

# Latest Trends in PFAS Testing and Regulations Landscape: from ppb to ppq in Water, Serum and beyond

**PFAS**

PER- AND POLY-FLUOROALKYL SUBSTANCES

**Management of  
Environmental & Health Risks**

June 4-5-6, 2024 - Paris

**Mike Chang**

**Market Development Manager**

**[mike.chang@restek.com](mailto:mike.chang@restek.com)**

# Evolution of PFAS Testing

2000's

PFOA  
PFOS

Mostly water



2010's

C4 – C18

Water  
Soil



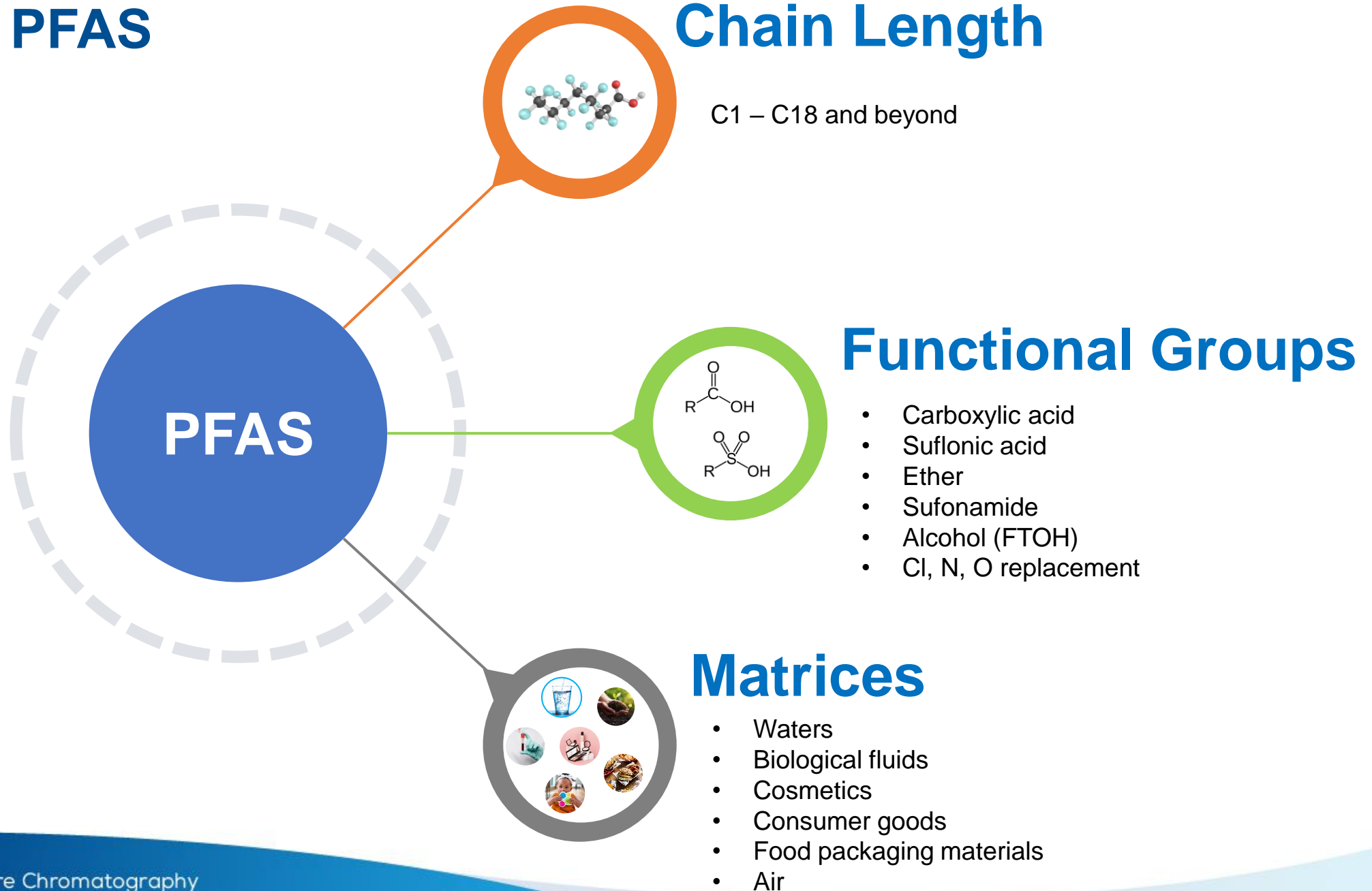
2020's

C1 – C18

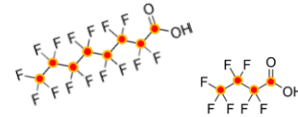
Water/Soil  
Food  
Food packaging  
Blood/serum  
Consumer products



