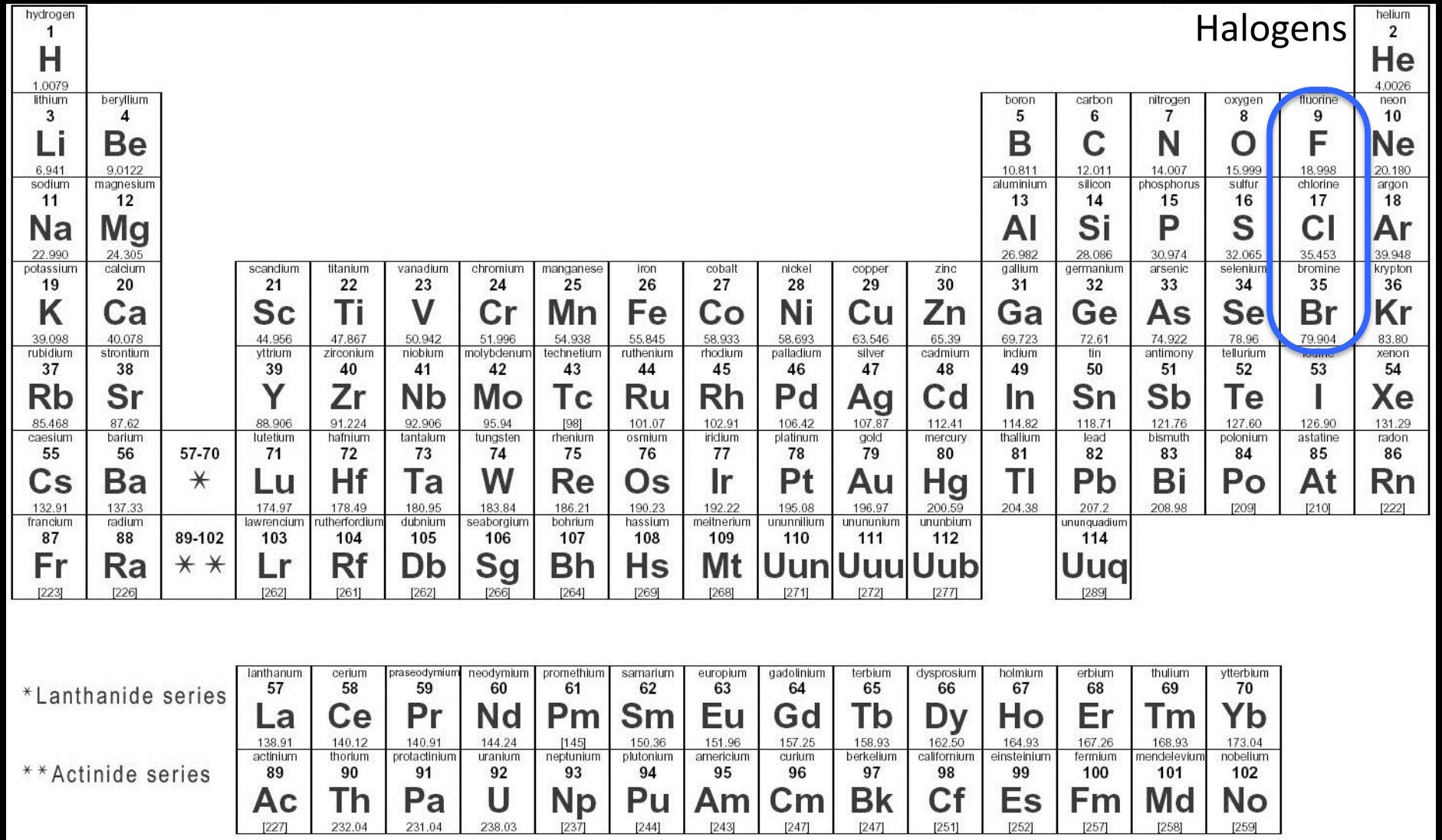
Is it necessary?

Is it worth it?

Is there a safer alternative?

Classes I to 3

Periodic table of elements



Cellular defense systems do not recognize organohalogens

Cellular bouncers

(ABC transporters)

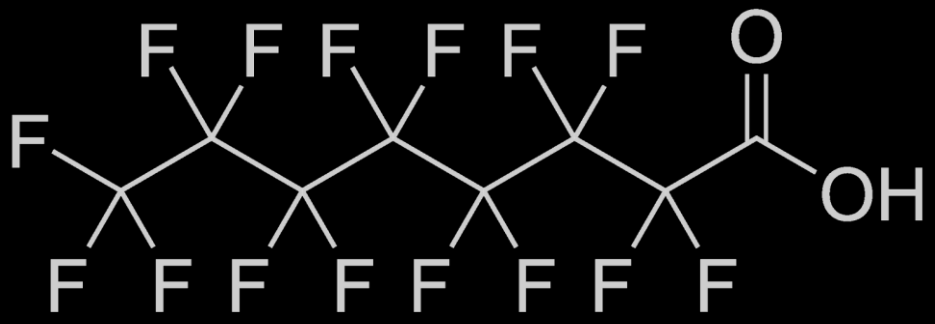
Cellular detoxification

Courtesy, David Epel, Stanford University

Class 1: Highly Fluorinated Chemicals (PFAS)

Carbon-Fluorine bond strength:

- Leads to oil and water repellency
- Lasts for geologic time!



Adapted from slide by Dr. Jennifer Field

PFAS Exposure is a health concern

Detectable serum PFASs in US

Non-detect

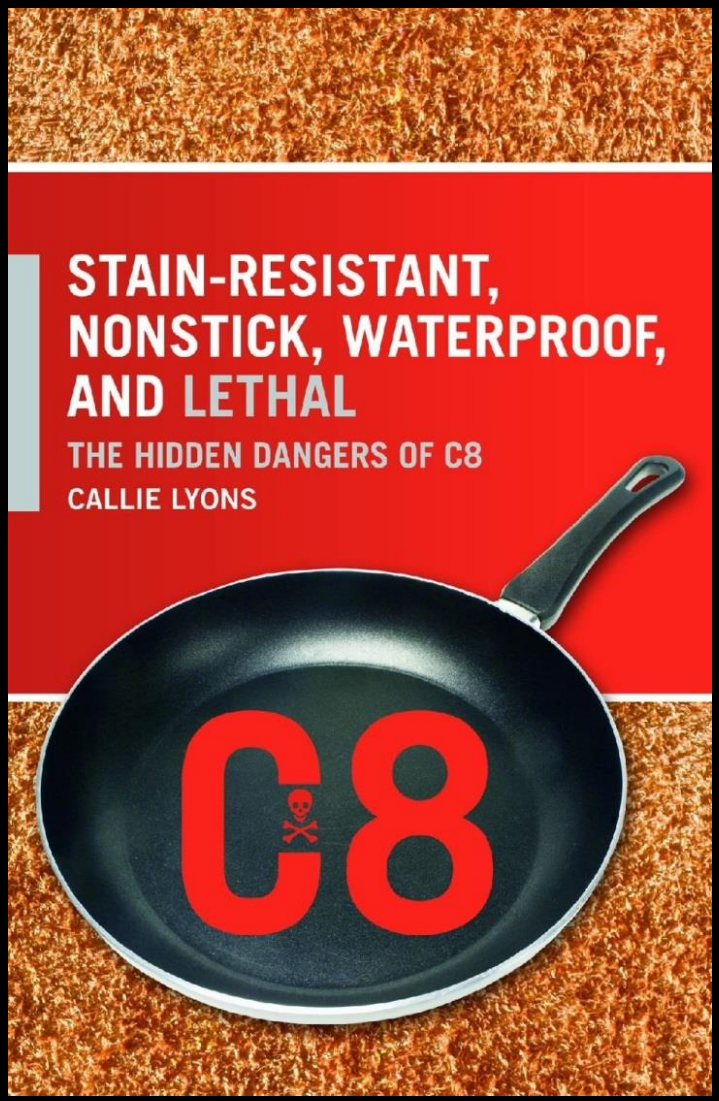
Exposure linked to health risks:

