



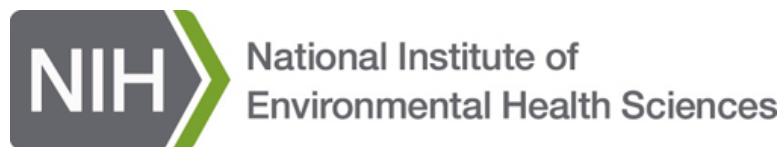
# Anthropogenic chemicals & nanomaterials: Persistent Concerns in Oceans and Human Health.

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*Woods Hole Center for Oceans and Human Health*

*Boston University Superfund Research Program*



US-NIEHS



US-NSF

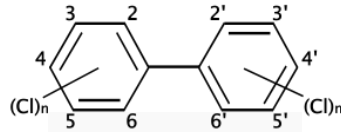


US-NIH Superfund

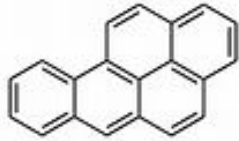
# Examples of Contaminants/toxins

## Legacy Pollutants

- PCBs

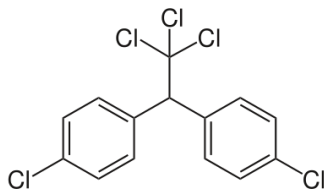


- PAHS



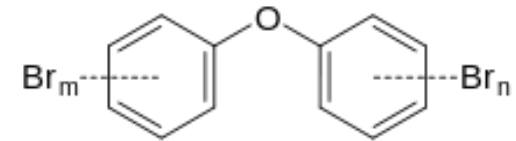
- Metals e.g. MeHg

- Pesticides e.g. DDTs



## More Recent Concerns

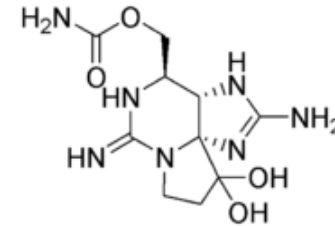
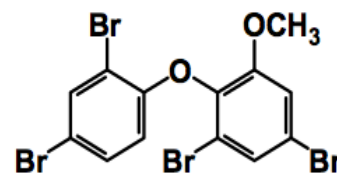
- PBDEs



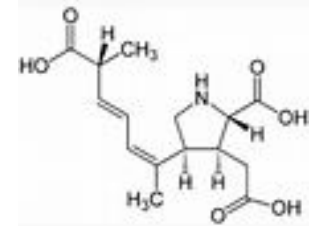
- Nanomaterials

- Personal Care Products

- Natural Products/Toxins



STX



DA

*Total numbers of chemicals are staggering.*

## Abundance and Implications

- Globally distributed

*Planet is chemically different than 100 yrs ago.*

- More abundant in coastal areas

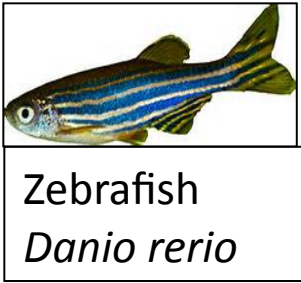
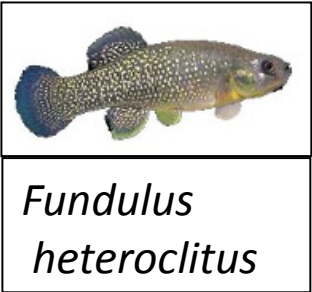
- Variable levels depending on input source  
(or algal bloom)

- Vectored to humans mostly in seafood  
(an issue in seafood safety)

- Variety of effects including on:

