

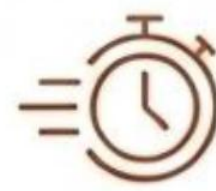
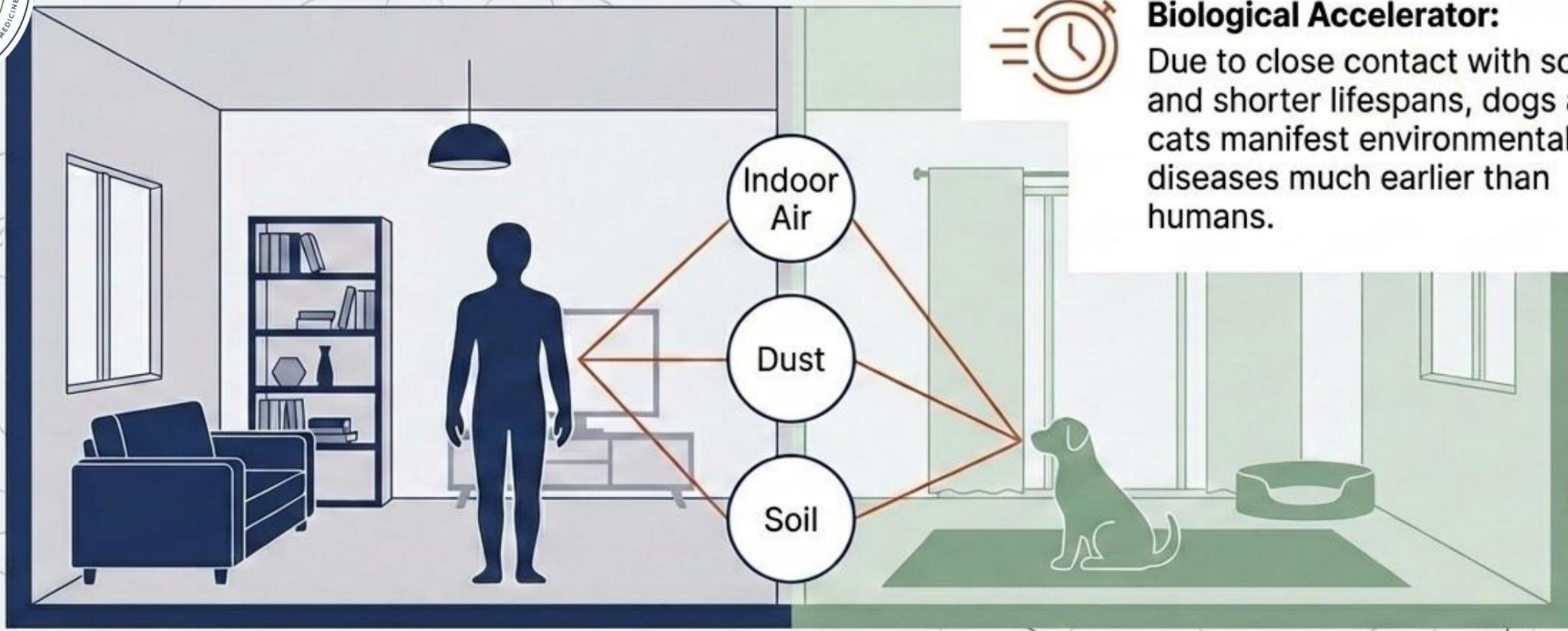


# Sentinels of the Anthropocene

How animals reveal invisible threats in domestic, urban, and global environments.

The 'One Health' Approach to Modern Toxicology.





**Biological Accelerator:**  
Due to close contact with soil and shorter lifespans, dogs and cats manifest environmental diseases much earlier than humans.

## Validated Practical Example

The incidence of pleural mesothelioma in dogs is an excellent early bio-indicator of past environmental exposure to asbestos for the human population residing in the same environment.

