

Enzyme Nomenclature

You can't study energy metabolism without having an awareness of enzyme names and functions. This is made a bit easier than it otherwise could be, as enzymes are typically named for the type of reaction they catalyze, so learning this new language is worth the effort. It is also customary to refer to chemical reactions by the enzyme of the reaction. In short, invest some time into this Section on enzymes and it will definitely pay off with enhanced understanding when you get to the Sections and Topics concerning energy metabolism.

The naming of enzymes has developed in a rather disorganized manner, with the existence of **trivial names** as well as chemical names for all enzymes. Nevertheless, such naming has been standardized since 1961 through the International Union of Biochemistry's adoption of a system of nomenclature for enzymes developed by the **Enzyme Commission** (EC). Thus, the EC names for enzymes now consist of three components; a **systematic name**, a corresponding **EC code**, and a **generic name** (Tables 1 and 2). The four numbers of each enzyme's numeric code represent the enzyme's division, sub-class, sub sub-class, and serial number. Table 1 lists the six major divisions of enzymes, with examples. Due to the presence of different structural forms of the same enzyme (**isozyme**), with different kinetic parameters, the EC has recommended that isozymes be given Arabic numerals. For example, we know that there are tissue specific isozymes of lactate dehydrogenase and ATPases. Thus, remember that EC names are not really for the enzyme protein, of which other names exist, but for the reaction catalyzed by the enzyme.

Table 1. The main categories and names of enzymes involved in cellular metabolism.

Code	Name	Trivial Name(s)	Explanation
EC1	Oxidoreductases	<i>dehydrogenases and oxidases</i>	Oxidation-reduction reactions
EC2	Transferases	<i>transferases, phosphorylases, syntases, kinases and transaminases</i>	Transfer of functional groups (methyl, acyl, amino, phosphate) from one compound to another
EC3	Hydrolases	<i>lipases, esterases, hydrolases, phosphatases,</i>	Formation of two products from a substrate by hydrolysis
EC4	Lyases	<i>variety</i>	Addition or removal of groups from substrates at C-C, C-N, C-O or C-S bonds
EC5	Isomerases	<i>isomerases, mutases, epimerases</i>	Intra-compound rearrangement
EC6	Ligases	<i>ligases, synthases, carboxylases</i>	Joining together of two compounds by new C-O, C-S, C-N, or C-C bonds

Enzyme Nomenclature

Understanding the commonalities in the use of trivial names for enzymes can really help you understand and learn metabolism. For example, as you can see from Figure 1, oxidoreductase enzymes are typically dehydrogenase (trivial name) enzymes. You should also learn that such reactions often involve oxidation and reduction involving NAD^+ and NADH , or FAD^+ and FADH_2 .

Table 2. Trivial names of key enzymes from each class, along with notable examples.

Code	Name (<i>trivial</i>)	Enzymes
EC1	Oxidoreductases (<i>dehydrogenases and oxidases</i>)	Lactate dehydrogenase Glucose-6-phosphate dehydrogenase
EC2	Transferases (<i>transferases, phosphorylases, syntases, kinases and transaminases</i>)	Phosphorylase Pyruvate kinase Phosphofructokinase Hexokinase Adenylate kinase
EC3	Hydrolases (<i>lipases, esterases, hydrolases, phosphatases, -ases</i>)	Triacylglycerol lipase Glucose-6-phosphatase
EC4	Lyases (<i>variety</i>)	Pyruvate decarboxylase Citrate synthase Adenylate cyclase
EC5	Isomerases (<i>isomerases, mutases, epimerases</i>)	Phosphoglucomutase Phosphoglycerate mutase Glucose-6-phosphate isomerase
EC6	Ligases (<i>ligases, synthases, carboxylases</i>)	Fatty acyl-CoA ligase

See below for additional explanation of trivial names. However, just remember that not all trivial names are consistent for all enzymes; hence the label of trivial!

Dehydrogenase - removal of electrons and protons

Kinase – transfer of a phosphate group

Phosphatase – removal of a phosphate group

Mutase – altered position of a side-group within a compound

Isomerase – altered geometric structure of the same molecule

Transferase – transfer of a side group from one compound to another

Synthase – joining together of two molecules

Lipase – cleavage of acyl groups from fatty acids

Enzyme Nomenclature

Glossary Words

trivial names are the names for enzymes developed prior to the work of the Enzyme Commission and establishment of “correct” chemical names.

Enzyme Commission (EC) is the sub-committee developed by the International Union of Biochemistry specifically for organizing the naming of enzymes.

systematic name is the name of an enzyme based on pure chemical derivation.

EC code is the numeric classification of an enzyme, based on the work of the Enzyme Commission.

generic name is the name of an enzyme, most often identical to its prior generic name.

isozyme is a different structural version of a given enzyme, causing different kinetic properties.

dehydrogenase is the trivial name for enzymes that remove electrons and protons.

kinase is the trivial name for enzymes that transfer of a phosphate group.

phosphatase is the trivial name for enzymes that remove a phosphate group.

mutase is the trivial name for enzymes that alter the position of a side-group within a compound.

isomerase is the trivial name for enzymes that alter the geometric structure of the same molecule.

transferase is the trivial name for enzymes that transfer a side group from one compound to another.

synthase is the trivial name for enzymes that join together two molecules.

lipase is the trivial name for enzymes that cleave acyl groups from fatty acids.