US EPA's Science-Based Approach to Understanding and Managing Environmental Risk from PFAS

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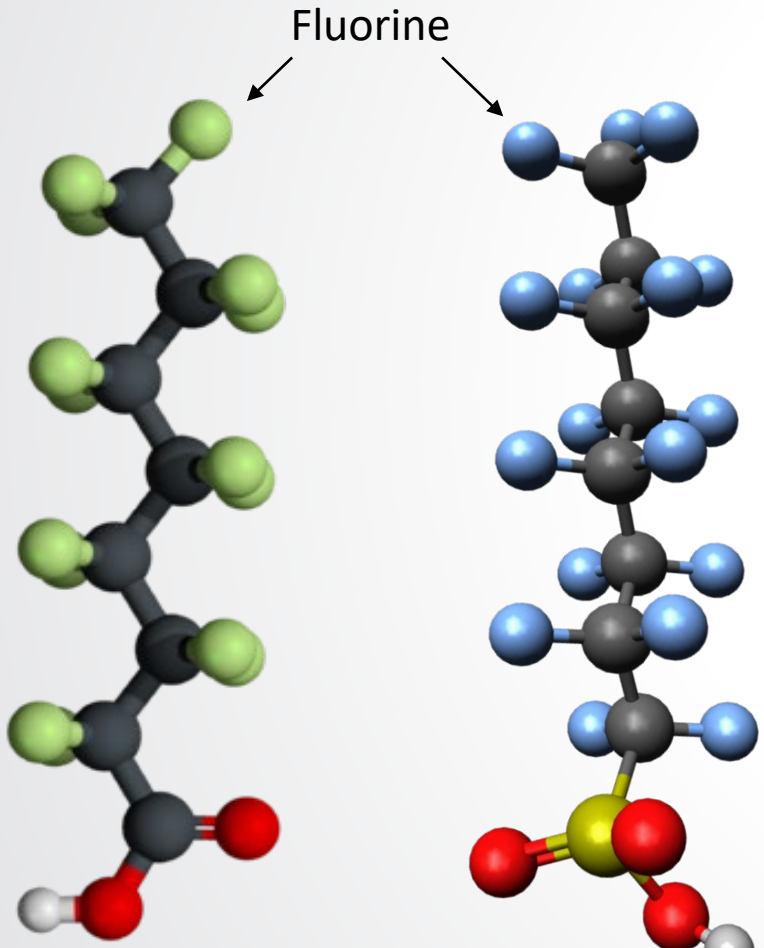
Per- & Polyfluoroalkyl Substances (PFAS)



PFOA

PFOS

- **A class of man-made chemicals**
  - **Chains** of carbon (C) atoms surrounded by fluorine (F) atoms, with different terminal ends
  - **Complicated chemistry** – thousands of different variations exist in commerce
  - **Widely used** in industrial processes and in consumer products
  - **Some** PFAS are known to be **PBT**:
    - **Persistent** in the environment
    - **Bioaccumulative** in organisms
    - **Toxic** at relatively low (ppt) levels

Background

- Per- and polyfluoroalkyl substances (PFAS) are a group of man-made chemicals that have been in use since the 1940s, found in a wide array of consumer products and facilities
- Most people have been exposed to PFAS. Some PFAS chemicals can accumulate and can stay in the human body for long periods of time
- There is evidence that exposure to certain PFAS may lead to adverse health effects
- PFAS is an issue of high and growing concern for EPA customers and the public, and so EPA is committed to taking action to address public concerns

Recent EPA Actions on PFAS

- National PFAS Leadership Summit - May 2018
  - Share information, identify actions, risk communication
- Major EPA Actions Announced at Summit
  - Develop groundwater cleanup recommendations for PFOA/PFOS (OLEM)
  - Examine options for listing PFOA/PFOS as Hazardous Substances (OLEM)
  - Release draft toxicity assessments for GenX and PFBS by fall 2018 (OW & ORD)
- Community Events June-Sept 2018
  - Series of 6 public meetings on PFAS concerns
- EPA PFAS Action Plan - February 14 2019
  - Building on lessons learned from Summit, Engagements, Docket
- EPA PFAS Action Plan Update – February 26, 2020
  - Progress report on actions undertaken as part of the EPA PFAS Action Plan

Action Plan Background

- EPA's PFAS Action Plan was developed based on feedback from various community events in addition to information received from approximately 120,000 comments submitted to the public docket.
- The Action Plan is EPA's first multi-media, multi-program, national research, management and risk communication plan to address a challenge like PFAS.

