Applying Passive Samplers to Assess Perfluoroalkylated Substances in Soils and Sediments

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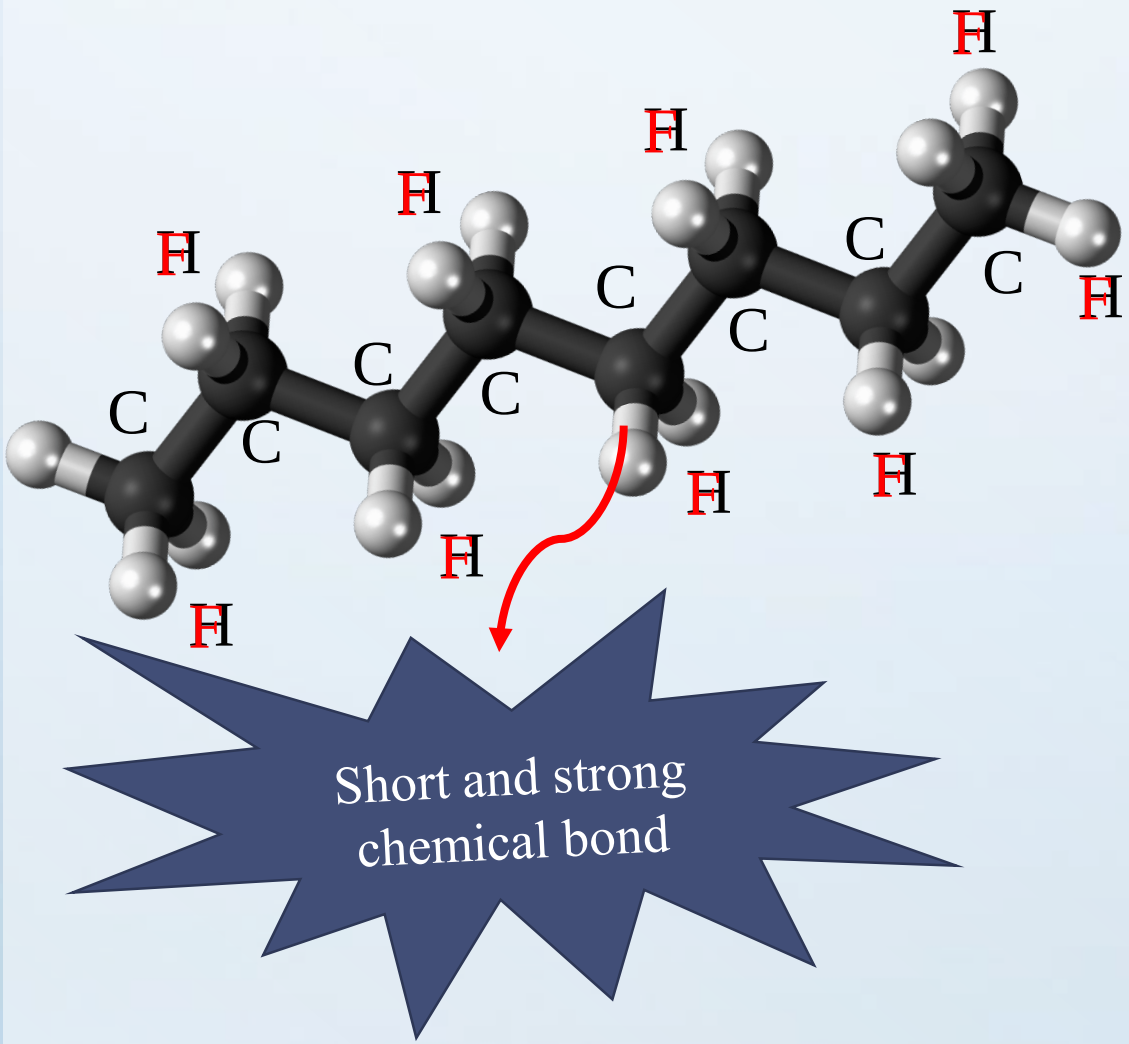
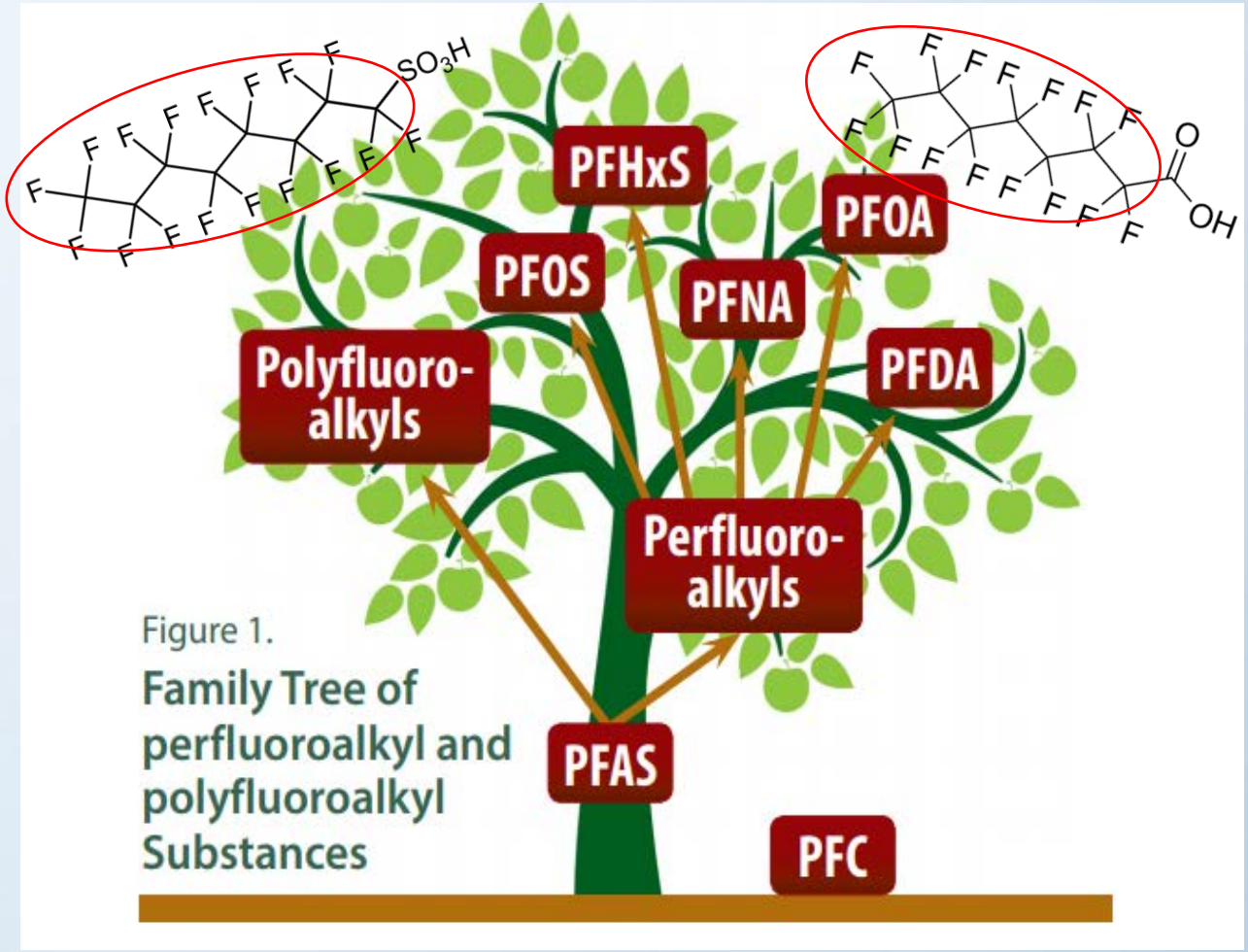
Introduction