*Neural development and function*

Approaches to study



Molecular  
Mechanisms



Biomedical  
Insight and use

Toxins and  
toxicants

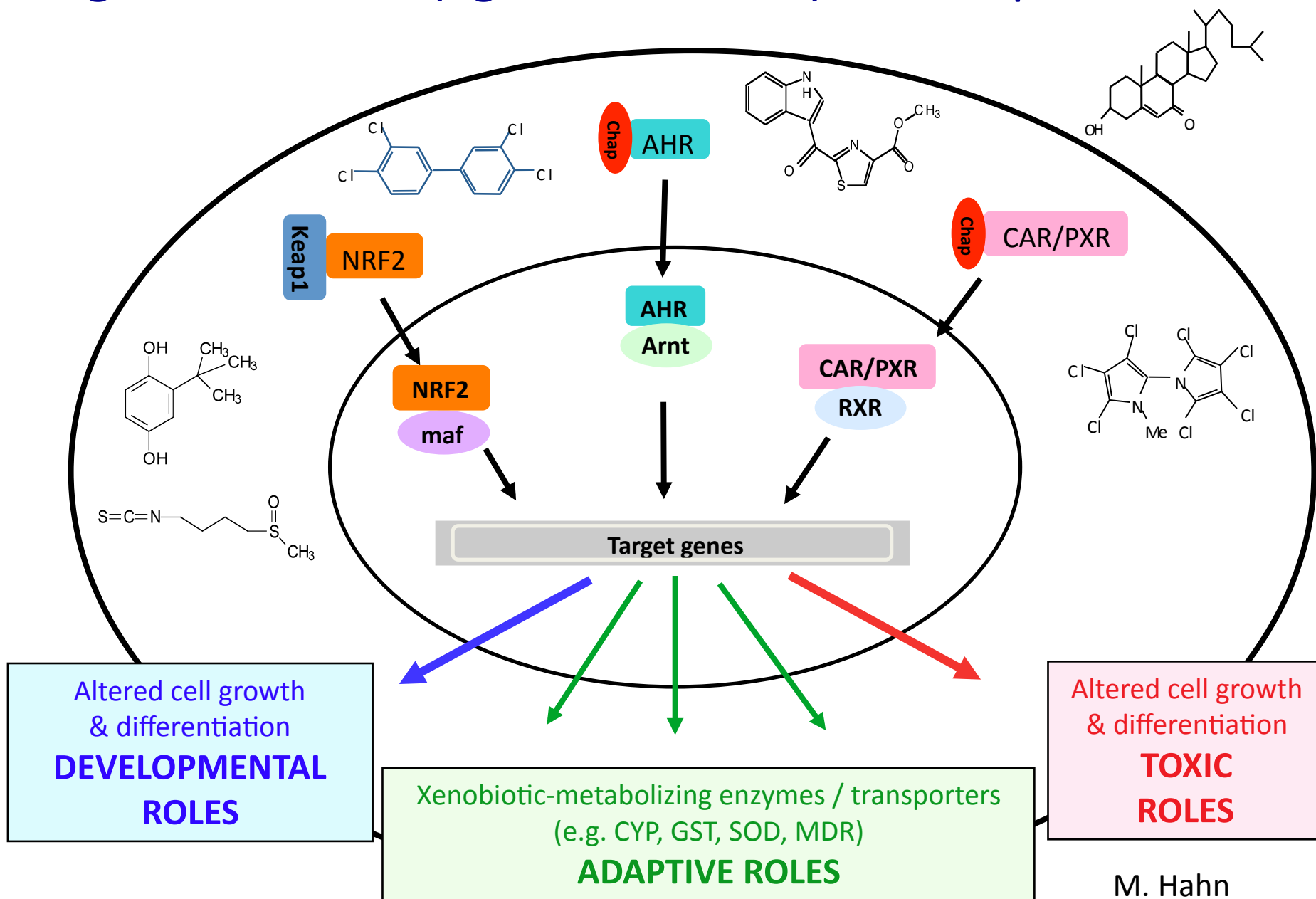
Global and  
Ocean issues



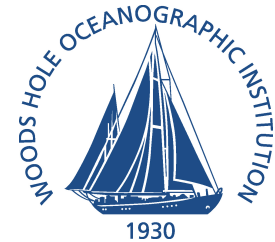
Evolution &  
Diversity



