Multimeric Enzymes Encyclopedia Article

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All **enzymes** are proteins. An enzyme is very specific in the reaction it catalyzes. The reaction requires the binding of the substrate to an **active site** in the enzyme. In some cases, association of more than one polypeptide molecule is required for the formation of the active site. The resulting quaternary structure, involving the interaction between polypeptides, is called a multimeric enzyme.

Multimeric enzymes have various functions, constituent molecules and shapes. A few examples will suffice to indicate the diversity of these enzymes. Lactose dehydrogenase and glyceraldehyde 3-phosphate dehydrogenase are tetrameric--they have four subunits--and are donut like in shape. Triose phosphate isomerase consists of two subunits arranged as a barrel. Finally, glutamine synthetase is a dodecmer, consisting of two hexagonal rings, with a water-filled channel through the middle, stacked against each other.

Multimeric enzymes can affect the accuracy of a complementation analysis. Complementation is a test of **gene** function. A complementation analysis asks if two versions of the same region of the **chromosome**, located in the same **cell** are mutated, acting independently can supply all the functions necessary for a wild-type phenotype. For example, when the two mutations affect copies of the same gene such that neither is capable of generating a wild-type product then the resulting strain will have a mutant phenotype. On the other hand, if the two mutations affect different genes, so that each copy of the region of **DNA** is able to generate some of the gene products required, then between the two regions of DNA all the gene products necessary for a wild-type phenotype might result. A **complementation test** looks for restoration of the wild-type phenotype in pairings between two mutant organisms.

The intereference in complementation analysis by multimeric enzymes, termed negative complementation, is rare, but real. The interference occurs in the product of a cross between two mutants where the mutations are in genes coding for components of the enzyme. A multimeric enzyme can be generated whose subunits come from both the mutant and wild-type genes. Thus, even though a normal complement of genes for the enzyme subunits exists, random chance creates an enzyme in which one or more of the subunits are coded for by mutant copies of the genes. The activity of the enzyme, if not completely abolished, can be diminished. Because of the negative complementation phenomenon, it can be difficult to gauge the number of genes in the region of DNA under study.