ENZYMATIC COFACTORS pdf

1: Vitamins: Critical Enzyme Co-Factors

A cofactor is a non-protein chemical compound or metallic ion that is required for an enzyme's activity. Cofactors can be considered "helper molecules" that assist in biochemical transformations.

Etymology and history Eduard Buchner By the late 17th and early 18th centuries, the digestion of meat by stomach secretions [7] and the conversion of starch to sugars by plant extracts and saliva were known but the mechanisms by which these occurred had not been identified. He wrote that "alcoholic fermentation is an act correlated with the life and organization of the yeast cells, not with the death or putrefaction of the cells. In a series of experiments at the University of Berlin , he found that sugar was fermented by yeast extracts even when there were no living yeast cells in the mixture. Sumner showed that the enzyme urease was a pure protein and crystallized it; he did likewise for the enzyme catalase in The conclusion that pure proteins can be enzymes was definitively demonstrated by John Howard Northrop and Wendell Meredith Stanley , who worked on the digestive enzymes pepsin , trypsin and chymotrypsin. These three scientists were awarded the Nobel Prize in Chemistry. This was first done for lysozyme , an enzyme found in tears, saliva and egg whites that digests the coating of some bacteria; the structure was solved by a group led by David Chilton Phillips and published in Different enzymes that catalyze the same chemical reaction are called isozymes. The first number broadly classifies the enzyme based on its mechanism. These sections are subdivided by other features such as the substrate, products, and chemical mechanism. An enzyme is fully specified by four numerical designations. For example, hexokinase EC 2. Protein structure Enzymes are generally globular proteins , acting alone or in larger complexes. The sequence of the amino acids specifies the structure which in turn determines the catalytic activity of the enzyme. Enzymes are usually much larger than their substrates. Sizes range from just 62 amino acid residues, for the monomer of 4-oxalocrotonate tautomerase , [25] to over 2, residues in the animal fatty acid synthase. The remaining majority of the enzyme structure serves to maintain the precise orientation and dynamics of the active site. The most common of these is the ribosome which is a complex of protein and catalytic RNA components. Binding sites in blue, catalytic site in red and peptidoglycan substrate in black. Enzymes are usually very specific as to what substrates they bind and then the chemical reaction catalysed. Enzymes can therefore distinguish between very similar substrate molecules to be chemoselective , regioselective and stereospecific. Some of these enzymes have " proof-reading " mechanisms. Here, an enzyme such as DNA polymerase catalyzes a reaction in a first step and then checks that the product is correct in a second step. Many enzymes possess small side activities which arose fortuitously i. Hexokinase has a large induced fit motion that closes over the substrates adenosine triphosphate and xylose. In some cases, such as glycosidases , the substrate molecule also changes shape slightly as it enters the active site. Creating an environment with a charge distribution complementary to that of the transition state to lower its energy [44] By providing an alternative reaction pathway: Temporarily reacting with the substrate, forming a covalent intermediate to provide a lower energy transition state [45] By destabilising the substrate ground state: Distorting bound substrate s into their transition state form to reduce the energy required to reach the transition state [46] By orienting the substrates into a productive arrangement to reduce the reaction entropy change [47] the contribution of this mechanism to catalysis is relatively small [48] Enzymes may use several of these mechanisms simultaneously. For example, proteases such as trypsin perform covalent catalysis using a catalytic triad , stabilise charge build-up on the transition states using an oxyanion hole , complete hydrolysis using an oriented water substrate. These motions give rise to a conformational ensemble of slightly different structures that interconvert with one another at equilibrium. For example, different conformations of the enzyme dihydrofolate reductase are associated with the substrate binding, catalysis, cofactor release, and product release steps of the catalytic cycle. Allosteric regulation Allosteric sites are pockets on the enzyme, distinct from the active site, that bind to molecules in the cellular environment. These molecules then cause a change in the conformation or dynamics of the enzyme that is transduced to the active site and thus affects the reaction rate of the enzyme. Thiamine pyrophosphate cofactor in yellow and xylulose 5-phosphate substrate in black. Cofactor biochemistry Some enzymes do not need

