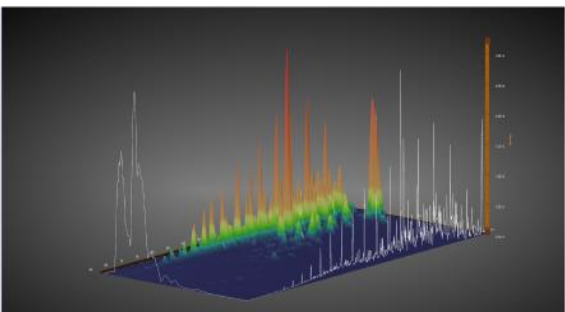




Understanding PFAS (the basics) and the ecological risk associated with replacement compounds



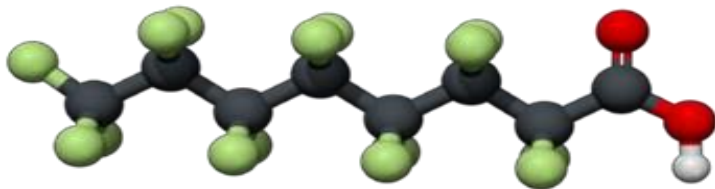
AGAT Laboratories 

Lisa Neville Ph.D.

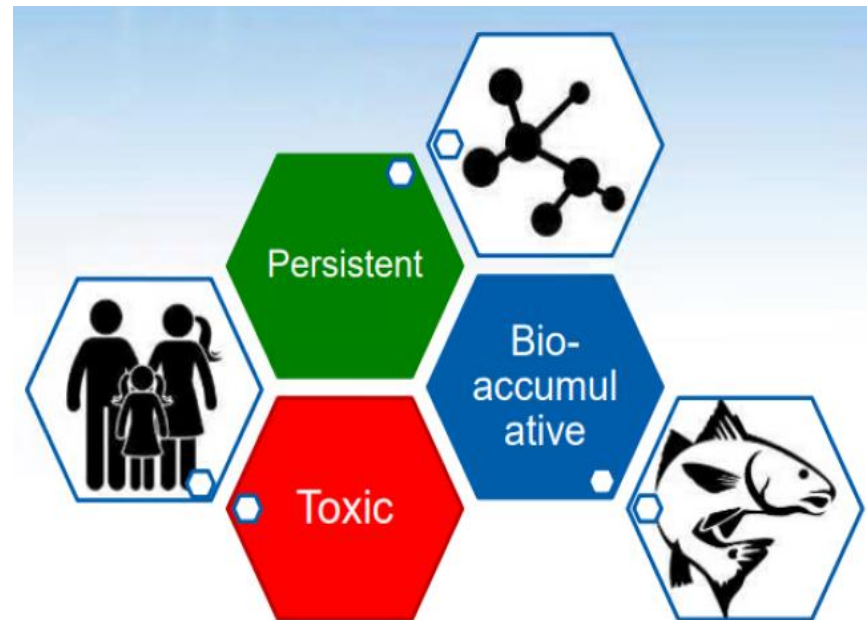
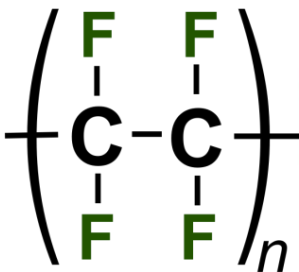


What is PFAS?

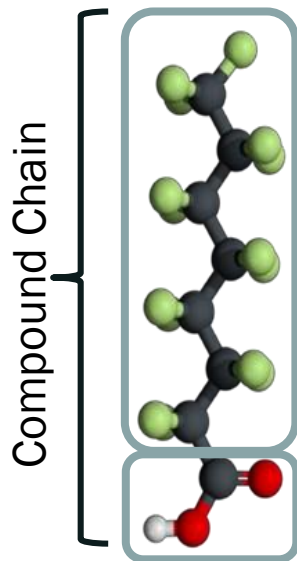
Synthetic compounds formed from carbon chains with fluorine atoms



The C-F bond is one of the shortest and strongest in nature



What makes it special?



