

# EDCs & Reproductive Health: Effects of chemical mixtures on ovarian function

Shuo Xiao (肖硕), MBBS, PhD

Department of Pharmacology and Toxicology

Ernest Mario School of Pharmacy (EMSOP)

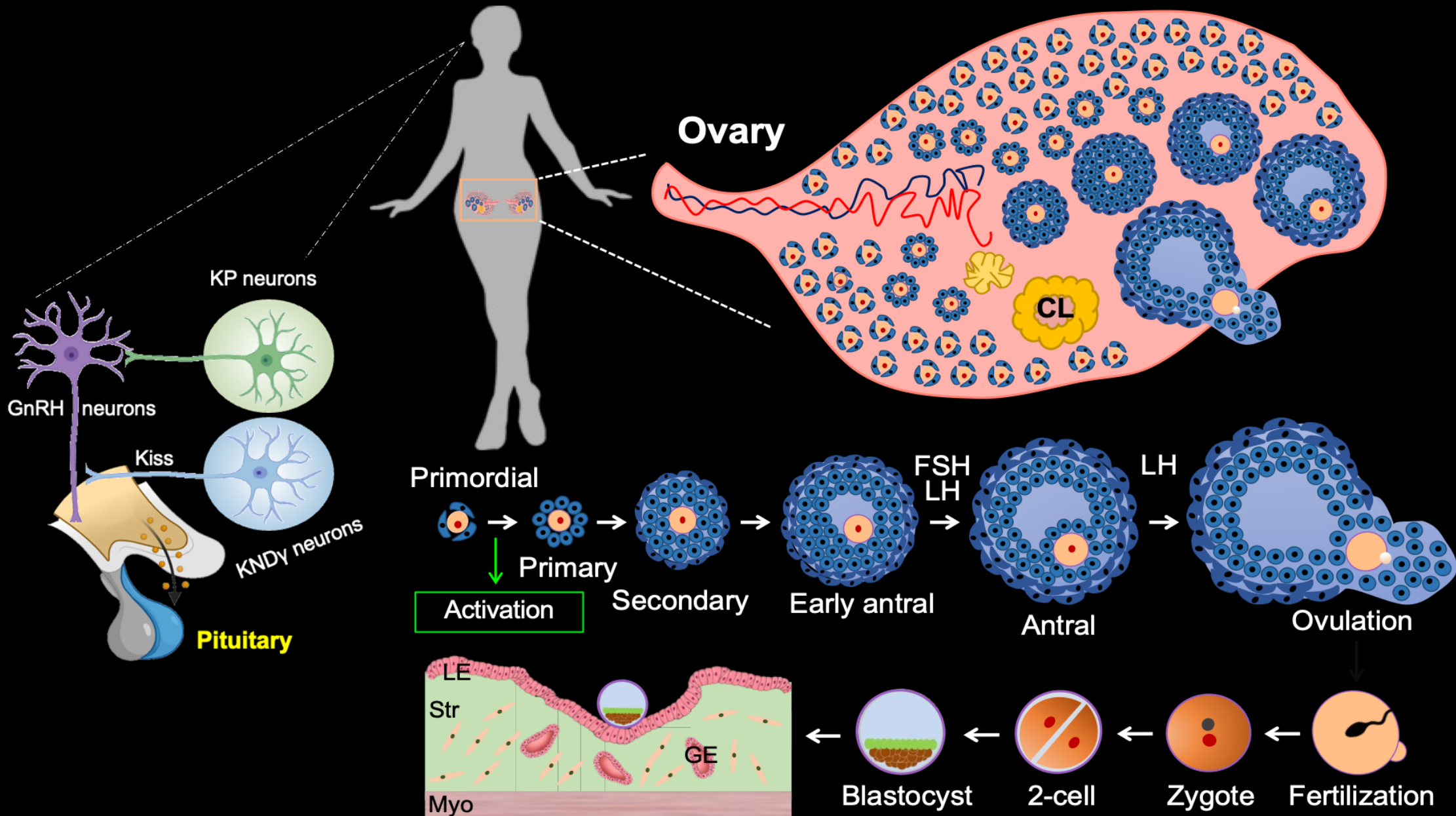
Environmental and Occupational Health Sciences Institute (EOHSI)

Rutgers, The State University of New Jersey

Lou Guillette Jr Outstanding Young Investigator Award Webinar

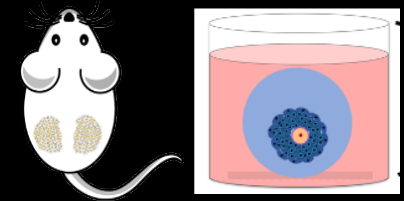
2026-02-12



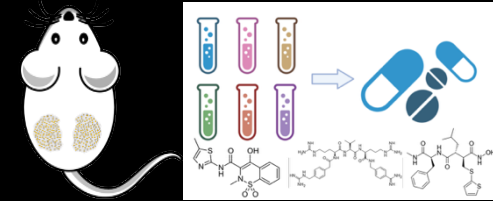


# Our research advancing women's reproductive health

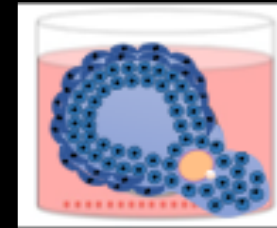
I. Reproductive toxicology (EDCs & pharmaceuticals)



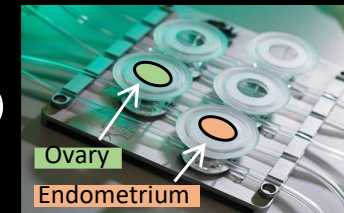
II. Ovarian protectant for fertility preservation

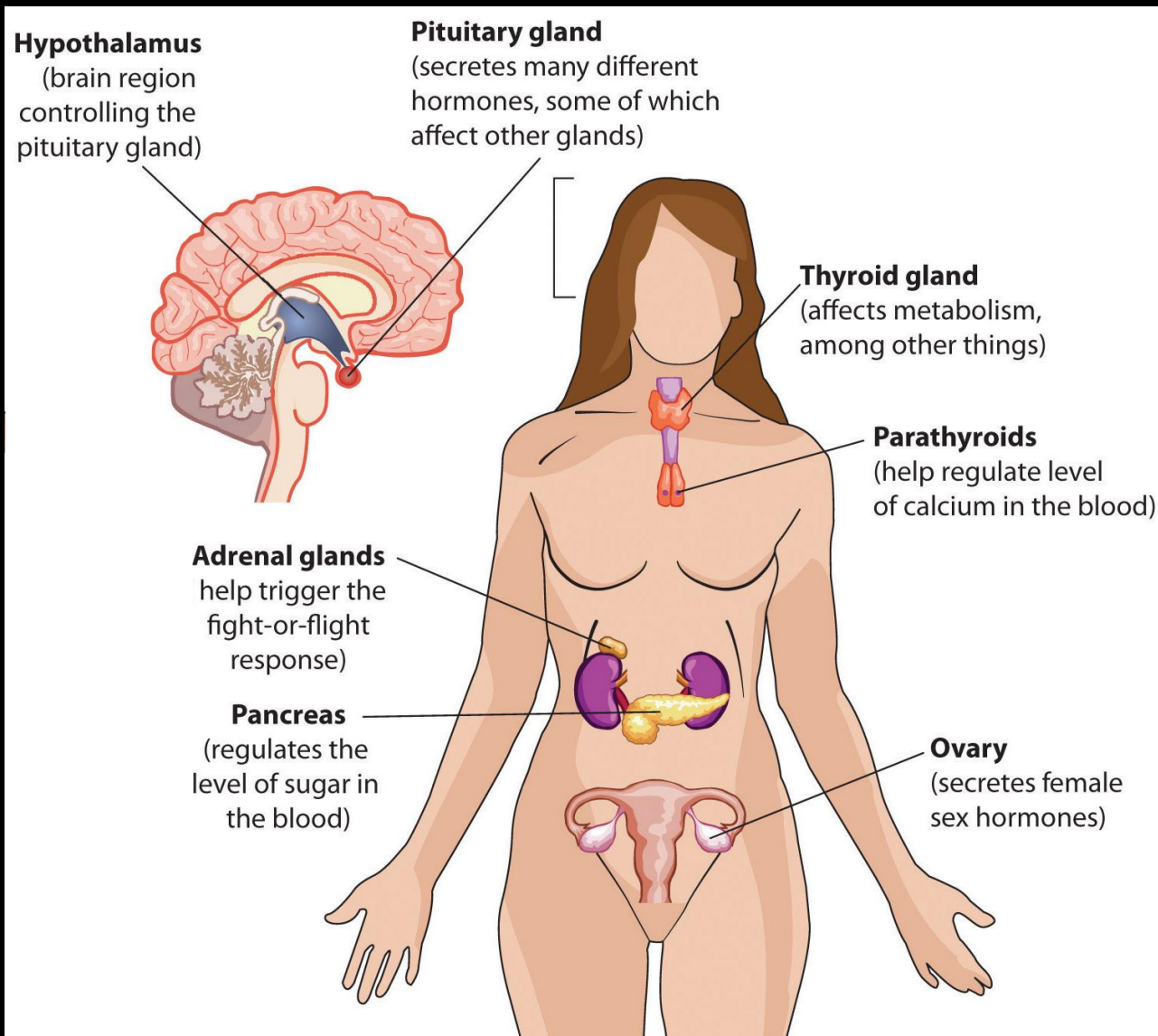


III. Non-hormonal contraceptive targeting ovulation



IV. Female reproductive organoids and organ-on-chip





## Endocrine disrupting chemicals (EDCs):

Chemicals that interfere with the function of the endocrine system – the hormones that coordinate the health and function of all organs in the body. In some cases, they mimic the actions of hormones, in others they block the actions of hormones, and still others change how the body makes or breaks down natural hormones.