additional components to show full activity. Others require non-protein molecules called cofactors to be bound for activity. These cofactors serve many purposes; for instance, metal ions can help in stabilizing nucleophilic species within the active site. Organic prosthetic groups can be covalently bound e. An enzyme together with the cofactor s required for activity is called a holoenzyme or haloenzyme. The term holoenzyme can also be applied to enzymes that contain multiple protein subunits, such as the DNA polymerases ; here the holoenzyme is the complete complex containing all the subunits needed for activity. Coenzymes transport chemical groups from one enzyme to another. These coenzymes cannot be synthesized by the body de novo and closely related compounds vitamins must be acquired from the diet. The chemical groups carried include: For example, about enzymes are known to use the coenzyme NADH. For example, NADPH is regenerated through the pentose phosphate pathway and S-adenosylmethionine by methionine adenosyltransferase. This continuous regeneration means that small amounts of coenzymes can be used very intensively. For example, the human body turns over its own weight in ATP each day. Uncatalysed dashed line , substrates need a lot of activation energy to reach a transition state , which then decays into lower-energy products. Activation energy , Thermodynamic equilibrium , and Chemical equilibrium As with all catalysts, enzymes do not alter the position of the chemical equilibrium of the reaction. In the presence of an enzyme, the reaction runs in the same direction as it would without the enzyme, just more quickly.

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2: Co-factors, co-enzymes, and vitamins (video) | Khan Academy

Cofactor, a component, other than the protein portion, of many enzymes. If the cofactor is removed from a complete enzyme (holoenzyme), the protein component (apoenzyme) no longer has catalytic activity.

Without coenzymes, inactive enzymes would be unable to convert into their active forms to catalyze reactions, such as breaking down food for energy. Coenzymes are essential for normal and specialized cellular functions and your overall health. One of the reasons vitamins are so integral to your health is because many coenzymes are synthesized using vitamins. Coenzymes, sometimes called cosubstrates, are organic nonprotein cofactors that help enzymes drive chemical reactions in the body. Coenzymes are not enzymes â€” they are simply small molecules that loosely attach themselves to an inactive enzyme, called an apoenzyme. Not all enzymes require cofactors to perform their chemical reactions. The relationship between coenzymes and enzymes is a bit like that between lock and key. The apoenzyme is the lock, and the coenzyme is the key. Only certain keys coenzymes will fit certain locks, the active site on apoenzymes in this metaphor. The unique fit of the active sites on apoenzymes ensures only the correct coenzymes will fit and work. How Coenzymes Function The temporary binding between coenzymes and their apoenzymes means coenzymes can easily detach themselves from the enzyme after a biochemical reaction occurs. These small organic cofactors can then take part in further enzymatic reactions. The other type of cofactors, called prosthetic groups, work in much the same way as coenzymes. The main difference between coenzymes and prosthetic groups is that prosthetic groups are typically metal ions. These cofactors bind much more tightly, using covalent bonds, to their apoenzymes and, unlike coenzymes, cannot detach themselves easily from the enzyme. Once the cofactor, either the coenzyme or prosthetic group, and apoenzyme have formed a cofactor-enzyme complex, it becomes a holoenzyme. This is the active form of an enzyme. But coenzymes do more than just help enzymes function. They can help transfer compounds between enzymes. This is often a successive process, with every enzyme reaction slightly modifying the original molecule along the enzyme pathway. Coenzymes also help attract the correct compounds and repel incorrect compounds to the active site of their enzyme. This is an important function of coenzymes because of a phenomenon called competitive inhibition. Why Are Coenzymes Essential? This is why certain forms of vitamins are better than others and why some vitamins are considered metabolically inactive. Coenzymes are largely responsible for the transfer of functional groups active sections or arms of chemical compounds , electrons, hydrogens, and energy.

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3: Cofactors, Coenzymes and Prosthetic group | Biochemistry for Medics â€“ Lecture Notes

Cofactors are often classified as inorganic substances that are required for, or increase the rate of, catalysis. Examples of some enzymes that require metal ions as cofactors is shown in the table below.

