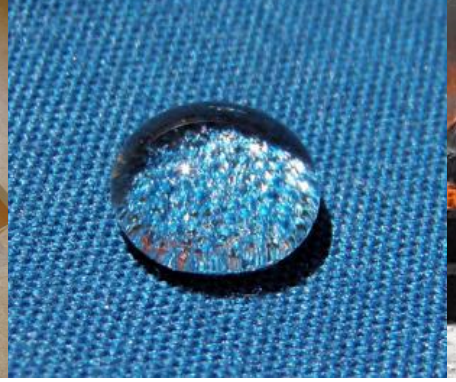




Introduction to PFASs
Highly Fluorinated Chemicals

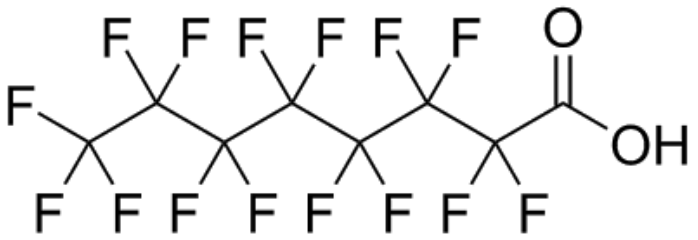
Laurel Schaider, Ph.D.

SILENT SPRING INSTITUTE
Researching the Environment and Women's Health

Highly fluorinated chemicals or PFASs
Per- and polyfluoroalkyl substances

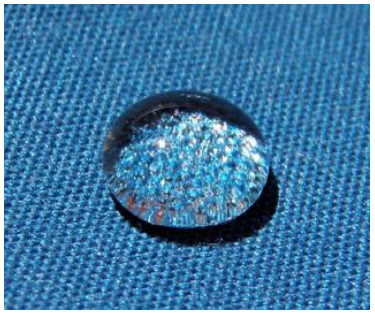
What makes this family of chemicals unique?

