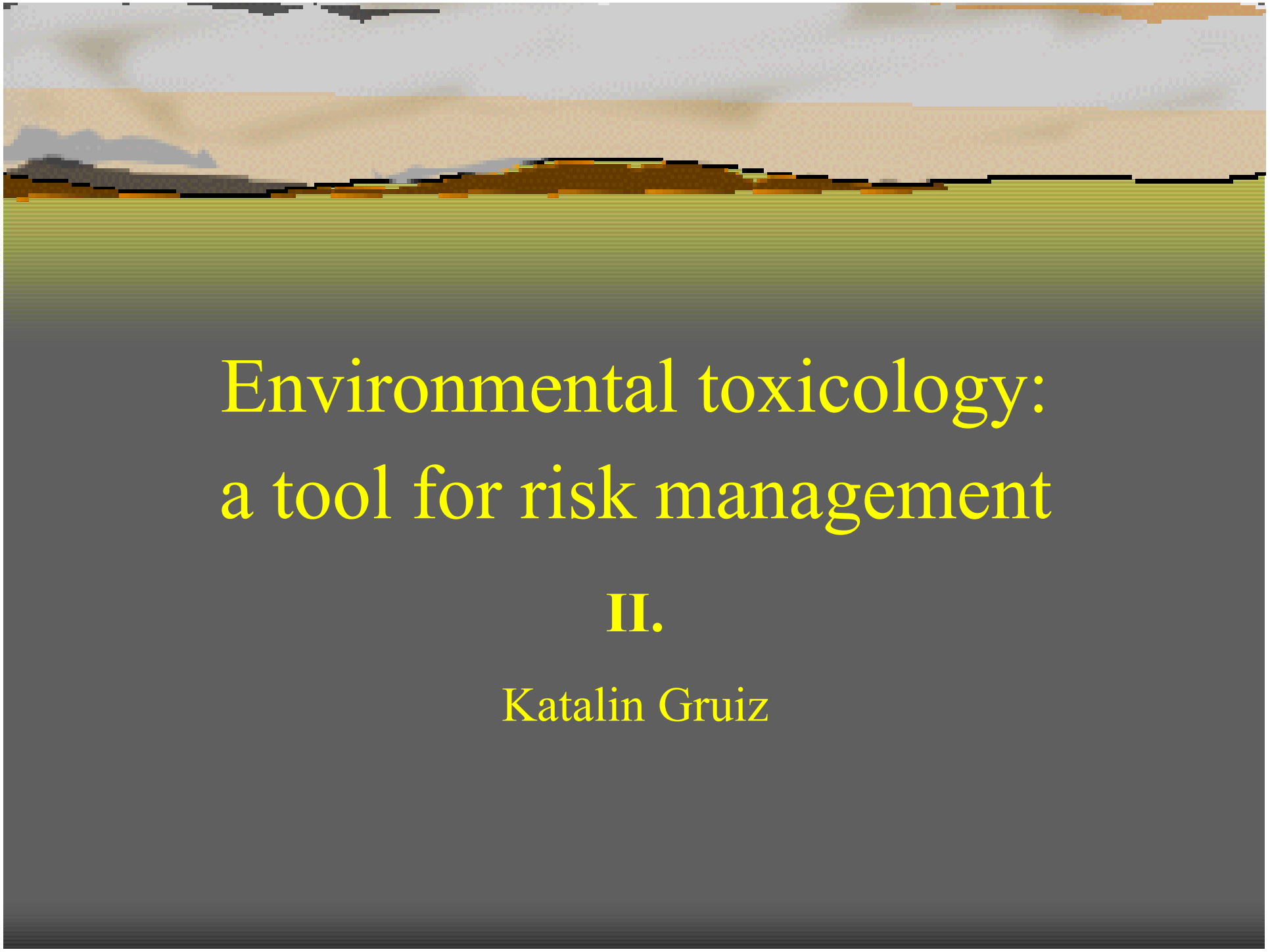


Environmental toxicology: a tool for risk management

II.

