CLASSIFICATION OF ENZYMES

A system of enzyme nomenclature that is comprehensive, consistent and at the same time easy to use has proved elusive. The common names for most enzymes derive from their most distinctive characteristic, i.e. their ability to catalyze a specific chemical reaction. In general, an enzyme's name consists of a term that identifies the type of reaction catalyzed followed by the suffix *-ase.* For example, dehydrogen*ases* remove hydrogen atoms, prote*ases* hydrolyze proteins, and isomer*ases* catalyze rearrangements in configuration. One or more modifiers usually precede this name. Unfortunately, while many modifiers name the specific substrate involved (xanthine oxidase), others identify the source of the enzyme (pancreatic ribonuclease), specify its mode of regulation (hormone-sensitive lipase), or name a distinguishing characteristic of its mechanism (a cysteine protease). When it was discovered that multiple forms of some enzymes existed, alphanumeric designators were added to distinguish between them (eg, RNA polymerase III). To address the ambiguity and confusion arising from these inconsistencies in nomenclature and the continuing discovery of new enzymes, the International Union of Biochemists (IUB) developed a complex but unambiguous system of enzyme nomenclature. In the IUB system, each enzyme has a unique name and code number that reflect the type of reaction catalyzed and the substrates involved.

Enzymes are grouped into six classes, each with several subclasses.

1. **Oxidoreductases** catalyze oxidations and reductions.

2. Transferases catalyze transfer of groups such as methyl or glycosyl groups from a donor molecule to an acceptor molecule.

3. Hydrolases catalyze the hydrolytic cleavage of C□C, C-O, C-N, P-O, and certain other bonds, including acid anhydride bonds.

4. Lyases catalyze cleavage of C-C, C-O, C-N, and other bonds by elimination, leaving double bonds, and also add groups to double bonds.

5. Isomerases catalyze geometric or structural changes within a single molecule.

6. Ligases catalyze the joining together of two molecules, coupled to the hydrolysis of a pyrophosphoryl group in ATP or a similar nucleoside triphosphate.

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Many enzymes have been named by adding the suffix "-ase" to the name of their substrate or to a word or phrase describing their activity. Thus urease catalyzes hydrolysis of urea, and DNA polymerase catalyzes the polymerization of nucleotides to form DNA. Other enzymes were named for a broad function, before the specific reaction catalyzed was known. For example, an enzyme known to act in the digestion of foods was named pepsin, from the Greek *pepsis*, "digestion," and lysozyme was named for its ability to lyse bacterial cell walls. Sometimes the same enzyme has two or more names, or two different enzymes have the same name. Because of such ambiguities, and the ever increasing number of newly discovered enzymes, biochemists have adopted a system for naming and classifying enzymes. This system divides enzymes into six classes, each with subclasses, based on the type of reaction catalyzed. Each enzyme is assigned a four-part classification number and a systematic name, which identifies the reaction it catalyzes. As an example, the formal systematic name of the enzyme catalyzing the reaction [ATP + D-glucose → ADP + D-glucose 6-phosphate] is ATP:glucose phosphotransferase, which indicates that it catalyzes the transfer of a phosphoryl group from ATPto glucose. Its Enzyme Commission number (E.C. number) is 2.7.1.1. The first number (2) denotes the class name (transferase); the second number (7), the subclass (phosphotransferase); the third number (1), a phosphotransferase with a hydroxyl group as acceptor; and the fourth number (1), D-glucose as the phosphoryl group acceptor. For many enzymes, a trivial name is more commonly used—in this case hexokinase. A list of thousands of enzymes is maintained by the Nomenclature Committee of the International Union of Biochemistry and Molecular Biology.