- **Persistence**
- **Complexity**
- **Versatility**

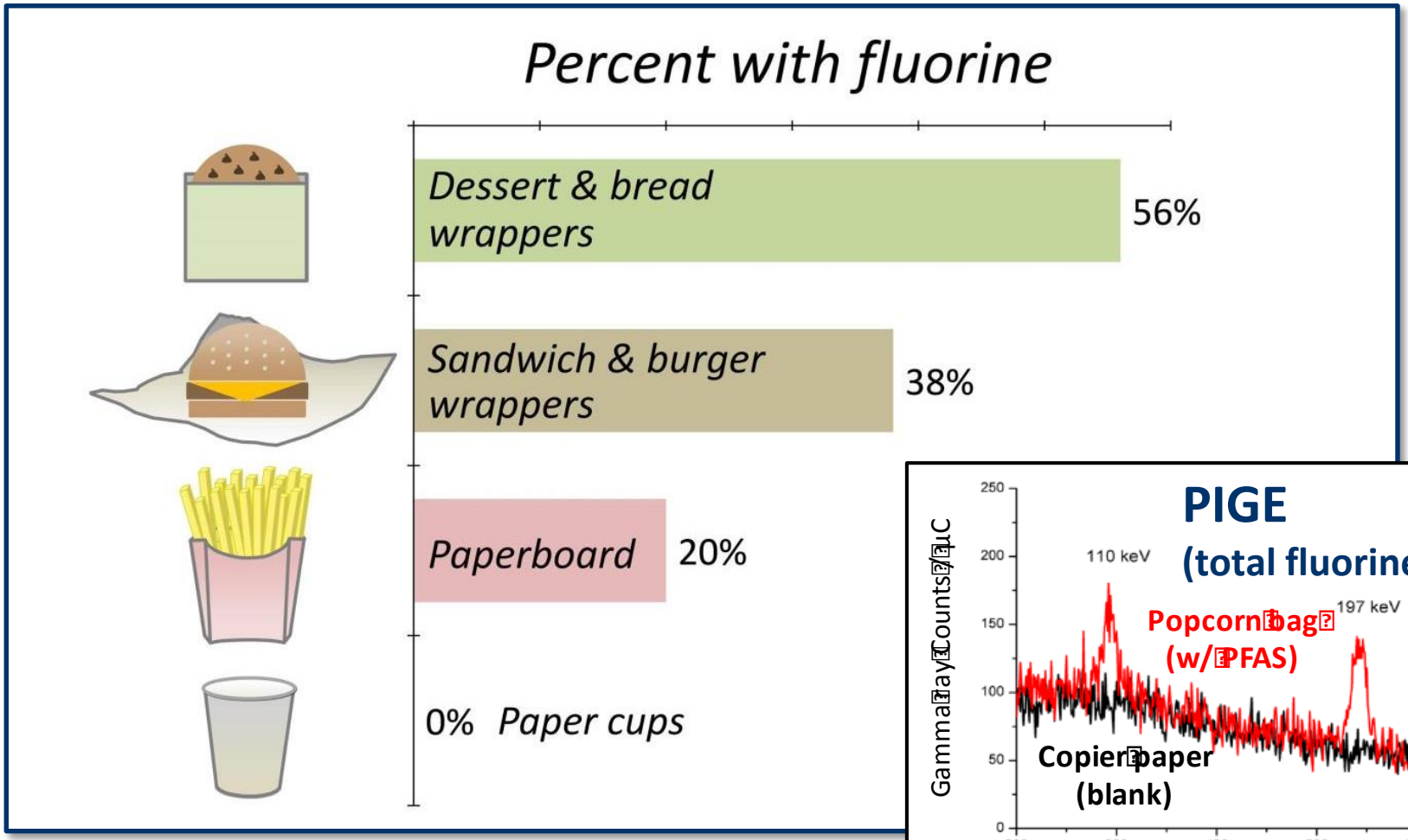


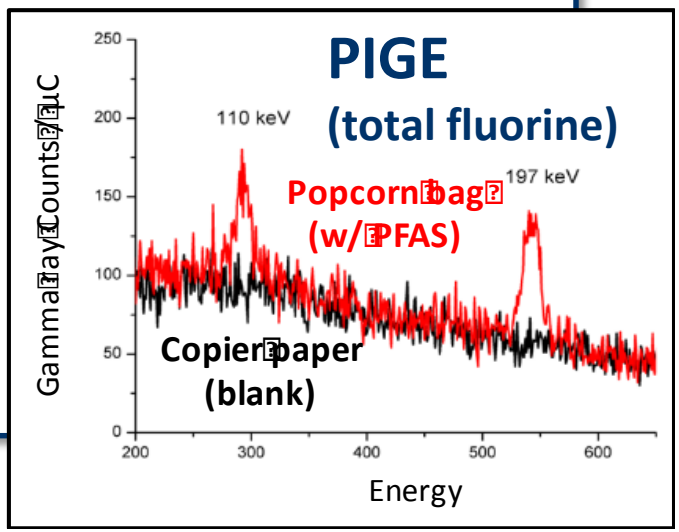
Widely used in household products

- Carpets & upholstery
- Waterproof apparel
- Waxes (floor, skis)
- Non-stick cookware
- Grease-proof food packaging
- Dental floss
- Paints



Prevalence of fluorinated chemicals in U.S. fast food packaging

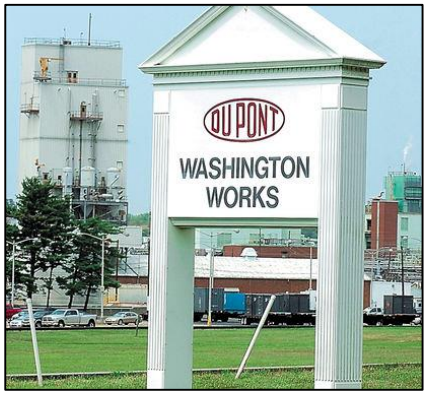




Schaider *et al*. 2017. *ES&T Letters.* 4(3):105–111.

