

Boston University Superfund Research Program*



Boston University
Superfund Research Program



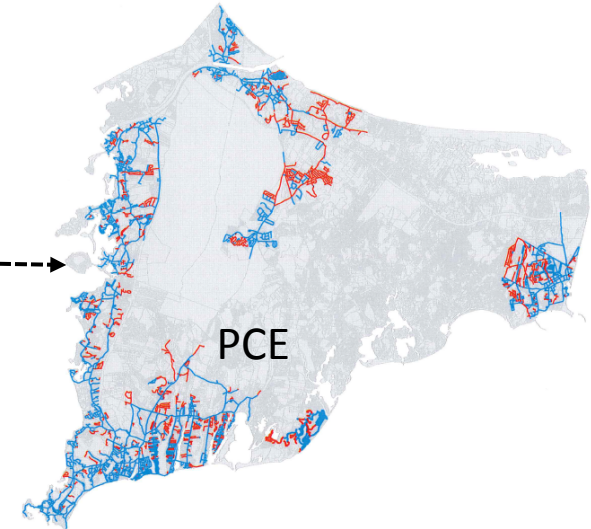
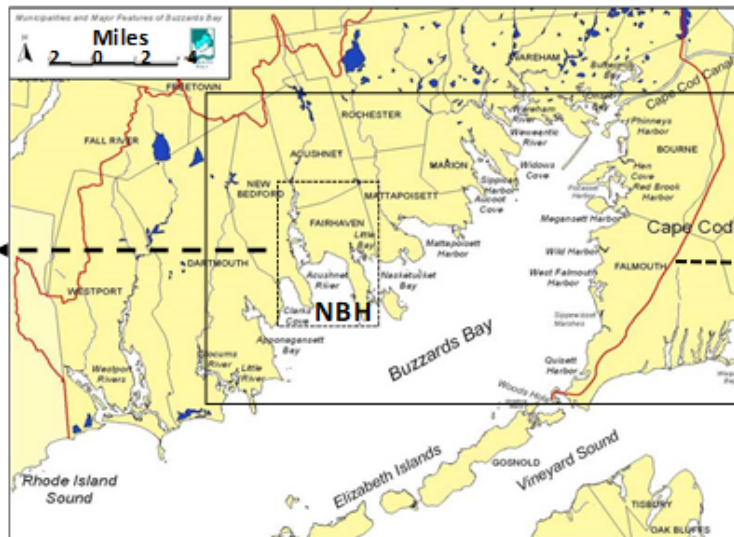
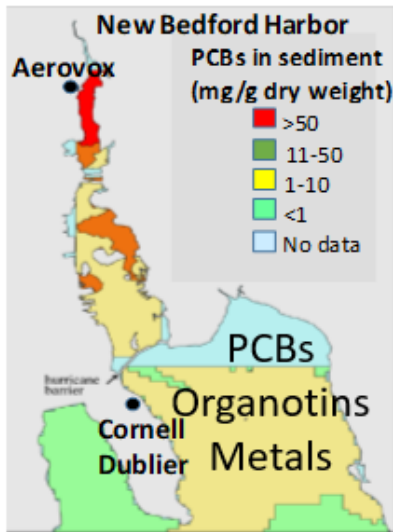
National Institute of
Environmental Health Sciences
Superfund Research Program



* Established 1995

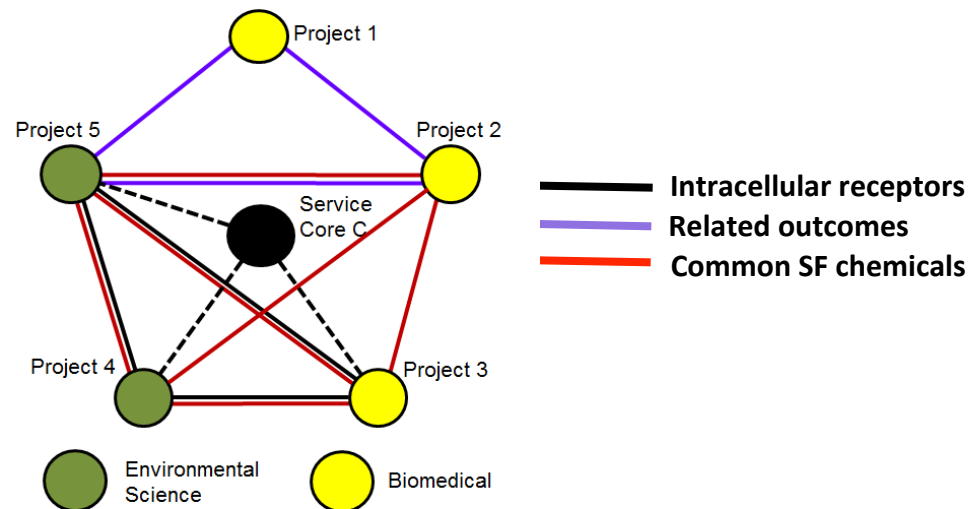
New Bedford Harbor/Cape Cod

Top ranked U.S. fishing port for the last 17 years



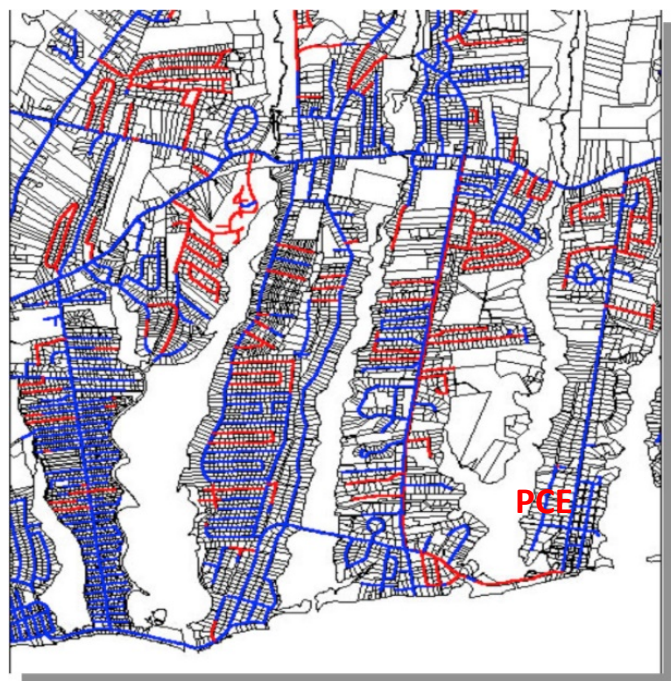
Common Themes Within The Interdisciplinary BU SRP Program

