Glossary terms

**α particles**: form of ionizing radiation consisting of two neutrons and two protons; carries a +2 charge.

**acid deposition** - the deposition of wet or dry acidic (pH<5.7) material from the atmosphere onto water or land

**acid mine drainage** – drainage water from mine workings, waste and tailings, made acidic by the oxidation of sulphide minerals. The resulting sulphuric acid dissolves iron and other metals from the ore and other geological material. The highly acidic metal-bearing water, often with pH as low as 2.0, drains into surface water bodies.

**acid rain** – wet, acidic (pH<5.7) material (rain, snow, hail or fog) that may be deposited from the atmosphere onto water or land.

**acid volatile sulfides (AVS)** Weak acid (often cold 1-M HCL) extraction of sulfides

**acidosis** - formation of excess acidity in blood and tissues, either through net production of H⁺ ions by metabolic processes or through accumulation of H⁺ ions from acid environments.

**acclimation**: Within the context of a bioassay it is defined as the temperature at which organisms are held prior to toxicant exposure. It may or may not differ from the experimental temperature although usually organisms are acclimated to the experimental temperature for several hours before the initiation of the assay.

**acclimatization**: (acclimation) - adaptation of biological function to a change in environmental conditions.

**acetylcholinesterase**: enzyme that catalyses the hydrolysis of the neurotransmitter acetyl choline.

**active transport** Transmembrane or transepithelial chemical transport against a concentration gradient requiring the expenditure of energy (from ATP).

**acute to chronic ratio (ACR)** - the ratio of acute LC₅₀ to a measure of chronic toxicity (e.g. MATC)

**acute toxicity bioassay** - cumulative mortality recorded over a period of 96 h or less (usually 24h, 48h or 96h)

**adduct** - Product of covalent bonding between a xenobiotic and an endogenous molecule such as DNA.

**adsorption**: accumulation of a substance at the boundary of two phases, usually between solid and liquid phases.
**advisory** – a value that is the basis of a warning, rather than a regulation, for the public, concerning the safety of a named product or food item

**anadromous** – refers to organisms that move from the sea to rivers to breed

**aneuploidy** - uneven distribution of chromosomes following mitosis

**anoxia, anoxic** – a condition in which there is no oxygen, synonymous with anaerobic

**antagonism** – less-than-additive effects of two or more substances, normally refers to toxic effects

**aphasia** – loss or impairment of the ability to use or to comprehend words

**apoptosis** - a process of programmed cell death

**application factor (AF)** – multiplier derived from ACR, used to extrapolate from acute to chronic toxicity

**artificial selection** - compare with natural selection, for which the genetic mechanism is the same: artificial selection occurs when selection pressure is exerted deliberately, under laboratory or other experimental conditions

**aryl hydrocarbon hydroxylase (AHH):** enzyme catalyzing hydroxylation of aryl hydrocarbons such as benzo(a)pyrene; used as a measure of cytochrome P-450 activity.

**ataxia** – inability to co-ordinate voluntary muscular movements

**B-cells**: small lymphocytes produced by bone marrow primarily responsible for humoral immunity and production of circulating antibody.

**β particles:** negatively charged electrons formed when an excess of neutrons in the nucleon causes a neutron to be changed into a proton.

**beneficiation** - the preparation of ore for metallurgical processing, usually by means of crushing and grinding (comminution) and concentration

**Bequerel (Bq):** measurement of radioactive emission equivalent to 1 nuclear disintegration per second.

**bioaccumulation** - the tendency of substances to accumulate in the body of exposed organisms with increases over time or with age. See also bioconcentration

**bioaccumulation factor (BAF)** – the ratio of the concentration of a given compound or
element in an organism to its concentration in the immediate environment, measured
in the field and thus incorporating food chain as well as direct sources. Compare with BCF

**bioassay** – a measurement, usually quantitative, of the effect of a chemical, physical or
biological action, using the response of a living system, typically a population

**bioavailable, bioavailability** – see biologically available

**biologically available** – synonymous with **bioavailable** - in a form that is assimilable by a living
organism

**biochemical markers** – used synonymously with **biomarkers** in the present text. The former is
our preferred term. Biomarker or biochemical markers are biochemical and molecular responses,
and are a particular category of indicators. Some authors have used “biomarkers” in a broader
sense, even as synonymous with biological indicators

**bioconcentration** - the phenomenon whereby a living organism contains higher concentrations of
a given substance than the concentration in its immediate source of that substance. See also
bioaccumulation.

**bioconcentration factor (BCF)** - The ratio of the concentration of a given compound or
element in an organism to the concentration of the same in its immediate environment, measured
in the laboratory under defined conditions. Compare with BAF

**biological half-life (t½)** - the time required for elimination from the body of named organism
of 50% of the total body concentration.

**biological indicator** – a biological response, at any level of organisation, that is used to provide
information concerning the condition of the biological system

**biological oxygen demand (BOD)** – the amount of oxygen that is consumed by micro-
organisms in water in a standardized test. BOD is in effect an indicator of the amount of organic
matter

**biomagnification** – a food chain or food web phenomenon, whereby a substance or element
increases in concentration at successive trophic levels

**biomarkers** - see **biochemical markers**

**biominification** - the tendency for a substance to diminish in concentration at successively
higher trophic levels, a phenomenon exemplified by lead (Pb). Compare with biomagnification.