# PFAS ≠ PFAS



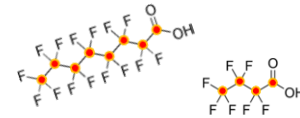
# PFAS Measurement Technologies



## PFAS

# PFAS Measurement Technologies

## AOF/EOF



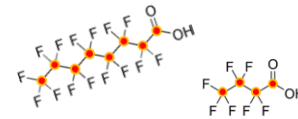
## PFAS

# PFAS Measurement Technologies

**AOF/EOF**

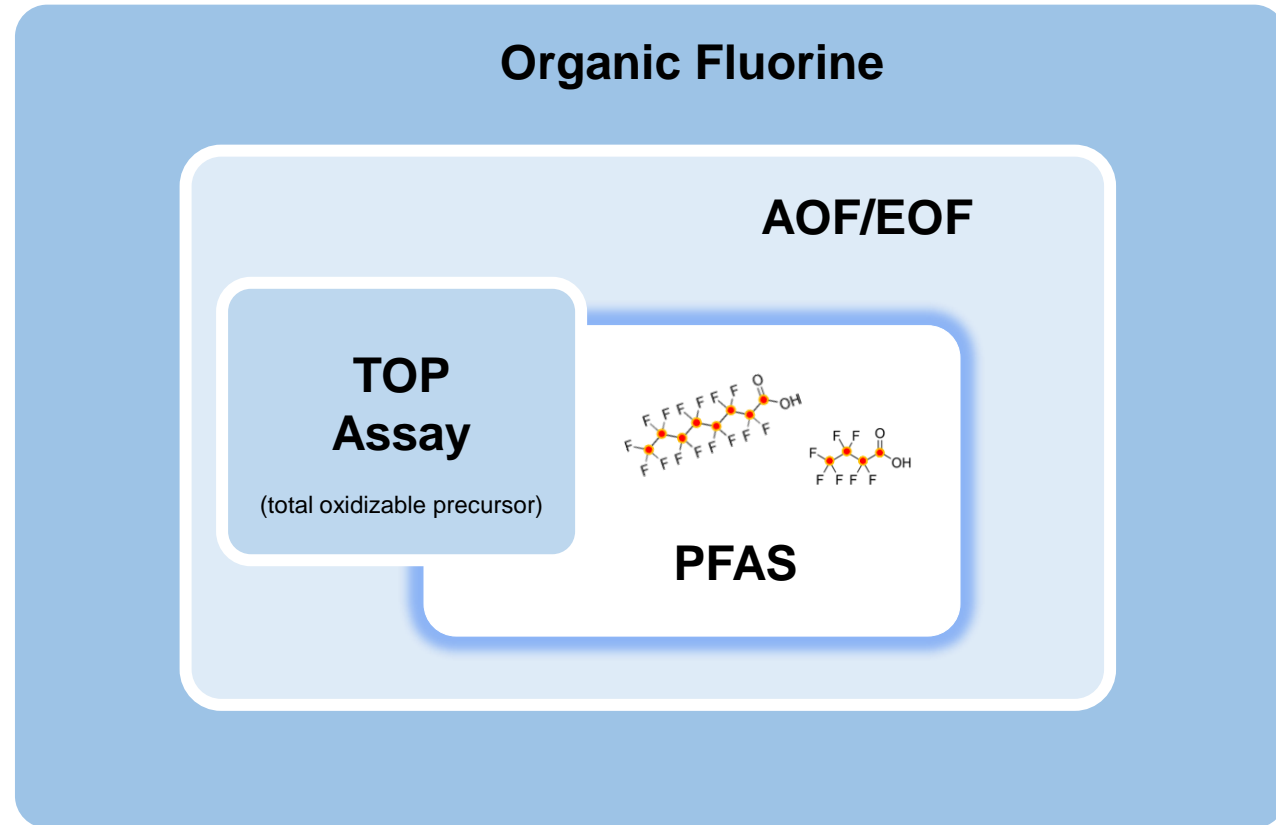
**TOP  
Assay**

(total oxidizable precursor)



**PFAS**

# PFAS Measurement Technologies



# PFAS Measurement Technologies

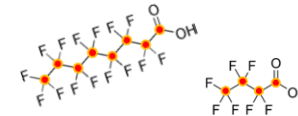
**Inorganic Fluorine**

**Organic Fluorine**

**AOF/EOF**

**TOP  
Assay**

(total oxidizable precursor)



