

HOW PFAS BIOACCUMULATION AND PERSISTENCE VARY ACROSS COMMUNITY EXPOSURES

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PFAS Exposure and Patient Health | *PFAS Summit* | September 23, 2026

PFAS IN THE CULTURAL ZEITGEIST

SCIENCE

You probably have “forever chemicals” in your body. Here’s what that means.

A chemist explains how PFAS can harm us — and what to do about them.

by **Benji Jones**

Updated Jun 23, 2023, 11:51 AM EDT



Forever Chemicals Are Everywhere. Here’s How to Limit Your Exposure.

UPDATED APRIL 11, 2024

We have updated our guidance to reflect the EPA's requirement that municipal water systems remove six forever chemicals from drinking water by 2029.

Competition to destroy ‘forever chemicals’ heats up

Cleantech start-ups vie for a piece of the PFAS destruction market

by **Britt E. Erickson**

March 4, 2024 | A version of this story appeared in **Volume 102, Issue 7**



Reddit · r/PFAS

50+ comments · 1 year ago

I'm starting to go crazy. What's important to worry about and ...

I work as a chemist testing **PFAS** and the main pathway they get into your body is through consumption, they don't readily absorb into your skin.

55 answers · 8 votes: Filter your water and vacuum/dust regularly are the biggest way to avoid PFAS



Reddit · r/explainlikeimfive

10+ comments · 12 months ago

If "forever chemicals" are non-reactive, how are they toxic?

PFAS and PFOA are dangerous because they suppress immune response (amongst other things) without being broken down by our bodies' metabolisms.

17 answers · Top answer: We don't know for sure the exact way they cause harm, but the leading theo...



Reddit · r/Permaculture

100+ comments · 3 years ago

Anyone else freaked out about PFAS (forever chemical) ...

Also, since **PFAS** chemicals build up, if they are passing through humans, they can then go into the sludge. Spread year after year onto fields ...



Reddit · r/moderatelygranolamoms

90+ comments · 1 year ago

Toilet paper without pfas? : r/moderatelygranolamoms

there are definitely **PFAS** free floss. i use flosspot. radius is another option, but there are plenty of options.

97 answers · Top answer: Wait, toilet paper has pfas too? Is nothing safe! (Not sarcasm. This is frustrat...

HOW IS BIOACCUMULATION TYPICALLY UNDERSTOOD?

- The insecticide DDT (and Rachel Carson's accounts of its impacts in *Silent Spring*¹) made the concept of bioaccumulation famous.
- For chemicals like DDT, bioaccumulation is driven by lipophilicity – they “prefer” organic phases (like the bodies of humans and wildlife) to water.
- These chemicals can also biomagnify—increasing from prey to predator along food webs, leading to high concentrations in top predators (including humans).