# Endocrine disrupting chemicals (EDCs)

## Plastics & Plasticizers



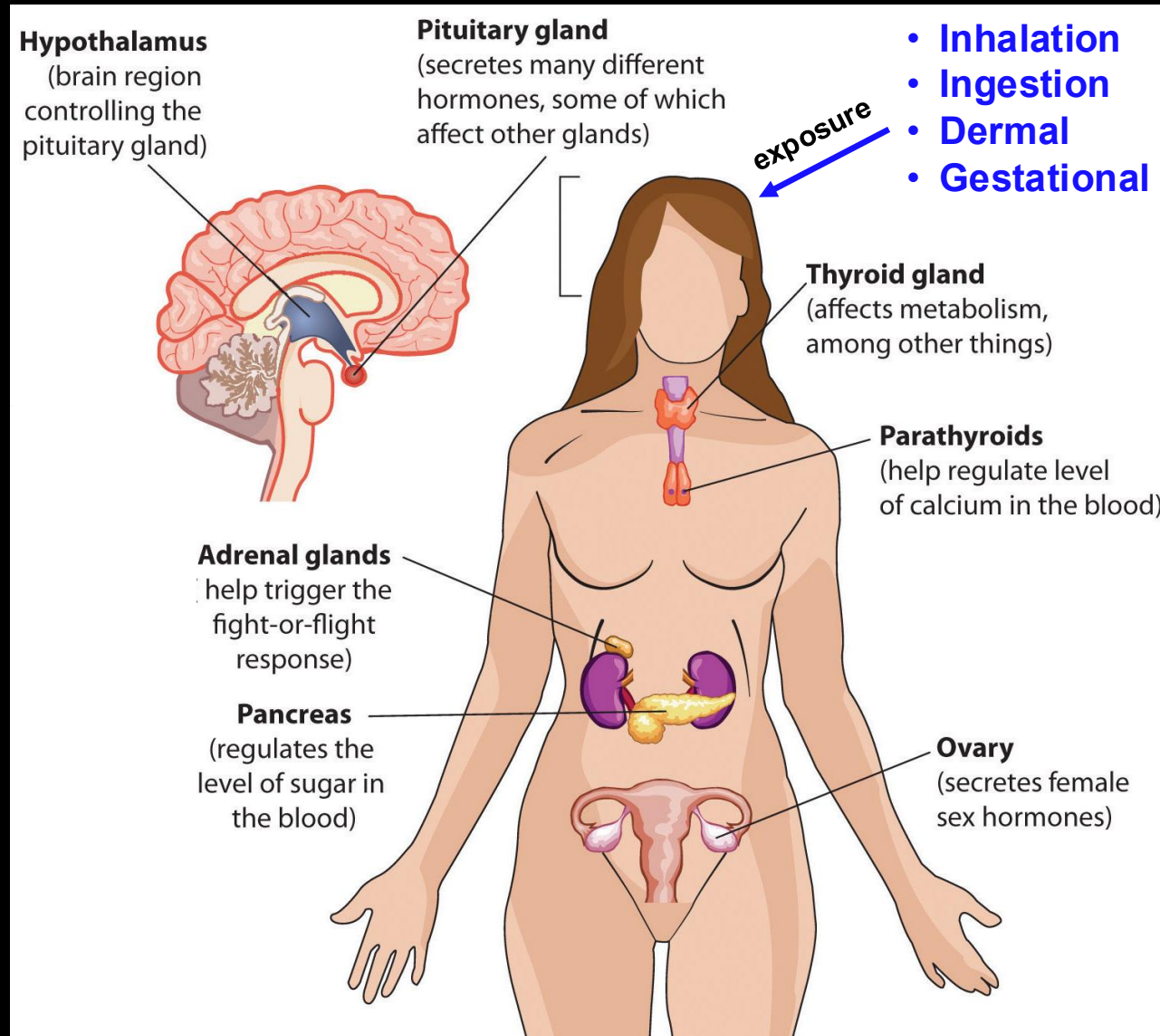
## Flame retardants



## Personal care products



## Food packaging



## Industrial chemicals



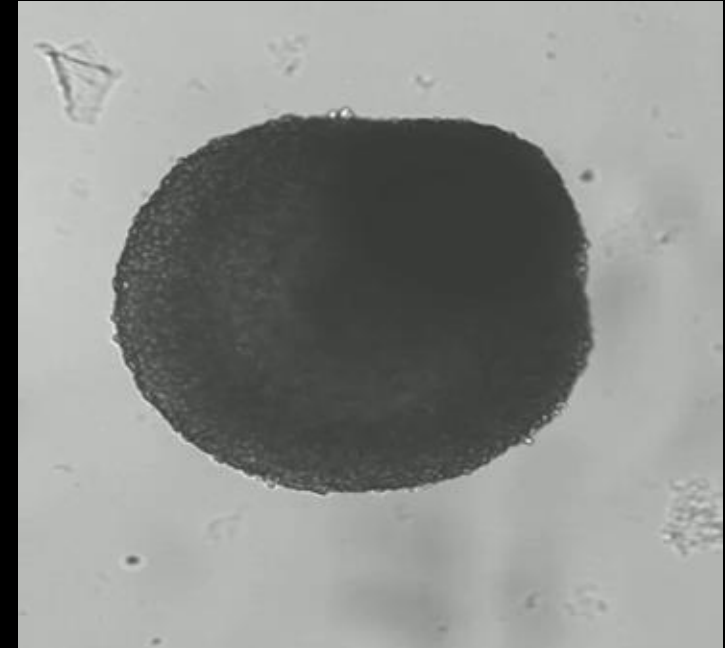
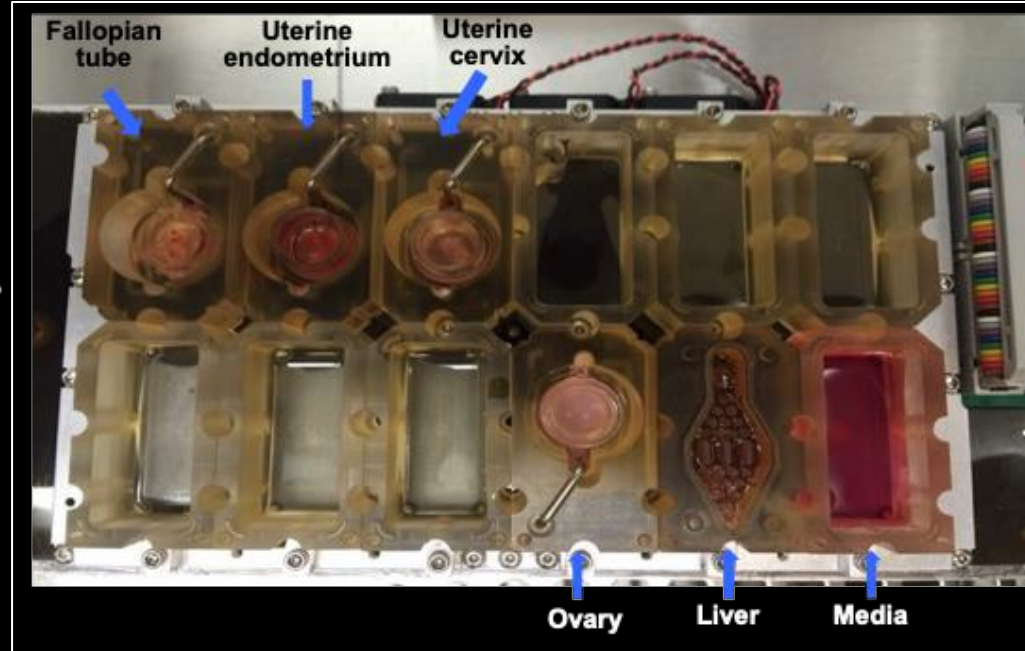
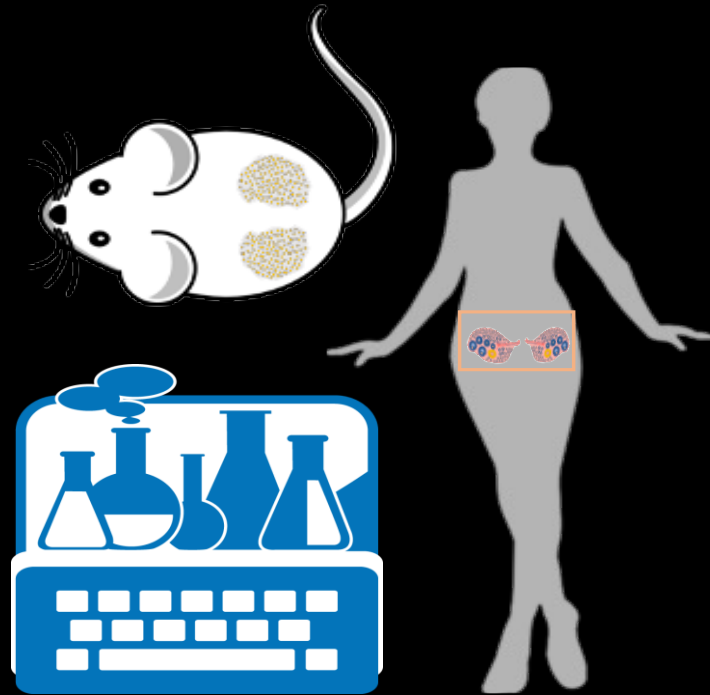
## Pesticides, herbicides



