nantucket PFAS ACTION GROUP

MICHIGAN STATE UNIVERSITY

NORTHEAST CONFERENCE
THE SCIENCE OF PFAS:
PUBLIC HEALTH & THE ENVIRONMENT

PFAS IN CONSUMER PRODUCTS, PT.2

CONTAMINATION IN COATS:

PFAS CONCERNS IN THE FIRE SERVICE

// APRIL 6, 2022

AYESHA KHAN
NANTUCKET PFAS ACTION GROUP

DR. COURTNEY CARIGNAN
MICHIGAN STATE UNIVERSITY

JAIME HONKAWA
NANTUCKET PFAS ACTION GROUP

NICE TO MEET YOU.

WE'RE HERE FOR THE FIREFIGHTING COMMUNITY.

NANTUCKET PFAS ACTION GROUP

NORTHEAST CONFERENCE


CANCER IS NOW THE LEADING CAUSE OF DEATH AMONGST FIREFIGHTERS ON THE JOB. BETWEEN 2002-2019, 66% OF FIREFIGHTER DEATHS WERE FROM CANCER.
• INTERNATIONAL ASSOCIATION OF FIRE FIGHTERS •

A LACK OF PFAS INFORMATION LEADS TO THIS:

PHOTO:
FFTOB

PHOTO: BRAD CREACEY

PHOTO: GOOD MORNING AMERICA

NANTUCKET PFAS ACTION GROUP
NORTHEAST CONFERENCE

PFAS IN TURNOUT GEAR

DR. COURTNEY CARIGNAN

MICHIGAN STATE UNIVERSITY

CANCER INCIDENCE AND MORTALITY ELEVATED IN FIREFIGHTERS

SIGNIFICANTLY ELEVATED:

- **BLADDER**
- **BRAIN AND CNS**
- **COLORECTAL**
- **NON-HODGKIN'S LYMPHOMA**
- **SKIN MELANOMA**
- **PROSTATE**
- **TESTICULAR**

SUGGESTIVELY ELEVATED:

- Kidney
- Hodgkin's lymphoma
- Leukemia
- Lymphosarcoma and reticularsarcoma
- Multiple myeloma
- Pancreatic

LIST FROM SYSTEMATIC REVIEW AND META ANALYSIS BY SOTERIADES ET AL. 2019

PAHs IN SMOKE AND SOOT

PAHs IN SMOKE AND SOOT

INTERVENTIONS:

SCBA

LAUNDRY SYSTEM

GEAR ROOM

DIESEL FUMES AND PARTICULATES FROM TRUCKS

DIESEL FUMES AND PARTICULATES FROM TRUCKS

INTERVENTIONS:

TAILPIPE EXHAUST SYSTEM

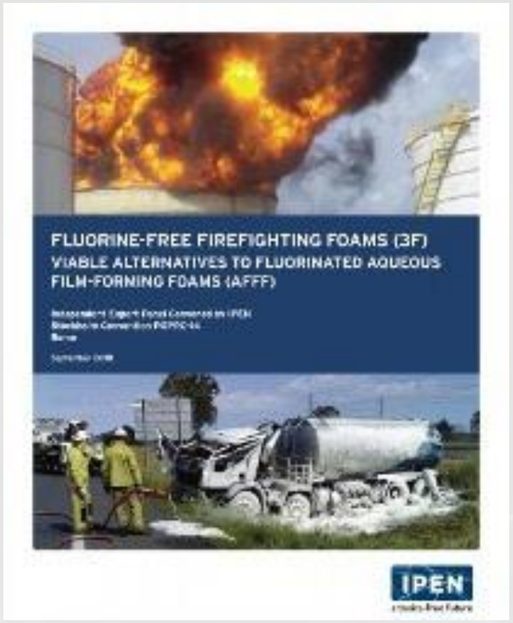
FIREHOUSE LAYOUT

PFAS IN AQUEOUS FILM FORMING FOAM

PFAS IN AQUEOUS FILM FORMING FOAM

INTERVENTIONS:

SCBA, PPE



FLUORINE FREE FOAM

TIMELINE OF FIREFIGHTER HEALTH AND PFAS

2008

2011

2012

2015

2016

TIMELINE OF FIREFIGHTER HEALTH AND PFAS

ELEVATED CANCERS NOTED IN MA FIREFIGHTERS

2008

2011

2012

2015

2016

TIMELINE OF FIREFIGHTER HEALTH AND PFAS

ELEVATED CANCERS NOTED IN MA FIREFIGHTERS

2008 | 2011 | 2012 | 2015 | 2016

ELEVATED PFOS AND PFHxS IDENTIFIED IN FIREFIGHTERS ENROLLED IN C8 HEALTH STUDY

TIMELINE OF FIREFIGHTER HEALTH AND PFAS

2008 — ELEVATED CANCERS NOTED IN MA FIREFIGHTERS

2011 — ELEVATED PFOS AND PFHxS IDENTIFIED IN FIREFIGHTERS ENROLLED IN C8 HEALTH STUDY

2012 — PROBABLE LINK DETERMINED FOR PFAS AND TESTICULAR CANCER

2015

2016

TIMELINE OF FIREFIGHTER HEALTH AND PFAS

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2015 — ELEVATED PFAS CONCENTRATIONS IDENTIFIED IN FIREFIGHTER BLOOD

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TIMELINE OF FIREFIGHTER HEALTH AND PFAS

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2012 — PROBABLE LINK DETERMINED FOR PFAS AND TESTICULAR CANCER

2015 — ELEVATED PFAS CONCENTRATIONS IDENTIFIED IN FIREFIGHTER BLOOD

2016 — ELEVATED PFHxS BLOOD CONCENTRATIONS AT PEASE FROM AFFF CONTAMINATED WATER

LT. PAUL AND DIANE COTTER

CHRISTINE PETERSON/TELEGRAM & GAZETTE

LT. PAUL AND DIANE COTTER

MEN'S HEALTH 2021

PFAS IN TEXTILES

Shown in Table 1 and Table 2 are non-comprehensive lists of textile-related PFAS materials.

Non-Comprehensive List of Textiles-Related PFAS Materials

Name & Compound Type		Textile-Related Function	Other End-use Examples[13]	Terminal Degradant, Impurity or Metabolite		Production Status in US[14]
PTFE	PFAS Polymer	Vapor-permeable membranes for waterproofness	Electronics, surgical instruments, cable housing	-	-	ongoing
Long-chain fluorinated polymer ("C8")	PFAS Polymer	Oil, stain, and water repellency	Fire-fighting foam, paints, coatings	PFOA, PFOS	PFAS Non-Polymer	discontinued, replaced by short-chain
Short-chain fluorinated polymer ("C6" or "C4")	PFAS Polymer	Oil, stain, and water repellency	Fire-fighting foam, paints, coatings	PFHxA	PFAS Non-Polymer	ongoing

Table 1

Non-Comprehensive List of PFAS Non-Polymer Processing Aids for PTFE

Name	Compound Type	Production Status in US
PFOA or PFOS	PFAS Non-Polymer	discontinued
GenX Chemicals	PFAS Non-Polymer	Ongoing

Table 2

Sullivan 2021

Environmental Science & Technology Letters

pubs.acs.org/journal/estlcu

Another Pathway for Firefighter Exposure to Per- and Polyfluoroalkyl Substances: Firefighter Textiles

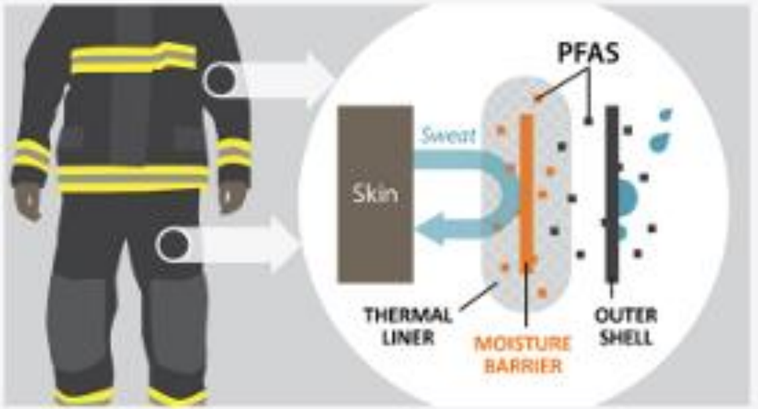
Graham F. Peaslee,* John T. Wilkinson, Sean R. McGuinness, Meghanne Tighe, Nicholas Caterisano, Seryeong Lee, Alec Gonzales, Matthew Roddy, Simon Mills, and Krystle Mitchell

Cite This: https://dx.doi.org/10.1021/acs.estlett.0c00410

Read Online

ACCESS | Metrics & More | Article Recommendations | Supporting Information

ABSTRACT: Occupational exposure to aqueous film-forming foams (AFFF) can lead to elevated concentrations of per- and polyfluorinated alkyl substances (PFAS) in firefighter blood sera. AFFF are also one exposure source of PFAS in the general population because of their environmental persistence and solubility in groundwater. Because of the documented adverse health effects of PFAS, the primary concern to date in the fire services has centered on repeated use and exposure to AFFF. In this work, an additional PFAS exposure source for firefighters is presented: PFAS that are shed from their protective clothing. Textiles used as firefighter turnout gear were found to have high levels of total fluorine (up to 2%), and individual PFAS were identified and measured on new and used firefighting turnout gear. Used gear showed lower levels of PFAS as well as an increased migration into untreated material. A dust measurement from a textile storage area also suggests direct loss of PFAS from the fluoropolymers in the textiles. Because PFAS that are shed from the textiles used in turnout gear are more mobile, they represent another viable exposure source for firefighters that warrants further study.