General information[edit] Cofactors, mostly metal ions or coenzymes, are inorganic and organic chemicals that assist enzymes during the catalysis of reactions. Coenzymes are non-protein organic molecules that are mostly derivatives of vitamins soluble in water by phosphorylation; they bind apoenzyme to proteins to produce an active holoenzyme. Apoenzymes are enzymes that lack their necessary cofactor s for proper functioning; the binding of the enzyme to a coenzyme forms a holoenzyme. Holoenzymes are the active form of an apoenzyme. They are able to assist in performing certain, necessary, reactions the enzyme cannot perform alone. They are divided into coenzymes and prosthetic groups. A holoenzyme refers to a catalytically active enzyme that consists of both apoenzyme enzyme without its cofactor s and cofactor. There are two groups of cofactors: Coenzymes are small organic molecules usually obtained from vitamins. Prosthetic groups refer to tightly bound coenzymes, while cosubstrates refer to loosely bound coenzymes that are released in the same way as substrates and products. Loosely bound coenzymes differ from substrates in that the same coenzymes may be used by different enzymes in order to bring about proper enzyme activity. Enzymes without their necessary cofactors are called apoenzymes, which are the inactive form of an enzyme. Cofactors with an apoenzyme are called a holoenzyme, which is the active form. General formula Metal cofactors[edit] Metal ions are common enzyme cofactors. Some enzymes, referred to as metalloenzymes, cannot function without a bound metal ion in the active site. In daily nutrition, this kind of cofactor plays a role as the essential trace elements such as: In some bacteria such as genus Azotobacter and Pyrococcus furiosus, metal cofactors are also discovered to play an important role. An example of cofactors in action is the zinc-mediated function of carbonic anhydrase or the magnesium-mediated function of restriction endonuclease. Coenzyme[edit] A coenzyme is a small, organic, non-protein molecule that carries chemical groups between enzymes. Sometimes, they are called cosubstrates and are considered substrates that are loosely bound to the enzyme. Coenzymes are frequently consumed and recycled. Chemical groups are added and detached continuously by an enzyme. Coenzyme molecules are mostly derived from vitamins. They are also commonly made from nucleotides such as adenosine triphosphate and coenzyme A. Through further research in coenzyme activity and its binding effect on the enzyme, more can be revealed about how the enzyme changes conformationally and functionally. These enzymes are crucial in the catalytic transformation of lipophilic substrates, which are involved in arachidonic acid derived messengers production and xenobiotic detoxification. It also works as a substrate for DNA ligases in posttranslational modification, where the reaction removes acetyl groups from proteins. NADH later on unloads the extra electron through oxidative phosphorylation to generate ATP, which is the energy source humans use every day. In addition to catabolic reactions, NADH is also involved in anabolic reactions such as gluconeogenesis, and it also aids in the production of neurotransmitters in the brain. FADH[edit] flavin adenine dinucleotide is a prosthetic group that, like NADH, functions as a reducing agent in cellular respiration and donates electrons to the electron transport chain.

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4: Protein - Cofactors | www.enganchecubano.com

Coenzymes: A nonprotein component of enzymes is called the cofactor. If the cofactor is organic, then it is called a coenzyme. Coenzymes are relatively small molecules compared to the protein part of the enzyme.

Cofactors Although some enzymes consist only of protein, many are complex proteins; i. A complete enzyme is called a holoenzyme; if the cofactor is removed, the protein, no longer enzymatically active, is called the apoenzyme. A cofactor may be a metalâ€"such as iron , copper , or magnesium â€"a moderately sized organic molecule called a prosthetic group, or a special type of substrate molecule known as a coenzyme. The cofactor may aid in the catalytic function of an enzyme, as do metals and prosthetic groups, or take part in the enzymatic reaction, as do coenzymes. Functions of B-vitamin coenzymes in metabolism. A coenzyme serves as a type of substrate in certain enzymatic reactions and thus reacts in the exact proportions i. A coenzyme may, for example, assume the role of a hydrogen acceptor, as does nicotinamide adenine dinucleotide NAD , which accepts hydrogen from the substrate, or a chemical-group donor, as does adenosine triphosphate ATP , which donates phosphoric acid to the substrate. After ATP has donated a phosphoric acid molecule to the substrate, the phosphoric acid can be reacquired in a second stoichiometric reaction catalyzed by a second enzyme. The catalytic nature of a coenzyme is apparent only when it couples the activities of two enzymes in this way. Coenzymes thus are the links, or shuttles, in metabolic pathways that enable substancesâ€"e. The nature of enzyme-catalyzed reactions The nature of catalysis In a chemical reactionâ€"for example, one in which substance A is converted into product Bâ€"a point of equilibrium eventually is reached at which no further chemical change occurs; i. The so-called thermodynamic-equilibrium constant expresses this chemical equilibrium. A catalyst may be defined as a substance that accelerates a chemical reaction but is not consumed in the process. The amount of catalyst has no relationship to the quantity of substance altered; very small amounts of enzymes are very efficient catalysts. Because the presence of an enzyme accelerates the rate of conversion of a compound to a product, it accelerates the approach to equilibrium; it does not, however, influence the equilibrium point attained. The molecules in the watery medium of the cell are in constant thermal motion but, because they are more or less stable compounds , they would react only occasionally to form products in the absence of enzymes. There exists an energy barrier to the reaction of a molecule. The energy required to overcome the barrier to reaction is called the energy of activation. A reaction proceeds to equilibrium only if the molecules have sufficient energy of activation to form an activated complex, from which products can be derived. Enzymes greatly increase the chances for reactions by their ability to make large numbers of specific molecules more reactive i. The unstable intermediates quickly break down to form stable products, and the enzymes, unchanged by the reaction, are able to catalyze the formation of additional products.