Sources of drinking water contamination

- AFFF (aqueous film-forming foam) for fuel fires
- Production facilities
- Other industries
- Waste disposal sites
- Wastewater

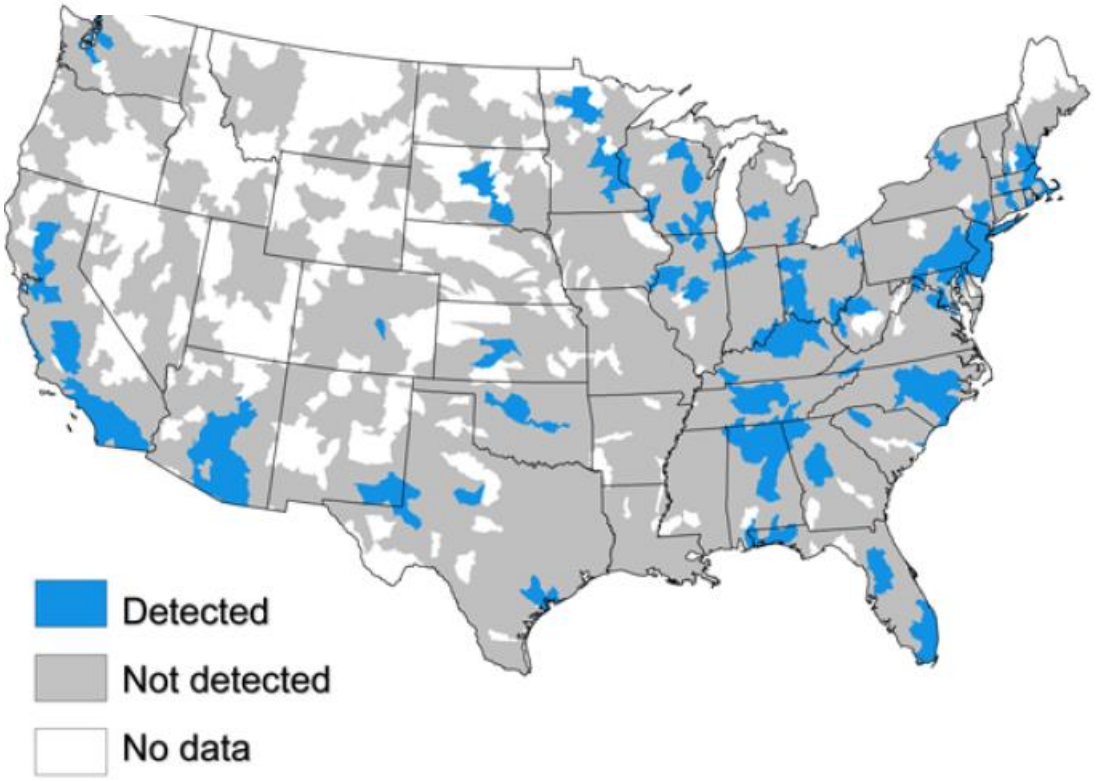


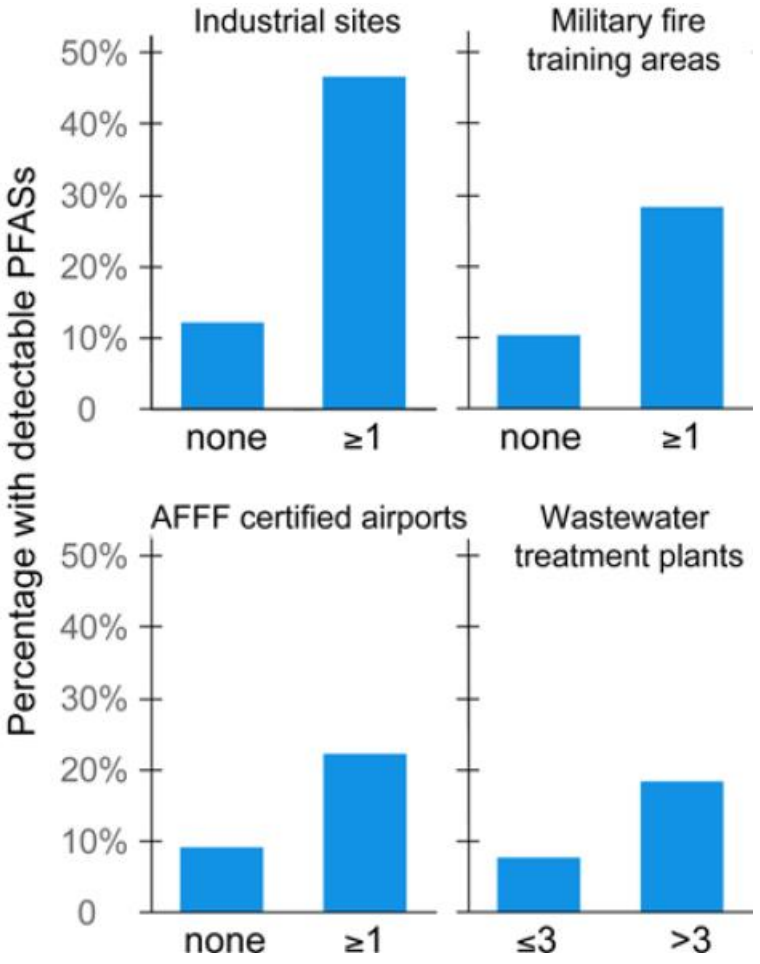
SAINT-GOBAIN
PERFORMANCE PLASTICS
Advanced Film Products

Sources of PFASs to public water supplies

U.S. EPA's UCMR3 data (2013–2015)

Subbasins (large watersheds) with detectable PFASs





Hu *et al*. 2016. *ES&T Letters.* 3:344-350.

Cape Cod, Massachusetts