Fluorocarbon Chain "Tail" = Hydrophobic



Functional Group "Head" = Hydrophilic



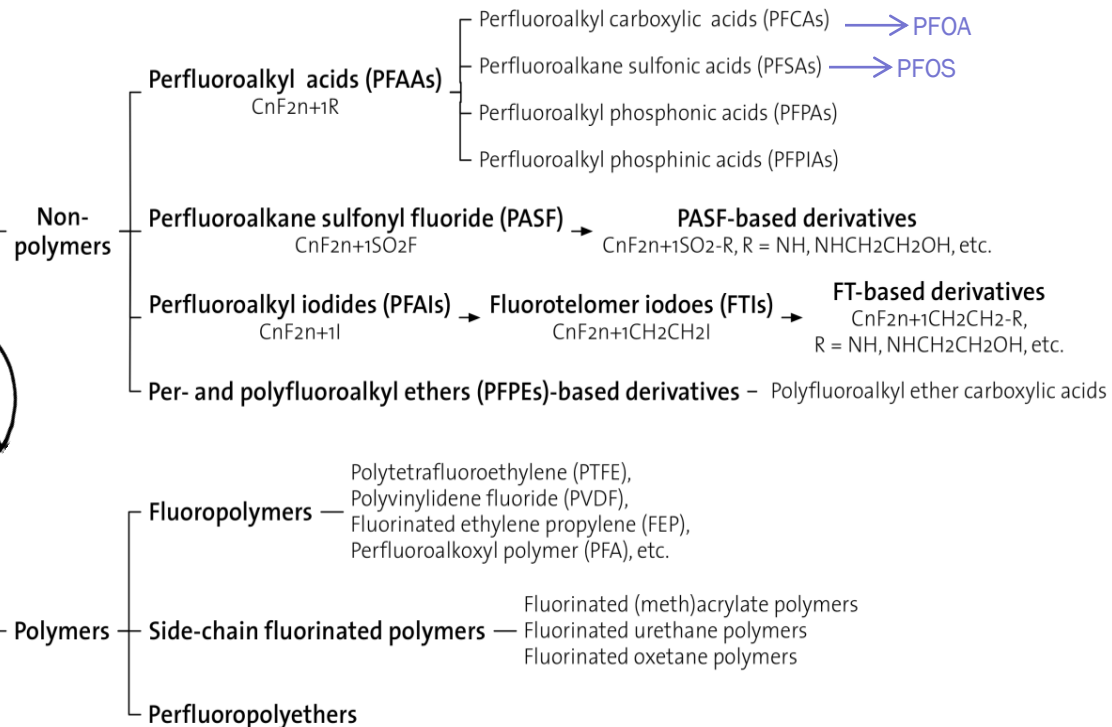
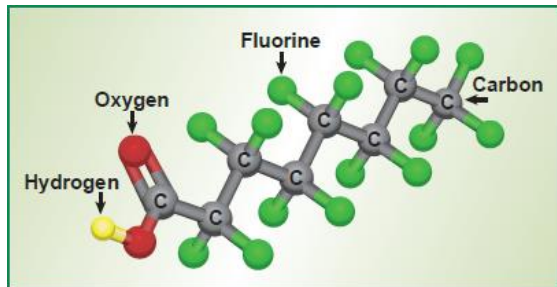
Nomenclature?

Per- and polyfluoroalkyl Substances (PFAS)

(Per)fluorinated : Fully

(Poly)fluorinated : Partly

Alkyl : Functional Group



*PFC's – perfluorinated compounds/chemicals

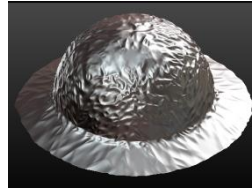


What's it used for?



Manufacturing

- Raw Material
- Industrial Chemical
- Consumer Products



Where is it?



CFB Greenwood without clean drinking water



CBC News · Posted: Apr 18, 2010 12:22 PM AT | Last Updated: April 18, 2010

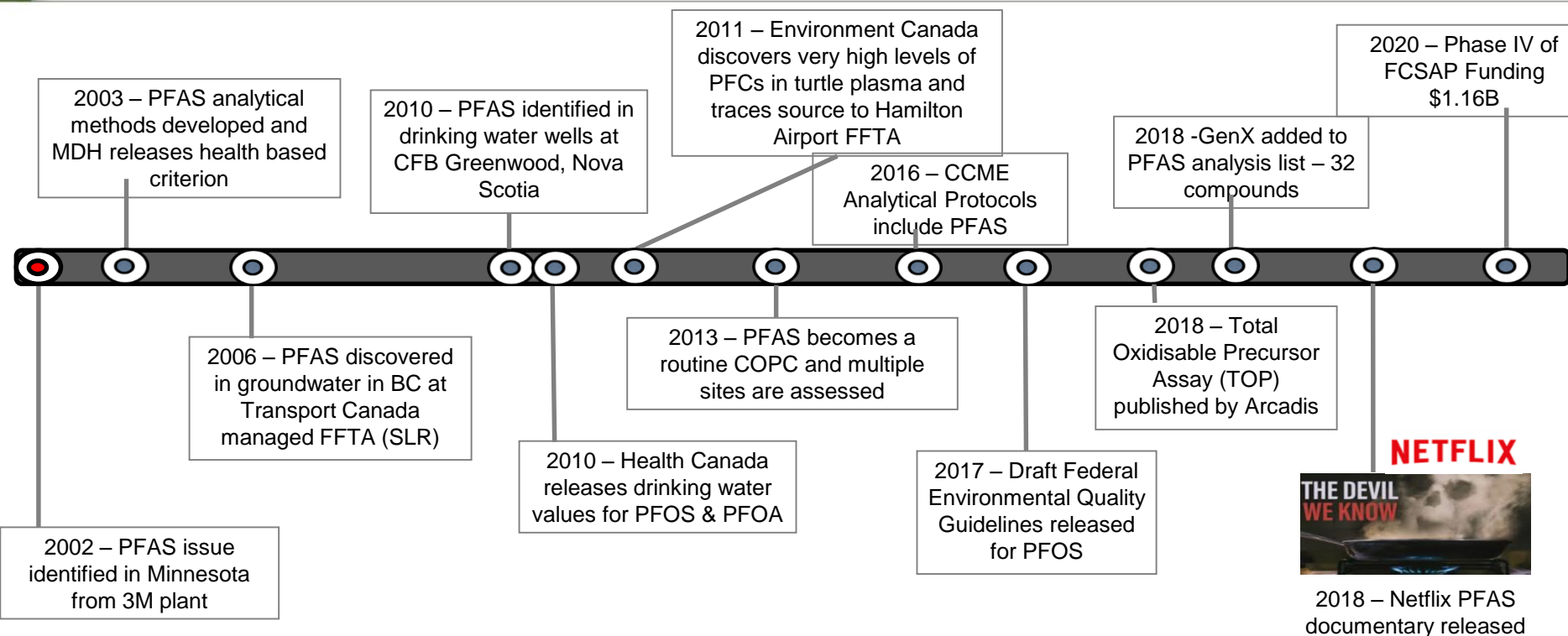
About 250 people living on Nova Scotia's Canadian Forces Base Greenwood have been without their regular supply of clean drinking water for nearly a month.

