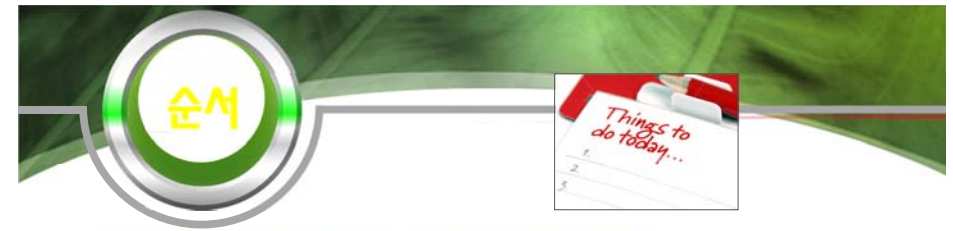


오염 생물학

PART 2. 환경독성학

김종성
(서울대 지구환경과학부)



오염 생물학-2.환경독성학

1. 환경독성학
2. 유해물질의 노출경로
3. 위해성 평가
4. 최근연구동향



Environmental Toxicology

- ‘ecotoxicology’
 - study of impacts of pollutants on the structure and function of ecosystems’
 - manmade poisonous chemicals and their effect on the environment
- does not include the study of naturally occurring toxins, e.g., cholera toxin or brevitoxin etc

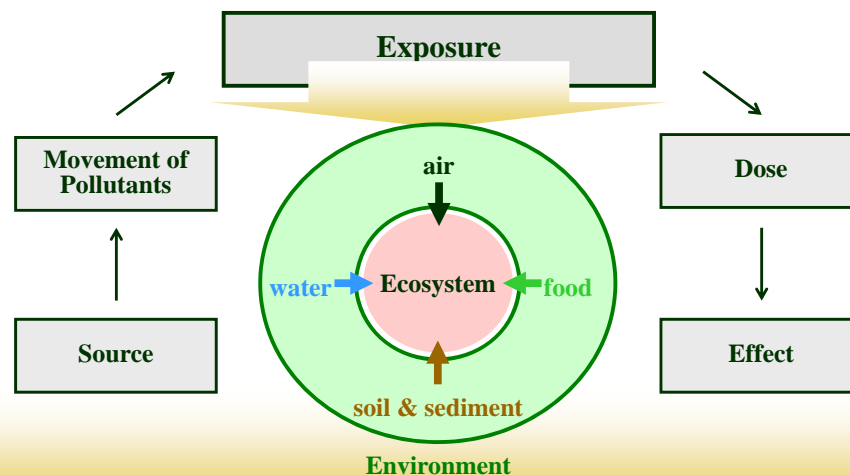
(SETAC, 1979)

Concerns in Environmental Toxicology

- Air
 - Ambient
 - Indoor
 - Occupational
- Water
 - Drinking
 - Surface
 - Ground
- Soil & Sediment
 - Contact
 - Uptake or Migration
- Food
- Consumer Products
 - Commercial
 - Drugs
 - Cosmetics
- “Toxics” (other than above)
 - Hazardous substances
 - Waste disposal

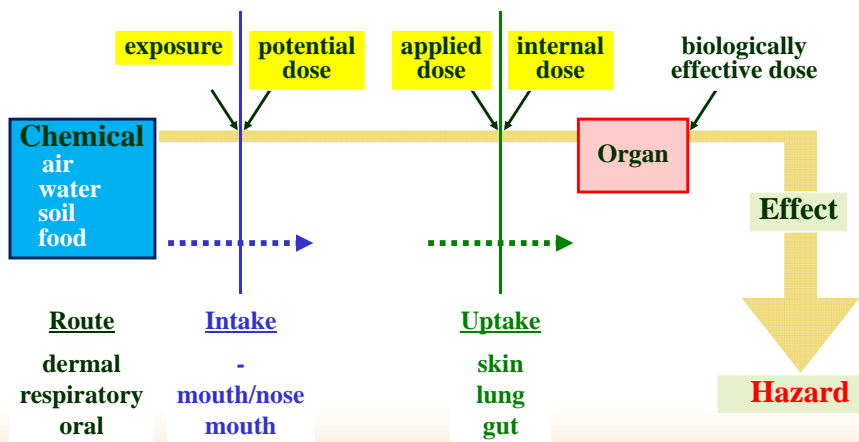
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Environmental Exposure (conceptual)



