

Glossary - Microbiology (see also Genetics)

Activator Protein: A regulatory protein that binds to specific sites in DNA and stimulates transcription; involved in positive control.

Agar: A gelatinous substance derived from certain red algae; used as a solidifying agent in the preparation of nutrient media for growing microorganisms

An-/Aerobe: An organism that grows in the presence of O₂; may be facultative or obligate. / an organism that grows in the absence of O₂. Some may even be killed by O₂.

A. Respiration: Use of an electron acceptor other than O₂ in an electron-transport-based oxidation. Most common anaerobic electron acceptors are nitrate, sulfate, and carbonate.

Facultative: A qualifying adjective indicating that an organism is able to grow either in the presence or absence of an environmental factor (e.g., facultative aerobe).

Obligate: A qualifying adjective referring to an environmental factor always required for growth (e.g., obligate anaerobe).

Archaea: An evolutionary distinct group (domain) of prokaryota consisting of the Methanogenes, most extreme Halophiles and Hyperthermophiles, and Thermoplasma.

ATP: The principle energy carrier of the cell (see biochemistry):

AMP - Adenosine **mono-phosphate**

ADP - Adenosine **di-phosphate**

ATP - Adenosine **tri-phosphate**

Bacteria: All prokaryota that are not members of the domain Archaea.

Bacteriophage: A virus that infects prokaryotic cells.

Cell: The fundamental unit of living matter. Embedded by a distinct membrane layer:

Lipid: Water-insoluble organic molecules important in structure of the cytoplasmic membrane and (in some organisms) the cell wall (see also phospholipid).

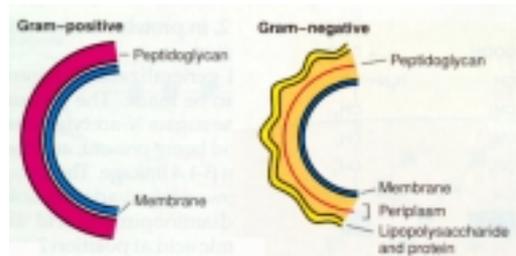
- **Phospholipid:** Lipids containing a substituted phosphate group and two fatty acid chains on a glycerol backbone.

Membrane: Thin layer composed of a phospholipid bilayer, see also cytoplasmic membrane.

Peptidoglycan: The rigid layer of cell walls of Bacteria, a thin sheet composed of N-acetylglucosamine, N-acetylmuramic acid, and a few amino acids; also called murein.

Gram-Negative: Cell wall containing relatively little peptidoglycan (10%) but contains an lipo-polysaccharide (LPS) layer with embedded complex macromolecules;

- **Lipo-polysaccharide (LPS):** Complex lipid structure containing unusual sugars and fatty acids
- **Periplasmic space:** Area b/w the cytoplasmic membrane and the cell wall, containing certain enzymes involved in nutrition, lipoproteins and the peptidoglycan layer.



Gram-Positive: A prokaryotic cell whose cell wall consists chiefly of peptidoglycan (90%) and lacks the outer membrane of Gram-negative cells.

Chemical Bonds:

Covalent B.: A nonionic chemical bond formed by sharing of electrons between atoms.

Hydrogen B.: A weak chemical bond between a hydrogen atom and a second, more electronegative element, usually an oxygen or nitrogen atom.

Peptide B.: A type of covalent bond joining amino acids in a polypeptide.

- **Polypeptide B.:** Several amino acids linked together by peptide bonds.

Phosphodiester B.: A type of covalent bond linking nucleotides together in a polynucleotide.

Chemiosmosis: The use of ion gradients across membranes, especially proton gradients, to generate ATP, see proton-motive force.

Chemotaxis: Movement toward or away from a chemical.

Chloroplast: The chlorophyll-containing organelle of photosynthetic eukaryota.

Cloning Vector: Genetic elements into which genes can be recombined and replicated.

Codon: A sequence of three purine and/or pyrimidine bases in mRNA that encodes a specific amino acid.

Anticodon: A sequence of three bases in tRNA that base pairs with a codon in mRNA.

Concentration Gradient: The concentration difference of a substance per unit distance; e.g. across cell-membrane.

Conjugation: Transfer of genes from one prokaryotic cell to another by mechanism involving cell-to-cell contact and a plasma.

Cytochrome: (Gk. kytos, hollow vessel; chroma, color) Ion-containing porphyrin rings complexed with proteins (Heme proteins), which act as electron carriers in the electron transport system (in respiration and photosynthesis).

Cytoplasm: Cellular contents inside the cytoplasmic membrane, excluding the nucleus.

Cytoplasmic Membrane: The permeability barrier of the cell, separating the cytoplasm from the environment; see cell wall.