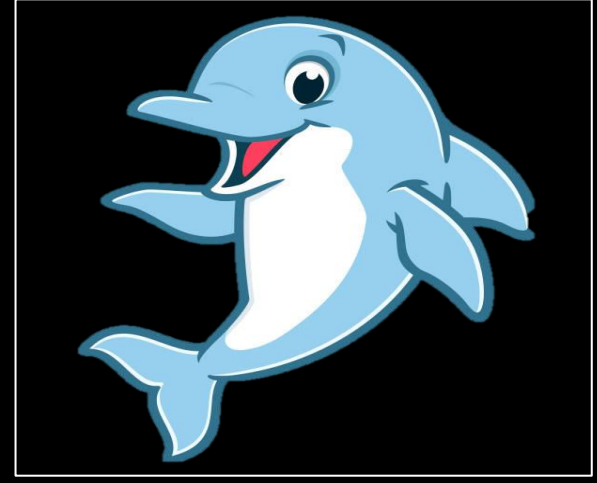
## Contaminated water and air



# Classic and novel research models studying EDC and repro tox



# Our environmental female reproductive toxicology research



Xu et al, *Tox Sci*, 2020

Wang et al, *BOR*, 2021

Wang et al, *Repro Tox*, 2020

Zhang et al, *Endo Rev*, under review

Zhan et al, *ENDO*, 2024

Wang et al, *EHP*, 2023

Wang et al, *Repro Tox*, 2020

Xu et al, *Tox Sci*, 2020

Wang et al, *BOR*, 2021

McMclam, *Arch Public Health*, 2023

Zhang et al, *BOR*, 2025

Pattarawat et al, *EHP*, 2025

# Per- and Polyfluoroalkyl Substances (PFAS, forever chemical)

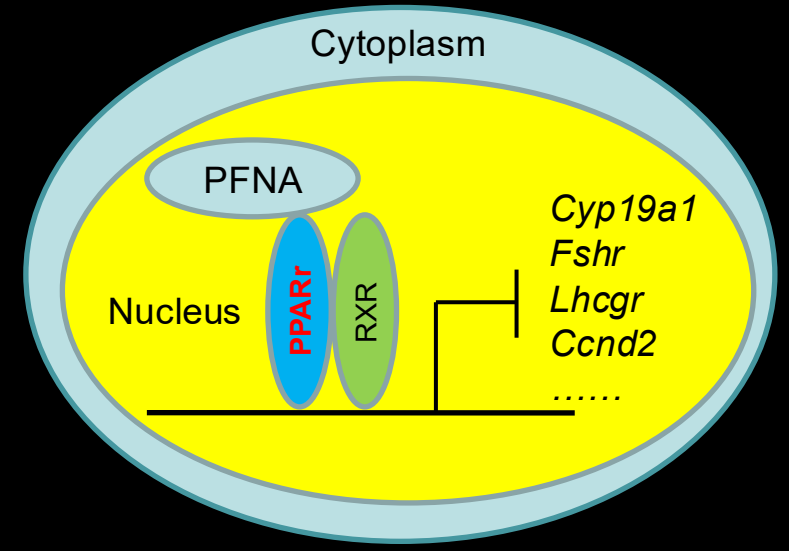
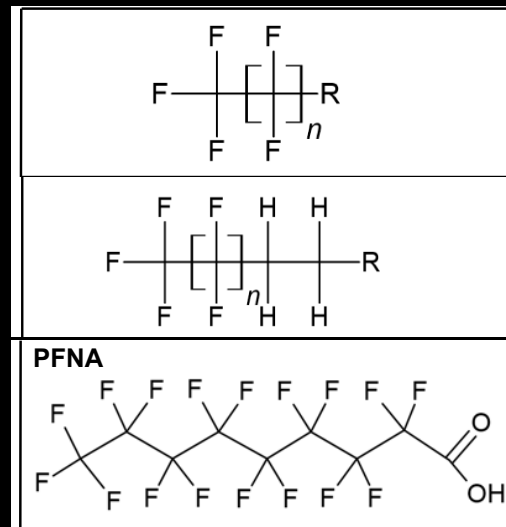


Environmental Health Perspectives

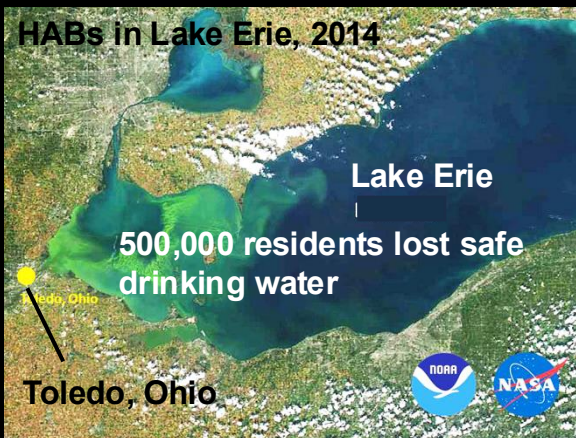
| Research | 7 April 2025

## Exposure to Long- and Short-Chain Per- and Polyfluoroalkyl Substances in Mice and Ovarian-Related Outcomes: An *in Vivo* and *in Vitro* Study

**Authors:** Pawat Pattarawat, Tingjie Zhan, Yihan Fan, Jiyang Zhang, Hilly Yang, Ying Zhang, Sarahna Moyd, Natakai C. Douglas, Margrit Urbanek, Brian Buckley, Joanna Burdette, Qiang Zhang, Ji-Yong Julie Kim, and Shuo Xiao [SHOW FEWER](#) | [AUTHORS INFO & AFFILIATIONS](#)



# Harmful algal bloom (HAB) toxins



**ehp Research Article**  
Effects of Cyanobacterial Harmful Algal Bloom Toxin Microcystin-LR on Gonadotropin-Dependent Ovarian Follicle Maturation and Ovulation in Mice  
<https://doi.org/10.1289/EHP12034>

**MC-LR**

(5) Adda (6) D-Glu (7) Mdha (1) D-Ala (2) X (3) D-MeAsp (4) Z Arginine (R) Leucine (L)

Protein phosphatase 1 (PP1)