### Bibliography

- [1] Glickman, L. T., Domanski, L. M., & Hayes, H. M. (1983). Canine mesothelioma: a model for human disease. *American Journal of Industrial Medicine*, 4(1), 219-227.
- [2] Backer, L. C., et al. (2001). Household and Environmental Contaminants. *Journal of Environmental Health*, 64(6),

## The Historical Warning



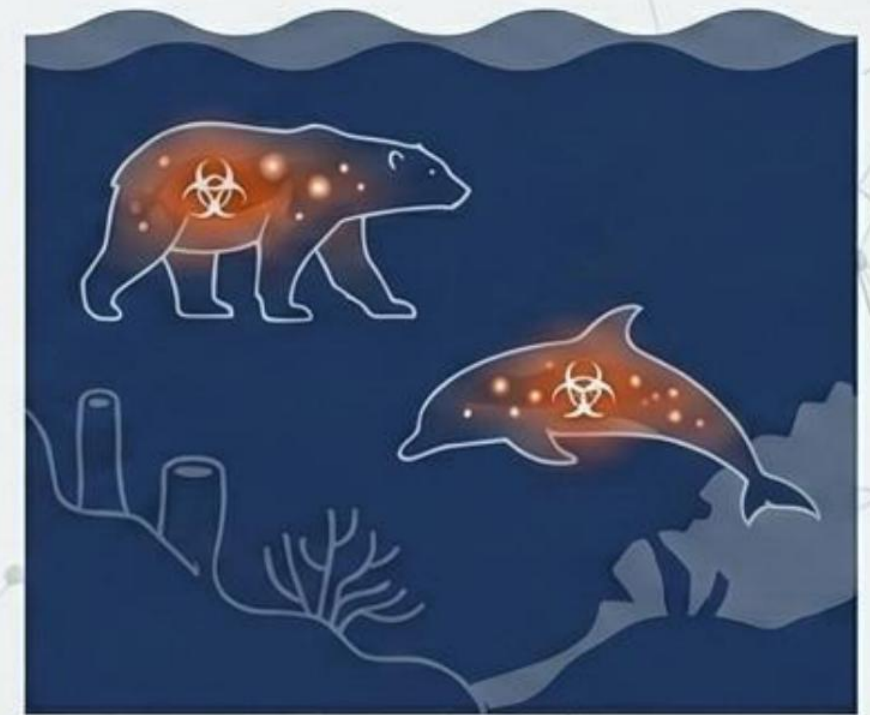
Avian eggshell thinning was the first and decisive warning signal against the overuse of the insecticide DDT.

## Extreme Vulnerability



As aquatic and terrestrial species, they exhibit rapid rates of feminization and severe developmental anomalies in response to pesticide exposure.

## Bioaccumulation



Enormous burdens of persistent organic pollutants (POPs) concentrate in their tissues. In mollusks, phenomena of *imposex* serve as a barometer for marine health.

**3.70** MILLION

tonnes of agricultural pesticides used globally in 2022 [1].

**385** MILLION

estimated cases of acute unintentional pesticide poisoning worldwide [2].

**≈11,000**

estimated annual deaths from acute unintentional pesticide poisoning worldwide [2].



## The Ecological Cost

Intensive agriculture relies on large volumes of chemical inputs. Pollinators and other non-target organisms are among the first biological indicators of ecosystem pressure.


### Bibliography

[1] FAO (2023). Pesticide Use, FAOSTAT.

[2] Boedeker W. et al. (2020). The global distribution of acute unintentional pesticide poisoning: estimations based on a systematic review. BMC Public Health, 20, 1875.