			Early Life Exposures	Later Life Outcomes	New Bedford Harbor	Uses the Bioinformatics, Molecular Modelling, and Statistics Core	Nuclear Receptors	Chlorinated Chemical Stressors	Social Stressors	Resilience Factors	Adaptation	Mixtures	Risky Behavior
Project 1	Aschengrau	Epidemiology	✓	✓	✓	✓		✓	✓	✓		✓	✓
Project 2	Levy/Korrick	Epidemiology	✓	✓	✓	✓		✓	✓	✓		✓	✓
Project 3	Schlezinger	Laboratory and Field	✓	✓	✓	✓	✓	✓				✓	
Project 4	Hahn	Laboratory and Field	✓	✓	✓	✓	✓	✓		✓	✓	✓	
Project 5	Stegeman/Goldstone	Laboratory and Field	✓	✓	✓	✓	✓	✓			✓		✓
RT, CEC, Training	Heiger-Bernays, Scammell, van Seventer/McClean	Everywhere	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

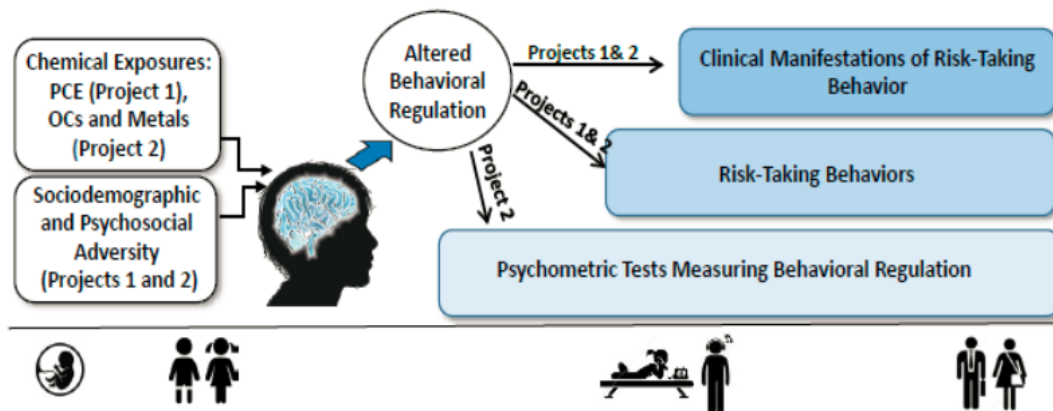


Project 1: Impact of Early Life Exposure to Environmental and Social Stressors on Substance Use

Ann Aschengrau
"Cape Crusader"



Vinyl-lined pipe —
Unlined pipe —



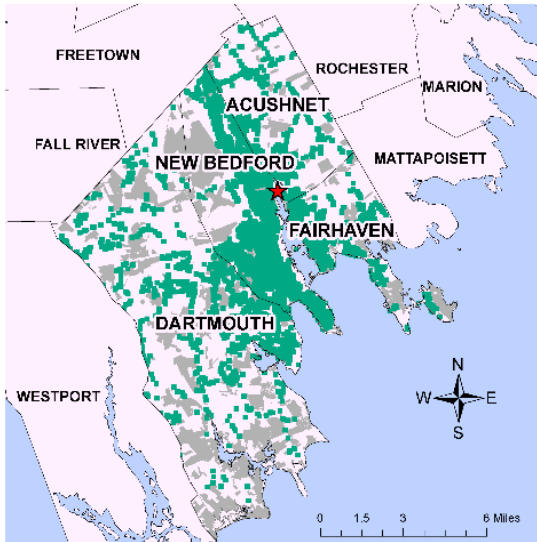
PCE Exposure + Social Stressors
 ↓ ↓ ↓ ↓ ↓
Illicit Drug Use & Unhealthy Alcohol Consumption



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Project 2: The Impact of Early Life Environmental Exposures on Risk-taking Behavior in Adolescence and Implications for Risk Assessment in Communities Near the New Bedford Harbor Superfund Site

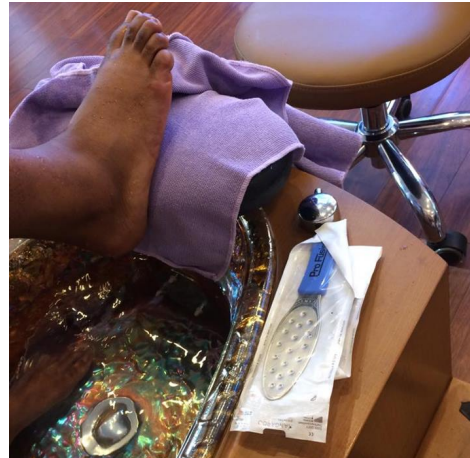
New Bedford Cohort



Legend

- ★ New Bedford Harbor Superfund Site
- New Bedford Cohort participants
- Non-residential space

Contemporary exposure characterization



Jon Levy



Susan Korrick



Future health risk modeling

- Exposure regression models to estimate exposures for recent births in PELL
- Application of epidemiological evidence

Pregnancy to Early Life Longitudinal Data System (PELL): A collaboration of DPH, Boston University School of Public Health, and the Centers for Disease Control and Prevention.



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Project 2 (Cont' d): Outcomes of Early Life Environmental Exposures in Communities Near the New Bedford Harbor

Outcomes for characterizing risk-taking behavior/related neurobehavior in adolescents from NBC and PELL

Outcomes Tested	Assessment (acronym)	Population
Continuous psychometric measures of neurobehavior		
Adverse behavior	Behavior Assessment System for Children, 2 nd ed. (BASC-2)	NBC (15 yrs)
Attention/impulse ctrl	Conners' Attention Deficit Scale (CADS)	NBC (15 yrs)
	Integrated Visual & Auditory Continuous Performance Test (IVA-CPT)	NBC (15 yrs)
Executive function	Delis-Kaplan Executive Function System (D-KEFS)	NBC (15 yrs)
Substance use Violence/safety Sexual activity		
	Dichotomous self-reported risk taking behaviors CDC Youth Risk Behavior Questionnaire	NBC (15 yrs)
Clinical manifestations of risk taking behaviors		
Substance abuse tx Assault/injuries Teen pregnancy/birth	Hospital discharge records (HD), observational stay records (OS), emergency dept visits (ED), Substance abuse treatment services	PELL (up to 19 yrs)

