

# Chemicals in Consumer Products: Exposure Science at the Forefront of Regulation



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**CIRCLE**

**The Center for Integrative Research on  
Childhood Leukemia and the Environment**



National Institute of Environmental Health Sciences  
*Your Environment. Your Health.*



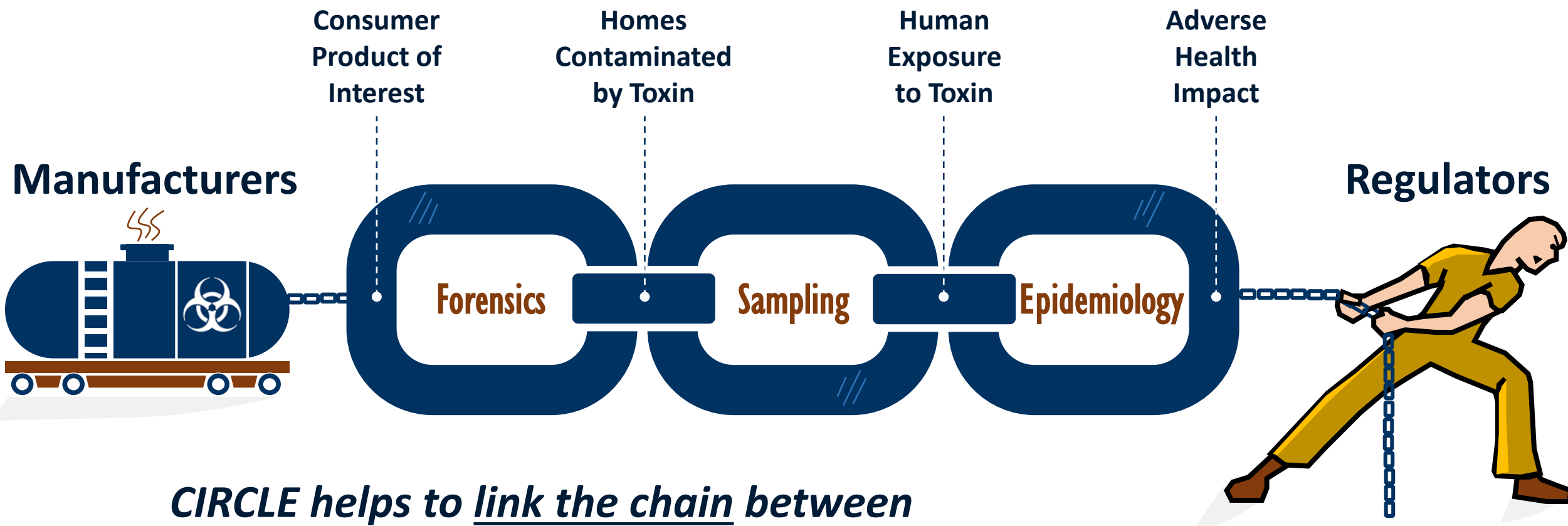
United States  
Environmental Protection  
Agency

# Center Overview

- **Research objective:** Discover the environmental risk factors for childhood leukemia.
- **Approach:** Innovative exposome research, studying mechanisms of immune development, epigenetics.
- **Center mission:** Intervene to prevent future cases of childhood leukemia.



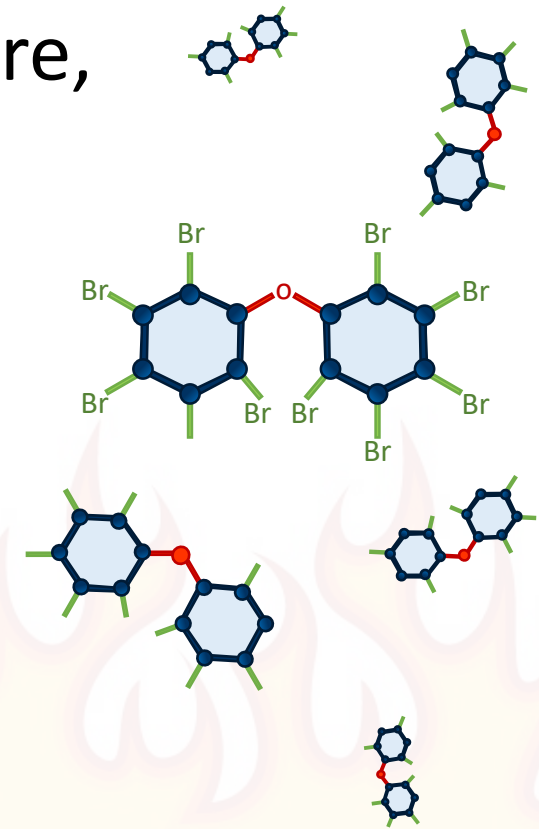
# Theme: "Links in a Chain"