## The Action

40%\*



**Urban Pest Control:**  
Dispersion of tons of insecticides (e.g., Pyrethroids) in cities against flies and mosquitoes.

## Collateral Damage

60%\*

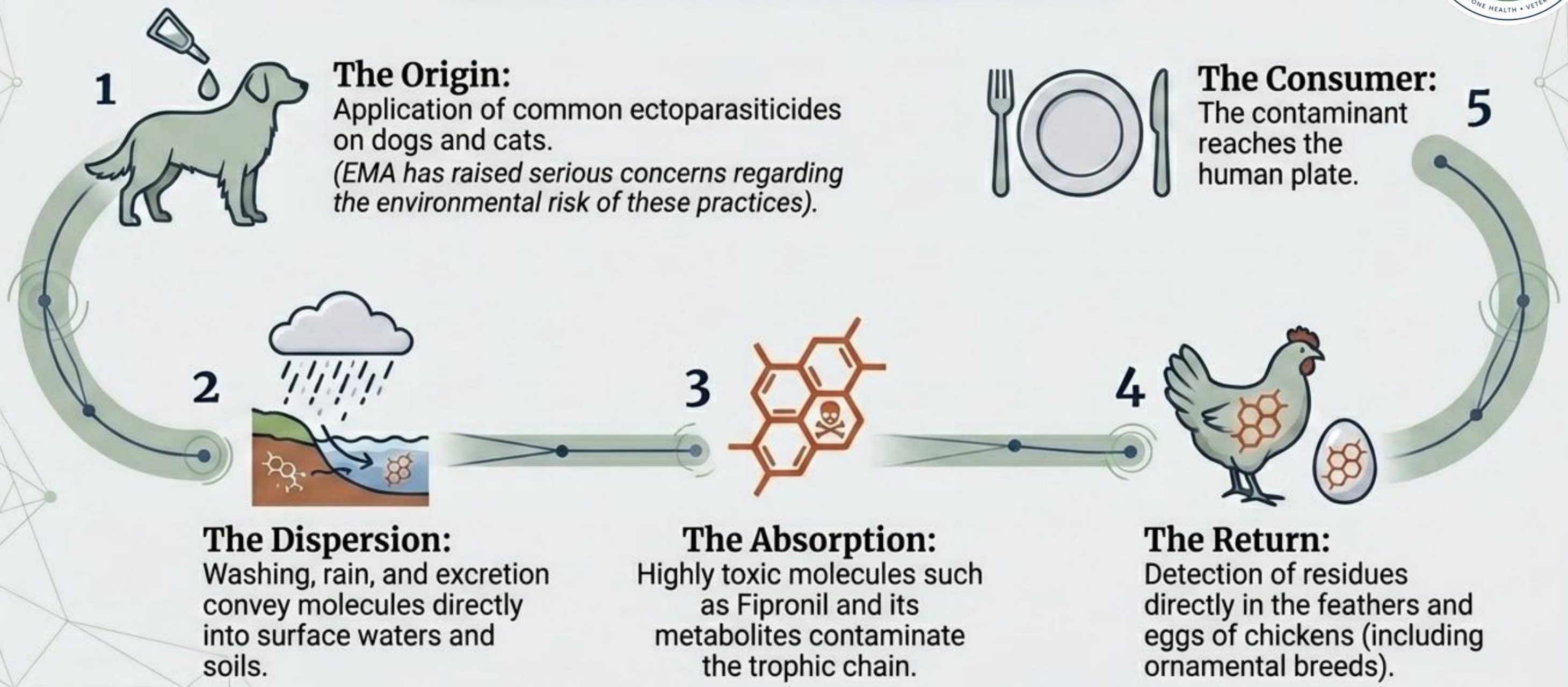


Extremely high lethal toxicity for fish and aquatic invertebrates even at minimal concentrations.