**PFAS**



# PFAS Measurement Technologies

## Total Fluorine

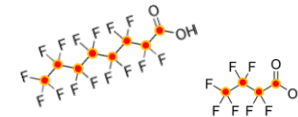
Inorganic Fluorine

Organic Fluorine

AOF/EOF

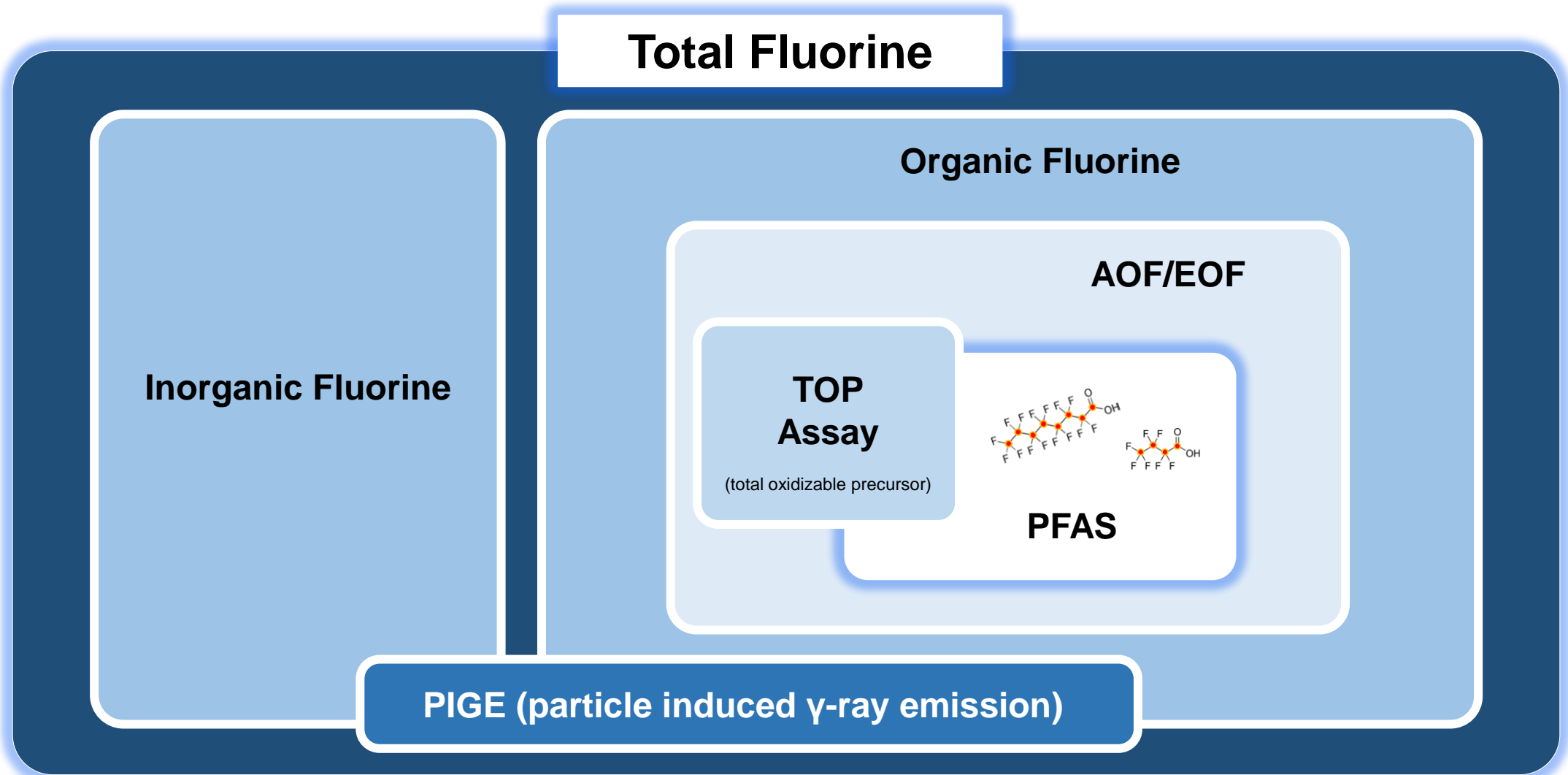
TOP  
Assay

(total oxidizable precursor)

