

Glossary of Biochemistry and Molecular Biology

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David M. Glick, Ph.D.

Associate Professor of Biochemistry

The Medical College of Wisconsin

Milwaukee, Wisconsin

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PREFACE

Biochemists speak a language that is not always understood by others. The intention is never (or seldom) to use this as an artificial barrier to novices or eavesdroppers, but a barrier it nonetheless is. I hope this glossary will assist students and others with an interest in biochemistry and molecular biology to learn the language so we may more easily begin to converse.

Of the thousands of possible words that might have been included, I usually have avoided the names of particular enzymes, proteins, metabolites, and so on, because this book is not intended to be an encyclopedia. Information about such items can be accessed through the indexes of the many good textbooks available. I have concentrated on words and phrases that are unique to biochemistry and molecular biology (e.g., G proteins) or that have assumed unique meanings in these fields (e.g., library). The boundaries between biochemistry/molecular biology and medicine, cell biology, and chemistry are arbitrary, so one will find chemical words, such as epimer, and medical terms, such as serum, because these are used commonly by biochemists.

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David M. Glick
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A

A-DNA A right-handed helix, a variant of the dominant B-form of DNA in solution, one in which the basepairs are tilted somewhat out of the perpendicular orientation to the axis of the helix (*see also* Z-DNA).

(A + T)/(G + C) ratio A reference to the base composition of dsDNA, DNA from different sources having different ratios of the A to T and G to C basepairs; e.g., DNA isolated from organisms living in hot springs has a higher GC content, taking advantage of the increased thermal stability of the GC basepair. (*see also* Chargaff's rule).

absolute configuration The actual, as opposed to relative to some other compound, orientation of atoms in space at an asymmetrical center.

absorbance (*see* Beer-Lambert equation).

absorption spectrum The absorption or extinction coefficient as a function of wavelength, usually displayed with absorbance on the ordinate and wavelength on the abscissa.

abzyme An antibody with catalytic properties; often raised against a hapten that chemically resembles the transition state of the intended substrate so as to force a substrate into that transition state.

accelerated diffusion (*synonym*: facilitated diffusion).

acceptor splice site A site in hnRNA corresponding to the 3'-end of the intron and the 5'-end of the next exon, the last two bases of the intron at the acceptor splice site being AG.

acceptor stem The 3'-end of a tRNA molecule, which has a CCA terminal sequence, that can bind an amino acid in an ester bond to one of the free hydroxyl groups (*see also* cloverleaf; tRNA).

acetal (*see* hemiacetal).

acetate rule The observation, first based on inspection of structures, later on experimentation, that many natural products appear to have been assembled from multiple acetate (acetyl-CoA and malonyl-CoA) units in head-to-tail condensations (*see also* acetogenin; propionate rule).

acetogenin A compound derived from acetyl units donated by acetyl-CoA and malonyl-CoA units, assembled into a nonreduced polyketide, i.e., with the carbonyl groups intact, often, then, cross-linked by aldol condensation and processed by further biochemical transformations to the final product, e.g., orsellinic acid, griseofulvin (*see also* acetate rule, depside).

acid protease (*synonym*: aspartic proteinase).

acinar cell A secretory cell within an acinus.

acinus A cluster of secretory cells surrounding a duct.

acrosome A specialized lysosome of a spermatozoon, containing hyaluronidase, the proteinase acrosin, and other hydrolytic enzymes.

action spectrum A measure of the effectiveness of various wavelengths in promoting photosynthesis; usually a plot of photosynthetic efficiency versus wavelength.

activation energy The energy needed to raise the reactants, or an enzyme-substrate complex, to the transition state, where it has an equal likelihood of conversion to product or reversion to reactants; evaluated in an Arrhenius plot, $\ln K$ vs $1/T$, where K is the rate constant and T is the absolute temperature, the slope being E_a/R , where E_a is the activation energy and R is the gas constant (*see also* Q_{10} , reaction coordinate).

activator In enzyme kinetics, a compound that increases the rate of an enzymatic reaction (*see also* allostery).

active acetaldehyde The CH_3CHOH^- group when attached to the thiamine pyrophosphate prosthetic group of the pyruvate dehydrogenase complex.

active glycolaldehyde The $\text{HOCH}_2\text{CHOH}^-$ group when attached to the thiamine pyrophosphate prosthetic group of transketolase.

active site The binding and catalytic sites of an enzyme.

active transport An energy-requiring transport mechanism that works against a concentration gradient (*see also* facilitated diffusion; passive diffusion).

acyl-enzyme An intermediate in the hydrolysis of substrates by some peptidases and esterases, e.g., by serine proteinases, in which the acyl moiety of the substrate is transiently attached to a serine hydroxyl group of the enzyme.