Katalin Gruiz

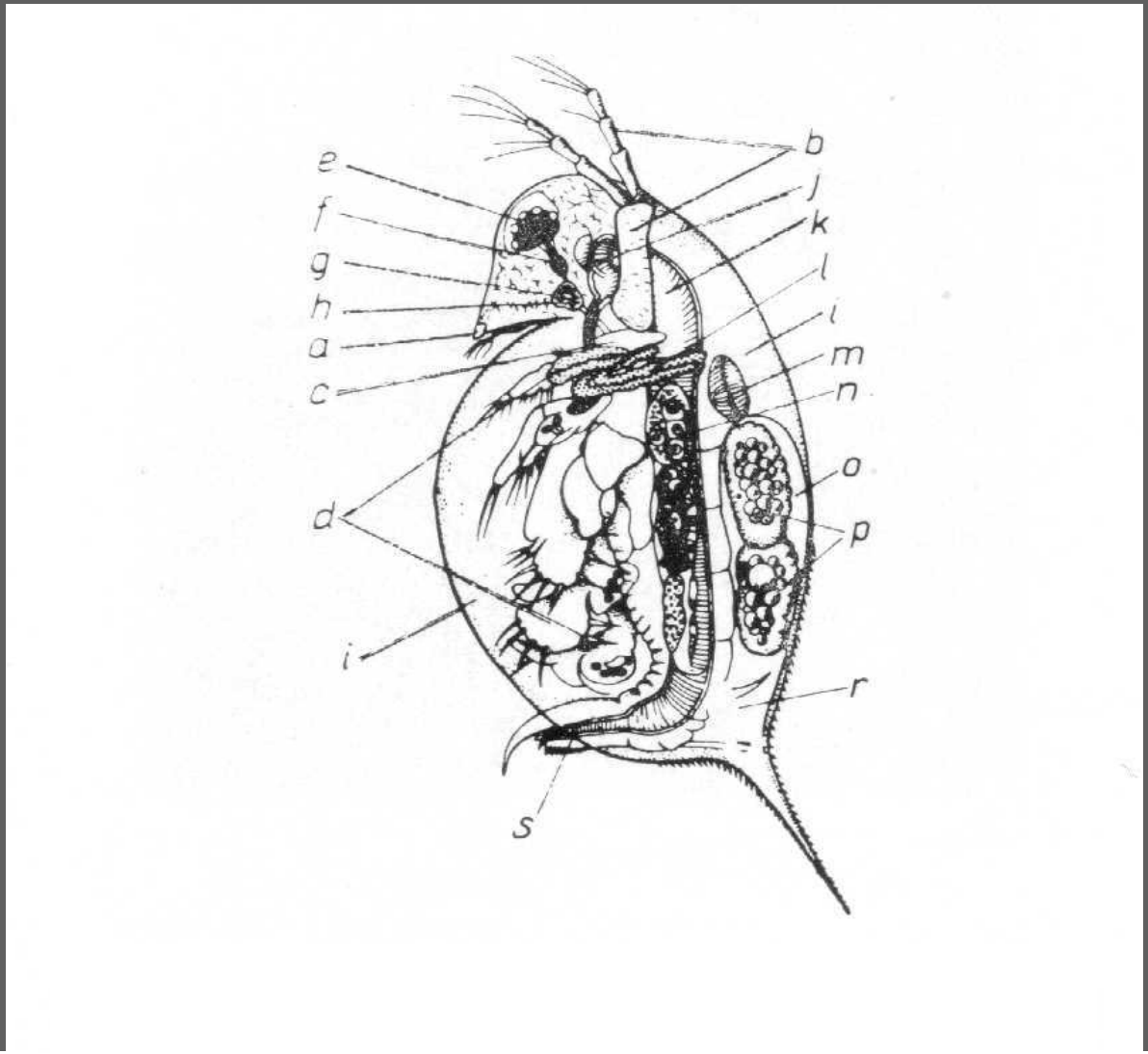
The testorganism: general requirements

1. Availability: the testorganism should be widely available
   - Laboratory culture
   - Other culture facility
   - Collection from the field
2. Maintenance
   - Successfully maintained in the laboratory
   - Available in sufficient quantity
3. Genetics of the culture
   - Genetic composition
   - Genetic history (Norway rat, E. coli)
4. Sensitivity
   - Relative sensitivity for toxicants (contaminants)
   - Special sensitivity for one or a few toxicants
   - Sensitivity for a broad number of toxicants
5. Representing the ecosystem
   - Sensitivity should be representative for the class or phyla
     - The most sensitive
     - More sensitive as the average of the ecosystem
     - "Average" sensitivity
   - Which families or phyla are represented by the testorganism
   - Some families or phyla are not represented at al

The testorganism: general requirements

6. Concentration – response
   - Response should be proportional to the concentration of the toxicant
   - The effective concentration range should be broad
7. Reproducibility, statistics

Daphnia magna



Test parameters of acute and chronic *Daphnia* test*

Daphnia magna	Chronic toxicity test	Acute toxicity test
Organism	*Dahnia magna*	*Daphnia magna*
Age of test organism	less, then 24 h	less, then 24 h
Number of test organism/chamber	10	minimum 10
Experimental design		
Test vessel type and size	100 ml beakers	250 ml