Introduction

PFAS?



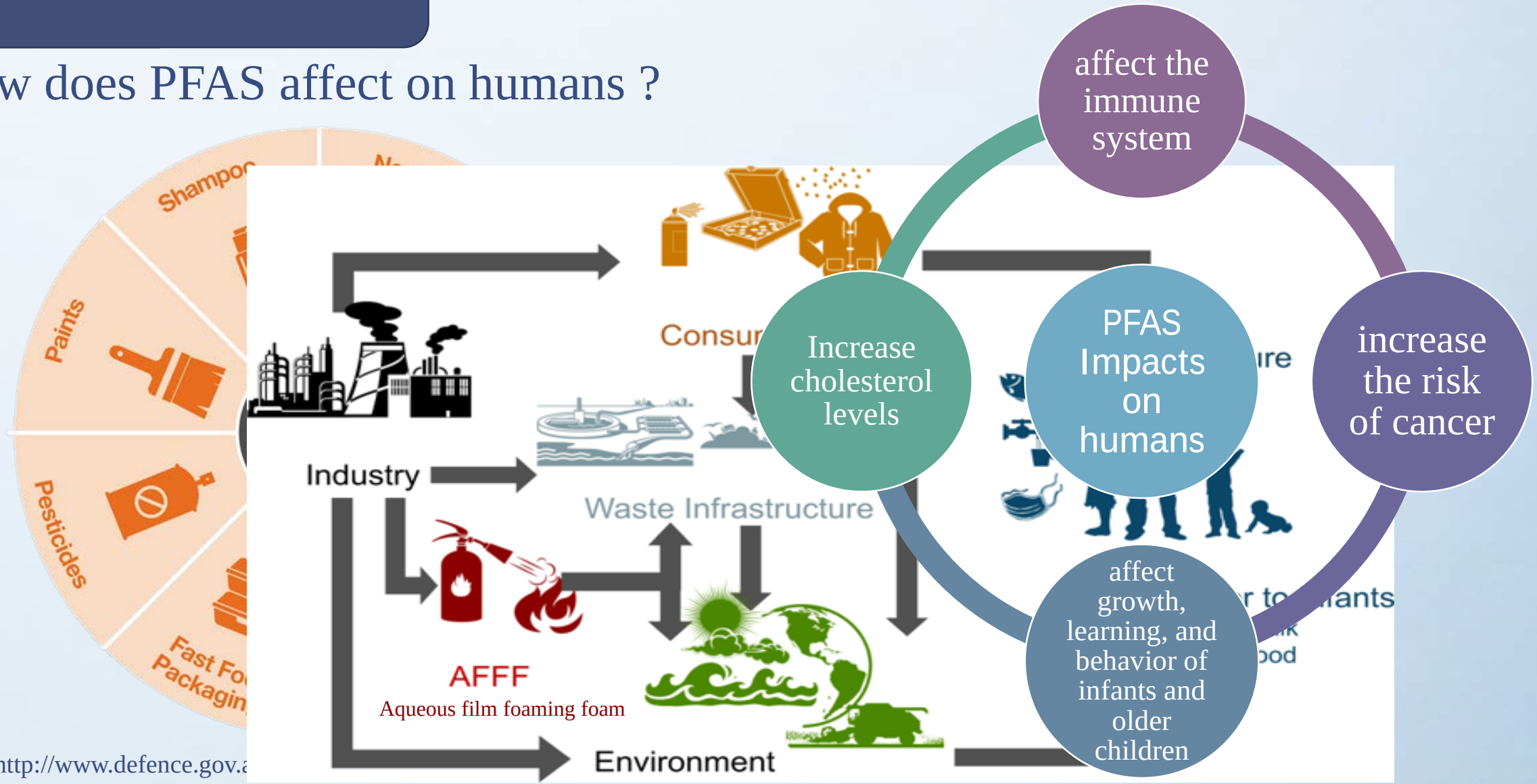
lipophilic and hydrophilic



https://www.atsdr.cdc.gov/pfas/docs/PFAS_FamilyTree_EnvHealthPro-508.pdf

Introduction

How does PFAS affect on humans ?