Kidney and testicular cancer, elevated cholesterol, obesity, immune suppression, and endocrine disruption

Courtesy, Cindy Hu, Harvard University

(Ref: Lewis et al., 2015; Grandjean et al., 2012; Braun et al., 2016; Barry et al., 2013)

Published 2007



2017

Watershed

Tracy K. Smith

US Poet Laureatte

200 cows more than 600 hilly acres

property would have been even larger

had J not sold 66 acres to DuPont for

waste from its Washington Works factory where J was employed

did not want to sell

but needed money poor health

mysterious ailments

May 2015 The Madrid Statement on Highly Fluorinated Chemicals

"We call on the international community to cooperate in limiting the production and use of PFASs and in developing safer non-fluorinated alternatives."

Signed by 230 scientists from 40 countries

2015: Environmental Health Perspectives

2015-16

The Opinion Pages | OP-ED COLUMNIST

The New York Times

Chemicals in Your Popcorn?

JUNE 4, 2015

Nicholas Kristof

What do a pizza box, a polar bear and you have in common?

All carry a kind of industrial toxicant called poly- and perfluoroalkyl substances, or PFASs, that do two things: They make life convenient, and they also appear to increase the risk of cancer.

These Chemicals in Pizza Boxes and Carpeting Last Forever

More than 200 scientists around the world document the threats of perfluorinated compounds and call for more government control.

By **Lindsey Konkel**, National Geographic

PUBLISHED MAY 01, 2015

NATIONAL GEOGRAPHIC

The Intercept_

THE TEFLON TOXIN

DuPont and the Chemistry of Deception

Sharon Lerner

Aug. 11 2015, 3:35 p.m.

133

Home

The New York Times Magazine

The Lawyer Who Became DuPont's Worst Nightmare

Rob Bilott was a corporate defense attorney for eight years. Then he took on an environmental suit that would upend his entire career — and expose a brazen, decades-long history of chemical pollution.

By NATHANIEL RICH JAN. 6, 2016

Law: Claims in the Ohio Valley

(The Teflon Toxin Goes to Court, Sharon Lerner, *The Intercept)*

September 2015: 3,500 personal injury and 37 wrongful death claims in Ohio Valley against DuPont went to trial

October 2015: $1.6 million for kidney cancer.

July 2016: $5 million for testicular cancer.

January 2017: $10.5 million for malice

February 2017: $671 million to settle claims in Ohio Valley

"If the chemical were really dangerous, DuPont attorneys contended, government agencies would have regulated it. "

Policy: Drinking Water Levels

January 2009:

US EPA provisional level of 400 ppt for PFOA and 200 ppt for PFOS

May 2016:

US EPA Lifetime Health Advisory of 70 ppt for PFOA and PFOS

December 2016:

Vermont enforceable standard for 20 ppt for PFOA and and PFOS

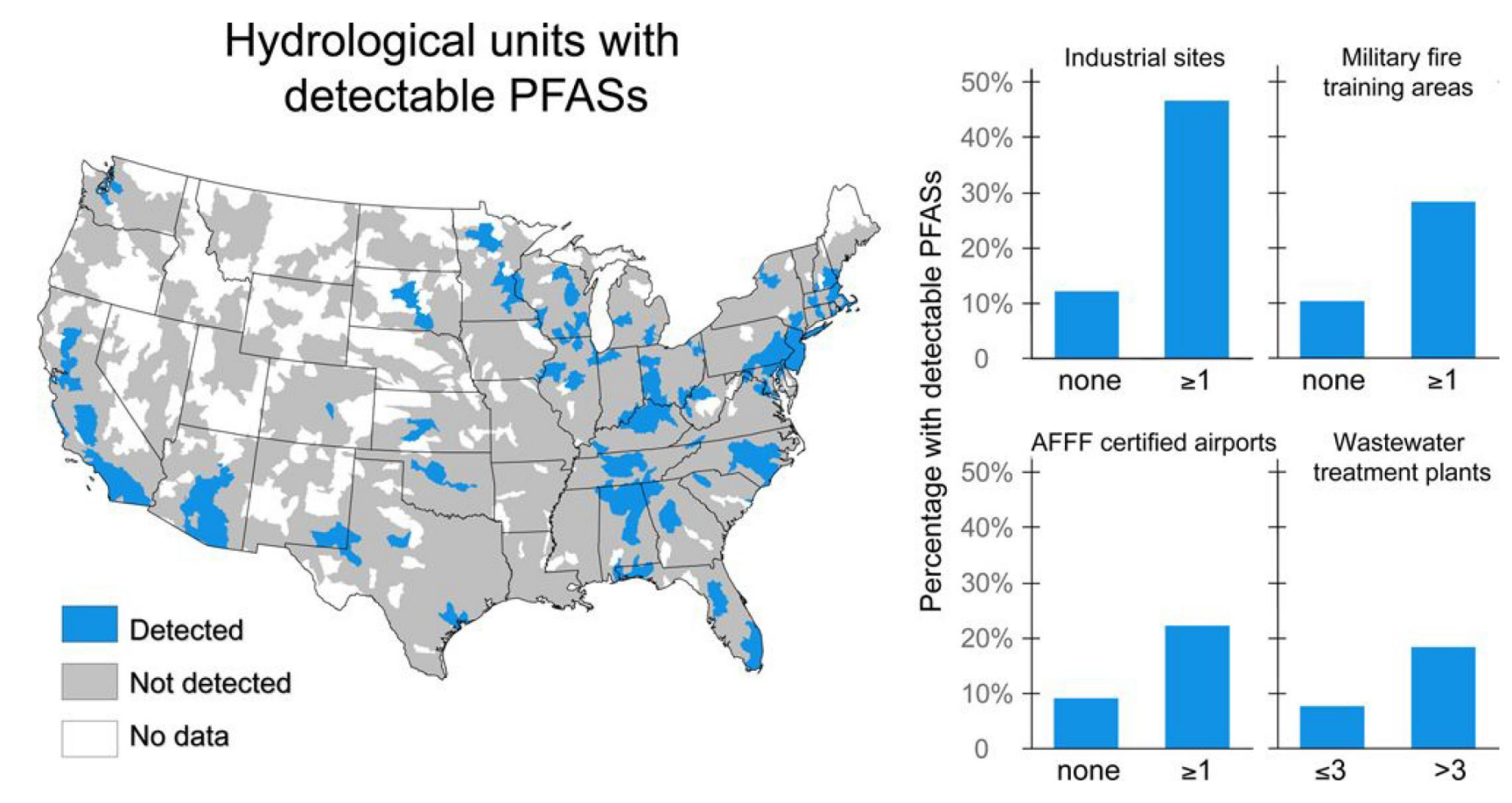
September 2016:

Draft New Jersey Drinking Water Quality Institute recommended enforceable standard for PFOA of 14 ppt

April 2017:

Australian advisory level of 70 ppt for total of PFOS and PFHxS

Watersheds with point sources have higher detection frequencies for PFASs



Cindy Hu et al, ES&T Letters, 2016

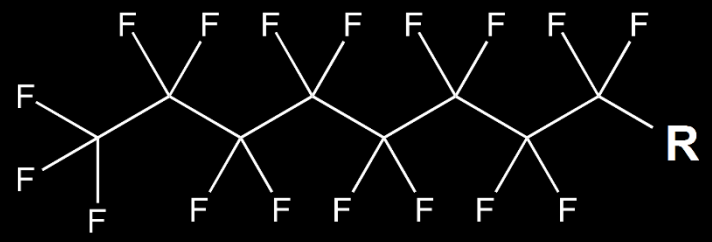
AFFF foam in training exercises

- Drinking water of six million Americans contaminated with PFAS
- AFFF firefighting are a major contributor
- Air Force said:
  - "will not use AFFF foam in training"
  - "will replace all C8 foam with C6"

Is C6 an improvement over PFOA and PFOS?

