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PFAS: What? Why? Where? Who?

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Chemical & Engineering News

PFAS

Synthetic chemicals with carbon and fluorine atoms bonded to each other.

C-F

- Carbon-fluorine bond is one of the strongest known -- rare in nature
- This bond makes PFAS hard to break down

PFAS: Complicated name

- Acronym for per- and polyfluoroalkyl substances
- Named in 2011 by Buck et al *(Integr. Environ. Assess. Manage. 2011, DOI: 10.1002/ieam.258)*
- Formerly called perfluorochemicals or PFCs

PFAS

- Popularly called “forever chemicals”
- Data show some PFAS are toxic at extremely low levels
- Many PFAS with “active” ends, like acids, are known to be toxic.

PFAS

Exposure to active forms of these chemicals are linked to:

- Decreased antibody response to vaccines
- Abnormally high cholesterol
- Decreased fetal and infant growth
- Increased risk of kidney cancer

National Academies of Sciences, Engineering and Medicine, 2022
DOI 10.17226/26156.

PFAS

Limited evidence links exposure to:

- Breast cancer
- Testicular cancer
- Thyroid dysfunction
- Liver problems
- Pregnancy-induced hypertension
- Ulcerative colitis

National Academies of Sciences, Engineering and Medicine, 2022, DOI 10.17226/26156.

HOW MUCH IS TOO MUCH?

- People with a blood concentration over 20 ng/mL of seven widely detected PFAS, combined, are at the highest risk of adverse health effects

- People with between 2 and 20 ng/mL face some risk.

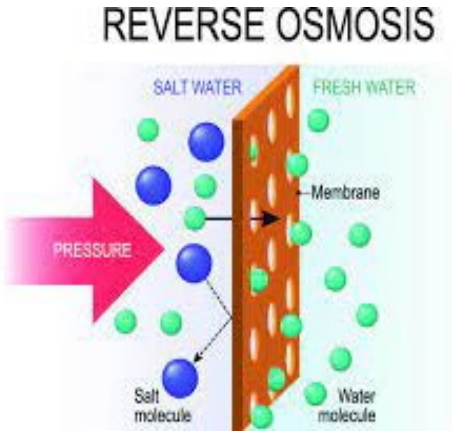
- Ng/mL is parts per trillion.

-- National Academies of Sciences, Engineering, and Medicine, 2022

Why and how do we use PFAS in society?


