

CATABOLISM



INTRODUCTION

- The metabolic breakdown of complex molecules into simpler ones, often resulting in a release of energy.
- A series of degradative chemical reactions that break down complex molecules into smaller units, and in most cases releasing energy in the process.
- The catabolic chemical reactions in the living cell break down ***polymers*** into their constituent ***monomers***.
- For example:
 - Polysaccharides are broken down into monosaccharide.
 - Proteins are broken down into amino acids.

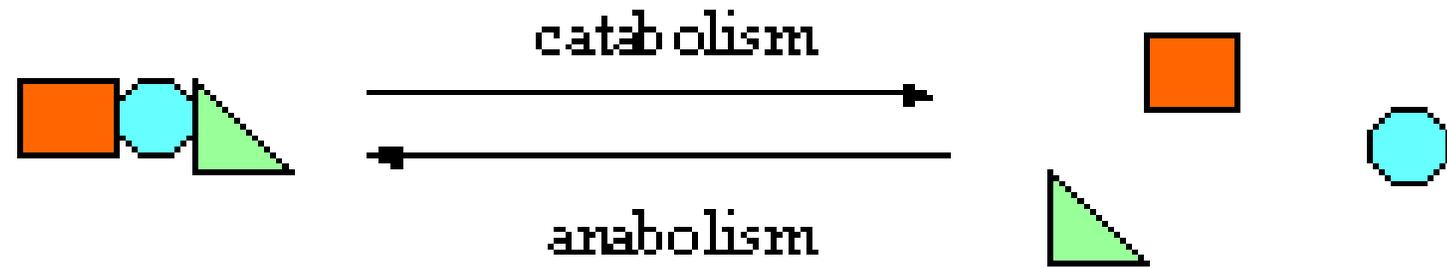


IMPORTANCE OF CATABOLISM

- The human body needs nutrients (both micro and macro) to rebuild and grow muscle. If the body is deprived of nutrition, then it will target essential fatty acids and muscle for energy – making it impossible to build muscle.
- The Anabolic state occurs during rest, when provided with proper nutrition. If you are finding it difficult to gain muscle, most likely you are not getting enough rest or nutrition. We do not grow in the gym; in fact, the gym promotes a Catabolic state – the breaking down of muscle. It's the rest and nutrition we get after the gym that promotes Anabolic growth.