Research Translation

Brown Bag Lunch Series – Sharing Science

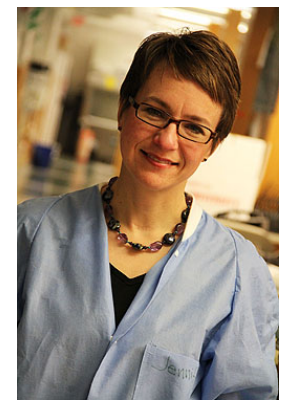


- **Objective:** Bidirectional sharing of science and information
- **Attendees:** Scientists from the MassDEP/Office of Research and Standards and trainees from the BU SRP
- **Long-Term Neurotoxic Effects of Early Life Exposure to Tetrachloroethylene (PCE)-Contaminated Drinking Water**
- Featured Speaker: Dr. Ann Aschengrau, PI Project 1
- **The impact of early life environmental exposures on risk-taking behavior in adolescence and implications for risk assessment in communities near the New Bedford Harbor Superfund site.**
- Featured Speakers: Drs. Jonathan Levy and Susan Korrick, Co-PIs Project 2
- **Adverse effects of environmental contaminants on metabolic health: What may emerging flame retardants and PFAS have in common?**
- Featured Speaker: Dr. Jennifer Schlezinger, Head-PI Project 3



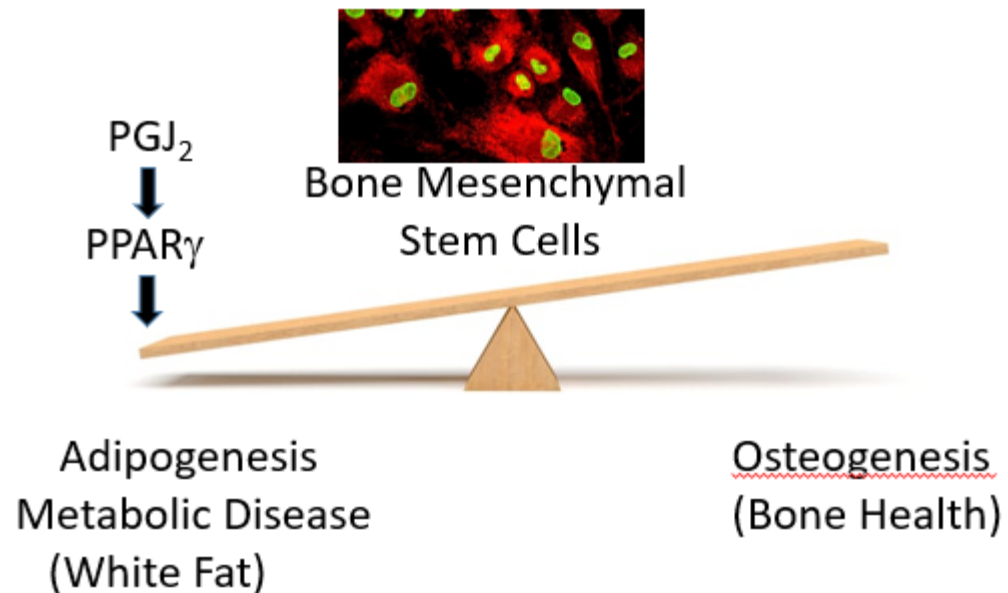
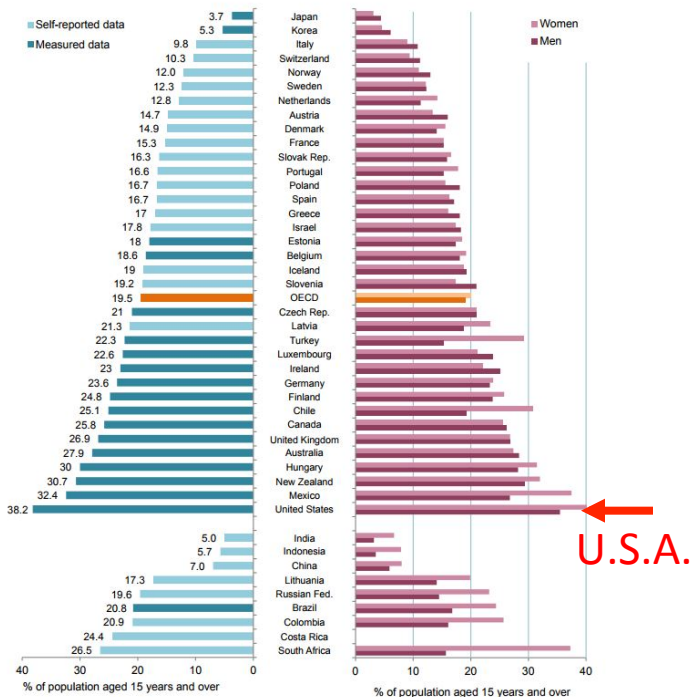
Project 3: Environmental PPAR γ Pathway Activators: Multifaceted Metabolic Disruptors Impacting Adipose and Bone Homeostasis

Or
Do these Chemicals Make Me Look Fat?



Jennifer Schlezinger

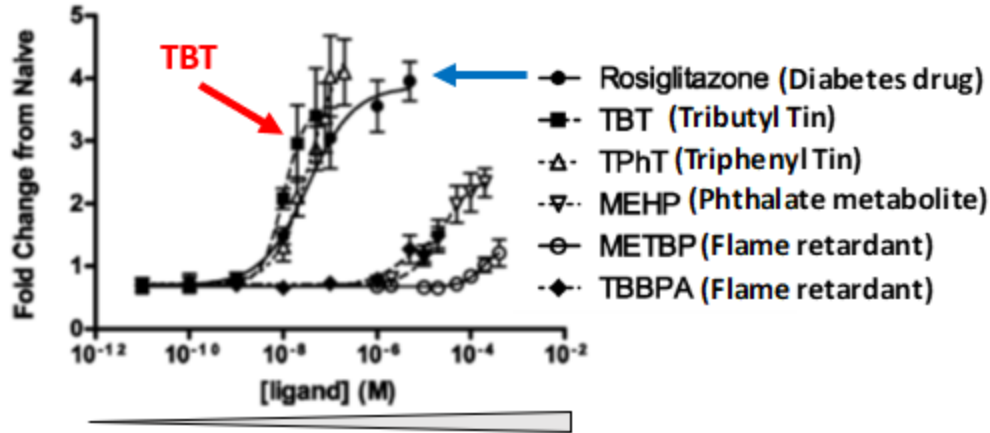
Figure 1: Obesity among adults, 2015 or nearest year



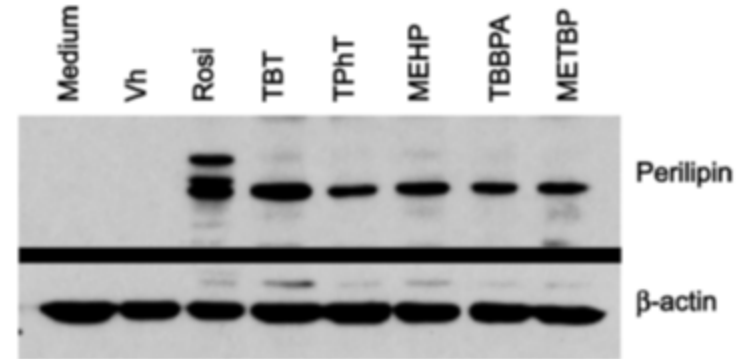
The central hypothesis is that environmental ligands selectively modulate PPAR γ 's activation and function to compromise adipose and bone homeostasis.

