

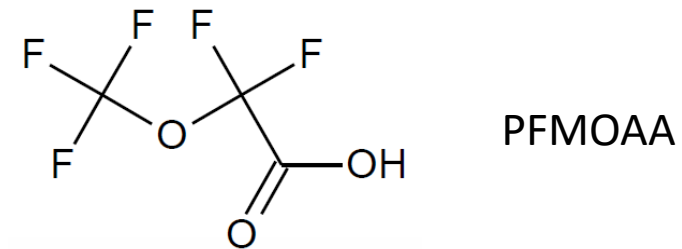
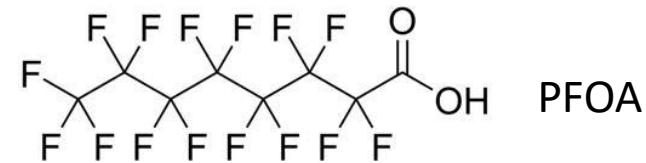
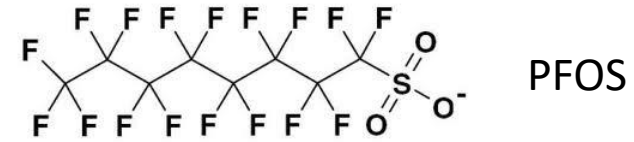
# Challenges of PFAS

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National Institute of Environmental Health Sciences  
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Scholar in Residence, Duke University

*Maine Legislature – May 3, 2021*

# What are Per- and Polyfluoroalkyl Substances (PFAS)?

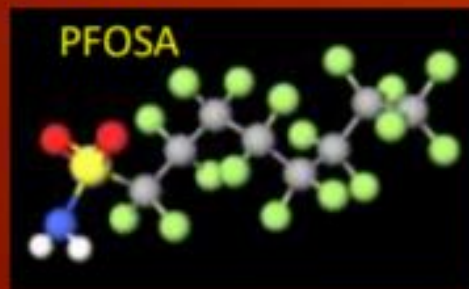
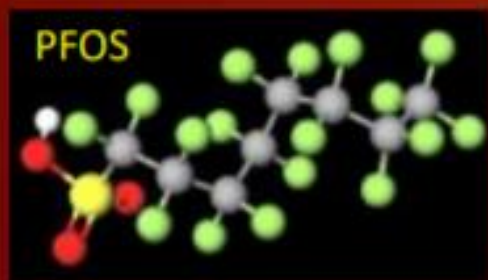
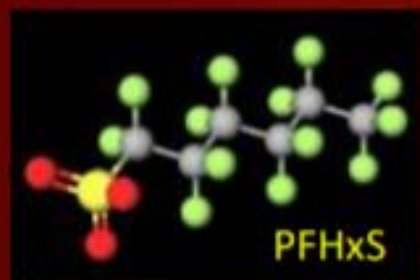
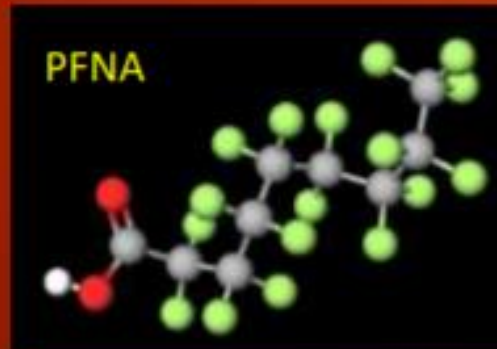
- **Total number of PFAS >9,000 chemicals**
  - Includes products, impurities and degradants
    - Teflon
    - Scotchguard
    - Aqueous Film Forming Foams (AFFFs)
  - Many unknown formulation
- Resistant to grease, water & oil
  - Surfactants, stain repellants
  - Fire suppression - AFFF
- Persistent, mobile and bioaccumulative
- Emergence of short-chain alternatives - less well studied
  - Few studied – same effects as long chains



# Some Background Chemistry



All PFAS contain carbon-fluorine bonds, and there are literally thousands of molecular structures possible. Some examples:

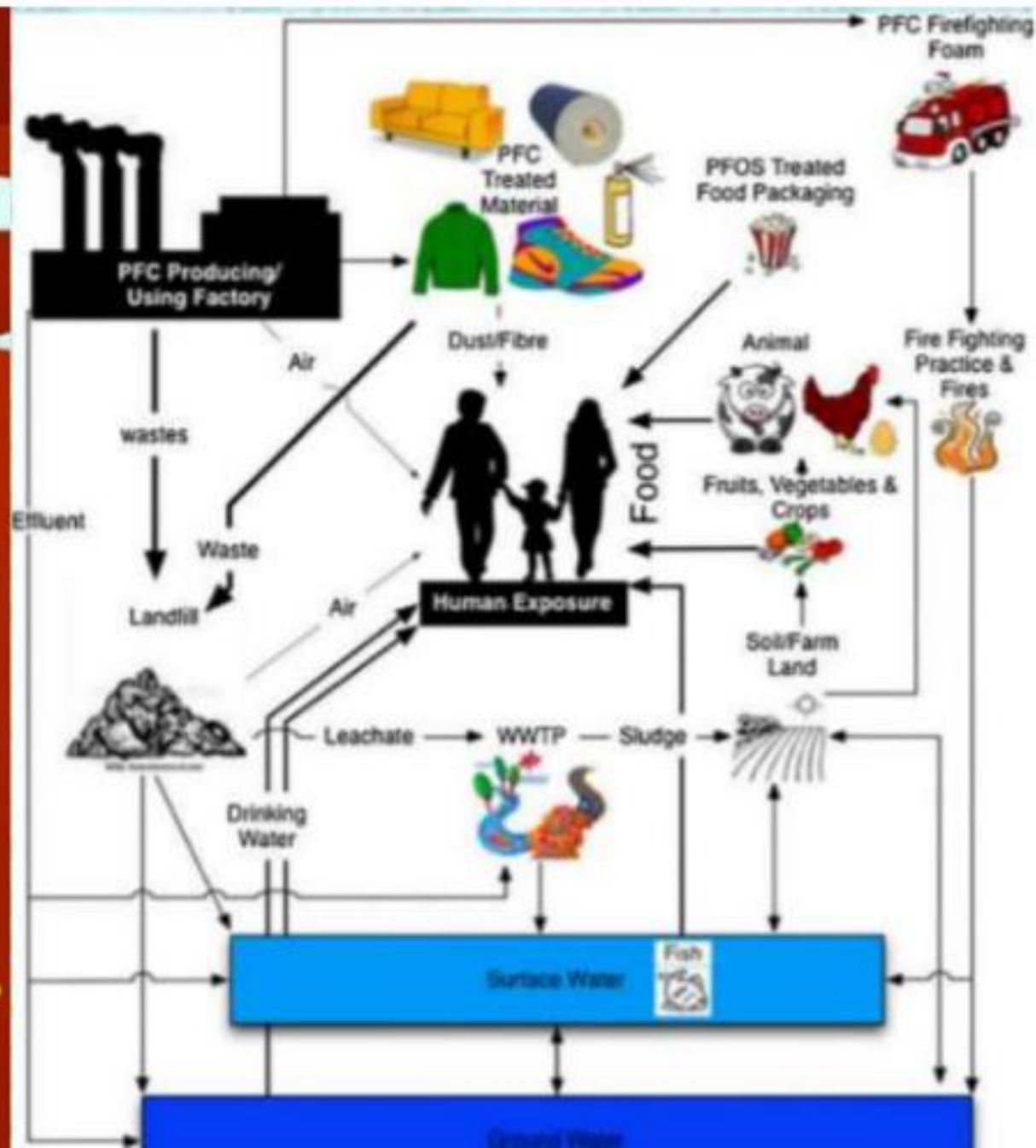


>9000!!!

>4700 compounds...

# Environmental Persistence

PFAS do not degrade;  
Pass through Waste-  
Water Treatment Plant...