The Department of National Defence announced in March that it found dangerous levels of perfluorooctane sulfonate, a chemical that is used as an additive in special firefighting foam, in the base's well-water supply.

The 250 people affected by the contamination are being supplied with bottled water for drinking, cooking and cleaning.



PFAS History in Canada



Replacement Compounds

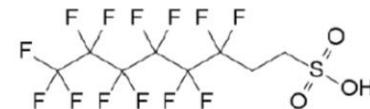
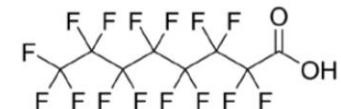
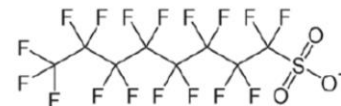
Phase out of longer chain compounds and replacement with shorter chain



Original
Replacement

PFOA
"GenX"
F-53B

PFOS
ADONA

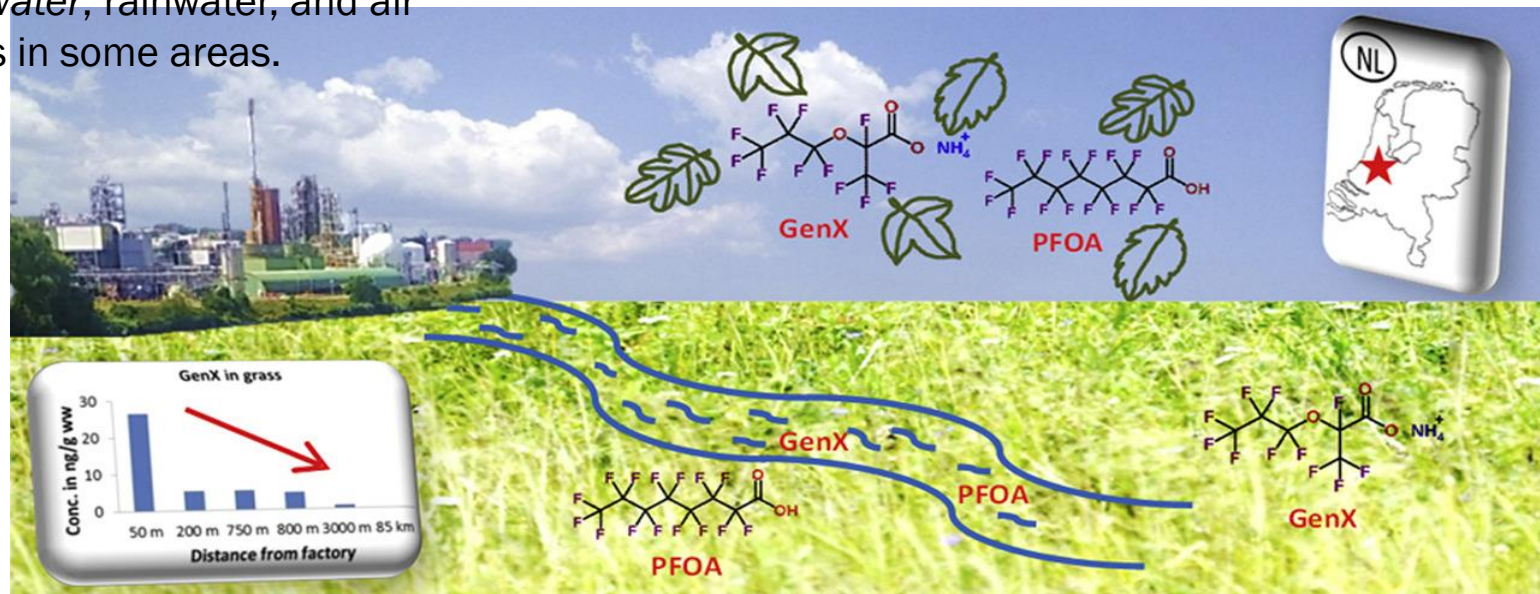


- Lower toxicity
 - Lower bioaccumulation
- BUT**
- Greater mobility
 - Equivalent persistence
 - Toxicity much less understood
 - Bioaccumulation under question
 - Properties much less useful = more variants required



Replacement Compounds

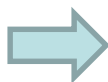
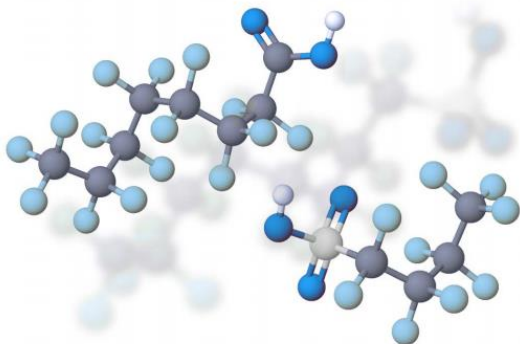
surface water, groundwater, *finished drinking water*, rainwater, and air emissions in some areas.