Test solution volume	80 ml	200 ml
Number of replicates per sample	minimum 2	minimum 3
Feeding regime	trout chow, yeast, alfalfa, green algae, diatoms	no feeding
Test duration	21 days	48 hours
Physical & chemical parameters		
Water temperature	20 °C	20 +/-2 °C
Light quality	ambient laboratory levels	ambient laboratory levels
Light intensity	up to 600 lux	540 to 1080 lux
Photoperiod	16 h light & 8 h dark, 15-30 min transition	16 h light & 8 h dark
pH range	7.0–8.6	7.0–8.6
DO concentration	40–100 %	60–100 %
Aeration	not necessary	none
Endpoint	survival, growth, reproduction	immobilisation

*Landis, 2000

Some commonly used aquatic testorganisms

Aquatic vertebrates

Coho salmon – *Onchorhynchus kisutch*
Rainbow trout – *Onchorhynchus mykiss*
Brook trout – *Salvelinus fontinalis*
Goldfish – *Carassius auratus*
Fathead minnow – *Pimephales promelas*
Channel catfish – *Ictalurus punctatus*
Bluegill – *Lepomis macrochirus*
Green sunfish – *Lepomis cyanellus*

Freshwater invertebrates

Daphnids – *Daphnia magna, D. pulex, D. pulicaria, Ceriodaphnia dubia*
Amphipods – *Gammarus lacustris, G. fasciatus, Hyalella azteca*
Crayfish – *Orconetes sp., Combarus sp., Pacifastacus leniusculus*
Stoneflies – *Pteronarcys sp.,*
Mayflies – *Baetis sp., Ephemerella sp., Hexagenia limbata*
Midges – *Chironomus sp.*
Snails – *Physa integra, P. heterostropha, Amnicola limosa, (Mollusca, Gastropoda)*
Planaria – *Dugesia tigrina, (Platyhelminthes, Turbellaria)*