*>200 Use Categories  
[Glüge et al., Environ  
Sci: Processes&Impacts,  
2020]*

# How are we exposed?

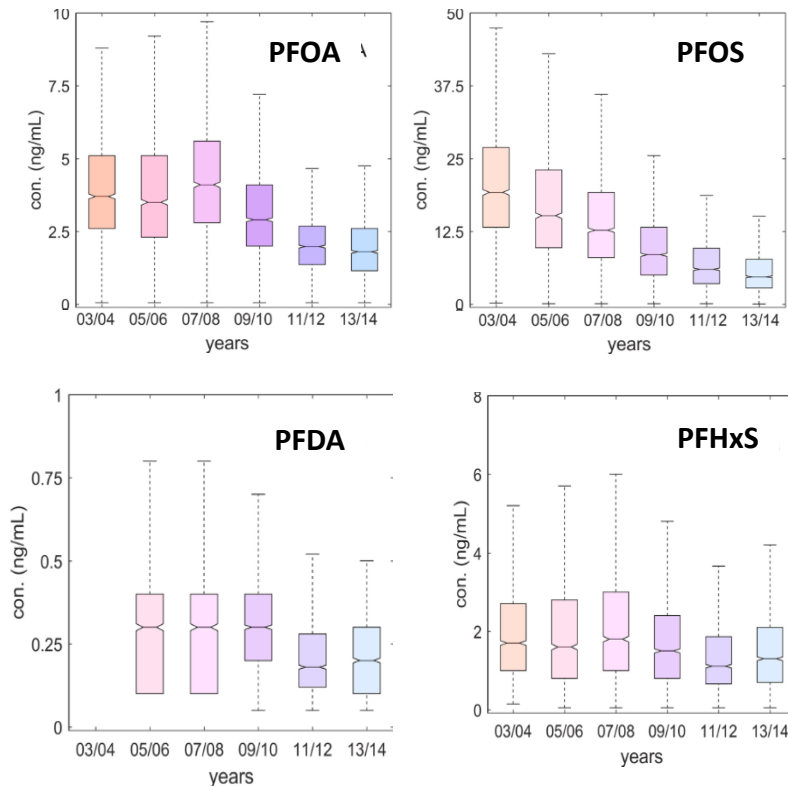
- Diverse group of chemical compounds used in industry and consumer products worldwide since 1950s
- Contaminant in Drinking water
- Found in various products:
  - Carpet and Fabric
  - Food Packaging and Food
  - Pots and Pans
  - Clothing
  - Cardboard packaging
  - Firefighting foams (AFFF)



**Ingestion (Drinking Water, Food, Dust), Inhalation, Dermal**

# We All Have PFAS in Our Bodies

- Detected in humans globally
- >98% of people in the U.S. have measurable amounts of PFAS
- Levels of PFOA and PFOS have declined following phase-outs
- Changes in exposure to other PFAS are less pronounced