Metabolism

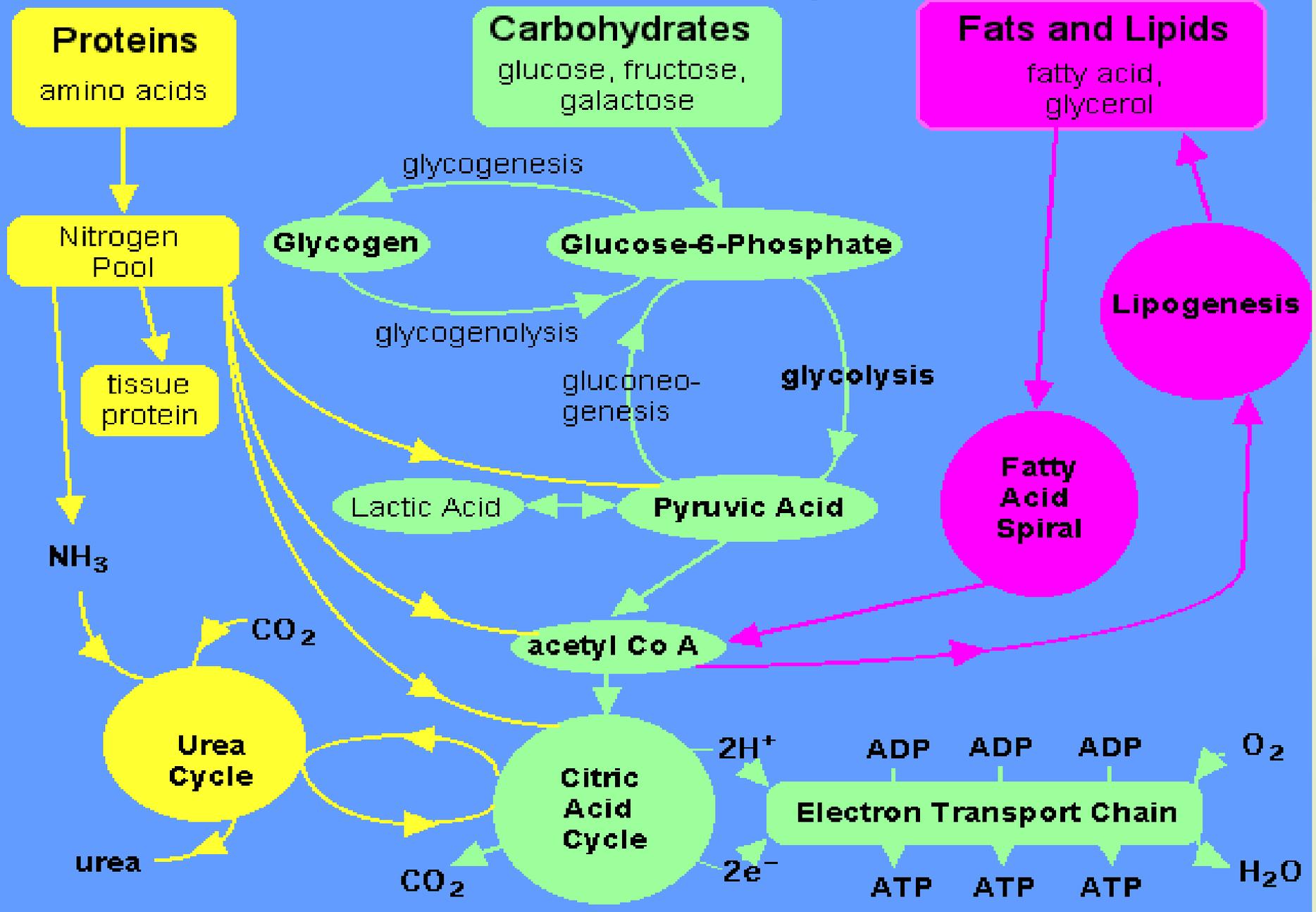
- ★ The sum of chemical reactions within a cell or whole organism. Includes
 - ❖ Catabolism - the energy-releasing breakdown of molecules.
 - ❖ Anabolism - the synthesis of complex molecules and new protoplasm (the living material of cells).



CARBOHYDRATE CATABOLISM

- Glycolysis is the initial pathway in the catabolism of carbohydrates, by which a molecule of glucose is broken down to two molecules of pyruvate, with a net production of ATP molecules and the reduction of two NAD^+ molecules to NADH.
- Under aerobic conditions, these NADH molecules are reoxidized by the electron transport chain.
- Under anaerobic conditions, a different electron acceptor is used.
- The terminal products of glycolysis are carbon dioxide and water.