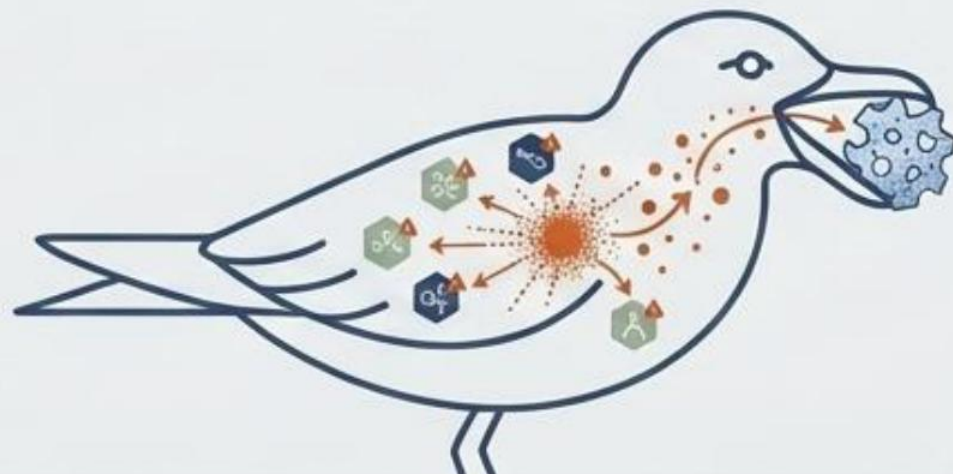
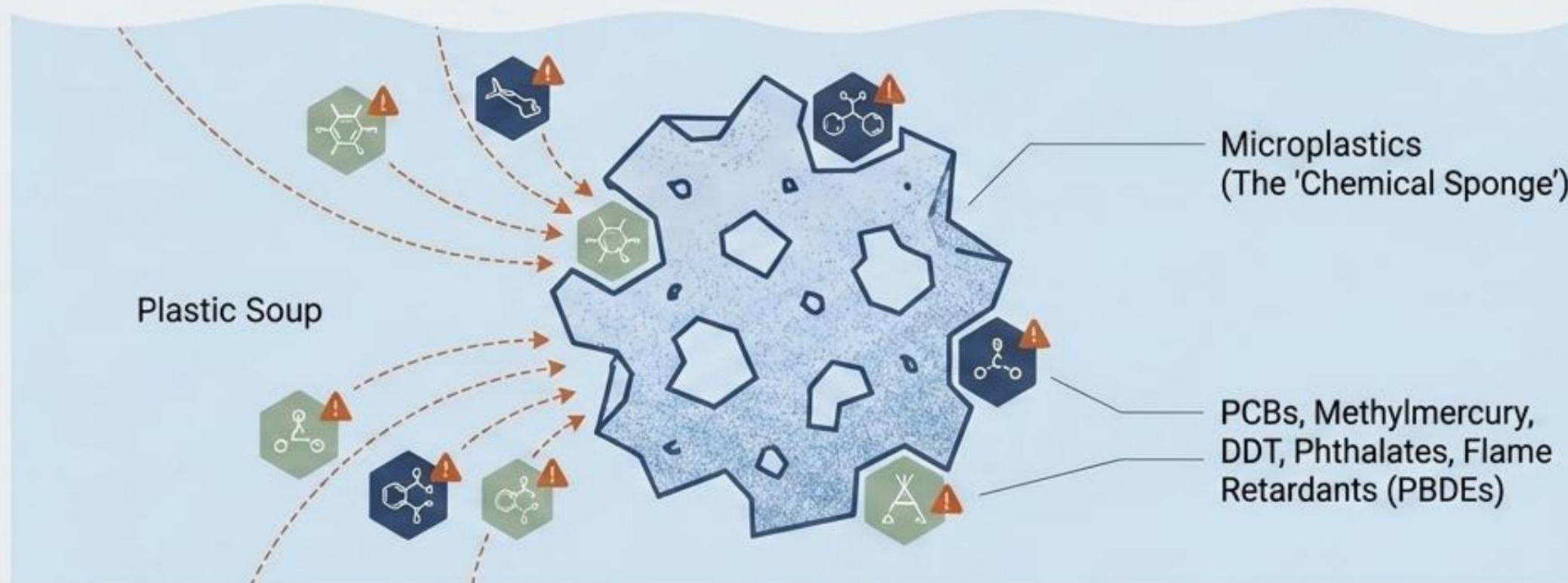
Chronic exposures to 'sub-lethal' doses of permethrin destroy olfactory memory and learning capacities of bees, compromising their survival.

**Companion-animal ectoparasiticides are a relevant pathway of environmental release for active substances such as fipronil and imidacloprid.**