DNA (deoxyribonucleic acid): A double chain of linked nucleotides (having deoxyribose as their sugars); the fundamental substance of which genes are composed;

in **eukaryota**: DNA wrapped around histones, forming nucleosomes on solenoids; i.e. chromosomes.

in **prokaryota**: DNA is circular and supercoiled, do not have chromatin (histones etc.).

DNA Double Helix: Two interlocking helices joined by hydrogen bonds between the pairs purine-pyrimidine bases (see genetics).

DNA Sequence: The linear assembly of purine / pyrimidine nucleotides along a DNA strand.

DNA Topoisomerase: Enzyme unwinding the tightly coiled DNA arrangement, for DNA-replication.

DNA Replication: Semiconservative replication, where one strand determines the sequence of the complementary strand (DNA synthesis).

Electron-transport phosphorylation: Synthesis of ATP involving a membrane-associated electron transport chain and the creation of a proton-motive force. Also called oxidative phosphorylation, see also chemiosmosis.

Endospore: A differentiated cell formed within the cells of certain gram-positive bacteria and extremely resistant to heat as well as to other harmful agents.

Energetic Reactions: Chemical reactions requiring / liberating chemical energy.

Endergonic R.: A chemical reaction requiring input of energy to proceed, see exergonic reaction.

Exergonic R.: A chemical reaction that proceeds with the liberation of energy, see endergonic reaction.

Enzyme: A protein functioning as a catalyst in living organisms, which promotes specific reactions or groups of reactions.

Activation Energy: Energy needed to make substrate molecules more reactive; enzymes function by lowering activation energy.

Coenzyme: A low-molecular-weight chemical which participates in an enzymatic reaction by accepting and donating electrons or functional groups. (examples: NAD^+ FAD).

Restriction E. (endo-nuclease): Enzymes that recognize and cleave specific DNA sequences, generating either blunt or single-stranded (sticky) ends.

FAD: FlavinAdenineDineucleotide, a coenzyme formed by the condensation of riboflavin phosphate and adenylic acid; it performs an important function in electron transport (oxidation of fuel molecules) and is a prosthetic group for some enzymes (see biochemistry DNA-RNA).

FADH - intermediate to FADH₂; only one site of the isoalloxazine ring is occupied;

FADH₂ - isoalloxazine ring can occupy 2e⁻ and 2H⁺;

Frameshift: Since the genetic code is read three bases at a time, if reading begins at either the second or third base of a codon, a faulty product usually results. This is called a frameshift (the reading frame refers to the pattern of reading).

Genome: The complete sets of genes present in an organism;

Chromosome: A genetic element carrying genes essential to cellular metabolism. Prokaryota typically have a single chromosome, consisting of circular DNA molecule. Eukaryotic cells contain several chromosomes, each containing a linear DNA molecule complexed with specific proteins.

Gene: A unit of heredity; a segment of DNA specifying a particular portion or polypeptide chain, a tRNA or rRNA.

- **G. Disruption:** Use of both in vitro and in vivo recombination to substitute an easily selected mutant gene for a wild-type gene.
- **Exon:** The coding sequences in a split gene of eukaryota.
- **Introns:** The intervening non-coding sequences in a split gene of eukaryota.
- **Genotype:** The precise genetic constitution of an organism; information encoded by the genome;
- **Phenotype:** The observable properties of an organism; i.e. information expressed by the genome;

Host: An organism capable of supporting the growth of a virus or other parasite.

Hybridisation: Formation of a double nucleic acid molecule with strands derived from different sources by complementary base pairs; see bacterial systematics.

Hydrophobic Interactions: Attractive forces between molecules due to the positioning of nonhydrophobic portions of two molecules.

Induction: The process by which an enzyme is synthesized in response to the presence of an external substance, the inducer.

Inhibition: Absorption of water and swelling of colloidal materials because of the absorption of water molecules onto the internal surface of the materials.

Insertion: A genetic phenomenon in which a piece of DNA is inserted into the middle of a gene.

Kilobase (kb): A 1000 base fragment of nucleic acid. A kilobase pair is a fragment containing 1000 base pairs.

Krebs Cycle: (citric acid cycle, or tricarboxylic acid cycle): A series of steps by which pyruvate is oxidized completely to CO₂, also forming NADH, which allows ATP production.

Lysis: Rupture of a cell, resulting in loss of cell contents.

Glycolysis: Also EMP pathway - reaction in which glucose is oxidized to pyruvate.

Hydrolysis: Breakdown of a polymer into smaller units, usually monomers, by addition of water, digestion.

Lysogen: A prokaryote containing a prophage, see also temperate virus.

Magnetosomes: Small particles of Fe₃O₄ present in cells that exhibit magnetotaxis.

Metabolism (Gk. metabole, change): All biochemical reactions in a cell, both anabolic and catabolic.