Project 3 (Cont' d): Environmental Chemicals Induce Adipogenesis Through PPAR γ

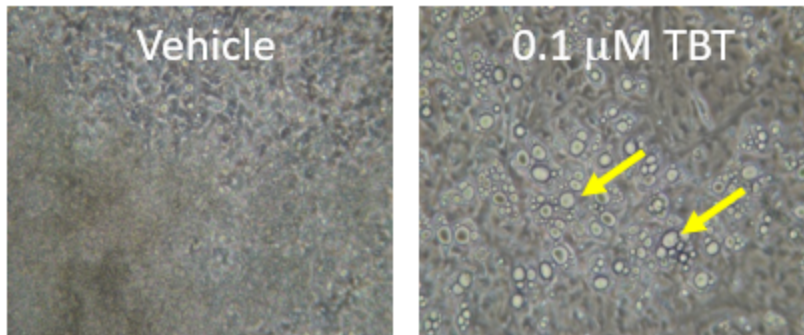
A. Activation of PPAR γ



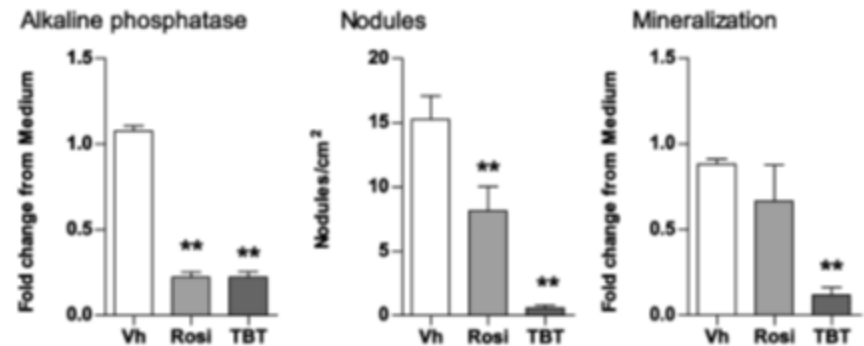
B. Induction of an Adipogenesis Marker



C. Induction of Fat Formation



D. Inhibition of Bone Formation



Project 4: Mechanisms and Impacts of Non-ortho (Dioxin-like) PCB Resistance in Fish



Diane Nacci
(EPA ORD)

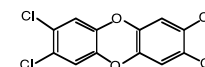
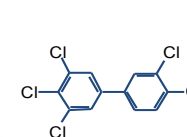


Atlantic Killifish

Mark Hahn, Neel Aluru,
Sibel Karchner



- New Bedford Harbor, MA DL-PCBs
- Bridgeport, CT DL-PCBs, PAHs
- Newark, NJ Chlorinated dioxins
- Elizabeth River, VA PAHs

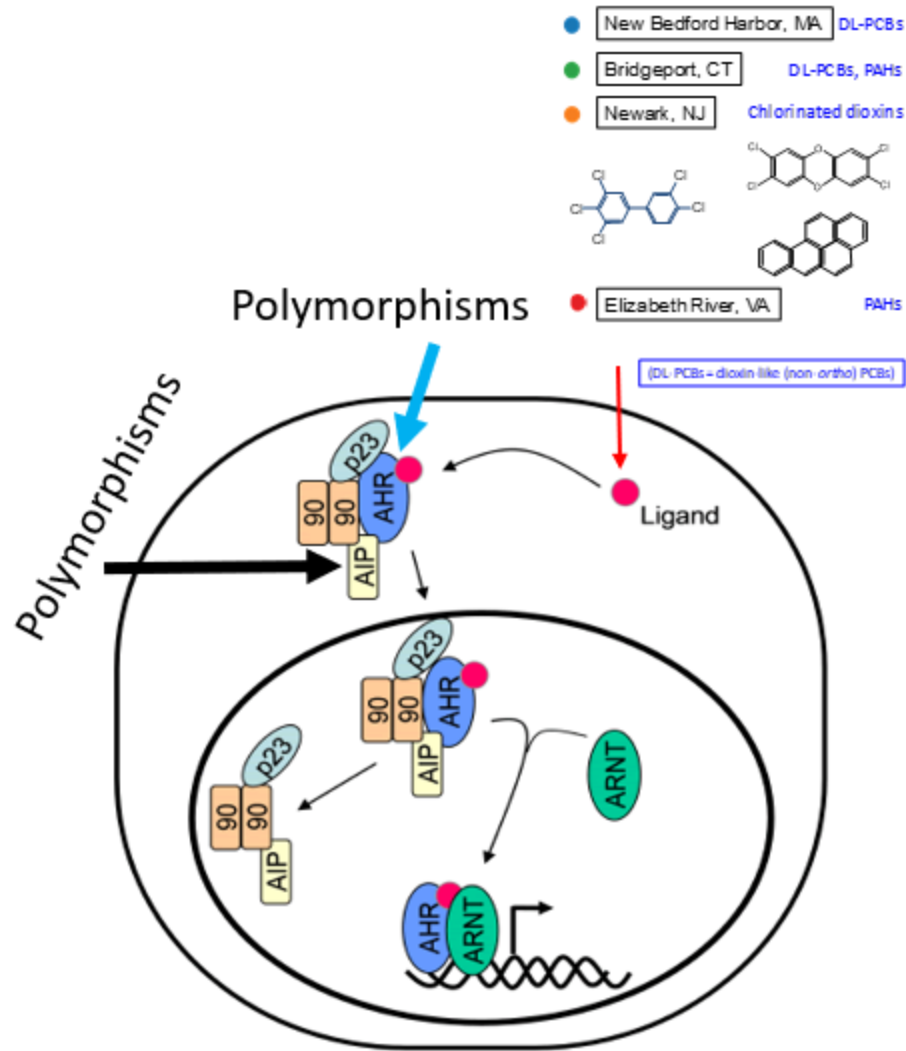


(DL-PCBs = dioxin-like (non-ortho) PCBs)