PFAS Action Plan - Research

- The EPA is rapidly expanding the scientific foundation for understanding and managing risk from PFAS.
- This research is organized around:
  - understanding **toxicity**
  - understanding **exposure**
  - assessing **risk**
  - identifying effective **treatment and remediation** actions

Research – Analytical Methods

- **Data Gap**: Standardized/validated analytical methods for measuring PFAS
- **Action**: Develop and validate analytical methods for detecting, quantifying PFAS in water, air, solids, and tissues
- **Near Term Research Products:**
  - New **DW** Method 533 for ~26 PFAS including shorter chains (2019 Q4)
  - Method for **air emission** sampling and analysis (2020 Q1)
  - Isotope Dilution methods for 24 PFAS in **surface water, ground water, soils, sediments, and biosolids** (2020 Q3)
  - Method for **Total Organic Fluorine** (TOF) (2020 Q4)
  - Non-targeted analysis methods to characterize PFAS chemicals in environmental media (Ongoing)
- **Impact**: Stakeholders will have reliable standardized analytical methods to test for known and discover new PFAS in water, solids, and air

Research – Chemical Data Curation

- **Data Gap**: Lack of tools to access and integrate PFAS chemical data
- **Action**: Develop databases and tools to streamline access to PFAS chemical data
- **Near Term Research Products:**
  - Physical reference library of PFAS chemicals for Agency and State use (Ongoing)
  - QSAR models to better predict chemical properties and environmental fate (Ongoing)
  - Public online databases such as the Chemicals Dashboard and ECOTOX knowledgebase to house and serve data on chemical and physical properties, sources, exposure, and effects (Ongoing)
- **Impact**: Stakeholders will have easy access to the most comprehensive and current PFAS-relevant chemical data

Research – Exposure

- **Data Gap**: Knowledge on sources, site-specific concentrations, fate and transport, bioaccumulation, and human and ecological exposure
- **Action**: Develop and test methods, models, and databases to characterize PFAS sources and predict human and ecological exposures
- **Near Term Research Products:**
  - Literature review of PFOS and PFOA in environmental media (2019 Q4)
  - Case Study: PFAS fate and transport/air dispersion (2020 Q3)
  - Incorporate PFAS chemistry into the Chemical Transformation Simulator (2020 Q4)
- **Impact**: Stakeholders will be able to identify and assess potential PFAS sources and exposures, and identify key pathways for risk management

Research – Human Health Assessment

- **Data Gap**: Human toxicity information for many PFAS of interest
- **Action**: Address data gaps for PFAS with **sufficient** existing published studies
  - Conduct systematic review/evidence mapping of PFAS toxicology literature
  - Add PFAS literature to the HERO database of scientific studies
  - Develop standard toxicity assessments (e.g. IRIS) where data are available
- **Near Term Research Products:**
  - Final toxicity assessments for PFBS (2020 Q2), HFPO-DA (2020 Q4)
  - Public review draft IRIS assessments for PFBA, PFHxA (2020 Q3), PFDA (2020 Q4), PFHxS and PFNA (2021 Q1)
- **Impact**: Stakeholders will have PFAS toxicity reference values to inform risk analysis, management decisions, and risk communication

Research – Human Health Toxicology

- **Data Gap**: Human toxicity information for many PFAS of interest
- **Action**: Address data gaps for PFAS with **limited/no** existing published studies
  - Use *in vitro*, high throughput toxicity and toxicokinetic testing to fill in gaps to support prioritization, chemical grouping, read across, relative toxicity and mixtures assessment
  - Apply New Approach Methods (NAMs) to inform hazard characterization and prioritization for further *in vivo* testing
- **Near Term Research Products:**
  - Prioritize subset of PFAS for *in vivo* testing (2020 Q3)
  - Report on bioactivity analysis of (~150 different PFAS) x (7 sets of assays) (2020 Q4)
  - Test categorization, read across and bioactive dose level approaches (2021 Q2)
- **Impact**: Stakeholders will have PFAS toxicity information to inform risk analysis, management decisions, and risk communication

Research – Ecological Toxicity

- **Data Gap**: Knowledge on ecotoxicity for PFAS of concern
- **Action**:
  - Research to identify sensitive taxa, quantify bioaccumulation, support establishment of benchmarks and thresholds
  - Use High-throughput data to develop PFAS-related Adverse Outcome Pathways (AOPs) to inform mode-of-action
- **Near Term Research Products:**
  - Review/synthesis of PFAS bioaccumulation literature (2021 Q1)
  - *In vitro* screening of thyroid based HT ecological assays (2021 Q2)
- **Impact**: Stakeholders will have PFAS ecotoxicity information (e.g. aquatic life criteria) to support risk analysis and management decisions