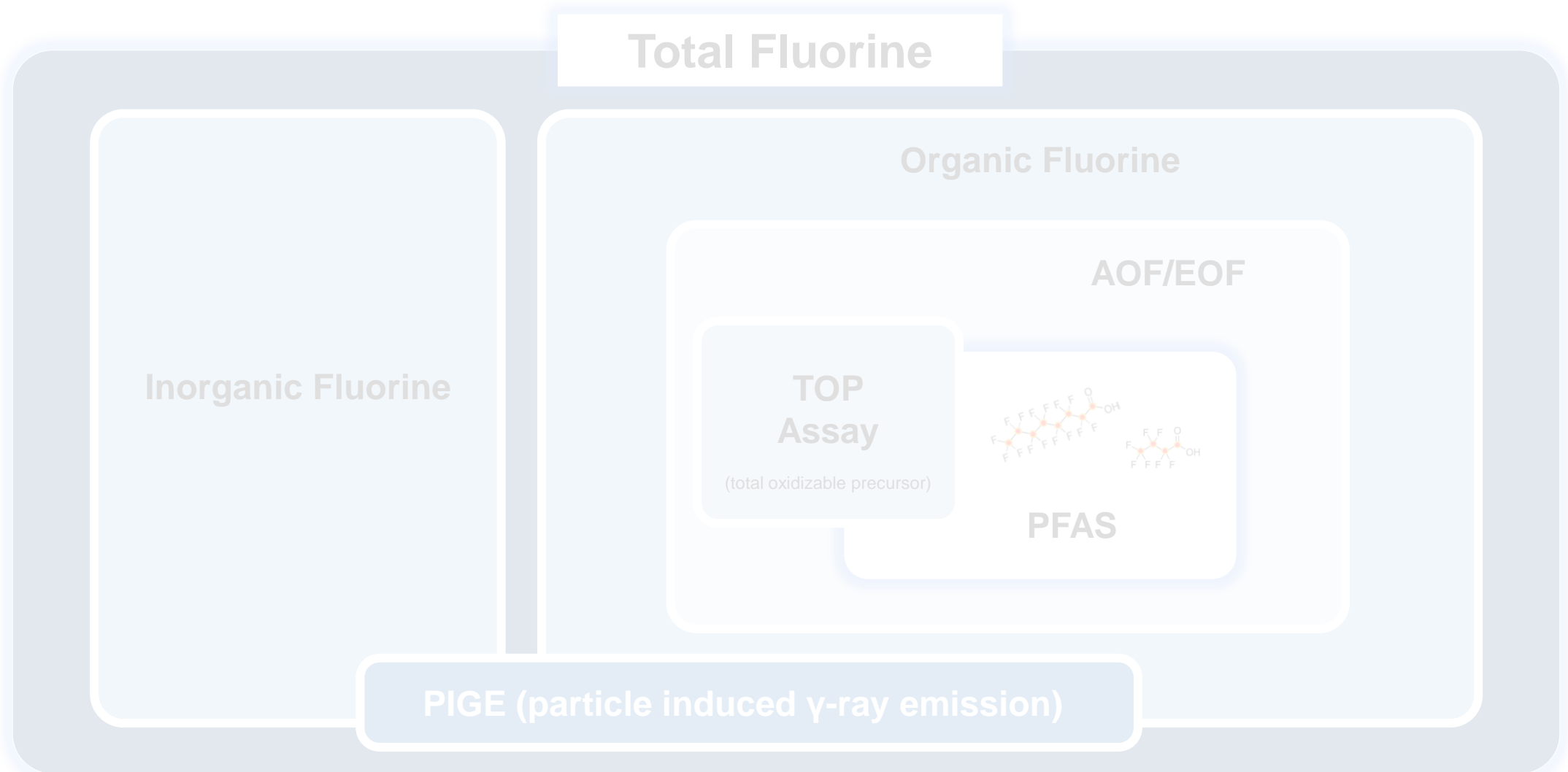


PFAS

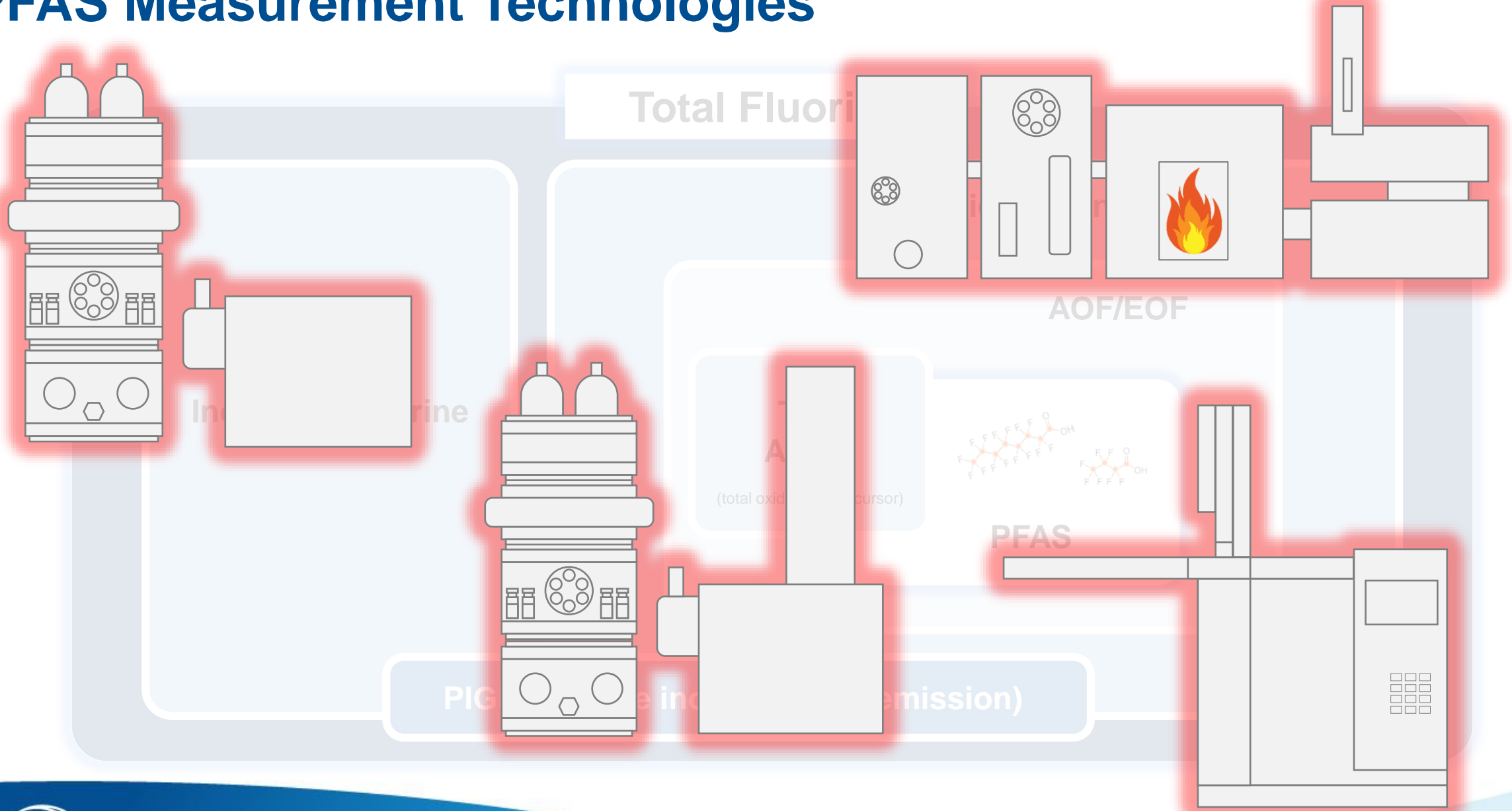
# PFAS Measurement Technologies



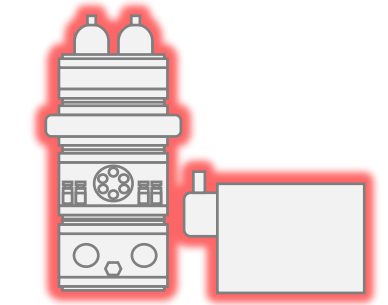
# PFAS Measurement Technologies



# PFAS Measurement Technologies

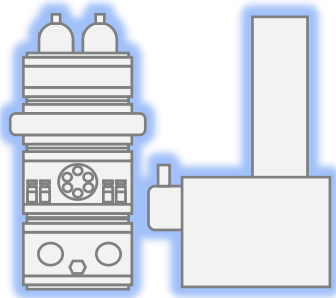


# PFAS Measurement Technologies



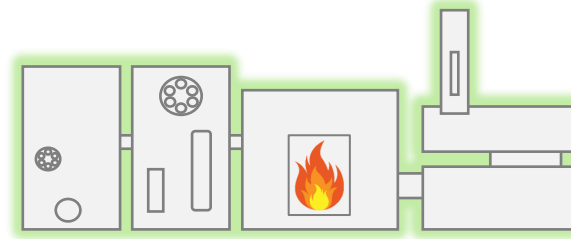
Targeted Analysis

ppq



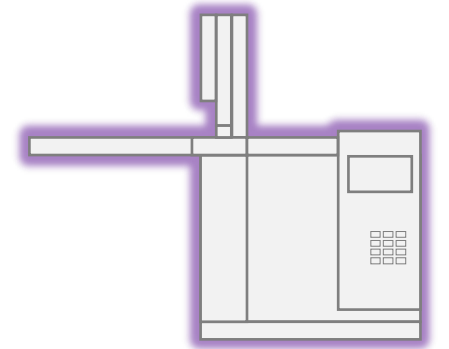
NTA  
Non-target Analysis

ppt



AOF/EOF

ppb



Volatile PFAS

ppt, ppb(?)

# PFAS Sample Preparation Technologies



Direct Injection



SPE



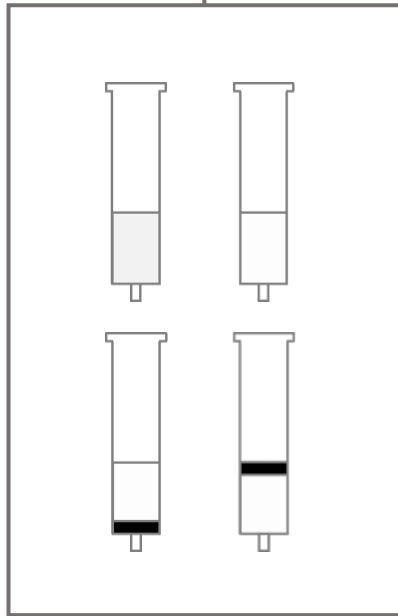
QuEChERS



Thermal Desorption



Air Canisters



# Automation / Homogenization Technologies



# PFAS Methods



537.1

533

1633

8327

OTM-45

OTM-50



QSM 6.0 Table B-24



FDA C-101.01



D7968

D7979

D8421



ISO 21675

ISO 23702



DIN EN 17892

DIN 38407-42



# PFAS Regulations & Guidelines



- PFOA: 4.0 ppt
- PFOS: 4.0 ppt
- PFHxS: 10 ppt
- HFPO-DA: 10 ppt
- PFNA: 10 ppt
- Mixture of PFHxS, PFNA, HFPO-DA, PFBS: 1 HI

MCL: Maximum Contaminant Level  
MCLG: Maximum Contaminant Level Goal

$$\text{Hazard Index (1 unitless)} = \left( \frac{[\text{HFPO-DA}_{\text{ppt}}]}{[10 \text{ ppt}]} \right) + \left( \frac{[\text{PFBS}_{\text{ppt}}]}{[2000 \text{ ppt}]} \right) + \left( \frac{[\text{PFNA}_{\text{ppt}}]}{[10 \text{ ppt}]} \right) + \left( \frac{[\text{PFHxS}_{\text{ppt}}]}{[10 \text{ ppt}]} \right)$$



- EU 2023/915 (food stuffs)
- EU 2022/1431 (food)
- EU 2020/2184 (drinking water)
- EURL POPs Version 1.2 (food)

