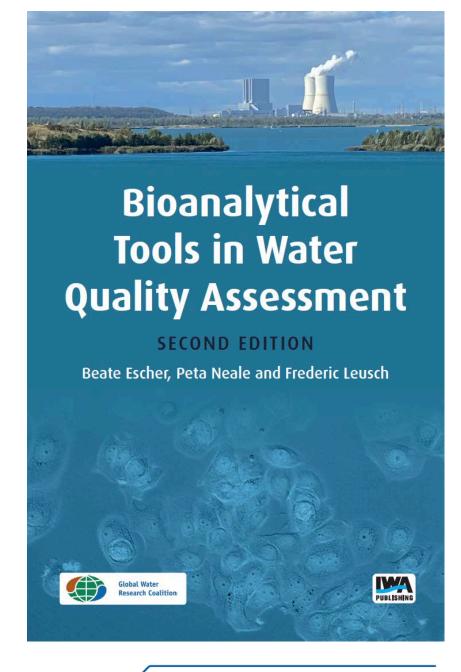
## Chapter 6 Toxicity pathways of chemicals in aquatic organisms

This presentation accompanies Chapter 6 of "Bioanalytical Tools in Water Quality Assessment" https://www.iwapublishing.com/books/9781789061970/bioanalytical-tools-water-quality-assessment-2nd-edition

Exercises can be found at www.ufz.de/bioanalytical-tools

Questions? please send an e-mail to bioanalytical-tools@ufz.de

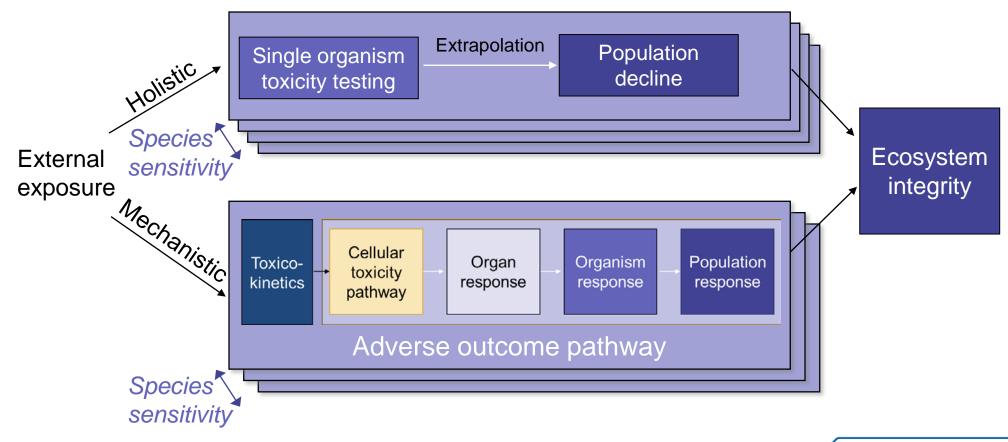


## Learning goals

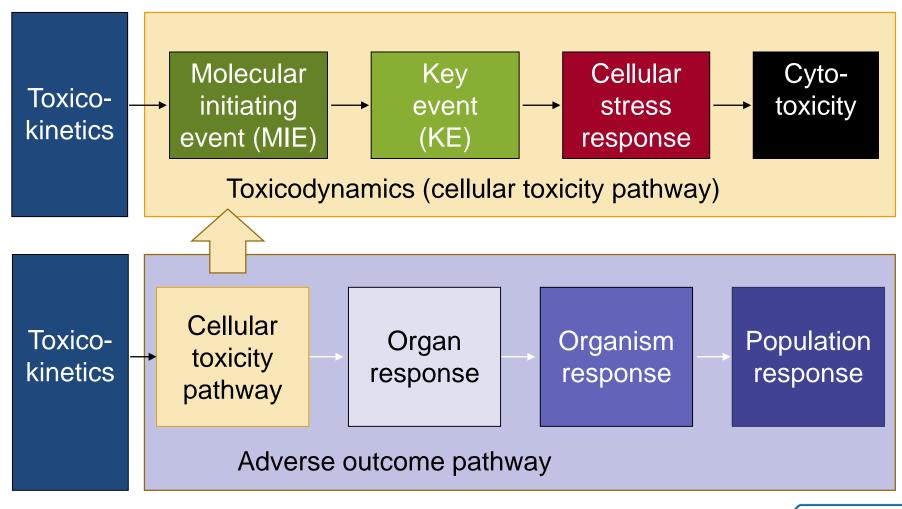
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## Baseline toxicity

XXX



## Link between cellular toxicity pathways and adverse outcome pathways





 hydrophobicity dependent bioaccumulation

#### Adverse outcome pathway in algae: baseline toxicity



Molecular interaction

- changes in fluidity of cellular membranes
- changes in photosynthetic electron transport chain

Cellular response

reduced availability of energy  decrease of cell size

Organism

response

no cell division (reproduction)

- Population response
  - biomass decline
  - smaller growth rate of population



• hydrophobicity dependent bioaccumulation metabolism

### Adverse outcome pathway in algae: inhibition of photosynthesis



#### Molecular interaction

- binding to Photosystem II causing shutdown of photosynthesis
- production of reactive oxygen species



#### Cellular response

- reduced availability of energy
- oxidative stress



#### Organism response

- "bleaching" of cells (loss of chlorophyll)
- decrease of cell size
- cell death



## response

- biomass decline
- smaller growth rate of population

#### Adverse outcome pathway in water flea: baseline toxicity

## Toxico-kinetics

- hydrophobicity dependent bioaccumulation
- metabolism

## Molecular interaction

- changes in fluidity of cellular membranes
- interference with transport processes
- mitochondrial dysfunction



## Cellular response

- interference with nerve signal transduction
- reduced respiration
- reduced availability of energy



## Organism response

- immobilisation
- decreased reproduction
- mortality



 decline of numbers

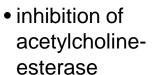


 metabolic activation necessary for organophosphates

#### Adverse outcome pathway in water flea: insecticides



Molecular interaction





Cellular response

- accumulation of acetylcholine
- interference with nerve signal transduction



- over-excitation
- immobilisation
- mortality

Population response

smaller growth rate of population



 hydrophobicity dependent bioaccumulation

## Adverse outcome pathway in fish: baseline toxicity



Molecular interaction



Cellular response



Organism response



Population response

- changes in fluidity of cellular membranes
- interference with transport processes
- mitochondrial dysfunction

- reduced metabolic activity
- reduced respiration
- reduced availability of energy

- loss of equilibrium
- mortality

- decline of numbers
- impaired predator avoidance



hydro phobicity
 dependent
 bioaccu mulation
 metabolism

### Adverse outcome pathway in fish: reproductive toxicity



**Molecular** interaction



Cellular response



Organism response



Population response

- binding to estrogen receptor as agonist
- antagonistic effect on androgen receptor
- COX inhibition

- increased vitellogenin production in hepatocytes
- feminised phenotype of various cells
- reduced serum testosterone
- reduced hypothalamic prostaglandin

- increased vitellogenin levels in males
- ovotestis
- intersex
- feminised phenotype
- damaged and/or immature sperm
- reduced oocyte maturation
- delayed embryo development

- reproductive failure
- decline of population numbers

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