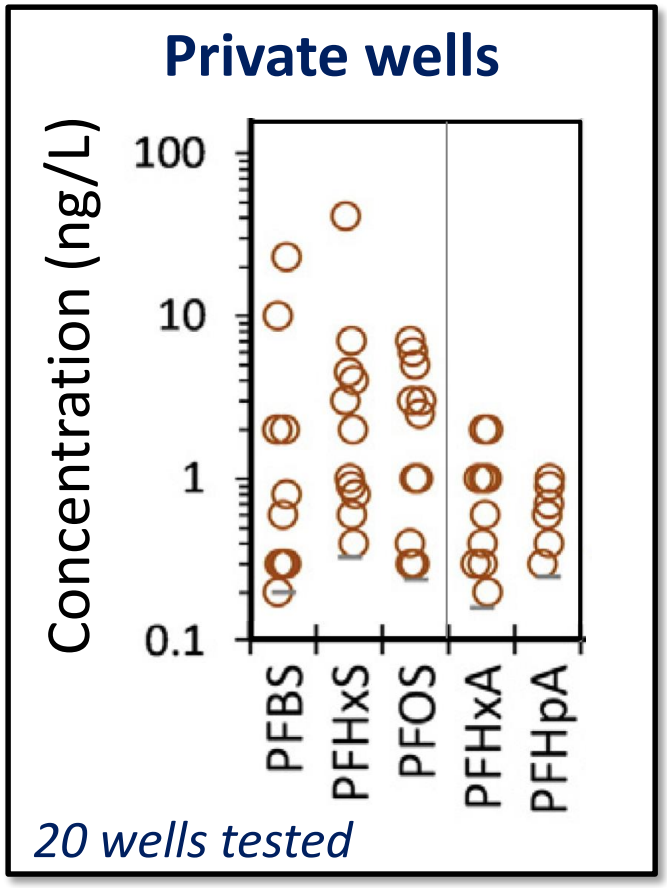
- PFASs in public and private wells:
  - County fire training area
  - Municipal airport
  - Military base
  - Household wastewater

CAPE COD TIMES

Hyannis residents warned about water quality

Posted May. 24, 2016 at 3:05 PM

HYANNIS — Barnstable officials are recommending that pregnant women, nursing mothers and infants in Hyannis not drink or cook with well water until further notice after a federal agency changed thresholds for two contaminants in the drinking water.



