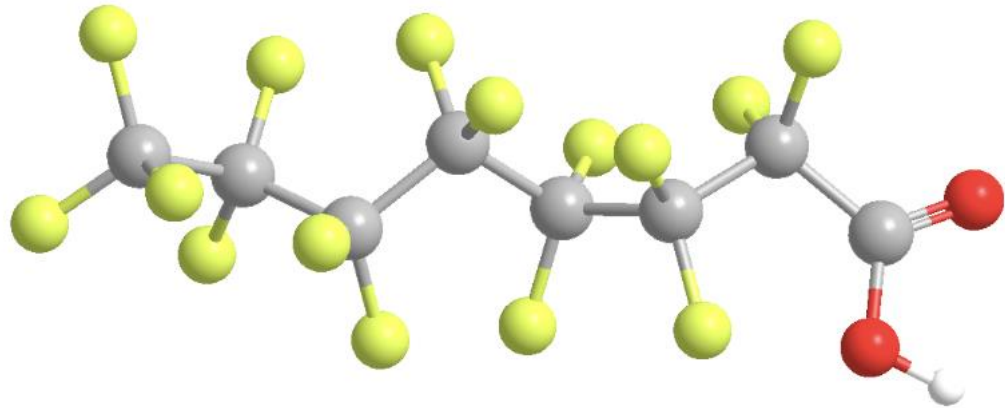


PFAS and Gasification: Reasons for Concern



What are PFAS?

- Per-and polyfluoroalkyl substances
- *Thousands* of substances
- All have C-F backbone
- All are persistent (nicknamed “forever chemicals”); many are bioaccumulative; all we have tested are toxic
- Used as water and stain repellants; surfactants
- Ubiquitous