C6 is called the “environmentally friendly” alternative

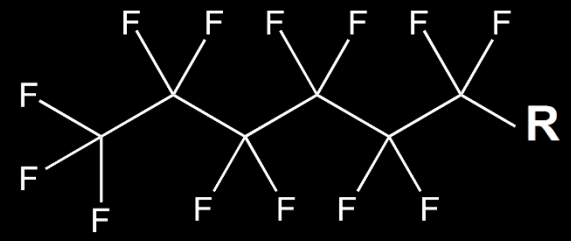
C8



Concerns:

- Extreme persistence
- Bioaccumulation
- Toxicity

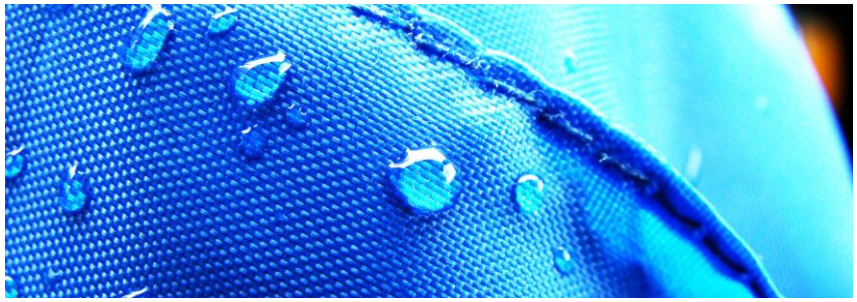
C6



Concerns:

- Extreme persistence
- Bioaccumulation in plants
- Suspected toxicity
- More mobile
- Remediation more difficult

Fluorinated Alternatives?



Fluorinated Alternatives: Myths versus Facts

Long-chain highly fluorinated chemicals — including PFOA, PFOS and other C8 compounds — were used for decades to give water-repellant, stain-resistant, and non-stick properties to furnishings, carpets, outdoor gear and other products. Exposure to PFOA has been linked to kidney and testicular cancer, elevated cholesterol, decreased fertility, thyroid problems and changes in hormone functioning in adults as well as adverse developmental effects and decreased immune response in children[1].

Due to such harmful effects, the long-chain chemicals were recently phased out and replaced by numerous similar compounds, including short-chain molecules called C6 and C4[2]. Industry says these alternatives are safe, sustainable, and well-tested[3]. A look at the facts shows those claims don't stick.

THE BOTTOM LINE

Highly fluorinated chemicals pose a potential risk to human health and the environment, and they should only be used with safeguards when their function is essential.

MYTH: "PFOA-free" means safe.
FACT: Products advertised as "PFOA-free" often contain replacement chemicals made with the same problematic chemical building blocks as PFOA.

Since PFOA has been phased out, numerous related chemicals that are equally persistent and may pose similar health risks have replaced it[4]. To prevent such "regrettable substitutions", the entire class of highly fluorinated chemicals should be avoided.

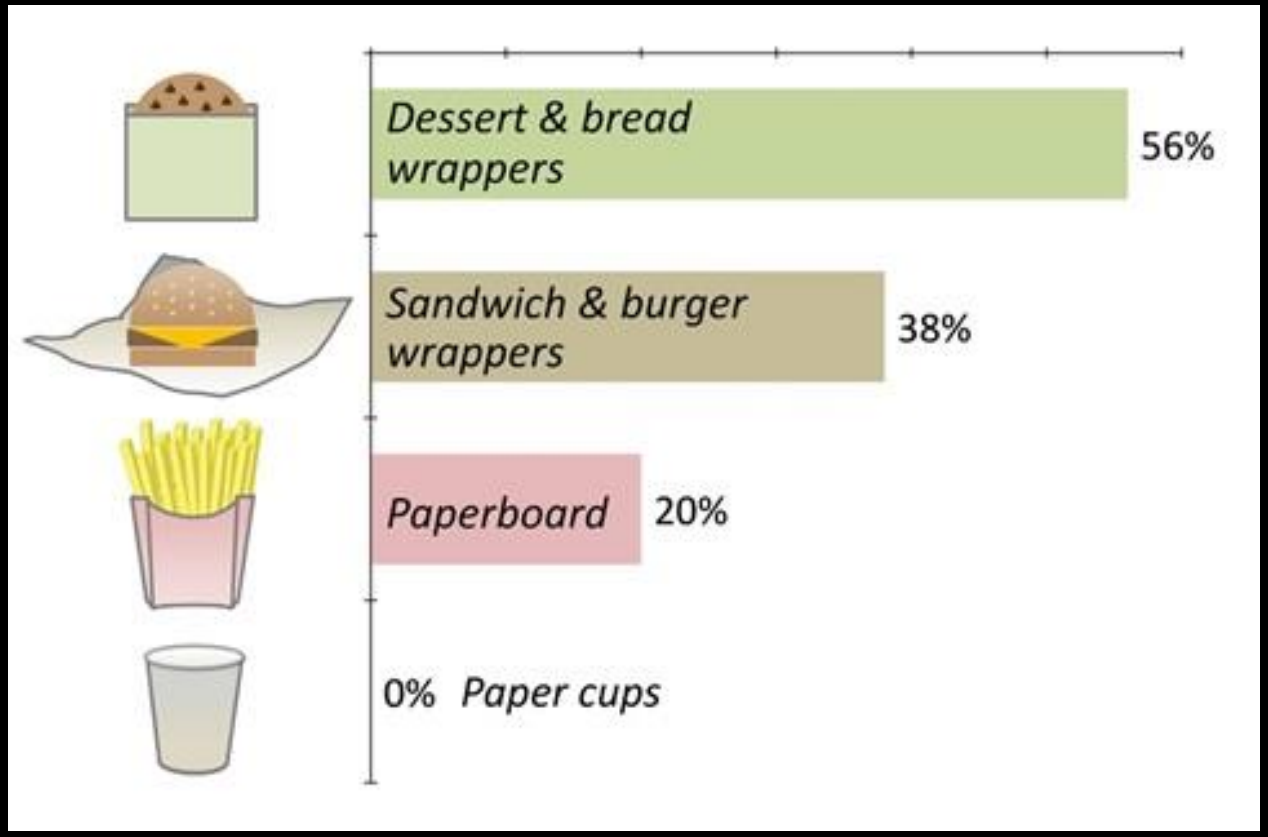
MYTH: Short-chain fluorinated alternatives like the 6 and 4 carbon-based compounds have been thoroughly tested and are safe.
FACT: Recent studies suggest these alternatives may cause similar health problems as the long chain compounds.

Green Science Policy Institute www.GreenSciencePolicy.org + 1 (510) 898-1739 Info@GreenSciencePolicy.org

www.greensciencepolicy.org/highly-fluorinated-chemicals/

Fluorine in U.S. fast food packaging paper

(percent positive; 400 products sampled)



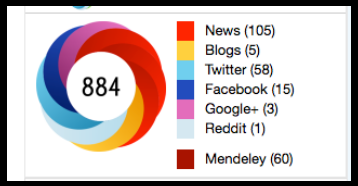
Adopted from Schaider L. 2016 *Fluorinated compounds in U.S. fast food packaging*.

