De Novo Purine Synthesis

PLAY PICMONIC

PRPP Synthesis

Ribose-5-Phosphate
Rib-O (5) Hand Phosphate-P
Ribose is a pentose sugar. It is an integral component of nucleic acids. DNA contains deoxyribose sugar and RNA contains ribose sugar. A nucleoside contains base and sugar (ribose or deoxyribose), linked by an N-glycosidic bond, whereas a nucleotide contains a nucleoside linked by a 3'-5' phosphodiester bond. Ribose-5-Phosphate is formed during the non-oxidative phase of the pentose phosphate pathway or the HMP shunt pathway in RBCs.

PRPP (Phosphoribosyl Pyrophosphate)
PRePPy-boy
Phosphoribosyl Pyrophosphate is synthesized by PRPP synthase, by combining ribose 5-phosphate with ATP to form PRPP and AMP as a by-product.

IMP Synthesis

Glutamine PRPP Amidotransferase
Glued-Amigo PRePPy-boy Amigo Transformer
In the de-novo synthesis of Purines, Inositol Mono-phosphate is formed from a 10-step reaction.
The first reaction is the rate-limiting reaction and involves the transfer of amino-group from Glutamine to PRPP to form 5-phosphoribosylamine with the help of the enzyme, Glutamine PRPP Amidotransferase. This enzyme is inhibited by the products of purine synthesis, AMP, IMP, and GMP as a part of negative feedback.

Phosphoribosylamine
Rib-O Phosphate-P Amigo
Phosphoribosylamine is formed by the transfer of an amino group from Glutamine to PRPP by Glutamine PRPP Amidotransferase. It is an intermediate between PRPP and IMP. It serves as an intermediate of a complicated 9 step process that involves the addition of carbon and nitrogen moieties to Inositol's cytoskeleton for Purine synthesis.

Folate Cofactor
Foliage Crow-flagger
Folate, in the form of 5,10 Methyl Tetrahydrofolate is required for the synthesis of the Inosine skeleton. It donates, 2 Carbons, one in the 5-membered ring and the other in the 6-membered ring. Thus, folate serves as a substrate in purine synthesis.

Inosine Monophosphate
N-SYNC with Monkey-phosphate
In the Inosine Mono-phosphate ring skeleton, nitrogen is donated by Glutamine(2), Glycine(1), Aspartate(1), and carbon is donated by Glycine(2), Carbon dioxide(1), 10-formyl THF (2). It is noteworthy to know that 4 molecules of ATP are required to form IMP from 5-Phosphoribosylamine.

AMP Synthesis

Adenosine Monophosphate

A-dentist-singing Monkey-phosphate

The IMP skeleton contains 4 Nitrogen and 1 Oxygen, whereas the AMP skeleton contains 5 Nitrogen moieties. Therefore, conversion of IMP to AMP requires the replacement of Oxygen with Nitrogen via the substrate Aspartic Acid to form Adenylosuccinate. This is a high-energy bond and requires GTP for energy. Adenylosuccinate is cleaved to form AMP and release fumarate as a byproduct.

Requires GTP

Gold-TP wrapped Battery

The conversion of the Oxygen moiety (of Inosine Monophosphate) to Nitrogen moiety of (Adenosine Monophosphate) requires a high-energy reaction carried out by Adenosuccinate synthetase with GTP and Aspartate as substrates.

GMP Synthesis

Guanosine Monophosphate

G-iguana Monkey-phosphate

IMP skeleton contains 4 Nitrogen and 1 Oxygen, whereas the GMP skeleton contains 5 Nitrogen and 1 Oxygen moieties. Therefore, conversion of IMP to GMP requires the replacement of Hydrogen with Oxygen first and then, the replacement of Oxygen with Nitrogen. The first reaction involves oxidation and thus, requires a dehydrogenase enzyme and water for the formation of NADH. The second reaction involves trans-amination using Glutamine as a substrate by the action of GMP synthetase. This is a high-energy bond and requires ATP for energy. Adenylosuccinate is cleaved to form AMP and release fumarate as a by-product.

Requires ATP

ATP-battery

The conversion of the Oxygen moiety(of Xanthosine Monophosphate) to Nitrogen moiety of (GMP) requires a high-energy reaction carried out by GMP synthetase with ATP and Glutamine as substrates.