PFAS discovered accidentally in 1938 by Chemours scientists





CARPETS



CARPET CLEANING PRODUCTS



FOOD PACKAGING



FURNISHINGS



COSMETICS



OUTDOOR GEAR



CLOTHING



ADHESIVES AND SEALANTS



PROTECTIVE COATINGS



NON-STICK COOKWARE



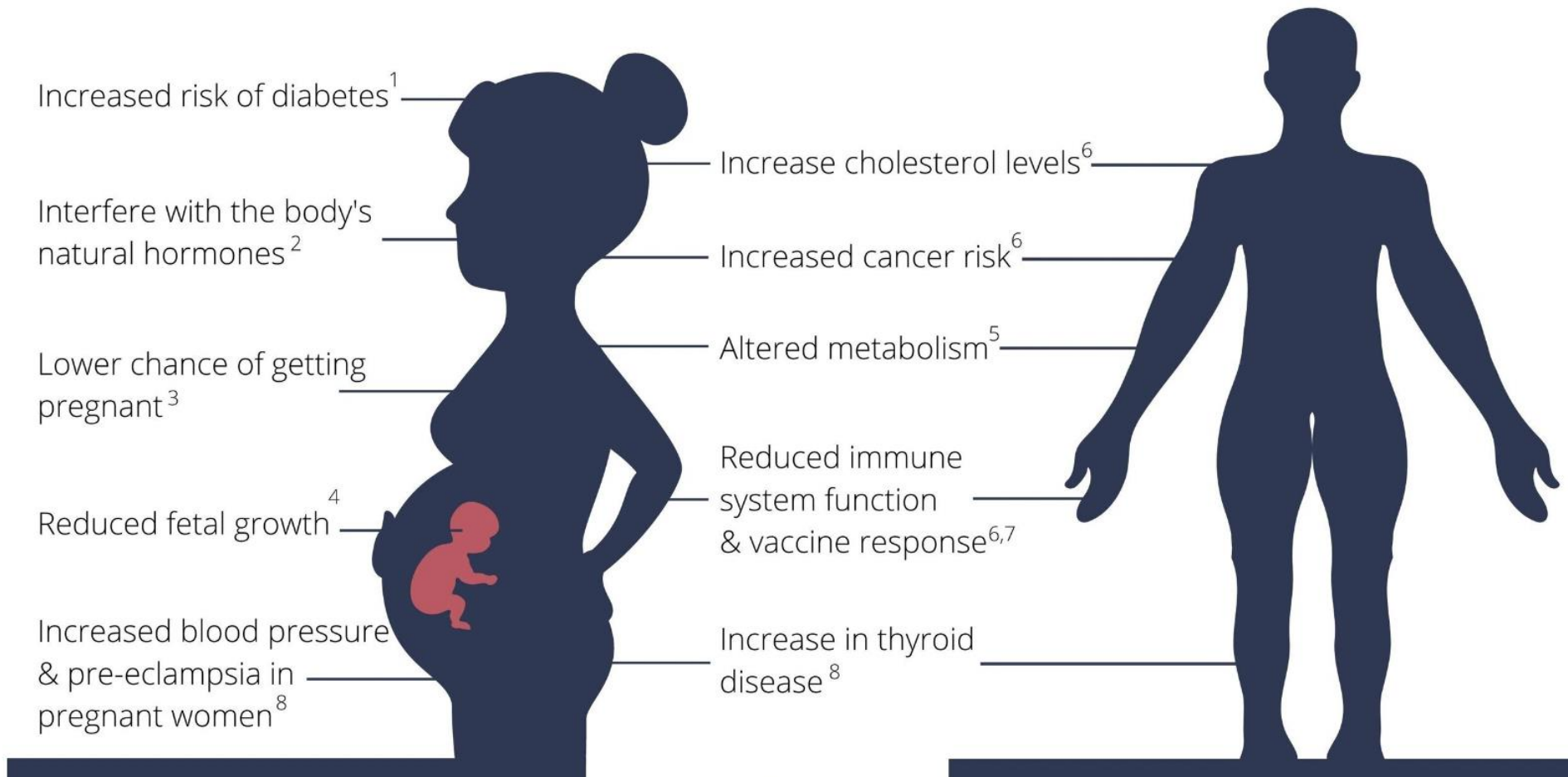
CARSEATS



FIREFIGHTING FOAM

Three routes of exposure

- Ingestion
- Inhalation
- Dermal absorption



While the knowledge of potential PFAS health effects has grown, many questions remain unanswered. Continued research is needed to better understand the effects of PFAS exposure.²

How toxic are they?

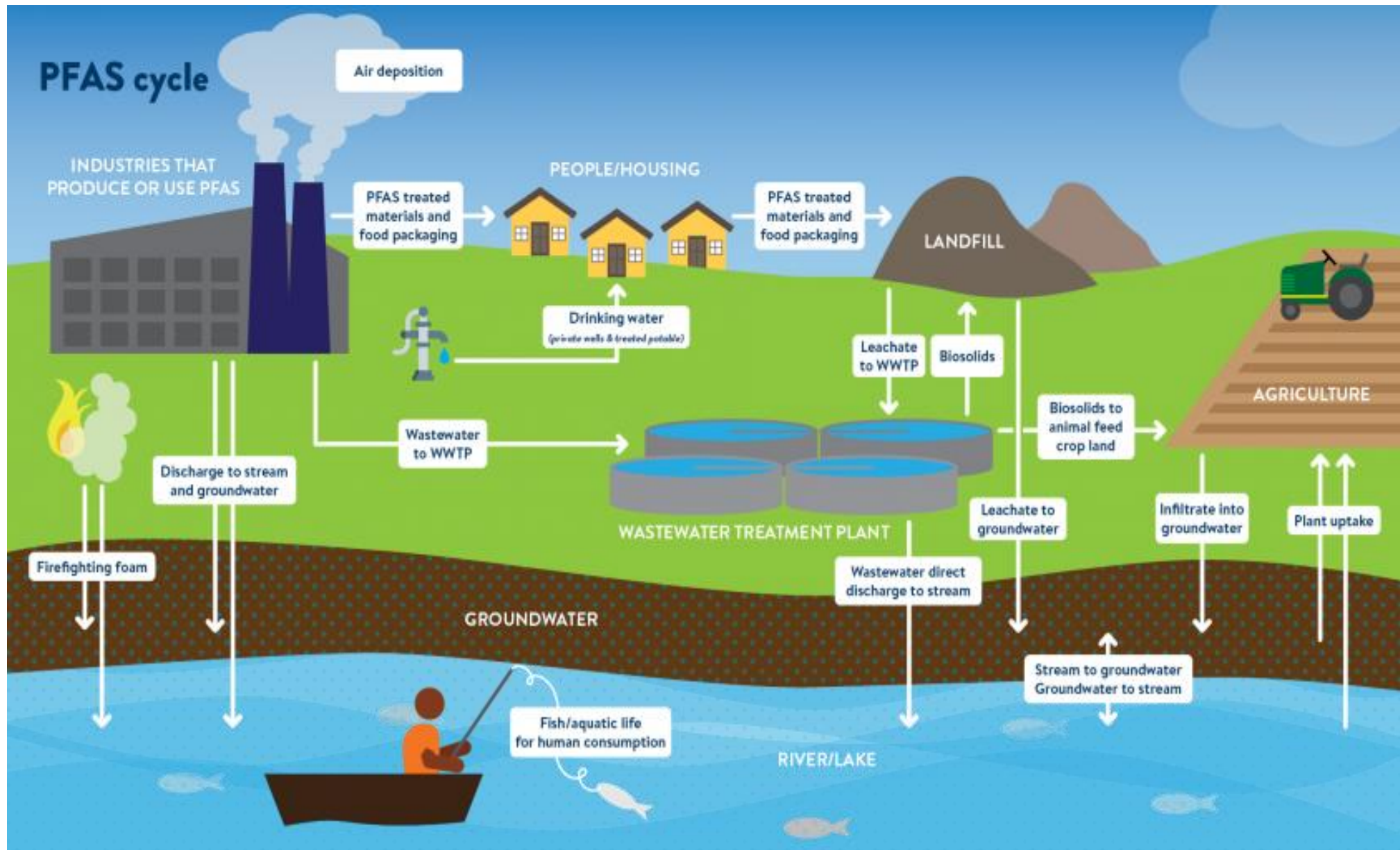
- Currently, states regulate PFAS in **parts per trillion (ppt)**.