adenylate energy charge A measure, on a scale of 0 to 1, of the degree of phosphorylation of adenine nucleotides; $([\text{ATP}] + \frac{1}{2}[\text{ADP}])/([\text{ATP}] + [\text{ADP}] + [\text{AMP}])$ (*see also* phosphorylation potential).

adipo- A prefix indicating fatty tissue, e.g., adipocyte (a fat cell).

adipose tissue Fat tissue.

adrenergic Responsive to the adrenal medullary hormone, i.e., epinephrine, and by extension, responsive to other catecholamines, β -adrenergic responses being those that result in the intracellular generation of cyclic AMP.

affinity chromatography The separation of soluble macromolecules using a stationary phase that is designed to interact specifically with, and thus retard the elution of, the desired material, e.g., a hapten attached to a resin to help isolate an immunoglobulin directed toward it.

affinity labeling A technique that depends on the tight attachment of a ligand to a binding site on a protein or cell, followed by a

chemical reaction to covalently link the ligand to its binding site (*see also* photoaffinity labeling).

agglutination The clumping together of cells that are suspended in a fluid.

agglutinin A compound that crosslinks cells, e.g., a lectin, an antigen that reacts with sensitized cells.

aggreptope A consensus sequence that permits a protein, usually a foreign protein, to bind to a particular MHC protein of a T cell.

aglycone A nonsugar moiety of a glycoside.

agonist A compound, often a hormone or its analog, that binds to a receptor and elicits a response (*see also* antagonist).

albumin Originally, a protein that is soluble in salt-free water and that will coagulate when heated; also the principal albumin of serum (*see also* globulin).

aldimine form (*see* quinimine form).

aldol condensation The reversible formation of a bond between two carbons, one of a carbonyl group, the other adjacent to a second carbonyl group; by extension, a condensation of compounds that share that kind of chemistry, e.g., the citrate synthase reaction.

alkaloid A nitrogen-containing natural product of a plant, often with pharmacological properties, e.g., morphine, nicotine, strychnine.

all-or-none assay A technique to measure the total amount of a functional enzyme, regardless of its efficiency or affinity for substrate; e.g., to distinguish uniformly impaired chymotrypsin from a mixture of fully active and fully inactive enzyme, the spectrophotometric assay of chymotrypsin based on acylation of the enzyme by the substrate, cinnamoyl imidazole, the rapid burst of absorbance from which being proportional to the number of func-

tional chymotrypsin molecules, followed by the much slower development of absorbance due to the steady state turnover of substrate, being limited by the efficiency of enzyme deacylation.

allele Any one of the sequence variants present at a genetic locus; an individual with identical alleles at a genetic locus is a homozygote, one with nonidentical alleles is a heterozygote.

allosteric effector A compound that modifies the activity of an enzyme or its affinity for substrates by binding to a site distinct from the active site; a positive effector increasing the activity, a negative effector decreasing the activity (*see also* heterotropic enzyme; homotropic enzyme).

allostery Allosteric regulation; the modification of binding or catalytic properties of a protein by binding of a regulator at a site distinct from the ligand- or substrate-binding site; typically resulting in sigmoid kinetics (*see also* heterotropic enzyme; homotropic enzyme).

allotype A classification of immunoglobulin molecules according to the antigenicity of the constant regions; a variation that is determined by a single allele (*see also* idiotypic; isotype).

alpha₁- or alpha₂-cysteine proteinase inhibitor (*see* cysteine proteinase inhibitor).

alpha-cell (*see* islet).

alpha-configuration (*see* configuration).

alpha-helix (*see* helix).

alpha-isomer (*see* isomer).

alpha-oxidative decarboxylation (*see* oxidative decarboxylation).

amber mutation A nonsense mutation, the formation of a non-functional protein due to premature appearance in the mRNA of

the terminator codon, UAG (*see also* ochre mutation; opal mutation).

Ames test A test for mutagenicity and carcinogenicity, using specially constructed bacterial strains, by screening the effects of test compounds for reverse mutations that will restore the ability to grow in the absence of an essential metabolite.

amino acid Usually an α -amino acid, in which a carboxyl and an amino (or imino) group are attached to the α -carbon; triple and single letter codes are shown:

alanine	Ala	A	leucine	Leu	L
arginine	Arg	R	lysine	Lys	K
asparagine	Asn	N	methionine	Met	M
aspartic acid	Asp	D	phenylalanine	Phe	F
cysteine	Cys	C	proline	Pro	P
glutamic acid	Glu	E	serine	Ser	S
glutamine	Gln	Q	threonine	Thr	T
glycine	Gly	G	tryptophan	Trp	W
histidine	His	H	tyrosine	Tyr	Y
isoleucine	Ile	I	valine	Val	V
aspartic acid or asparagine				Asx	B
4-carboxyglutamic acid				Gla	
glutamic acid or glutamine				Glx	Z
hydroxyproline				Hyp	
pyroglutamic acid				Pgl or <Glu	

amino acyl site The part of a ribosome that binds one amino acyl-tRNA where it will accept the peptidyl group held at the peptide site in the form of its tRNA ester (*see also* peptide site).