Should these products be considered compostable?

Press strategy for peer-reviewed articles

Communication strategy can increase media coverage and downloads

Title	Journal	Year	# Downloads	Altmetric Score
UCMR3 PFAS	*ES&T Lett.*	2016	22,851	885
Fast food PFAS	*ES&T Lett.*	2017	7.097	844
Never-ending story PFAS	*ES&T*	2017	1,611	85



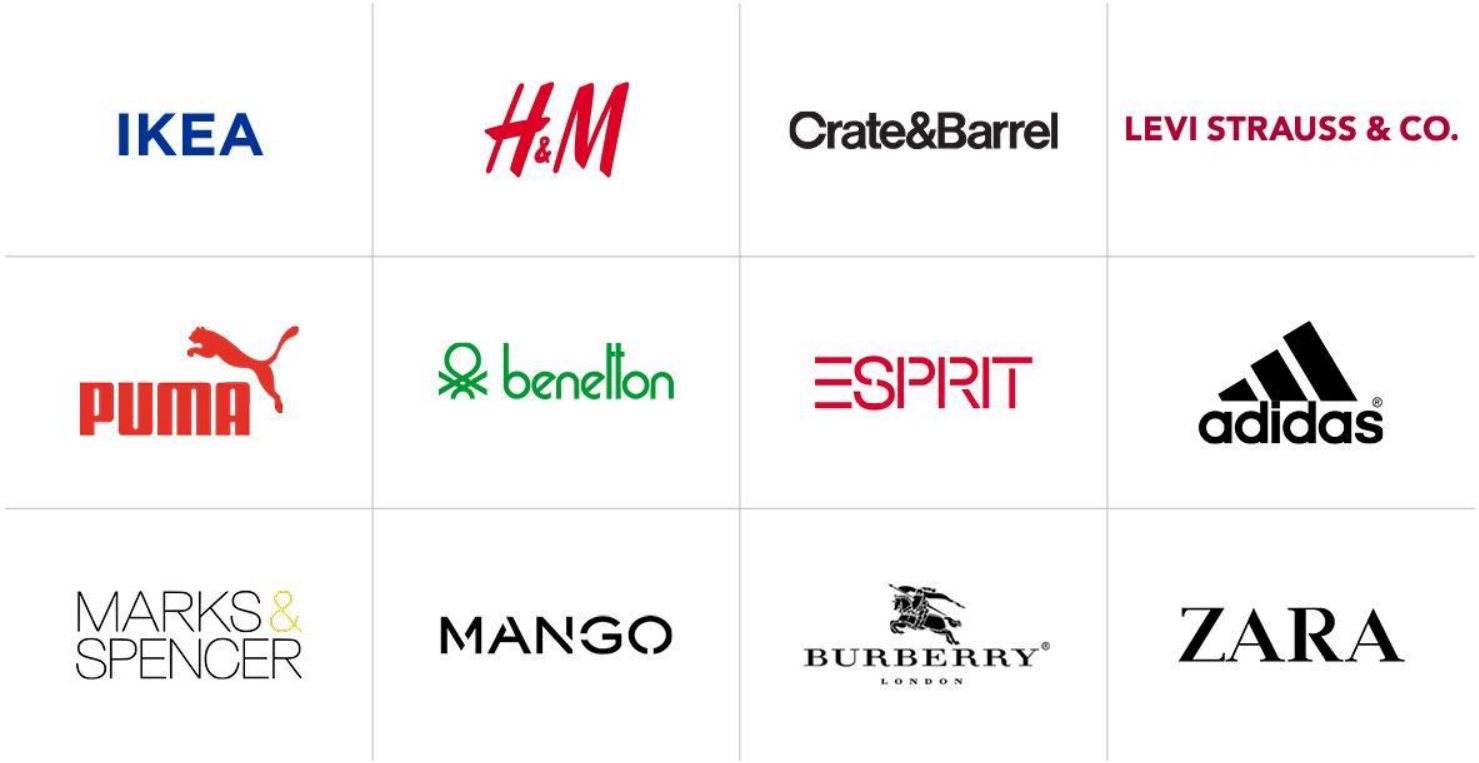
#2 for ES&T Letters

#3 for ES&T Letters

Policy: New York

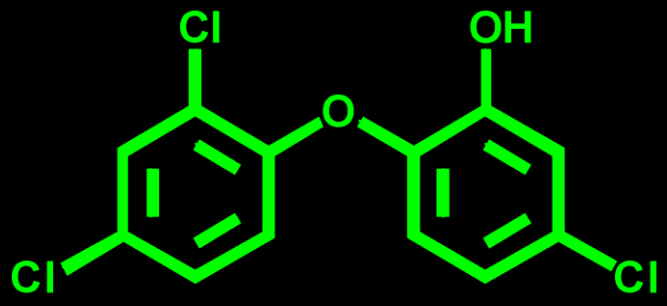
- New York state's new purchasing requirements for single use food containers and packaging:
  - "...products purchased …on State contracts shall not contain perfluorinated chemicals (PFCs)..."