Anabolism (biosynthesis): Is the process by which a cell is built up from the simple nutrients obtained from the environment, and it results in the biochemical synthesis of new material. Biosynthesis is an energy-requiring process, there are **two kinds of energy sources:** light and chemicals.

Catabolism: The biochemical process involved in the breakdown of organic compounds, usually leading to the production of energy.

- **Catabolite repression:** Repression of variety of unrelated enzymes when cells are grown in a medium containing glucose.
- **Fermentation:** Catabolic reactions producing ATP in which organic compounds serve as both primary electron donor and ultimate electron acceptor.

Mitochondrion: Eukaryotic organelle responsible for processes of respiration and electron-transport phosphorylation (ATP-generation).

Cristae: Enfoldings of the inner mitochondrial membrane, which form a series of crests or ridges containing the electron transport chain involved in ATP formation.

Monomer: A building block of a monomer.

Murein: see peptidoglycan.

Mutagen: An agent that induces mutation, such as radiation or certain chemicals.

Mutant: A strain differing from its parent because of mutation.

Mutation: An inheritable change in the base sequence of the DNA of an organism.

Point M.: A mutation which involves one or only a very few base pairs.

NAD: Nicotinamide Adenine Dinucleotide, a widely distributed coenzyme in living organisms; made up of adenine, nicotinamide, and 2 molecules each of d-ribose and phosphoric acid; it serves as an electron acceptor in many oxidation reactions of cell respiration see biochemistry - DNA-RNA.

NAD⁺ - oxidized form; is a major electron acceptor in the oxidation of fuel molecules (respiratory chain); with the reactive part the pyridine ring on top;

NADH - reduced form of NAD⁺; in the oxidation process accepts a H-ion and two electrons, which are equivalent to a hydride ion;

NADP⁺ - oxidized form, a coenzyme that functions as an electron acceptor in many of the reduction reactions of biosynthesis; similar in structure to NAD⁺ except that it contains an extra phosphate; It is exclusively used as an e-donor in reductive biosynthesis, whereas NADH is oxidized by the respiratory chain to generate ATP.

Nucleic Acid: A polymer of nucleotides. (see genetics, biochemistry DNA, RNA).

Nucleoid: The aggregated mass of DNA that makes up the chromosome of prokaryote.

Nucleotide: A single unit of nucleic acid, composed of a phosphate, a 5-C sugar (either ribose or deoxyribose), and a purine or a pyrimidine.

Nutrient: A substance taken by a cell from its environment and used in catabolic or anabolic reactions.

Operon: A cluster of genes whose expression is controlled by a single operator.

Organelle: A membrane-enclosed body specialized for carrying out certain functions; found in eukaryotic cells.

Osmosis: Diffusion of water through a membrane from a region of low solute concentration to one of higher concentration.

Oxidation-Reduction (redox) reaction: A coupled pair of reactions, in which one compound becomes oxidized, while another becomes reduced and takes up the electrons released in the oxidation reaction.

Oxidation: A process by which a compound gives up electrons, acting as an electron donor, and becomes oxidized (mostly by oxygen, leading to this terminus).

- **Electron Donor:** A compound that donates electrons during an oxidation-reduction reaction. An electron donor is a reductant.

Oxidative Phosphorylation (electron transport): The non-phototrophic production of ATP at the expense of a proton motive force formed by electron transport.

Reduction: A process by which a compound accepts electrons to become reduced.

- **Electron Acceptor:** A substance that accepts electrons during an oxidation-reduction reaction. An electron acceptor is an oxidant.
- **R. Potential (E_0'):** The inherent tendency of a compound to act as an electron donor or an electron acceptor, measured in volts.

Phosphorylation: Synthesis of high-energy phosphate bonds as ATP.

Substrate-Level P.: Synthesis of high-energy phosphate bonds through reaction of inorganic phosphate with an activated (usually) organic substrate.

Plaque: A zone of lysis or cell inhibition caused by virus infection of a lawn of sensitive cells.

Plasmid: An extra-chromosomal genetic element not essential for growth and which has no extracellular form.

Polymer: A large molecule formed by polymerisation of monomeric units.

Polymerase Chain Reaction (PCR): A method used to amplify a specific DNA sequence in vitro by repeated cycles of synthesis using specific primers and DNA polymerase.

Pribnow Box: The consensus sequence TATAAT located approximately 10 base pairs upstream from the transcription start site for polymerase.

Primer: A molecule (usually a polynucleotide) to which DNA polymerase can attach the first nucleotide during DNA replication.

Prion: An infectious agent whose extracellular form may contain no nucleic acid.

Prokaryota: A cell or organism lacking a unit membrane-bound (true) nucleus and other organelles, usually having its DNA in a single circular molecule.

Promoter: The site on DNA where the RNA polymerase binds and begins transcription.

Protein: (Gk. Proteios, primary) A complex organic compound composed of many (about 100) aminoacids joined together by peptide bonds. (see polypeptide chain).