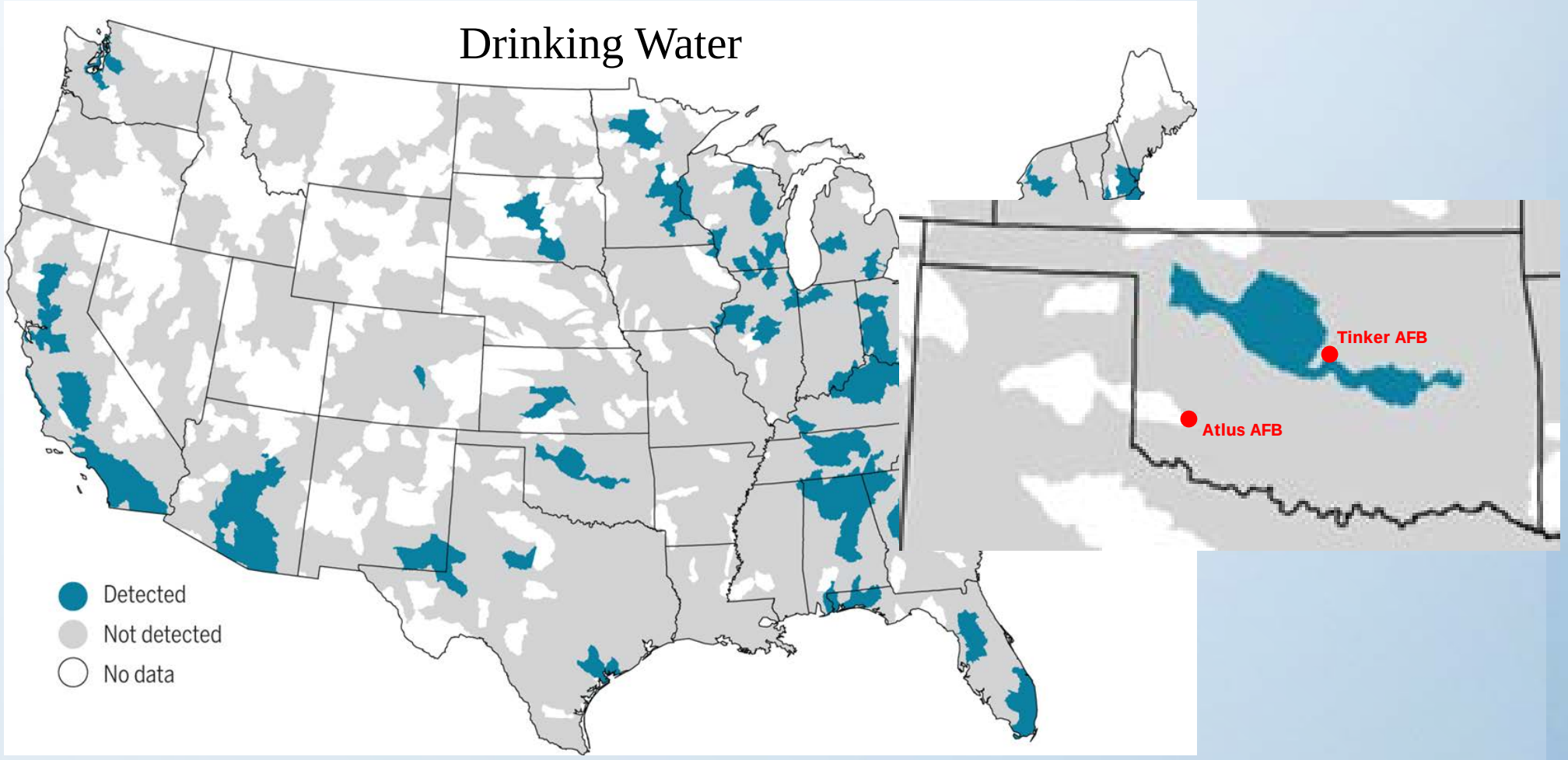


http://www.defence.gov.a

Elsie M. Sunderland, Xindi C. Hu, Clifton Dassuncao, Andrea K. Tokranov, Charlotte C. Wagner & Joseph G. Allen, "A Review of the Pathways of Human Exposure to Poly- and Perfluoroalkyl Substances (PFASs) and Present Understanding of Health Effects", Journal of Exposure Science & Environmental Epidemiology 29, 131-147 (2019).

Introduction

Where are PFAS found around the country?