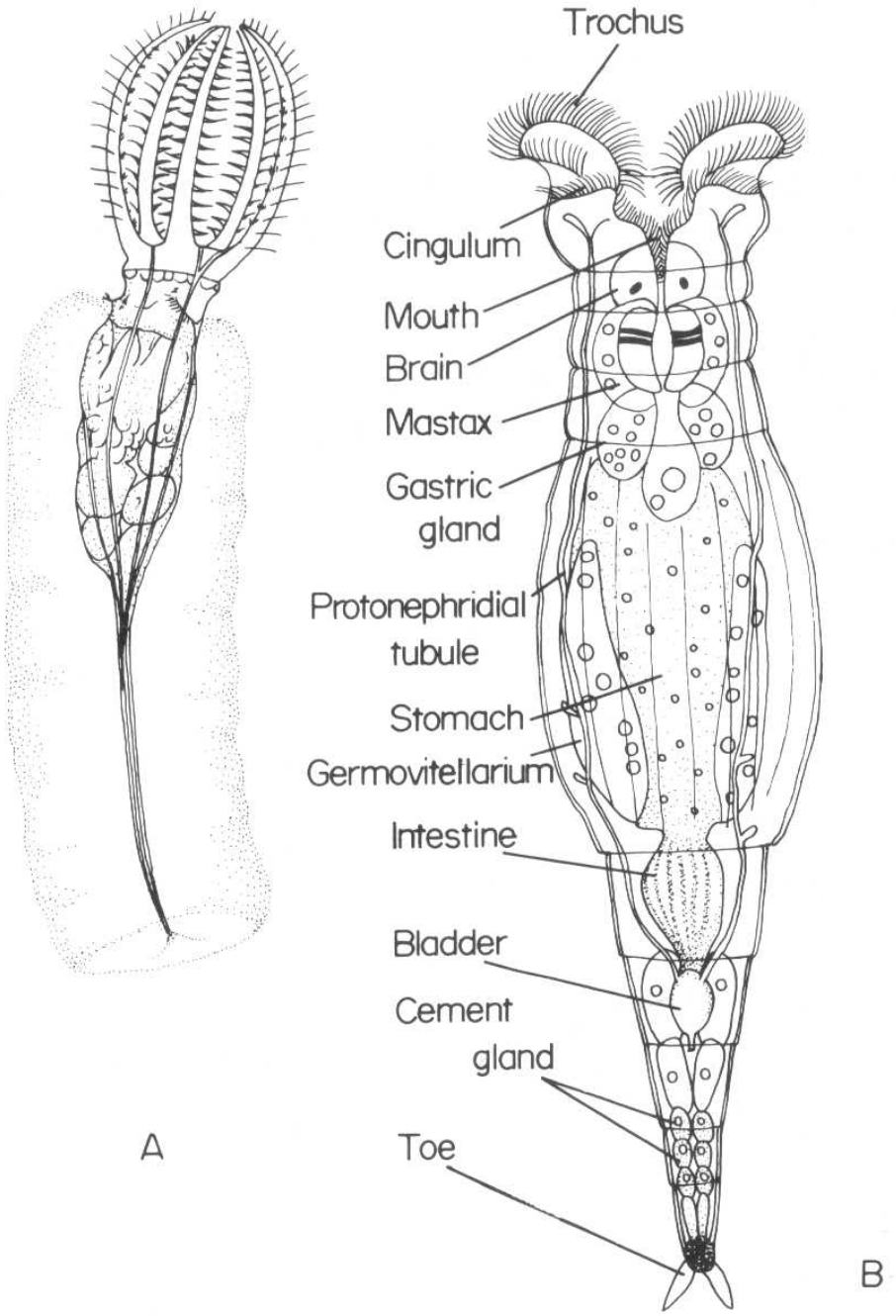
Saltwater invertebrates

Copepods – *Acartia clausi, Acartia tonsa*

Rotifer

Habitat: fresh water or wet soil

Size: smaller, than 1 mm

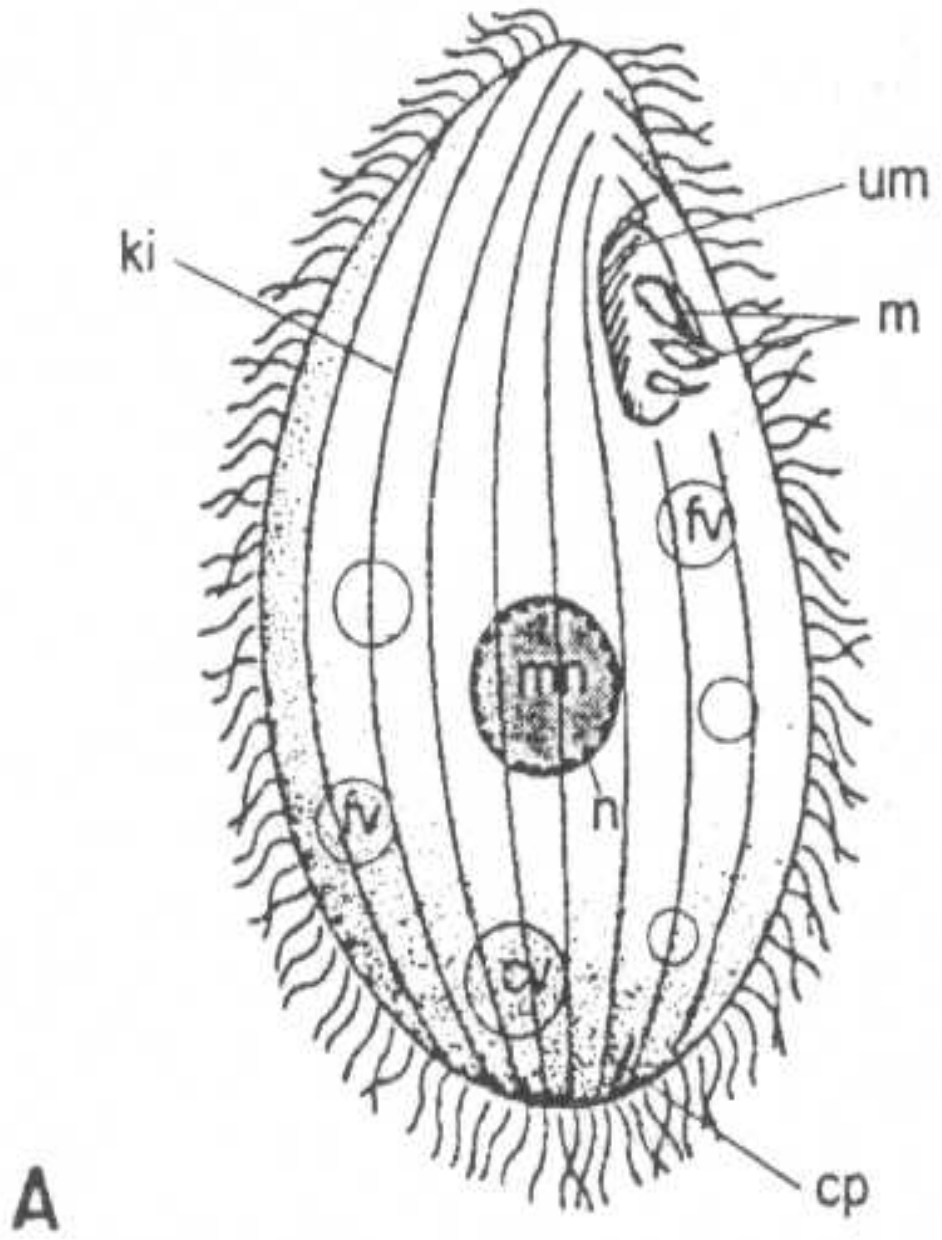


Tetrahymena

Protozoon

Habitat: fresh water or soil

Size: microscopic



QSAR and ecotoxicological testing

- Increasing number of chemicals

Yearly more thousand additional new chemicals come to the cca. 100 000 already produced and used chemical substances. So many substances cannot be examined from all point of view.

- Missing ecotoxicity data

Ecotoxicity data are not available for all kind of chemicals. QSAR makes possible the environmental toxicologist to estimate the toxicity of not tested chemicals, on the basis of its chemical structure, by comparing its effect to known substances.

- QSAR = Qantitative Structure – Activity Relationship

Toxicity of chemically similar substances can be described by mathematical equations.

