Understanding Toxicity

Okala Practitioner Chapter 14

Toxicity nomenclature

Toxicity refers to the capacity of a substance to damage the health of or to kill an organism.

Persistence refers to the capacity of a substance to remain in a stable form over many years under normal conditions.

Bioaccumulation refers to the capacity of a substance to concentrate in the tissues of an organism and move up the food network to carnivores and humans.

Toxic substance exposure

The toxicity of a substance is measured in a multi-phase process.

1
The substance is **distributed in a medium**: air, water, food, or surface of an object.

2
The substance is then physically transferred **on or into the organism**.

3
The substance is then transported within the organism **to various tissues**.

Toxic substance exposure

Toxicity metrics can take many forms, including growth inhibition, cancer, endocrine disruption, and a large range of non-cancer effects that may be debilitating or even lethal.

Damage is dependent on both the **potency** of the substance and the **dose** that the organism is exposed to.

A substance that is not harmful to one organism may be quite harmful to another organism.

Toxicity data sources

Human toxicity data result largely from medical research. Adequately controlled human toxicity tests are rare, so animal testing is commonly relied upon.

Ethicists urge the development of cultured animal tissue tests to reduce reliance on animal testing.

Ecotoxicity data are less plentiful than human toxicity data. Ecotoxicity data can come from a wide variety of sources including plankton, algae, fish, aquatic insects, terrestrial plants and trees.

Metal toxicity

Metals are composed of pure elements or alloys of pure elements.

Metals fall in three toxicity groups:

1. Inert (non-toxic) metal

2. Bionutrient metals,

toxic at higher dosage

3. Non-bionutrient metal,

toxic at low dosage

Inert metal

Gold is the only metal yet identified as nontoxic at any dosage to an organism.

Bionutrient metals, toxic at higher dosage

Many metals are necessary for organism health at low concentrations but are toxic at higher concentrations:

Arsenic	As
Boron	Bo
Chromium (monovalent)	Cr(I)
Cobalt	Co
Copper	Cu
Iodine	I
Iron	Fe
Magnesium	Mg
Manganese	Mn
Molybdenum	Mo
Nickel	Ni
Selenium	Se
Zinc	Zn

Non-bionutrient metals, toxic at low dosage

Other metals are unnecessary for organism life and toxic at lower concentrations, and can be toxic if at concentrations higher than ten parts per million:

Antimony	Sb
Barium	Ba
Beryllium	Be
Cadmium	Cd
Chromium (hexavalent)	Cr(VI)
Lead	Pb
Mercury	Hg
Titanium	Ti
Tungsten	W