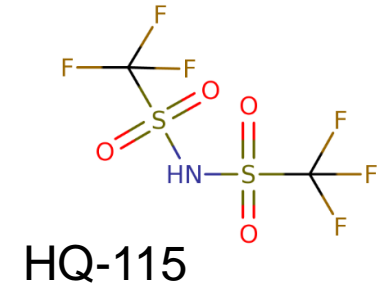
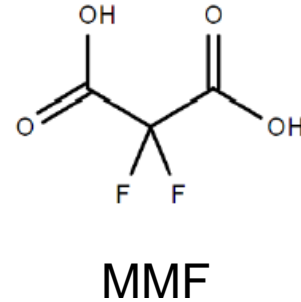
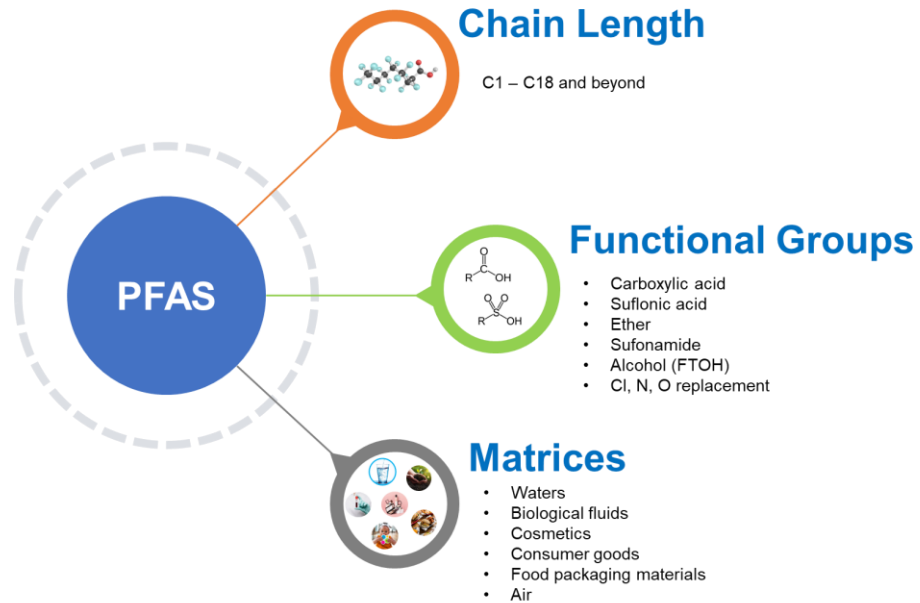


- SMPR 2023.003  
(Method submission due April 24<sup>th</sup>, 2024)

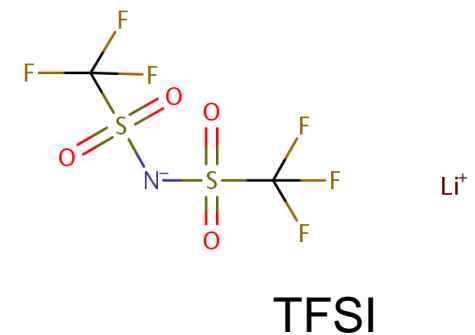
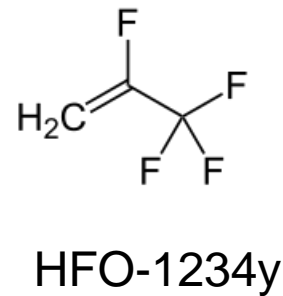


- D8560-24 (airborne PFAS)

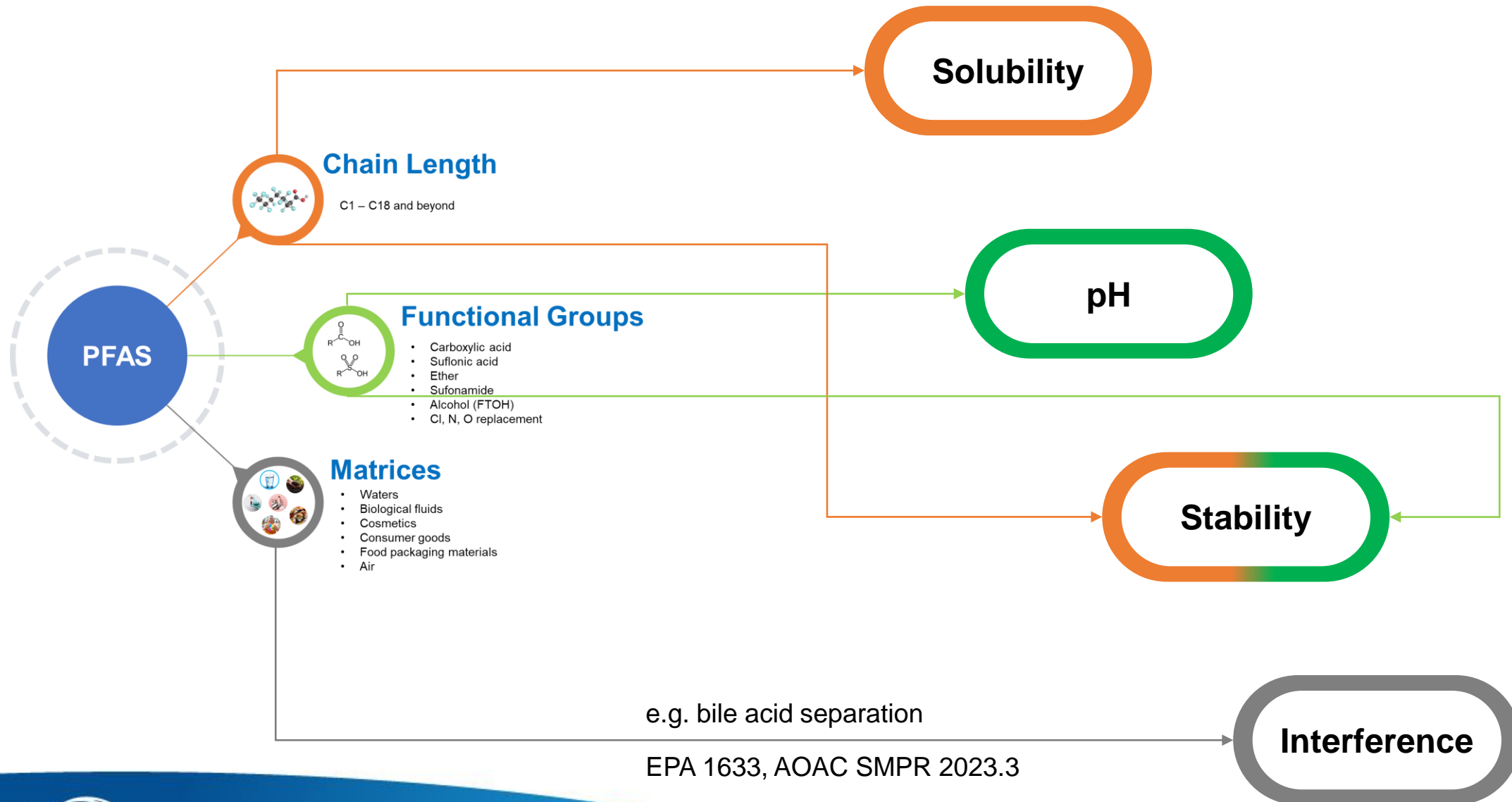
# Most Recent Trends in PFAS Analytical Methods