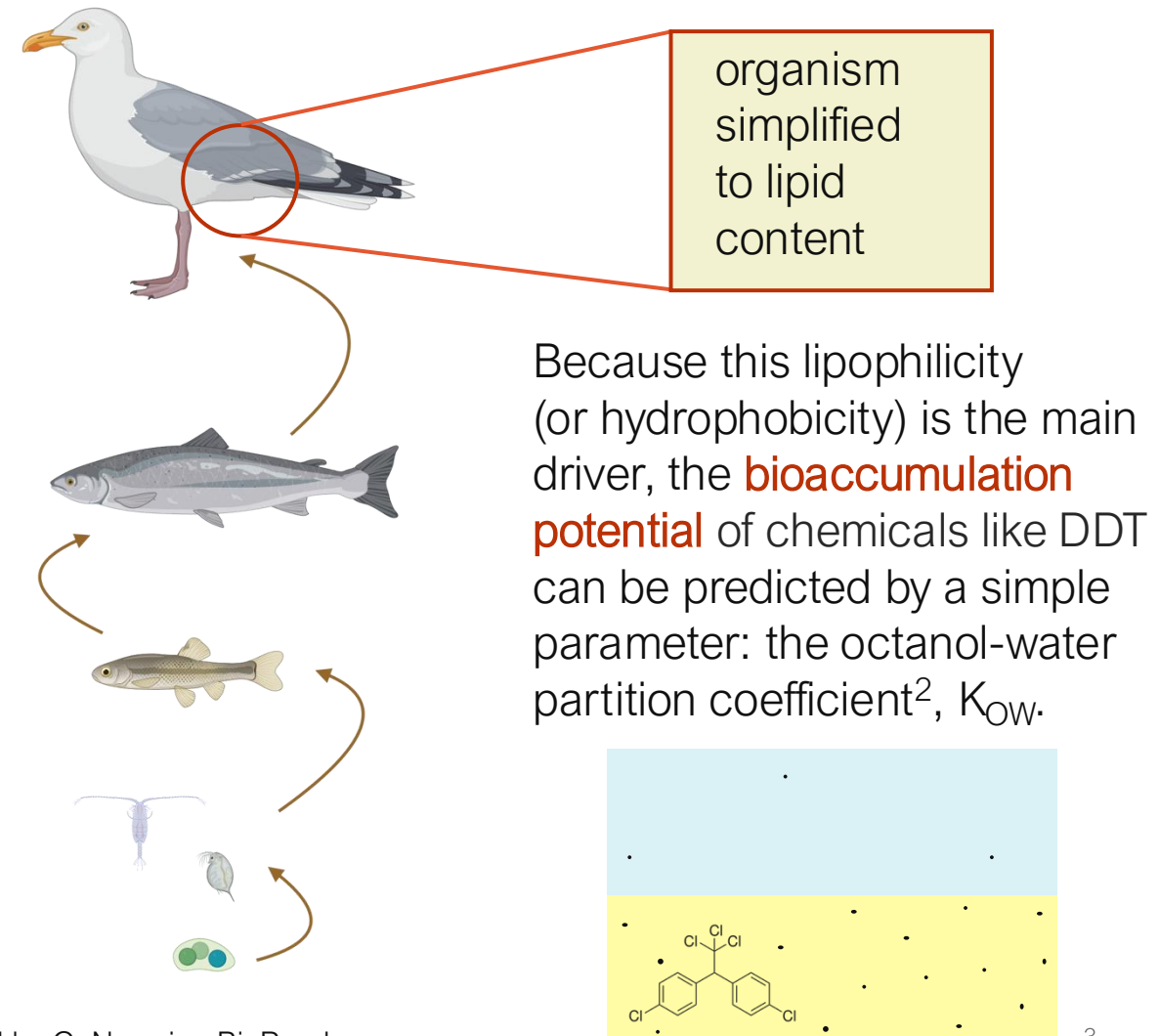
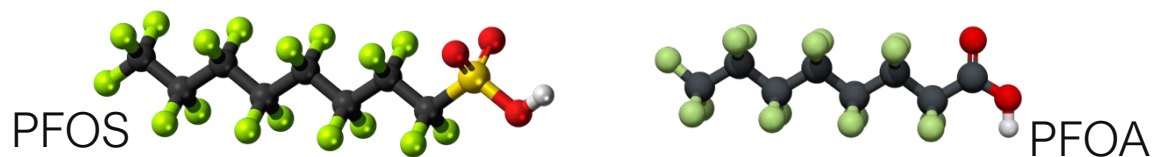


Figure created by C. Ng using BioRender

WHY PFAS ARE DIFFERENT*

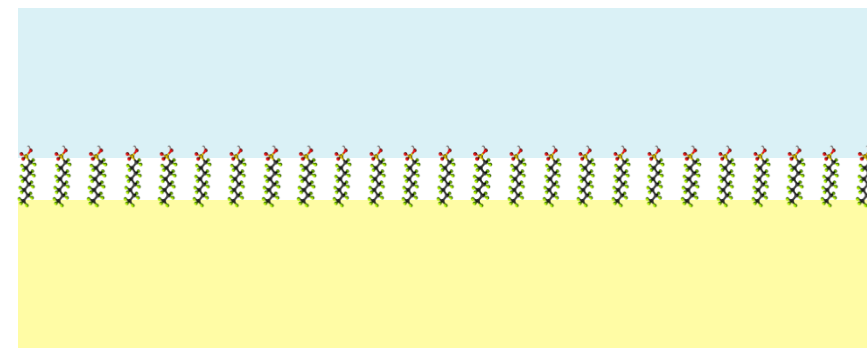
- PFAS became key components of many industrial and consumer projects based on their ability to impart unique surface properties.