Maturation Ovulation

- Irregular periods
- Infertility
- Reproductive disease

**Microcystis**

© iStock.com/Olena Liatina

# Endocrine disrupting chemicals (EDCs)

## Plastics & Plasticizers



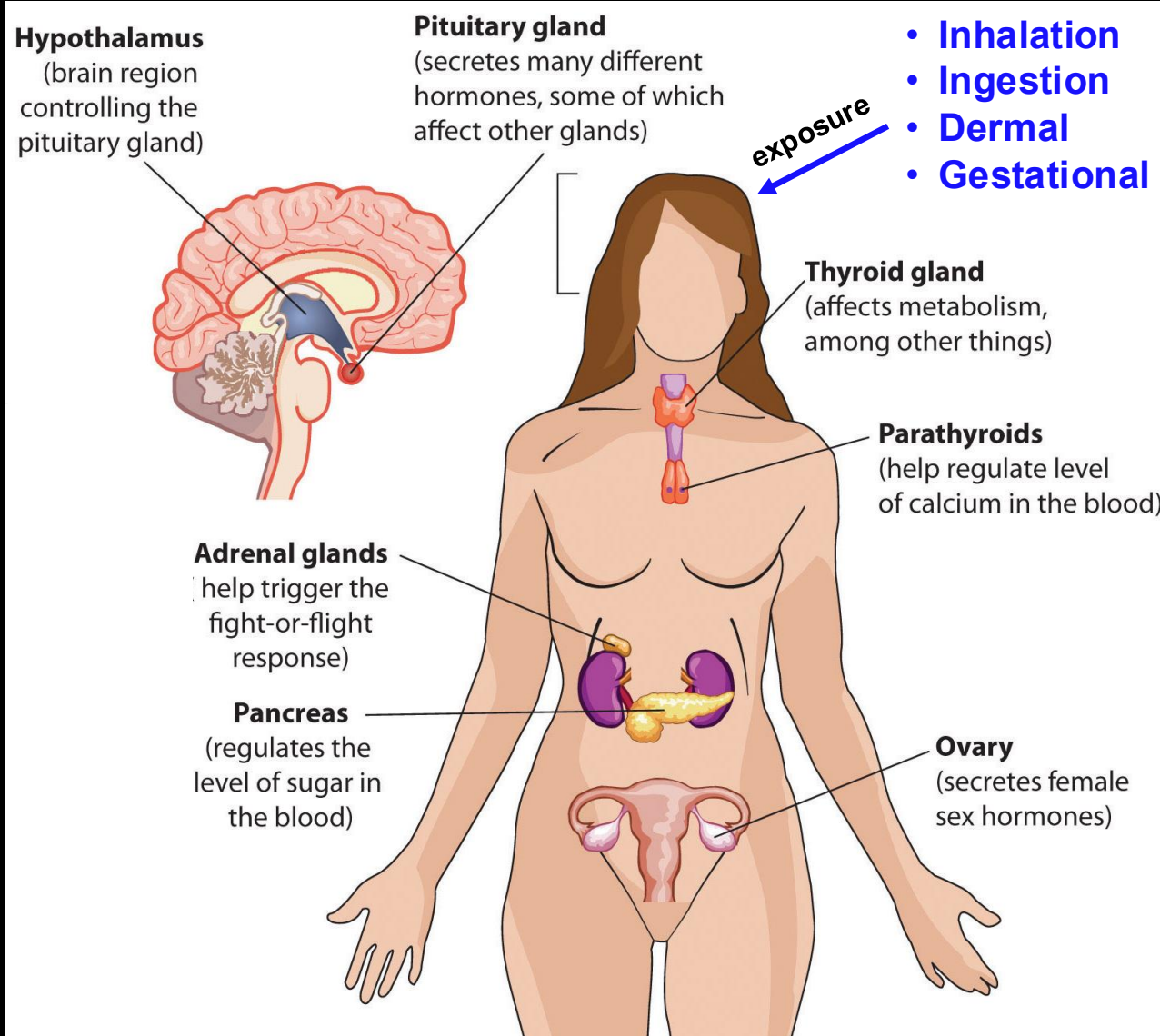
## Flame retardants



## Personal care products



## Food packaging



## Industrial chemicals



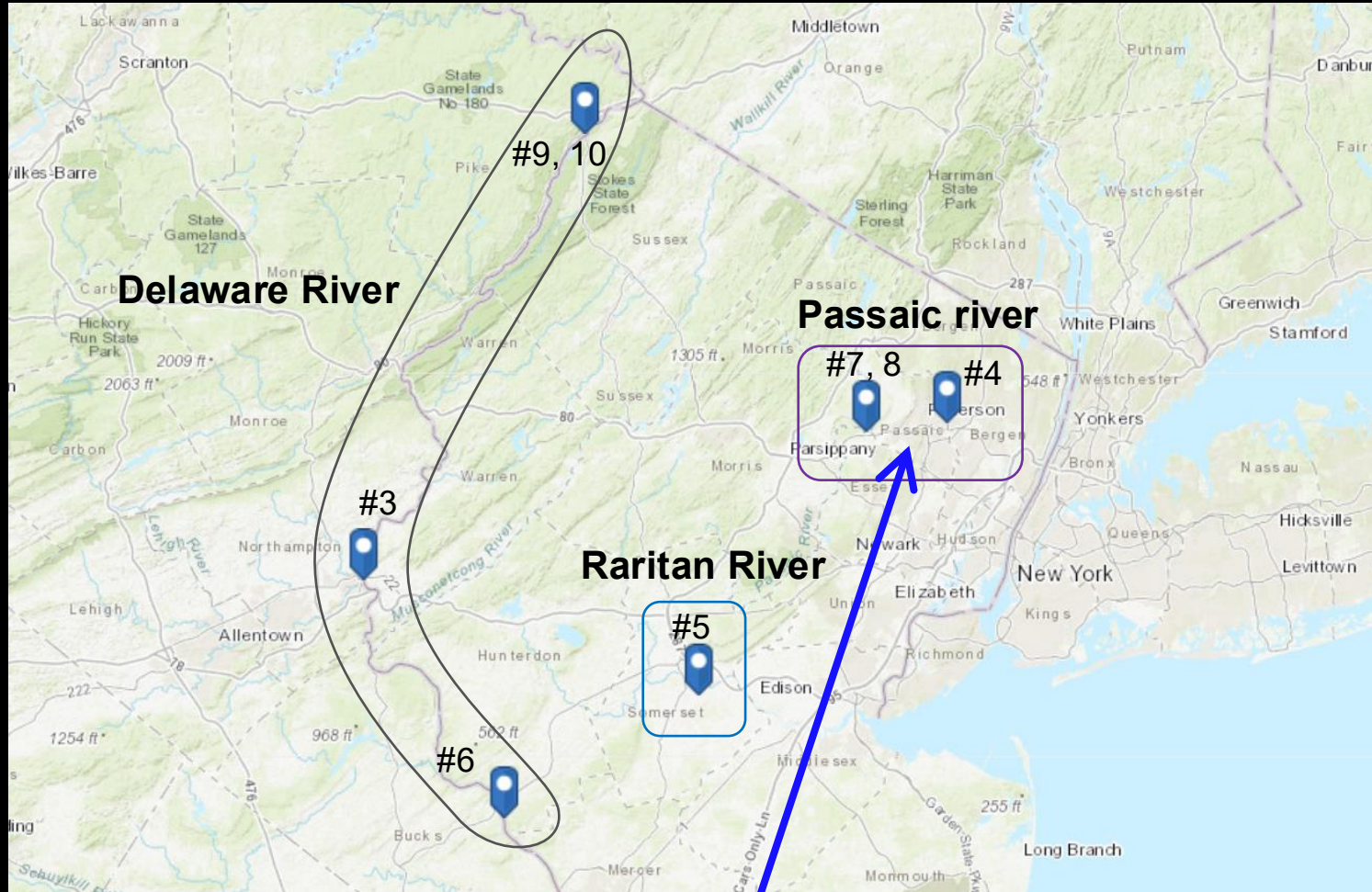
## Pesticides, herbicides



## Contaminated water and air



# Real-world EDC mixture collection



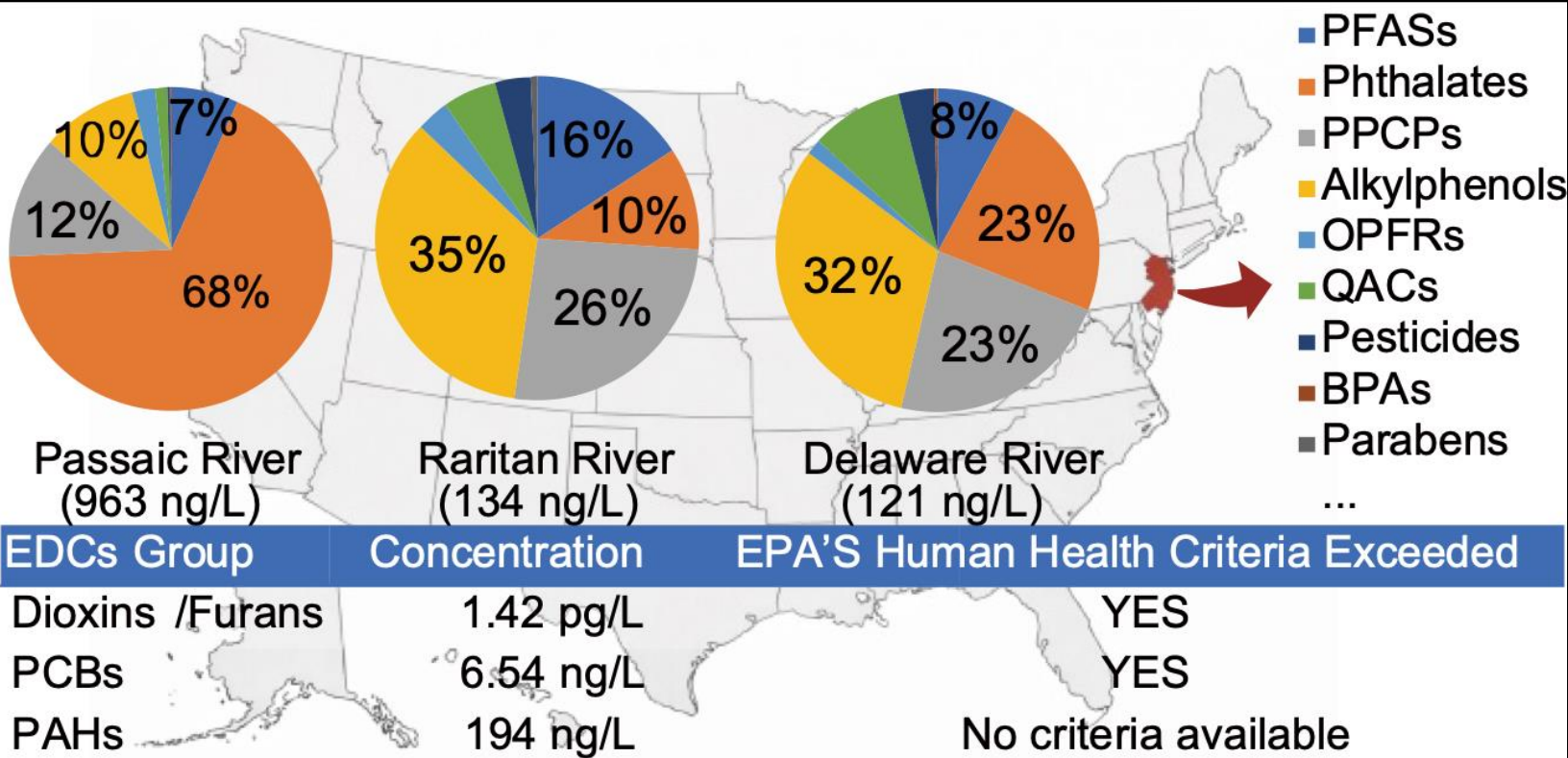
- **Passaic River:** Federal Superfund site due to contamination of TCDD, PAHs, PCBs, heavy metals ...
- Downstream drinking water, fish consumption, recreation, flooding