Brandsma et al., 2019. The PFOA substitute GenX detected in the environment near a fluoropolymer manufacturing plant in the Netherlands.

Replacement Compounds

EPA's Per- and Polyfluoroalkyl Substances (PFAS) Action Plan



EPA Priority Action

ACTION: The EPA is developing toxicity values for GenX chemicals and PFBS.

PURPOSE: Industry has phased out the use of PFOS and PFOA in favor of shorter-chain PFAS such as GenX chemicals and PFBS. Toxicity values for these **replacement** chemicals will help inform risk management decisions of federal agencies, states, and tribes to protect human health.

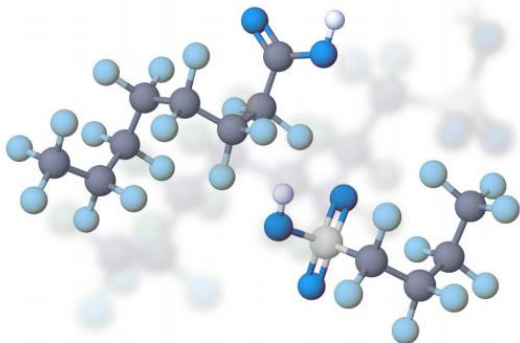
NEXT STEPS: The EPA plans to release final toxicity values for GenX chemicals and PFBS in 2019. Toxicity values for five other PFAS are under development.

Some replacement PFAS are capable of degrading to PFOA or other long-chain PFAS. Recent research suggests that additional factors aside from chain length may affect the bioaccumulation potential and toxicity of individual PFAS (ITRC 2018a, Ng et al. 2014).



Replacement Compounds

EPA's Per- and Polyfluoroalkyl Substances (PFAS) Action Plan



U.S. Environmental Protection Agency



EPA Priority Action

ACTION: The EPA is developing toxicity values for GenX chemicals and PFBS.

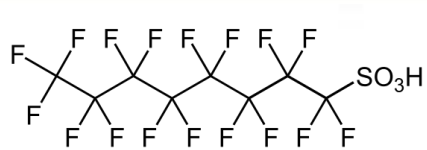
PURPOSE: Industry has phased out the use of PFOS and PFOA in favor of shorter-chain PFAS such as GenX chemicals and PFBS. Toxicity values for these **replacement** chemicals will help inform risk management decisions of federal agencies, states, and tribes to protect human health.

NEXT STEPS: The EPA plans to release final toxicity values for GenX chemicals and PFBS in 2019. Toxicity values for five other PFAS are under development.