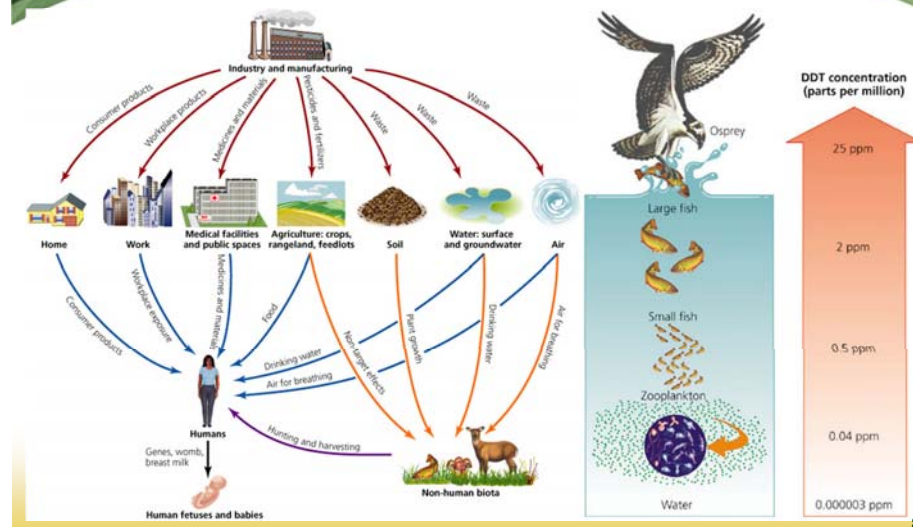
6

Toxicology: Routes of Exposure



7

Exposure of Toxicants



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Toxicology: Important Terms!

- **Toxicity:**
The adverse effects that a chemical may produce



- **Dose:**
The amount of a chemical that gains access to the body



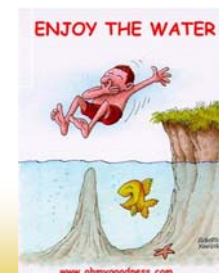
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Toxicology: Important Terms!

- **Exposure:**
Contact providing opportunity of obtaining a poisonous dose

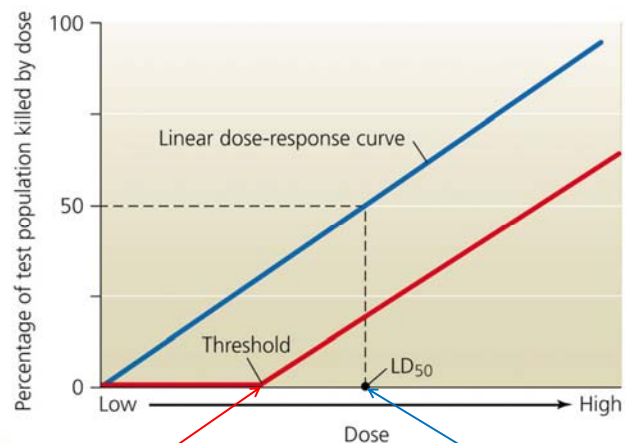


- **Hazard:**
A likelihood that the toxicity will be expressed
viz. hazardous chemicals = potential toxic chemicals



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Dose-Response Curve



Threshold

(dose at which response begins)