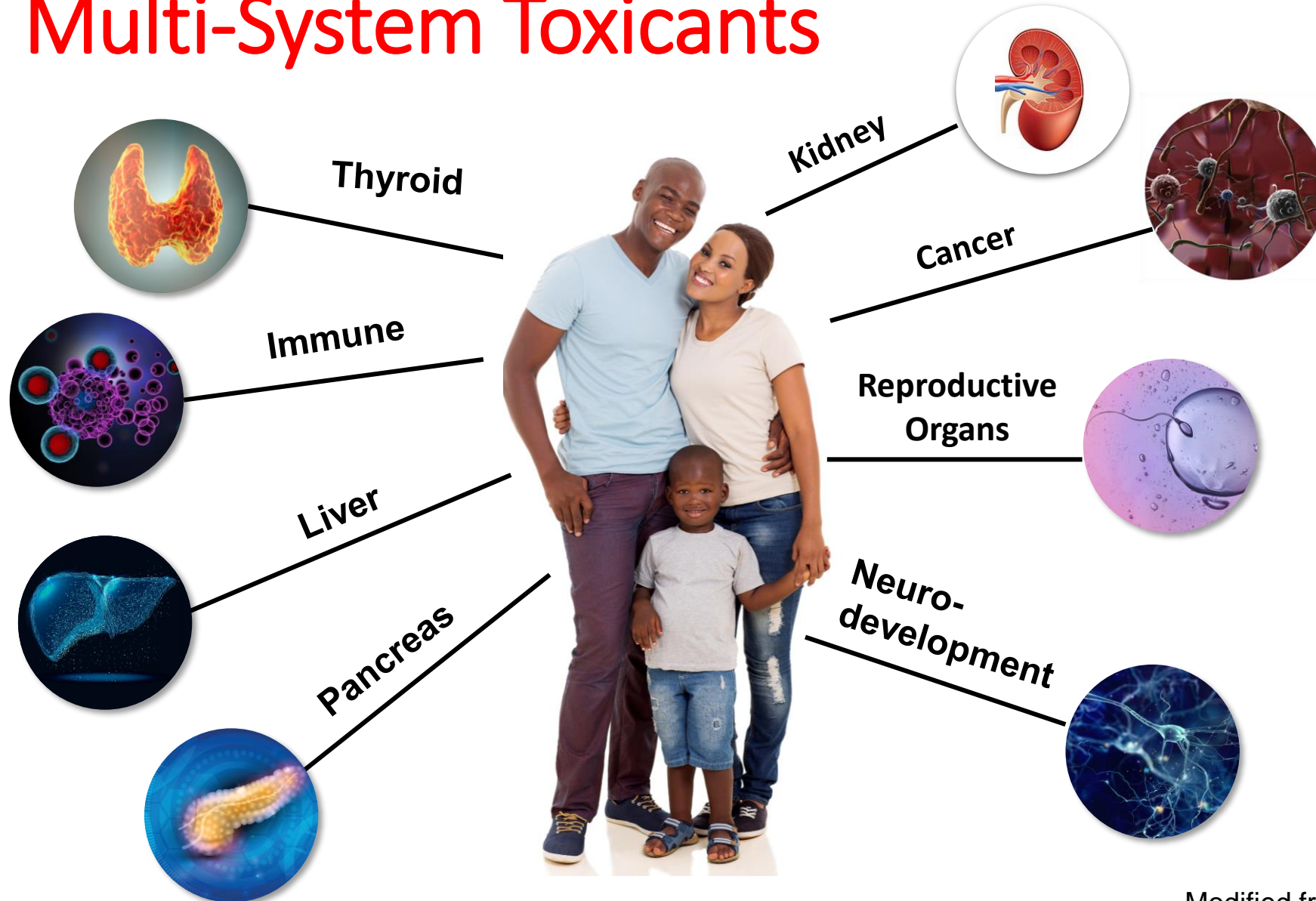


PFAS exposure trends in NHANES 2003 – 2014

Sunderland et al., J Expos Sci & Epidemiol, 2019

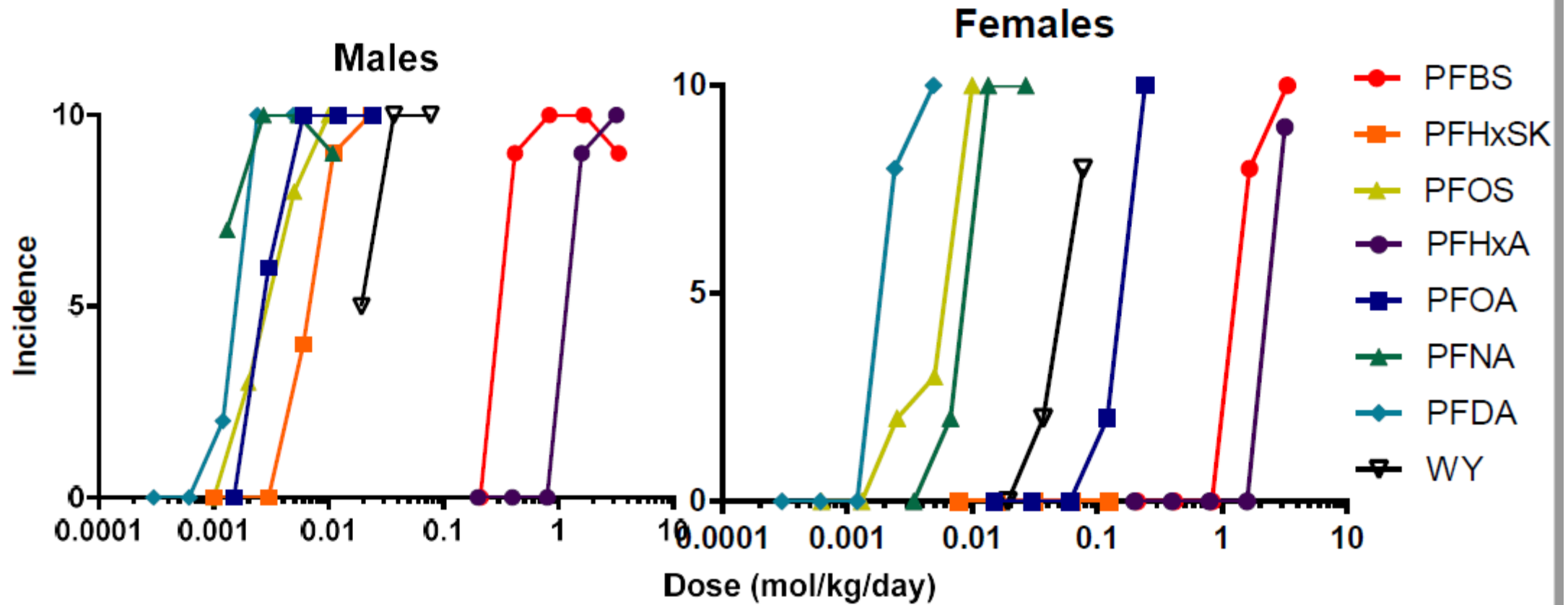
Dong et al., Ecotox and Environ Safety, 2019

# PFAS: Multi-System Toxicants





# Liver: Hepatocyte Hypertrophy





# PFAS in Fast