- Unlike typical neutral organic chemicals, PFAS are both hydrophobic and lipophobic. At high concentrations, they prefer to create their own phase at the interface between air and water.
- At lower concentrations, they seek out phases that accommodate their dual natures.



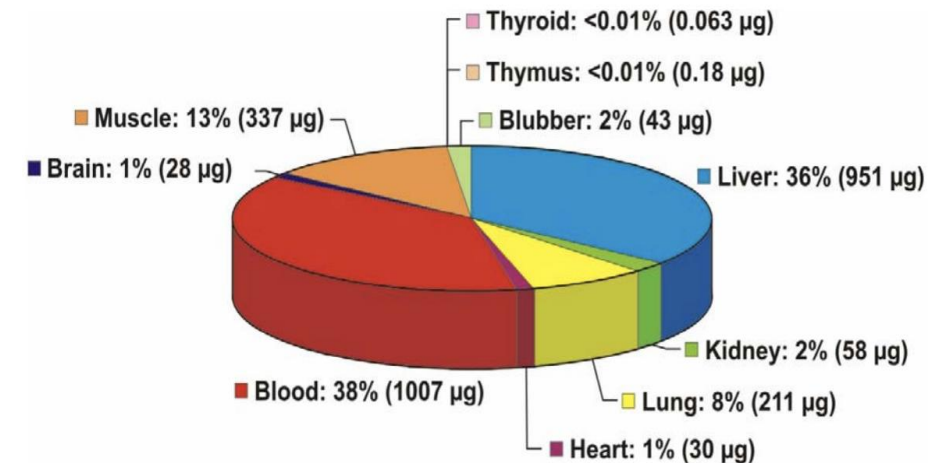
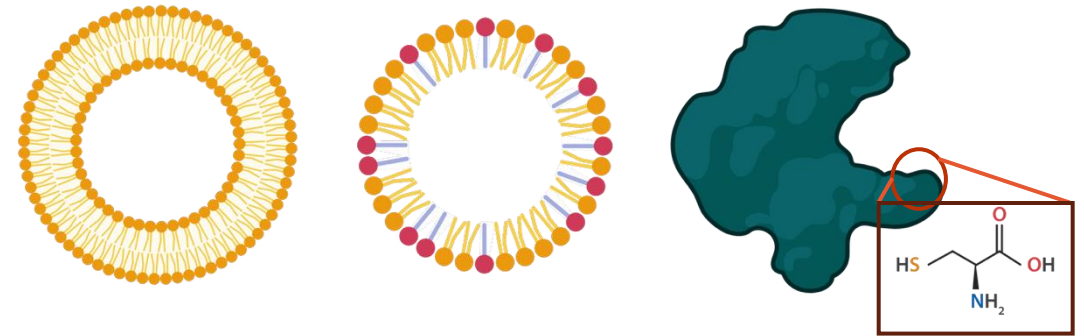
Image credit: Aathavan jaffna, CC BY-SA 3.0
<<https://creativecommons.org/licenses/by-sa/3.0/>>, via Wikimedia Commons



* Based on what we know about the best-studied PFAS 4

WHY PFAS ARE DIFFERENT* - TISSUE DISTRIBUTION

- The “phases” the PFAS* interact with in the body are not neutral lipids (adipose tissue) but membrane phospholipids and proteins— phases that have both nonpolar (hydrophobic) and polar (hydrophilic) components.
- This leads PFAS to accumulate in blood (where they associate with serum albumin), liver (rich in blood, membrane phospholipids, and proteins), and other tissues.
- While these interactions have led them to be labeled “proteinophilic” this is not a generic interaction— they do not accumulate in structural (muscle) proteins.