With Dr. Dan Millemann from NJDEP

# Real-world EDC mixture collection



Brian Buckley, PhD  
Rutgers EOHSI



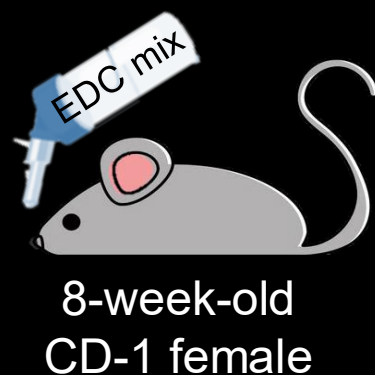
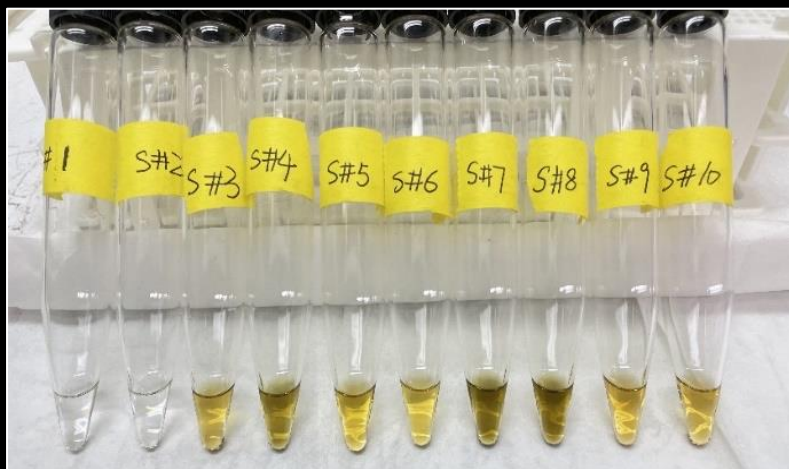
- Alkylphenols
- Antimicrobials
- Bisphenols
- Hormones
- **Herbicides**
- **OPFRs**
- Parabens
- PCPs (Personal care products)
- **PFAS**
- Pharmaceuticals
- **Phthalates**
- QACs (Quaternary ammonium compounds)
- **Zeranol**

# Female reproductive impact of real-world EDC mixtures



Tingjie Zhan,  
PhD, Postdoc

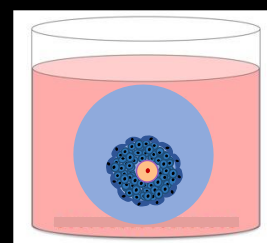
## Organic matter extraction



0, 1x, 3x, and 10x  
in drinking water

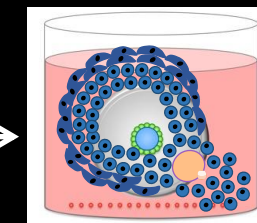
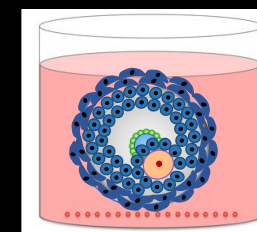
8-week oral exposure  
via daily drinking water

- General health
- Reproductive cycles
- Molecular change



EDC mixture  
*in vitro* exposure

Follicle development



# Female reproductive impact of real-world EDC mixtures



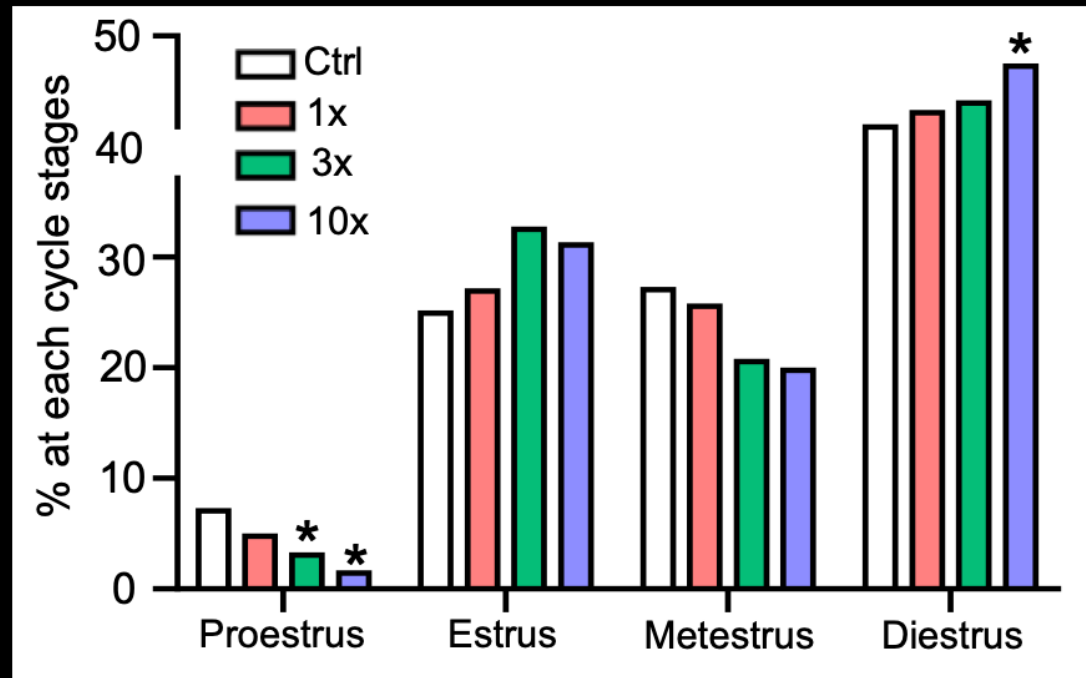
8-week-old  
CD-1 female

0, 1x, 3x, and 10x  
in drinking water

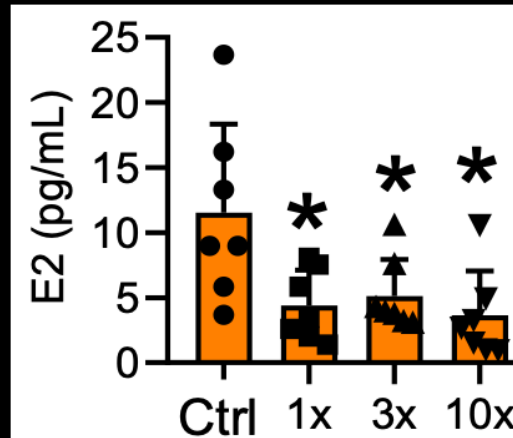
8-week oral exposure  
via daily drinking water

- General health
- Reproductive cycles
- Molecular change

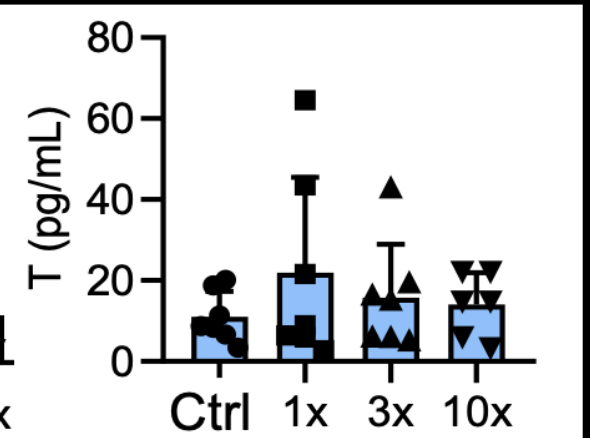
## Mouse estrous cycles



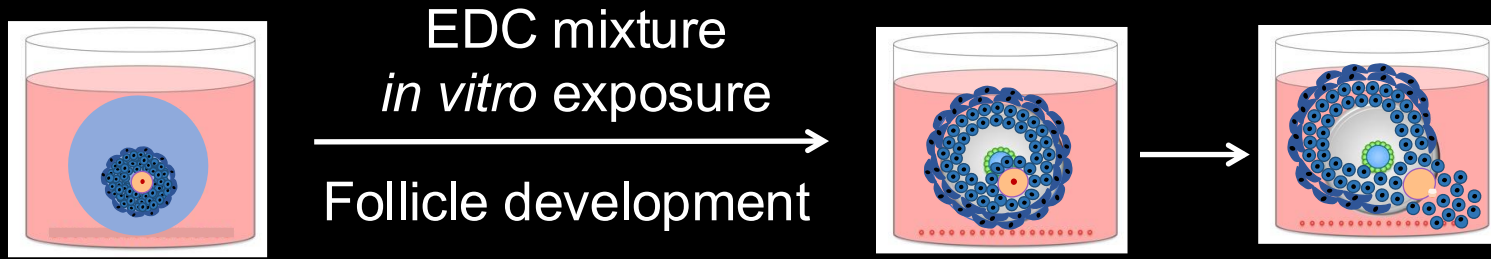
## Estradiol (E2)