ammonotelic Descriptive of an organism that excretes ammonia as an end product of nitrogen metabolism (*see also* ureotelic; uricotelic).

amniocentesis A procedure to obtain fetal cells during pregnancy by puncturing the womb with a needle and removing some fluid that surrounds the fetus; the procedure is used, in part, to obtain fetal cells from which DNA can be isolated for prenatal genetic analysis.

amphibolic pathway A metabolic pathway that participates in both anabolic and catabolic pathways, e.g., the tricarboxylic acid cycle.

amphipathic Having both polar and nonpolar groups, as a detergent.

amphipathic helix A protein structure that serves in part as an interface between polar and nonpolar phases; an α -helix that displays nonpolar residues on one side and polar residues on the other; e.g., in many globular proteins, in which polar residues project into the surrounding water whereas the nonpolar residues are directed inward, and in the proteins of ion channels, in which the helix shows one face to the lipid of the bilayer and another face to the channel that traverses the membrane.

amphitropic Having an affinity for both lipid and aqueous environments, e.g., a membrane-associated protein that has domains embedded in the membrane and others extending into the cytosol or the extracellular space.

amphoteric Having both acidic and basic groups, as an amino acid.

anabolism Those energy-requiring metabolic pathways that result in synthesis of macromolecules and their building blocks, e.g., gluconeogenesis, fatty acid synthesis (see also amphibolic pathway; catabolism).

anabolite A metabolite built up from a certain compound (see also catabolite).

anaerobic glycolysis (see glycolysis).

analytical ultracentrifugation A technique of very high speed centrifugation that is capable of sedimenting soluble macromolecules and characterizing them according to their rate of sedimentation (sedimentation-velocity ultracentrifugation) or the extent of their sedimentation (equilibrium sedimentation ultracentrifugation) (*see also* density gradient centrifugation).

anapleurotic pathway Metabolic reactions that replenish the pools of intermediates of the TCA cycle, which are depleted as they serve, besides the functioning of the cycle, as precursors for amino acid synthesis, gluconeogenesis, and other anabolic reactions.

androgen A compound, usually a steroid, that supports the development of male secondary sex characteristics, e.g., testosterone.

anion exchanger (*see* ion-exchange chromatography).

anisotropic Descriptive of a physical property that varies with the angle of observation (*see also* isotropic).

annealing The time- and temperature-dependent process by which two complementary single-strand polynucleotides associate to form a double helix.

anomer One of the two possible compounds that arise when the open chain form of a sugar condenses in a hemiacetal or hemiketal bond and produces a new asymmetrical center (*see also* α -isomer; β -isomer).

antagonist A compound, often an analog of a hormone, that binds to a receptor but elicits no response (*see also* agonist).

anthrone reaction A colorimetric method for estimation of sugars, involving treatment with sulfuric acid and anthrone.

anti-configuration The orientation about the glycosidic bond of a nucleoside or nucleotide that places the base away from the sugar

moiety, contrasted with the *syn* conformation, in which the base and sugar are oriented toward each other (*see also* Z-DNA).

antibody An immunoglobulin molecule that reacts specifically with another, usually foreign, molecule, the antigen.

anticodon The three-nucleotide sequence of a tRNA molecule that is complementary to the triplet of mRNA, the codon, which specifies a certain amino acid.

anticodon arm The loop of a tRNA molecule that contains the anticodon (*see also* cloverleaf).

antiergotypic Descriptive of killer T cells that recognize and respond to a cell surface marker of an actively immunoglobulin-secreting T cell; contrasted with antiidiotypic, descriptive of killer T cells that recognize and respond to a cell surface marker of T cells that produce a specific immunoglobulin idiotype.

antifolate An antimetabolite that blocks the action of tetrahydrofolic acid-dependent reactions, usually by inhibiting folic acid reductase.

antigen A substance that causes production of an antibody directed against itself.

antigenic determinant (*synonym*: epitope).

antiidiotypic (*see* antiergotypic).

anti-Lepore hemoglobin (*see* Lepore hemoglobin).

antimetabolite An inhibitor of a key enzyme in metabolism, used to suppress activity of the cell; often used for chemotherapy.

antioxidant A scavenger of reactive oxygen species (OH^\cdot , O_2^- , etc.) and other oxidizing compounds, e.g., heme compounds with high-valence iron.

antiparallel In protein chemistry, the orientation of extended polypeptide chains interacting in a pleated sheet structure, one

chain in an amino-to-carboxyl direction, the other in a carboxyl-to-amino direction; in nucleic acid chemistry, orientation of the two polynucleotide chains of a double helix, one running in a 3'-to-5' direction, the other, 5'-to-3'.