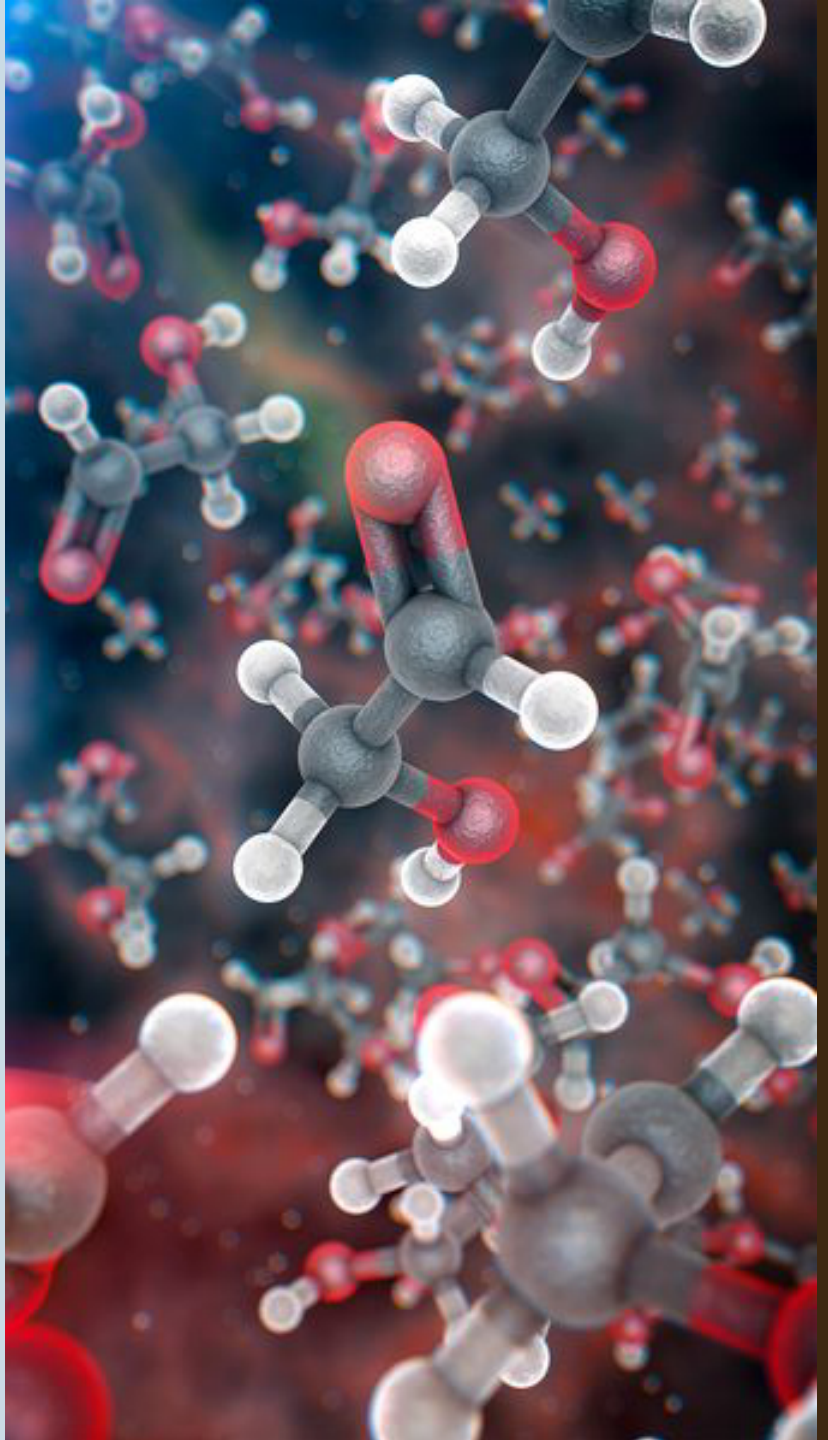
Organic chemicals

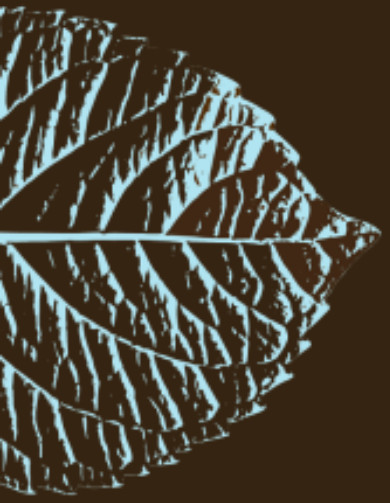
Organic chemicals contain carbon. All organisms are made of organic chemicals. Some organic chemicals, however, are especially toxic. These have most often been synthesized by humans.

Many organic chemicals have been carefully studied for their toxic potentials. Many more organic chemicals, unfortunately, have not been studied for their toxicity.

The European Union REACH directive requires the toxicity testing of all chemicals produced within the E.U..

Aspects of toxicity are discussed in greater detail in *Okala Practitioner.*





Okala Practitioner

Integrating Ecological Design

This presentation is part of an educational presentation series that supports teaching from the *Okala Practitioner* guide.

Okala Practitioner and these presentations were created by the Okala Team to disseminate fact-based knowledge about ecological design to the design disciplines and business.

Unless provided in the presentations, Information sources are found in the *Okala Practitioner* guide.

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The Okala Team initiated the collaboration with the US EPA and the Industrial Designers Society of America (IDSA) in 2003. The team developed Okala Practitioner with support from Autodesk, IBM, Eastman Chemical and the IDSA Ecodesign Section.

Okala Practitioner is available through amazon.com.

More information and the free Okala Ecodesign Strategy App are found at Okala.net.