5: Enzyme - Wikipedia

Cofactors can be metals or coenzymes, and their primary function is to assist in enzyme www.enganchecubano.com are able to assist in performing certain, necessary, reactions the enzyme cannot perform alone.

Pernicious anemia is a megaloblastic anemia resulting from vitamin B12 deficiency that develops as a result of a lack of intrinsic factor being released from stomach parietal cells leading to subsequent malabsorption of the vitamin. The major cause of the loss of intrinsic factor is an autoimmune destruction of the parietal cells that secrete it. Surgical removal of a part of the stomach can also result in loss of intrinsic factor resulting in pernicious anemia. In rare cases individuals inherit mutation in the GIF gene that encodes intrinsic factor resulting in pernicious anemia. The pernicious anemias result from impaired DNA synthesis due to a block in purine and thymidine biosynthesis. The block in nucleotide biosynthesis is a consequence of the effect of vitamin B12 on folate metabolism. When vitamin B12 is deficient essentially all of the folate becomes trapped as the N5-methylTHF 5-methylTHF; or simply methylTHF derivative as a result of the loss of functional methionine synthase also called homocysteine methyltransferase. This trapping prevents the synthesis of other THF derivatives required for the purine and thymidine nucleotide biosynthesis pathways. Neurological complications also are associated with vitamin B12 deficiency and result from a progressive demyelination of nerve cells. The demyelination is thought to result from the increase in methylmalonyl-CoA that results from vitamin B12 deficiency that is associated with loss of methylmalonyl-CoA mutase activity. The loss of methylmalonyl-CoA mutase activity with deficiencies in B12 results in an accompanying methylmalonic acidemia. Methylmalonyl-CoA is a competitive inhibitor of malonyl-CoA in fatty acid biosynthesis as well as being able to substitute for malonyl-CoA in any fatty acid biosynthesis that may occur. Since the myelin sheath that protects nerve cells is in continual flux the methylmalonyl-CoA-induced inhibition of fatty acid synthesis results in the eventual destruction of the sheath. The incorporation methylmalonyl-CoA into fatty acid biosynthesis results in branched-chain fatty acids being produced that may severely alter the architecture of the normal membrane structure of nerve cells. Contributing to the neural degeneration seen in vitamin B12 deficiency is the reduced synthesis of S-adenosylmethione SAM; also abbreviated AdoMet due to loss of the methionine synthase catalyzed reaction. The conversion of phosphatidylethanolamine PE to phosphatidylcholine PC requires the enzyme phosphatidylethanolamine N-methyltransferase encoded by the PEMT gene which carries out three successive SAM-dependent methylation reactions. This reaction is a critically important reaction of membrane lipid homeostasis. Therefore, the reduced capacity to carry out the methionine synthase reaction, due to nutritional or disease mediated deficiency of vitamin B12 , results in reduced SAM production and as a consequence contributes to the neural degeneration i. Deficiencies in B12 can also lead to elevations in the level of circulating homocysteine and elevated excretion of the oxidized dimer of homocysteine called homocystine. Elevated levels of homocysteine are known to lead to cardiovascular dysfunction. Due to its high reactivity to proteins, homocysteine is almost always bound to proteins, thus thiolating them leading to their degradation. Homocysteine also binds to albumin and hemoglobin in the blood. Production of defective collagen and elastin has a negative impact on arteries, bone, and skin and the effects on arteries are believed to be the underlying cause for cardiac dysfunction associated with elevated serum homocysteine. The increased risk for thrombotic episodes, such as deep vein thrombosis DVT , associated with homocysteinemia is due to homocysteine serving as a contact activation nucleus for activation of the intrinsic coagulation cascade. Folic acid is sometimes referred to as vitamin B9. The terms folic acid and folate are sometimes used interchangeably but from a dietary perspective they are distinctly different. The term folate should be used to refer only to the bioactive forms of folic acid, namely dihydrofolate DHF and tetrahydrofolate THF and their derivatives. Folic acid is a conjugated molecule consisting of a pteridine ring structure linked to para-aminobenzoic acid PABA that forms pteroic acid. Pteroic acid is then converted to folic acid through the N-esterification of glutamic acid to the carboxylic acid of the PABA portion of pteroic acid. This latter structure is the form of "folate" present in dietary supplements and when used to fortify manufactured food products. Dietary folates which are predominately the N5-methylTHF