PFOA IN TURNOUT GEAR

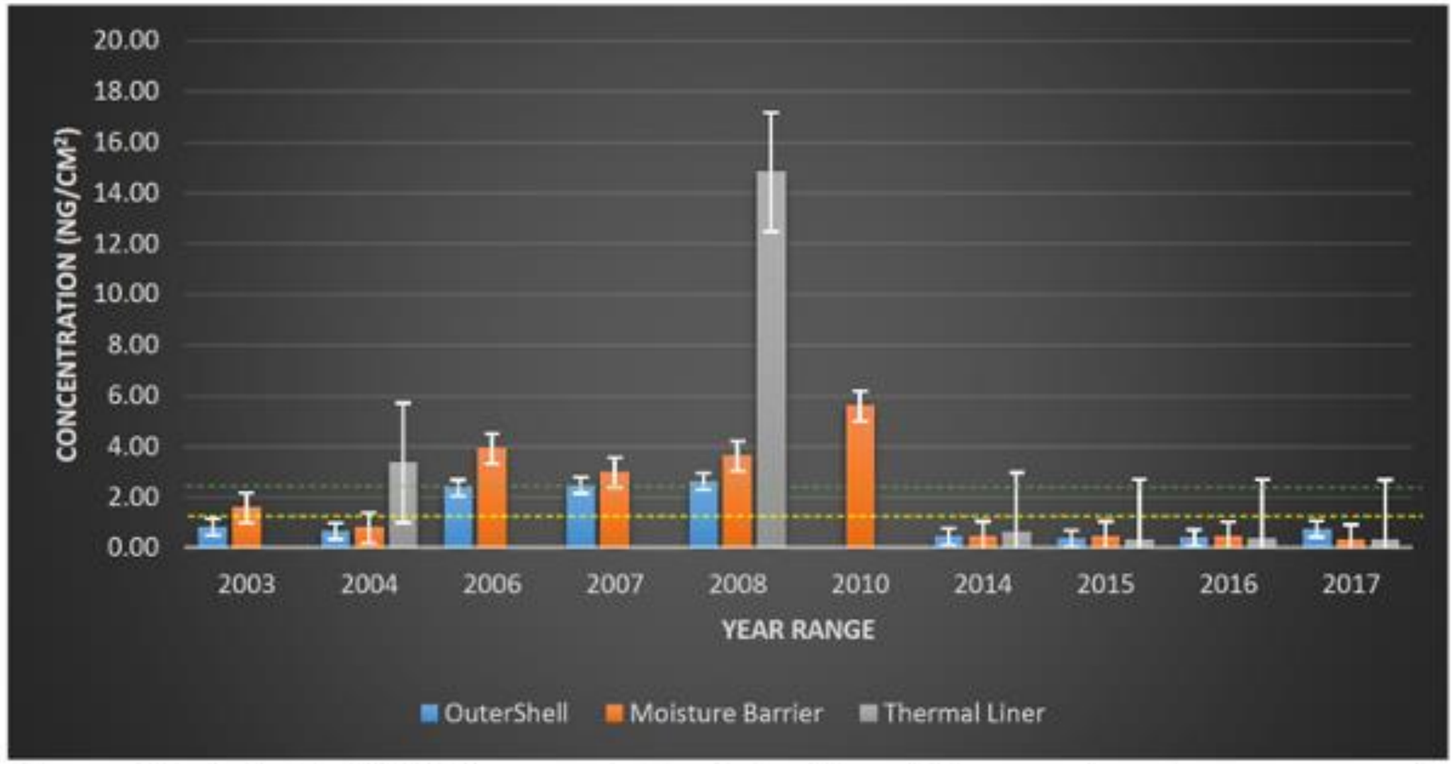


Figure 5.3: Analysis of PFOA concentration (ng/cm^2) possibly present on ten-year range of firefighter turnout gear, 2003 to 2017, due to extraction in a pressurized solvent extractor. Yellow dashed line represents LOD (0.95 ng/cm^2) of analytical method. Green dashed line represents LOQ (2.41 ng/cm^2) of analytical method

Zane et al. 2020

Harvard University Discovers Fire Station Dust Loaded with PFAS in Published Study

Posted on February 11, 2021 by Jon Marr // 4 Comments

A new peer-reviewed study published recently in the Journal of Exposure Science & Environmental Epidemiology highlighting Per- and polyfluoroalkyl substance (PFAS) content in fire station dust. The study was conducted in 15 fire stations throughout Massachusetts, including Boston. The result of this dust study provides further evidence and credibility to a fire gear PFAS content study published last year by Dr. Graham Peaslee of Notre Dame in Environmental Science & Technology Letters.

Environmental Science & Technology

pubs.acs.org/est

Article

Disposition of Fluorine on New Firefighter Turnout Gear

Derek J. Muensterman, Ivan A. Titaley, Graham F. Peaslee, Leah D. Minc, Liliana Cahuas, Alix E. Rodowa, Yuki Horiuchi, Shogo Yamane, Thierry N.J. Fouquet, John C. Kissel, Courtney C. Carignan, and Jennifer A. Field*

Cite This: https://doi.org/10.1021/acs.est.1c06322

Read Online

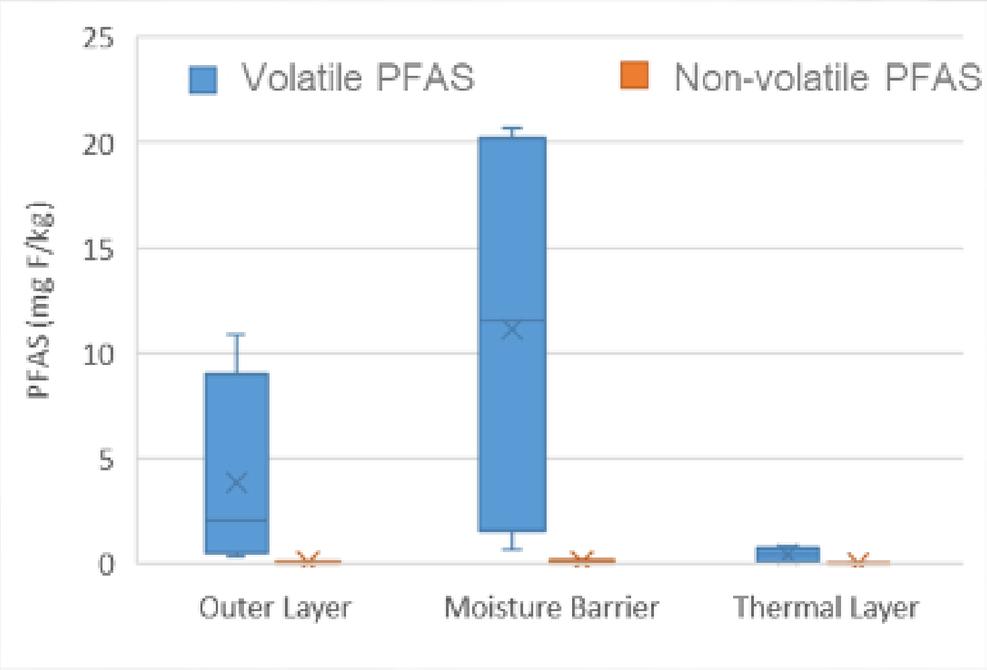
ACCESS | Metrics & More | Article Recommendations | Supporting Information