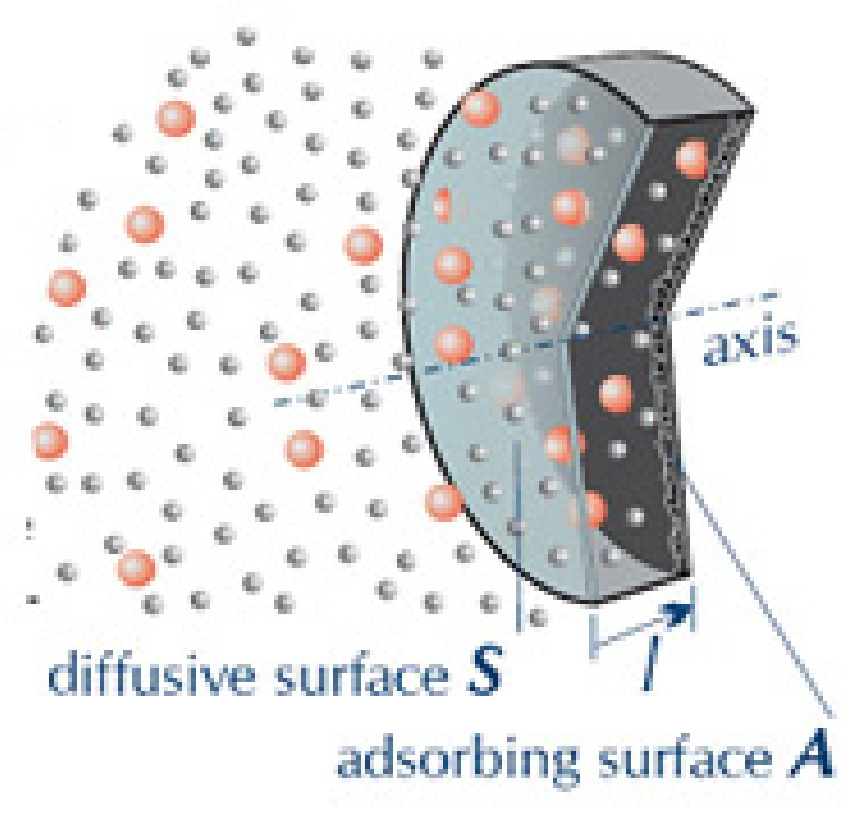


https://pubs.acs.org/doi/10.1021/acs.estlett.6b00260

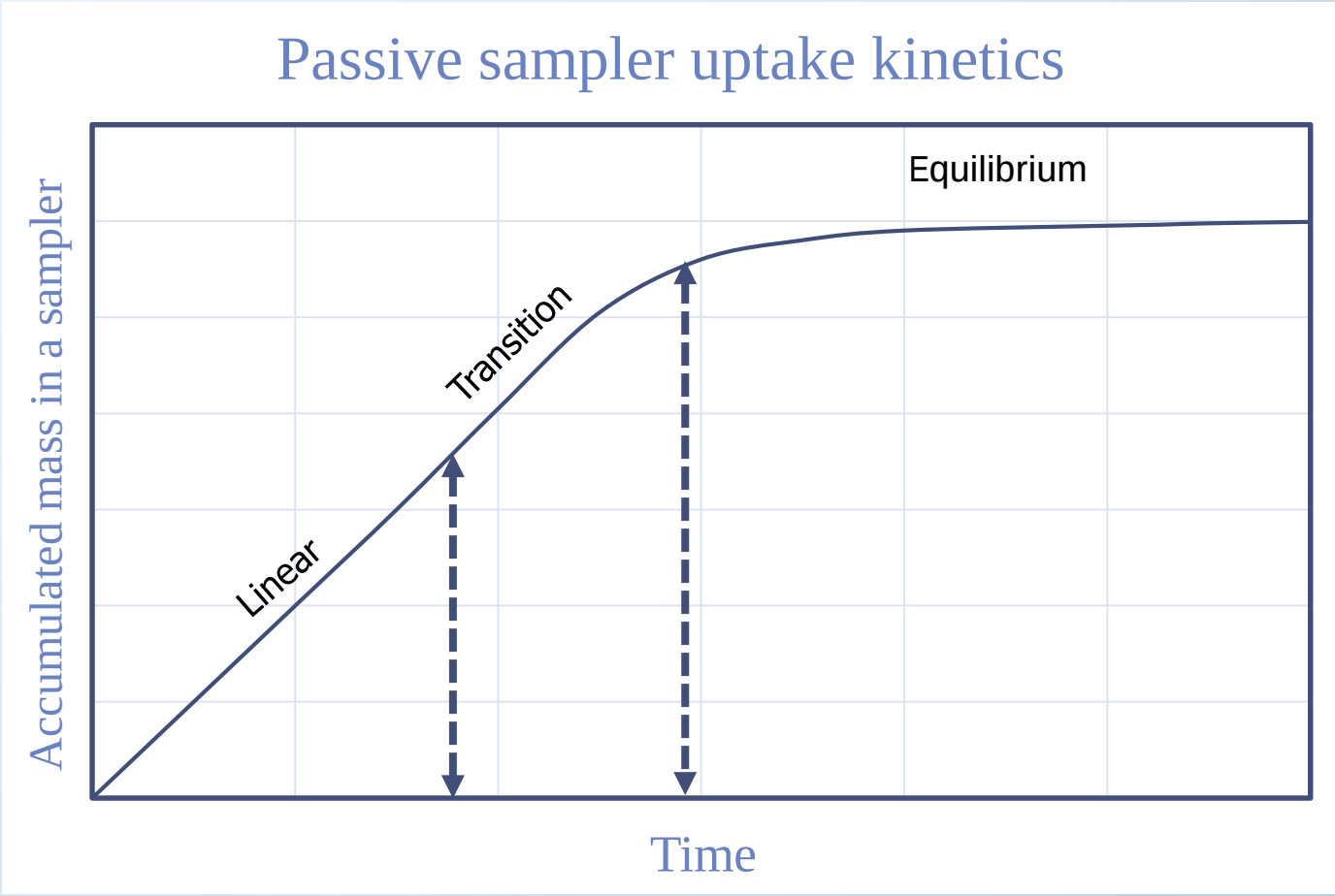
Introduction

Passive Sampling

Relies on molecular diffusion of analytes through a diffusive surface onto an adsorbent



https://www.sigmaaldrich.com/analytical-chromatography/air-monitoring/passive-sampling.html



Goal and application

Goal

Develop an approach for PFAS analysis in soils and sediments by using passive samplers

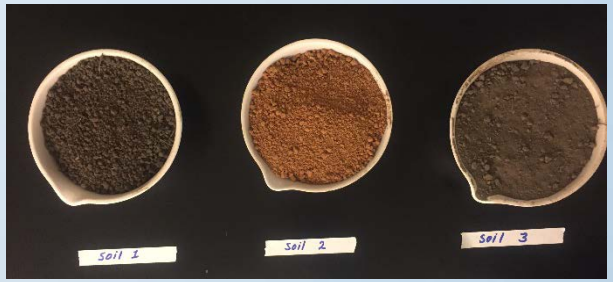
Application

- Military bases
  - Tinker Air Force Base in Oklahoma City, OK
  - Altus Air Force Base in Altus, OK
- Landfills
- Evaluate various remedial alternatives (remedial investigation and feasibility study (RI/FS) process)