BRANDS ARE ELIMINATING HIGHLY FLUORINATED CHEMICALS

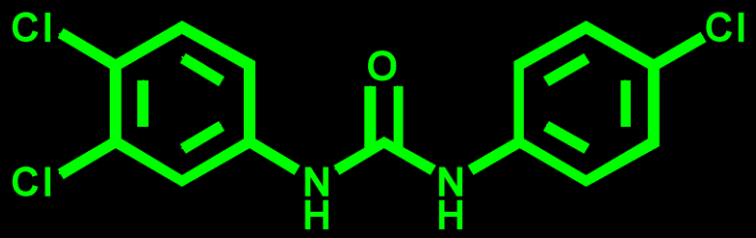


Class 2: Antimicrobials

Triclosan

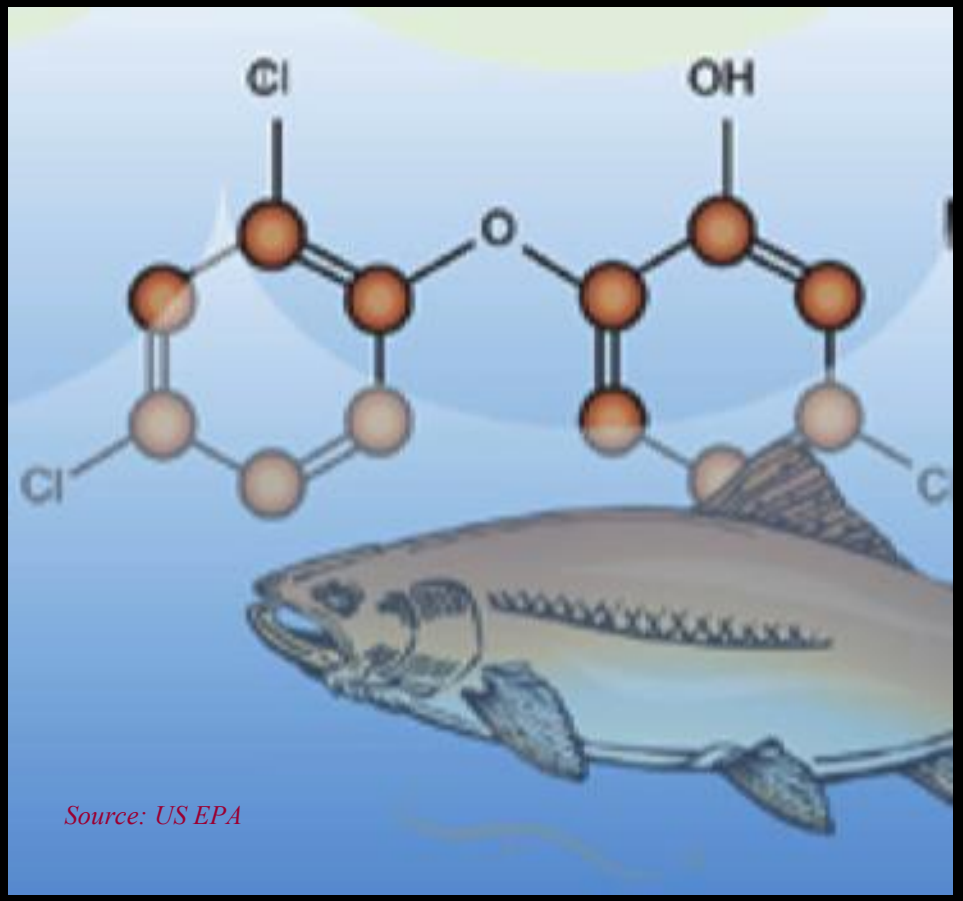


Triclocarban

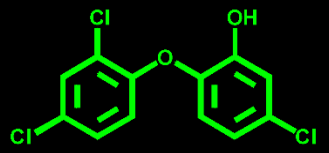


Courtesy: Dr. Gary Ginsberg

5 – 10 Seconds
(ineffective)



Lifetime exposure in aquatic organisms
(toxic)



A History of Triclosan in the U.S.

1964 — Patented

1974 — FDA Draft Monograph on lack of efficacy and safety

1984 — First detection in fish

1994 — FDA removes assorted antimicrobials from drug category

2002 — Top ten water contaminant

2007 — Endocrine disruptor; Detectable in 97% of breast milk samples

2010 — NGOs petitions FDA to prohibit triclosan in soaps. NGO sues FDA.

2013 — > 2,000 antimicrobial products.

2016 — FDA determines 19 antimicrobials not safe or effective in consumer soaps

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Env Sci Tech, 2014, 48, 3603 - 3611

The Florence Statement on Triclosan and Triclocarban

Documents the scientific consensus about:

- potential for harm
- recommendations to prevent further harm

Signed by 205 international scientists

2017: *Environmental Health Perspectives*

Class 3 Flame retardants

1970s Flammability Standards

- Children's sleepwear
- Furniture and baby product foam
- Foam building insulation

Brominated Tris Flame Retardant

Tris (2,3-dibromopropyl) phosphate

- In children's sleepwear 1975 to 1977
- Up to 10% of the weight of fabric
- In children's urine
- Mutagen and possible carcinogen

Science, January 7, 1977

Flame-Retardant Additives as Possible Cancer Hazards

The main flame retardant in children's pajamas is a mutagen and should not be used.

Arlene Blum and Bruce N. Ames

CPSC Bans TRIS-Treated Children's Garments

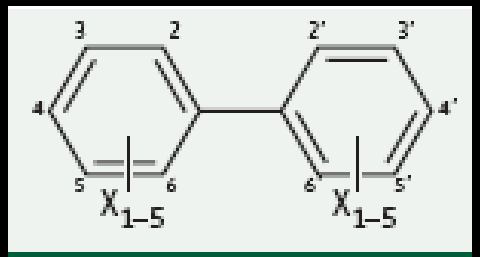
April 7, 1977

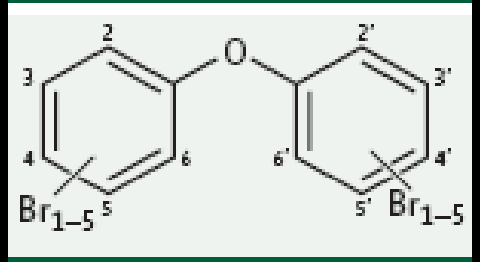
Chlorinated Tris (TDCPP) replaced Brominated Tris

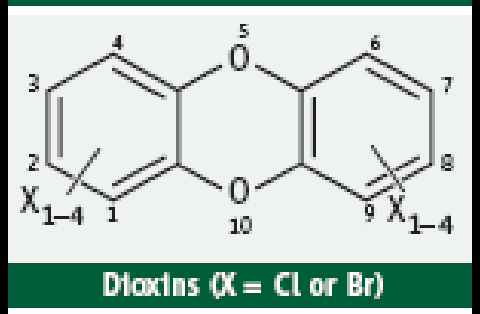
- removed from children's PJ's in 1977
- used furniture until 2012

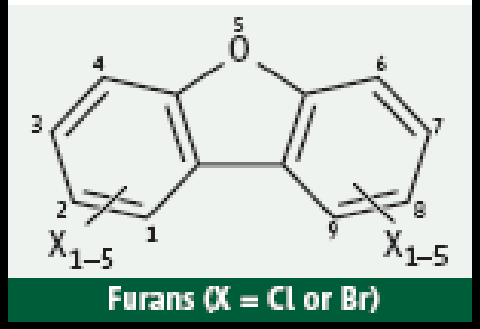
Technical Bulletin 117

- Required furniture foam to withstand a small open flame for 12 seconds
- No significant fire safety benefit (fires start in exterior fabric not filling)