ABSTRACT: Firefighter turnout gear is essential for reducing occupational exposure to hazardous chemicals during training and fire events. Per-and polyfluoroalkyl substances (PFASs) are observed in firefighter serum, and possible occupational sources include the air and dust of fires, aqueous film-forming foam, and turnout gear. Limited data exist for nonvolatile and volatile PFASs on firefighter turnout gear and the disposition of fluorine on the individual layers of turnout gear. Further implications for exposure to fluorine on turnout gear are not well understood. Three unused turnout garments purchased in 2019 and one purchased in 2008, were analyzed for 50 nonvolatile and 15 volatile PFASs by liquid chromatography quadrupole time-of-flight mass spectrometry (LC-qTOF-MS) and gas chromatography−mass spectrometry (GC−MS), respectively. Particle-induced gamma ray emission (PIGE), a surface technique, and instrumental neutron activation analysis (INAA), a bulk technique, were used to

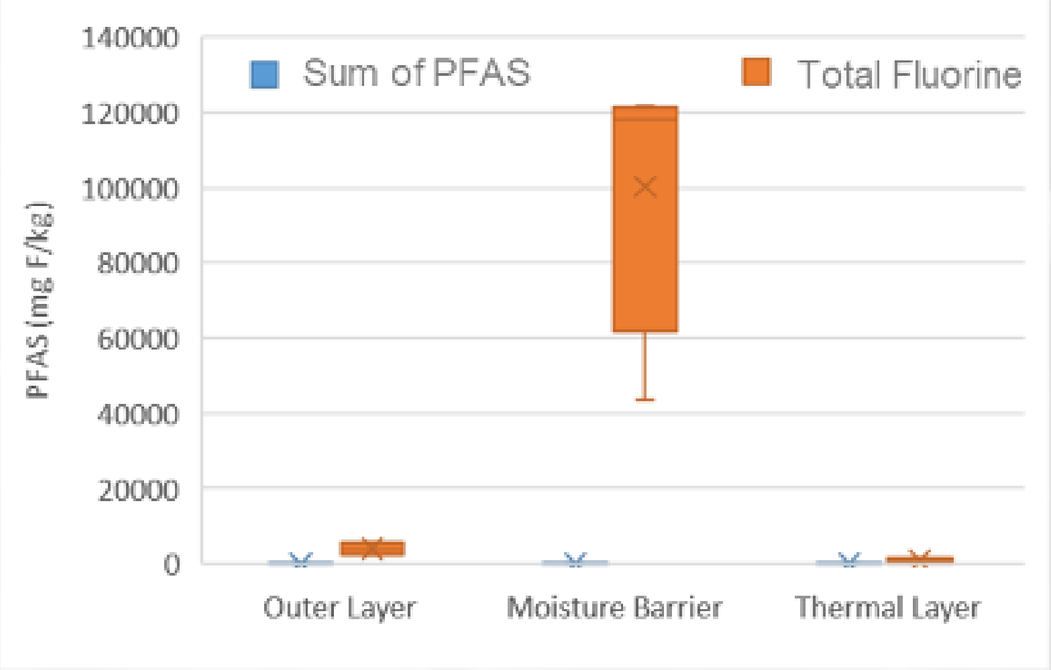
VOLATILE PFAS HIGHER THAN NON-VOLATILE

TOTAL FLUORINE MUCH HIGHER THAN EXTRACTABLE PFAS

a) Volatile and Non-volatile PFAS



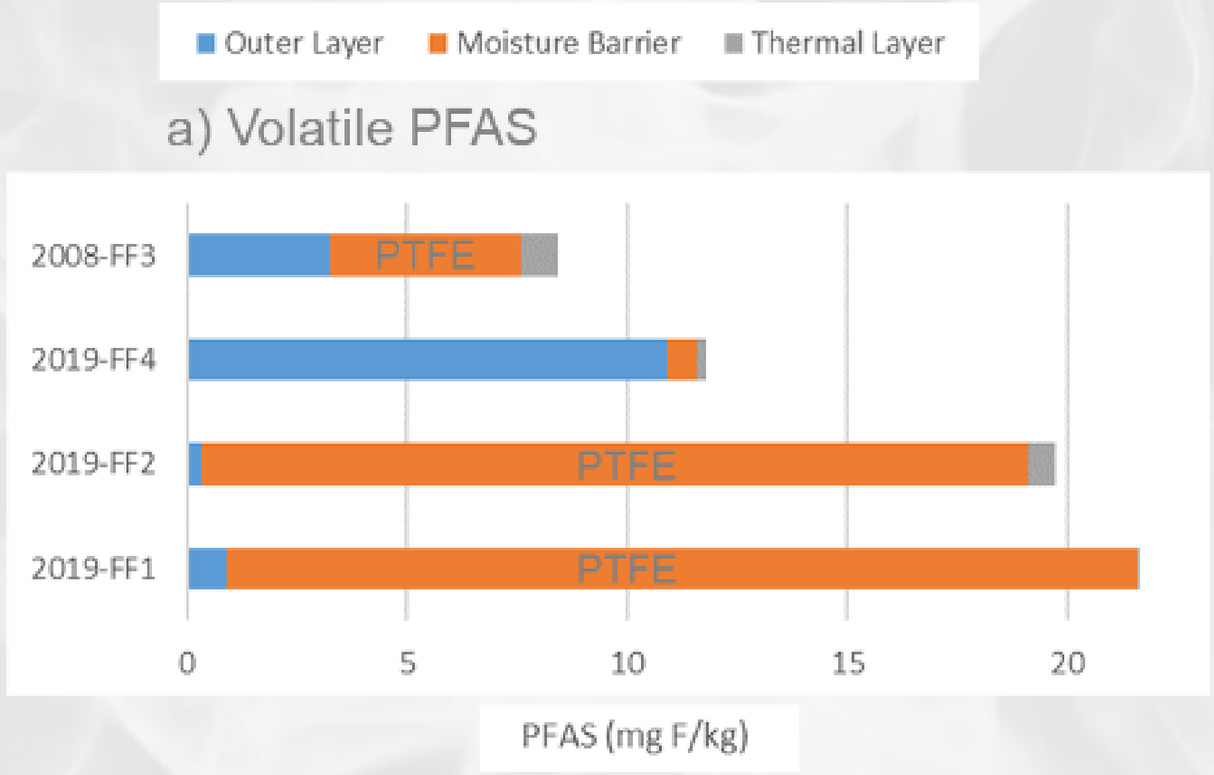
b) Sum of PFAS and Total Fluorine



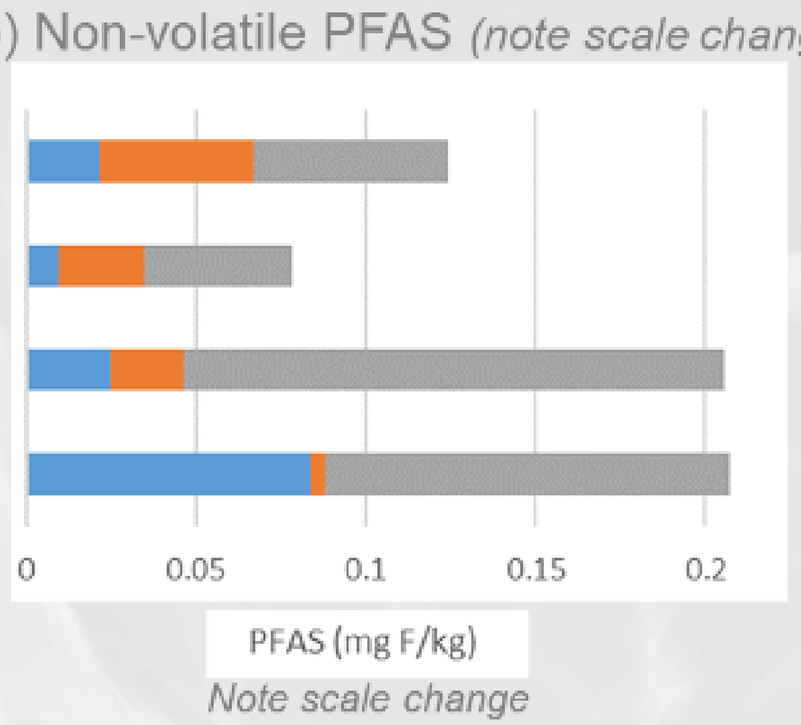
Adapted from Musterman et al. 2021

VOLATILE PFAS HIGHER THAN NON-VOLATILE

HIGHEST FROM OUTER LAYER AND MOISTURE BARRIER

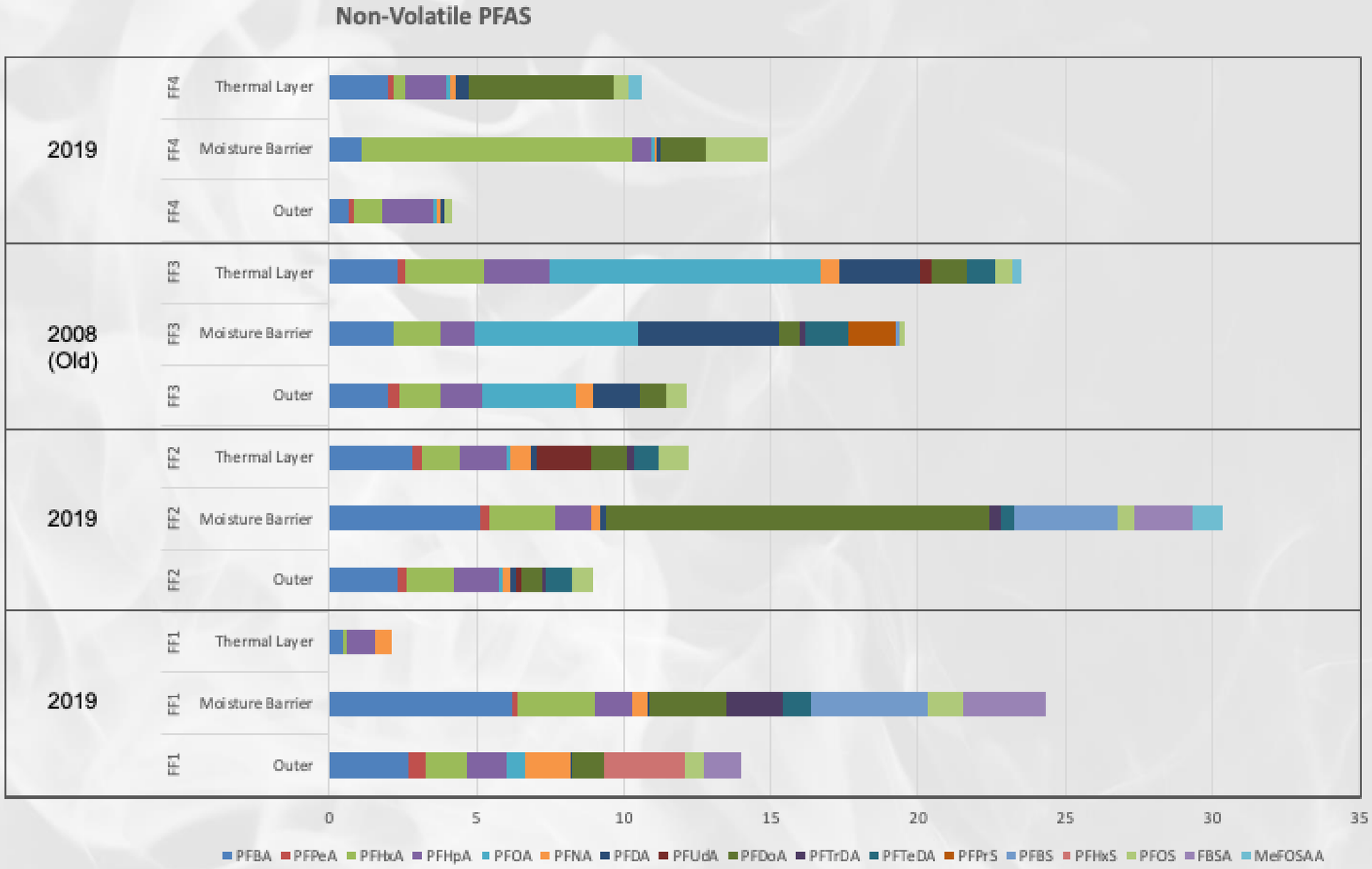


PTFE indicates a fluoropolymer film was identified in that layer



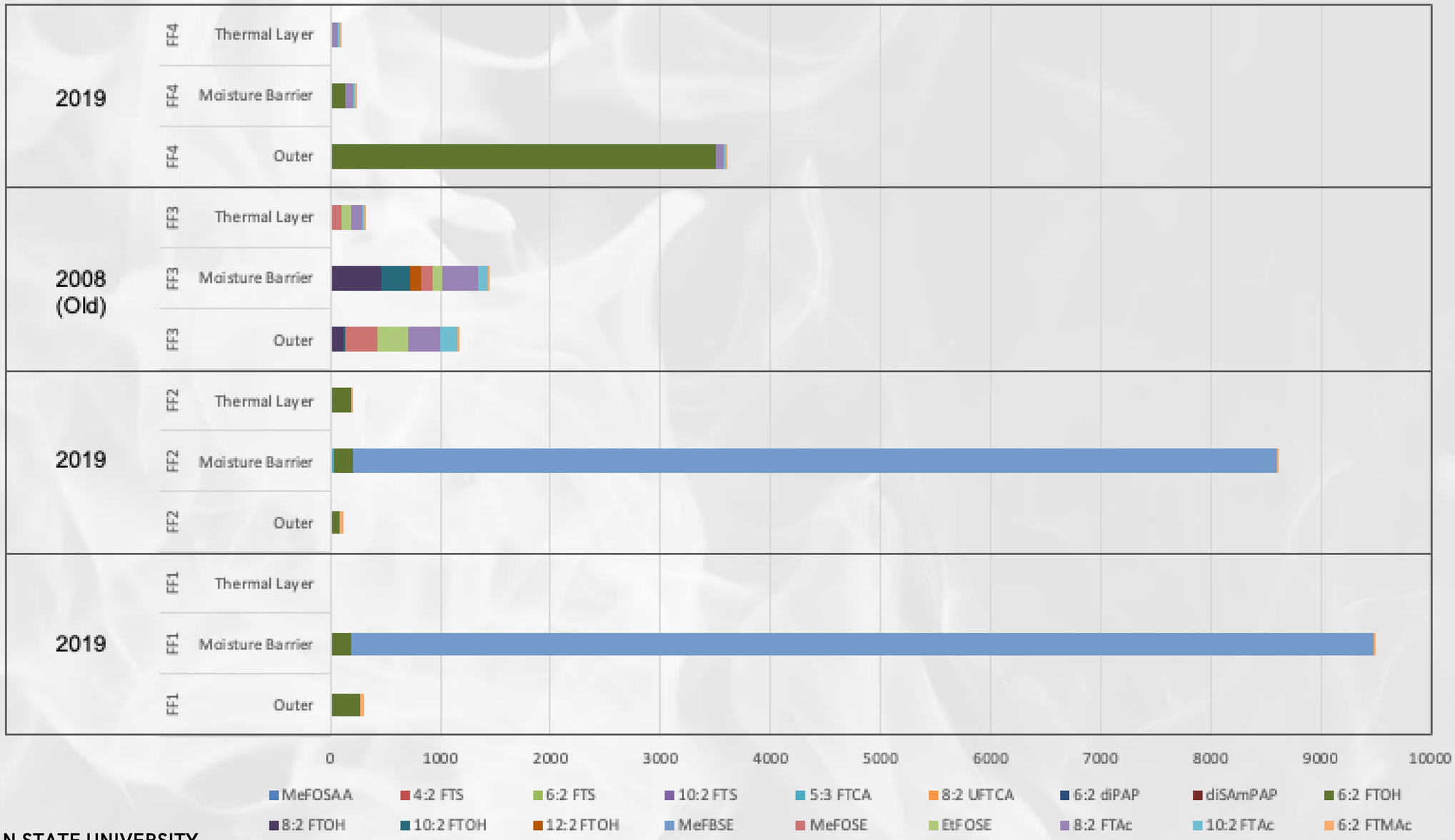
Note scale change

Adapted from Musterman et al. 2021



Adapted from Musterman et al. 2021

Volatile PFAS – Note Change in Scale



Adapted from Musterman et al. 2021

SUMMARY OF PFAS MEASURED IN NEVER USED GEAR

2008

- Predominantly volatile PFASs (FTOH, FOSE, & FTAc's etc)
- Contains non-volatile PFASs (PFOA, PFOS, PFDA, PFBA, etc)
- Found in all layers
- **Highest level: 6:2 FTOH from the PTFE moisture barrier**