How to grasp the concept of a ppt?

- 1 second in 317.1 centuries
- In March of 2023, EPA proposed drinking water MCLs for 6 PFAS: PFOA, PFOS, GenX, PFBS, PFNA, and PFHxS.
- “PFOA and PFOS are likely to cause cancer (e.g., kidney and liver cancer) and ... there is no dose below which either chemical is considered safe...”

Assumption behind EPA's proposed MCLs

- EPA assumes that 20% of our exposure is from drinking water
- This means that 80% of our exposure is from other sources



What does Aries say?

- “The operating temperature ... **should** give time for thermal decomposition of **most** PFAS compounds...”
- “...thermal oxidizer at 1800 °F gives another opportunity for the most stable PFAS compounds, which can require temperatures as high as 1000°C (1830°F) to decompose completely, to be destroyed to **some degree**.”
- “**appreciable or** complete reductions in PFAS contamination compared to the incoming biosolids.”
- “...it is expected that the gasifier will be effective at thermally cracking **most, but not all**, PFAS chemicals.”

Sample Location	PFAS Concentration (ppb)
ASR Feed	9.121
Bed	0
Cyclone / Bed	0
Filter	1.507

Figure 2. Measured PFAS concentrations in pilot testing with ASR

Aries' conclusion

- Because of the lack of gas analysis in this initial testing, it ***remains possible that some of the PFAS was volatilized but not decomposed*** ... These initial positive results at very low temperatures are however very promising and ***further testing and gas analysis will be needed to confirm the decomposition of PFAS.***”

What do scientists say?

- “additional research is needed” on the “fate and transformation products” of PFAS “in the residuals, oils, and gases from thermal treatment technologies”
- “Additional research is warranted to understand all potential PFAS transformation emission routes and optimal air pollution emissions control strategies for this technology class.”
- “tetrafluoromethane (CF_4) has the highest degradation temperature of approximately 1200–1400 °C [2192 – 2552 °F] ... Given this, it has been suggested that CF_4 should be used as a surrogate for all CEC contamination”

What do scientists say, cont.?

- “...thermal technologies are energy-intensive and have the potential to create harmful by-products, including fluorinated products of incomplete combustion...”
- “Further development of analytical methods capable of identifying and quantifying thermal PFAS decomposition and recombination products in a complex matrix is urgently needed.”

Conclusion

- The absence of evidence does not mean the evidence of absence;
- We can only test for roughly 70 targeted PFAS;
- Some PFAS are not destroyed at approximately 2550 °F;
- We don't know what the PFAS emissions will be.

References

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