# E.g., Conditional (ligand-activated) transcription factors

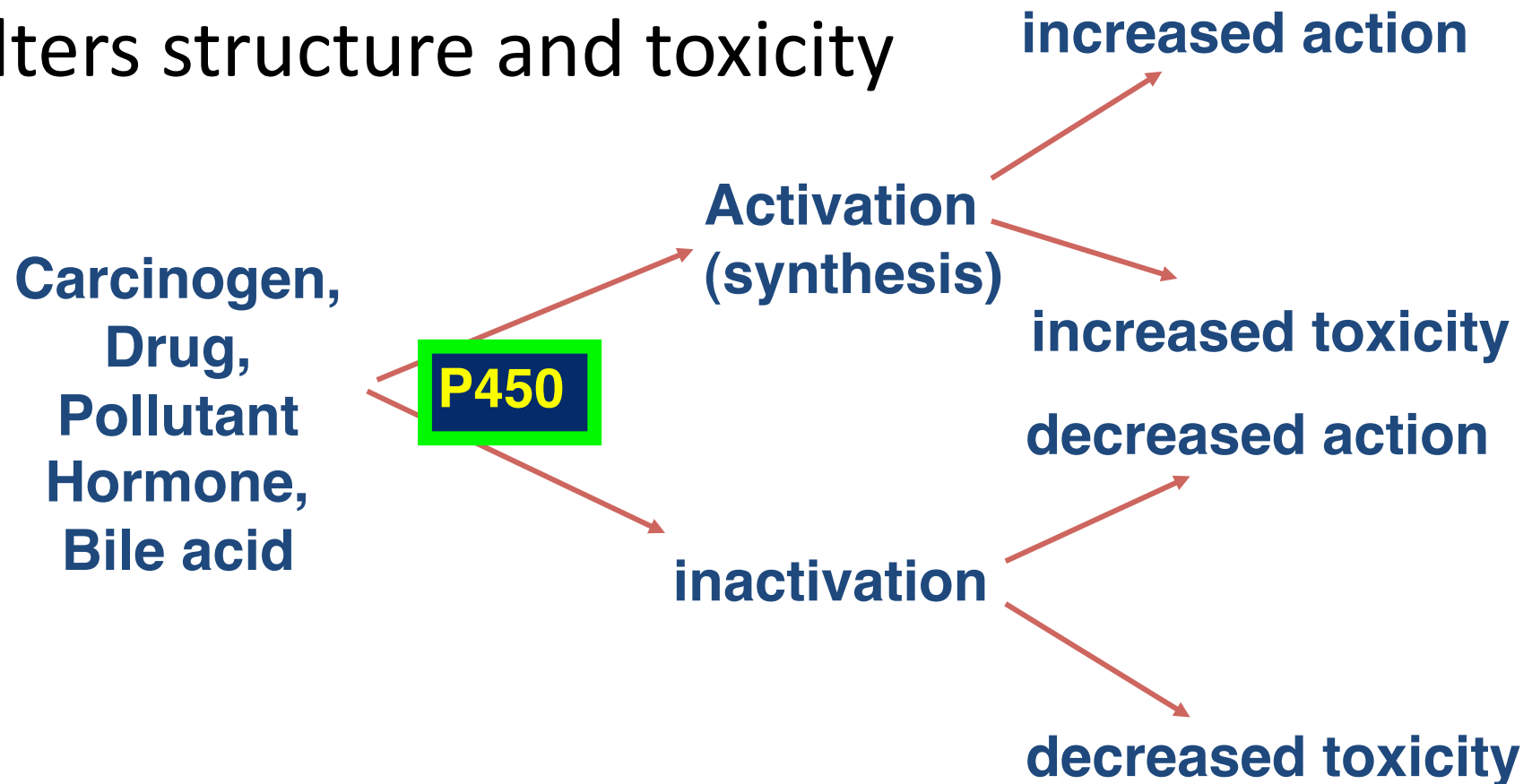


# Complexities

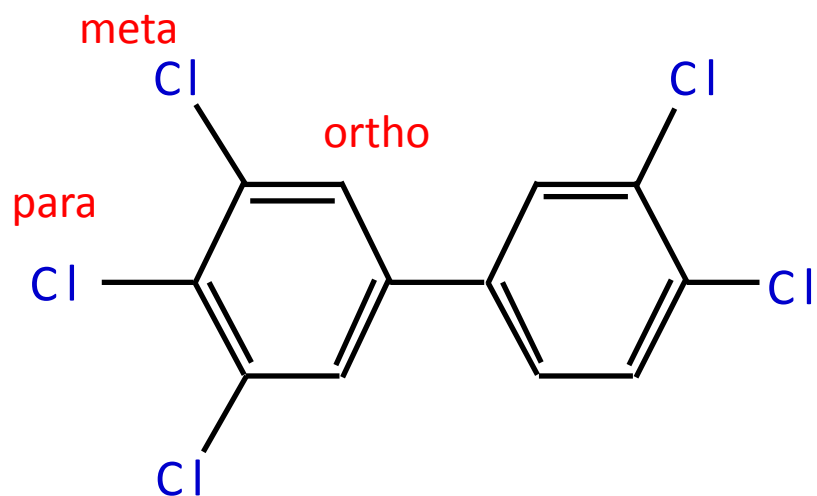


- Multiple Structures
  - e.g., 209 possible congeners of PCBs & PBDEs
- Diverse Structure-activity relationships
- Biotransformation
- Multiple mechanisms of toxicity