LD₅₀

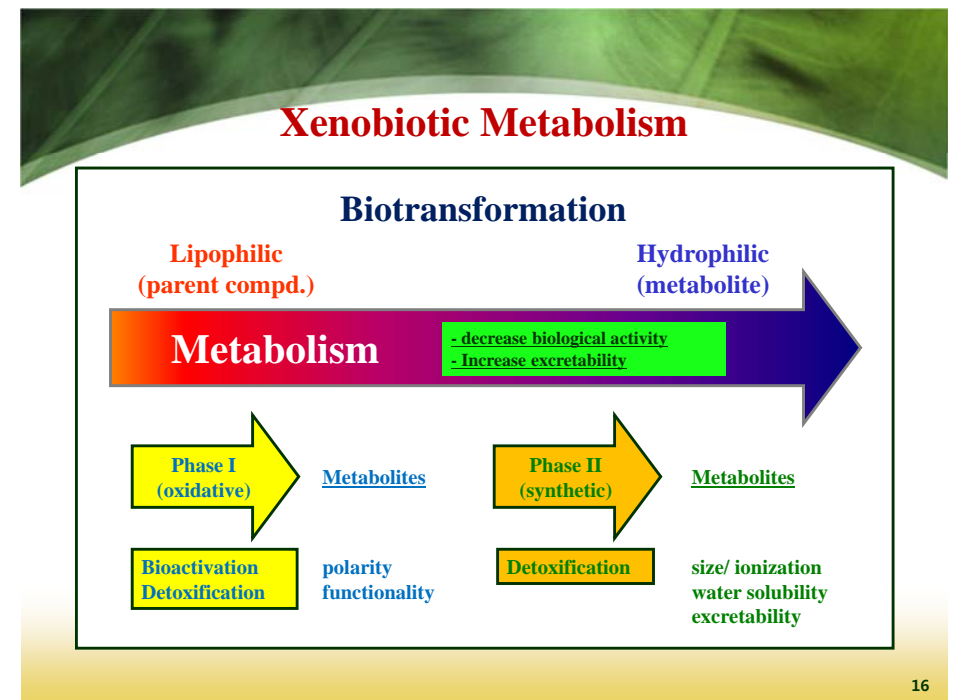
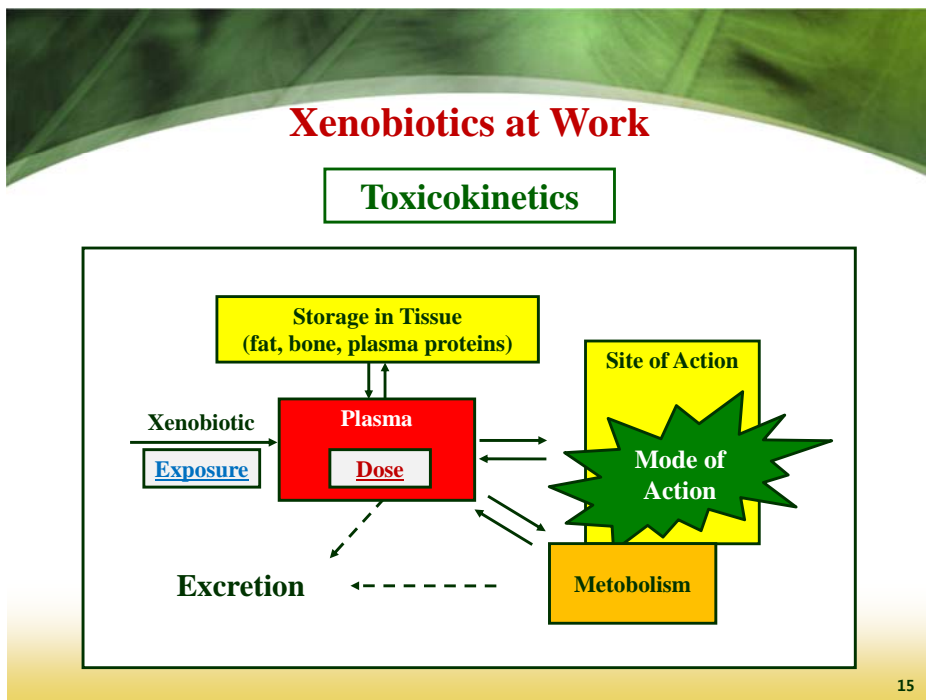