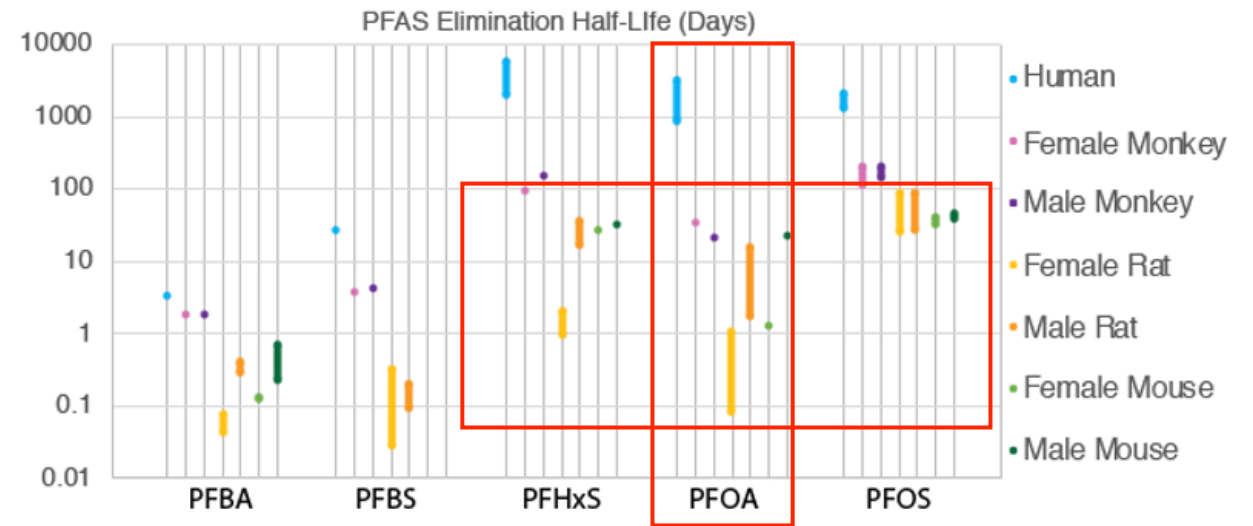


Ahrens et al. 2009: PFAS in seals³

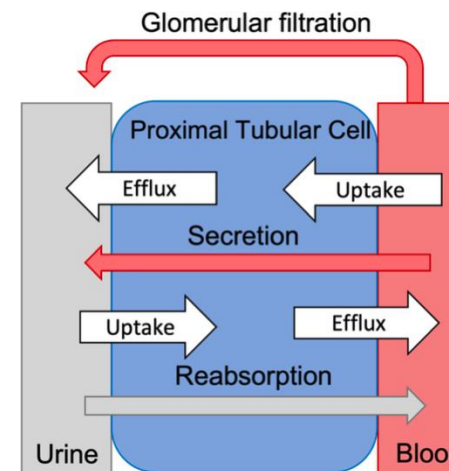
* Based on what we know about the best-studied PFAS

WHY PFAS ARE DIFFERENT* - PERSISTENCE IN THE BODY

- Their interactions with proteins are also important because it can influence some of their toxic effects (as Jamie and Sue will describe) and the length of time they stay in the body.
- The biological half-life is a key metric for how quickly PFAS can be cleared from the body once exposure stops.
- A long half-life contributes to bioaccumulation: PFOA has an average half-life of 2-3 years, PFOS 4-5 years, and PFHxS a median half life of 5-6 years.⁶



Data extracted from Pizzuro et al. 2019 Reg Toxicol Pharmacol.⁴



Kidney clearance of PFAS: glomerular filtration, tubular secretion, and reabsorption. Transporters are also active in the gut, brain, and other tissues.⁵

* Based on what we know about the best-studied PFAS

HOW PEOPLE ARE TYPICALLY EXPOSED TO PFAS



For communities near a contaminated site, drinking water is usually the major exposure route.

Without drinking water contamination*, food is usually the major source, both from the food itself and its processing and packaging.