**biomonitor** – an organism that takes up the contaminant into tissues resulting in concentrations
that reflect the exposure of the contaminant in the environment
bioremediation - application of the phenomenon of degradation or transformation of a toxic substance into benign form(s), by which the organisms can literally “clean up” a contaminated environment

biotransformation - chemical change mediated by biological activity

bioturbation – the action of stirring, irrigating or otherwise disturbing sediments, by the action of infauna or epifauna

blood:gas partition coefficient - coefficient describing relative chemical concentrations in blood and adjacent gaseous medium under equilibrium conditions

bloom, algal bloom – a burst of productivity in phytoplankton, resulting in an increase in standing crop of algae, usually visible as colour and a decrease in transparency of the water

bottom-top trophic efficiency - that fraction of the carbon fixed by autotrophs which eventually reaches top carnivores

bottom-up - extrapolation from simple to complex systems, e.g. measurements of rate of maturity and development and of fecundity may contribute functional data on population growth. Analogous measurement of nutrient or contaminant transfer at the bottom of a food-chain may allow the assessment of their “flow” to higher trophic levels.

buffering capacity – the ability of a chemical system to neutralize excess acidity

ATPases - Adenosine triphosphatases; often involved with active transport of electrolytes across membranes. Hence CaATPase. May also transport metabolic precursors and trace metals (esp. in bacteria).

carbamate pesticides - anticholinesterase pesticide derivatives of carbamic acid (NH₂COOH)

carcinogen – a substance or agent producing cancer

channels - passages through cell membranes allowing selective movement of electrolytes

chelate - a complex in which a the donor ligand is multidentate

chelation – a special case of complexation, when two or more donor groups surround the central cation. See also multidentate

chemical speciation – a distribution of the chemical forms in which an element can exist, e.g., the free ion, the chloride (charged or uncharged), the citrate, etc.

chemiluminescence (CL) - property of compounds to emit photons under certain conditions; utilized in measurement of ROI production by the chemiluminescent compound luminol (5’-amino-2,3-dihydro-1,4-phtalazinedione)
**chemotactic** – orienting or moving in response to a chemical

**chemotactic efficiency** - the ability of immunocells such as macrophages to migrate toward a stimulus

**chlorosis** – the yellowing or mottling of leaves which is a symptom of a number of types of abnormal metabolism in vascular plants, typically resulting from some damage to the production or maintenance of chlorophyll by a toxic agent or a pathogen

**cholinesterase** – enzyme responsible for the hydrolysis of choline esters: inhibited by organophosphate pesticides; thus cholinesterase inhibition can be used as a quantitative measure of exposure to this type of pesticide

**chronic toxicity** - mortality may still be used as an end-point but may involve longer exposures than 96 h. In this regard, the term chronic toxicity is often used. However in many texts the term chronic is conventionally reserved for a group of sub-lethal bioassays involving graded end-points such as level of biochemical activity, fecundity or growth

**chronicity index (CI)** - ratio of acute to chronic expressed as a dose rate (e.g., mg kg$^{-1}$ d$^{-1}$) designed to detect cumulative effects of repeated doses

**cinnabar** – mercuric sulphide: used as a pigment

**classical toxicology** - the science of the biological effects of toxic substances, mainly referring to effects on humans

**clastogenisis** - gene mutations caused by breaks, omissions and translocations of chromosome pieces

**co-carcinogenicity** - the potentiation of a carcinogen by a non-carcinogen (see potentiation).

**congeners**: members of a family of chemicals sharing a common structure but differing in configuration of side-chains.

**committed equivalent dose**: unit of radiation risk for humans taking into account the potential for radiation dose to be delivered over long period of time following ingestion.

**complete carcinogens** - chemical able to induce cancer in normal cells having properties of initiation, promotion and progression.

**complexation** - the combination of an inorganic anion with a positively charged ligand that may be inorganic or organic

**concretion** – a solid structure within living tissue, usually mineralised, which is not a part of the organism’s functional anatomy
connectance (communities): number of actual interspecific interactions divided by the possible interspecific interactions.

critical body residue (CBR): total mass of toxicant present in organism at time of death.

Curie (Ci): measurement of radioactive emission equivalent to $2.2 \times 10^{12}$ nuclear disintegrations per minute.

cytochrome p450: family of catalytic haem-based enzymes found in all tissues (especially liver endoplasmic reticulum) which play key roles in metabolism of endogenous compounds such as steroid hormones, fat-soluble vitamins and fatty acids. Also responsible for detoxication of wide range of non-polar xenobiotics. May cause activation of some to carcinogen intermediates. Basic cytochrome p450 action is monooxygenation where a single oxygen atom is incorporated into the substrate.

cytosol: intracellular fluid exclusive of nucleus and vesicular inclusions.

degradation reactions – chemical changes by which molecules are converted to simpler compounds or elements

detoxification – decrease of the toxic quality of a chemical substance by biological or chemical transformation into one or more less toxic compounds or elements.