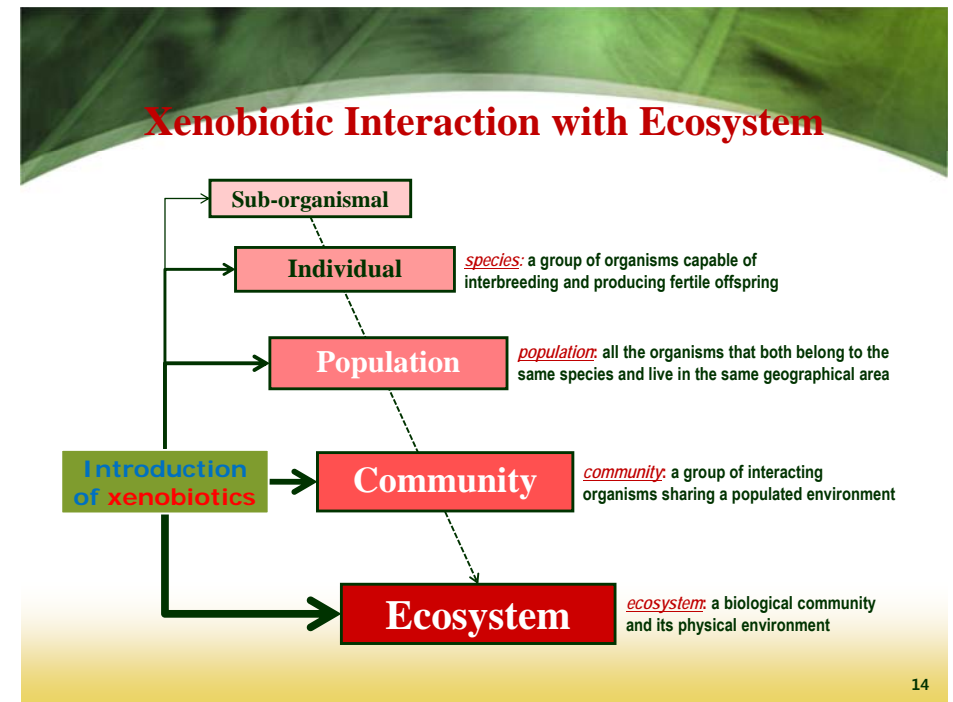
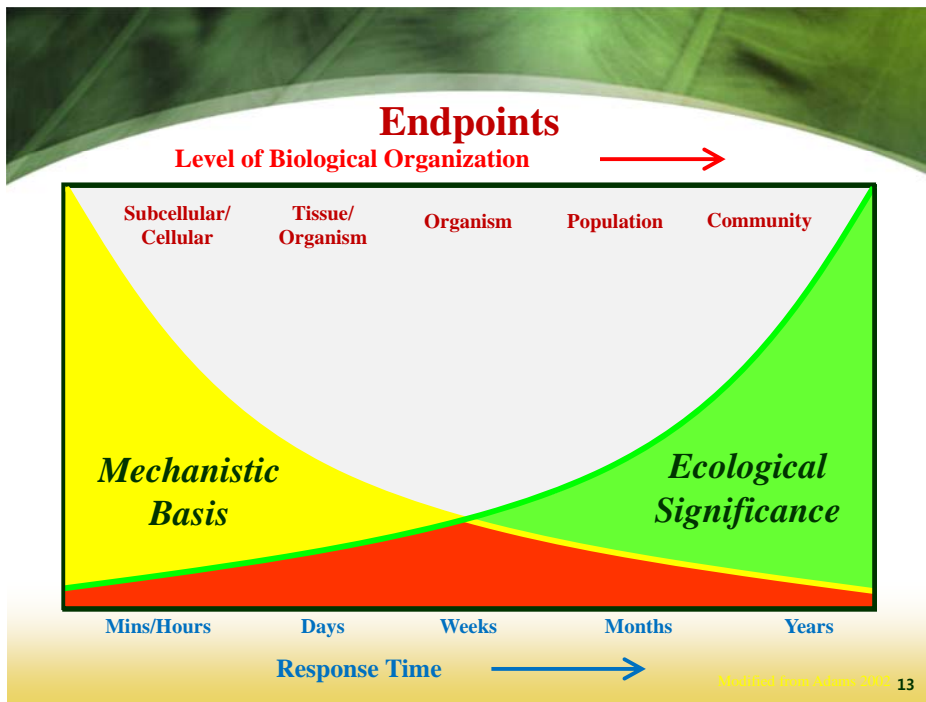
(dose lethal to 50% of test animals)