*CIRCLE helps to link the chain between consumer products and health impacts.*

# Case Study: PBDEs in Furniture

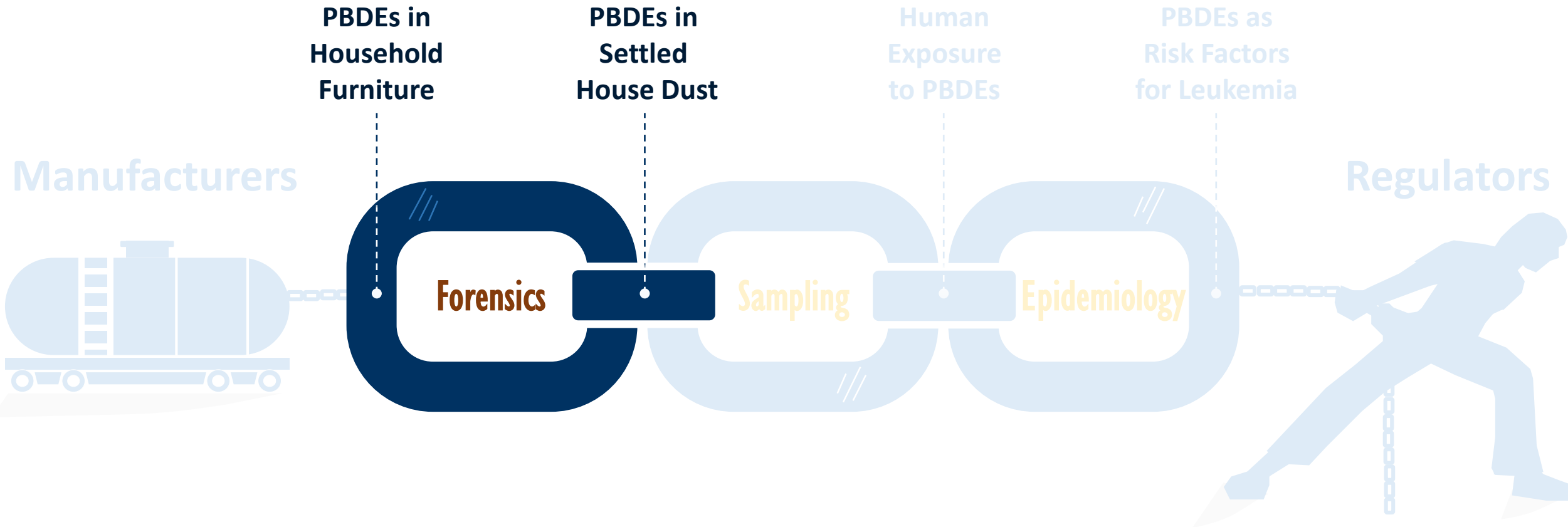
- **Source:** Polyurethane foam in upholstered furniture, electronic housings of TVs and computers.
- **Purpose:** Ostensibly to slow the spread of fires.
- **Concern:** Structurally similar to PCBs, persistent, bioaccumulative, potential for mobilization.



**FORENSICS**



# Link #1: Product-to-home



Overview

**Forensics**

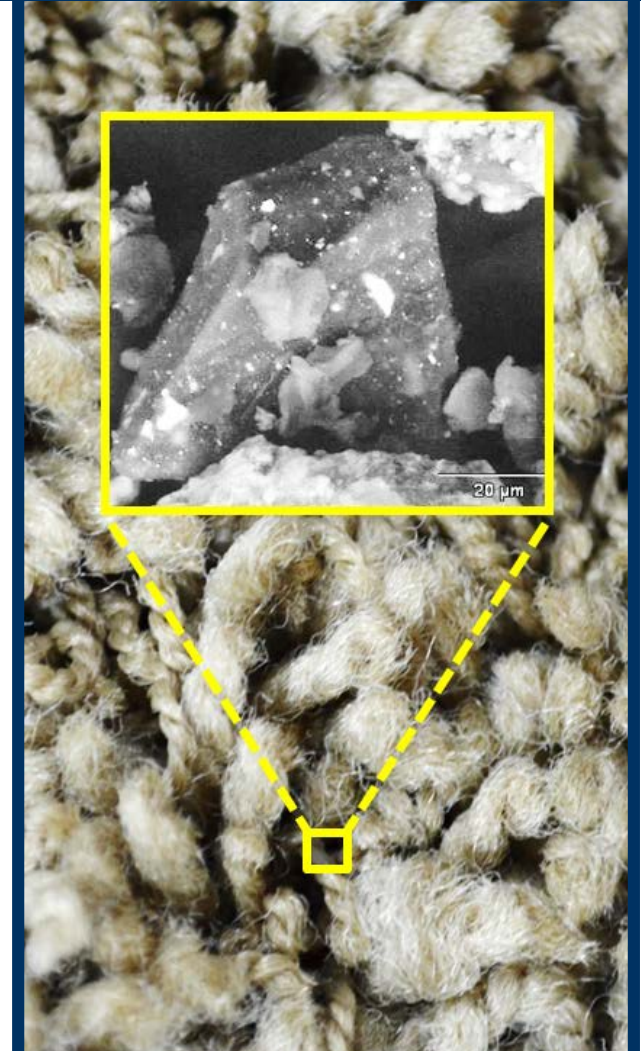
Sampling

Epi

Future

# PBDEs in Settled Dust

- **Rationale:** Dust is a reservoir for persistent chemicals in the home.
- **Sampling:** Settled dust collected via routine vacuum cleaning in 500+ homes.
- **Analysis:** Identify contamination sources via forensic microscopy, participant interviews.