dissolved organic carbon (DOC) – unspecified organic compounds, naturally-occurring or synthetic, collectively determined in water

diversity indices (communities): measures that combine species richness and evenness with a particular weighting for each.

dose - mass of toxic chemical ingested or energy absorbed by an organism

ecological indicator - a biological response that is used to provide information concerning the condition of an ecosystem. See also biological indicator

ecotype – a local population of an otherwise widely distributed species that is genetically adapted to a particular set of environmental condition, such as soils with unusually high metal concentrations

electrophile - molecule with an electron-deficient, positively charged atom capable of sharing electron pairs with electron-rich nucleophile (see nucleophile).

electrowinning – the removal of metals from a solution by electrolysis

end-point – a biological process used to quantify response
**endogenous** - synthesised by an organism

**entrainment** – the process whereby a small amount of material is moved within a large moving matrix, as when soil or dust particles are picked up and carried in a moving air mass

**epidemiology** – the study of the occurrence, transmission and control of disease in a population

**epidemiological** - related to epidemiology

**epigenetic** - category of carcinogens that are not classified as genotoxic

**epiphytic** – growing on the surface of a plant

**epoxides** - unstable, highly reactive compounds having an oxygen molecule linked to two adjacent carbon atoms in a ring structure. Epoxides are often intermediates or end-products of cytochrome P-450 catalysed reactions.

**equilibrium partitioning** – the proportional distribution of a substance between or among two or more phases, at equilibrium

**ethoxyresorufin O-deethylase (EROD):** enzyme catalysing O-deethylation of ethoxyresorufin. Ethoxyresorufin is a three-ringed endogenous compound, not an environmental contaminant, although EROD activity is induced by xenobiotics and is a biomarker.

**euryhaline** – able to live in waters of a wide range of salinity

**eurytoxic** - having tolerance to a wide range of toxicants

**eutrophication** – the process by which a body of water increases in productivity as a response to an increase in the concentration of nutrients

**eutrophic** – the property of a body of water that has high nutrient loading and is very productive. See also mesotrophic and oligotrophic

**eutrophication, cultural** – eutrophication caused by anthropogenic input of nutrients

**evenness (communities):** variance of the species abundance distribution.

**exclusion** – a mechanism whereby a substance does not enter the cell or is secreted rapidly.

**exogenous** – synthesised outside the body of a specific organism

**facilitated diffusion** - carrier-mediated molecular transport across a membrane in the direction of the concentration gradient and not requiring energy
fecundity – reproductive performance, usually measured as number of offspring

Fick’s Law – the equation that expresses the rate of movement of a substance across an interface in terms of the diffusion coefficient and the concentration gradient

flow-through tests - tests performed using metering devices (dosers) designed to deliver an appropriate range of chemical concentrations on a once-through basis.

fluorescence – the emission of electromagnetic radiation, usually as visible light, occurring during the absorption of radiation from some other source

free ion activity model (FIAM) – a theory stating that the concentration (activity) of the free ion is the best predictor of the bioavailability of a metal.

free radical: a molecule possessing an unshared electron, usually signified by a dot (●).

fugacity - a thermodynamic criterion of equilibrium of a substance in solution in two phases. It is closely related to chemical potential and can be regarded as an idealised partial pressure

γ radiation: electromagnetic photons released from the atomic nucleus of radioisotopes. Their energy is proportional to their wavelength, and highly energetic photons with short wavelengths can pass completely through the human body.

Gaussian curve - the Gaussian curve essentially reflects a normally-distributed population response with early mortalities among more sensitive individuals and prolonged survival of the most resistant organisms

geobotany – the study of the geographical distribution and relationships of plants, including conditions of the soil or other substratum. Also called phytogeography

generalised linear models (GLM) – a method of plotting dose-response without the use of a preconceived model explaining how a test population might respond.

genotoxic - compounds having the potential to alter the genetic code (see epigenetic)

genotype - the particular complement of genes present in an individual

genotypic – related to the genotype

β-glucuronidase - enzyme occurring in lysosomes and intestinal bacteria, responsible for hydrolysis of glucuronide conjugates

glucuronyl transferase - enzyme catalyzing the formation of conjugates between glucuronic acid and metabolites

glucosuria – decreased renal absorption of glucose
**glutamic pyruvic transaminase** - (GPT) liver enzyme involved in gluconeogenesis; used as a non-specific indicator of toxic liver damage. Damage is inferred from increased serum levels of GPT.

**glutathione (GSH)** - a tripeptide compound (γ-glutamyl-L-cysteinyl-glycine), which plays two contrasting roles in detoxification – as an intermediate in phase II metabolism via GST and as an important antioxidant.

**glutathione disulfide (GSSG):** oxidized form of glutathione. GSSG • radical can oxidize O2 to O2•.

**glutathione transferases (GST)** - a family of enzymes that function as catalysts for the conjugation of various electrophilic compounds (e.g. organic nitrates, epoxides of PAH) with glutathione.