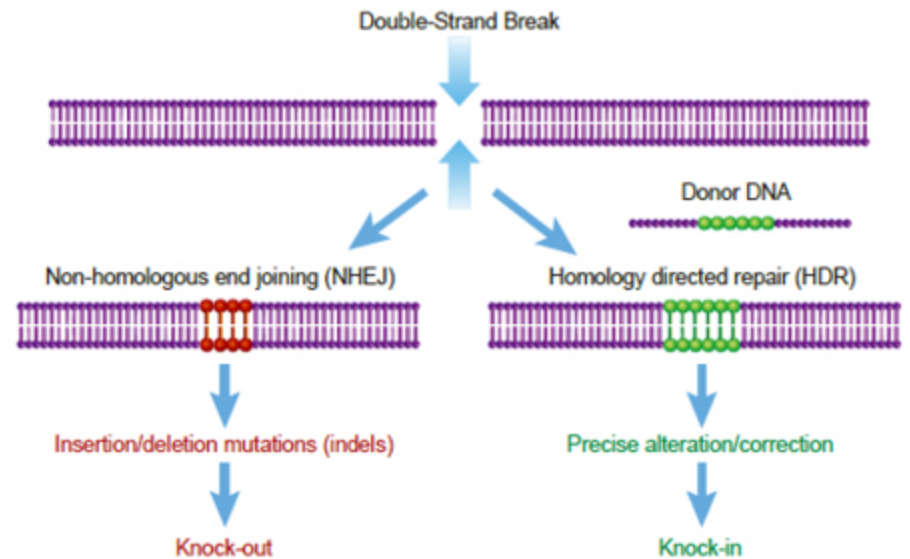
The central hypothesis is that the mechanism of evolved resistance to dioxin/planar PCBs in populations of killifish involves altered interactions between AHR-interacting protein (AIP) and one or more of the four killifish AHRs.

Project 4 (Cont' d): Environmental Chemicals Drive Evolution

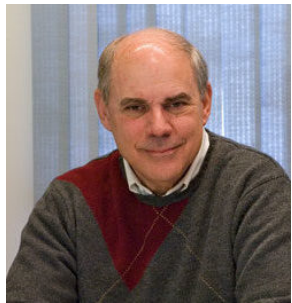
A. The AHR complex



B. Gene editing to recapitulate polymorphism



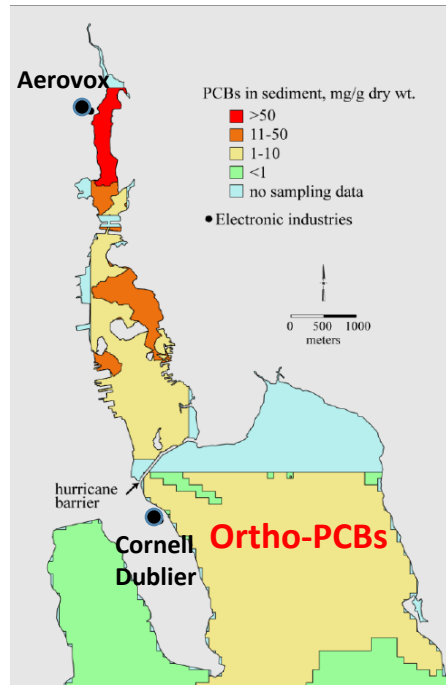
Project 5: A Novel Mechanisms of Ortho-PCB-induced Toxicity: Targeting Nuclear Receptors in Fish Brains