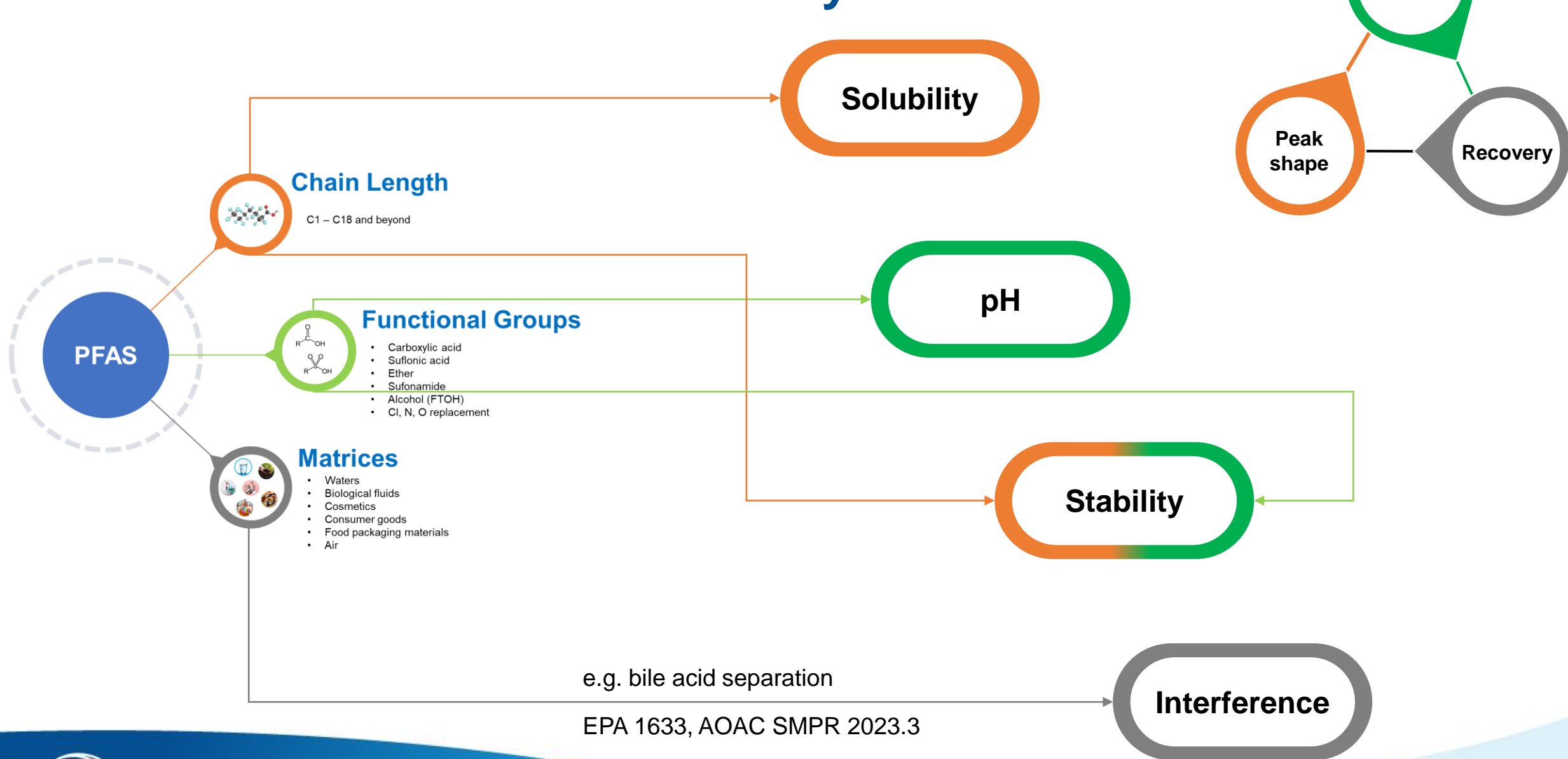
- Exotic PFAS Method
- Conventional reversed phase LC method
- Polar X phase LC method (Ultrashort-Chain)