**granuloma** - mass of inflamed granulated tissue

**Gray (Gy):** measure of radioactive energy absorption of 1J kg⁻¹

**greenhouse effect** - warming effect on earth’s surface and lower atmosphere produced by absorption of infrared radiation (heat) by certain gases (greenhouse gases)

**Haber-Weiss reaction:** chemical reaction: \( \text{O}_2^- \rightarrow \text{H}_2\text{O}_2 \rightarrow \cdot\text{OH} + \text{OH}^- \)

**hazard assessment** – determination of the potential for adverse effects

**heat shock proteins (hsp)** - group of proteins (also known as stress proteins) induced by a variety of stressors, including, but not limited to, salinity and osmotic changes, trace metals, anoxia, heat (and cold) shock and xenobiotics. Hsps have been found in all organisms examined to date, from prokaryotes to humans. Five groups of hsp have been identified in eukaryotes.

**Henderson-Hasselbach equations** - equations relating pH to ionized/unionized forms of weak acids and bases

**Henry’s Law** - the amount of gas dissolved in a liquid is proportional to its partial pressure in the gaseous phase until the point of saturation in the liquid is reached

**histopathology** – histological study of the adverse effects of toxicants on tissues and cells

**homeostatic** - acting to maintain a stable internal chemical environment

**hormesis** - a stimulatory effect of low levels of toxic agent on an organism
hyperkeratosis - hypertrophy of outer layer of skin with derangement of squamous epithelium

hypoxia - low oxygen concentrations

imposex: imposition of male characteristics on females often induced by endocrine-disrupting chemicals.

incipient LC$_{50}$ - lowest LC$_{50}$ reached in a time series, i.e., longer exposures to lower toxicant levels produce no further mortality. Also known as incipient median lethal concentration.

incipient median lethal concentration - see incipient LC$_{50}$.

index of biotic integrity (IBI) - method of quantifying disruptive effects of toxicants on a community. Index may include information on habit and trophic structure, tolerant vs. intolerant species and pathological conditions relative to a reference community from a similar habitat. Originally applied to stream communities, IBIs have been modified for other habitats.

inhibition, competitive - inhibitory effect resulting from toxicant competing with a particular substrate for an active site. Typically, this would slow enzymic expression/substrate kinetics.

inhibition, non-competitive - active site is poisoned in non-competitive manner, e.g. by denaturation of enzyme

initiation - causing damage to cellular DNA that results in a mutation.

intercalation - physical insertion of small planar molecules into the molecular structure of large molecules, e.g. intercalation of xenobiotic between base pairs of DNA. Intercalating molecules may be loosely bound or covalently bound. Either case has mutagenic potential.

ionizing radiation: energy released during radioactive decay. Consists principally of $\alpha$, $\beta$ and $\gamma$ radiation.

isobologram - graphical representation of interaction between two toxicants expressed in terms of equivalent toxic units.

isotope – any one of two or more atoms of an element with the same atomic number and position in the periodic table and the same chemical properties but with differing atomic mass

isozymes (also isoenzymes) - any of the chemically distinct forms of an enzyme which perform the same biochemical function

leaching – the process by which dissolved substances are moved, typically by percolating water or other solvent. In metallurgy, leaching has as technical meaning as a process for extracting a soluble metal by a solvent
**lentic** - related to still water, typically lakes or ponds

**Leslie matrix model**: see stage-based demographic model.

**lethal body burden (LBB)** - toxicant concentration in the body of an organism at the time of death

**lethal concentration 50 (LC_{50})** - the toxicant concentration which kills 50% of the test population at time \( t \). It represents an estimate of that concentration which would cause 50% mortality of the infinitely large population from which the test population was taken.

**life-cycle management** –sometimes referred to as “cradle-to-grave”, the approach that considers all aspects, particularly the potentially harmful aspects, of a substance or process over time, rather than limiting it to a particular point in time

**life table** - Initially developed as a tool for the study of population dynamics, the life table provides a more detailed evaluation of reproductive success through the determination of the intrinsic rate of natural population increase (\( r \)).

**ligand** – a group, ion or molecule co-ordinated to a specific atom (typically a metal) in a complex

**limnocorrals** – relatively large enclosures suspended in a water column, typically open to the atmosphere and either closed or open to the sediment, used for experimental manipulation of biotic or abiotic factors, while retaining some of the realism of the natural system

**limiting nutrient** – an essential nutrient that is present in the least supply of all nutrients, relative to the biological or ecological requirements; the limiting nutrient is the one that restricts production. If its supply subsequently exceeds its requirement, then by definition, some other nutrient will become limiting

**linear transfer energy (LTE)**: measure of ability of ionizing radiation to transfer energy to tissue per unit of exposure.