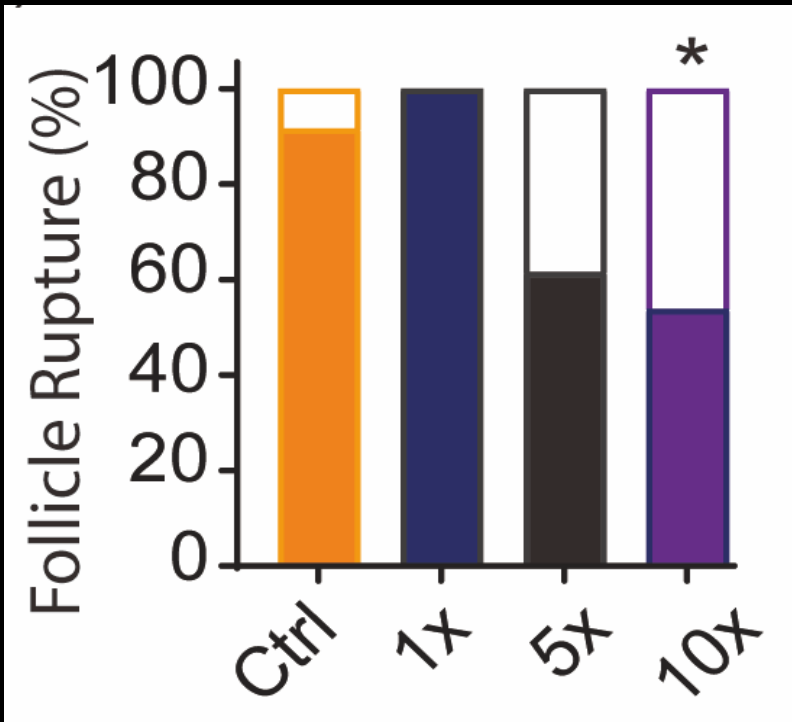
## Testosterone



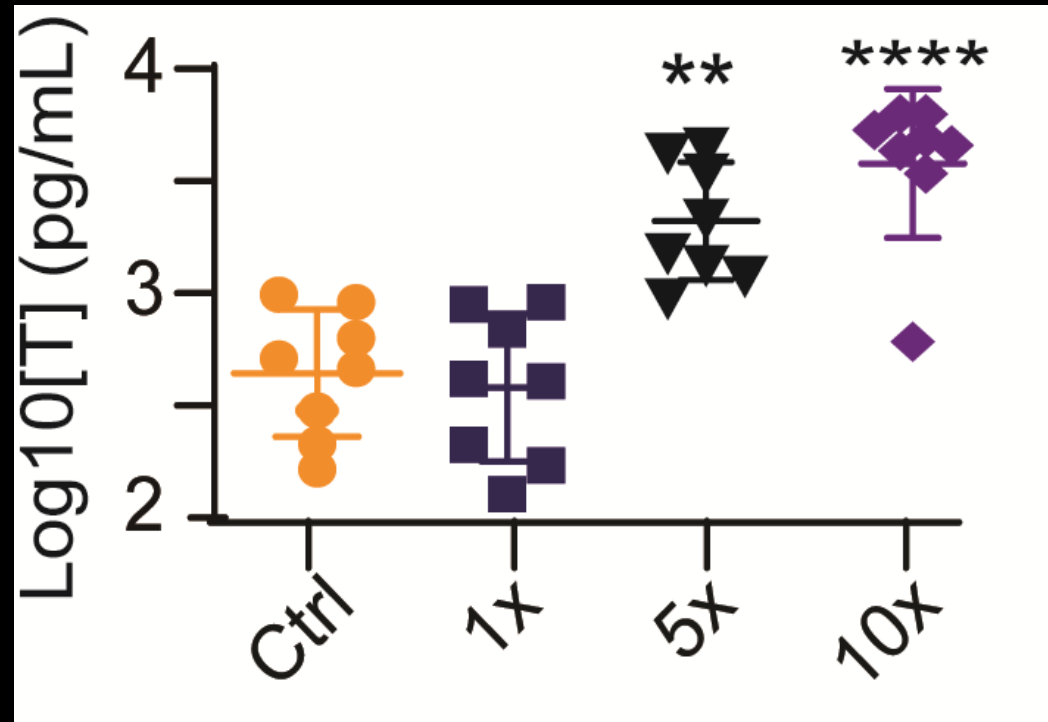
# Female reproductive impact of real-world EDC mixtures