2019

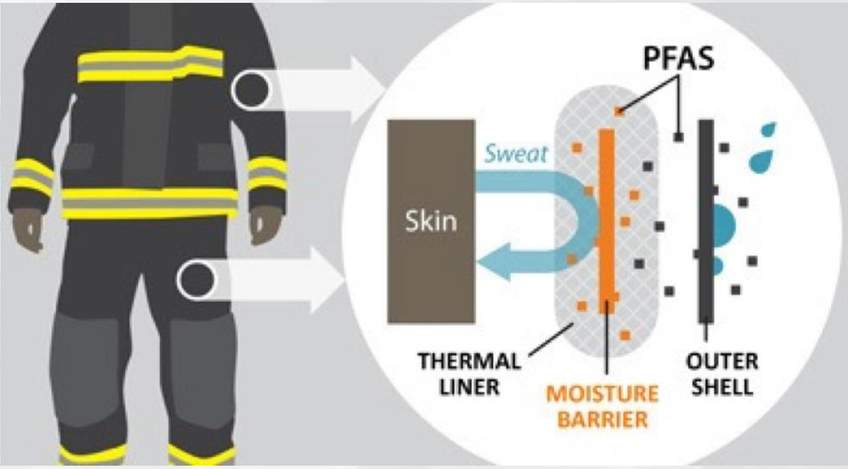
- Predominantly volatile PFASs (6:2 FTOH and MeFBSE)
- Contains non-volatile PFASs (PFBA, PFHxA, PFHpA, PFDoA, PFBS, PFOS, etc)
- Found in all layers
- **Highest level: MeFBSE from the PTFE moisture barrier**

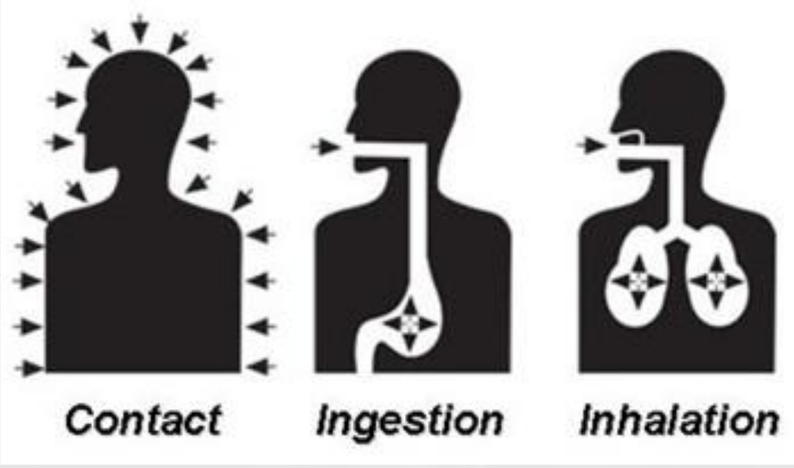
ELEVATED PFAS IN FIREFIGHTERS, TEXTILES, & FIREHOUSES

	Australian Firefighters (2015)	Southern California Firefighters (2015)	Chinese Textile Factory (2016)	San Francisco Firefighters (2020)	Gear room dust and Turnout gear wipes (2021)	Detected in Never worn Turnout gear (2021)
PFOS	X	X				X
PFHxS	X	X		X		X
PFHxA					X	X
PFOA		X	X	X		X
PFDA (PFDeA)		X	X	X	X	X
PFHpA		X			X	X
PFNA				X		X
PFUnDA		X		X		X
PFDoDA					X	X
8:2 FTOH			X			X
6:2 FTOH			X			X

EXPOSURE ROUTES

DUST: INCIDENTAL INGESTION
SKIN: DERMAL ABSORPTION





FIREFIGHTER FACEMASKS

Analyte	SUD	N95	RC-1	RC-2	RC-3	RC-4	RC-5	RC-6	FF
PFBA									
PFPeA									
PFHxA									
PFHpA									
PFOA									
PFNA									
PFDA									
PFUdA									
PFDoA									
PFTrDA									
PFTeDA									
PFPrS									
PFBS									
PFHxS									
PFOS									
4:2 FTS									
6:2 FTS									
7:3 FTCA									
6:2 FTCA									
10:2 FTCA									
6:2 UFTCA									
HFPO-DA									
6:2 diPAP									
6:2 FTOH									
8:2 FTAc									
Sum (µg/m^2)	46±16	15	120	140	160	520	490	910±190	2900

Legend	
<LOQ or <LOD	
0.1-1 ug/m^2	
1-10 ug/m^2	
10-100 ug/m^2	
100-1000 ug/m^2	
1000-10000 ug/m^2	

Environmental Science & Technology Letters

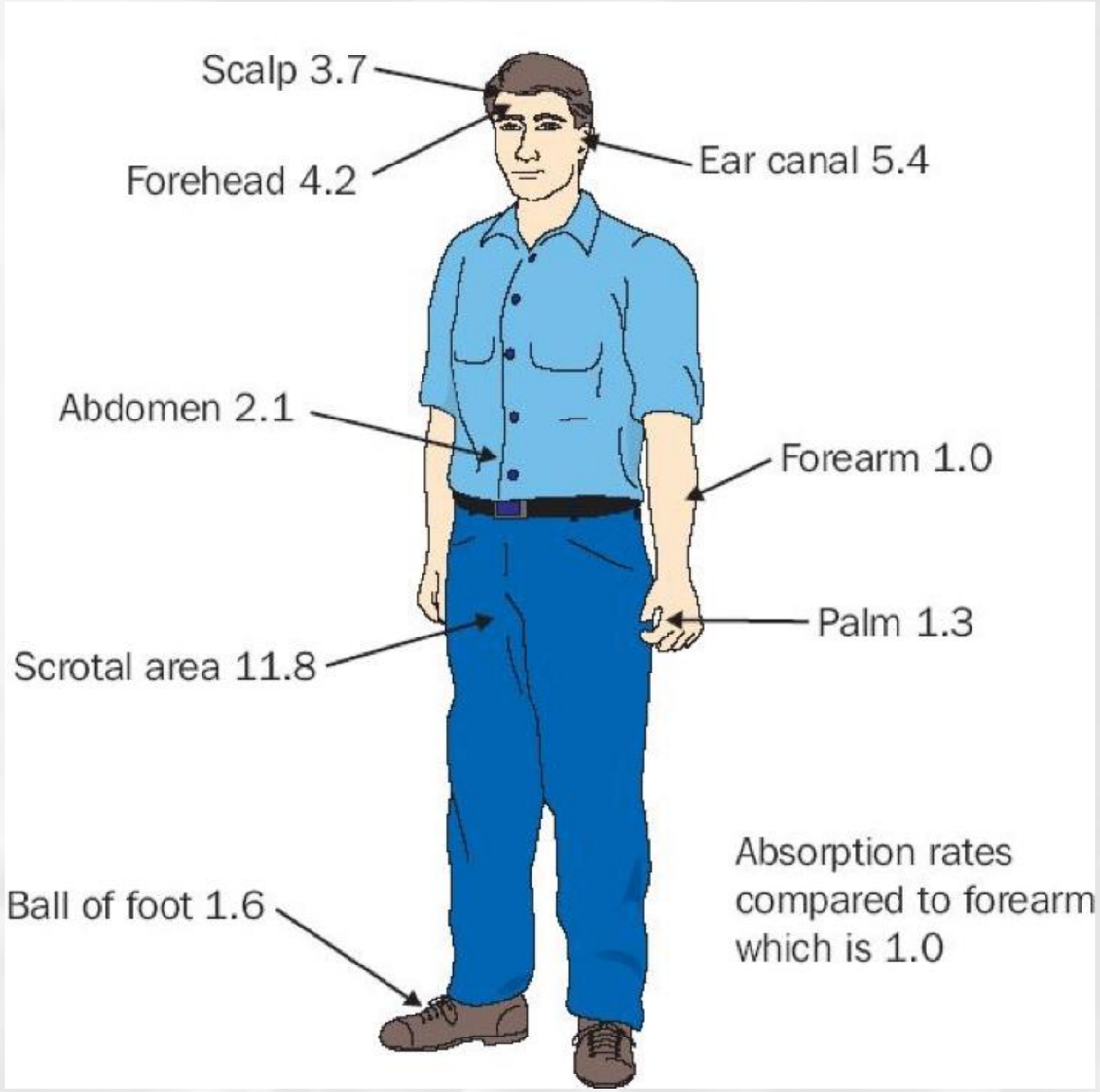
pubs.acs.org/journal/estlcu Letter

Per- and Polyfluoroalkyl Substances (PFAS) in Facemasks: Potential Source of Human Exposure to PFAS with Implications for Disposal to Landfills

Derek J. Muensterman,[▽] Liliana Cahuas,[▽] Ivan A. Titaley,[*,▽] Christopher Schmokel, Florentino B. De la Cruz, Morton A. Barlaz, Courtney C. Carignan, Graham F. Peaslee, and Jennifer A. Field