MANHATTAN PROJECT
A
BOMB

MULTIPLE USES



WATER AND STAIN RESISTANCE

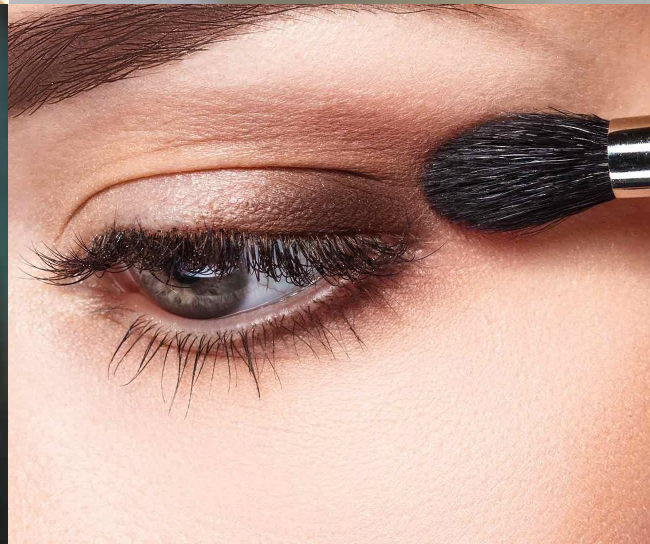
MEDICAL MESH

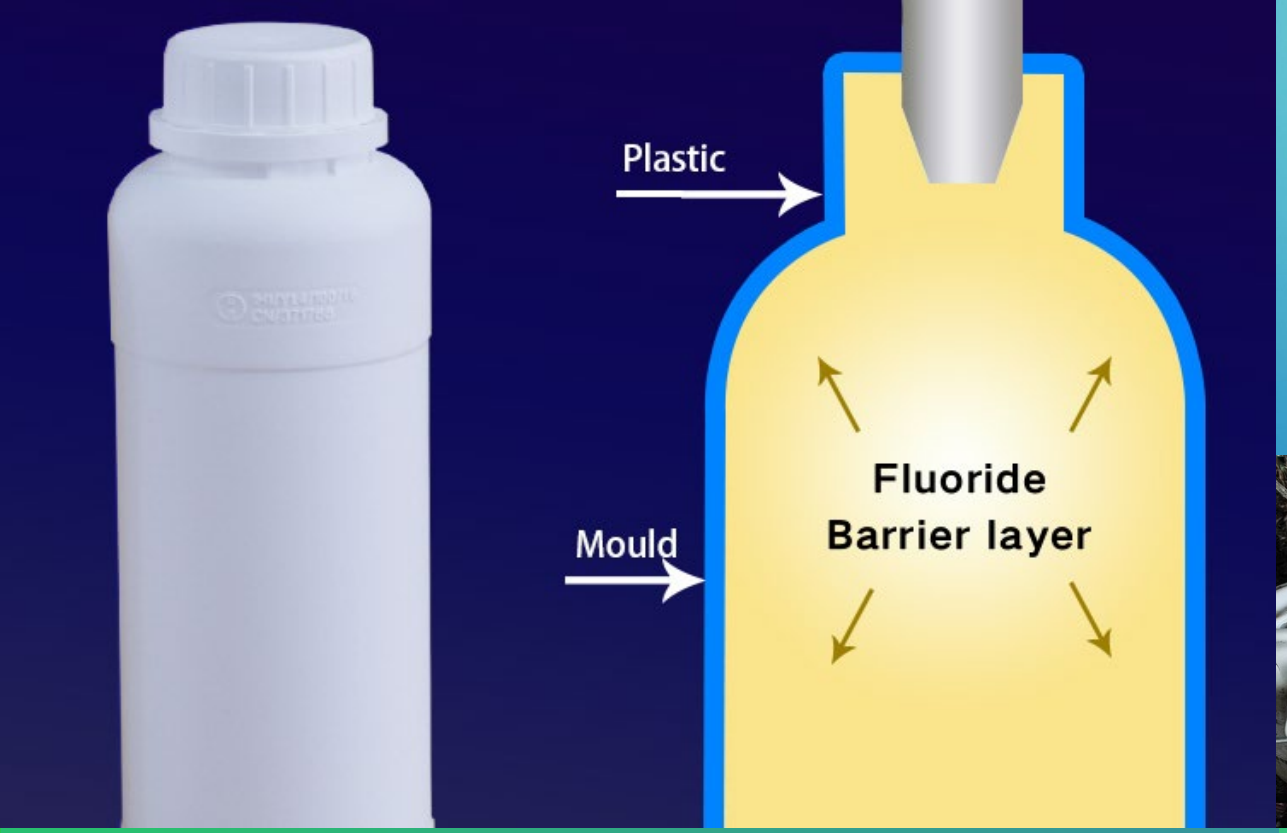
OTHER USES

- Aerospace applications (heat and pressure resistance)
- Firefighting foams

OTHER USES

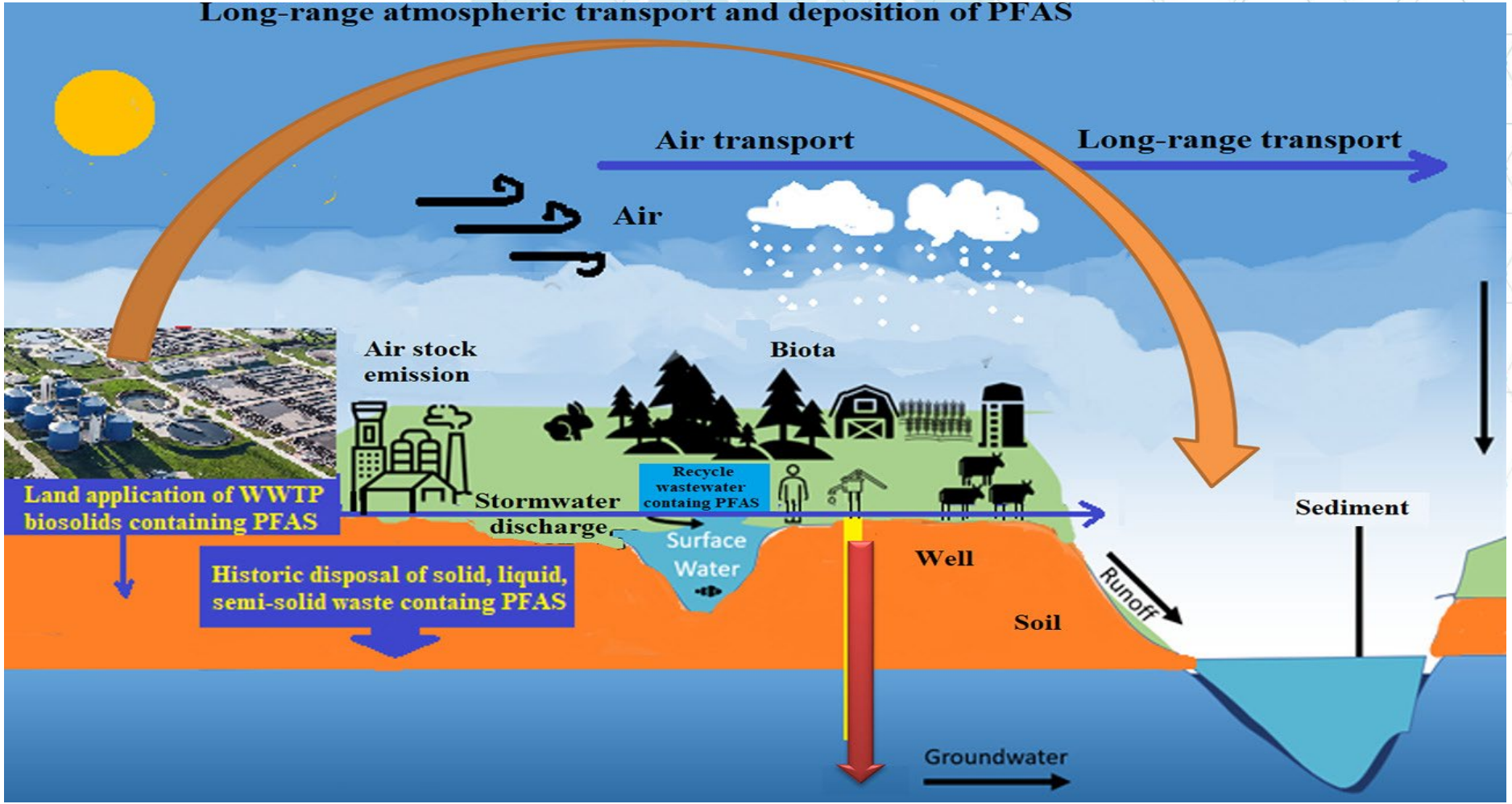

Oral-B
Glide
PRO-HEALTH
ADVANCED
MULTI-PROTECTION
FLOSS
CLEAN MINT
43.7 yd (40 m)





UNINTENTIONAL PFAS

Where does the PFAS go when we’re done with a product?



S. Kurwadkar et al, *Science of The Total Environment*, 2022

PFAS: Their definition evolves

C_nF_{2n+1}

Buck et al., 2011 **OECD, 2021** **US EPA, 2021**

R_1, R_2, R_3 = nonhydrogen atoms

PFAS: Why the definition matters

- EPA definition: about **37,000** chemicals*
- OECD definition: almost **1.8 million** chemicals*
- **Which chemicals will be in regulators' purview?**

*Communication with authors of *Digital Discovery* 2022, DOI: 10.1039/D2DD00019A

Questions?