Materials and Methods

- PFOA, PFOS, and PFBS → three key PFAS with existing drinking water advisories
- Sampler
  - 316 stainless steel washer (ID 21 mm and OD 37 mm) * 3
  - 316 stainless steel screw and wingnut (0.5 mm pitch) * 4
  - Polyethersulfone (PES) membrane (0.45 μm pore size and 25 mm diameter) * 2

- Resin (Sepra ZT WAX 30 μm, weak anion mixed mode polymeric sorbent)
- 3 different soils (Tallgrass Prairie Preserve, OK)
- 300-gallon tank * 1
- 3-gallon PP pail * 12

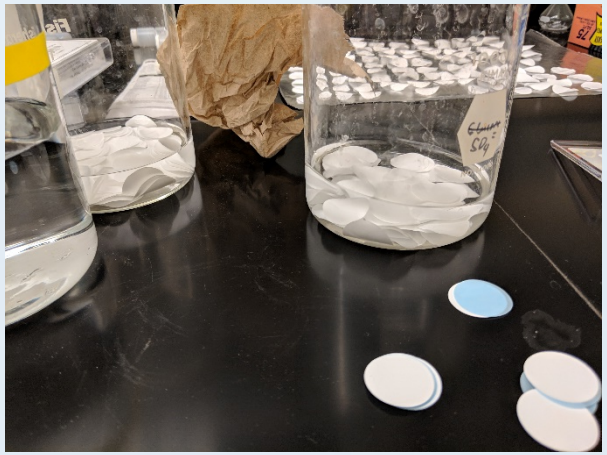


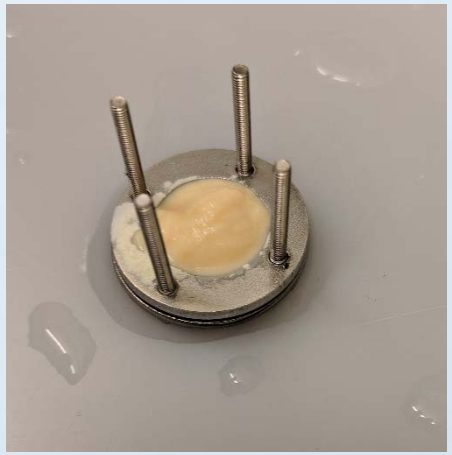
	Soil 1	Soil 2	Soil 3
OM (%)	4.15	0	4.36
Particle density (g/cm3)	2.64	2.09	1.79
Moisture Content (%)	11.17	0.83	4.41
Porosity (%)	62	60	48