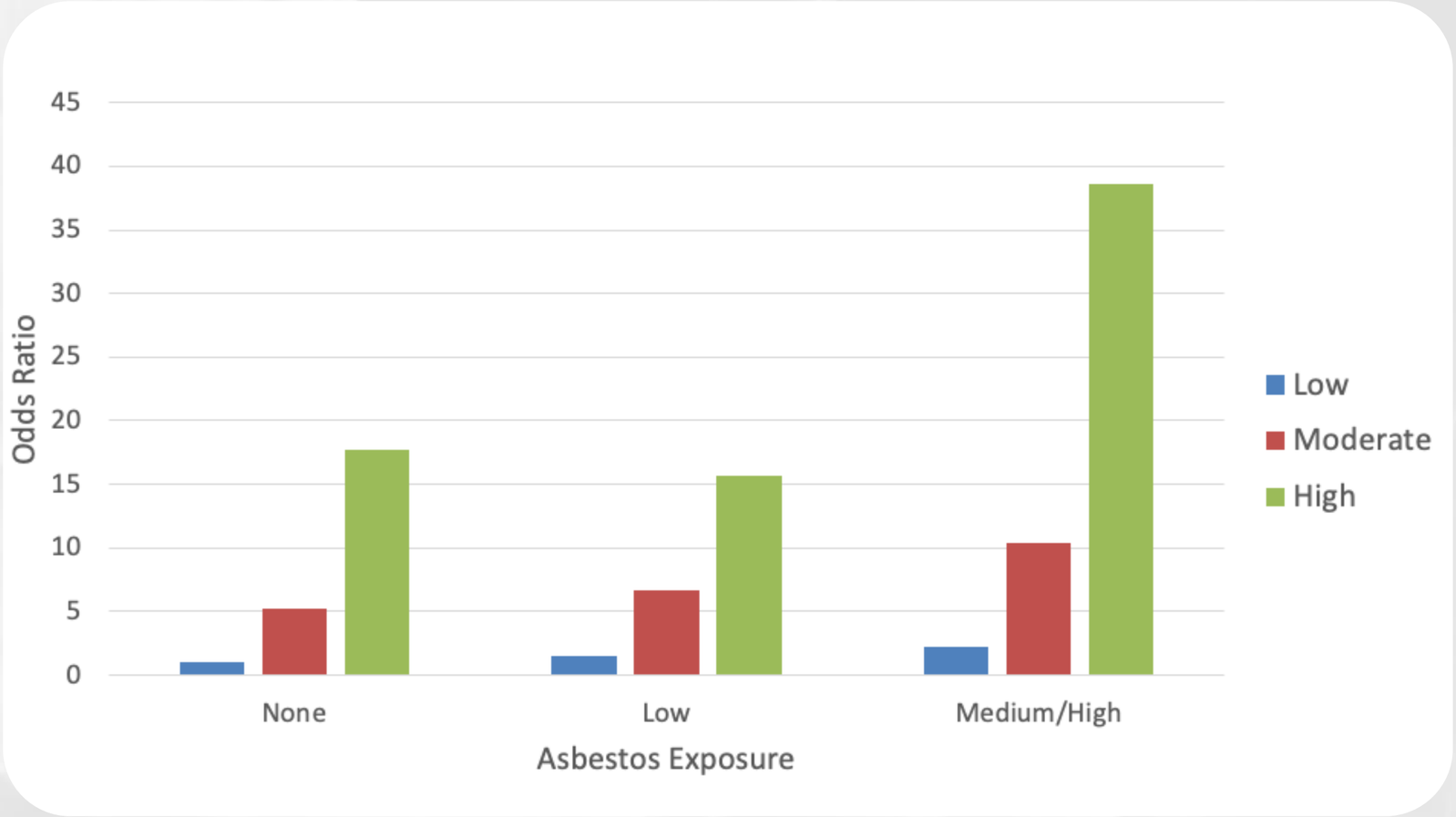
Cite This: https://doi.org/10.1021/acs.estlett.2c00019 Read Online

NOTE: SKIN ABSORBS DIFFERENTLY FOR PARTS OF THE BODY



EXPOSURE TO MULTIPLE CARCINOGENS CAN INCREASE RISK

E.G. SMOKING + ASBESTOS EXPOSURE DOUBLES ODDS RATIO FOR LUNG CANCER



FIREFIGHTERS WANT PFAS-FREE GEAR

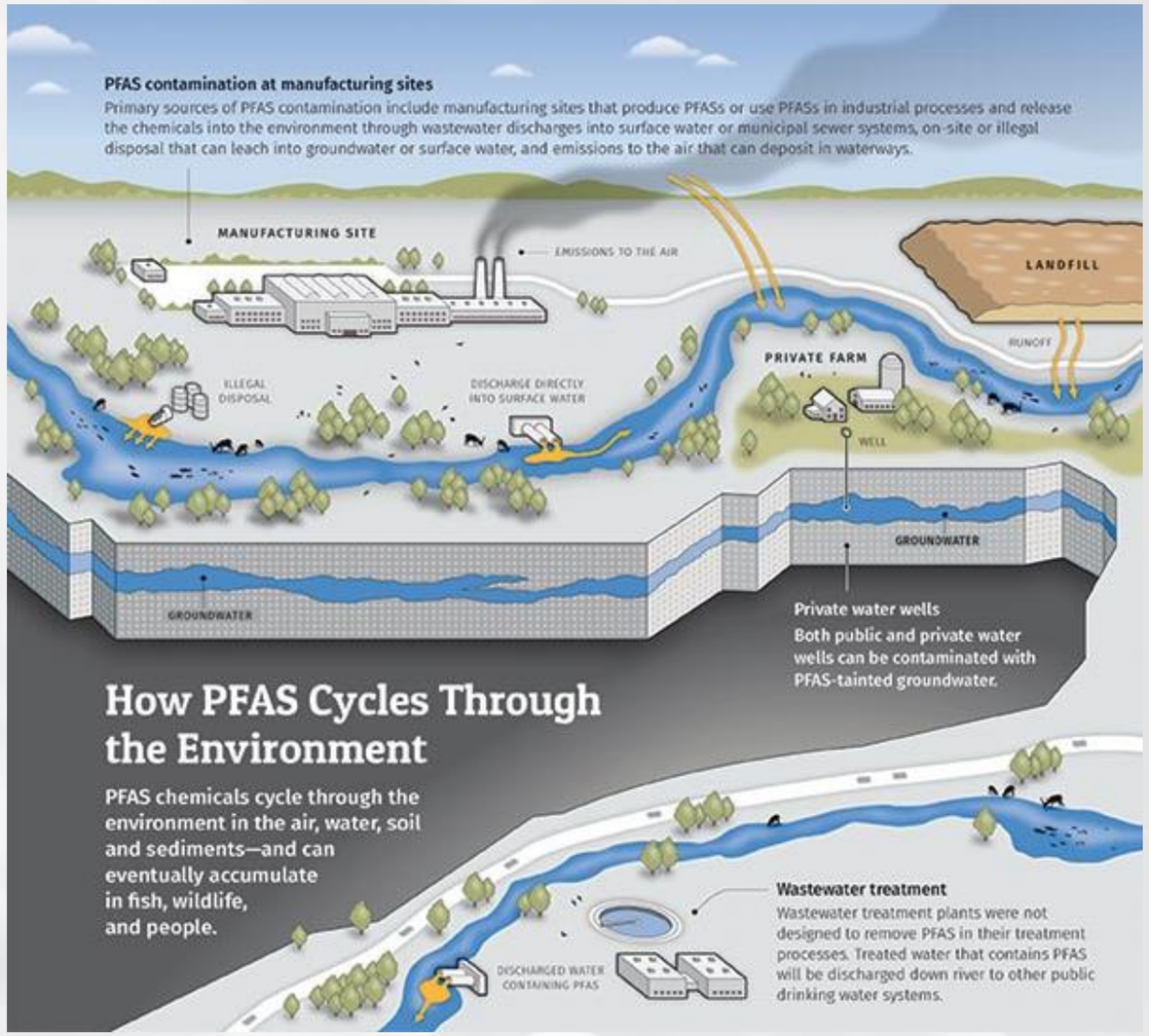
PFZero Turnout Gear:

- **No PFAS in outer or thermal layer**
- **PTFE in moisture barrier**

Greensboro, NC – Burlington is excited to launch ***PF Zero™*** sustainable repellency technology for high-performing apparel fabrics. ***PF Zero*** is a non-fluorocarbon, water-based repellency finish with exceptional durability and maximum protection, offering the next level of environmentally-conscious innovative fabric solutions.