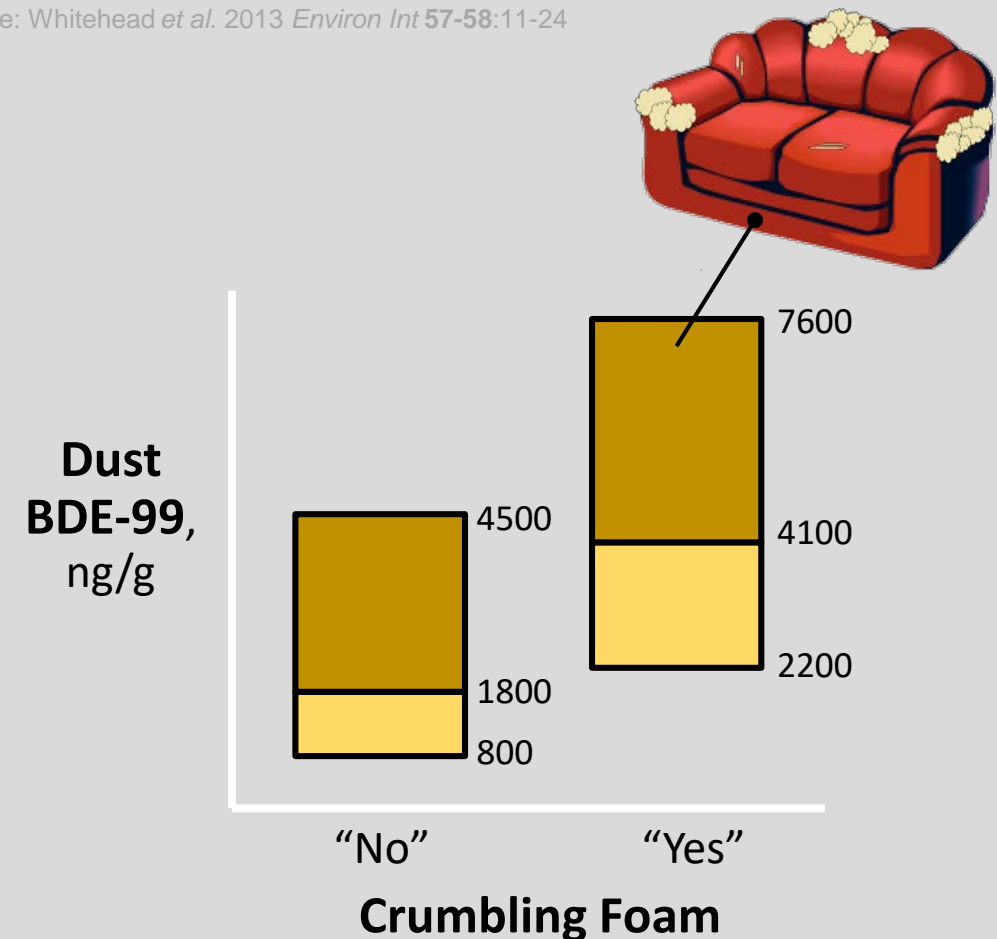


Source: Wagner et al. 2013 Environ Int 59:16-26

# Crumbling or Exposed Foam

- **Consumer product:** Participants asked about furniture condition.
- **Home environment:** Settled dust collected with vacuum cleaners, analyzed for PBDEs.
- **Link:** Upholstered furniture with crumbling or exposed foam resulted in higher levels of PBDEs 28, 47, 99, 153 in settled dust.

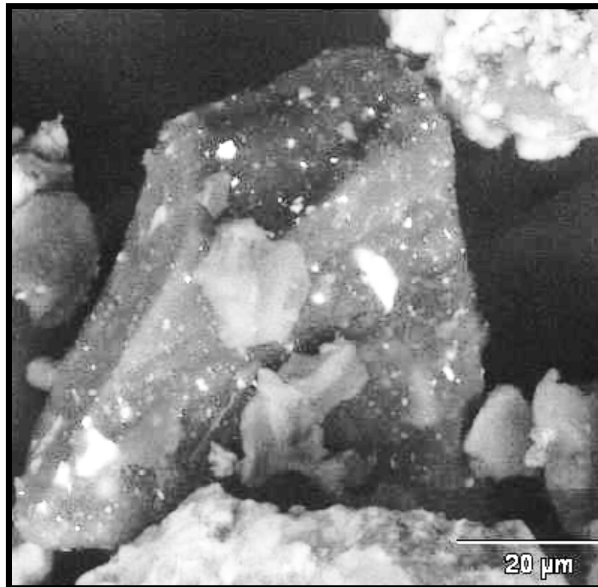
Source: Whitehead et al. 2013 *Environ Int* 57-58:11-24



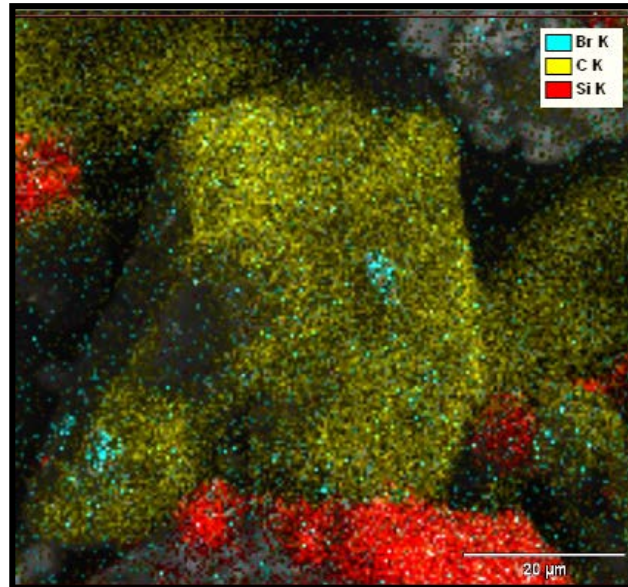


# Forensic Microscopy

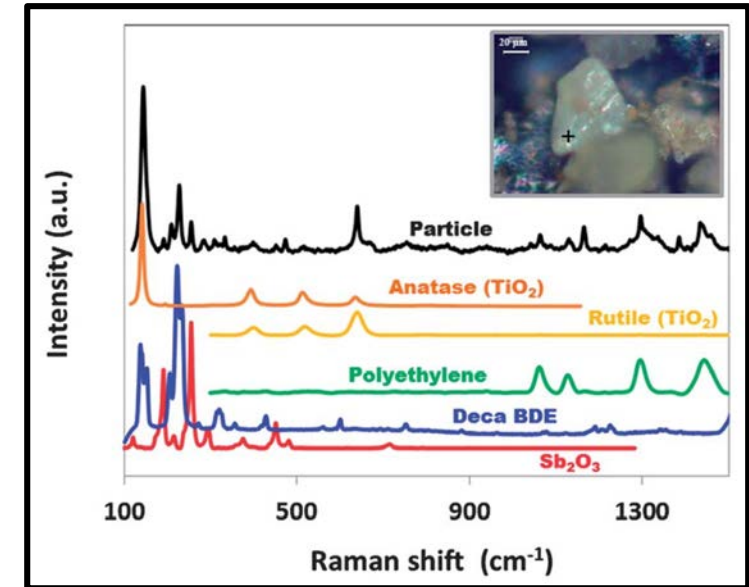
Sources: Wagner et al. 2013 *Environ Int* 59:16-26 || Ghosal et al. 2013 *Analyst* 138: 3836-3844



- **Morphology:**  
Angular, suggests abrasion or weathering.



