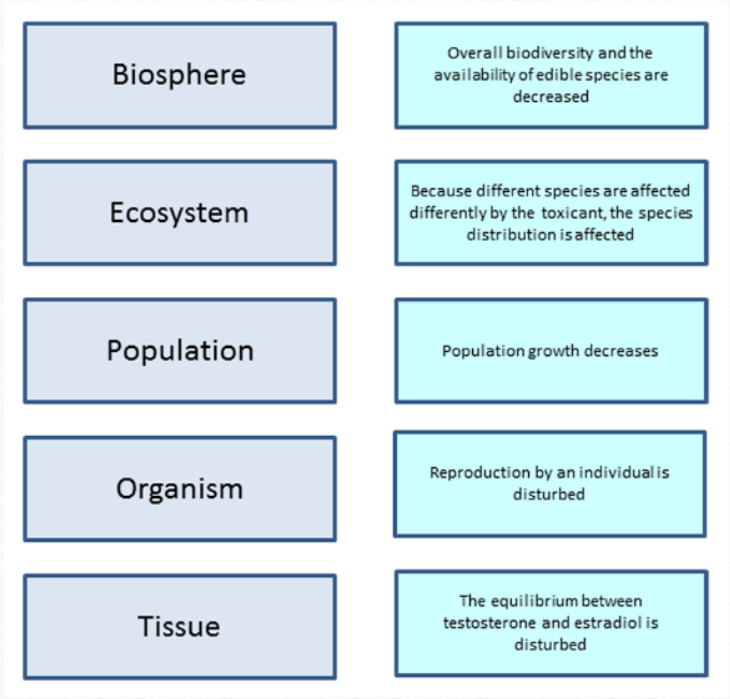
# WATER TOXICOLOGY

- Toxicological effects must be effects on an individual, unless they are indirect.
- With indirect effects, that affect an organism via a toxicological effect on another species.
- Direct effects must affect the function of an organism..
- Notably, there cannot be ecological effects without some organism being directly affected. In these cases, organisms that are likely affected, but not conspicuous, may escape attention in the short term.

# An environmental toxicant can effect at different levels




Taken from; Nıkınmaa, M. 2014. An introduction to Aquatic Toxicology, USA.

TABLE 2.1 Major Types of Aquatic Contaminants

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|---|---|
| Metals and metalloids | Includes essential metals such as copper, zinc, and iron; nonessential metals such as cadmium, lead, mercury, and silver; and metalloids such as arsenic. Major sources are household effluents, mining, and associated industry (e.g. smelteries), fertilizers, fuels, and well water |
| Organometallic compounds | Contaminants include organic tin compounds and methylmercury. Although methylmercury is partially of anthropogenic origin, natural methylation/demethylation processes also cause its presence in waterways. Organic tin compounds used to be important components of antifouling paints of boats and ships but have now been banned |
| Fertilizers | Include especially nitrates, ammonium nitrogen, and phosphates. Their sources are household effluents, agriculture, and aquaculture |
| Greenhouse gases | Carbon dioxide production is involved in ocean acidification, and methane can be liberated in natural gas production |
| Oxides of sulfur and nitrogen | Their deposition in smoke from energy production and traffic causes acid rain |
| Radioactive compounds | A natural source of radioactivity is radon gas. In addition, effluent from plants performing military processing (enriching) of uranium is a major source of radioactivity in water. If nuclear power plants are functioning properly, the radioactivity given out to water is smaller than from power plants using coal. However, abnormal occurrences, such as earthquakes or accidents in the power plants, may result in high environmental radioactivity. Further, leaks from storing radioactive material and uranium mining can be significant sources of radioactivity in water |