Food Packaging

## Report finds chemicals in one-third of fast food packaging

By Ben Tinker, CNN  
 Updated 8:33 AM ET, Wed February 1, 2017

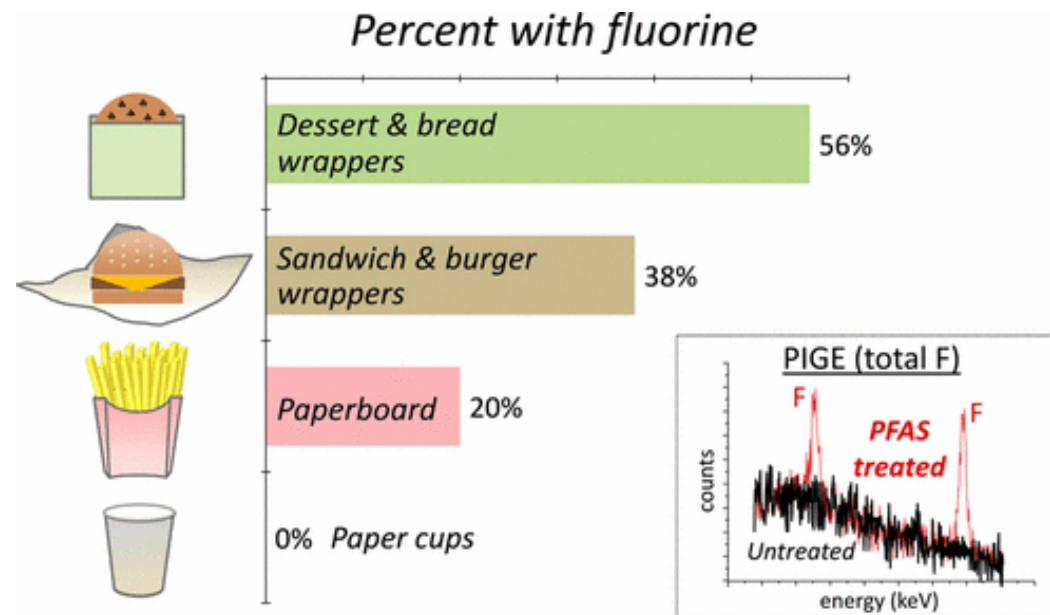


**Top stories**

- Tick-borne disease suspected in 2-year-old's death
- Lindsay Graham: 'Half of what Trump does is not OK'