Fish toxicity of aliphatic and aromatic hydrocarbons

$1/LC_{50} = 0.871 * \log K_{ow} - 4.871$

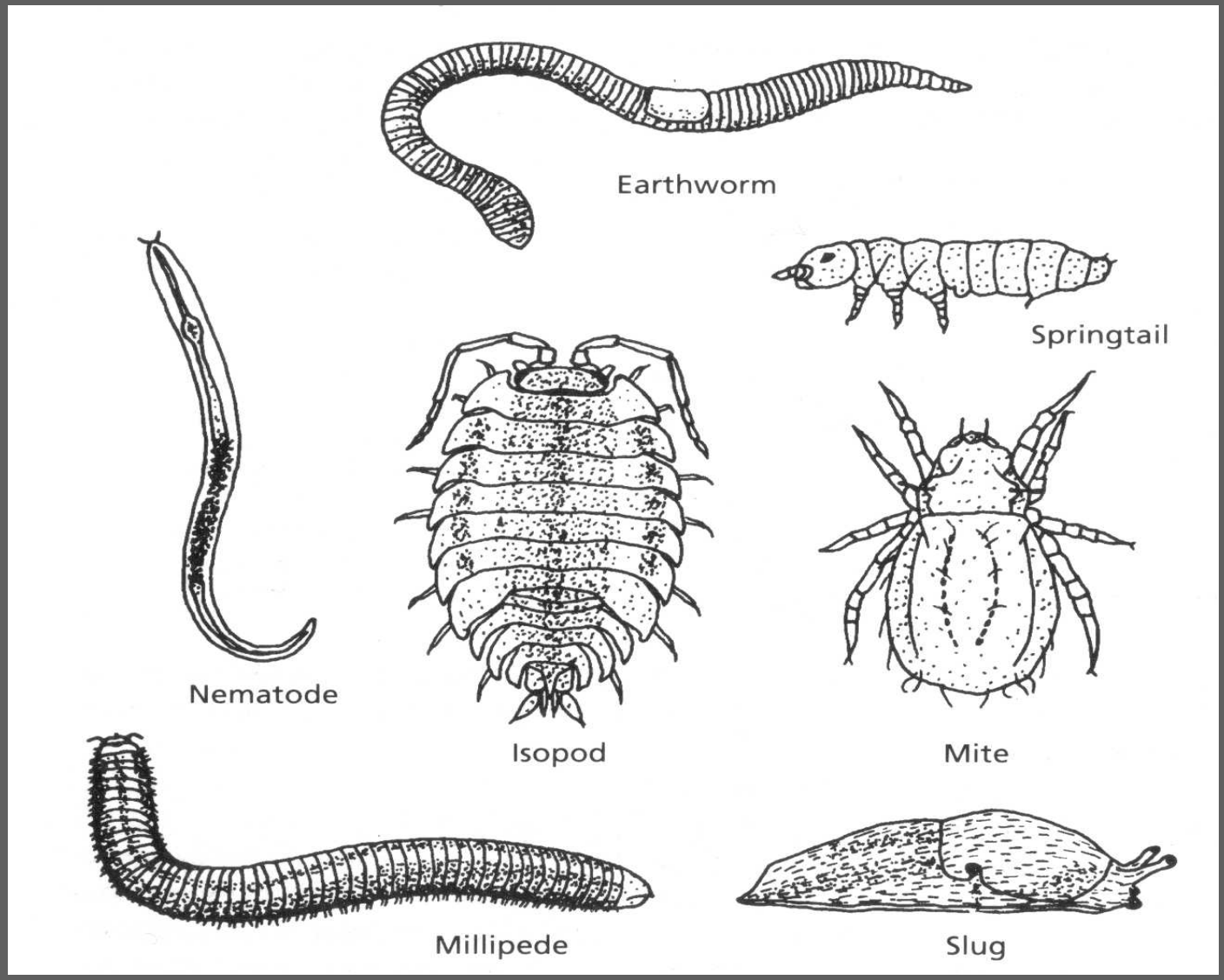
Bioconcentration of aromatic compounds by *D. magna*