*(Continued)*

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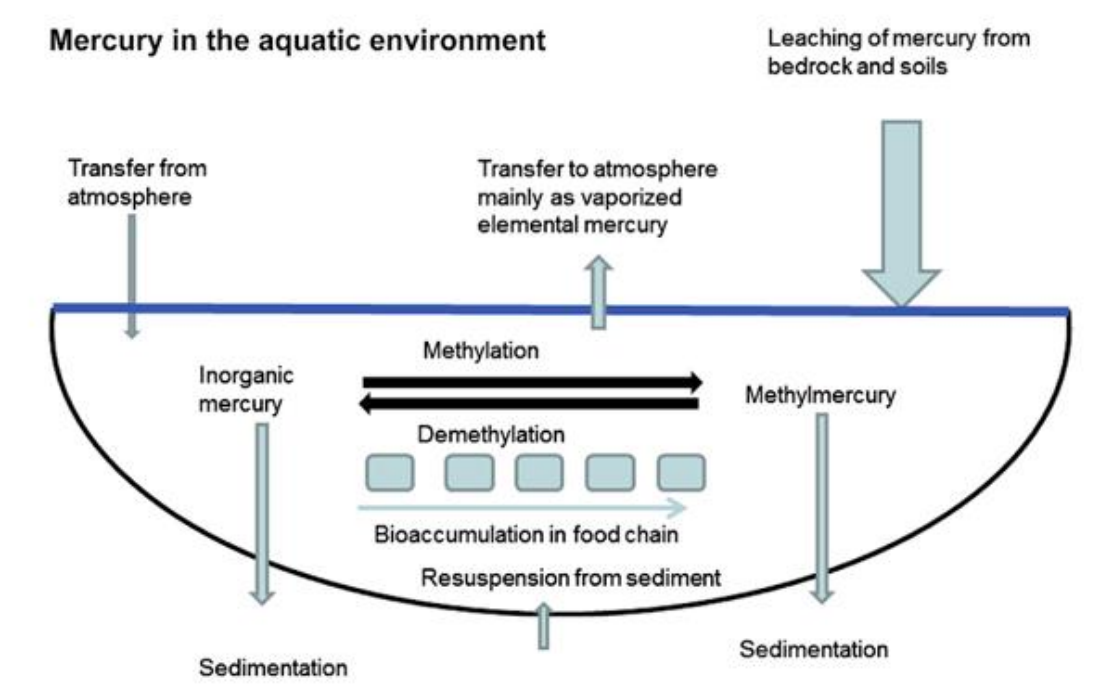
| | |
|---|---|
| Oil and its components | Oil spills can take place during oil drilling, as a result of shipwrecks during oil transport, and from effluent discharges from oil refineries. Also, oil tanks of ships are surprisingly often cleaned in open sea, resulting in oil discharges. The most toxic oil components are compounds with aromatic rings |
| Pharmaceuticals and personal care products | Since the intention is to produce drugs with minimal breakdown, these often pass through water cleaning unmodified. In addition, antibiotics may kill bacteria in biological water purification. Soaps and other detergents dissolve lipid membranes, and sunscreens are often photochemically modified to more toxic compounds |
| Halogenated compounds | Persistent organic pollutants (POPs) include halogenated compounds as a major component. Important halogenated compounds are polychlorinated biphenyls (PCBs), dioxins (e.g. TCDD), furans, and organochlorine insecticides. The appearance of new chlorinated organic compounds in the environment has markedly decreased recently, for two reasons: first, the reliance of paper bleaching on chlorinated compounds has markedly decreased and, second, the use of organochlorine insecticides (such as DDT) is severely restricted. However, chlorinated organic compounds are still a group of chemicals of concern, as they are highly persistent and bioconcentrate. They are further present in sediments in the vicinity of paper mills. Brominated organic compounds are extensively used in flame retardants. Fluorinated compounds are also increasingly found in the environment |
| Paper- and pulp-mill effluents | Since chlorinated compounds have disappeared from effluents, the major toxic compounds are natural compounds of trees, such as resin acids from coniferous trees and phenolics from deciduous trees |
| Endocrine-disrupting compounds | These include several types of compounds with various modes of action. Although several different types of hormonal pathways could be targeted, the term is most commonly used for compounds that disturb reproductive hormone cycles |
| Pesticides | Pesticides contain several different types of compounds, including herbicides, insecticides, and fungicides |
| Nanomaterials | The definition of a nanomaterial is any material with a maximal dimension of 100 nm. The use of nanomaterials has increased markedly during recent years, and nanotoxicology has consequently gained importance. This requires development of new methods, as conventional methodology is poorly suited for determining nanomaterial toxicity |
| Ultraviolet (UV) radiation | The effects are restricted to surface layers of water bodies, as light penetrates only a short distance in water |
| Ionic liquids | These compounds are called "environmentally friendly" solvents, because their vapor pressure is small; however, their aquatic effects are poorly known |
| Genetic modification | Contaminant effects of genetic modification are largely caused by methodological aspects |

- Taken from; Nıkınmaa, M. 2014. An introduction to Aquatic Toxicology, USA.