Class	**Type of reaction catalyzed**
1. Oxidoreductases	Transfer of electrons (hydride ions or H atoms)
2. Transferases	Group transfer reactions
3. Hydrolases	Hydrolysis reactions
4. Lyases	Addition of groups to double bonds, or formation of double bonds by removal of groups
5. Isomerases	Transfer of groups within molecules to yield isomer
6. Ligases	Formation of C-C, C-S, C-O, and C-N bonds by condensation reactions coupled to ATP cleavage

Subclass	Name
EC 1	**Oxidoreductases**
EC 1.1	Acting on the CH-OH group of donors
EC 1.2	Acting on the aldehyde or oxo group of donors
EC 1.3	Acting on the CH-CH group of donors
EC 1.4	Acting on the CH-NH_2 group of donors
EC 1.5	Acting on the CH-NH group of donors
EC 1.6	Acting on NADH or NADPH
EC 1.7	Acting on other nitrogenous compounds as donors
EC 1.8	Acting on a sulfur group of donors
EC 1.9	Acting on a heme group of donors
EC 1.10	Acting on diphenols and related substances as donors
EC 1.11	Acting on a peroxide as acceptor
EC 1.12	Acting on hydrogen as donor
EC 1.13	Acting on single donors with incorporation of molecular oxygen (oxygenases)
EC 1.14	Acting on paired donors, with incorporation or reduction of molecular oxygen
EC 1.15	Acting on superoxide radicals as acceptor
EC 1.16	Oxidising metal ions
EC 1.17	Acting on CH or CH_2 groups
EC 1.18	Acting on iron-sulfur proteins as donors
EC 1.19	Acting on reduced flavodoxin as donor
EC 1.20	Acting on phosphorus or arsenic in donors
EC 1.21	Acting on X-H and Y-H to form an X-Y bond
EC 1.22	Acting on halogen in donors
EC 1.97	Other oxidoreductases
EC 2	**Transferases**
EC 2.1	Transferring one-carbon groups
EC 2.2	Transferring aldehyde or ketonic groups
EC 2.3	Acyltransferases
EC 2.4	Glycosyltransferases
EC 2.5	Transferring alkyl or aryl groups, other than methyl groups
EC 2.6	Transferring nitrogenous groups
EC 2.7	Transferring phosphorus-containing groups
EC 2.8	Transferring sulfur-containing groups
EC 2.9	Transferring selenium-containing groups
EC 2.10	Transferring molybdenum- or tungsten-containing groups
EC 3	**Hydrolases**
EC 3.1	Acting on ester bonds
EC 3.2	Glycosylases

EC 3.3 Acting on ether bonds
EC 3.4 Acting on peptide bonds (peptidases)
EC 3.5 Acting on carbon-nitrogen bonds, other than peptide bonds
EC 3.6 Acting on acid anhydrides
EC 3.7 Acting on carbon-carbon bonds
EC 3.8 Acting on halide bonds
EC 3.9 Acting on phosphorus-nitrogen bonds
EC 3.10 Acting on sulfur-nitrogen bonds
EC 3.11 Acting on carbon-phosphorus bonds
EC 3.12 Acting on sulfur-sulfur bonds
EC 3.13 Acting on carbon-sulfur bonds

EC 4 Lyases

EC 4.1 Carbon-carbon lyases
EC 4.2 Carbon-oxygen lyases
EC 4.3 Carbon-nitrogen lyases
EC 4.4 Carbon-sulfur lyases
EC 4.5 Carbon-halide lyases
EC 4.6 Phosphorus-oxygen lyases
EC 4.99 Other lyases

EC 5 Isomerases

EC 5.1 Racemases and epimerases
EC 5.2 *cis-trans*-Isomerases
EC 5.3 Intramolecular isomerases
EC 5.4 Intramolecular transferases (mutases)
EC 5.5 Intramolecular lyases
EC 5.99 Other isomerases

EC 6 Ligases

EC 6.1 Forming carbon—oxygen bonds
EC 6.2 Forming carbon—sulfur bonds
EC 6.3 Forming carbon—nitrogen bonds
EC 6.4 Forming carbon—carbon bonds
EC 6.5 Forming phosphoric ester bonds
EC 6.6 Forming nitrogen—metal bonds

Source: www.chem.qmul.ac.uk/iubmb/enzyme

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