Schaider *et al.* 2016. *Sci Tot Env.* 547:470-81.

In our bodies and the environment

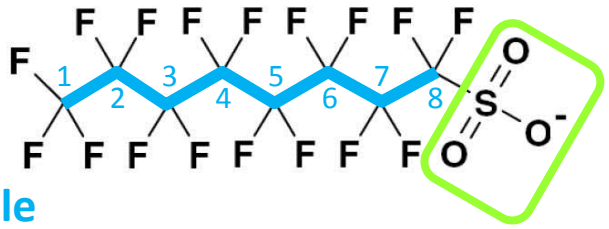
- Global transport recognized in early 2000s
  (Giesy and Kannan, 2001, *ES&T.* 35:1339-1342)
- Some can bioaccumulate and biomagnify
  (Conder et al., 2008, *ES&T*. 42:995-1003)
- >98% of Americans have PFASs in their blood (NHANES)
  (Calafat et al., 2007, *EHP*. 115: 1596-1602)

Long-chain PFASs

- Long chain of fluorinated carbon atoms
  - At least 6 for sulfonates, at least 7 for carboxylates
- Some PFASs can be converted to PFOS or PFOA

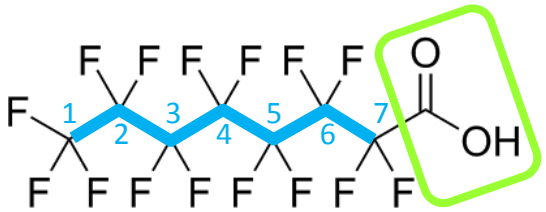
PFOS *(sulfonate)*

Tail: Water and oil insoluble



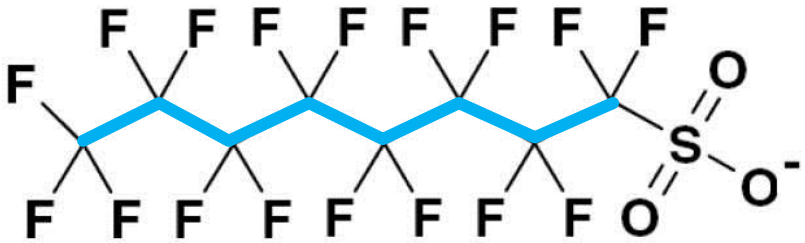
Head: Water soluble

PFOA or C8 *(carboxylate)*



Per- versus poly- fluorinated

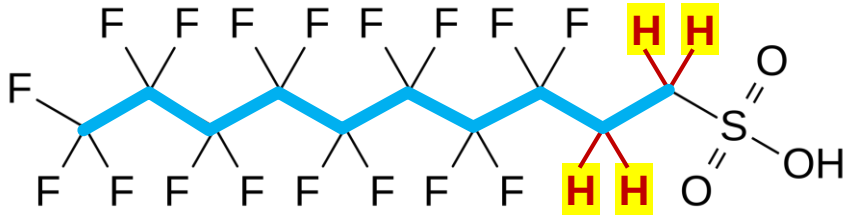
Per = fully fluorinated



PFOS

Perfluorooctane sulfonic acid

Poly = partly fluorinated



8:2 FtS

Fluorotelomer sulfonate

Phasing out long-chain PFASs

- Concerns about toxicity and persistence led to phase out of U.S. production of PFOS and PFOA
  - 2000: 3M phase-out of PFOS
  - 2006: EPA's 2010/2015 PFOA Stewardship Program
- Stockholm Convention for Persistent Organic Pollutants
  - PFOS: 2009, Annex B (Restriction)
  - PFOA: 2015, Nominated for listing