Repressor P.: A regulatory protein which binds to specific sites on DNA and blocks transcription; involved in negative control.

P. Structure: A polymeric molecule consisting of one or more polypeptides.

- **Primary S.:** In an informational macromolecule, such as a polypeptide or nucleic acid, the precise sequence of monomeric units.
- **Secondary S.:** The initial pattern of folding of a polypeptide or a polynucleotide, usually the result of hydrogen bonding.
- **Tertiary S.:** Final folded structure of a polypeptide that has previously attained secondary structure.
- **Quartary S.:** The number and arrangement of individual polypeptides in the final protein molecule.

Proton Motive Force: An energized state of a membrane created by expulsion of protons through action of an electron transport chain.

Protoplasma: The complete cellular contents, cytoplasmic membrane, cytoplasm, and nucleus; considered to be the living portion of the cell, thus excluding those layers peripheral to the cytoplasmic membrane.

Quinone: Found in the bacterial plasma membrane are of essential need for the electron transport chain and oxidative phosphorylation (ATP-generation as a result of the transfer of electrons from NADH or FADH₂ to O₂ by a series of electron carriers).

Recombination: The process by which parts or all of DNA molecules from two separate sources are exchanged or brought together into a single unit.

Redox.: See oxidation-reduction reaction.

Respiration: Catabolic reactions producing ATP in which either organic or inorganic compounds are primary electron donors and organic or inorganic compounds are ultimate electron acceptors. An intercellular process in which molecules, particularly pyruvate in the Krebs Cycle, are oxidized with the release of energy. The complete breakdown of sugar or other organic compounds to CO₂ and H₂O is termed aerobic respiration, although the first step in this process are anaerobic.

Ribosome: A cytoplasmic particle composed of ribosomal RNA and protein, which is part of the protein-synthesizing machinery of the cell.

Ribozyme: An RNA molecule that can catalyze a chemical reaction.

RNA (ribonucleic acid): A single stranded nucleic acid similar to DNA but having ribose as its sugar and uracil rather than thymine as one of the bases; see genetics;

mRNA (messenger RNA): An RNA molecule transcribed from the DNA of a gene, and from which a protein is translated by the action of ribosomes (constituting for 5% of total RNA).

rRNA (ribosomal RNA) A class of small and large subunit-RNA molecules, coded in the nuclear organizer, that have an integral role in ribosome structure and function (80% of total RNA).

tRNA: (transfer RNA): Small cloverleaf RNA molecules that bear specific amino acids (at the 3'-end =CCA) to the ribosome during translation; the amino acid is inserted into the growing polypeptide chain when the anticodon of the tRNA pairs with a codon on the mRNA being translated (15%).

RNA processing: The conversion of a precursor RNA into its mature form (cutting out the introns).

Spontaneous Generation: The hypothesis that living organisms can originate from nonliving matter.

Substrate: The molecule undergoing reaction with an enzyme.

Transcription: (L. trans, across; scribere, to write) The synthesis of complementary mRNA using portions of the sense-DNA template (ORF) with the help of RNA-polymerase; see genetics.

Reverse T.: The process of copying information found in RNA into DNA.

Transduction: Transfer of host genes from one cell to another by a virus.

Transformation: A process by which a normal cell becomes a cancer cell / also the transfer of bacterial genes involving free DNA.

Trophic Requirements: The movement of energy through an microbial ecosystem is structured according to the primary energy source:

Autotroph: (Gk. autos, self; trophos, feeder) Organism able to use CO₂ as sole source of carbon.

Auxotroph: A mutant that has a growth factor requirement. Contrast with a prototroph.

Heterotroph: Utilization of chemotrophic food sources; can be further differentiated into:

- **Chemo-litotroph**: Organism obtaining its energy from the oxidation of inorganic compounds.
- **Chemo-organotroph**: Organism obtaining its energy from the oxidation of organic compounds.

Phototroph: An organism that obtains energy from light.

Toxin: A microbial substance able to induce host damage.

Tricarboxylic Acid Cycle: see Krebs Cycle.

Viroid: A small RNA molecule with viruslike properties.

Virion: A virus particle; the virus nucleic acid surrounded by protein coat and in some cases other material.

Virus: A genetic element containing either DNA or RNA that is able to alternate between intracellular and extracellular states, the latter being the infectious state.

Pro-V. (prophage): The state of the genome of a temperate virus when it is replicated in synchrony with that of the host, typically integrated into the host genome.

Retro-V.: Virus containing single-stranded RNA as its genetic material and which produces a complimentary DNA by action of the enzymes reverse transcriptase.

Temperate V.: A virus which upon infection of a host does not necessarily cause lysis but whose genome may replicate in synchrony with that of the host, see lysogen.

Virulent V.: A virus which lysis or kills the host cell after infection; a non-temperate virus.