John Stegeman



Jared Goldstone

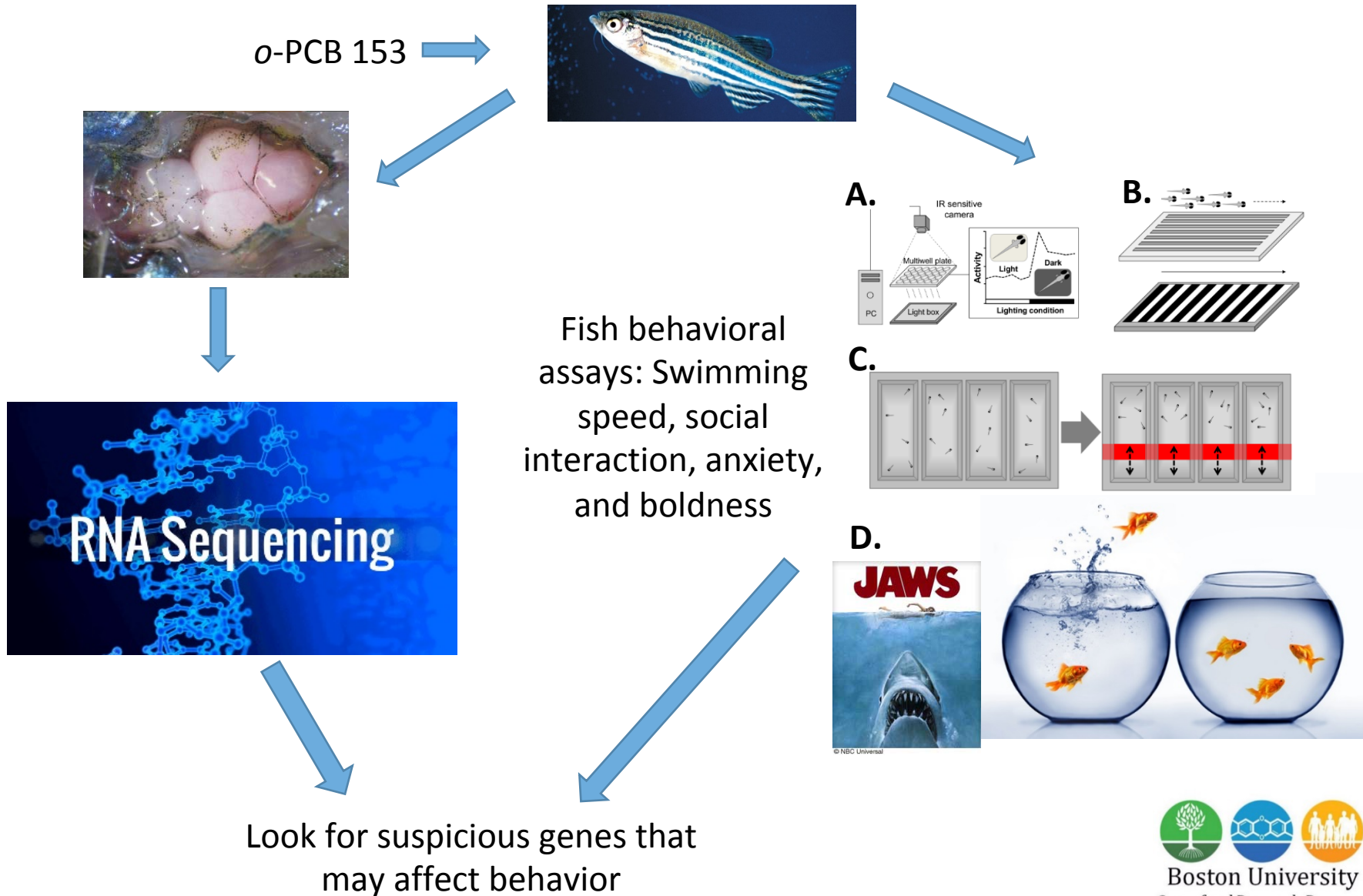


- *o*-PCBs linked to neuro behavioral changes in mice and rats.
- Rats fed *o*-PCBs at puberty exhibit hyperactivity that correlates with changes in genes involved in signal transduction and neuronal growth.
- neurodevelopmental disabilities, including attention deficit hyperactivity disorder and cognitive impairments in humans, may be linked to chemical exposures.
- *o*-PCBs have been implicated in behavioral health effects.

Central Hypothesis: Ortho-PCB-mediated transcriptional and proteomic changes in fish brains affects neurodevelopment and behavior

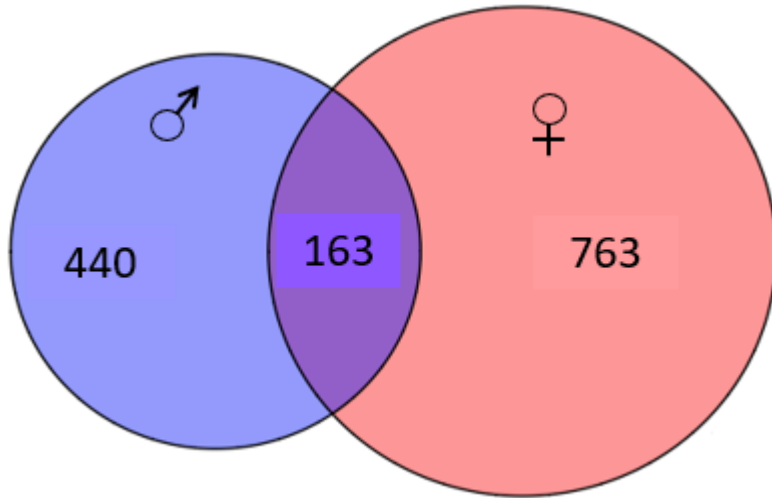


Project 5 (Cont' d): Experimental Design

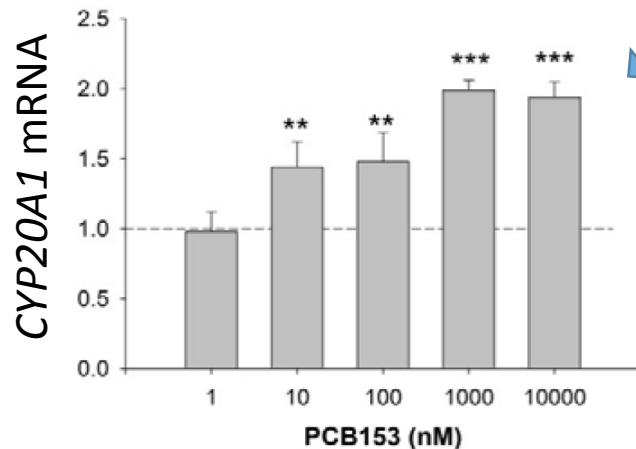
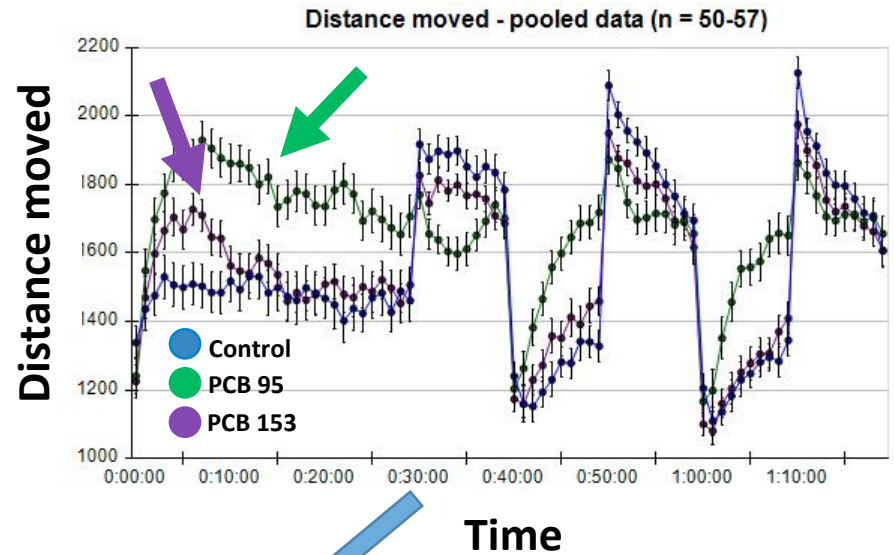