Materials and Methods

Samplers Preparation

- Clean and rinse the stainless steel stuff with warm soapy water and acetone
- Clean the PES membranes in 200 mL of methanol for 20 min followed by 400 mL of DI water for 10 min
- Add 440 mg of the resin into the space between the two washers and add DI water droplet gradually to remove any air from the sampler
- Place all the assembled samplers into the refrigerator





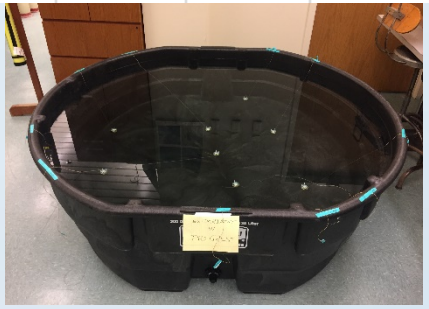
Materials and Methods

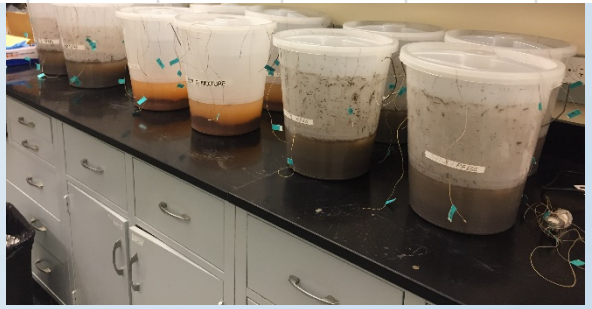
Experiments

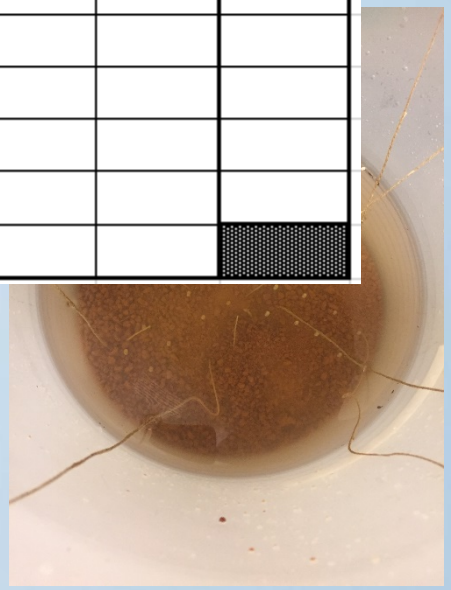
Experiments \ Samples	Soil/water 1				Soil/water 2				Soil/water 3				Water
	PFOA	PFOS	PFBS	PFAS	PFOA	PFOS	PFBS	PFAS	PFOA	PFOS	PFBS	PFAS	PFAS
Aqueous Phase (t = 0)													
Integrative Sampler (t = 0.5)													
Integrative Sampler (t = 1)													
Integrative Sampler (t = 2)													
Integrative Sampler (t =4)													
Integrative Sampler (t = 6)													
Integrative Sampler (t = 10)													
Integrative Sampler (t = 12)													
Integrative Sampler (t = 15)													
Integrative Sampler (t = 20)													
Integrative Sampler (t =25)													
Aqueous Phase (t = 25)													
Soil (t = 25)													