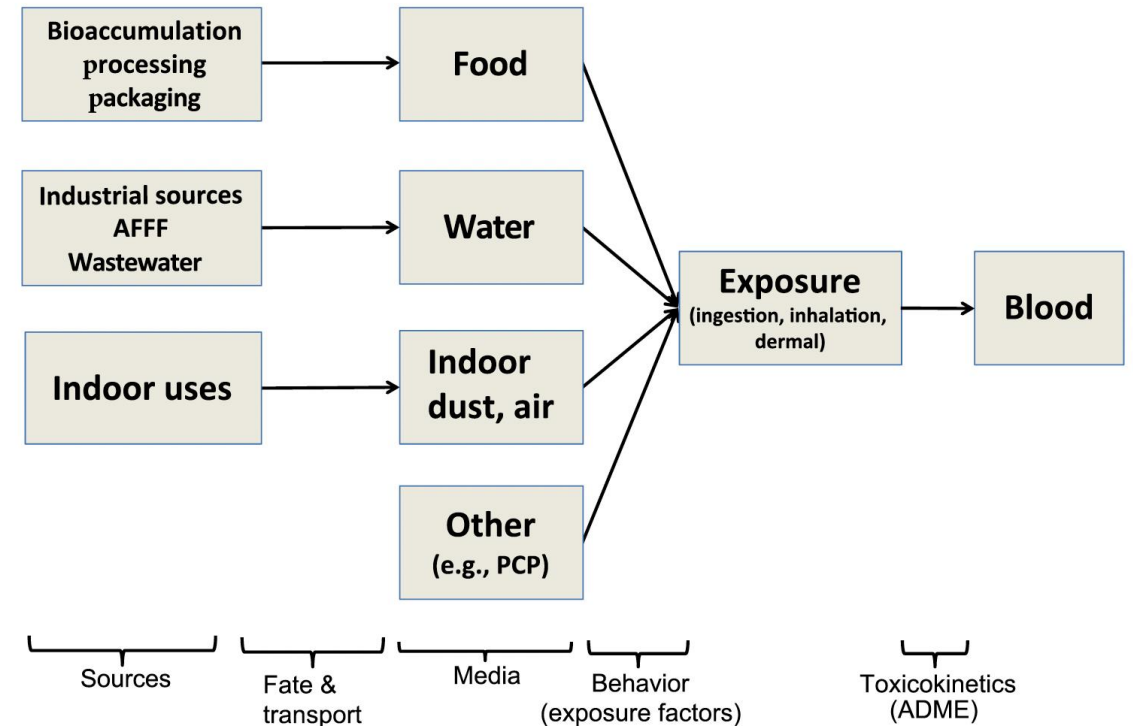


Research has also uncovered indoor sources (e.g. via cleaning/ personal care products, carpets), as well as inhalation exposures (via indoor and outdoor air).