Project 5 (Cont' d): o-PCBs induce *CYP20A1*, an ADHD-associated Gene

Killifish brain transcriptomics



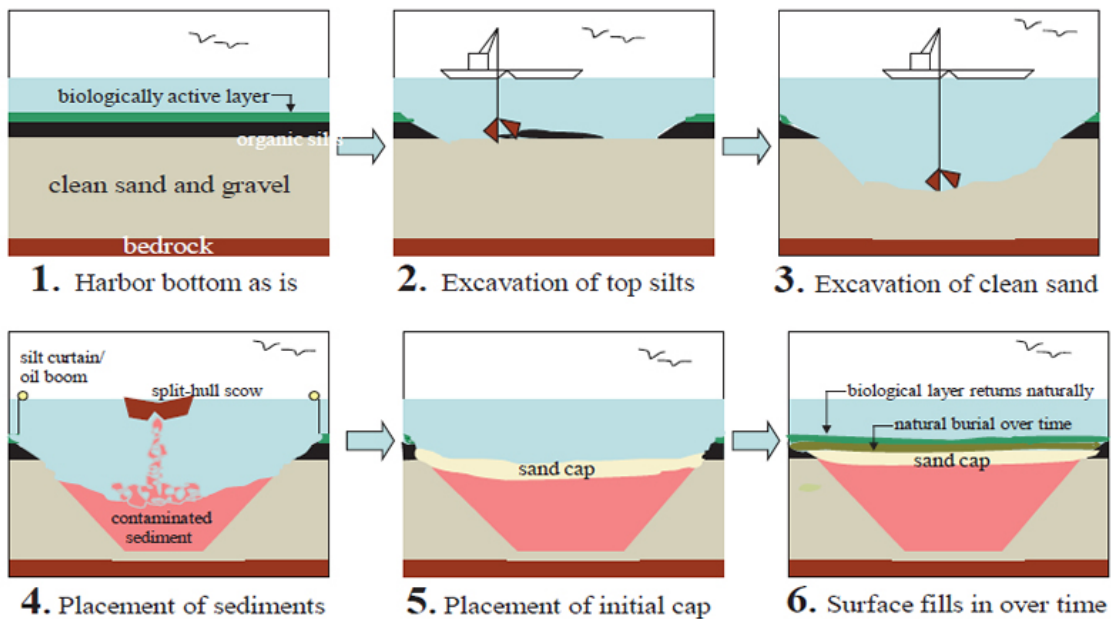
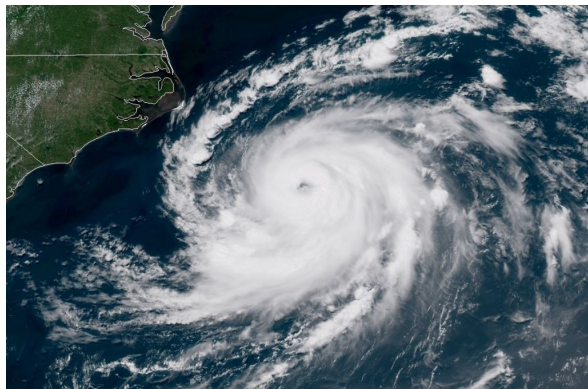
Zebrafish behavior



CYP20A1 Polymorphisms are associated with human ADHD

A Future Direction

Confined Aquatic Disposal (CAD Cell): A Reliable Remediation?



For illustrative purposes only – NOT TO SCALE

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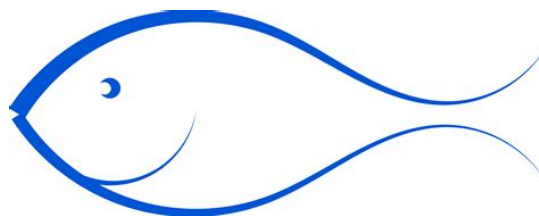
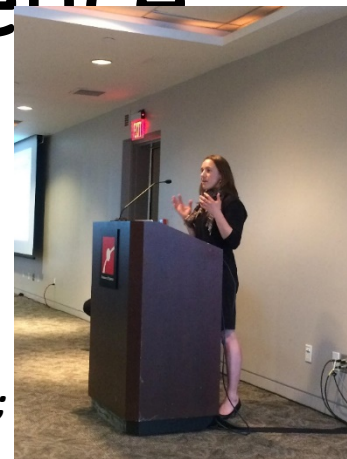
What's in Your Fish? Forum 2.0 at the Boston Museum of Science



- **Objective:** engage communities in the science and education of eating fish caught in contaminated waters; engage decision makers in the creation and development of appropriate fish consumption advisories
- **Attendees:** community members, SRPs, researchers, agency representatives, and NGO representatives

Discussion and documentation of issues regarding fish consumption; policy decision trade-offs; risks and benefits of the consumption of seafood; developing effective, culturally-relevant fish advisories

- Featured Participants: SRPs (BU, Brown, Dartmouth, MIT, Michigan State, Duke) UNC, Cambridge Health Department, MassDEP, EPA Region 1, Mystic River Watershed Association, Charles River Watershed Association



Moving the Science of SRP to Broad Audiences - CHE Calls

- **Objective:** bring BU' s research on environmental exposures and disease endpoints into the public spotlight –Collaborative on Health and the Environment, on BU/CHE partnership
- **December 4, 2017:** [Toxic Threats to Children and Teens: Preconception and Prenatal](#)
 - Featured Speakers: Mark Miller, MD, MPH; Ann Aschengrau, ScD
 - 105 registrants, 56 participants, 54 recording downloads
- **March 13, 2018:** [Superstorms and Superfund Sites: Preventing Toxic Exposures from Climate Change Disasters](#)
 - Featured Speakers: Anna Goodman Hoover, PhD, MA; Tiffany Skogstrom, MPH
 - 181 registrants, 114 participants, 82 recording downloads
- **May 1, 2018:** [Down the Drain with PFAS: The Latest on Testing, Measuring, and Mitigating Community W: Contamination](#)
 - Featured Speakers: Tom Webster, DSc; Nancy Rothman, PhD; Richard Spiese
 - 274 registrants, 170 participants, 57 recording downloads



**Collaborative on
Health and the
Environment**



Boston University
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CEC Activities: *bidirectional communication*

- www.Hear-db.org

This year 27 experts volunteered in response to Toxics Action Center queries, assisting 14 New England Communities.



- www.PFAShealth.info

Linked to via our website and National PFAS Contamination Coalition <https://pfasproject.net/>
32 new HEAR-db volunteers with PFAS expertise who have assisted the Coalition

Coming soon!

- New Bedford Harbor area virtual tour

PFAS chemicals and community health: An introduction

Home Q&A for Communities More PFAS Resources Health Studies

PFAS, or polyfluoroalkyl substances, are a large group of man-made toxic chemicals. (PFAS are sometimes also called PFCs, or perfluorinated compounds.)

In recent years, some PFAS chemicals have been found at high levels in drinking water systems around the world.

This page provides for communities concerned about PFAS contamination and their drinking water. This work is a collaboration of the [Boston University Superfund Research Program](#) and [Toxics Action Center](#), and is supported by independent funding from an anonymous donor.

PFAS and their health effects

- [What are PFAS?](#)
- [How are/were you exposed to PFAS?](#)
- [How do PFAS travel through the environment?](#)
- [What do we know about the health effects of PFAS exposure?](#)
- [What is still unknown about the risks of PFAS?](#)

Contamination, testing, and reducing risks

- [Is there a test for PFAS contamination in my water?](#)
- [Can I have my blood tested for PFAS? Should I have been tested?](#)
- [My test showed that I have PFAS in my blood. How should I interpret this result?](#)

Polyfluoroalkyl substances (PFAS)
A fact sheet for communities affected by PFAS-contaminated water

What are PFAS?
Polyfluoroalkyl substances (PFAS) are a large group of man-made toxic chemicals. PFAS are used to make consumer products resistant to water, grease or stains, including Gore-Tex rain gear, Teflon non-stick cookware and Scotchguard stain-repellent for carpets or furniture fabric. PFAS have also been used in firefighting foams. Two of the chemicals in the PFAS family that were the most commonly used and produced are perfluorooctanoic acid (PFOA, also referred to as C8) and perfluorooctane sulfonic acid (PFOS).