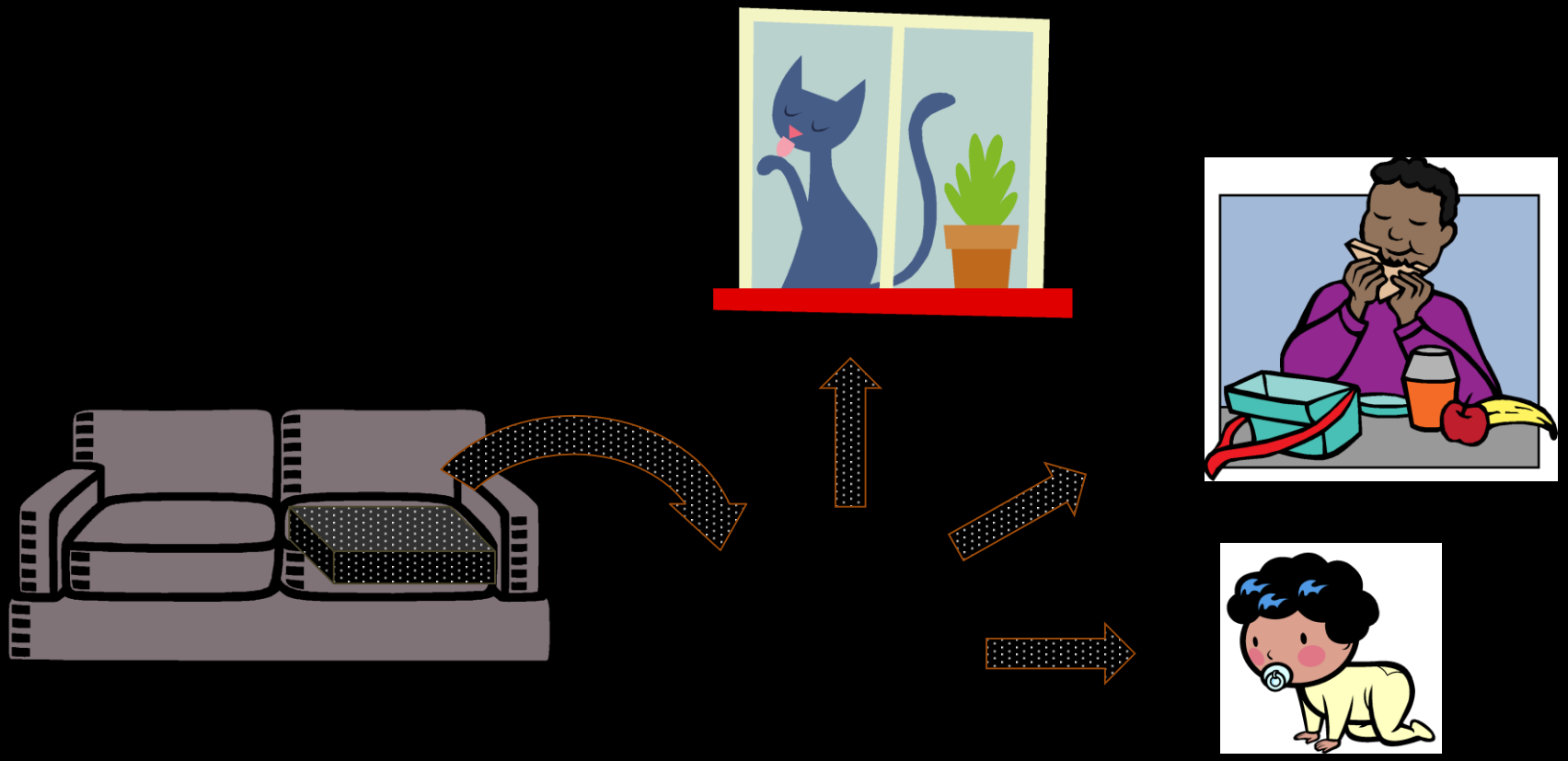
PentaBDE Flame Retardant

Used from 1975 to 2004

to meet TB117.

98% of use in US and Canada in 2003

From Products to People



Furniture foam flame retardant (PentaBDE) associations with human health problems – all reported after 2005

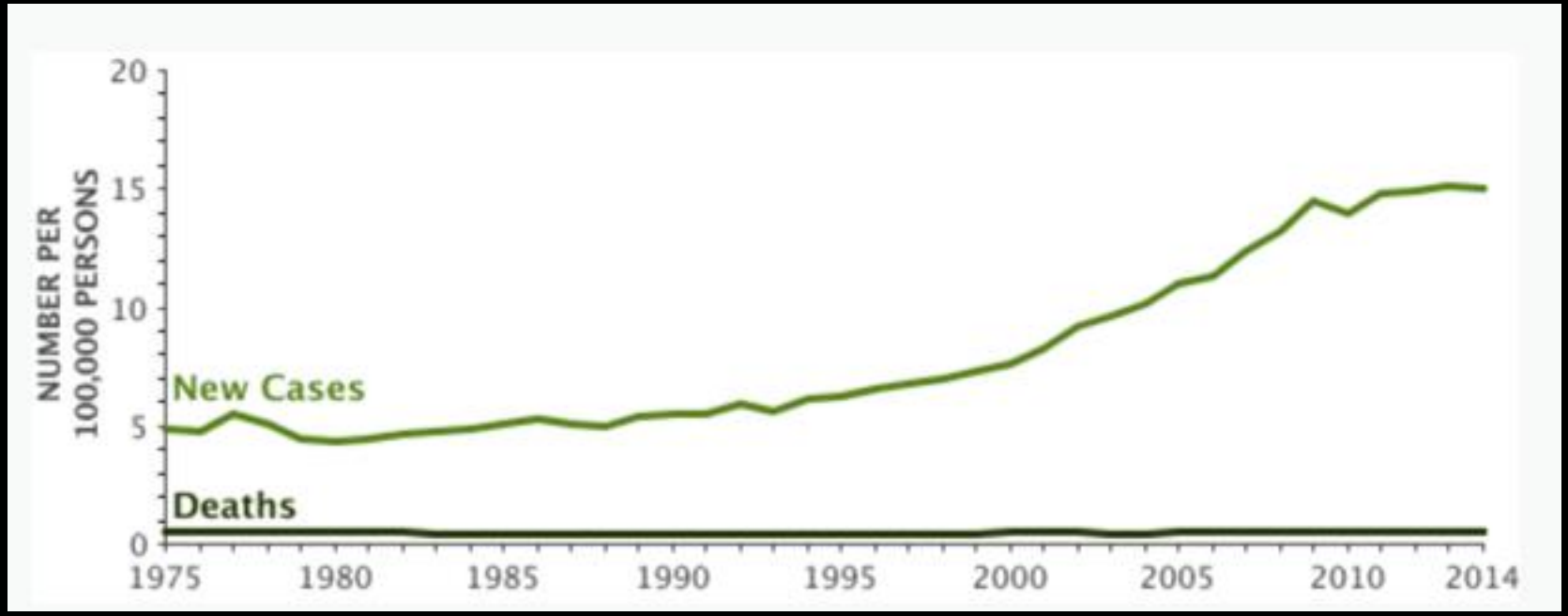
Higher pentaBDE exposures associated with:

Increased time to pregnancy
Altered thyroid hormone
Thyroid disease, esp. in post-menopausal women

Developmental toxicity
Baby boys' genital problems
Lower birth weight
Impaired attention
Poorer coordination
Lower IQ
Delayed puberty in girls
Earlier puberty in boys

Main et al. 2007; Goodyer et al 2017; Eskenazi et al., 2010, 2011, 2012; Herbstman et al. 2010; Makey et al. 2016; Windham et al. 2015; Harley et al. 2017; Allen et al. 2016

U.S. Thyroid cancer incidence and mortality: 1975 - 2014

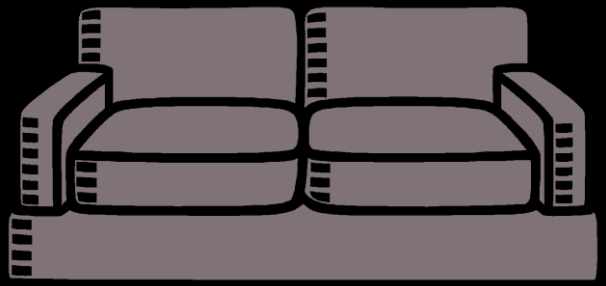


SEER 9 Incidence & U.S. Mortality 1975-2014, All Races, Both Sexes. Rates are Age-Adjusted.

Very recent study reports elevated risks of thyroid cancer linked to exposure to Tris (142% increase) and BDE-209 (129% increase).
(Hoffman et al. Environ Int Oct 2017)

TB117 Fire Safety Benefit?