- **Elemental composition:**  
Contains bromine, suggests presence of flame retardant.

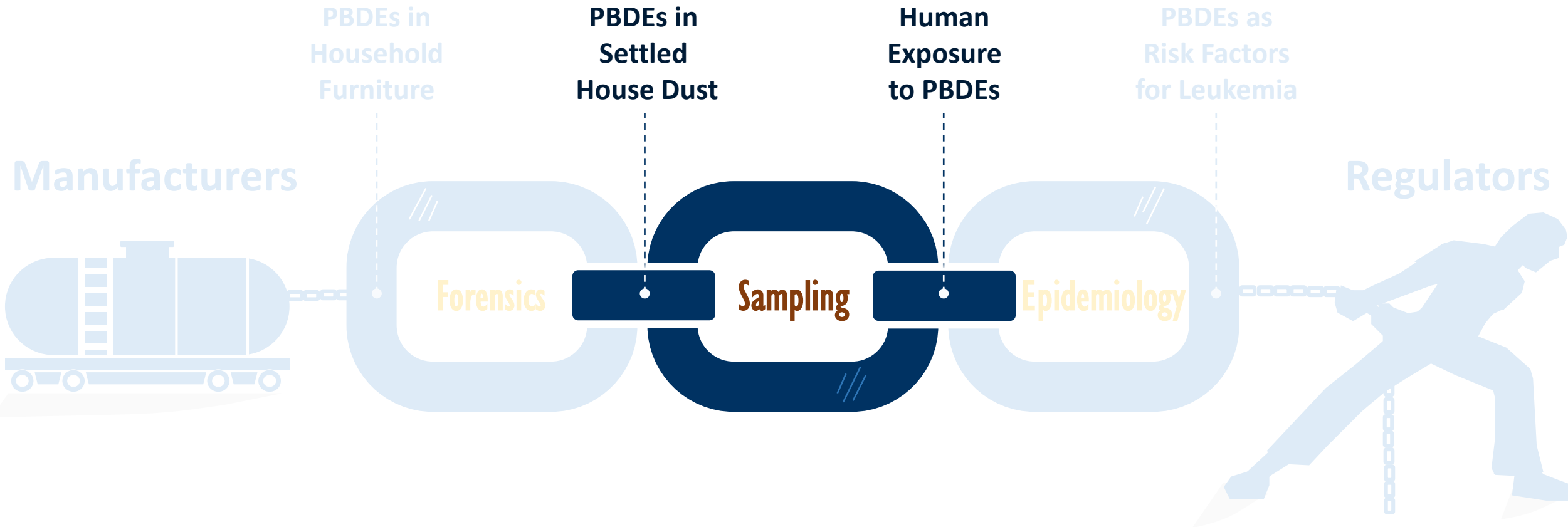


- **Chemical composition:**  
Contains polyethylene and BDE-209, suggests treated consumer product.

The image features a dark blue background with several thick, parallel yellow diagonal lines. The word "SAMPLING" is written in a bold, yellow, sans-serif font, slanted to follow the direction of the lines. The overall style is graphic and modern.

# SAMPLING

# Link #2: Home-to-human



Overview

Forensics

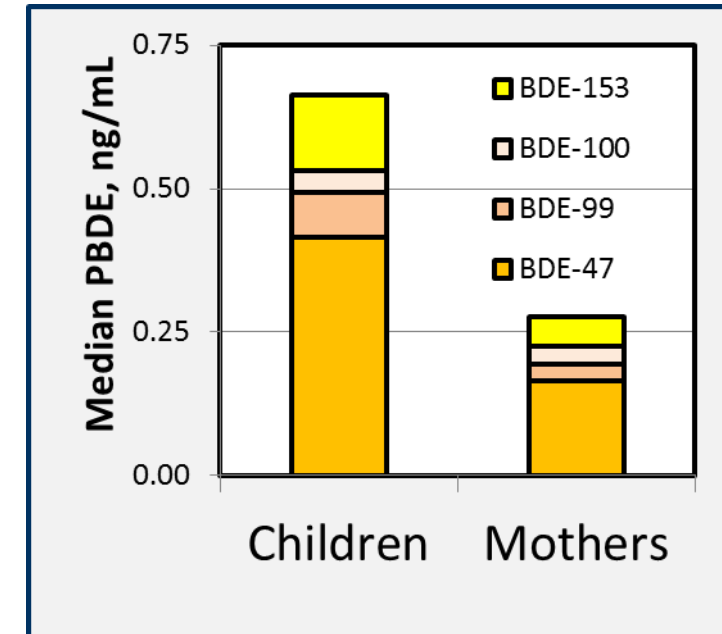
Sampling

Epi

Future

# PBDE Biomonitoring

- **Home environment:** PBDEs are present at high concentrations in dust from CA homes.
- **Human exposure:** Young children move near the floor and put their hands in their mouths.
- **Link:** Children have higher body burdens of PBDEs than mothers due to accidental dust ingestion.