11

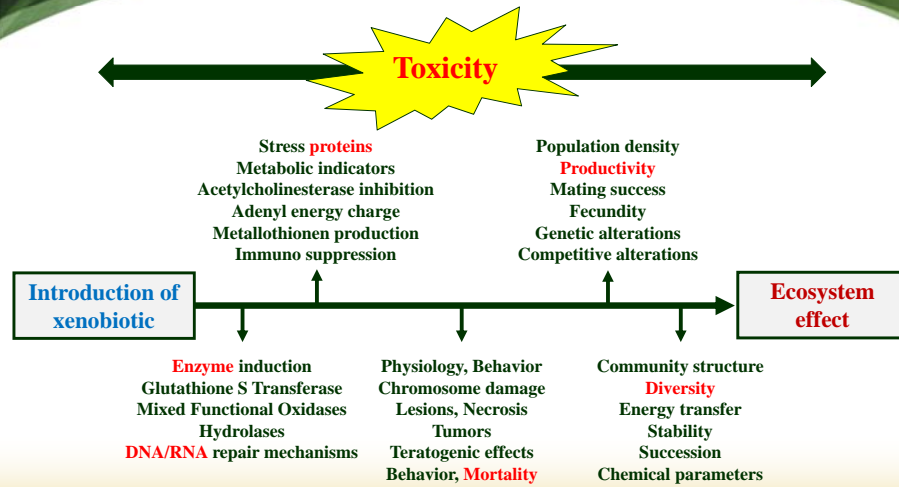
Exposure Concepts

- Different toxic responses may arise from different:
 - **Routes** of exposure
 - **Frequencies** of exposure
 - **Duration** of exposure (acute vs. chronic)

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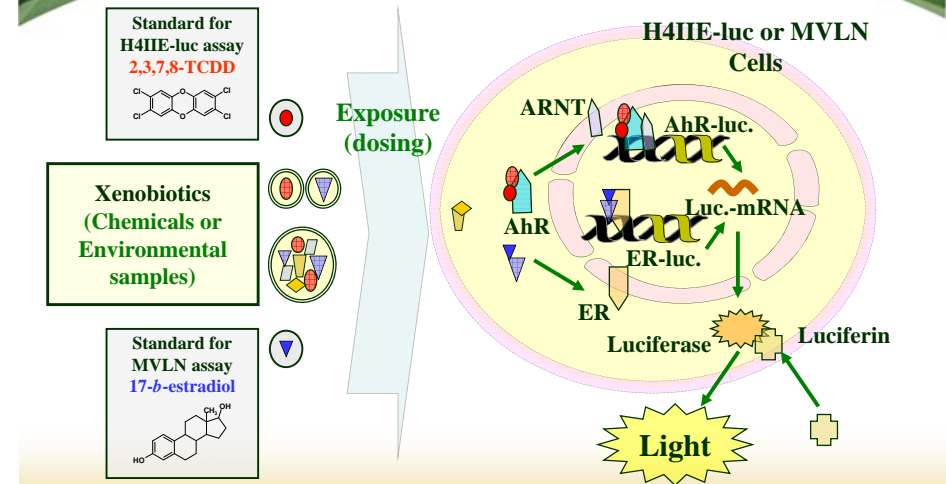


Xenobiotic vs. Toxicity



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Mode of Action-Example



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Type of Toxicants-Example

- **Carcinogens:** cause cancer
- **Mutagens:** cause mutations in DNA
- **Teratogens:** cause birth defects
- **Allergens:** cause unnecessary immune response
- **Neurotoxins:** damage nervous system
- **Endocrine disruptors:** interfere with hormones

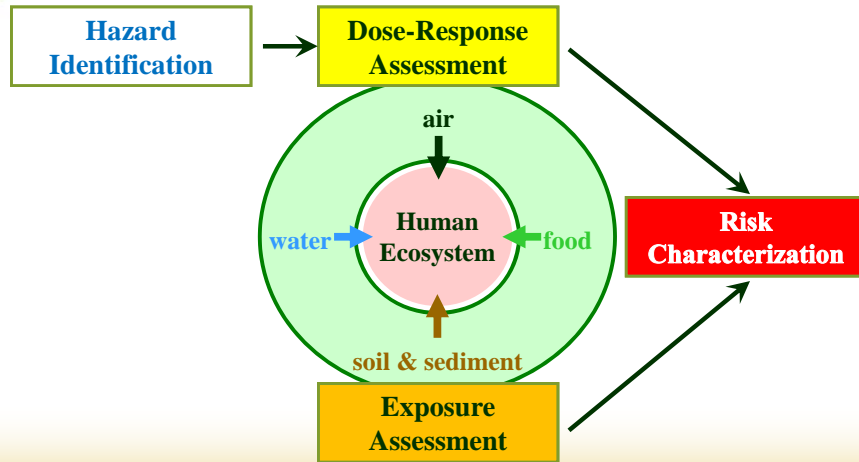
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Risk Assessment

- **Human Health Risk Assessment**
 - The characterization of the probability of potentially adverse health effects from **human** exposures to environmental hazards.
- **Ecological Risk Assessment**
 - A process that estimates the likelihood of undesirable **ecological** effects occurring as a result of human activities.