$\log BCF = 0.898 * \log K_{ow} - 1.315$

Biodegradability (BC) of phtalate-esthers

$BC = -24.308 * \log K_{ow} + 394.84$

Terrestrial testorganisms

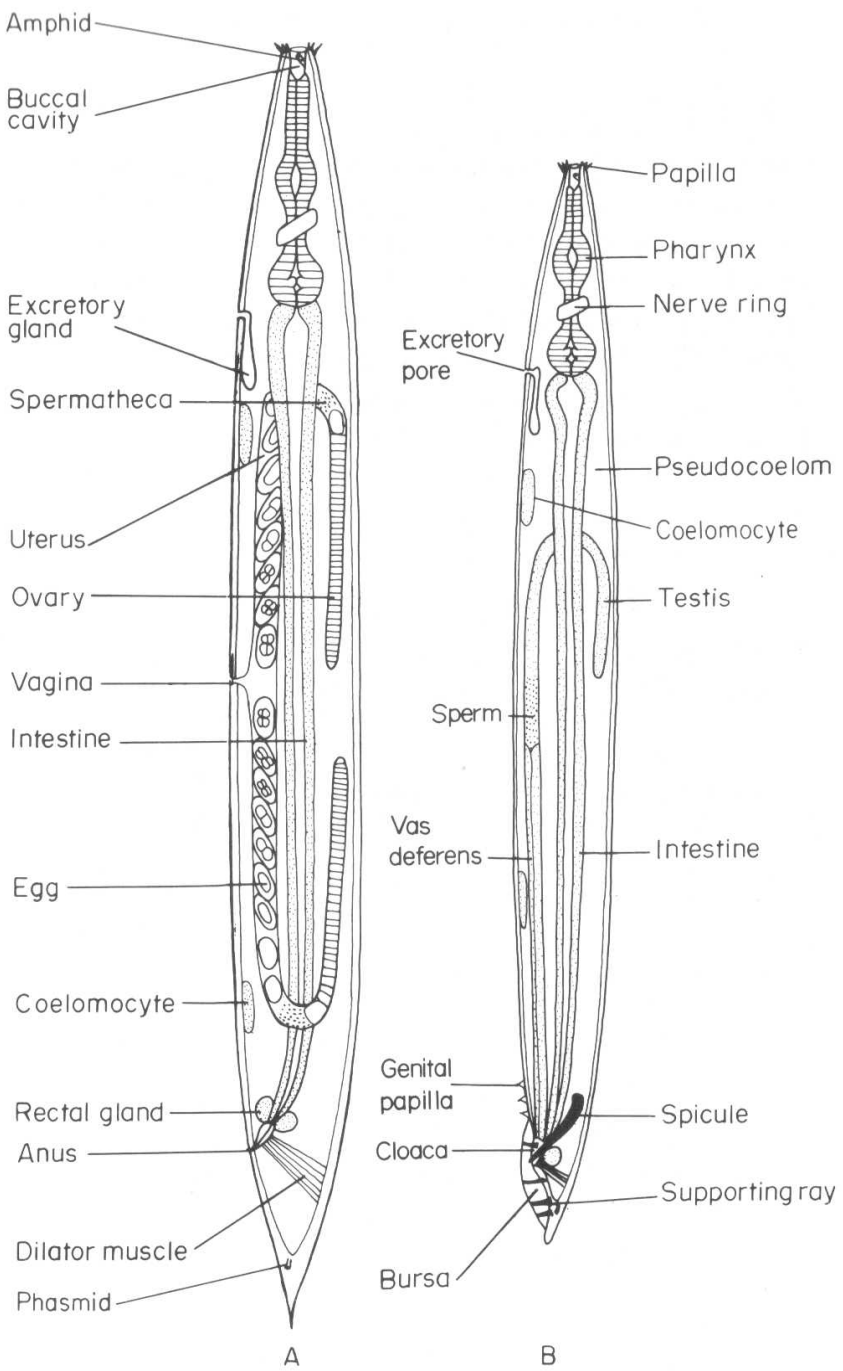


Nematodes

Types: free living or parasites

Habitat: fresh water, marine water or soil, in plant or animal organisms

Size: from microscopic to cm-s



Collembola grown in the lab on the surface of a black matrix of active carbon + gypsum

Acute toxicity of Collembola on the effect of hydrocarbons