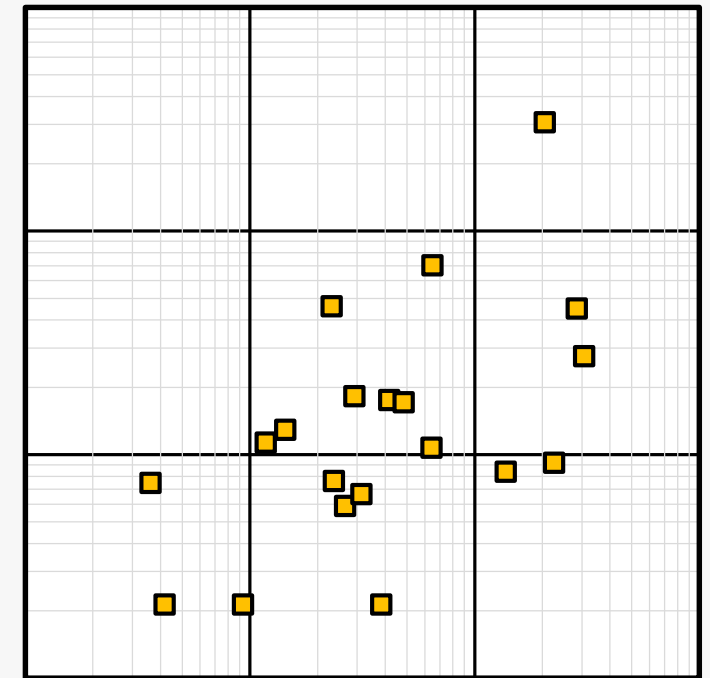
Sources: Whitehead et al. (2015) *Environ Res.* 136: 57-66.  
Whitehead et al. (2015) *ES&T.* 49(15): 9331-40.

# PBDE Biomonitoring – Patients

- **Human exposure:** PBDEs in a small volume of diagnostic blood, 100  $\mu$ L.
- **Home environment:** Settled dust analyzed for PBDEs, collected separately from blood.
- **Link:** Dust and blood levels of BDE-153 were correlated.

$$r_s = 0.52$$
$$p = 0.02$$
$$N = 20$$

**Blood**  
BDE-153



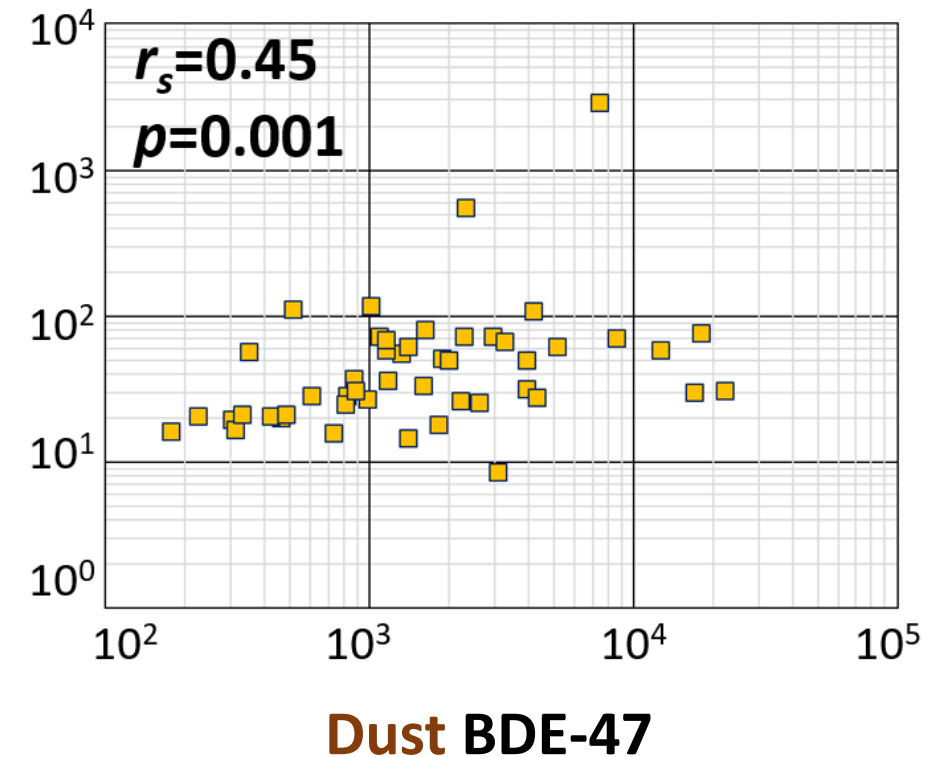
**Dust BDE-153**

Source: Whitehead *et al.* (2015) *ES&T*. 49(15): 9331–40.

# PBDE Biomonitoring – Mothers

- **Human exposure:** PBDEs in 1mL of serum from mother.
- **Home environment:** Settled dust analyzed for PBDEs, collected separately from blood.
- **Link:** Dust and blood levels of BDE-47 were correlated.