# Mercury Cycle

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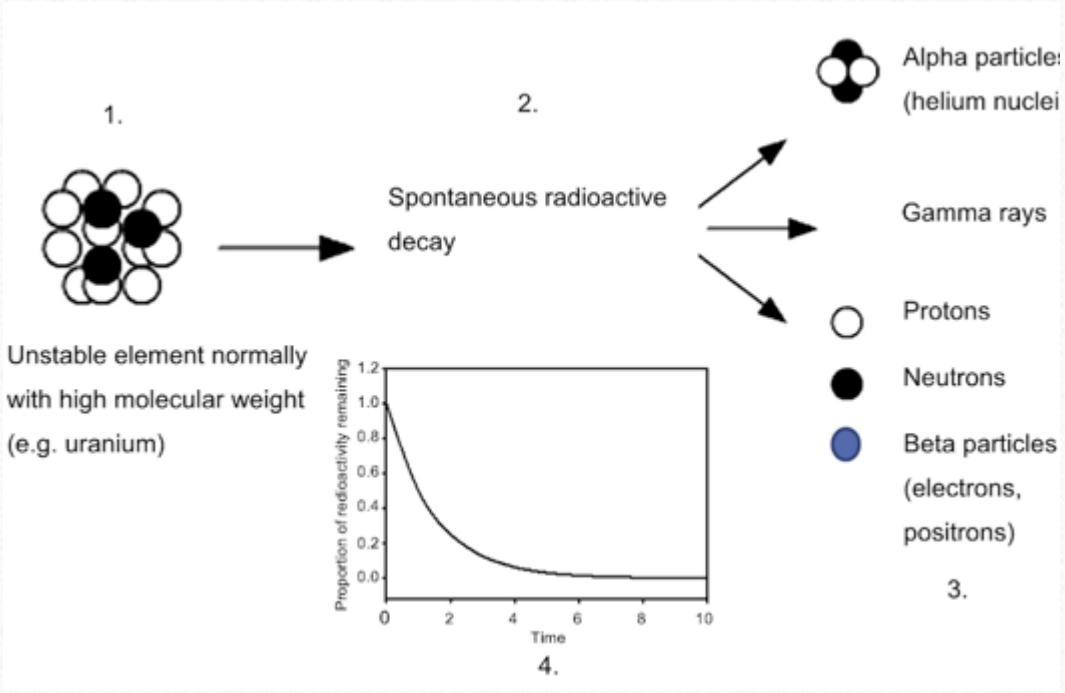


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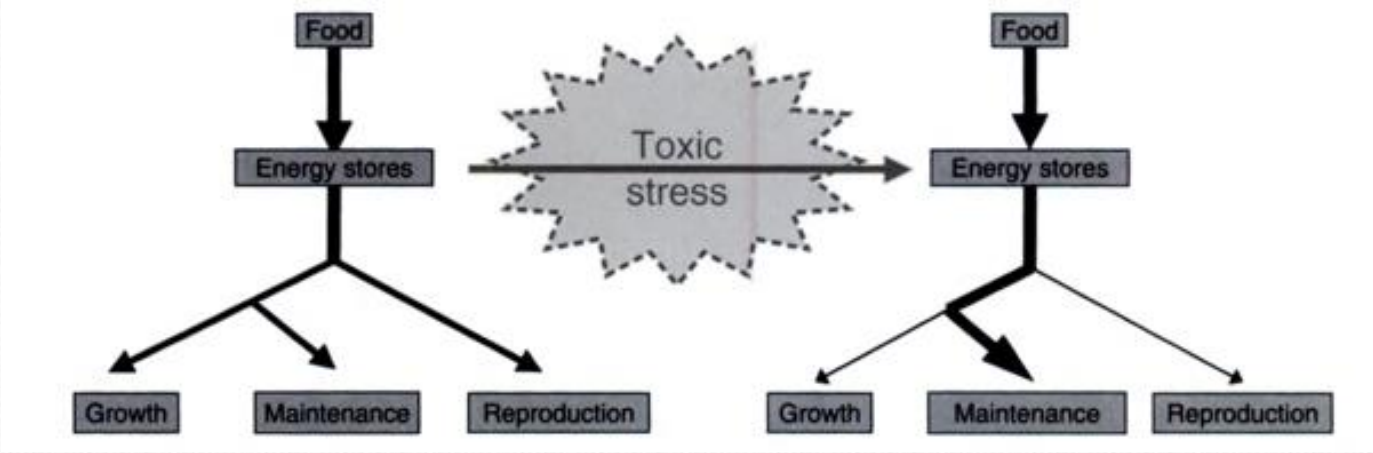
# Toxicant exposure effect




Taken fromOstrander G. K. . 2005. Techniques in Aquatic Toxicology, Vol 2, USA.