# Most Recent Trends in PFAS Analytical Methods



# Most Recent Trends in PFAS Analytical Methods



# ProEZLC PFAS Chromatogram Modeler

Pro EZLC Chromatogram Modeler

CompoundsConditionsMy EZLC

Column

Length50.00 mm

Inner Diameter2.10 mm

Particle Size1.80 μm

Available Columns50, 2.10, 1.80

Volume Effects

Dwell Volume0.25 mL

Extra-Column Volume25.00 μL

Mobile Phase

Eluent AWater

5 mM Ammonium Acetate

Eluent BMethanol

Temperature30.00 °C

Back Pressurepsi4235 psi

Gradient Program

Add Start Isocratic Hold

3 # of Gradient Steps

Add Final Isocratic Hold

Add Re-equilibration Time

Time (min)

0

4.2

11.3

14.6

%B

4

36

68

100

Flow (mL/min)

0.4

0.4

0.4

0.4

Target Resolution1.50

Optimize Gradient Slope

Results

Gradient Time + Delay / Run Time15.48 / 15.48 min

T00.25 min

Isobaric Compounds Separated7

Critical Pair17,19

Click here to request an evaluation column for your modeled solution

Untitled. Click here to edit.

Available Isobars:

m/z 499 Critical Pair 31,34 Rs 2

Reset

Column

Force C18 (cat.# 9634252)

Dimensions:

50 mm x 2.1 mm ID

Particle Size:

1.8 μm

Temp.:

30°C

Mobile Phase

A: Water, 5 mM Ammonium Acetate

B: Methanol

Time (min)	Flow (mL/min)	%A	%B
0	0.4	96	4
4.2	0.4	64	36
11.3	0.4	32	68
14.6	0.4	0	100

Detector

MS

Click and drag to zoom; double-click to reset. Mouse over peak numbers for compound info.

1

2

3

4

5

6,7

8

9

10

11

12

13

14

15,16,17,18

19

20

21,22,23

24

25

26,27

28,29,30

31,32

33,34

35,36,37

38

39,40,41

42

43,44

45,46,47

48,49

50,51,52,53,54

55,56

57

58,59

Click here to request an evaluation column for your modeled solution

Click and drag to zoom; double-click to reset. Mouse over peak numbers for compound info.

Available Isobars:

Select an Isobar

Reset

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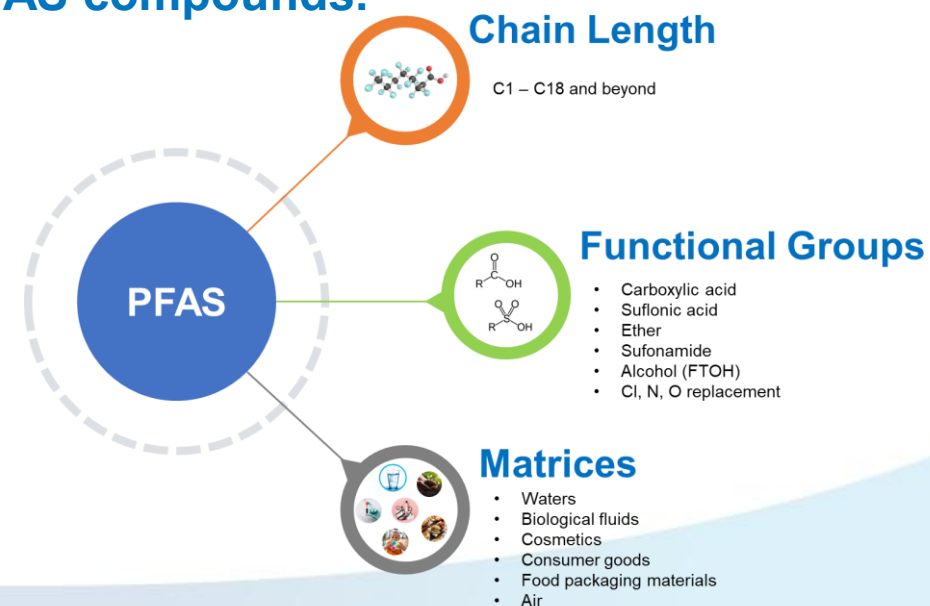
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4.2	0.4	64	36
11.3	0.4	32	68
14.6	0.4	0	100

Detector

MS

# Summary

- **PFAS testing methods and sample preparation technologies have been evolving with newer analyte types of PFAS.**
  - Direct injection
  - SPE (dual bed, WAX, SDVB), QuEChERS, protein precipitation and more
  - NTA (non-target analysis) using Orbitrap or QTOF
  - TOP Assay for precursor measurements
  - Air canisters for air testing
- **“One size fits all.” method is not possible due to the variety of PFAS compounds.**
  - Conventional C18 column method
  - Exotic PFAS method with lowered gas temperature
  - Ultrashort-Chain PFAS method using Polar X phase
- **ProEZLC PFAS library can save time in method development.**





# QUESTIONS

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**RESTEK**

Pure Chromatography