form; 5-methyl-THF are obtained primarily from yeasts and leafy vegetables as well as animal liver. When ingested from natural sources, or when stored in cells predominantly in the liver and the kidneys , folates exists in a polyglutamate form. Jejunal small intestine mucosal cells remove the glutamate residues to the monoglutamate state through the action of the enzyme, folate hydrolase 1 which is encoded by the FOLH1 gene. Folate hydrolase 1 is also commonly called glutamate carboxypeptidase II. Within the intestinal enterocytes, the monoglutamate forms of the folates are less negatively charged compared to the polyglutamic acids , and are therefore, more capable of being transported across the basolateral membrane facing the blood of the jejunal enterocytes and into the bloodstream. The function of the GGH encoded enzyme is to remove polyglutamates from intracellular stores of the folate derivatives that, as indicated, are predominantly stored in the liver and the kidneys. The GGH encoded enzyme is localized to the lysosomes. The function of the GGH encoded enzyme is to release glutamates from stored folates so that the monoglutamate forms can be excreted into the blood to meet systemic needs. Folates in the diet are predominantly the N5-methyltetrahydrofolate 5-methyl-THF form. Another folate transporter, that was originally thought to be the major intestinal folate uptake transporter, was originally identified as the reduced folate carrier RFC. Outside the intestine cellular folate uptake, particularly cells in the central nervous system, is carried out by the SLC46A1 encoded transporter. The activity of RFC-mediated folate transport is highest for reduced folates hence the name such as 5-methyl-THF with very low affinity for folic acid. The RFC is also utilized in the uptake of the anti-folate drugs such as methotrexate and palatrexate. RFC functions as an antiporter with organic phosphate being transported out of the cell in exchange for folate uptake. The critical role of the SLC46A1 encoded transporter in intestinal folate absorption is evident in individuals with an inherited form of folate malnutrition hereditary folate malabsorption, HFM that results from mutations in the SLC46A1 gene. The SLC46A1 gene is located on chromosome 17q Interestingly there are transporters of the multidrug resistance family that can efflux folates from the intestinal enterocyte back into the lumen of the intestines. Both transporters have been shown to efflux folates from intestinal enterocytes and, as such, can compete with the activity of PCFT in folate uptake. Another member of the multidrug resistance protein family, multidrug resistance-associated protein 3 MRP3; encoded by the ABCC3 gene , is expressed in the basolateral membrane of intestinal enterocytes and transports folic acid and 5-methyl-THF into the blood. Another important protein involved in folate transport in the adult human is the FOLR1 folate receptor 1 encoded receptor protein. The FOLR1 gene is located on chromosome 11q The FOLR1 gene represents one member of a family of folate receptor genes that are clustered at the 11q The FOLR2 gene is referred to as the fetal folate receptor gene given it was originally identified as being expressed in the placenta. The FOLR3 gene is expressed in bone marrow, thymus, and spleen, and its expression is elevated in ovarian and uterine cancers. The FOLR3 protein is exclusively secreted. When monoglutamate folates are taken up into cells, particularly in the liver and kidney where they can be stored but also in other cells , they are polyglutamated through the action of the enzyme folylpolyglutamate synthetase. Folylpolyglutamate synthetase is encoded by the FPGS gene which is located on chromosome 9q The activity of folylpolyglutamate synthetase is lowest towards 5-methyl-THF and this prevents this form of the vitamin from being trapped within intestinal enterocytes. Folic acid, which is the form found in fortified foods and supplements is also a poor substrate for folylpolyglutamate synthetase accounting for its efficient uptake from the intestines and release to the blood. The level of DHFR activity in the human liver is relatively low such that high levels of folic acid intake such as by megadosing vitamins can lead to pathological consequences. Several studies have shown increased rates of colon cancer and prostate cancer associated with the intake of large doses of folic acid. However, the lack of folate in the diet, or the lack of folic acid supplementation, is directly correlated to neural tube defects occurring during fetal development. The function of THF derivatives is to carry and transfer various forms of one carbon units during biosynthetic reactions. The one carbon units are either methyl, methylene, methenyl, formyl or formimino groups. Active center of tetrahydrofolate THF. Only the portion of the tetrahydrofolate THF molecule where the one-carbon entities are attached the N5 and N10 positions is shown in this Figure. Note that the N5 position often just written as the 5-position is the site of attachment of methyl groups, the N10 often just written as the position the site for attachment of formyl and formimino groups and that both N5 and