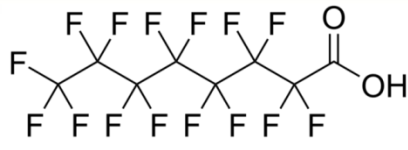
EPA's PFAS Action Plan | 20



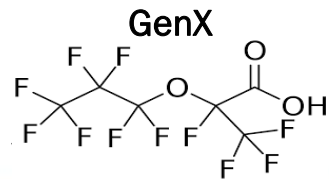
Phytotoxicity



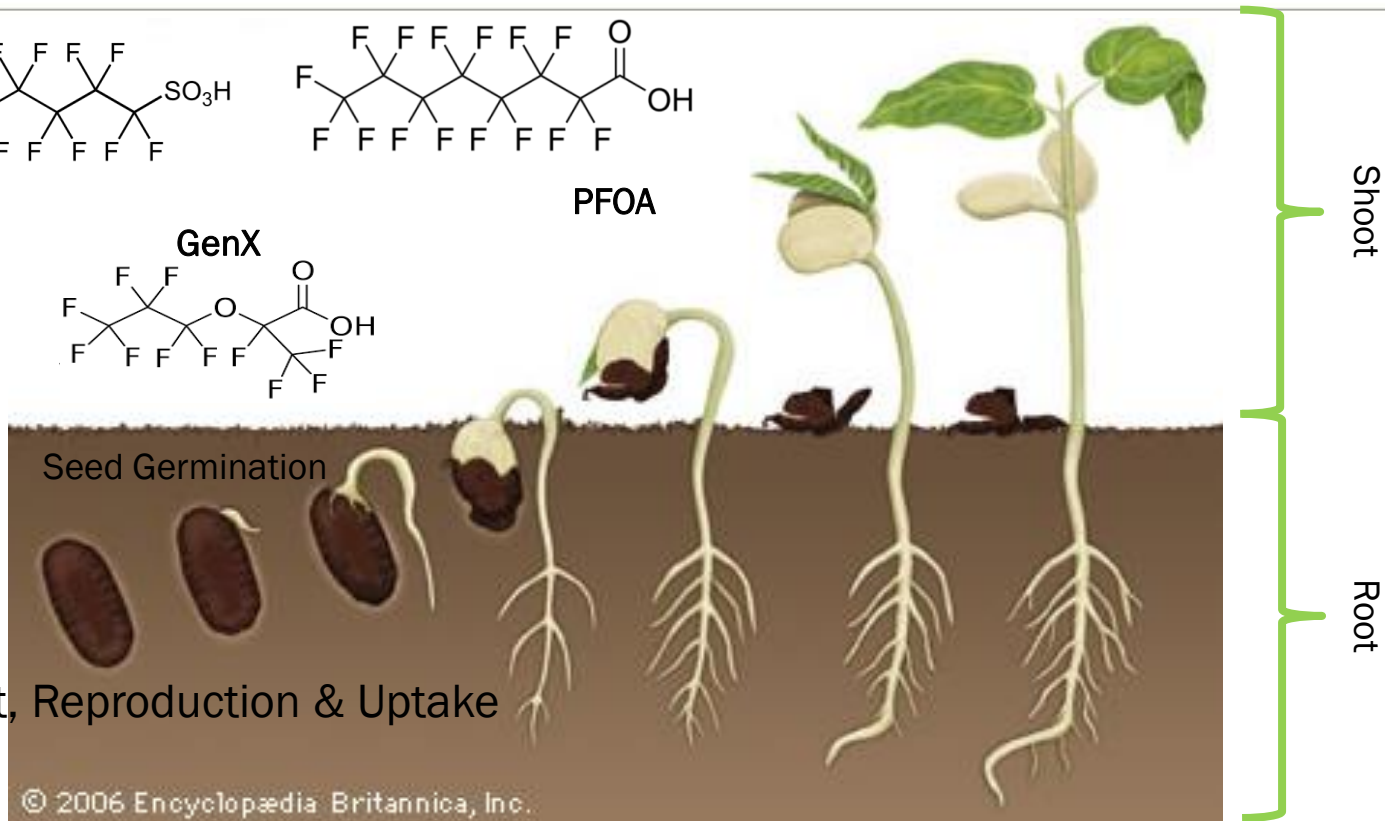
PFOS



PFOA



GenX

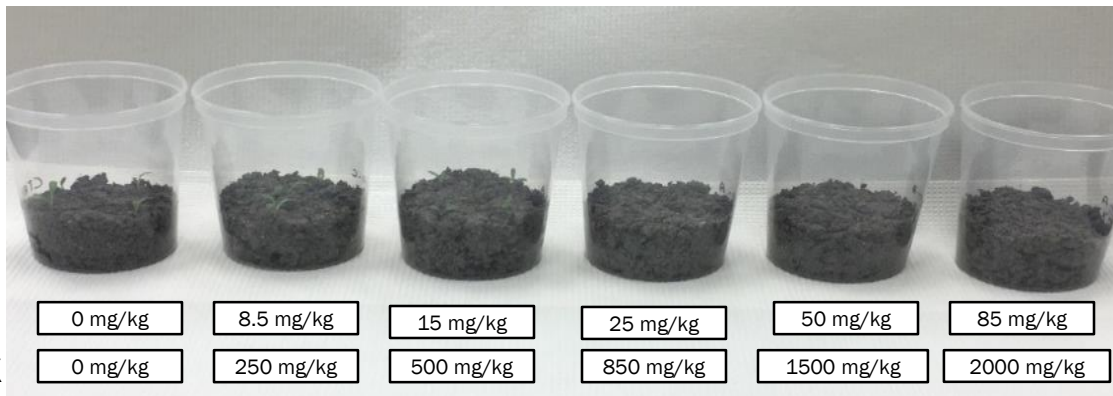


Development, Reproduction & Uptake

© 2006 Encyclopædia Britannica, Inc.