Research – Drinking Water Treatment

- **Data Gap**: Water treatment technology performance and cost data for PFAS removal
- **Action**:
  - Review PFAS performance, cost data from different configurations and range of system sizes (collaborative with utilities, industry, DoD, academia, international)
  - Test commercially available granular activated carbons (GACs) and ion exchange (IX) resins for effectiveness over a range of PFAS under different water quality conditions
  - Evaluate technologies for regeneration or disposal of spent GAC and IX
- **Near Term Research Products:**
  - Updated Drinking Water treatment performance, cost models, and data (2020 Q1)
  - Updates to DW Treatability Database (ongoing, next is 2020 Q2)
  - PFAS fate from reactivation/thermal treatment of spent GAC and IX (2021 Q1)
- **Impact**: Utilities will be able to better identify the cost effective treatment strategies for removing PFAS from drinking water compatible with their situation

Research – Site Remediation

- **Data Gap**: Knowledge to support remediation and clean up of PFAS-contaminated sites
- **Action**:
  - Characterize PFAS sources such as fire training/emergency response sites, manufacturing facilities, production facilities, disposal sites
  - Evaluate technologies for remediating PFAS-impacted soils, waters, and sediments
  - Generate performance and cost data with collaborators to develop models and provide tools to determine optimal treatment choices
- **Near Term Research Products:**
  - Groundwater remediation performance, cost models and data (2020 Q4)
  - PFAS fate from thermal treatment of contaminated soils (2021 Q1)
  - PFAS fate and transport from land application of PFAS-contaminated biosolids (2021 Q1)
- **Impact**: Responsible officials will have greater information to make decisions to reduce risk of PFAS exposure and effects at contaminated sites, and to repurpose sites for beneficial use

Research – PFAS Disposal

- **Data Gap**: Knowledge regarding end-of-life management and disposal of PFAS-containing materials
- **Action:**
  - Characterize end-of-life PFAS disposal streams (e.g. municipal, industrial, manufacturing, recycled waste streams)
  - Evaluate efficacy of disposal technologies (e.g. landfilling, incineration, composting, stabilization) to manage end-of-life disposal
  - Evaluate performance and cost data to manage these materials and avoid environmental PFAS re-releases following disposal
- **Near Term Research Products:**
  - PFAS presence in different types of landfills and leachates in FL (2020 Q1)
  - State-of-science on thermal treatment of PFAS (2020 Q1)
  - PFAS behavior in incineration environments (2021 Q2)
- **Impact**: Responsible officials will be able to manage effectively end-of-life disposal of PFAS-containing materials

Recent EPA Advances in PFAS Science

- Updated Methods 537.1 and 533 for 29 PFAS in Drinking Water
- Draft SW-846 Method 8327 for 24 PFAS in non potable water
- High Resolution Mass Spec methods to discover unknown PFAS
- Research analytical methods for PFAS in serum and estuarine waters
- PFAS library of 430 reference samples to enable consistent analysis
- HERO human toxicity literature database with citations for ~600 PFAS
- ECOTOX knowledgebase with data for 96 PFAS across 264 species
- Draft toxicity assessments for GenX, PFBS posted for public comment
- Drinking Water Treatability Database to include data on 22 PFAS
- Tested POE water filters for PFAS removal
- Technical Assistance analytical reports provided to multiple states

Collaboration

PFAS is a topic of interest to many different organizations, and EPA is committed to leveraging partnerships and collaborations to achieve results. Some examples:

- **National Toxicology Program** (NTP) - high throughput toxicology testing, **FDA** and **USDA** on analytical methods
- **DOD** - analytical method development, treatment/remediation approaches, and participation in the Strategic Environmental Research and Development Program (SERDP)
- **States and public utilities** - testing and applying PFAS sampling, measurement, and treatment methods
- **Academic community** - EPA's Science to Achieve Results (STAR) and National Priorities competitive grant programs

Extramural Funding

Water National Priorities program – Congressional mandate to fund ~4 million for water quality/availability research to not-for-profit organizations

- 2019: PFAS impacts on water quality and availability (2 awards)
- 2020: PFAS impacts on agriculture and rural communities (2-3 awards pending)