168 SAMPLES!

e tank







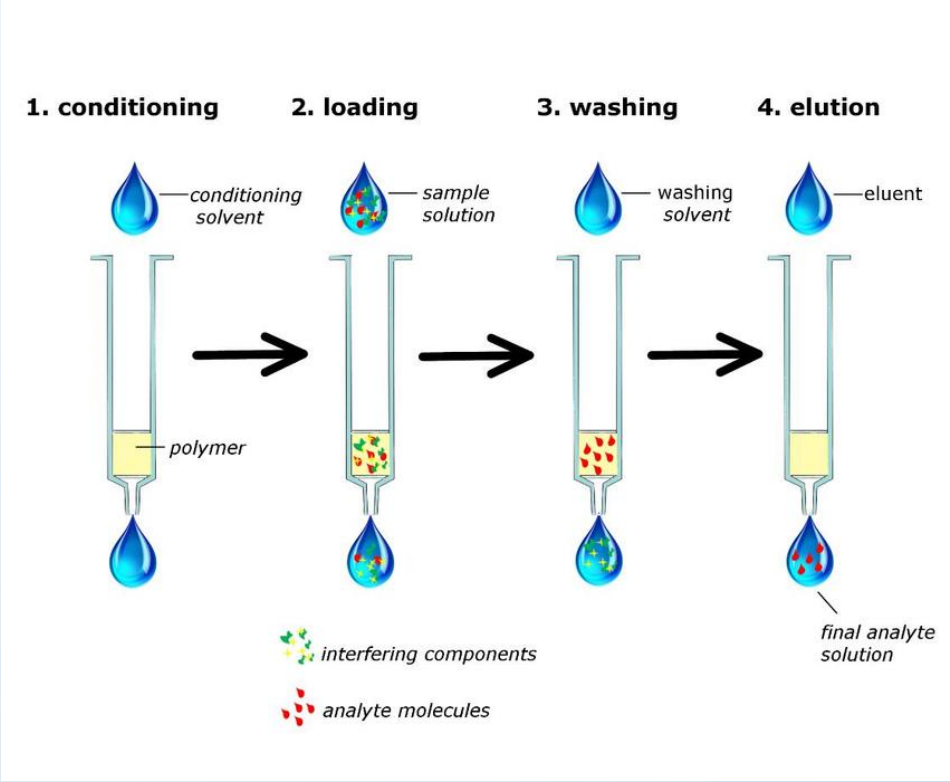
Materials and Methods

Quantification of PFAS

- Samplers' disassembly
- Transfer resin to a solid-phase extraction (SPE) cartridge
- Liquid chromatography

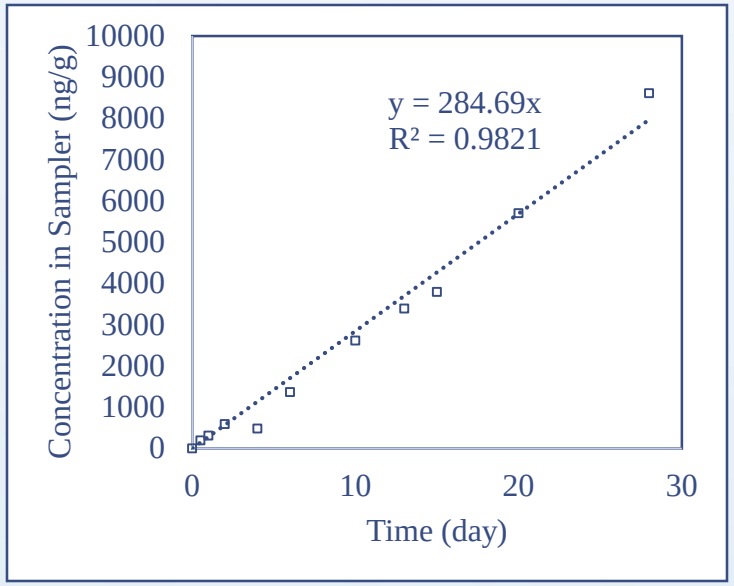
  tandem mass spectrometry

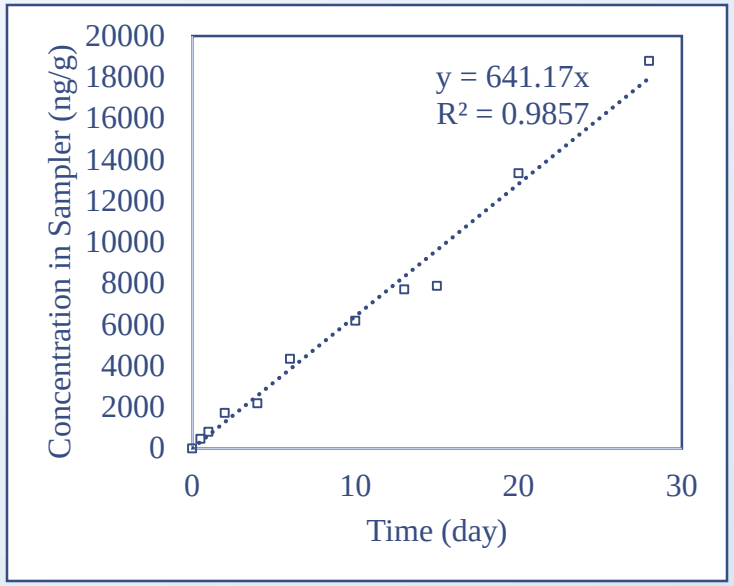
  (LC/MS/MS)