**lotic** - related to actively-moving water

**lowest observed effect concentration (LOEC)** - the lowest toxicant concentration in a bioassay which shows significant difference from the control

**lowest observed effect level (LOEL)** – same as LOEC

**luxury uptake** –the uptake and storage of a nutrient when it in excess supply

**macrophages** - component cells of immune system capable of engulfing foreign particles. They may be motile or non-motile. Macrophages can secrete soluble factors, cytokines, that assist with phagocytosis.
mass balance modelling - a calculation of the concentrations of various chemicals in various media in a specified system

maximum acceptable toxic concentration (MATC) - the geometric mean of two other values: the NOEC and the LOEC

median effective concentration or EC₅₀ - analogous to the LC₅₀: the chemical concentration causing a sub-lethal response in 50% of the test population. In each case the significance (or otherwise) of the response is measured by comparison with the mean control value but is counted in a quantal way, e.g. an organism is either scored as normal or abnormal.

median lethal time – elapsed time to reach 50% mortality of the test population

mesocosm - the enclosure of a representative segment of a real ecosystem. See also microcosm. Microcosms and mesocosms are experimental systems set up to recreate part or all of a particular ecosystem. These range from constructed systems such as simple aquaria, with perhaps only one representative species at each trophic level, to large enclosures (e.g., limno-corrals, test plots) in the external (i.e., real-world) environment, which may be tens of cubic meters in volume.

mesotrophic – the condition of an aquatic ecosystem that has moderate supplies of nutrient: it is intermediate between oligotrophic and eutrophic

metalloids – elements such as arsenic and selenium which have some of the same characteristics as metals, but their chemical properties are such that they may form compounds in which they behave as anions or cations.

metallothioneins (MTs) - small proteins rich in sulphur-containing amino acids (thiols) that effectively bind many trace metals. Originally the term was restricted to animal proteins, but now may be used for chemically similar plant proteins, the latter usually called phytochelatins

metal-tolerant – able to live at concentrations of metal in water or soil or other substrate that would normally be considered toxic. The definition is not absolute but rather should be considered in a comparative sense.

methylation – the addition of one or more methyl (CH₃) groups, sometimes by microbial or other biological activity, as in the case of the environmental formation of methylmercury from inorganic mercury

Michaelis constant (Kₘ) - substrate concentration at which enzyme is half saturated. Also used to characterize ionic/molecular pumps where the ion or molecule carried is analogous to the substrate and the pump is analogous to the enzyme. Low Kₘ values signify high carrier affinity.
**Michaelis-Menten plot** Plot of enzyme (carrier) substrate complex vs. substrate concentration indicating saturable characteristics.

**microcosm** – a small, usually very simple, synthetic ecosystem, typically involving two trophic levels. See also mesocosm

**mineralisation** – transformation into mineral or inorganic form

**mixed function oxidase (MFO) system (cytochrome p-450 system)** - enzyme system responsible for the transformation of non-polar organics to more polar, water soluble products.

**moving average method:** method of determining LC50 for equal numbers of organisms exposed to a geometric range of toxicant concentrations.

**multidentate:** an organic ligand with two or more donor groups, which when complexed with a metal, forms a chelate

**multidrug resistance (MDR)** - resistance to a variety of unrelated compounds, including xenobiotic chemicals with carcinogenic properties.

**multixenobiotic resistance:** see multidrug resistance

**mutagenicity** – potential for altering gene expression

**narcosis:** anaesthetic effect produced by narcotic.

**natural selection** – differential reproduction in nature, resulting from some set of environmental conditions, leading to the increase in frequency of certain genes or gene combinations and to a decrease in the frequency of others

**necrosis:** irreversible tissue death often accompanied by inflammation and discoloration of tissue

**neoplasm:** relatively autonomous tissue lesion caused by alteration of genetic material of cells.

**nitrogen fixers:** organisms that can convert gaseous nitrogen into more complex nitrogenous compounds, ultimately organic nitrogen. Known nitrogen fixers are free-living as well as symbiotic with higher plants and include bacteria, both blue-green autotrophs and heterotrophs, as well as some other types of microorganisms

**nitrosamines** – compounds, some of which are carcinogens, formed from inorganic nitrogen compounds, such as nitrites, by microbial activity

**no effect concentration (NEC)** - operationally defined as the LC0.01 obtained by extrapolation from a probit curve at t00. Effectively estimates concentration at which no toxic response is seen
**no observed effect concentration (NOEC)** - the highest concentration having a response not significantly different from the control

**no observed effect level (NOEL)** - same as NOEC

**non-polar:** having no net electrical charge associated with the molecule, which tends to be lipophilic.

**normal equivalent deviate (NED)** – a measure of the variance associated with the median response of a normally-distributed test population. It is equivalent to standard deviation and forms the basis of the probit scale

**nuclear waste, front end** – tailings and other waste, especially uranium mill tailings produced in the early stage of the processing of uranium ore; typically large in volume and relatively low in radioactivity

**nuclear waste, high-level** - the end-product produced in a nuclear reactor, especially radioactive spent fuel. Relatively low in volume but highly radioactive and likely to continue decaying and emitting radiation for centuries

**nuclear waste, low-level** – radioactive material from the reactor plant, including pipes, radioactive material in workers clothing, and tools used by reactor workers.

**nucleophilic:** term used to describe molecules containing electron-rich atoms (see electrophilic).

**octanol-water partition coefficient (K<sub>ow</sub>)** – the distribution of a given substance between octanol and water, at equilibrium. Generally the K<sub>ow</sub> is a good indicator of the tendency of a substance to move from water to lipid and thus its tendency to move from the aqueous environment into biological membranes.