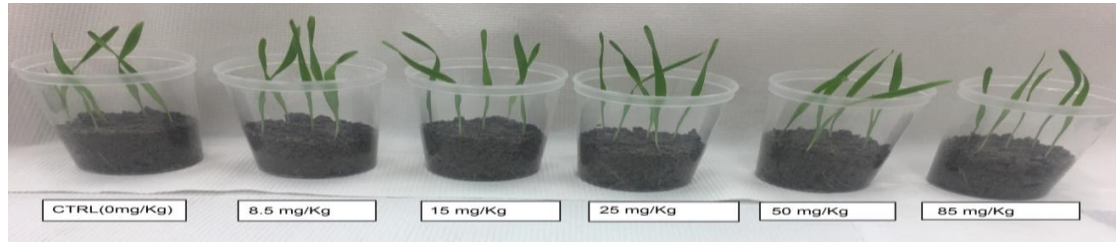
Analytics



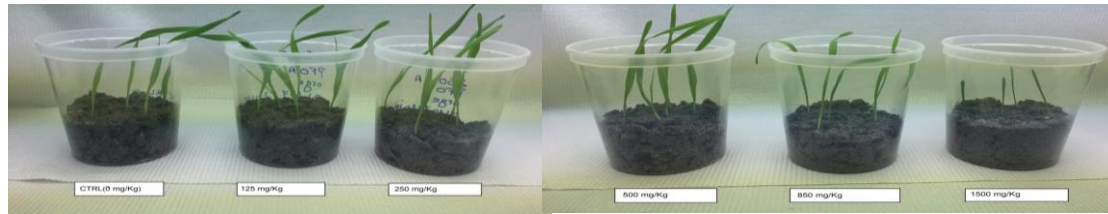
Artificially prepared soil at t=0



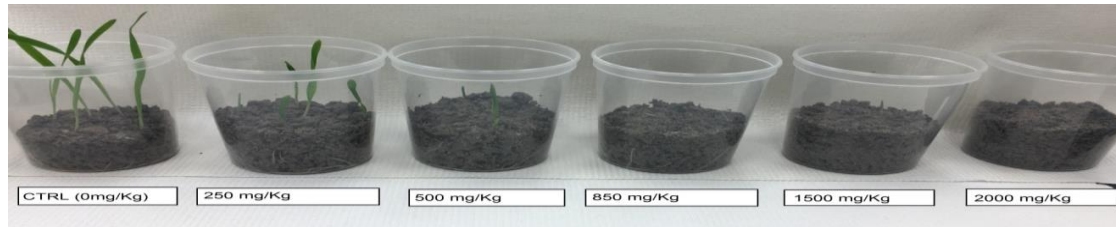
Phytotoxicity



PFOS



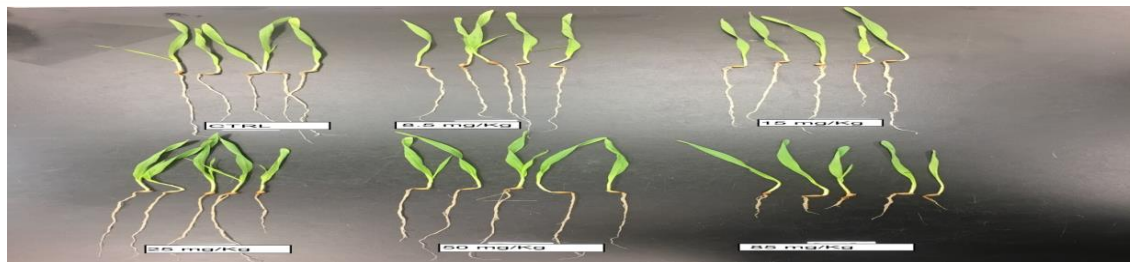
PFOA



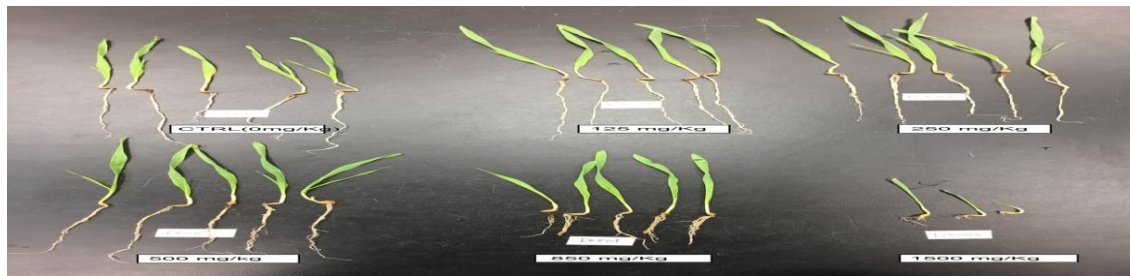
GenX



Phytotoxicity



PFOS



PFOA



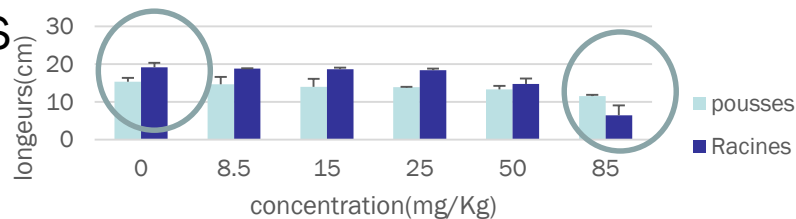
GenX



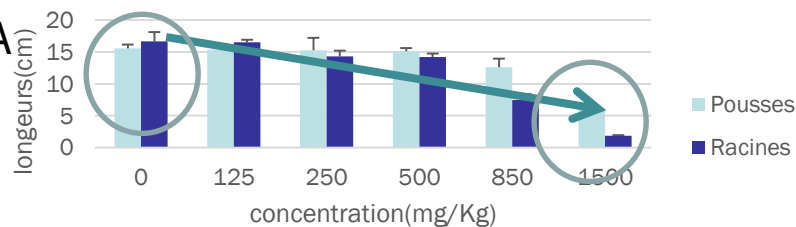
Phytotoxicity



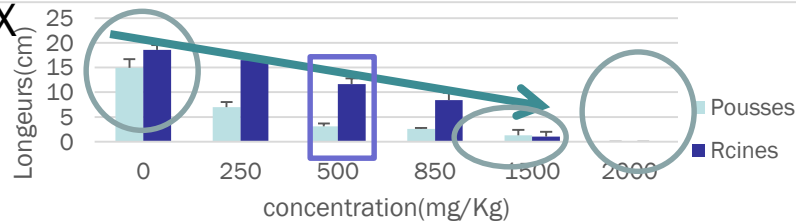
PFOS



PFOA



GenX



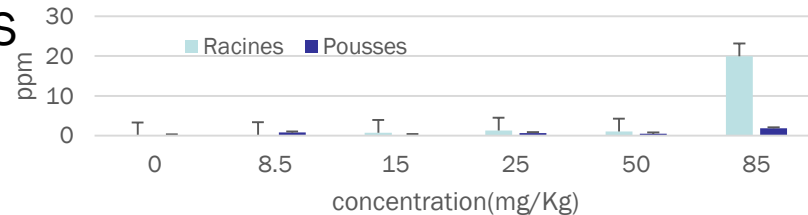