*most drinking water contains low levels of PFAS

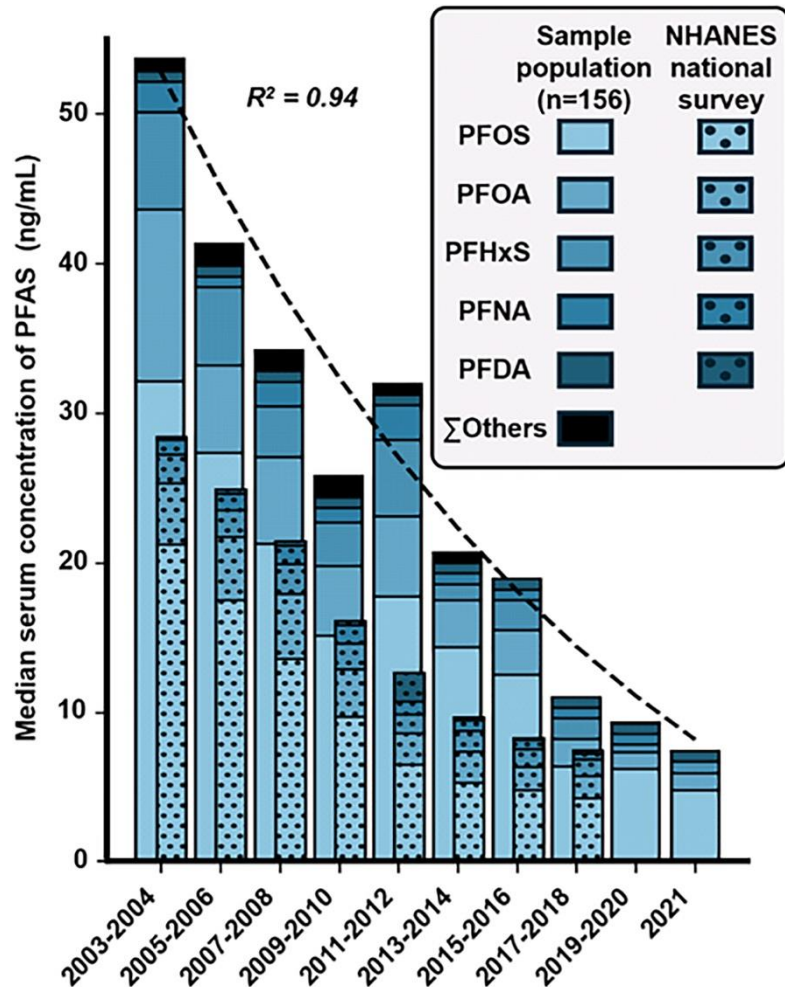
WHY EXPOSURE SOURCE AND ROUTE MATTER

- Community exposure **sources** are important because they affect:
 - The types of PFAS present.
 - The relative concentrations of different PFAS.
- Community exposure **routes** are important because they affect:
 - Selection of effective interventions.
 - Kinetics of uptake (e.g. via skin vs. gut).