**oligotrophic** – a condition of a water body with a low supply of nutrients and low productivity. See also eutrophic and mesotrophic

**ombrotrophic bog** – a wetland that receives no nutrients from ground or surface water, so that all inputs are from the atmosphere, i.e., from wet or dry deposition

**oncogene:** a gene capable of inducing one or more aspects of the neoplastic phenotype

**ore** – naturally-occurring mineral containing a potentially valuable metal or metals

**organochlorine** - a class of compounds in which one or more atoms of chlorine are combined with an organic molecule, e.g., chloroform, carbon tetrachloride, DDT
organophosphate – a phosphate-containing organic pesticide which competes with acetyl choline for the enzyme cholinesterase

$^{32}$P post-labelling: technique used to identify (DNA) adducts wherein the radioisotope label is added following chromatographic separation

$pk_a$: negative logarithm of the acid dissociation constant $K_a$ where $K_a = \frac{[H^+][A^-]}{[HA]}$

pathology – the study of the nature of diseases, especially the structural and functional changes produced by them.

percentage inhibition concentration (ICp) - measure of the degree of response relative to a control, e.g., IC$_{30}$ = 30% inhibition of the measured parameter compare with a control

periphyton - the community of aquatic organisms that grow attached to surfaces, predominantly composed of algae and bacteria

peroxisomes: subcellular organelles involved in lipid, sterol and purine metabolism including peroxidative detoxification

peroxidative detoxification

peroxidative – the property of a compound by which it remains in its original form in the environment, i.e., is not degraded or transformed. Also refers to the time for which a substance persists

perturbation - in general terms a disturbance from the regular or normal; used here to indicate any measurable change in the environment, without necessarily implying a harmful result

phagocytic: property of immune system cells to engulf and absorb foreign bodies in tissues and blood. Hence phagocytosis.

pharmacology - the science of drugs including medical uses and toxicology

phase I enzymes: enzymic components of the mixed function oxidase (MFO) system involved with the catabolism of non-polar substrates to more polar hydrophilic products.

phase II (conjugating) enzymes: anabolic enzymes controlling the conjugation of polar metabolites (usually from phase I reactions) with endogenous polar groups and compounds.

phenotype – the physical manifestation of a genetic trait

phenotypic – related to the phenotype

photolytic – breaking down in the presence of light
**phytochelatins** – see metallothioneins - small proteins rich in sulphur-containing amino acids (thiols) in plants that effectively bind many trace metals

**phytoplankton** – the community of photosynthetic organisms, mainly algae, that occur freely suspended in the water column

**phytotoxicity** - the property of being poisonous, toxic, to plants

**phytotoxicology** - the study of toxic effects on plants

**pinocytosis**: transmembrane movement of solvents and solutes by the formation of vesicles within the membrane.

**plumbism** – chronic lead poisoning

**pneumonitis**: toxicant-induced inflammation of lung tissue

**population distribution vector**: component of a population projection model which defines the number of organisms at any specific stage of development.

**potable** – in general terms, drinkable; in a regulatory context, refers to conditions that assure the safety of water for ingestion by humans

**potentiation**: situation where the toxicity of a combination of compounds exceeds the sum of the toxicities of individual compounds. Special case where a particular compound enhances the toxicity of the other(s).

**precautionary principle** – the philosophy of taking preventive or protective action even when there is no conclusive scientific evidence to prove a causal link between emissions and effects

**principle of Conservation of Mass** - in any chemical change the quantity of matter at the end of the change is the same as before

**production** – the quantity of organic matter that is produced by biological activity, typically expressed per area or volume. Primary production refers to the production of autotrophs; secondary production to production by the rest of the trophic chain

**productivity** – the rate of production

**progression**: stage in carcinogenesis describing transition from production of initiated cells to a biologically malignant cell population

**promotion** - the process of increased replication (hyperplasia) of initiated cells leading to the production of a precancerous condition.

**proteinuria** – decreased renal absorption of protein
protoporphyrin – precursor of haem. Increased circulating levels are diagnostic of inhibition, by lead, of enzymes involved with haem synthesis. Levels of protoporphyrin in serum erythrocytes increase when lead (Pb) concentrations are elevated.

pseudoreplication - inappropriate clumping of samples from treatments within a laboratory assay or a field sampling program.

pump: membrane-bound enzyme capable of energy-dependent configurational changes causing translocation of substrate from one side of the membrane to the other.

quantitative structure-activity relationship (QSAR): relationship between the toxicity of chemicals and their physical structure and properties.

r - intrinsic rate of population increase.

rad.: measure of absorbed radioactivity. Amount of radioactivity causing 1kg of tissue to absorb 0.01 joules of energy.

radioactive decay: process of energy release as a radio isotope reverts to a less energetic state.

radionuclide – radioactive atom of a specific element.

raptor – bird of prey

reactive oxygen intermediates (ROIs): highly reactive, cytotoxic radicals (e.g. O$_2^*$, OH$,\cdot$, H$_2$O$_2$), produced by the progressive univalent reduction of molecular oxygen.