In May 2016, EPA issued stricter drinking water guidelines for PFOS and PFOA

- 2009 guidelines:
  - 200 ng/L PFOS, 400 ng/L PFOA
- 2016 guideline:
  - PFOS + PFOA: 70 ng/L

- Guidelines lacking for other PFASs
- Some states have lower guidelines
  - NJ noted effects on mammary gland development

Replacements: Short-chain PFASs

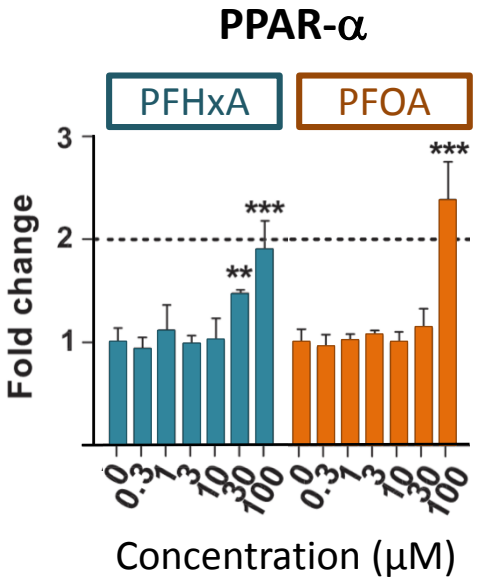
- Mainly shorter versions of PFOA, PFOS, and related compounds
- Retained in body for days to weeks
  - Shorter than long-chains
  - Longer than some other chemicals of concern

Half-lives in the human body *(geometric means)*		
PFHxS	7.3 years	**Long chain**
PFOS	4.8 years	
PFOA	3.5 years	
PFHxA	32 days	**Short chain**
PFBS	26 days	
BPA	3-6 hours	

Olsen *et al*. 2007. *EHP.* 115:1298.
Olsen *et al.* 2009. *Toxicol.* 256:65.
Russell *et al.* 2013. *Chemosphere*. 93:2419.
Taylor et al. 2011. *EHP*. 119:422.