"The ***PF Zero*** technology, combined with other Burlington fabric innovations, creates the ultimate in performance and comfort for active lifestyles," said Nelson Bebo, Vice President Performance Fabrics. "***PF Zero*** offers the next level of sustainable performance to Burlington's advanced fabric technologies with a PFAS free finish offering superior repellency that can be combined with other Burlington Labs technologies – whether it be a moisture activated cooling sensation, a smart technology that adapts to your environment hot or cold, basic wicking or UV protection. Life can be unpredictable. Burlington's ***PF Zero*** fabrics give you the comfort and confidence to take it all in stride."

LIFE-CYCLE


PFAS contamination at manufacturing sites
Primary sources of PFAS contamination include manufacturing sites that produce PFASs or use PFASs in industrial processes and release the chemicals into the environment through wastewater discharges into surface water or municipal sewer systems, on-site or illegal disposal that can leach into groundwater or surface water, and emissions to the air that can deposit in waterways.
MANUFACTURING SITE
EMISSIONS TO THE AIR
LANDFILL
RUNOFF
PRIVATE FARM
ILLEGAL DISPOSAL
DISCHARGE DIRECTLY INTO SURFACE WATER
WELL
GROUNDWATER
GROUNDWATER
Private water wells
Both public and private water wells can be contaminated with PFAS-tainted groundwater.
How PFAS Cycles Through the Environment
PFAS chemicals cycle through the environment in the air, water, soil and sediments—and can eventually accumulate in fish, wildlife, and people.
Wastewater treatment
Wastewater treatment plants were not designed to remove PFAS in their treatment processes. Treated water that contains PFAS will be discharged down river to other public drinking water systems.
DISCHARGED WATER CONTAINING PFAS

LIFE-CYCLE

Vents outside

Wastewater treatment plant

FIREFIGHTER'S ARE REQUESTING PFAS BLOOD TESTING

PFAS Blood Tests allows people to:

- **Better understand and mitigate their personal exposures**
- **Share with their clinician as a risk factor and consider medical screening**

WHAT'S MY EXPOSURE?

Information from your blood report

	Value	Unit
PFOA **Perfluorooctanoic acid**	0.85	ng/mL (n
PFOS **Perfluorooctane sulfonic acid**	7.6	ng/mL (n
PFHxS **Perfluorohexane sulfonic acid**	2.7	ng/mL (n
PFNA **Perfluorononanoic acid**	0.84	ng/mL (n

Your state (optional)

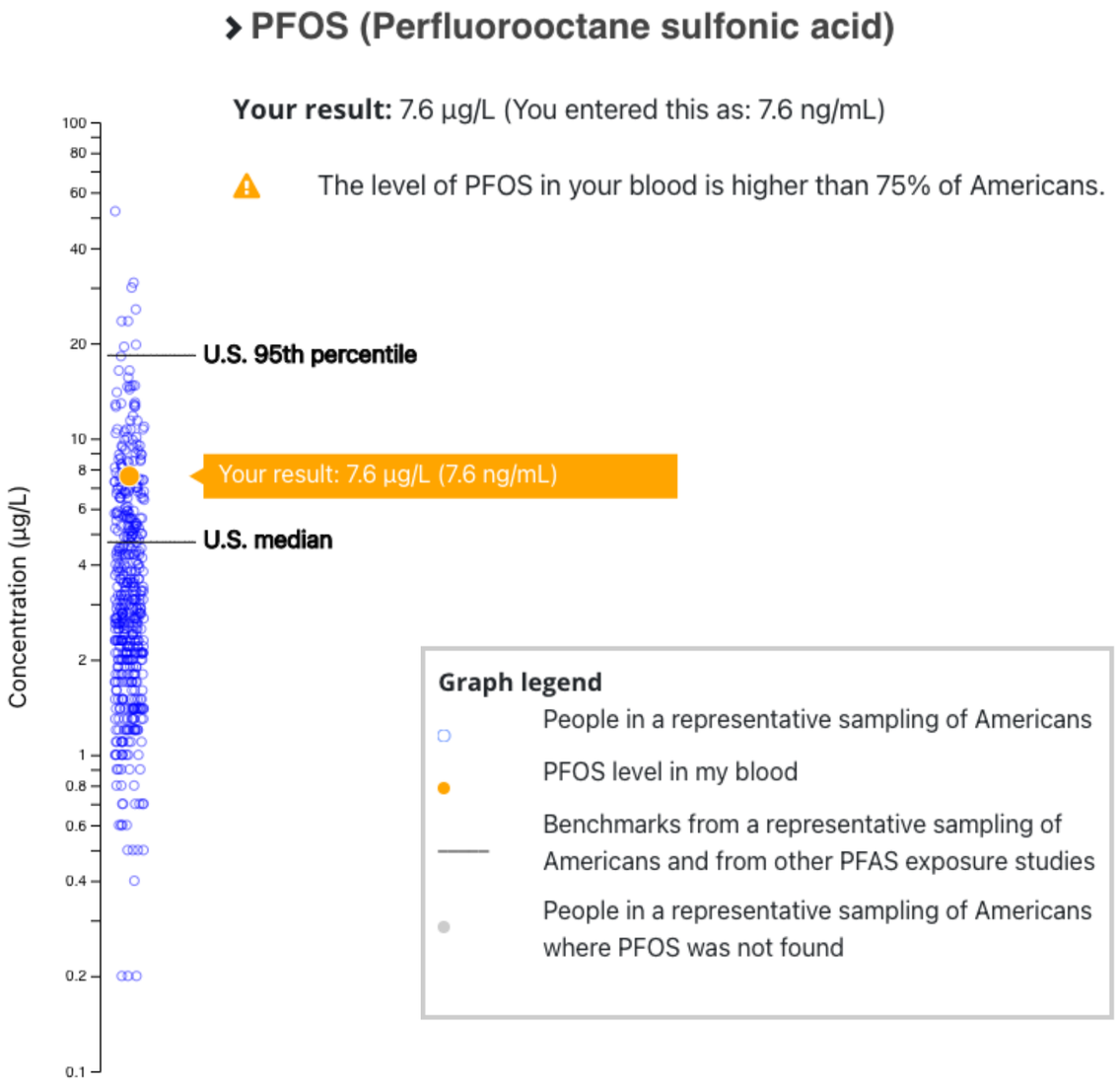
Knowing what state you live in helps us customize your water graph — but feel free to leave your state blank.

- Select -

GENERATE REPORT

PFAS Exchange
www.pfas-exchange.org

context rich report back



MICHIGAN STATE UNIVERSITY
NORTHEAST CONFERENCE

Jun 29, 2021

Improved medical screening in PFAS-impacted communities to identify early disease

People highly exposed to PFAS often face significant hurdles in getting screened for potential health effects from the exposure. That needs to change.

Isabella Raponi , Phil Brown and Alissa Cordner

MEDICAL SCREENING COMPANION DOCUMENTS

COMMUNITY MEMBERS

PFAS-REACH

PFAS Exposure: Information for patients and guidance for clinicians to inform patient and clinician decision making

For people in PFAS-impacted communities

Purpose

This guidance document is intended for people living in communities with contaminated water or who have had some other source of substantial exposure to PFAS. This guidance document is not targeted to those at average risk from PFAS.

What is medical screening?

Medical screening is the testing for early signs of disease. Screening for certain conditions or subclinical changes may be advised for those who have or have had known elevated exposure to PFAS. Medical screening may identify early indicators of disease and allow you to work with your clinician to determine next steps.

What are PFAS?

Per- and polyfluoroalkyl substances (PFAS) are a large group of over 9,000 human-made chemicals, exposure to which has been associated with several serious health effects. They are extremely resistant to breakdown, highly mobile in the environment, and have contaminated hundreds of drinking water supplies. PFAS have been found in the blood of over 99% of Americans and some PFAS can remain in the body for years.

How can I be exposed to PFAS?

At home

- Drinking contaminated water
- Eating food contaminated from environmental sources or from processing and packaging
- Using stain- and water-resistant products, grease-proof food packaging, nonstick cookware, and many other consumer products

At work

Some people, such as firefighters and those in chemical production and application industries, may be exposed to products containing PFAS at work.

Early in life

PFAS can cross the placenta and accumulate in breast milk, so children can be exposed in the womb and during early life through breastfeeding.

How are PFAS regulated in drinking water?