**Blood**  
**BDE-47**

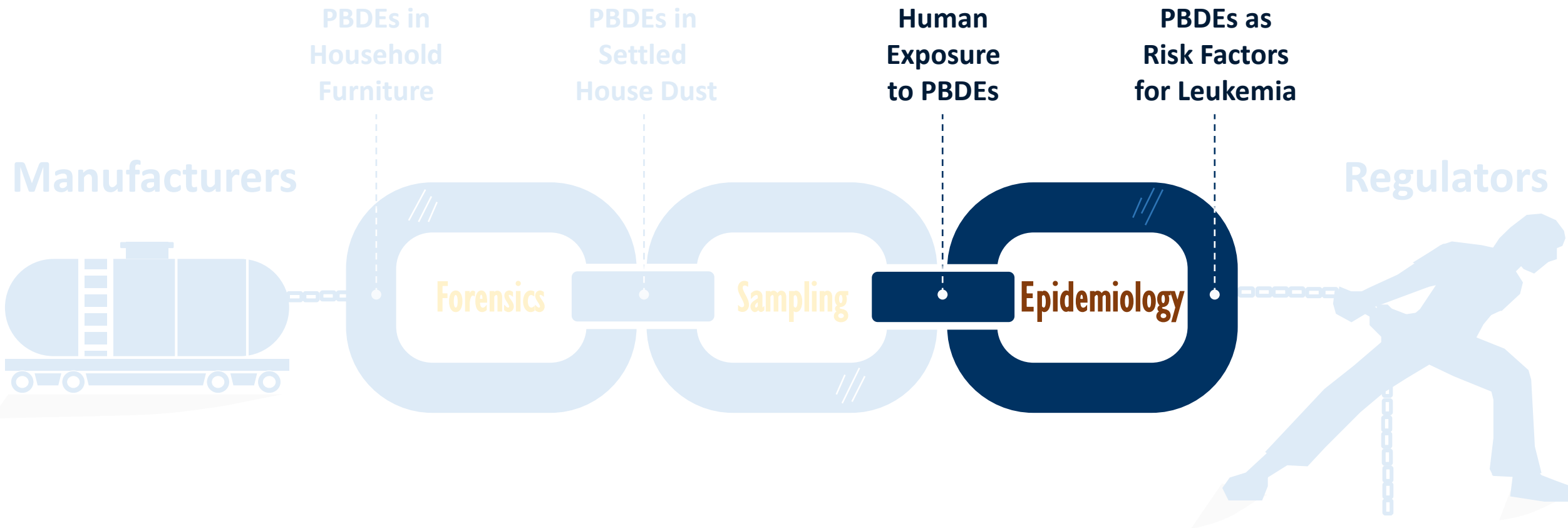


Source: Whitehead et al. (2015) *Environ Res.* 136: 57-66.

The image features a dark blue background with several thick, parallel yellow diagonal lines. A prominent yellow banner runs diagonally across the upper right portion of the frame. The word "EPIDEMIOLOGY" is written in a bold, yellow, sans-serif font within this banner. The overall style is graphic and modern.

**EPIDEMIOLOGY**

# Link #3: Human-to-health





# Established Environmental Risks



Overview

Forensics

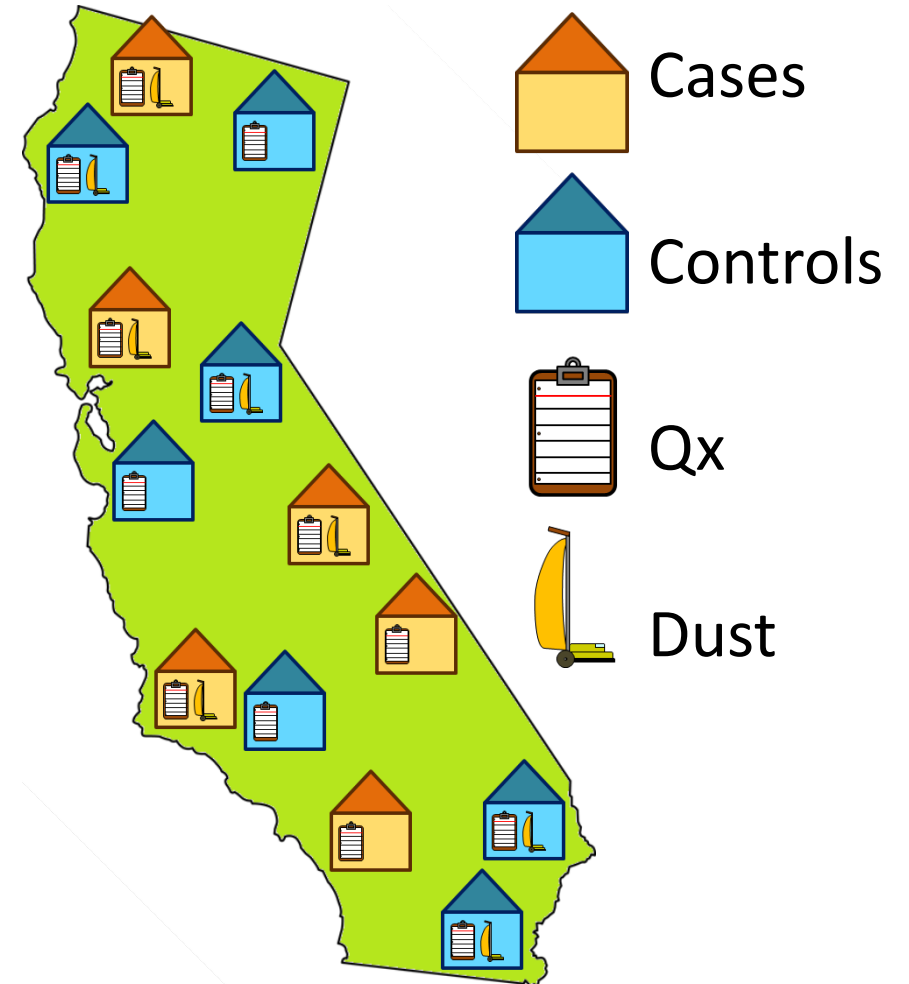
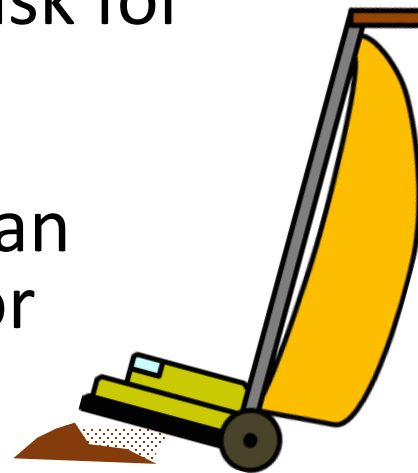
Sampling