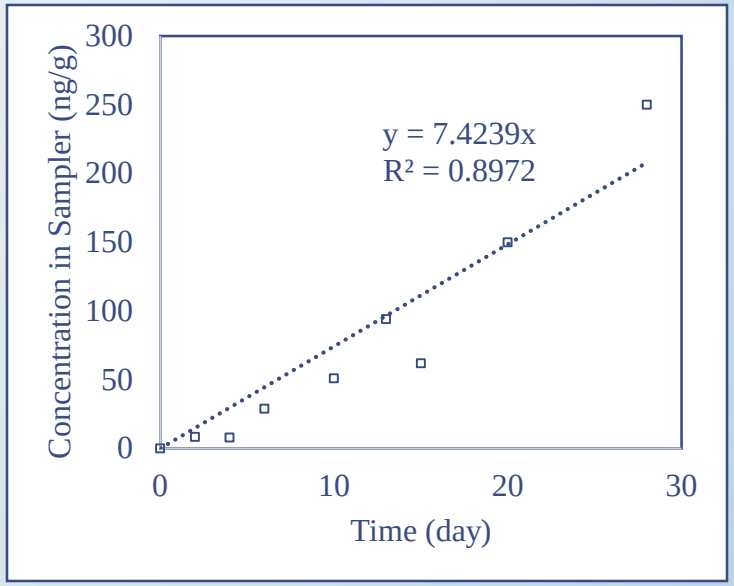


Maria Alexandra Sandoval R., "Extraction of Phorbol Esters (PEs) from Pinion cake using computationally-designed polymers as adsorbents for Solid Phase Extraction", (2016).

Preliminary Results

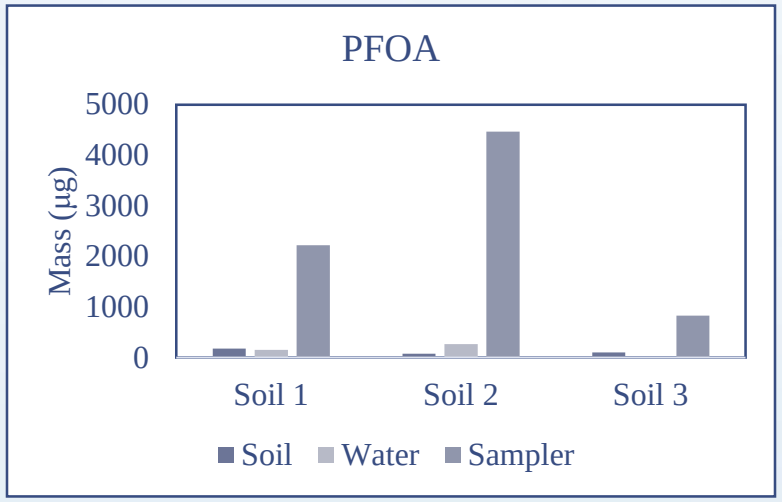


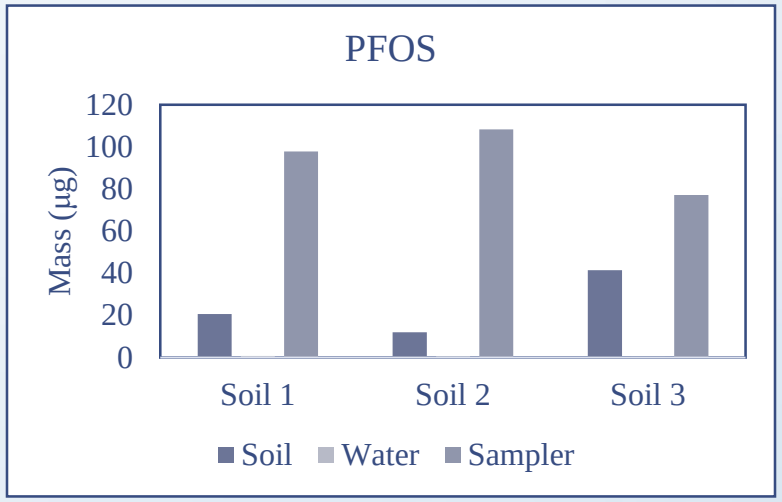


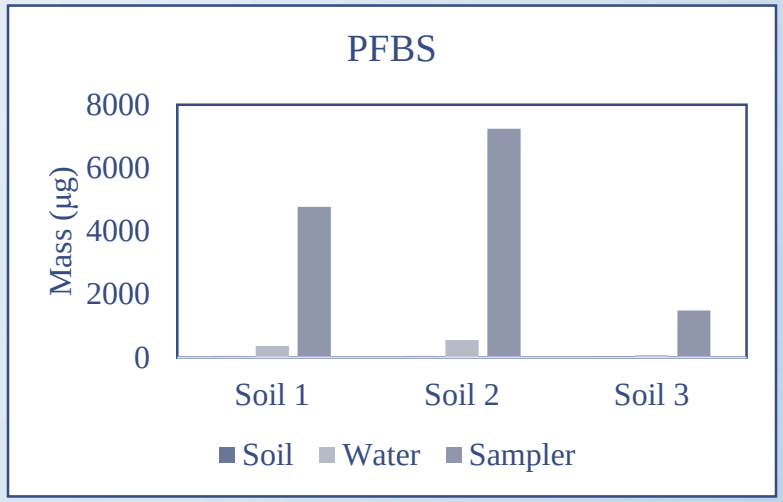


Uptake of PFOA, PFOS, and PFBS in the passive samplers vs. Time.

Preliminary Results







Mass distribution of PFOA, PFOS, and PFBS in the soil, water, and resin

Conclusions

- In the first 28 days, the passive samplers work completely linear in the large tank and to reach the equilibrium, more experiments should be performed.
- The most mass of PFAS has been distributed to the resin, so the passive samplers work appropriately.
- Further experiments need to figure out the impact of different soils on PFAS accumulation in passive samplers.

THANKS