Extraction Analytics



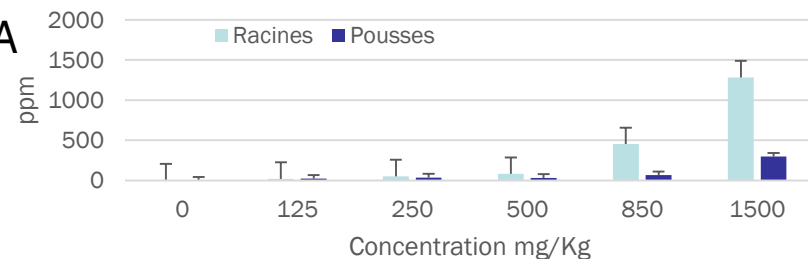
Phytotoxicity



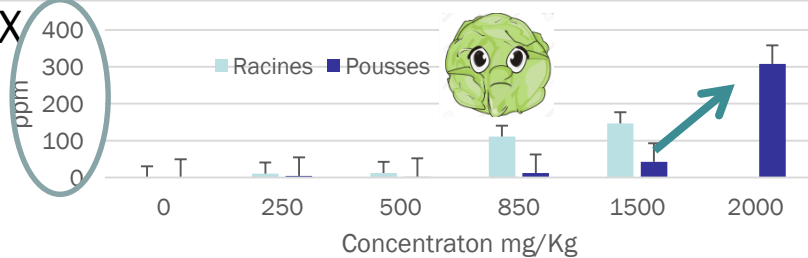
PFOS



PFOA



GenX



Conclusions... For now



- Phytotoxicity of PFOS is higher compared to PFOA and GenX.
- Phytotoxicity of GenX is very similar to PFOA
 - GenX is found in lower concentrations in plant.
 - Although found in lower concentrations GenX inhibits growth more than PFOA – specifically shoot.
- Concentration of GenX are much higher in shoots compared to roots.