N10 bridge the methylene and methenyl groups. The formyl group can be attached to the N5 position but this does not represent a significant THF derivative in human metabolism. The reduced pool consists solely of N5-methyl-THF 5-methyl-THF which is also the major form of folate absorbed from the small intestines as well as the major form circulating in the blood for transport to the various tissues. All of the other THF derivatives constitute the active pool. The active pool forms of THF can be converted to 5-methyl-THF but 5-methyl-THF cannot be used, in any significant capacity, tocontribute to the synthesis of the active pool folate derivatives. Mutations in the MTHFR gene results in a form of homocysteinemia referred to as hyperhomocysteinemia. Humans express additional genes that encode enzymes with activities similar the MTHFD1 encoded enzyme. One-Carbon Transfer Reactions The one carbon transfer reactions involving the various THF derivatives are required in the biosynthesis of serine, methionine, glycine, choline, the purine nucleotides, and dTMP. Indeed, the interconversion of serine and glycine , via the involvement of THF, represents a major pathway for the generation of 5,methylene-THF which of a member of the active folate pool. The active folate pool includes formyl-, 5,methenyl-, and 5,methylene-THF. Methyl-THF is referred to as the reduced folate pool. All of the active folate pool molecules can be converted to 5-methyl-THF but the reverse process does not occur. For this reason, the inability to convert 5-methyl-THF to THF as occurs via the B and folate-dependent enzyme, methionine synthase ; also known as homocysteine methyltransferase and then to any other THF derivative leads to trapping of folate in the "reduced" form. The ability to acquire choline and amino acids from the diet and to salvage the purine nucleotides makes the role of 5,methylene-THF, in dTMP synthesis , one of the most significant metabolic function for this vitamin. The role of vitamin B12 and 5-methyl-THF in the conversion of homocysteine to methionine also can have a significant impact on the ability of cells to regenerate needed active pool THF derivatives and as such represents the physiologically most significant reaction involving folate. Deficiencies in B12 or defects in methionine synthase will result in methyl-THF trapping with the result being the development of megaloblastic anemia due to the block in nucleotide production. Excellent vegetarian sources for folic acid are baked beans, raw spinach, asparagus, green peas, broccoli, lentils, turnip greens, egg noodles, avocado, peanuts, lettuce, wheat germ, tomato juice and orange juice. The most pronounced effect of folate deficiency on cellular processes is upon DNA synthesis. This is due to an impairment in dTMP synthesis which leads to cell cycle arrest in S-phase of rapidly proliferating cells, in particular hematopoietic cells. The result is megaloblastic anemia as for vitamin B12 deficiency. The inability to synthesize DNA during erythrocyte maturation leads to abnormally large erythrocytes termed macrocytic megaloblastic anemia. Since both folate and vitamin B12 deficiencies result in megaloblastic anemias, it is necessary to be able to clinically distinguish the cause as it relates to vitamin deficiency. Since B12 is required for both the methionine synthase reaction and the methylmalonyl-CoA mutase reaction a megaloblastic anemia resulting from B12 deficiency is also associated with an accompanying methylmalonic acidemia , whereas megaloblastic anemias caused by folate deficiency are not. An additional critical diagnostic is related to the onset of symptoms. Because human cells cannot store any significant amount of folate but the liver can store years worth of B12, folate deficient megaloblastic anemias manifest very quickly, whereas B12 deficient anemias take considerably longer to manifest. Folate deficiencies are rare due to the adequate presence of folate in food. Poor dietary habits as those of chronic alcoholics can lead to folate deficiency. The predominant causes of folate deficiency in non-alcoholics are impaired absorption or metabolism or an increased demand for the vitamin. The predominant condition requiring an increase in the daily intake of folate is pregnancy. This is due to an increased number of rapidly proliferating cells present in the blood. The need for folate will nearly double by the third trimester of pregnancy. Certain drugs such as anticonvulsants and oral contraceptives can impair the absorption of folate. Anticonvulsants also increase the rate of folate metabolism.

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6: Cofactor | biochemistry | www.enganchecubano.com

*The cofactors and coenzymes (organic cofactors) that help enzymes catalyze reactions. If you're seeing this message, it means we're having trouble loading external resources on our website. If you're behind a web filter, please make sure that the domains *www.enganchecubano.com and *www.enganchecubano.com are unblocked.*