Photos: Chemicals in fast food packaging

A study by the Silent Spring Institute found fluorinated chemicals in one-third of the fast food packaging tested. Previous studies have shown PFASs can migrate from food packaging into the food you eat. What types of packaging pose the greatest risk? Click through this gallery to find out.



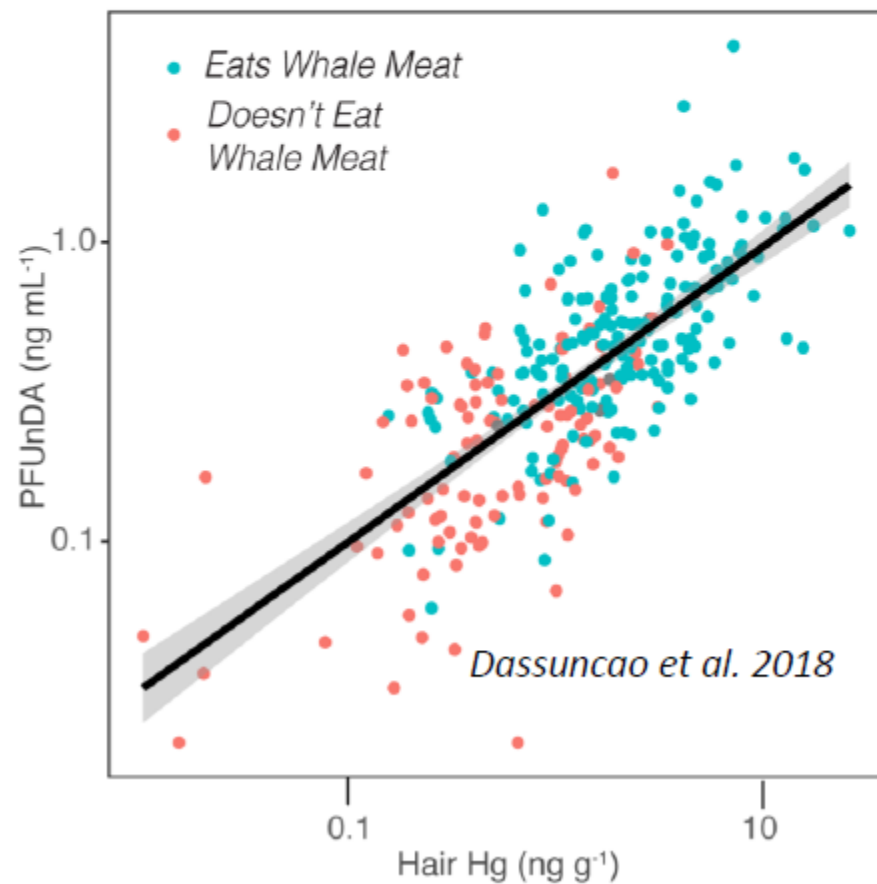
**Most common PFAS in samples: PFOA, PFHxA, PFBS, and 6:2 FTS**