## Ovulation

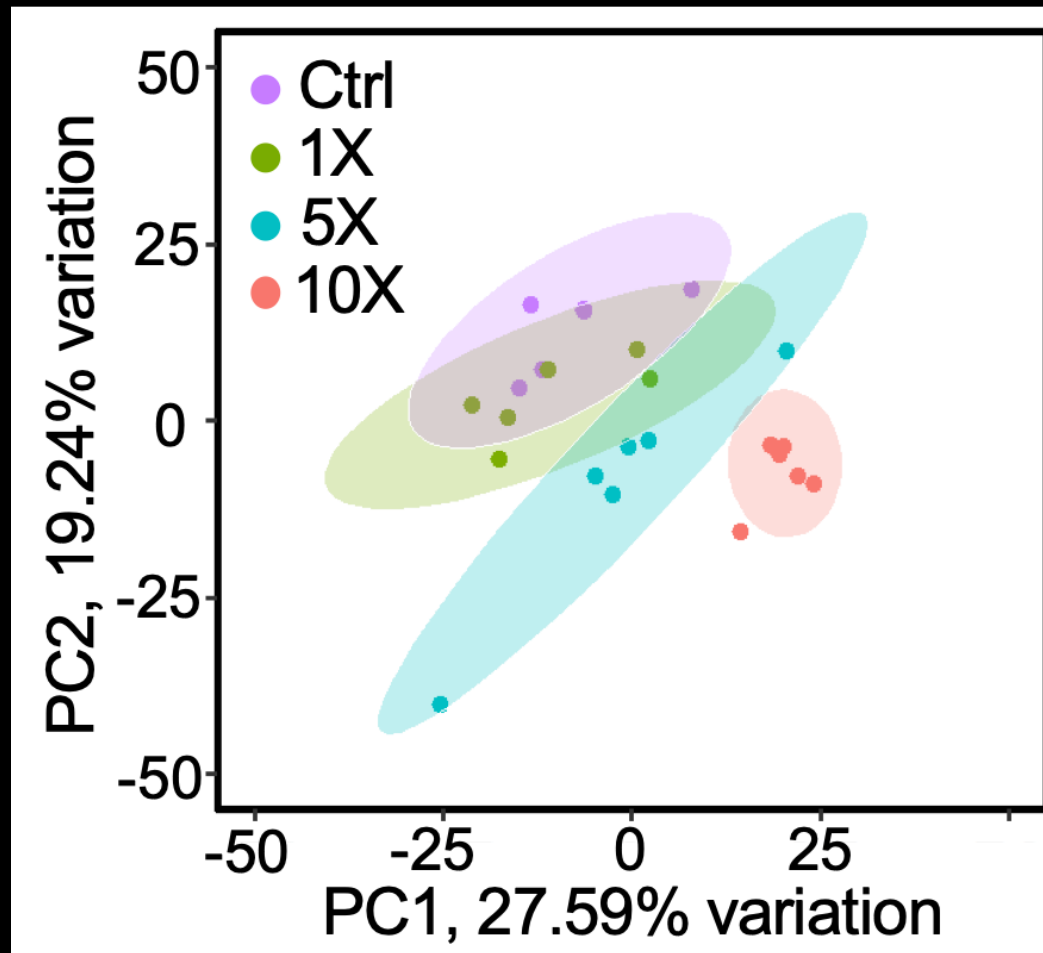


## Testosterone secretion



# Female reproductive impact of real-world EDC mixtures

## RNA-sequencing analysis

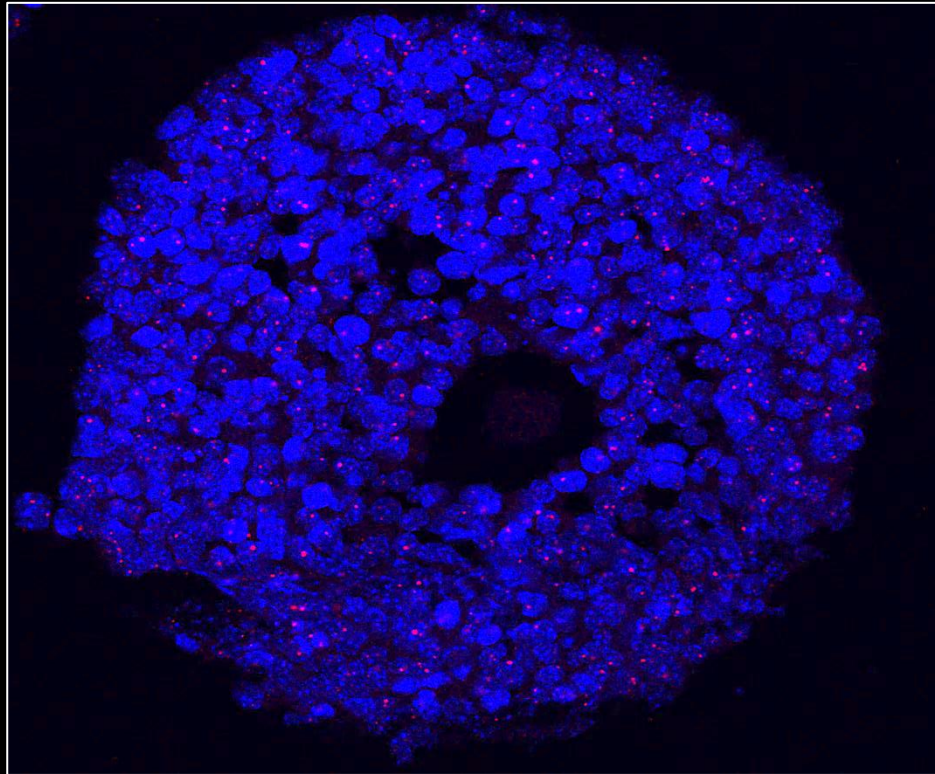


## Disrupted nuclear receptor

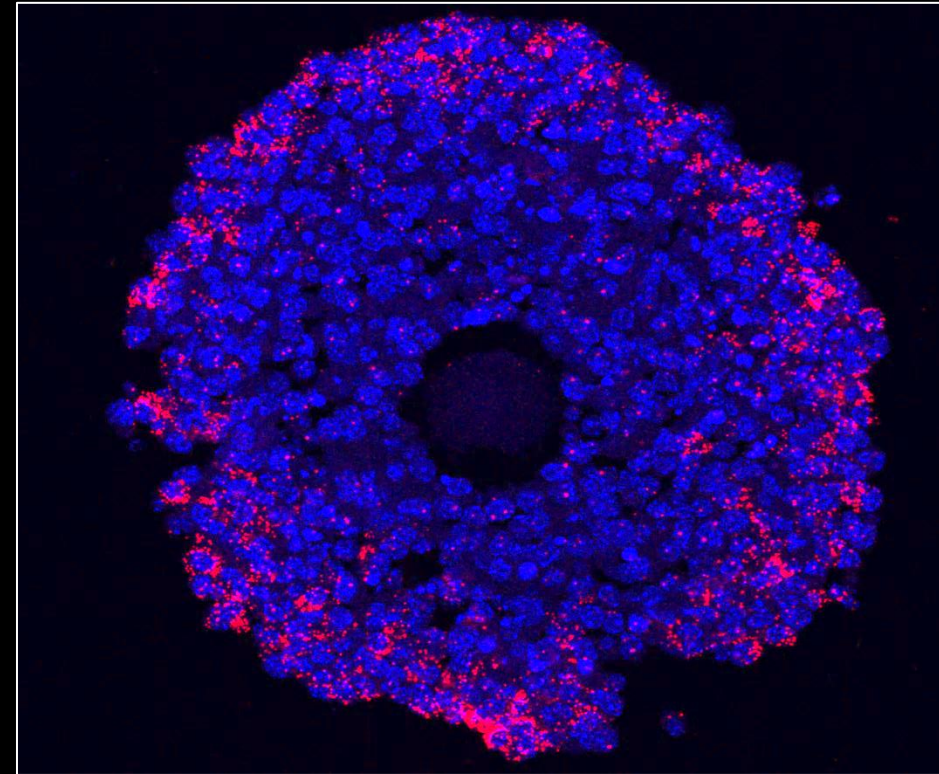


# Female reproductive impact of real-world EDC mixtures

Control



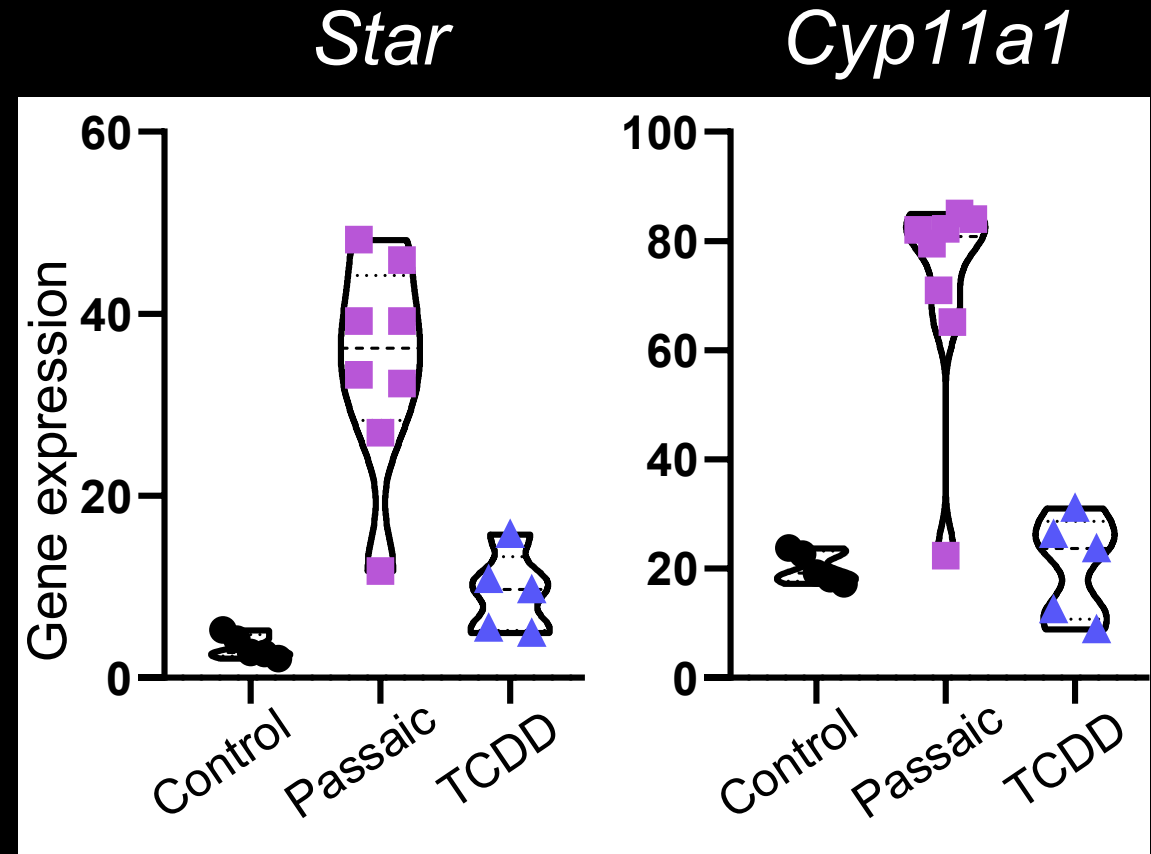
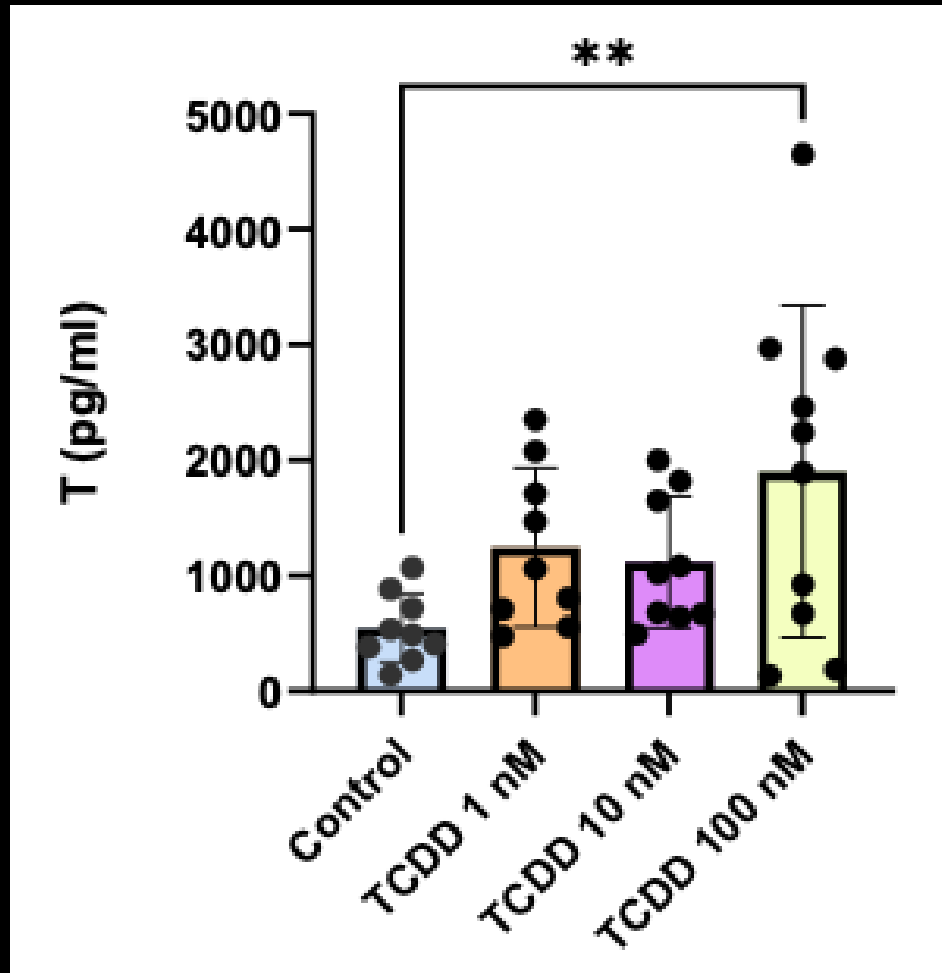
Passaic River EDC