De Silva et al. 2021 PFAS Exposure Pathways.⁷

HOW EXPOSURE PROFILES ARE CHANGING

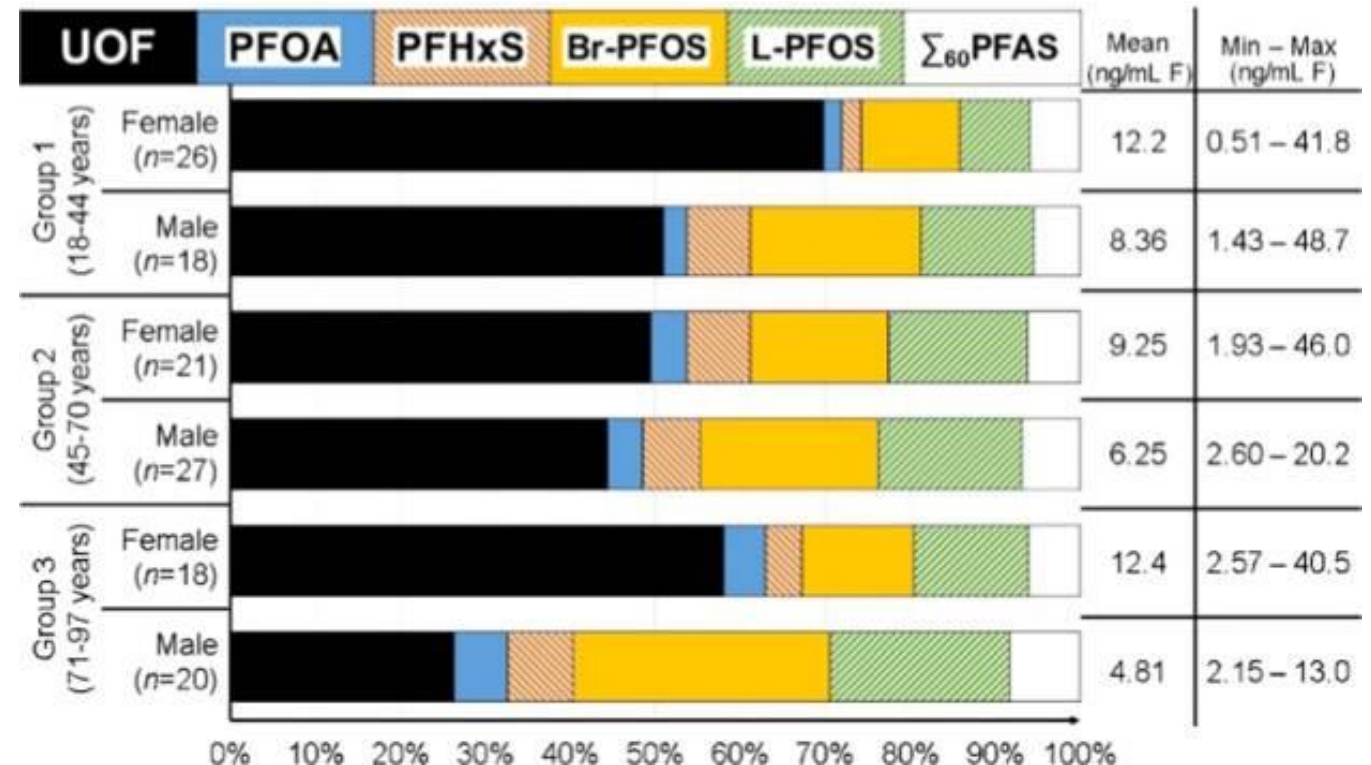


Kudzin et al. 2026 ES&T⁸ – most frequently detected PFAS in human serum in US.

- The good news: the phase-out of PFOS and PFOA are evident in studies of human serum data.
- Despite this, PFOA and PFOS still make up a large share of PFAS detected in serum.
- This does not reflect the totality of exposure—some common modern-day PFAS are present in the environment, are bioavailable, but do not accumulate in serum.
- Do we need to consider other monitoring methods?

THE DEVIL(S) WE STILL DON'T KNOW

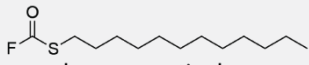
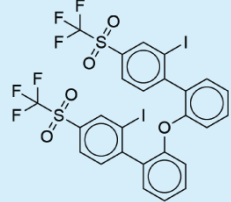
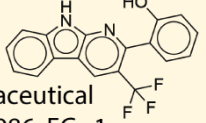
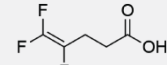
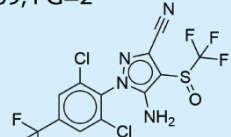
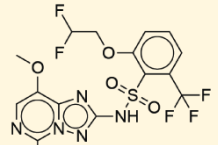
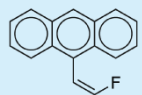
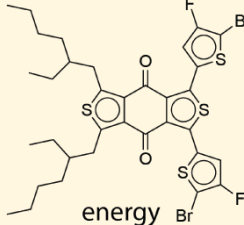
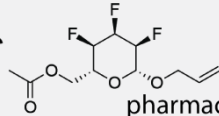
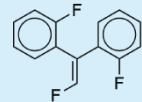
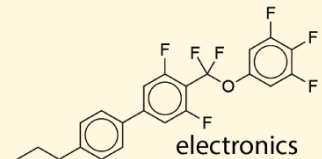
- There are many PFAS with unknown toxicity profiles that can be detected in the environment and in humans.⁹
- There is also a substantial fraction of unknown organofluorine signal in humans that scientists are actively working to describe.
- Structures must be known before we can try to predict or estimate effects.
- Mixtures remain a challenge, although for related PFAS methods are more developed.



Aro et al. 2021 ES&T⁹ – mass balance of known and unknown PFAS in human serum across Sweden shows growing ‘unknown’ burden.