Fast Facts
PFAS are found in public drinking water supplies serving 6 million U.S. residents in excess of federally recommended safety levels. PFAS were detectable in water systems in 23 states at the minimum reporting levels required by the EPA. In Bennington, VT, blood sampling has shown average PFOA levels nearly five times the national average – with some residents showing levels more than 100 times higher – far in excess of what the EPA considers safe. PFAS have been found in drinking water in all 16 New England states.

How are we exposed to PFAS?
The biggest threat of exposure to PFAS is through drinking water. While exposure is possible from consumer products – and in fact, nearly everyone tested has shown low levels of PFAS in their blood – contaminated drinking water is the most serious PFAS-related concern. PFAS are extremely persistent in the environment, which means they last a long time and harmful exposure is possible even after the active contamination has stopped. Contaminated water is most likely to be found near manufacturing facilities that have used PFAS or areas where the chemicals were used in firefighting foams, especially military bases. However, because of their persistence in the environment, PFAS are capable of traveling long distances and may be found far from the locations where they were initially released into the environment. Exposure may also occur by eating fish caught in contaminated water and may have seriously affected workers in facilities using PFOA and PFOS.

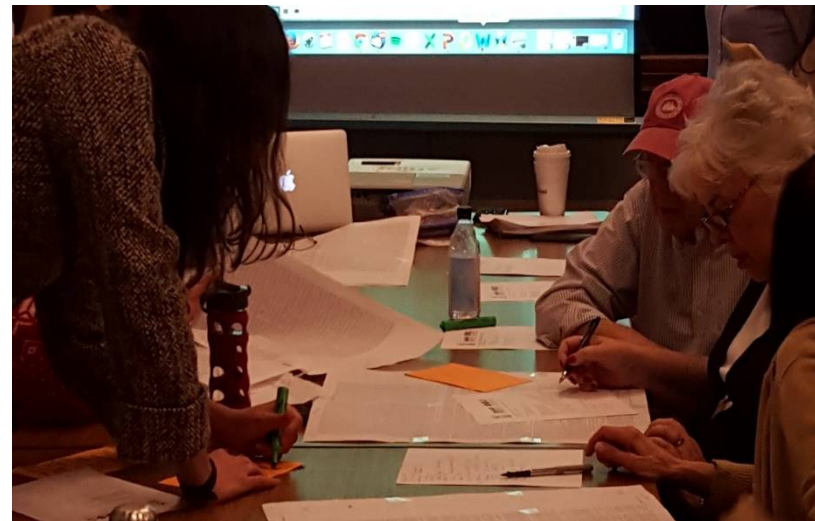
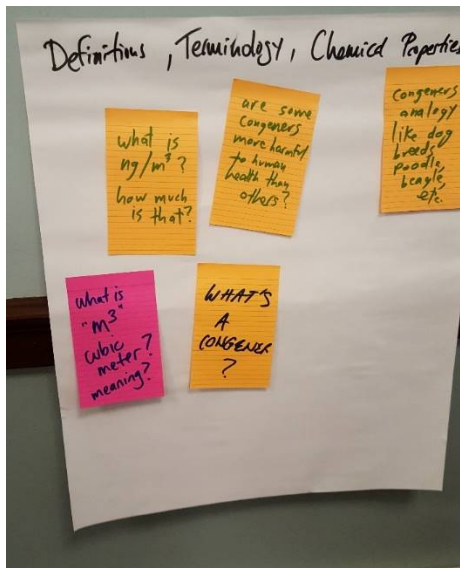
Is it regulated?
No. In 2016, EPA issued health advisories for PFOA and PFOS that suggest that any combined exposure over 70 parts per trillion (ppt) over the course of a lifetime is unsafe. However, health advisories are non-enforceable and there are no national regulations for PFOA or PFOS in drinking water.

If there are no regulations for it, does that mean it's not dangerous?
No. The Safe Drinking Water Act says that a nation-wide standard cannot be established until the following three conditions are met: the EPA must find that a chemical has adverse health effects, that it occurs frequently at levels of public concern, and that there is a meaningful opportunity for health risk reduction for people served by public water systems. This means that a chemical could be suspected – or even proven – to have adverse health effects, but if public water systems across the country lack the capacity to remedy the threat, a national standard cannot be established. However, many states have primary over the EPA, meaning that they can set more protective standards if they have the ability to measure and treat the contaminant. For example, Vermont's PFOA standard is 20 ppt, which is much stronger than EPA's standard. Massachusetts, on the other hand, has not set its own standard.



CEC and RTC

Volatile PCB Health Risk: Living Next to the Largest Marine Superfund Site in the USA



[Environmental Science and Pollution Research](#)

pp 1-12 | [Cite as](#)

Community reporting of ambient air polychlorinated biphenyl concentrations near a Superfund site

Authors [Authors and affiliations](#)

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[Open Access](#) | PCBs Risk Evaluation and Environmental Protection

First Online: 27 October 2017

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iowa superfund research program
semi-volatile PCBs: sources, exposures, toxicities

RTC Collaborators:

National, regional and local organizations:

- **Collaborative for Health & Environment (CHE)**
- **Museum of Science Boston (MOS)**
- ***Zephyr Educational Foundation***
- Mystic River Watershed Association
- Hands Across the River Coalition

Others:

- Mass. Dep. Env. Protection Agency, ORS
- Mass DEP, Bureau of Waste Site Clean-up
- MUS EPA Region 1
- Massachusetts Association of Health Boards
- Society for Risk Analysis New England (SRA-NE)
- *Ms. Tiffany Skogstrom, Disaster Resilience and Response, Toxics U: Reduction Institute, MA*



**Collaborative on
Health and the
Environment**



Museum of Science.



CEC Collaborators:

National, regional and local organizations:

- **Science & Environmental Health Network (SEHN)**
- **Toxics Action Center (TAC)**
- **Alternatives for Community & Environment (ACE)**
- NorthStar Learning Centers
- Hands Across the River Coalition (HARC)

Others:

- Dr. Robin Whyatt & Dr. Bruce Lanphear, International Society for Children's Health and the Environment
- Dr. Jennifer Sass, Natural Resources Defense Council
- Dr. Tracy Battaglia, BU Clinical & Translational Science Institute



*Established 1995