TB117 foam



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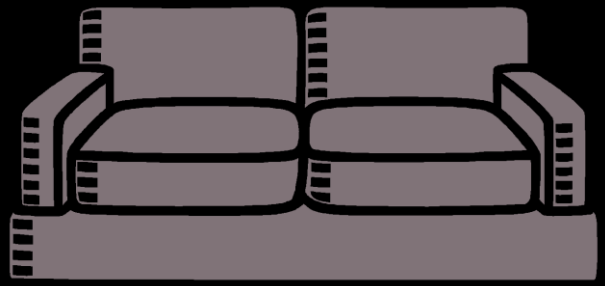
Non - TB117 foam



"No significant, consistent difference…"

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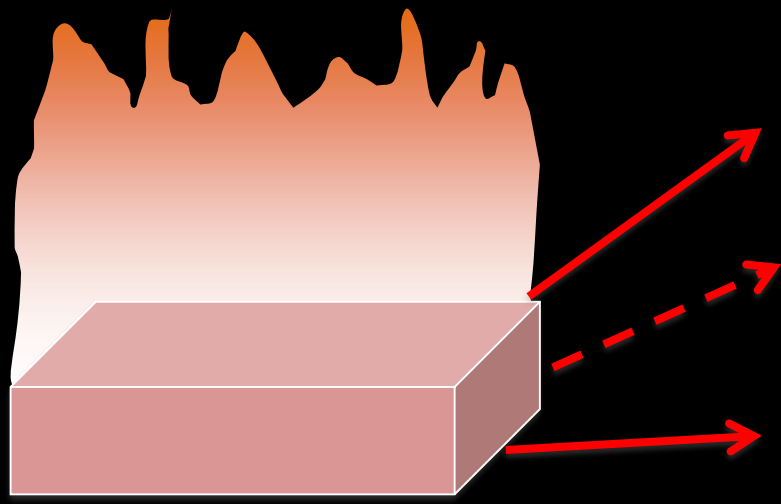
Babrauskas et al. 2011; Talley 1995; Mehta (CPSC) 2012

Fire & smoke toxicity increased by flame retardants

Flame retardants can delay, but do not prevent foam from burning

When foam does burn, flame retardants can increase….



soot and smoke

carbon monoxide & acid gases

dioxins and furans

Flame retardants in furniture foam can make smoke denser and more toxic.

Bocchini 2009; Mennear 1994

Open flame versus smolder tests

TB117

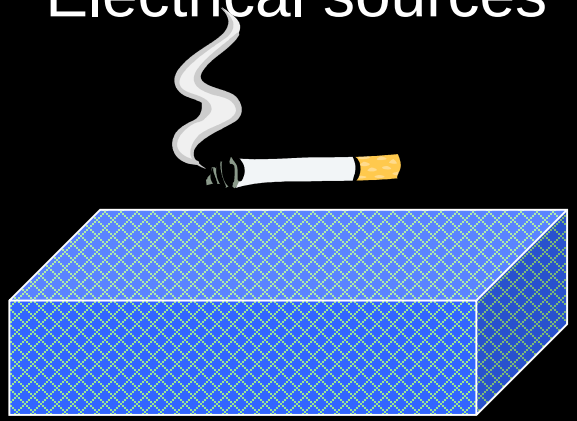
12-second delay of ignition of filling (foam) inside furniture

Flame retardants are added to meet this small open-flame laboratory standard

TB117-2013

Most furniture fires still start with smoldering:

- Cigarettes
- Electrical sources



Prevented by smolder-resistant fabric

NFPA, Ahrens 2011

San Antonio Statement on Brominated and Chlorinated Flame Retardants

- Signed by over 200 scientist's from 30 countries
- Documents health and environmental harm and lack of proven fire safety benefit

2010: Environmental Health Perspectives

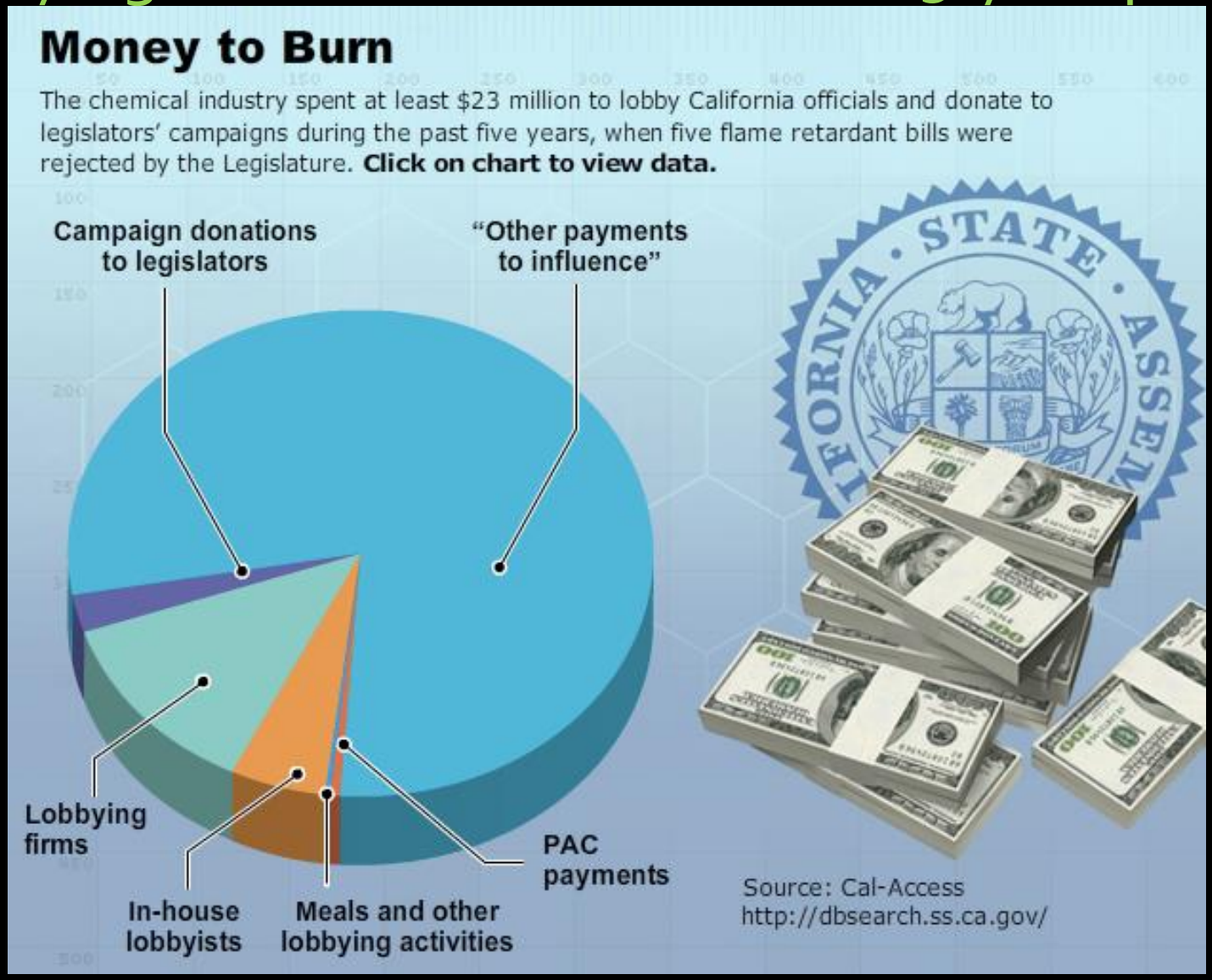
Increased fire safety without flame retardants

Assembly Bill 706, Senate Bill 772, Senate Bill 1291, Senate Bill147

Paid for by Californians for Fire Safety:

- Albemarle
- Chemtura
- Israel Chemicals LTD (ICL)

Flame retardant industry spent $23.2 million lobbying in California alone over a 5-year period