### Fluorinated Compounds in U.S. Fast Food Packaging

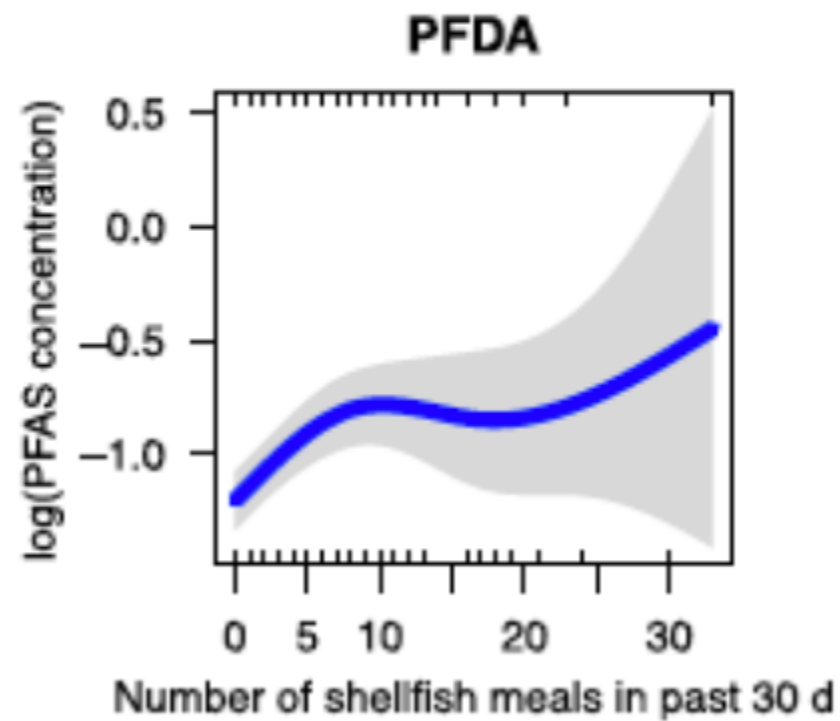
Laurel A. Schaidler,<sup>\*,†,Ⓜ</sup> Simona A. Balan,<sup>‡</sup> Arlene Blum,<sup>§,||</sup> David Q. Andrews,<sup>⊥</sup> Mark J. Strynar,<sup>#,Ⓜ</sup> Margaret E. Dickinson,<sup>∇</sup> David M. Lunderberg,<sup>∇</sup> Johnsie R. Lang,<sup>○</sup> and Graham F. Peaslee<sup>@</sup>

# Long-Chained PFCAs strongly associated with seafood consumption

Faroese Children



NHANES 2005-2006



*Hu et al. 2018*

# US Federal “Regulations” on PFAS

- **EPA**
  - Lifetime Health Advisories for Drinking Water – 70 ppt PFOA+PFOS
  - NO regulation of ground water
  - NO determination of ‘Hazardous Substance’
  - 172 PFAS added to TRI (in NDAA 2020 Bill)
- **FDA**
  - Food Contamination – 7 legacy PFAS + 6,2-FTOH
- **Department of Defense**
  - No PFAS in AFFF in practice/training – total ban by 10/2024
  - No PFAS in Food Packaging
- **Consumer Product Safety Commission**
- **FAA**
  - No PFAS in AFFF in domestic airports after 10/4/2021

*PFAS-containing AFFF banned in 180 countries except for emergencies*

# States are moving ahead...



- CA EPA just recommended regulating PFAS as a class in consumer products (Balan et al., 2021)
  - Logical, necessary and forward thinking
  - Helpful to other regulatory agencies in comprehensively addressing this large class
- 11 US states considering banning PFAS in food packaging
  - Maine, Washington, and New York have already acted
- 27 states considering policies across >180 bills with a primary focus on PFAS
- Several major grocery and restaurant chains announced policies to reduce or eliminate PFAS and other chemicals in food packaging

***Denmark is the first country to ban PFAS in food packaging as of July 2020  
Canada has just announced they intend to approach PFAS as a single class***

# Key Research Questions

- **Total organic fluorine analysis** – Are we measuring 90% or 10% of PFAS present in a sample?
- **How can we get rid of PFAS?** – Filtration? Incineration? Landfill?
- **Essentiality** – Where are chemicals really needed and where can we replace with safer alternatives? (*Cousins et al., 2019*)
- **Assessing alternatives** – Are our substitutes safer?
- **PFAS as a class** – One chemical group or subclasses? (*Kwiatkowski et al., ES&T Lett. 2020; Balan et al., EHP 2021*)
  - Too many PFAS to do proper toxicity testing (including mixtures)
  - NASEM strongly “....***an approach that uses subclasses to assess the chemicals is scientifically justifiable...***” [NASEM]

*THANK YOU...*

•Questions???