receptor - normal body constituents that are chemically altered by a toxicant, resulting in injury and toxicity; or, receptor molecules capable of binding specific substrates at the initiation of gene activation/metabolism/detoxification sequence, e.g. Ah receptor, RAR, RXR..

rem.: measure of destructive radioactive dose. Equivalent of 1 rad of hard x-rays or 0.05 rad of $\alpha$ particles.

resilience – the capacity (of a community or ecosystem) to return to equilibrium following a disturbance

resistance – in many texts, used synonymously with tolerance, i.e., the ability of an organism to exhibit decreased response to a chemical relative to that shown on a previous occasion. Various authors distinguish resistance from tolerance in several different ways: one is that resistance implies that the magnitude of the chemical change lies outside the normal range, and that negative effects of that stressor will eventually be manifested in the organism. Another considers that resistance is a more general term than tolerance, implying inter-species but not
necessarily intra-species comparisons, i.e., when typical members of entire species can grow without ill effects in the presence of elevated concentrations of a potentially harmful substance

**response** - organismal reaction to a toxic dose, quantitative or qualitative

**response, graded** – relative response e.g., percentage reduction in growth, compared with a control

**response, quantal** – all-or-none response, e.g., mortality

**risk** – the chance of an undesired effect, such as injury, disease, or death, resulting from human actions or a natural catastrophe

**risk assessment** - determination of the relationship between the exposure of an ecosystem (or part thereof) to a hazard and adverse effects.

**risk management** – action(s) taken by bringing together all the scientific information that is available to assess the magnitude of a risk, making decisions about the need to reduce the assessed risk, and if necessary designing some action to reduce risk, such as restricted exposure, remediation, pollution control technology, etc.

**roasting** – in metallurgy, preparation of ore for smelting, by heating the ore to oxidise and drive off sulphur gases

**Scatchard plot**: a reciprocal plot used to determine the relationship between enzyme (carrier) substrate complex and substrate concentration.

**scope for growth (SFG)**: describes the excess energy available to an organism, after its basic metabolic needs have been met. As such it represents the energy budget available for somatic and/or germinal growth.

**sequester** – in general, to set apart, isolate; in the present text, to bind up and thus prevent from exerting any effect

**serosal side**: side of a membrane or epithelium adjacent to the internal body fluid.

**Sievert (Sv)**: measure of destructive radioactive dose equivalent to 100 rem.

**sorption** – (from the verb to sorb) – the process of holding, by absorption or adsorption

**species richness**: number of species in an ecosystem.

**spectrometry** – a special case of spectroscopy, where the intensity of electromagnetic radiation is measured using an electronic device (detector)
**spectroscopic** – referring to spectroscopy

**spectroscopy** – the science that deals with the interaction of radiation (UV, visible light, microwave, gamma rays, etc.) with matter.

**stage-based demographic models** (Leslie matrix models) models which use empirical data from different life stages estimate probabilities of transition from one developmental stage to the next.

**stenotoxic**: narrow range of tolerance of toxic chemicals.

**sub-acute toxicity** - toxic effects at concentrations less than the acute LC$_{50}$.

**sulphatases**: enzymes catalysing the breakdown of sulphate conjugates.

**sulphotransferases**: enzymes catalyzing formation of conjugates between xenobiotics and sulphate.

**sulphydryl**: SH group.

**surrogate** – in general use, the term means a substitute. In the context of biological or ecological indicators, the term is used more in the context of an organism that is a representative indicator of the condition of the environment, but which is not necessarily of itself a key component, e.g., “the canary is a surrogate for the human”.

**static** - an aquatic assay in which organisms remain in the same medium throughout the test

**static-renewal test** – test in which some or all of the test medium is replenished periodically

**stress** - a non-specific term often used to imply a change in the environment that puts constraints on a biological system. Used in the present text as synonymous with perturbation.

**structure activity relationships (SAR)**: see quantitative structure activity relationships.

**synergism** – more-than-additive effect of two or more substances, typically of toxicants

**T-cells**: lymphocytes produced by the thymus gland responsible for cellular immunity and hypersensitivity responses e.g. to bacterial antigens.

**teratogenicity** – potential for causing morphological changes in developing organisms

**thiols**: molecules containing a sulphydryl group.

**threshold concentration** - the lowest concentration of a chemical that elicits a toxic effect.
tolerance - the ability to withstand exposure to abnormally high concentrations of contaminants, which would otherwise cause adverse biological effects, and which can be sustained indefinitely.

top-down - holistic approach to ecosystem function, using properties of the ecosystem as a whole, or of the upper trophic level.

toxic – poisonous, harmful in the context of a chemical substance

toxicants – substances that are toxic or potentially toxic

toxicity identification estimate (TIE) or toxicity reduction estimation (TRE) – a toxicity bioassay method involving the testing and retesting of an effluent before and after a series of chemical extractions and/or pH adjustments designed to isolate and identify the toxic fraction. Also known as whole effluent toxicity testing (WET).

toxicokinetics – the study of the dynamics and partitioning of toxicants within living systems

transformation, probit – in the probit transformation percentage mortality is plotted on a probability scale on the y-axis versus log chemical concentration on the x-axis (hence the logarithmic range of chemical concentrations used for the test).

transport processes – physical changes that alter the place in which a substance is located but which do not result in chemical change

volume of distribution Vd; apparent volume of distribution: hypothetical volume occupied by a substance in the body of an organism, assuming that substance to be evenly distributed.

whole effluent toxicity testing (WET): see toxicity identification estimate.

w; tissue-specific weighting factors reflecting relative susceptibilities of different body tissues to radiation damage.