Science to Achieve Results (STAR) program - EPA's competitive extramural grant program

- 2019: PFAS waste management, including landfills and PFAS destruction technologies (8 awards)

Technical Assistance

- **Data Gap**: State, tribes and communities often lack some capabilities for managing PFAS risk
- **Action:**
  - Make EPA technical staff available to consult on PFAS issues
  - Utilize applied research while also providing technical support to site managers
  - Summarize and share lessons learned from technical support activities
- **Examples of Projects and Impacts:**
  - **NC** – Discovery, identification of novel PFAS in source and finished water
  - **NH, NJ** – Assisted State in identifying novel PFAS in air and water
  - **MI/MN** – Characterizing PFAS sources in a chrome plating facility
  - **AK** – Testing emissions from permitted soil thermal treatment operation
- **Impact**: Enable states, tribes and communities to 'take scientifically sound action on PFAS'

Crosswalk: ORD PFAS R&D Across the A&E National Research Program

- **Analytical Methods**
  - Sampling and analysis of PFAS stack emissions
  - Sampling and analysis of PFAS ambient concentrations and deposition (future)
- **Exposure**
  - Atmospheric fate, transport, and deposition of PFAS stack emissions

Crosswalk: ORD PFAS R&D Across the CSS National Research Program

- **Analytical Methods**
  - Development and application of non-targeted analysis methods
- **Data Curation**
  - Toxicological data curation via the Chemistry Dashboard
  - Ecotoxicological data curation via the ECOTOX knowledgebase
- **Human Health Toxicology**
  - High throughout toxicology and toxicokinetic testing of 150 PFAS
- **Exposure**
  - Simulation of chemical transformation under environmental conditions
- **Ecological Toxicity**
  - *In vitro* screening of thyroid based HT ecological assays
  - Critical review and synthesis of PFAS bioaccumulation
  - Elucidation of Adverse Outcome Pathways

Crosswalk: ORD PFAS R&D Across the HERA National Research Program

- **Human Health Toxicology**
  - Systematic review and evidence mapping
  - Toxicological assessment for PFBS
  - IRIS toxicological assessment for PFBA, PFHxS, PFHxA, PNFA, and PFDA

Crosswalk: ORD PFAS R&D Across the SHC National Research Program

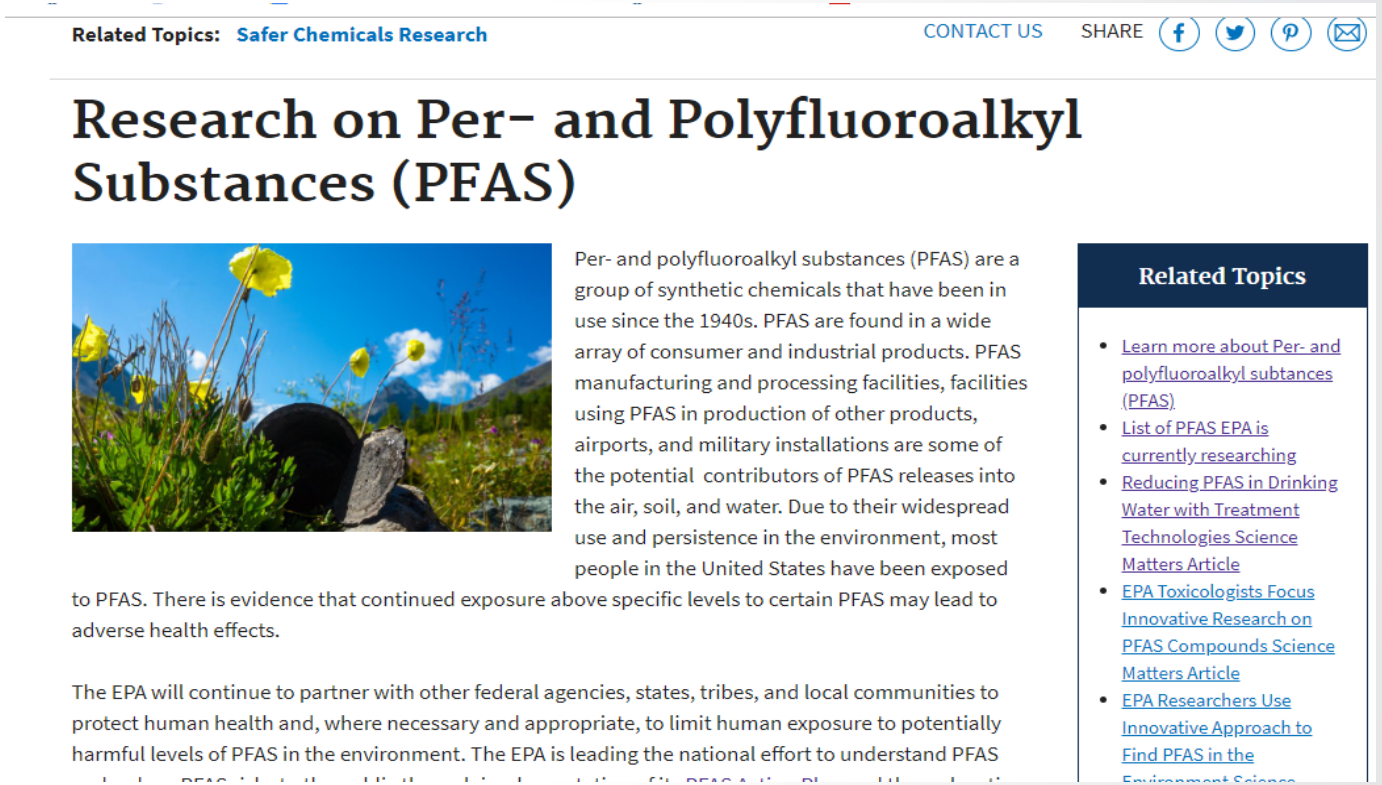
- **Exposure**
  - Development of PFAS exposure data sets suitable for modeling
  - Development of models to predict human exposures
  - Tools to support geospatial analysis of PFAS data
- **Remediation**
  - Tools to assist with contaminated site characterization
  - Implications of land application of contaminated biosolids
  - Tools to evaluate effectiveness and cost of contaminated site remediation
- **Disposal and Material Management**
  - Evaluation of landfills as sources of PFAS
  - Thermal treatment as a means of disposing of PFAS-contaminated materials
- **Extramural**: 2019 STAR Program/PFAS waste management (8 grants, SSWR and SHC funded)