antiport A transport mechanism that simultaneously drives two different compounds or ions in opposite directions across a membrane (*see also* symport; uniport).

antisense RNA An RNA strand complementary to mRNA, transcribed from the antisense strand of a gene and capable of base-pairing and annealing with mRNA and preventing translation.

antisense strand A polynucleotide that is complementary to the sense strand; sometimes referred to as the (-)-strand.

antiterminator A bacteriophage protein that prevents the normal termination of transcription, e.g., the N protein that binds to nut (N utilization) sites, thus countering the action of the rho protein.

apical Descriptive of the free border of an epithelial cell, where it is in contact with vascular space (*see also* basolateral).

apocrine Descriptive of a secretion mechanism in which vesicles containing the product burst through the cell membrane and are released along with some of the cytoplasm and plasma membrane (*see also* exocytosis; holocrine).

apoprotein A protein stripped of any prosthetic group or metal ion normally associated with it (*see also* holoprotein).

apparent K_m The Michaelis constant as observed under conditions, e.g., the presence of a competitive inhibitor, that would hinder the determination of the true value of the constant; in the case of a two-substrate enzyme, the Michaelis constant measured under the particular conditions of a defined concentration of the invariant substrate.

aprotinin Bovine pancreatic proteinase inhibitor.

apurinic DNA The polynucleotide that has lost its purine bases due to the lability in acid of the glycosidic bond to purines.

Arrhenius plot (*see* activation energy).

ascus A spore-like form yeast cells pass through in their life cycle; an outer wall surrounds a diploid cell that undergoes meiosis to form four haploid cells (ascospores), eventually rupturing to yield two diploid daughters.

aspartic proteinase A type of peptidase that has at its active site two aspartate residues (*see also* cysteine proteinase; metalloproteinase; serine proteinase).

association constant (*see* K_a).

asymmetrical reaction The unequal handling of like groups in a prochiral compound (*see also* meso-carbon; Ogston hypothesis).

ATPase An enzyme that hydrolyzes ATP; usually the partial activity of an enzyme, or system of enzymes, that uses the energy made available by the hydrolysis of ATP to drive an energetically unfavorable process, e.g., the Na^+/K^+ -ATPase of cell membranes.

atrophy A wasting away of an organ and/or its capabilities (*see also* hypertrophy).

attenuation The response in synthesis of bacterial mRNA to the nutritional state of the organism, e.g., the decrease in transcription of the *trp* operon in the presence of tryptophan due to the incomplete transcription of a leader mRNA sequence coded for by the attenuator sequence.

attenuator A polynucleotide sequence that occurs between an operon and its closest structural gene (*see also* attenuation).

autocatalysis The activation of a proenzyme preparation by that fraction of it that has already been activated.

autocrine Descriptive of a mechanism of intra- or intercellular communication in which a cell secretes a hormone, which then binds to receptors on the surface of the same cell (*see also* endocrine; exocrine; paracrine).

autogenous regulation A phenomenon in which a gene for a single protein is regulated by its own promoter and operator, constituting a one-protein operon.

autoimmune disease The reaction of an individual's immune system toward some of the individual's own proteins as if they were foreign proteins, e.g., myasthenia gravis, rheumatoid arthritis.

autonomic nervous system A functional division of the peripheral nervous system consisting of those pathways that are under involuntary control, e.g., those that regulate the gastrointestinal tract and glandular function.

autophagy The action of a lysosome to digest intracellular materials (*see also* heterophagy).

autoradiography A technique for visualizing radioactivity of histological preparations, paper chromatograms, or slab gels from electrophoresis by overlaying the surface with x-ray film and allowing the radiation to form an image on the film.

autosomal recessive Descriptive of a nonsex-linked genetic trait that must be inherited from both parents to be expressed on the phenotypic level.

autotroph A cell that can sustain itself on nonorganic nutrients, e.g., a photosynthetic cell.

auxin A type of plant hormone that affects cell size, e.g., indoleacetic acid.

axial Descriptive of the orientation of a substituent on a six-membered ring that is perpendicular to the plane of the ring; opposed

to equatorial, which is the orientation substantially within the plane of the ring (*see also* chair form).

axial ratio A measure of the asymmetry of a macromolecule, assumed to be an ellipsoid, given by the ratio of the major axis to the minor axis; evaluated from physical properties, e.g., hydrodynamic behavior, light scattering.

axon A long projection of a neuron through which it communicates with other cells.

axoneme The fundamental structural unit of eukaryotic flagella and cilia; composed of nine microtubular doublets (in cross-section, a first microtubule with a second fused to it) surrounding two microtubule singlets (*see also* triplet).

axoplasm The cytoplasm of an axon.