Epi

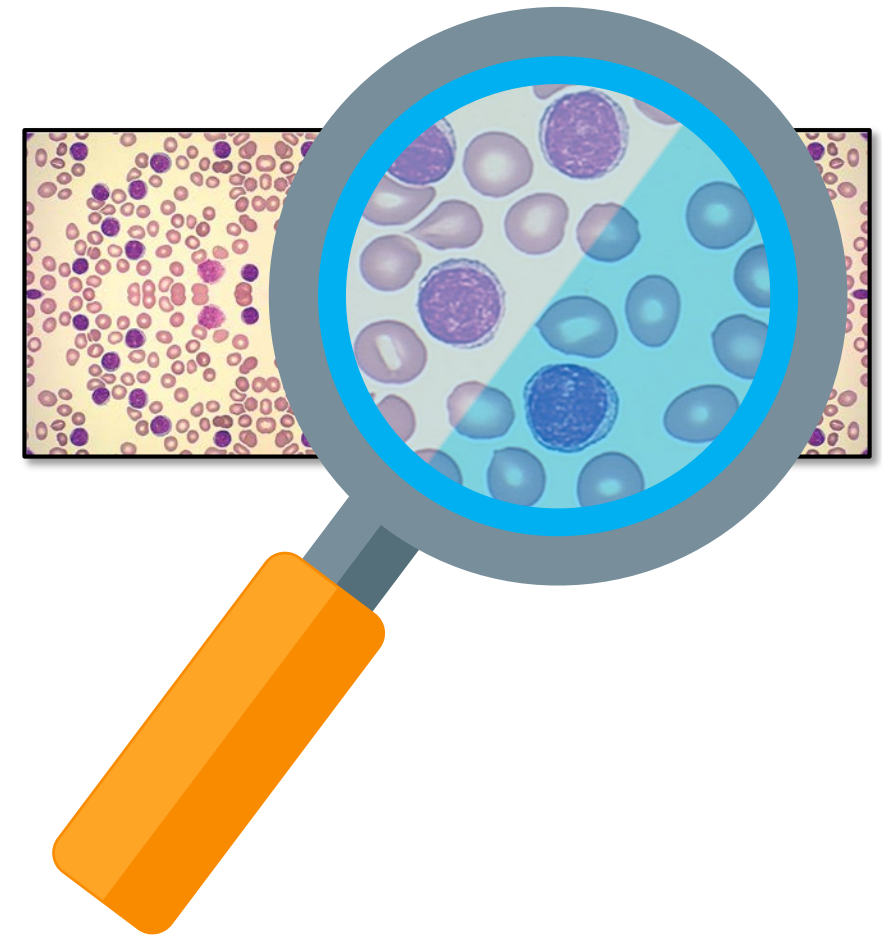
Future

# California Childhood Leukemia Study

- **Method:** Measured PBDEs in settled dust from case and control homes.
- **Results:** Comparing homes in the highest tertile to no detections, we found increased leukemia risk for PBDEs 196, 203, 206, 207.
- **Conclusion:** PBDEs may be an environmental risk factor for childhood leukemia.



- **Evaluating mechanisms:**  
Epigenetic changes,  
abnormal immune development.
- **Controlled experiments:**  
Mouse model of T(12:21) leukemia  
exposed prenatally to PBDEs.
- **Identifying window of susceptibility:**  
*In utero*, after birth, before conception.



**FUTURE**

# Fire Station Dust – OPFRs

- **Method:** Measured OPFRs in settled dust from fire station dust.
- **Results:** Found elevated levels of tris(1,3-dichloro-2-propyl)phosphate (TDCPP) or “chlorinated tris”.
- **Conclusion:** Firefighters are exposed to flame retardants away from fire events.



Source: Shen *et al.* “Organophosphate flame retardants in dust collected from United States fire stations” (submitted to *Env Int*).

# Collaborators

## **CIRCLE:**

Catherine Metayer (PI)  
Steve Rappaport  
Sharyle Patton

## **STUDENTS:**

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Lauren Baehner

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Sabrina Crispo-Smith  
Reber Brown  
Arthur Holden  
Ranjit Gill  
Joginder Dhaliwal