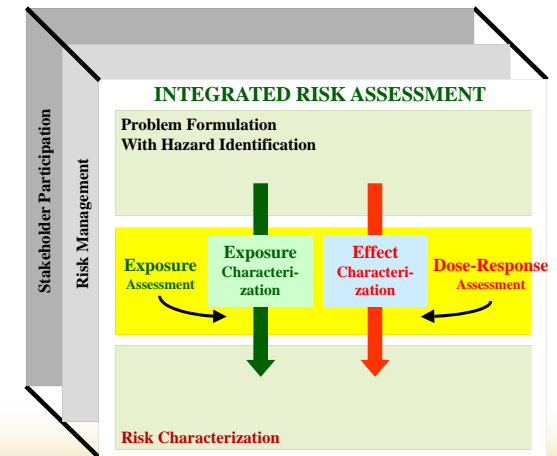
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Four Steps in Risk Assessment



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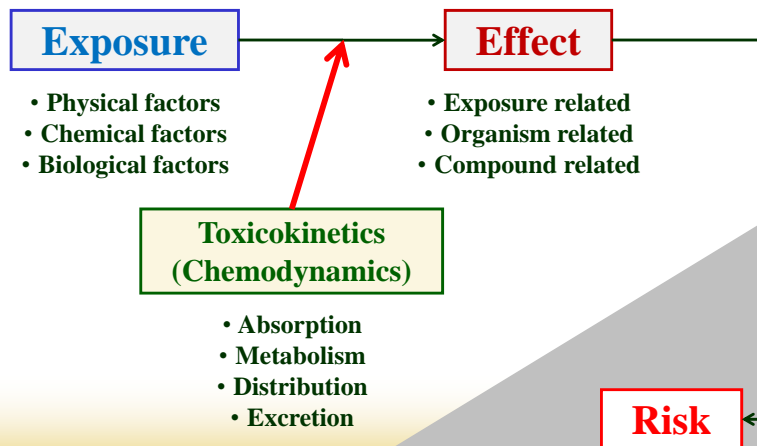
Integrated Risk Assessment (IRA)



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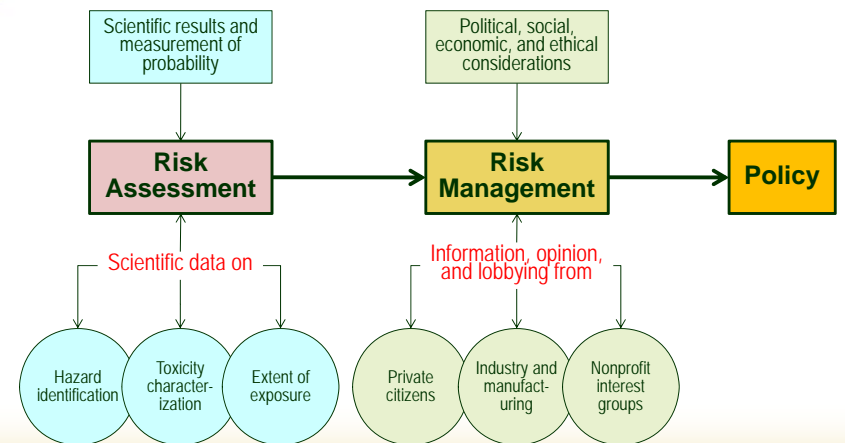
Now, How to Approach?