This is why ensuring that any layman who gets to read this article would be able to fully understand the topic and, hopefully, will be able to properly differentiate a cofactor from a coenzyme. We shall start by defining each term first. What is a cofactor? A cofactor is a non-protein chemical compound. It is bound to the protein and it is needed in the biological activity of the protein. There are two types of cofactors: Coenzymes Coenzymes are cofactors that are bound to an enzyme loosely. Prosthetic groups are cofactors that are bound tightly to an enzyme. As additional information, an enzyme can be without a cofactor, and this is called apoenzyme. An enzyme is considered complete if it has the cofactor and it is called a holoenzyme. What is a coenzyme? A coenzyme, on the other hand, is a small, organic non-protein molecule. It carries chemical groups between enzymes. Vitamins are good examples of a coenzyme. They carry chemical groups between the enzymes. Another term for them is cosubstrates. To summarize, here are the differences between a cofactor and a coenzyme: A coenzyme is a type of cofactor. It is the loosely bound cofactor to an enzyme. Cofactors are chemical compounds that are bound to proteins. A cofactor is a non-protein chemical compound, while a coenzyme is a non-protein molecule. It is important to understand that, in our body, enzymes are very important. They help in regulating metabolism. They help in controlling the chemical reactions in the body. This is why knowing about coenzymes and cofactors is quite essential in the processes of our body. For starters, coenzymes and cofactors combine with enzymes to alter and bring about change to the body by making, offering, and doing changes to the chemical reactions. At the same time, to achieve certain chemical reactions, cofactors and coenzymes are needed. Digestion is a chemical reaction. During digestion, the stomach breaks down large food molecules into smaller ones. When they have been broken down, there are parts of such molecules that become sugar. What happens is that sugar would metabolize into different compounds. These compounds would release energy. There are several chemical reactions that happen, and enzymes are very important in ensuring that these chemical reactions function properly in the body. Cofactors serve the same purpose as coenzymes, as they regulate, control, and adjust how fast these chemical reactions would respond and take effect in our body. The big difference is that coenzymes are organic substances, while cofactors are inorganic. Coenzymes function as intermediate carriers. This means they make sure that specific atoms are carried out to the specific group so the overall reaction is carried out and finalized, so to speak. Cofactors, on the other hand, as they are classified as inorganic substances, are needed and required to increase how fast the catalysis would take place. Our body definitely has several things going on within it. With so many different systems in our body, it certainly needs not just one type of reaction, chemical or otherwise, to ensure that it functions as it should. If you like this article or our site. Please spread the word.

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7: What Are Coenzymes and How Are They Vital to Your Health?

Cofactors and Enzyme Activity Cofactors are inorganic substrates. Some cofactors are required to produce a chemical reaction between the enzyme and the substrate, while others merely increase the rate of catalysis.

By Editors Coenzyme Definition A coenzyme is an organic non-protein compound that binds with an enzyme to catalyze a reaction. Coenzymes are often broadly called cofactors, but they are chemically different. A coenzyme cannot function alone, but can be reused several times when paired with an enzyme. Functions of Coenzymes An enzyme without a coenzyme is called an apoenzyme. Without coenzymes or cofactors, enzymes cannot catalyze reactions effectively. In fact, the enzyme may not function at all. If reactions cannot occur at the normal catalyzed rate, then an organism will have difficulty sustaining life. When an enzyme gains a coenzyme, it then becomes a holoenzyme, or active enzyme. Active enzymes change substrates into the products an organism needs to carry out essential functions, whether chemical or physiological. Coenzymes, like enzymes, can be reused and recycled without changing reaction rate or effectiveness. They attach to a portion of the active site on an enzyme, which enables the catalyzed reaction to occur. When an enzyme is denatured by extreme temperature or pH, the coenzyme can no longer attach to the active site. Types of Enzymes Cofactors are molecules that attach to an enzyme during chemical reactions. In general, all compounds that help enzymes are called cofactors. However, cofactors can be broken down into three subgroups based on chemical makeup and function: Coenzymes These are reusable non-protein molecules that contain carbon organic. They bind loosely to an enzyme at the active site to help catalyze reactions. Most are vitamins, vitamin derivatives, or form from nucleotides. Cofactors Unlike coenzymes, true cofactors are reusable non-protein molecules that do not contain carbon inorganic. They must also be supplemented in the diet as most organisms do not naturally synthesize metal ions. Prosthetic groups These can be organic vitamins, sugars, lipids, or inorganic metal ions. However, unlike coenzymes or cofactors, these groups bind very tightly or covalently to an enzyme to aid in catalyzing reactions. These groups are often used in cellular respiration and photosynthesis. Examples of Coenzymes Most organisms cannot produce coenzymes naturally in large enough quantities to be effective. Instead, they are introduced to an organism in two ways: Vitamins Many coenzymes, though not all, are vitamins or derived from vitamins. If vitamin intake is too low, then an organism will not have the coenzymes needed to catalyze reactions. Water-soluble vitamins, which include all B complex vitamins and vitamin C, lead to the production of coenzymes. Two of the most important and widespread vitamin-derived coenzymes are nicotinamide adenine dinucleotide NAD and coenzyme A. NAD is derived from vitamin B3 and functions as one of the most important coenzymes in a cell when turned into its two alternate forms. NADH, often called coenzyme 1, has numerous functions. In fact, it is considered the number one coenzyme in the human body because it is necessary for so many different things. This coenzyme primarily carries electrons for reactions and produces energy from food. For example, the electron transport chain can only begin with the delivery of electrons from NADH. A lack of NADH causes energy deficits in cells, resulting in widespread fatigue. Additionally, this coenzyme is recognized as the most powerful biological antioxidant for protecting cells against harmful or damaging substances. Coenzyme A, also known as acetyl-CoA, naturally derives from vitamin B5. This coenzyme has several different functions. First, it is responsible for initiating fatty acid production within cells. Fatty acids form the phospholipid bilayer that comprises the cell membrane , a feature necessary for life. Coenzyme A also initiates the citric acid cycle, resulting in the production of ATP. Non-Vitamins Non-vitamin coenzymes typically aid in chemical transfer for enzymes. They ensure physiological functions, like blood clotting and metabolism, occur in an organism. These coenzymes can be produced from nucleotides such as adenosine, uracil, guanine, or inosine. Adenosine triphosphate ATP is an example of an essential non-vitamin coenzyme. In fact, it is the most widely distributed coenzyme in the human body. It transports substances and supplies energy needed for necessary chemical reactions and muscle contraction. To do this, ATP carries both a phosphate and energy to various locations within a cell. When the phosphate is removed, the energy is also released. This process is result of the electron transport chain. Without the coenzyme ATP, there would be little energy available at the cellular