  - (plus, species/allelic variation in proteins involved)
- Poorly known interactive effects

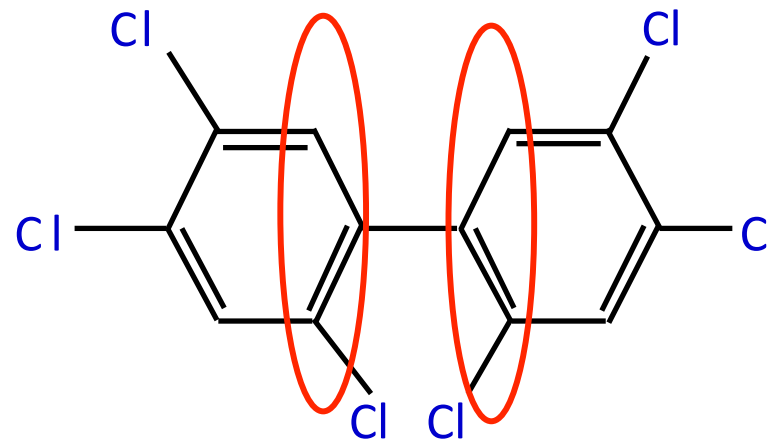
# Metabolism of chemicals alters structure and toxicity



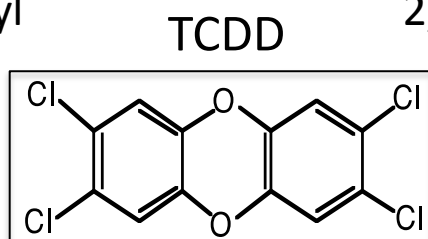
# Example of structural diversity: Polychlorinated biphenyls (PCBs)