Gross, L. Environmental Health News. Nov. 16, 2011

Pulitzer Prize

Finalist

Goldsmith Prize

Investigative Reporting

Environmental Journalists Society

Environmental Reporting

Gerald Loeb Award

Business and Financial Journalism

National Press Club

Consumer Award

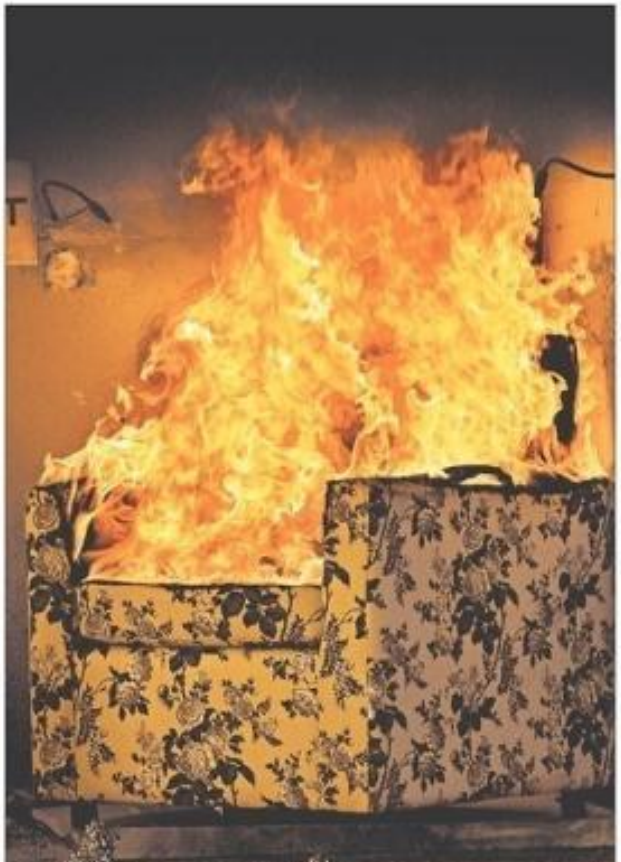
Chicago Tribune

QUESTIONS? CALL 1-800-TRIBUNE | SUNDAY, MAY 6, 2012 | BREAKING NEWS AT CHICAGOTRIBUNE.COM

TRIBUNE WATCHDOG

Playing with fire

A deceptive campaign by industry brought toxic flame retardants into our homes and into our bodies. And the chemicals don't even work as promised.



BY PATRICIA CALLAHAN AND SAM ROE
Tribune reporters

Dr. David Heimbach knows how to tell a story.

Before California lawmakers last year, the noted burn surgeon drew gasps from the crowd as he described a 7-week-old baby girl who was burned in a fire started by a candle while she lay on a pillow that lacked flame retardant chemicals.

"Now this is a tiny little person, no bigger than my Italian greyhound at home," said Heimbach, gesturing to approximate the baby's size. "Half of her body was severely burned. She ultimately died after about three weeks of pain and misery in the hospital."

Heimbach's passionate testimony about the baby's death made the long-term health concerns about flame retardants voiced by doctors, environmentalists and even firefighters sound abstract and petty.

But there was a problem with his testimony. It wasn't true. Records show there was no dangerous pillow or candle fire. The baby he described didn't exist.

Neither did the 9-week-old patient who Heimbach told California legislators died in a candle fire in 2009. Nor did the 6-week-old patient who he told Alaska lawmakers was fatally burned in her crib in 2010.

Heimbach is not just a prominent burn doctor. He is a star witness for the manufacturers of flame retardants.

His testimony, the Tribune found, is part of a decades-long campaign of deception that has loaded the furniture and electronics in American homes with pounds of toxic chemicals linked to cancer, neurological deficits, developmental problems and impaired fertility.

The tactics started with Big Tobacco, which wanted to shift focus away from cigarettes as the cause of fire deaths, and continued as chemical companies worked to preserve a lucrative market for their products, according to a Tribune review of thousands of government, scientific and internal industry

stoked the public's fear of fire and helped organize and steer an association of top fire officials that spent more than a decade campaigning for their cause.

Today, scientists know that some flame retardants escape from household products and settle in dust. That's why toddlers, who play on the floor and put things in their mouths, generally have far higher levels of these chemicals in their bodies than their parents.

Blood levels of certain widely used flame retardants doubled in adults every two to five years between 1970 and 2004. More recent studies show levels haven't declined in the U.S. even though some of the chemicals have been pulled from the market. A typical American baby is born with the highest recorded concentrations of flame retardants among infants in the world.

People might be willing to accept the health risks if the

June 18, 2012

Governor Brown Directs State Agencies to Revise Flammability Standards

‘We must find better ways to meet fire safety standards by reducing and eliminating - wherever possible - dangerous chemicals.”

Press release, CA Office of Gov. Edmund G. Brown, Jr.

California Flammability Standard TB117-2013

Mandatory January 1, 2015

Flame retardants not needed, but can still be used

Product Labels Required

NOTICE
THIS ARTICLE MEETS THE FLAMMABILITY REQUIREMENTS OF CALIFORNIA BUREAU OF ELECTRONIC AND APPLIANCE REPAIR, HOME FURNISHINGS AND THERMAL INSULATION TECHNICAL BULLETIN 117-2013. CARE SHOULD BE EXERCISED NEAR OPEN FLAME OR WITH BURNING CIGARETTES.

The upholstery materials in this product:
____contain added flame retardant chemicals
__X__contain NO added flame retardant chemicals

The State of California has updated the flammability standard and determined the fire safety requirements for this product can be met without adding flame retardant chemicals. The State has identified many flame retardant chemicals as being known to, or strongly suspected of, adversely impacting human health or development.

www.bearhfti.ca.gov/about_us/sb_1019_faq.pdf

PETITION HP 15-1
to the U.S. Consumer Product Safety Commission

Regarding Products Containing Organohalogen FRs

GRANTED – 20 September 2017

Declare as "banned hazardous substances" any:

- Children's products
- Residential furniture
- Mattresses & mattress pads
- Plastic electronics enclosures

containing additive, non-polymeric organohalogen FRs

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The "Big Idea"

CPSC approves Organohalogen Petition

Federal Register warning manufacturers, consumers, and especially those who are pregnant or with children against children's products, furniture, mattresses, and electronics cases containing organohalogenated flame retardants.

Large potential for health harm and no fire safety benefit from use of the flame retardants in these products.

Philip Landrigan, MD

SF bans the sale of furniture and children's products containing flame retardants

In October 2017, San Francisco passed an ordinance prohibiting the sale of:

- upholstered furniture and children's products, such as high chairs, strollers, and nursing pillows, containing flame retardants.
- includes on-line sales

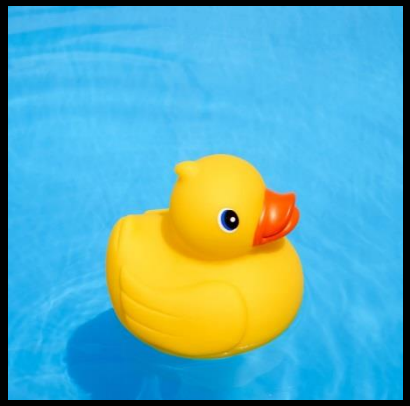
SF Environment
Our home. Our city. Our planet.

Class Four: Bisphenols




FUNCTIONS: hardening agents, strengtheners, stabilizers

Phthalates

FUNCTIONS: plasticizers, lubricants, solvents, fragrances

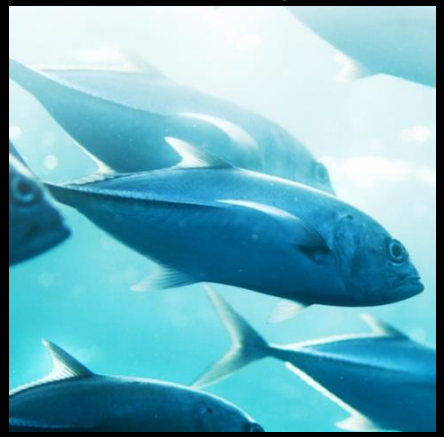
Class 5: Some Solvents




FUNCTIONS: dissolving and dispersing other substances

Class 6: **Certain Metals**

Mercury



Arsenic

Cadmium

Lead

FUNCTIONS: conductors, malleable, resistant to corrosion

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