- PFAS are not regulated under the U.S. Environmental Protection Agency's Safe Drinking Water Act. This means there are no federally enforceable standards and public water suppliers are not required to routinely test or treat for PFAS under federal law.
- In 2016, the U.S. Environmental Protection Agency established a non-enforceable Lifetime Health Advisory of 70 parts per trillion (ppt) for PFOA and PFOS (two of the most common PFAS chemicals) individually or combined, for municipal drinking water. Some scientists and regulators think this advisory is not sufficiently protective of human health.
- As of April 2021, 12 states have adopted more stringent, and in some cases enforceable, drinking-water guidelines. The PFAS Exchange provides more information about national and state drinking water guidelines. Some states have established guidelines for additional PFAS chemicals, down to 10–20 ppt.
- The Northeastern University Contaminated Site Tracker has documented hundreds of contaminated sites in the U.S., with more sites being added as testing continues.

This fact sheet is a product of the PFAS REACH (Research, Education, and Action for Community Health) study. PFAS-REACH is funded by the National Institute of Environmental Health Sciences (Grant No. P01ES028171).

June 2021

CLINICIANS

PFAS-REACH

PFAS Exposure: Information for patients and guidance for clinicians to inform patient and clinician decision making

For clinicians

About this guidance document

The guidance summarized here is to help inform discussion and decision making for physicians and their patients. Many of the tests and screenings noted are part of basic primary care annual appointments. In 2019, the American Medical Association (AMA) resolved to support research and policy to address the effects of PFAS exposure.

We based the following suggestions for medical screening tests on those previously developed and implemented for a PFAS-impacted community as well as peer-reviewed research and scientific assessments using weight of evidence approaches from:

- Agency for Toxic Substances and Disease Registry (2021)
- Centers for Disease Control and Prevention (2019)
- C8 Science and Medical Panels (2005-2013)
- European Environment Agency (2019)
- International Agency for Research on Cancer (2017)
- National Toxicology Program (2016)

These recommendations are for those living in communities with contaminated water or who are exposed to other sources of PFAS that substantially increases their internal burden of PFAS. These recommendations are not targeted to those with average levels of PFAS exposure.

Guidance for adult patients

Laboratory tests

- **Lipid panel (cholesterol, LDL, HDL, triglycerides).** PFAS exposure has been associated with higher total and LDL cholesterol and fatty liver.
- **Liver function tests**, such as ALT, AST, and GGT. PFAS exposure has been associated with higher-than-normal liver function tests, as well as hepatocytic, including hepatocyte and liver architecture damage.
- **Serum creatinine and urine protein and urine albumin**. PFAS exposure is associated with chronic kidney disease and kidney cancer. An important note for researchers is that there is enhanced excretion of PFAS in moderate to severe kidney disease, especially if there is albuminuria. Reduced serum PFAS concentrations for those individuals introduces a bias towards the null if not controlled for in epidemiologic studies.
- **Thyroid tests**, such as TSH with or without FT4. PFAS exposure has been associated with thyroid disease.

Clinical examinations

- **Regular testicular examinations**. Exposure to high levels of PFAS has been associated with increased risk of testicular cancer.

Counseling topics

- **Vaccine response**. There is currently no consensus on revaccinating patients with low vaccine titer when tested a month following vaccination (i.e., Tdap, MMR); more research is needed.
- **Home blood pressure monitoring during pregnancy**. PFAS are associated with elevated blood pressure during pregnancy and with preeclampsia.
- **Breastfeeding.** Babies can be exposed to PFAS during pregnancy since PFAS can cross the placenta. PFAS chemicals also accumulate in breast milk. However, the benefits of breastfeeding are clear, and include benefits to maternal as well as child health. There is insufficient evidence to recommend against breastfeeding based on maternal PFAS exposure.

WWW.PFAS-EXCHANGE.ORG/RESOURCES

THIRD NATIONAL PFAS CONFERENCE

JUNE 15-17, 2022
WILMINGTON, NC

HIGHLY FLUORINATED COMPOUNDS - ENVIRONMENTAL JUSTICE AND SCIENTIFIC DISCOVERY

REGISTRATION OPEN:
HTTPS://GO.NCSU.EDU/PFAS2022

MICHIGAN STATE UNIVERSITY
NORTHEAST CONFERENCE

LET’S BE PROACTIVE

- WE KNOW ENOUGH ABOUT THE IMPACTS OF PFAS TO START MAKING PROACTIVE DECISIONS IN THE INTEREST OF PUBLIC AND ENVIRONMENTAL HEALTH

- LET'S BRIDGE THE COMMUNICATION GAPS BETWEEN THE SCIENCE COMMUNITY AND THE FIREFIGHTING COMMUNITY

- A MAJORITY OF FIREFIGHTERS STILL DON'T KNOW ABOUT THEIR OCCUPATIONAL PFAS EXPOSURES

TURI COMMUNITY GRANT: EDUCATION & SEARCHING FOR SAFER ALTERNATIVES

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UMASS LOWELL

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FIREFIGHTER

NANTUCKET & FALL RIVER
MASSACHUSETTS
2021 - 2022

TURNOUT GEAR PFAS STUDY

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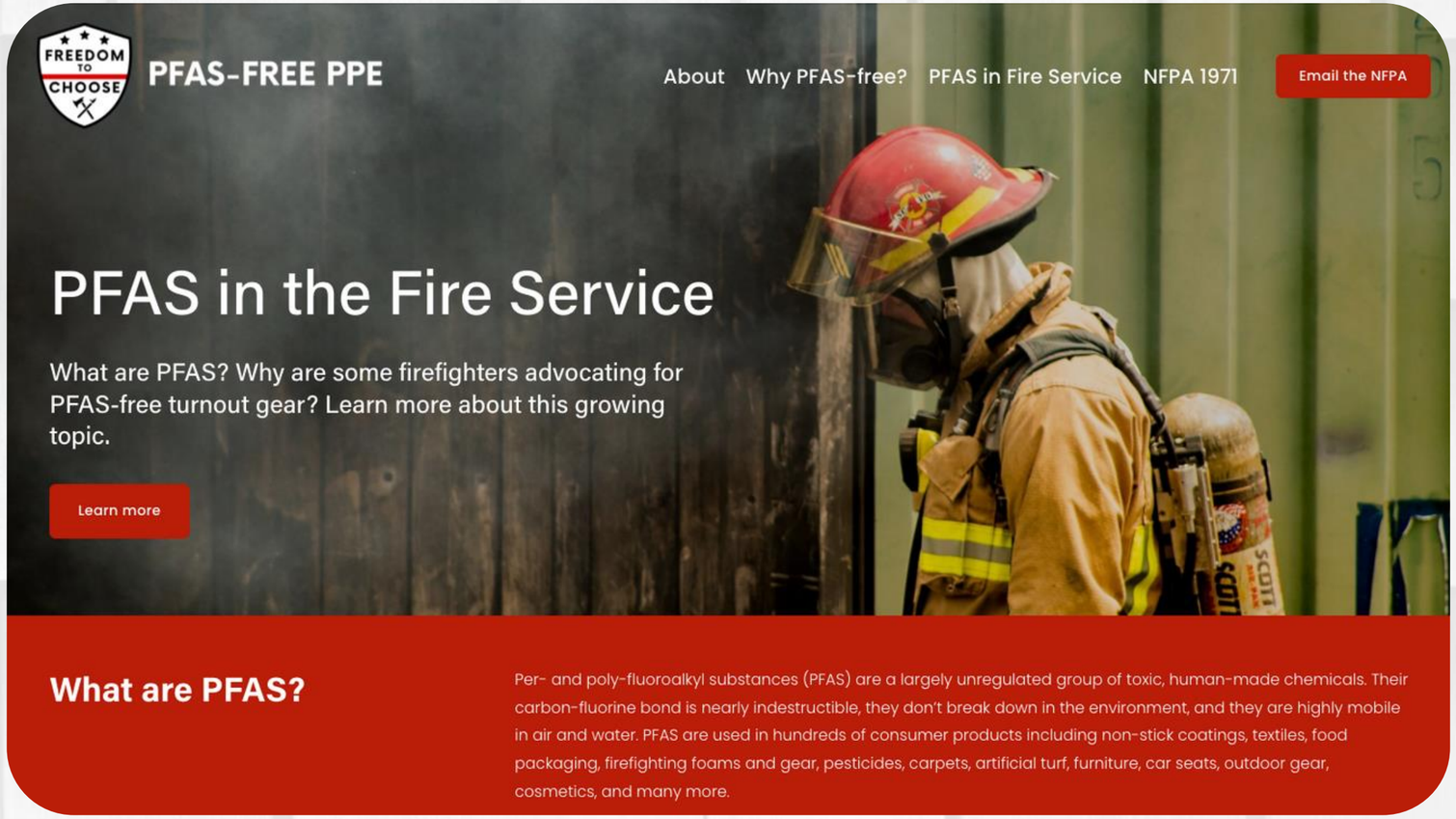
LEARN MORE AT:

PFASFREEPPE.COM



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THANK YOU!

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