**non-ortho PCB (PCB-126)**  
3,3',4,4',5-pentachlorobiphenyl

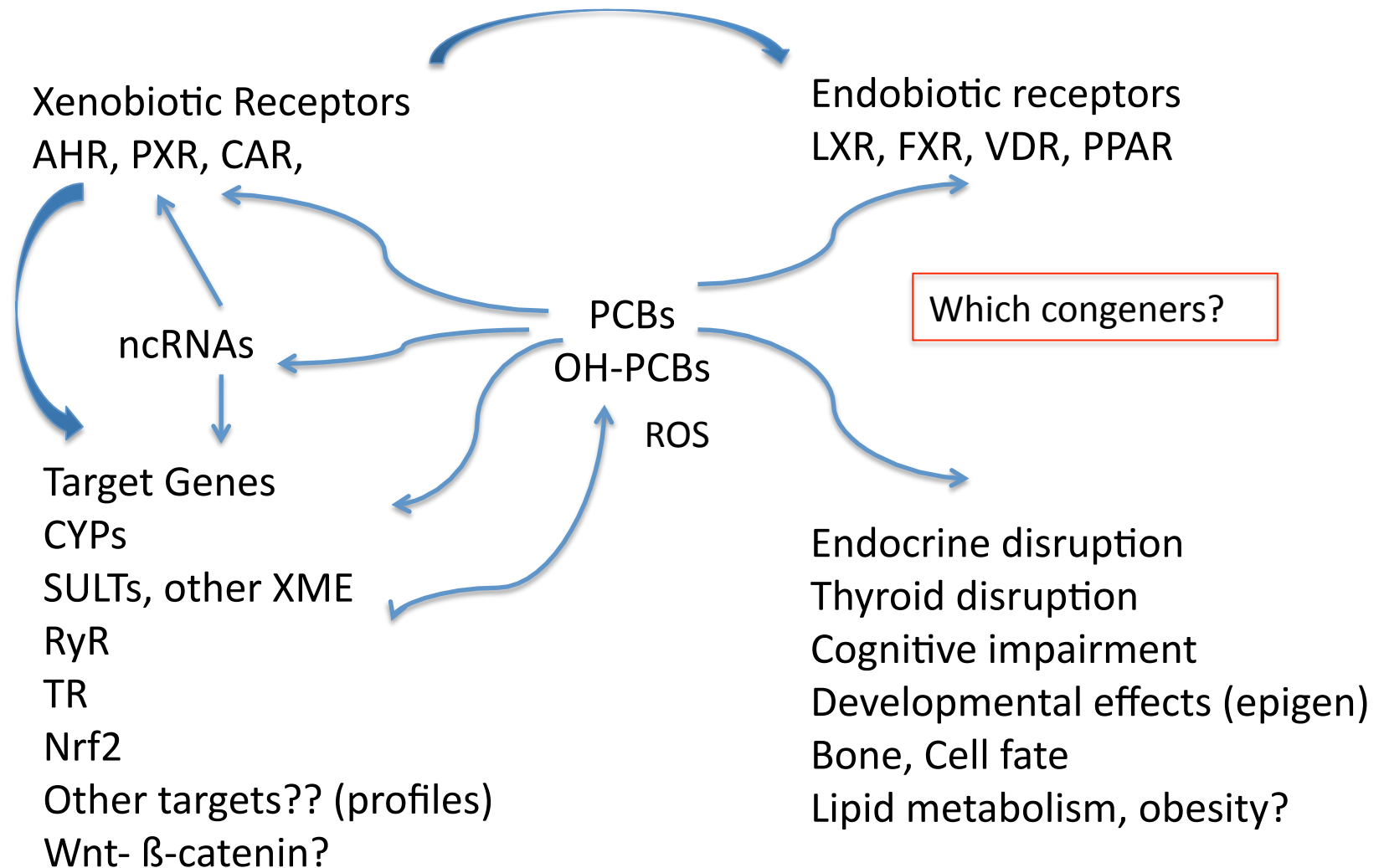


**Di-ortho PCB (PCB-153)**  
2,2',4,4',5,5'-hexachlorobiphenyl





# Complexities of PCB mechanisms



Stegeman, unpublished

## *Biological variation in response:*

### *Species differences:*

- Molecular response to dioxin -
- 5,000-fold difference among mammals

### *Allelic differences:*

- Activation of PXR by an agonist -
- 20-fold difference among strains of zebrafish\*

\*Collaboration with Goksoyr et al

# The Challenges

**Most challenges apply to chemicals and HAB toxins,  
and to wildlife as well as humans.**

**Needs:** Identify toxicants and establish exposure levels

Understand mechanisms

Determine significance of low level exposures

*Distinguish adaptive and adverse responses*

**Areas of more recent concern:**

Developmental origins of health & disease

Neurological defects (ADHD, cognitive issues)

Epigenetic effects → Transgenerational effects

Environment effects on chemical state & bioavailability