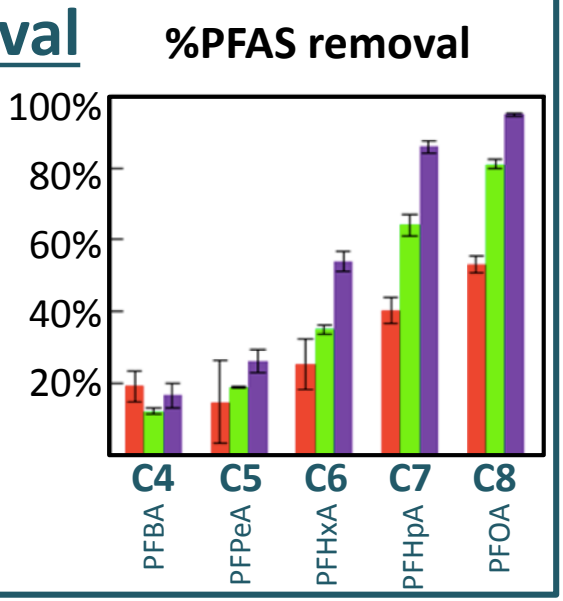
Concerns about short-chain PFASs

Similar biological activity in *in vitro* lab testing



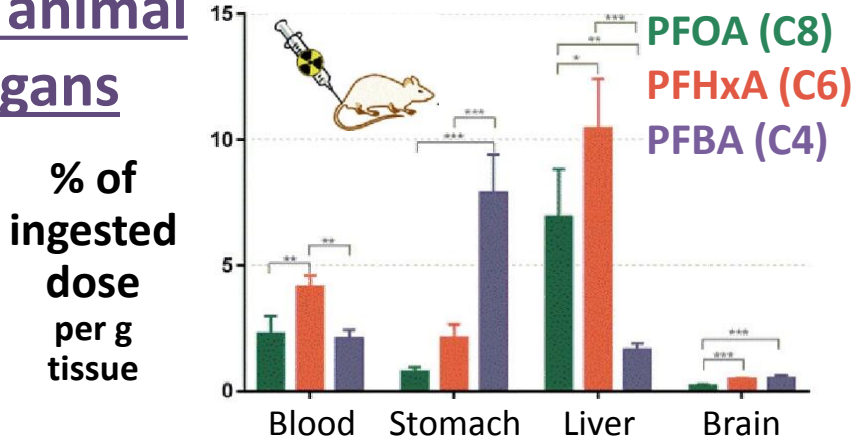
Rosenmai *et al*. 2016. *Andrology.* 4:662-672.

Poorer removal during GAC drinking water treatment



Sun et al. 2016. *ES&T Letters*. 3:415-419.

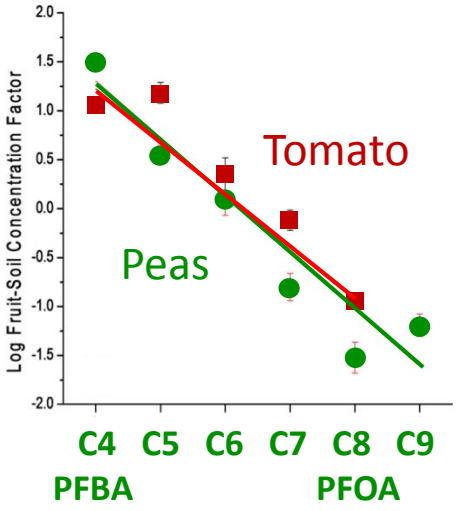
Varying patterns of accumulation in animal organs



Burkemper *et al*. 2017. *ES&T Lett.* 3/9/17

More accumulation in plant shoots and fruits

log [Fruit] / [Soil] ratio



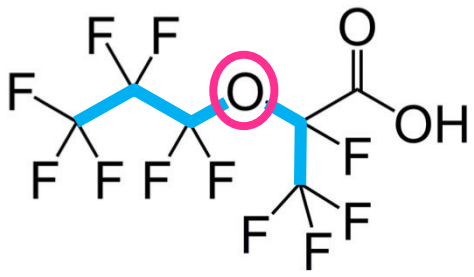
Blaine *et al*. 2014. *ES&T.* 48:7858.

Other replacements

Over 3,000 PFASs on the global market

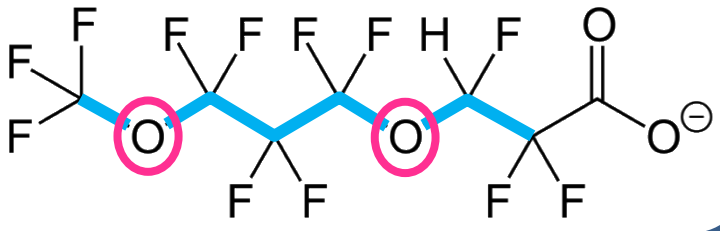
(Wang et al., 2017, *ES&T*, 51:2508.)