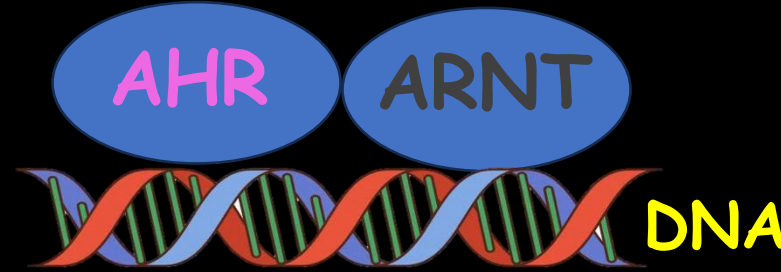
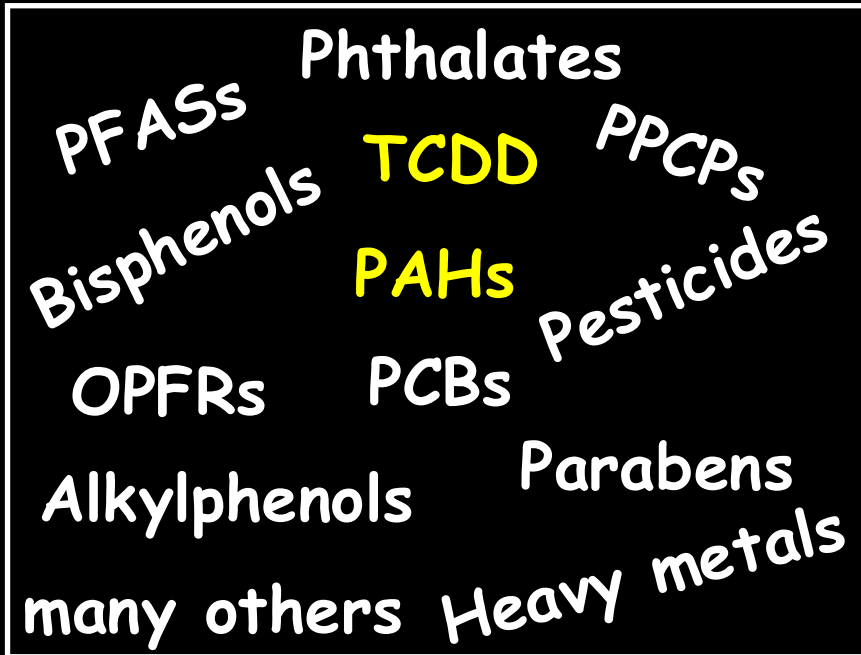
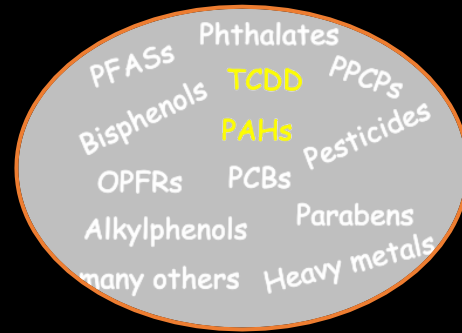
DAPI *Cyp1a1*

# Female reproductive impact of real-world EDC mixtures

## Testosterone secretion



# Female reproductive impact of real-world EDC mixtures



Dysregulated gene expression

Reproductive toxicities

AHR	●	●
AR	●	●
ESR1	●	●
ESR2	●	●
PGR	●	●
PPARA	●	●
PPARD	●	●
PPARG	●	●

# Ongoing research and future directions

PFASs Phthalates  
Bisphenols TCDD PPCPs  
OPFRs PAHs Pesticides  
Alkylphenols PCBs  
many others Parabens  
Heavy metals

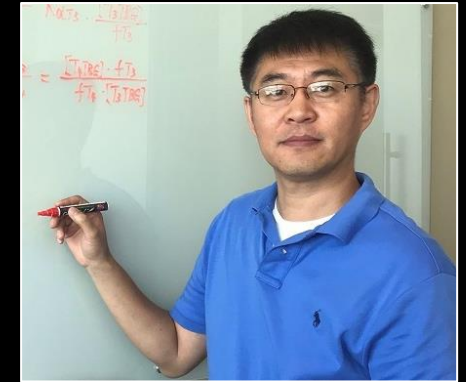
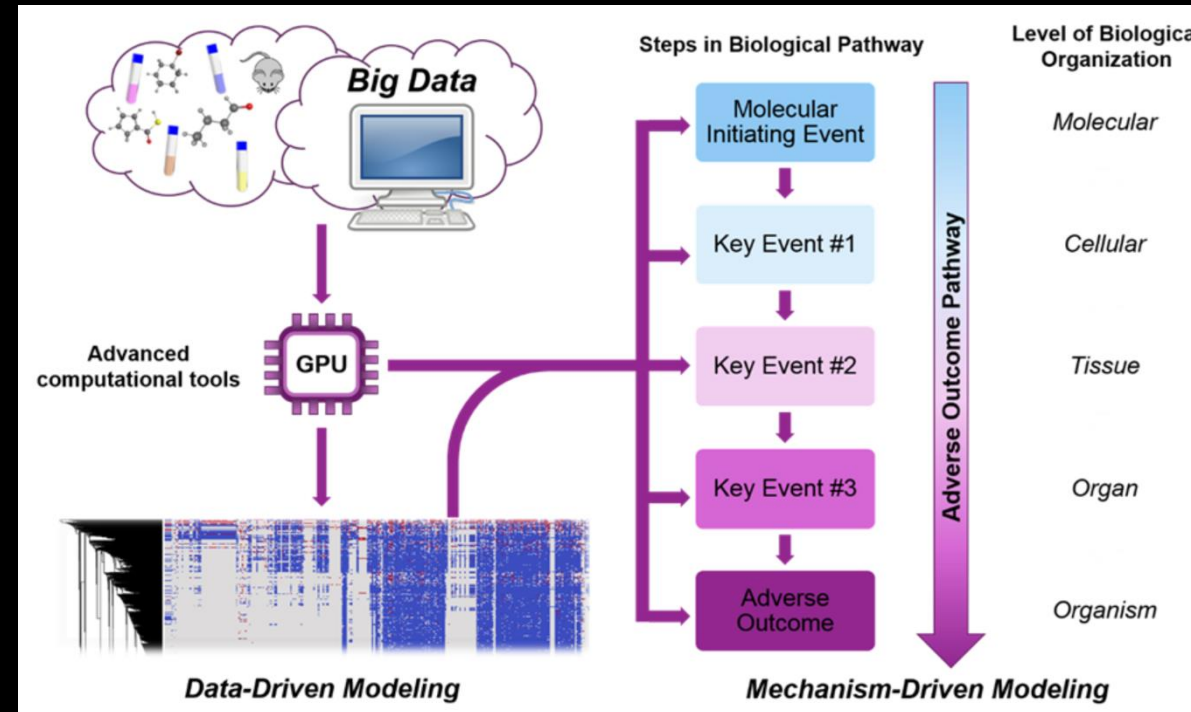
EDCs x receptors

Key ovarian events

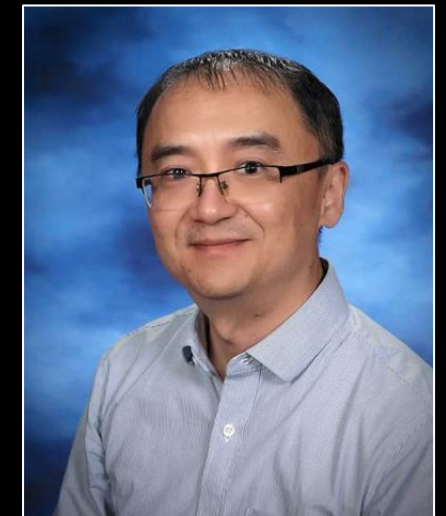
Reproductive outcomes

qAOP

Artificial intelligence



Qiang Zhang, PhD, Emory



Hao Zhu, PhD, Tulane

# Acknowledgements



**Emory University**  
Qiang Zhang, PhD

**Tulane University**  
Hao Zhu, PhD

**Rutgers**  
Brian Buckely, PhD  
Phil Demokritou, PhD  
Nataki Douglas, MD/PhD  
Anat Chemerinski, MD  
Lauren Aleksunes, PharmD/PhD  
Karen Shindler, PhD  
Jinchuan Xing, PhD  
So-Youn Kim, PhD  
**Dartmouth College**  
Brittany A Goods, PhD

**Michigan State University**  
Teresa K. Woodruff, PhD  
Ripla Arora, PhD  
Vasantha Padmanabhab

**UCLA**  
Amander Clark, PhD

**Oregon National Primate  
Research Center (ONPRC)**  
Mary Zelinski, PhD  
Leo Han, MD/PhD

**UIUC**  
Jodi Flaws, PhD

## Funding Supports

- Bill & Melinda Gates Foundation
- NIH/NIEHS R01 ES037796
- NIH/NIEHS R01 ES035766
- NIH/NIEHS R01 ES032144
- NIH/NICHD R01 HD115810
- NIH/NICHD R01 HD114750
- DOD TX220205
- NIH/NIEHS K01 ES030014
- NIH/NIEHS P30 ES005022
- NIH/NIEHS P01 ES028942
- NIEHS/NCATS UH3 ES029073
- NJDEP
- Start-up fund at Rutgers
- NSF 1832901

**I Am A FIRbee**  
Frontiers in Reproduction Course

## Xiao Lab

- Jiyang Zhang (Research AP)
- Shichao Liu (Research AP)
- Mi Ran Choi (Research Associate)
- Antonella Cares (postdoc)
- Congcong Zhang (postdoc)
- Yubing Liu (postdoc)
- Lauren Gibbs (REI fellow)
- Olovoa Chafitz (REI fellow)
- Kuhelica Mali (PhD student)
- Samantha Cheron (PhD student)
- Sonia Song (Pharmacy student)
- Shaojun Yang (Lab manager)
- Lisa Liu (Lab tech)
- Undergraduate students

## Former lab members

- Wenlong Zhao (postdoc)
- Li Chen (postdoc)
- Tingjie Zhan (postdoc)
- Pawat Pattarawat (postdoc)
- Yingzheng Wang (PhD, Cornell)
- Jingshan Xu (MS, SJU)
- Maria McClam (PhD, USC)
- Many others