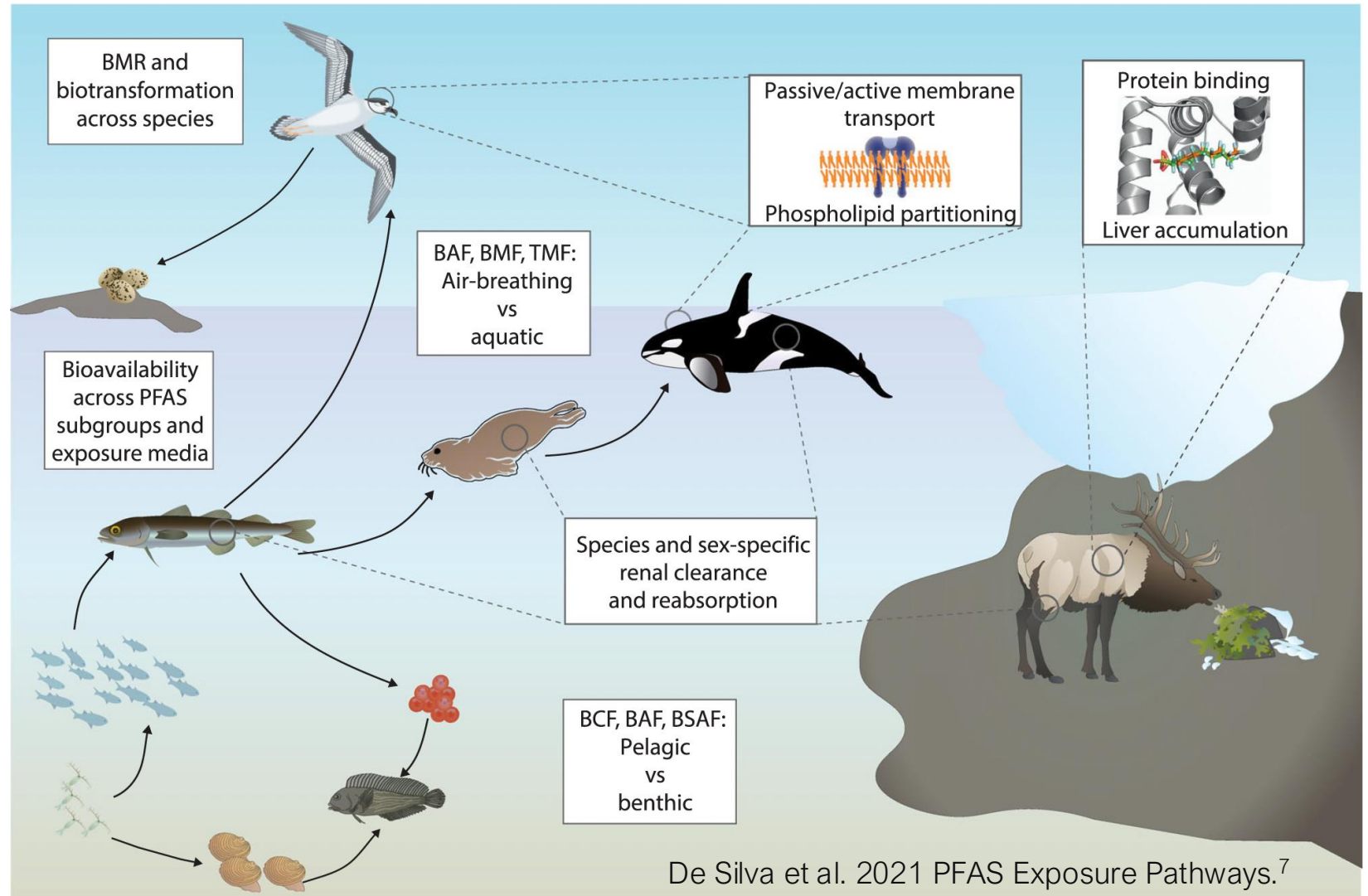
THE DEVIL(S) WE STILL DON'T KNOW

- Much of the knowledge we have developed over the decades since PFAS bioaccumulation became a topic of research (late 1990s, early 2000s) are based perfluoroalkyl acids.
- The diversity of organofluorine substances on the market and in the environment is staggering, and there is still much to be learned.

	ALIPHATIC	AROMATIC	MIXED
saturated	 pharmaceutical FAF = 0.056, FG=1	 pharmaceutical FAF = 0.109, FG=2	 pharmaceutical FAF = 0.086, FG=1
unsaturated	 industrial FAF=0.2, FG=0	 agrochemical FAF = 0.2, FG=2	 agrochemical FAF = 0.11, FG=2
cyclic	 agrochemical FAF = 0.029, FG=1	 pharmaceutical FAF = 0.036, FG=0	 energy FAF = 0.025, FG=0
	 pharmaceutical FAF=0.091, FG=0	 pharmaceutical FAF = 0.115, FG=0	 electronics FAF = 0.16, FG=0
fluorine-containing groups (FG)	$-\text{CF}_x$ $-\text{OCF}_x$ $-\text{SCF}_x$ $-\text{SCOF}_x$...		

THANK YOU!

- Feel free to reach out with follow-up questions:
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