# The Cocktail Effect:

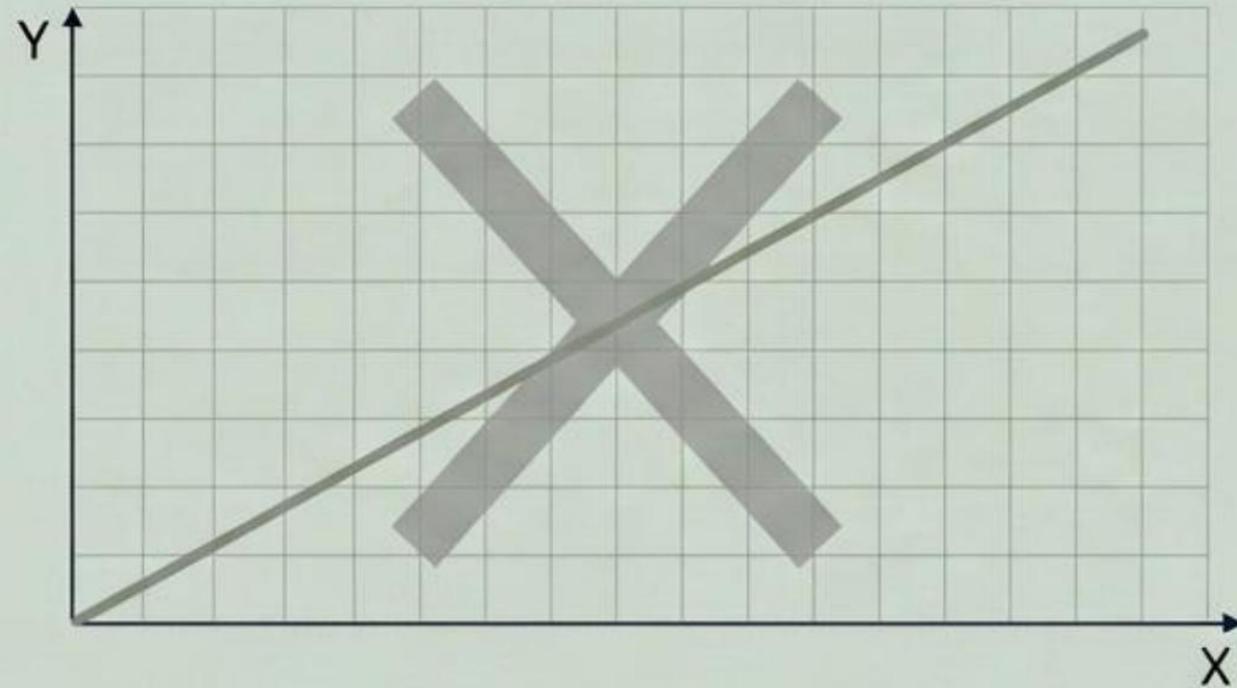
No living organism is exposed to a single isolated pollutant.  
We confront countless molecules simultaneously.



Once ingested by fish or marine birds,  
these plastics release their toxic load  
directly into the animal's tissues,  
drastically amplifying exposure.

# The Challenge of Modern Toxicology

The Old Dogma



Assessment based exclusively on lethal dosages and linear proportionality.