Germination

PFOS = 50 mg/kg

PFOA = 125 mg/kg

GenX = 250 mg/kg

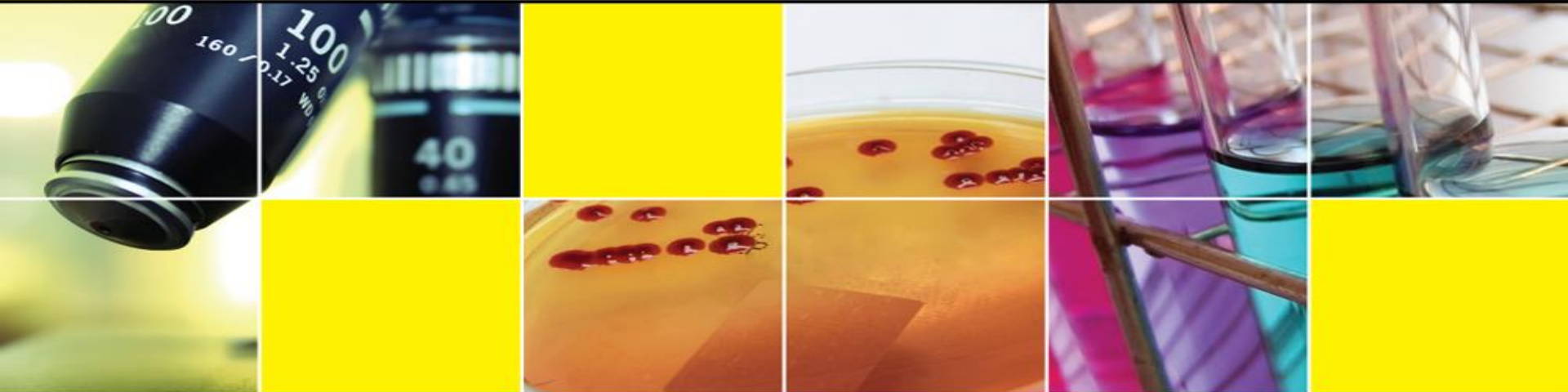




AGAT

Laboratories

■ Service Beyond Analysis
www.agatlabs.com



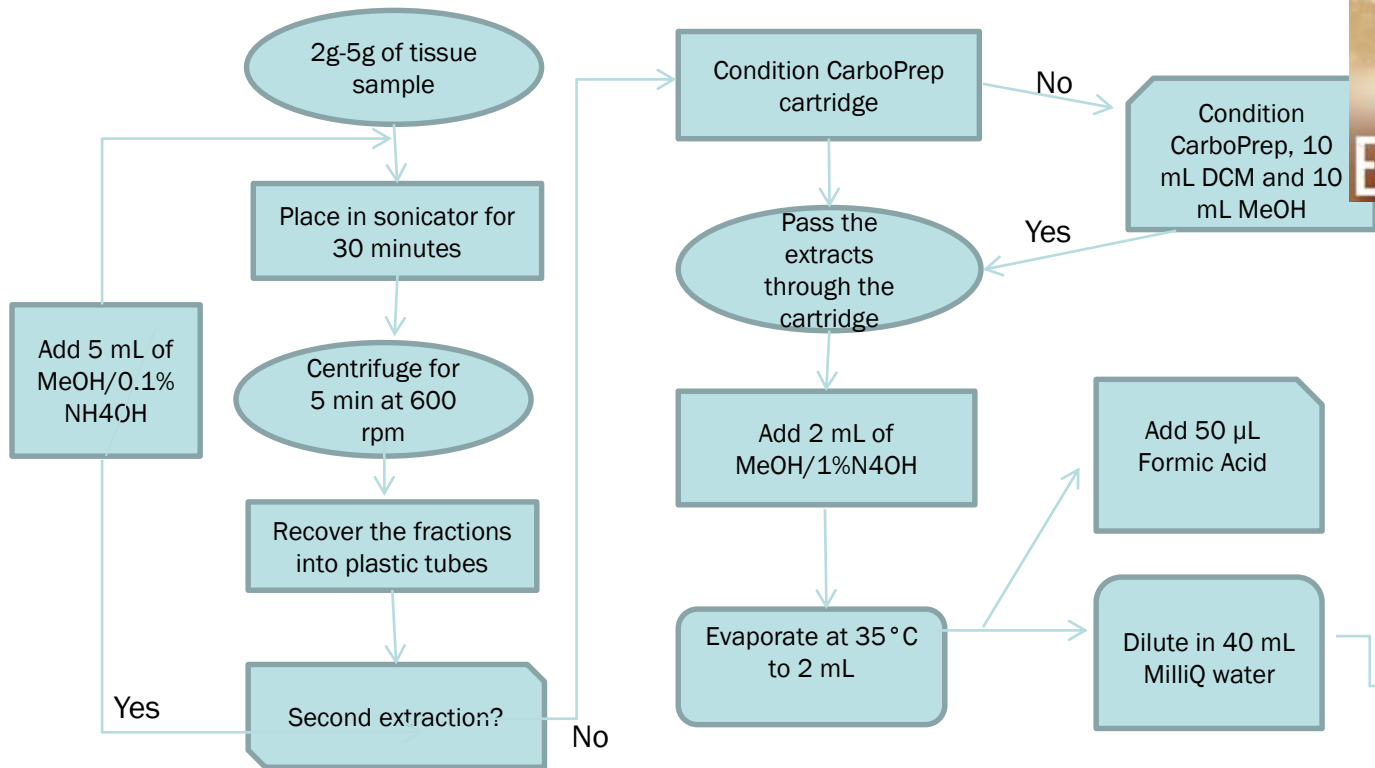
Université 
de Montréal

Olivier Lachance
Hajer Satouri
Virginie Bérubé
Philippe Morneau
Dr. Pierre Yves Robidoux

QUESTIONS AND DISCUSSION

Thank you

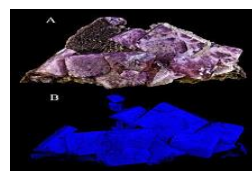
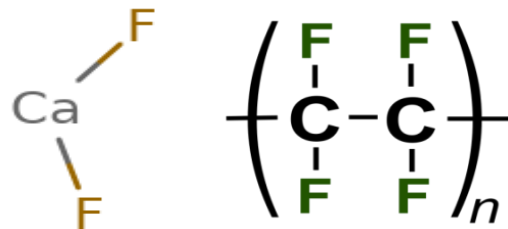
Extraction Analytics



What makes it special?

Fluorite (CaF₂)

- Used in smelting to decrease the viscosity and melting point of slag.
 - Strong bond & heat resistant
- Name of mineral comes from *fluo*, the Latin verb for flow.
- Fluorine = most electronegative element



Periodic Trends-Electronegativity

H																	He
2.1																	--
Li	Be											B	C	N	O	F	Ne
1.0	1.6											2.0	2.5	3.0	3.5	4.0	--
Na	Mg	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	Al	Si	P	S	Cl	Ar
0.9	1.3											1.6	1.9	2.2	2.5	3.0	--
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
0.8	1.3	1.4	1.5	1.6	1.7	1.6	1.8	1.9	1.9	1.9	1.7	1.6	2.0	2.2	2.6	2.8	--
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
0.8	1.0	1.2	1.3	1.6	2.2	2.1	2.2	2.3	2.2	1.9	1.7	1.8	2.0	2.1	2.1	2.7	2.6
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
0.8	0.9	1.1	1.3	1.5	1.7	1.9	2.2	2.2	2.2	2.4	1.9	2.0	2.3	2.0	2.0	2.2	--
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Uun	Uuu	Uub		Uuq				
0.7	0.9	1.1	--	--	--	--	--	--	--	--	--						