Multidisciplinary



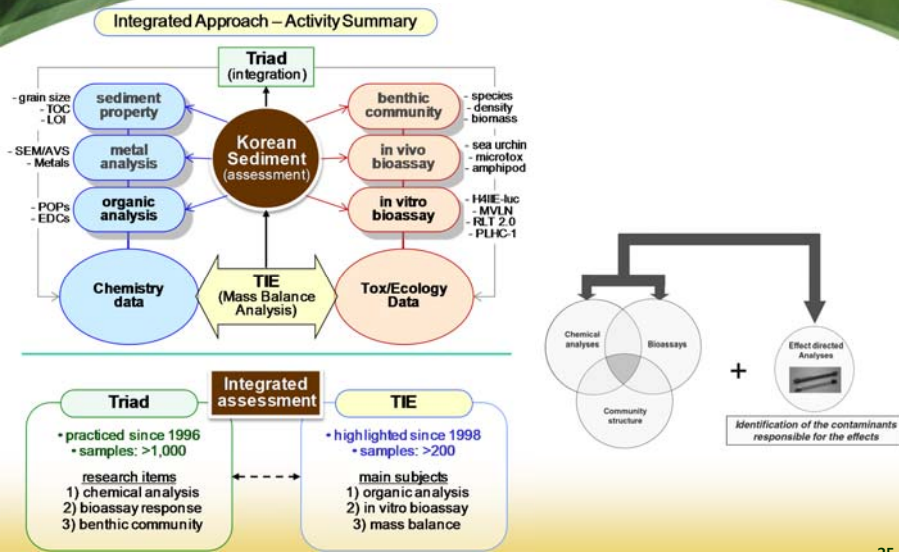
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Risk Assessment & Risk Management



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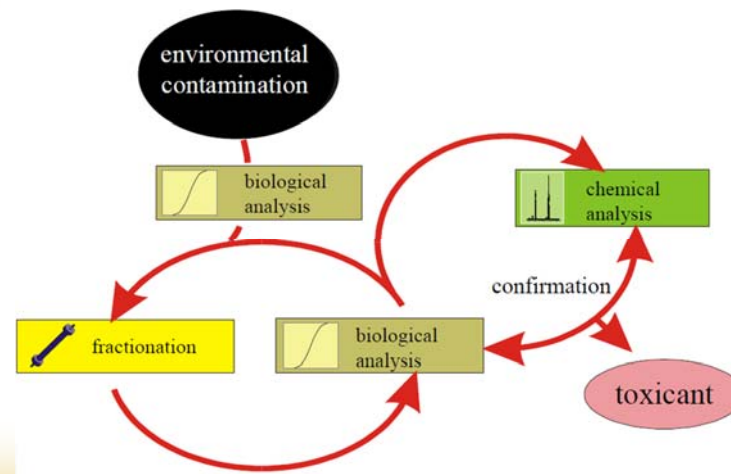
Research Example Integrated Assessment



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Effect-Directed Analysis

Effect-directed identification of toxicants



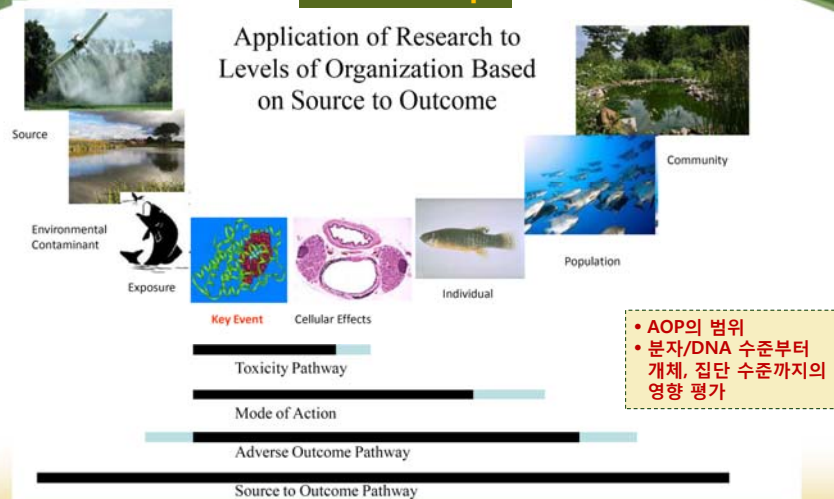
Hecker and Hollert, 2009. Environ. Sci. Pollut. Res. 16, 607-613

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Adverse Outcome Pathways

AOP concept

Application of Research to Levels of Organization Based on Source to Outcome



Perkins 2011 Mixtures and Cumulative Risk Assessment

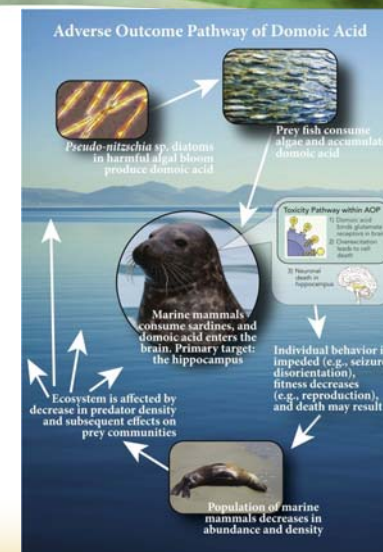
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Adverse Outcome Pathways