Wt, Quality (weighting): factor used to adjust absorbed radiation dose to effective radiation dose taking into account linear transfer energy (LTE). See linear transfer energy.

xenobiotics - novel or newly synthesised compounds are commonly given the name xenobiotics (from the Greek word xenos meaning stranger). The term is used in reference to compounds not know to occur in nature

Abbreviations

AAF: 2-acetylaminofluorene

Ar: aryl hydrocarbon (receptor)
AHH: aryl hydrocarbon hydroxylase

ALA: alpha-aminolaevulinic acid

ALAD: alpha-aminolaevulinic acid dehydratase

ARNT: Ah receptor nuclear translocator

ASP: amnesic shellfish poisoning

ASTM: American Society for Testing and Materials

ATP: adenosine triphosphate

AVLS: atomic vapor laser separation

AVS: acid-volatile sulphide (see glossary)

BSCF: biota-sediment concentration factor

CCME: Canadian Council of Ministers of the Environment (formerly CREM)

CFP: ciguatera fish poisoning

CTV: critical toxicity value

COSS: Coastal Oil Spill Simulation

CYP 1A1 and CYP 1A2: sub-families of the CYP1 gene family of p450 enzymes responsible for transformation of xenobiotics and endogenous substrates (see glossary, cytochrome p-450).

CWS: Canadian Wildlife Service

DDD: 1,1-dichloro-2,2-bis(p-chlorophenyl) ethane

DDE: 1,1-dichloro-2,2-bis(p-chlorophenyl) ethylene

DDT: 1,1,1-trichloro-2,2-bis(p-chlorophenyl) ethane

DMRP: Dredged Material Research Program

DMSO: dimethyl sulphoxide

DSP: diarrhetic shellfish poisoning
2,4-D: 2,4-dichlorophenoxyacetic acid

EEV: estimated exposure value

EF: enrichment factor

EDTA: ethylenediaminetetraacetic acid

ELA: Experimental Lakes Area

ENEV: estimated no effects value

ER: endoplasmic reticulum

EROD: ethoxyresorufin-O-deethylase

ETS: electron transport system

FISH: fluorescence in situ hybridisation

GC-MS: gas chromatography-mass spectrometry

GSSG - glutathione disulfide

GUS: Groundwater Ubiquity Score (UK). Defined as (1g soil t ) (4- (1g Koc))

HAB: harmful algal bloom

HPLC: high pressure liquid chromatography

pH: (negative logarithm of ) hydrogen ion concentration

IARC: International Agency for Research on Cancer

ICP-MS – inductively coupled plasma-mass spectrometry

ICRP: International Commission on Radiological Protection

ISE: ion selective electrode

IQ: intelligence quotient

Kₐ: dissociation constant for weak acid (see glossary)

KDa: kilodaltons
\(K_{ow}\) - octanol-water partition coefficient (see glossary).

**LAS:** linear alkylbenzene sulphonate

**LLIR:** low level ionising radiation

**LTE:** linear transfer energy (see glossary)

**LULU:** locally unwanted land use

**NAD(H):** nicotinamide adenine dinucleotide (reduced form)

**NADP(H):** nicotinamide adenine dinucleotide phosphate (reduced form)

**NIMBY:** not in my back yard

**NIMTO:** not in my term of office

**NTA:** nitrilotriacetic acid

**NOAA:** National Oceanographic and Atmospheric Administration (U.S.)

**NSP:** neurotoxic shellfish poisoning

**OPEC:** Organisation of Petroleum Exporting Countries

**OSHA:** Occupational Safety and Health Administration (U.S.)

**PAH:** polycyclic aromatic hydrocarbon

**PAN:** peroxyacetyl nitrate

**PCB:** polychlorinated biphenyl

**PMR:** premanufacturing registration

**PPAR:** peroxisome proliferase activated receptor

**PSP:** paralytic shellfish poisoning

**RAIN:** Reversing Acidification in Norway

**RAR:** retinoid receptor

**RXR:** retinoic acid receptor
SEM: simultaneously extracted metals (used in association with acid volatile sulfides, AVS)

SETAC: Society for Environmental Toxicology and Chemistry

SOD: superoxide dismutase

STP: sewage treatment plant

TBT: tributyltin

3,4,5-T: trichlorophenoxyacetic acid

2,3,7,8,TCDD: 2,3,7,8 tetrachlorodibenzodioxin

TEL: tetraethyl lead

TOC: total organic carbon

UDG: glucoronosyl transferase

UNSCEAR: United Nations Scientific Committee on the Effects of Atomic Radiation

US EPA: The United States Environmental Protection Agency

WHAM: Windermere Humic Acid Model