The New Reality

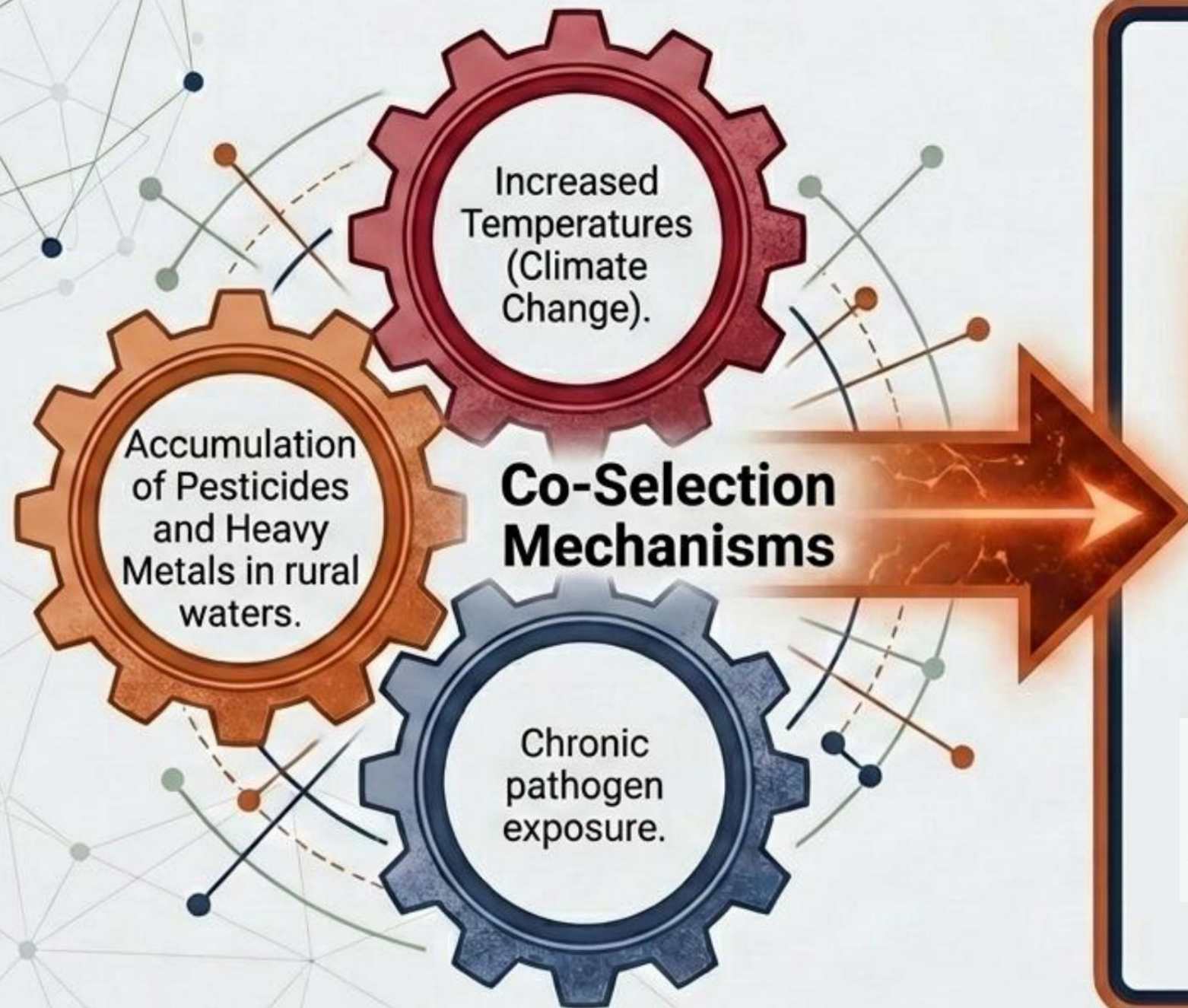


**Non-Monotonic Curves:** For endocrine disrupting chemicals (EDCs) and PFAS, effects at infinitesimal concentrations (low doses typical of chronic environmental exposure) are completely different and more subtle.

**Regulatory testing should better account for low-dose, chronic, mixture-related and non-monotonic effects, particularly for EDCs and PFAS.**



# The Biological Equation: Co-Selection Mechanisms and AMR



## Environmental co-selection

may contribute to the persistence and dissemination of antimicrobial resistance by exposing microbial communities to pesticides, heavy metals, temperature stress and chronic pathogen pressure.

## The Inexorable Circularity

Pollution does not remain 'outside'. Waste, pesticides, veterinary pharmaceuticals, and PFAS released into the environment inevitably re-enter our homes through water, food, and air.



## ⚠️ Mixture > Single

The real risk for organisms lies in the cocktail effect. Evaluating molecules individually severely underestimates the biological hazard.

## The One Health Paradigm

Pathologies in domestic animals and abnormalities in wildlife should be interpreted as potential early warning signals of shared environmental exposure and health risk.



# Bibliography and References

## Non-monotonic dose-response:

- Vandenberg LN et al. (2012). Hormones and Endocrine-Disrupting Chemicals: Low-Dose Effects and Nonmonotonic Dose Responses. *Endocrine Reviews*, 33(3), 378-455.

## Co-selection and AMR:

- Pal C et al. (2017). Co-selection of antibiotic and metal resistance in bacteria and its clinical implications. *FEMS Microbiology Reviews*, 41(4), 487-505.

## One Health paradigm:

- Zinsstag J et al. (2011). From 'one medicine' to 'one health' and systemic approaches to health and well-being. *Preventive Veterinary Medicine*, 101(3-4), 148-156.

## Mixture toxicity:

- Kortenkamp A. (2007). Ten years of mixing cocktails: A review of combination effects of endocrine-disrupting chemicals. *Environmental Health Perspectives*, 115(Suppl 1), 98-105.

## PFAS and environmental pollution:

- Sunderland EM et al. (2019). A review of the pathways and effects of PFAS in the environment and humans. *Journal of Exposure Science & Environmental Epidemiology*, 29(2), 131-147.

## Climate change and health:

- Intergovernmental Panel on Climate Change (IPCC). (2022). *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Relevant chapters on health.



## Prof. Domenico Britti

Life Sciences · One Health  
Veterinary Medicine

Veterinary Toxicology  
Environmental Health  
Pesticides · EDCs · AMR

[domenicobritti-rgb.github.io](https://github.com/domenicobritti-rgb)