Crosswalk: ORD PFAS R&D Across the SSWR National Research Program

- **Analytical Methods**
  - Validation of isotope dilution analytical method for non potable water, solids, and sediments
  - Development of Total Organic Fluorine (TOF) analytical method
- **Drinking Water Treatment**
  - Expanding the Drinking Water Treatability Database for PFAS
  - Tools to evaluate the effectives and cost of different drinking water treatment systems
- **PFAS Disposal**
  - Implications of regenerating or disposing spent GAC and IX
- **Extramural**: STAR and National Priority (NP) Grants
  - 2019 STAR Program/PFAS waste management (8 grants, SSWR and SHC funded)
  - 2019 NP PFAS Impacts on Water Quality and Water Availability (2 grants)
  - 2020 NP PFAS Impacts on Agriculture and Rural Communities (2-3 grants pending)

EPA PFAS Data and Tools

- Links to data and tools that include information related to PFAS and are available on EPA's website:



Related Topics: Safer Chemicals Research

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Research on Per- and Polyfluoroalkyl Substances (PFAS)

Per- and polyfluoroalkyl substances (PFAS) are a group of synthetic chemicals that have been in use since the 1940s. PFAS are found in a wide array of consumer and industrial products. PFAS manufacturing and processing facilities, facilities using PFAS in production of other products, airports, and military installations are some of the potential contributors of PFAS releases into the air, soil, and water. Due to their widespread use and persistence in the environment, most people in the United States have been exposed to PFAS. There is evidence that continued exposure above specific levels to certain PFAS may lead to adverse health effects.

The EPA will continue to partner with other federal agencies, states, tribes, and local communities to protect human health and, where necessary and appropriate, to limit human exposure to potentially harmful levels of PFAS in the environment. The EPA is leading the national effort to understand PFAS

Related Topics

- Learn more about Per- and polyfluoroalkyl subtances (PFAS)
- List of PFAS EPA is currently researching
- Reducing PFAS in Drinking Water with Treatment Technologies Science Matters Article
- EPA Toxicologists Focus Innovative Research on PFAS Compounds Science Matters Article
- EPA Researchers Use Innovative Approach to Find PFAS in the

https://www.epa.gov/pfas

https://www.epa.gov/chemical-research/research-and-polyfluoroalkyl-substances-pfas

https://www.epa.gov/pfas/pfas-action-plan-program-update-february-2020

For More Information

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