**The Center for Integrative Research on  
Childhood Leukemia and the Environment**

# Questions Welcome.

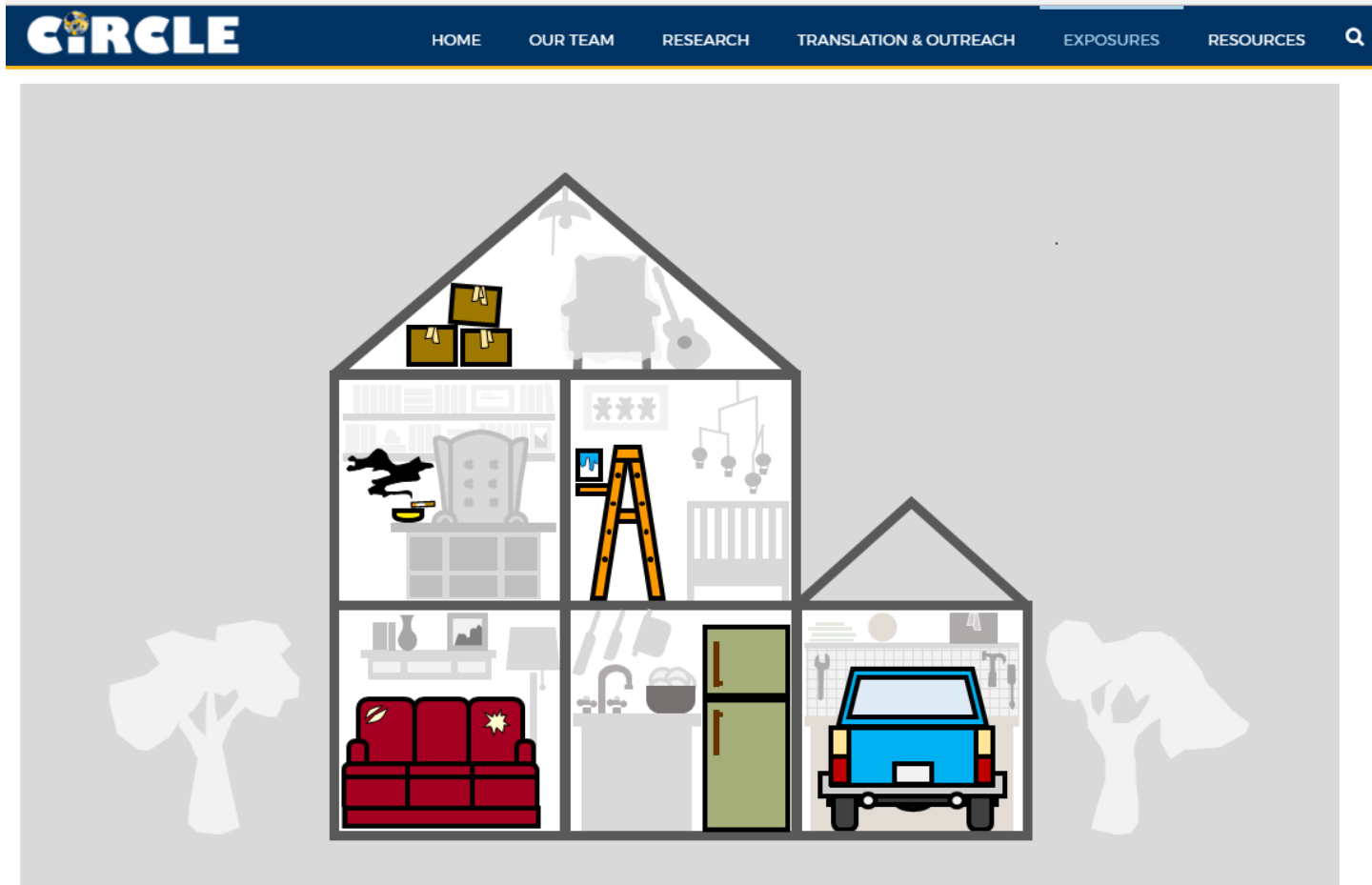


**National Institute of Environmental Health Sciences**  
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**United States  
Environmental Protection  
Agency**

Visit: <http://circle.berkeley.edu/>



- **Tips:** To avoid exposures to chemicals at home.
- **News:** From CIRCLE researchers.
- **Resources:** To find more information about leukemia.



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**Leukemia Prevention** @CIRCLE\_UCB  
CIRCLE, the Center for Integrative Research on Childhood Leukemia & the Environment, identifying causes and preventing future cases of leukemia. @UCBerkeleySPH  
Berkeley, CA  
circle.berkeley.edu  
Joined September 2017  
4 Photos and videos

**Tweets** **Tweets & replies** **Media**

**Who to follow**

- Rebecca Altman
- Vanessa, PhD, MPH
- Mustafa Santiago

**Trends for you**

- National Cheeseburger Day
- Monday Motivation
- Grisham Cassidy
- WTC Drought
- Parasit
- Salmon Innovation
- CHASE
- RADCOLOR

**Leukemia Prevention** @CIRCLE\_UCB · 2h  
The benefits of higher breastfeeding rates would include a reduction in the number of childhood leukemia cases.  
[journals.sagepub.com/doi/10.1177/0963426914168429](http://journals.sagepub.com/doi/10.1177/0963426914168429)

**UNC Public Health** @UNCpublichealth  
A new online calculator estimates the impact of changes in breastfeeding rates on population health. [unc.edu/2014/09/29/](http://unc.edu/2014/09/29/)

**Leukemia Prevention** @CIRCLE\_UCB · 3h  
A nice job done by @Lissa @SMBLLS to create a social media toolkit to help promote Blood Cancer Awareness month.

**WHO** @WHO · 4h  
Replying to @WHO  
Millions of deaths can be prevented each year by:  
#NoTobacco  
Healthy diet  
Physical activity  
Avoiding harmful use of alcohol  
#BeatNCD #UNGA

**Leukemia Prevention** @CIRCLE\_UCB · 3h  
On our site - an interactive dollhouse showing the risk factors for childhood leukemia that lurk inside homes.  
[circle.berkeley.edu/exposures-of-4/](http://circle.berkeley.edu/exposures-of-4/)

**Leukemia Prevention** @CIRCLE\_UCB · Sep 15  
Tips for healthy living courtesy of Carlos, the title character of our graphic novel 'Rosa & Carlos Get Married' (Art by Stephen Burdick).

**St. Baldrick's** @StBaldrs · Sep 15  
RT & raise awareness during Childhood Cancer Awareness Month! Help us. #TakeChildhoodBack w/ a donation [bit.ly/2ndRg17](http://bit.ly/2ndRg17)

**Leukemia Prevention** @CIRCLE\_UCB · Sep 15  
Childhood leukemia survivors remain at an increased risk for secondary cancers and neuropsychological problems later in life.

**St. Baldrick's** @StBaldrs  
RT: fact: Cancers in kids are different than cancers in adults. Learn more here: [bit.ly/213q0H](http://bit.ly/213q0H) #CCAM

**Leukemia Prevention** @CIRCLE\_UCB · Sep 14  
The fictional Rosa & Carlos Get Married, is a love story that provides practical advice based on CIRCLE research.  
[wpsites.ucsf.edu/projects/emprs...](http://wpsites.ucsf.edu/projects/emprs...)

**SmokefreeUS** @NCI · Sep 13  
Looking for a quick way to boost your mood while quitting? Get tips here: [smokefree.gov/quitlogos-when...](http://smokefree.gov/quitlogos-when...)

**Stephanie Stahl** @StahCBS · Sep 13  
Cancer death rates are going down, a growing number of people are surviving @AACR @calocal @qagf @f @BeatingCancer

**Study: Positive trend in Cancer Survival Rates**  
The power of personalized, precision medicine that comes from groundbreaking cancer research is happening... [phltechphila.com](http://phltechphila.com)

**Berkeley Health** @UCBerkeleySPH · Sep 13  
Join us live for a Super Making Us Sick! Tonight at 5 pm. [bit.ly/2a0p0u4](http://bit.ly/2a0p0u4) @BerkeleyHealthSPH