AOP 적용 연구사례

- 해양포유류의 서식밀도, 개체 수 감소
 - Predator 감소로 인한 Prey 군집 영향
 - 생태계 불균형 초래
 - 왜 해양포유류 개체수가 감소하였는가?
- HAB 과정에서 생성된 domoic acid
 - 식물플랑크톤을 섭식하는 물고기 체내에 축적됨
 - 해양포유류는 물고기를 섭식
- 해양포유류 체내로 유입된 domoic acid 가 뇌로 들어가 glutamate receptor 와 결합하여 세포손상 야기
 - 개체 수준에서 행동장애(발작, 방향 감각 상실), 체력감소(생식장애), 치사 등의 영향 나타남.

AOP concept

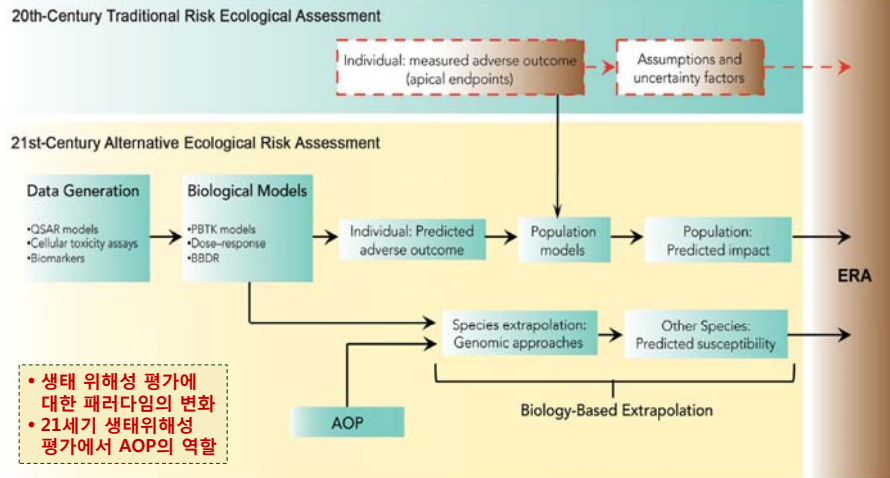


Villeneuve and Garcia-Reyero 2011 ET&C 30 1-8
Watanabe et al 2011 ET&C 30 9-21

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Adverse Outcome Pathways

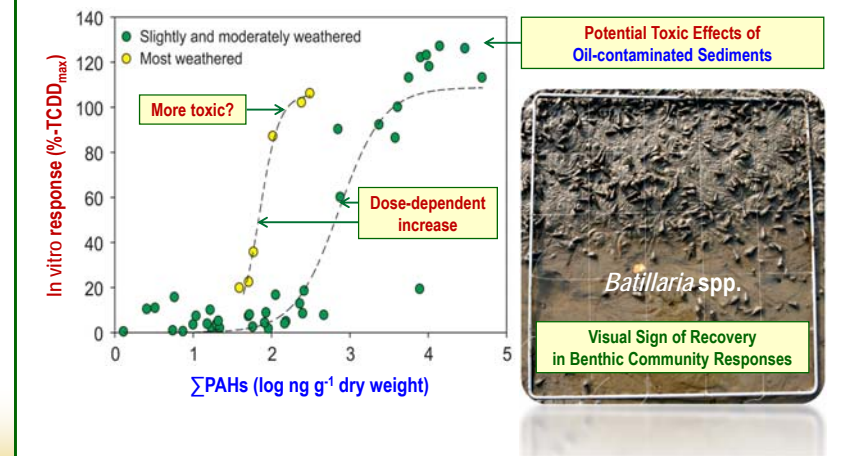
Challenges of Paradigm Shift



Villeneuve and Garcia-Reyero 2011 ET&C 30 1-8

Recent Example: Taean Study EDA-Triad-ATT Considered??

Two years after the Hebei Spirit oil spill, Taean, South Korea



NEXT STEP

Towards integrated sediment assessment