GenX



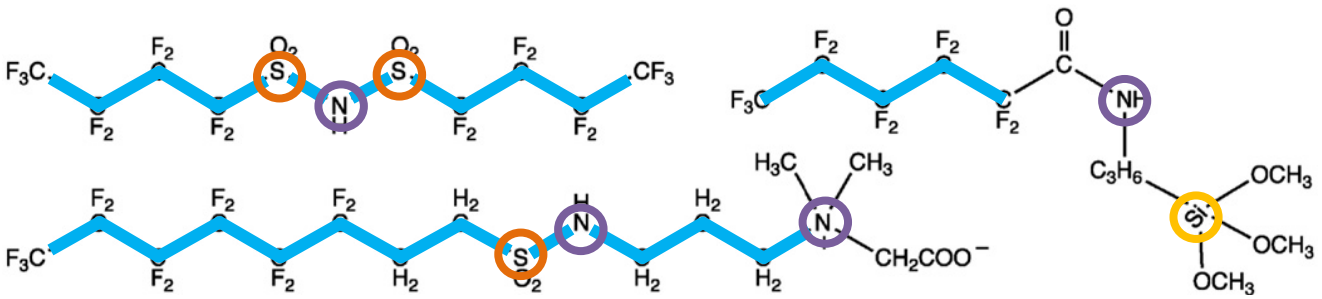
Sun et al. 2016. *ES&T Lett.* 3:415.

ADONA



Wang et al. 2013. *Environ. Int.* 60:242.

Firefighting foams and misc.



PFAS terminology is tricky

- Shift from PFCs to PFASs
- Long vs. short chain
- Definitions of “PFAS”
- How to interpret shifts in retailer and manufacturer actions?

PFOA FREE

Target’s Chemical Goals

CHEMICAL MANAGEMENT

» Improve textile products by removing added Perfluorinated Chemicals (PFC’s) from products by 2022.

GUARANTEED TO KEEP YOU DRY
GORE-TEX

RESPONSIBLE USAGE OF FLUOROMATERIALS

Gore Fabrics’ Goal and Roadmap for Eliminating PFCs of Environmental Concern

Class-based approach

Madrid Statement (2015)

"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

Next steps for scientists

- For scientists and regulators, chemical-by-chemical approach is too slow
- How much evidence is enough?
- How can we be strategic in filling gaps?

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- Flame Retardants
- Women Firefighters Biomonitoring Study
- Ethics in Community Research
  - Reporting Individual Exposure Results
  - Digital Exposure Report-Back Interface (DERBI)
  - Data Sharing and Privacy Protection

Chemicals and Breast Cancer
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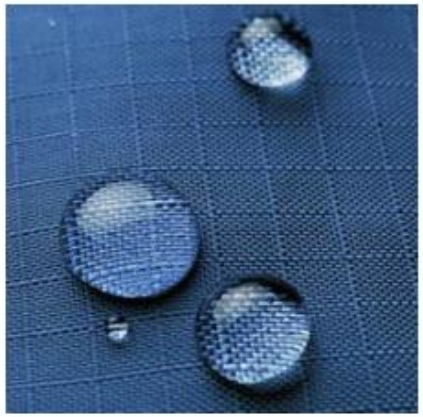
- Tools for Green Chemistry: High Throughput Screening
- Early Life exposures in Latina Adolescents (ELLA study)
- Mammary Gland Carcinogens List

Highly Fluorinated Chemicals (PFASs)



Highly fluorinated chemicals called PFASs (also known as PFCs) are added to many consumer products to make them non-stick, waterproof, and stain-resistant. They are also used in firefighting foams and industrial processes. Their strong bonds make them very effective at repelling water and oil even at high temperatures, but these characteristics also make them persistent. They are ubiquitous in the environment – even in Arctic wildlife – and most Americans have PFASs (per- and polyfluoroalkyl substances) in their bodies due to their widespread use. Silent Spring Institute is studying PFASs because some have been linked to cancer, including breast tumors in animal studies, hormone disruption, reproductive problems, and other health effects.

RELATED CONTENT

Event

Highly Fluorinated Compounds - Social and Scientific Discovery Conference, June 14-15

Dr. Laurel Schaider appears on the Dr. Oz Show to discuss harmful chemicals in fast food packaging, airing May 2

Research Update

Study identifies sources of drinking water contamination for millions of Americans

RELATED SCIENTIFIC RESOURCES

Fact Sheet

What You Should Know About Highly Fluorinated Chemicals

Contact: Laurel Schaider, schaider@silentspring.org