level and normal life functions could not occur. Here is an example of the electron transport chain. The vitamin-derived coenzyme NADH begins the process by delivering electrons. ATP is the final resulting product: Related Biology Terms Catalyze â€" To cause or accelerate a reaction. Enzyme â€" A protein that catalyzes chemical reactions within an organism. Active Site â€" The region on an enzyme where substrates bind during a reaction. Substrate â€" The substance on which an enzyme acts to make a new product. Why are coenzymes necessary? They catalyze reactions in an organism B. They attach to an enzyme which catalyzes a reaction C. They make vitamins and nucleotides D. They stop unnecessary reactions Answer to Question 1 B is correct. Coenzymes cannot function unless they are attached to an enzyme. A coenzyme is a protein.

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8: Enzyme cofactors and coenzymes (video) | Khan Academy

Some enzymes require helpers to recognize a substrate or complete a reaction. These helpers include cofactors, coenzymes, and prosthetic groups, which are required for some enzymes' functions.

A living system controls its activity through enzymes. An enzyme is a protein molecule that is a biological catalyst with three characteristics. First, the basic function of an enzyme is to increase the rate of a reaction. Most cellular reactions occur about a million times faster than they would in the absence of an enzyme. Second, most enzymes act specifically with only one reactant called a substrate to produce products. The third and most remarkable characteristic is that enzymes are regulated from a state of low activity to high activity and vice versa. Gradually, you will appreciate that the individuality of a living cell is due in large part to the unique set of some 3, enzymes that it is genetically programmed to produce. If even one enzyme is missing or defective, the results can be disastrous. Much of the information about enzymes has been made possible because they can be isolated from cells and made to work in a test tube environment. Extensive work has also been done with X-Ray diffraction techniques to elucidate the three-dimensional structure of some enzymes. The ribbon and backbone form of carboxypeptidase is shown on the left. The substrate is shown in magenta. The activity of an enzyme depends, at the minimum, on a specific protein chain. In many cases, the enzyme consists of the protein and a combination of one or more parts called cofactors. This enzyme complex is usually simply referred to simply as the enzyme. The polypeptide or protein part of the enzyme is called the apoenzyme and may be inactive in its original synthesized structure. The inactive form of the apoenzyme is known as a proenzyme or zymogen. The proenzyme may contain several extra amino acids in the protein which are removed, and allows the final specific tertiary structure to be formed before it is activated as an apoenzyme. A cofactor is a non-protein substance which may be organic, and called a coenzyme. The coenzyme is often derived from a vitamin with specific examples discussed later. Another type of cofactor is an inorganic metal ion called a metal ion activator. The inorganic metal ions may be bonded through coordinate covalent bonds. The type of association between the cofactor and the apoenzymes varies. In some cases, the bonds are rather loose and both come together only during the course of a reaction. In other cases, they are firmly bound together by covalent bonds. The activating role of a cofactor is to either: The overall enzyme contains a specific geometric shape called the active site where the reaction takes place. The molecule acted upon is called the substrate. Using a diagram and in your own words, describe the various parts of the enzyme, i. What is an enzyme? Organic nonprotein part of enzyme?

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These small organic cofactors can then take part in further enzymatic reactions. The other type of cofactors, called prosthetic groups, work in much the same way as coenzymes. The main difference between coenzymes and prosthetic groups is that prosthetic groups are typically metal ions.

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