Metabolism Summary





APPLICATION OF CARBOHYDRATE CATABOLISM



USED IN TREATMENT OF DISEASE CONDITION

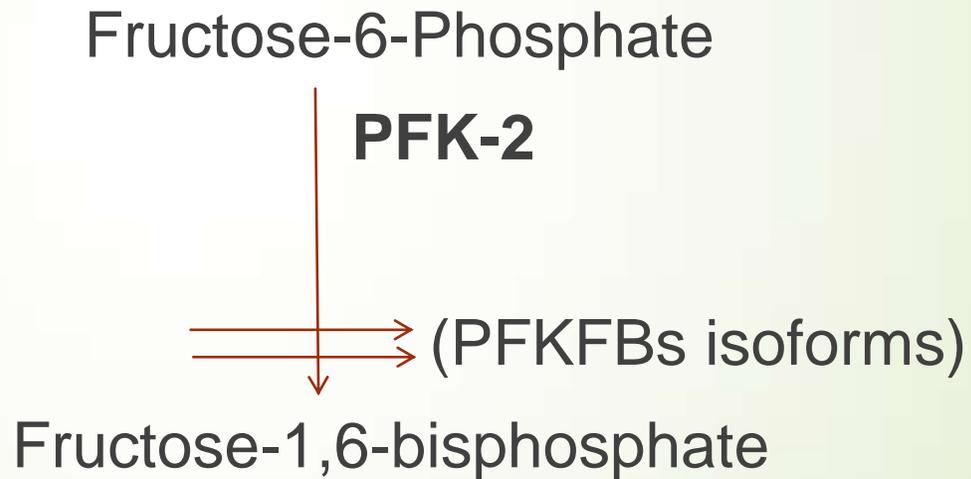
➤ **Glycerol:-**

Glycerol can cause a rapid, temporary decrease in the internal pressure of the eye. This can be a useful as emergency treatment of severely elevated eye pressure(Glaucoma).



- **Phosphofructokinase-2 (PFK-2) Inhibitor:-**

Phosphofructokinase-2 is a bifunctional enzyme and regulator of Glycolysis cycle.



- Thus used to treat breast cancer, ovarian cancer, lung cancer



USED TO DETECT CONGENITAL DEFECTS

- ▶ **Pyruvate Dehydrogenase Antibody:-**

Pyruvate Dehydrogenase Antibody is used to detect congenital defects that are usually associated with lactic acidosis.



USED FOR THE DESIGN OF NEW DRUGS

- ▶ **ANTI-TRYPANOSOME DRUG:-**

Glycolysis cycle is a target for the design of new anti-trypanosome drug used against parasitic trypanosomatid protozoa.

Protein Catabolism

➤ **MEANING :**

Breakdown of the proteins into the amino acids by the various proteases.



What happens during protein catabolism?

During protein catabolism, the proteins are first broken down into amino acids by the various proteases. The amino acids are then absorbed by the small intestine, from which they are sent to the liver via the hepatic portal vein. In the liver, the amino acids are deaminated.



When does protein catabolism usually occur?

- Due to illness

- Prolonged starvation

when the body does not get adequate energy, this excess of amino acid in the form of fats or sugar get breakdown and provides energy.

Protein Catabolic Reactions In Body

- **Catabolism of body protein to amino acids:**

Our body proteins are converted to amino acids via a series of catabolic reactions.

- **Transamination and Deamination**

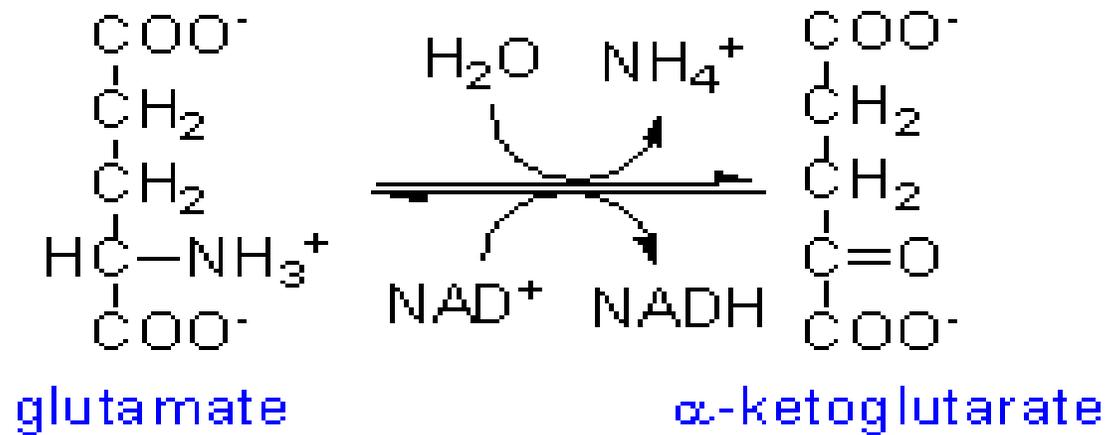


Deamination

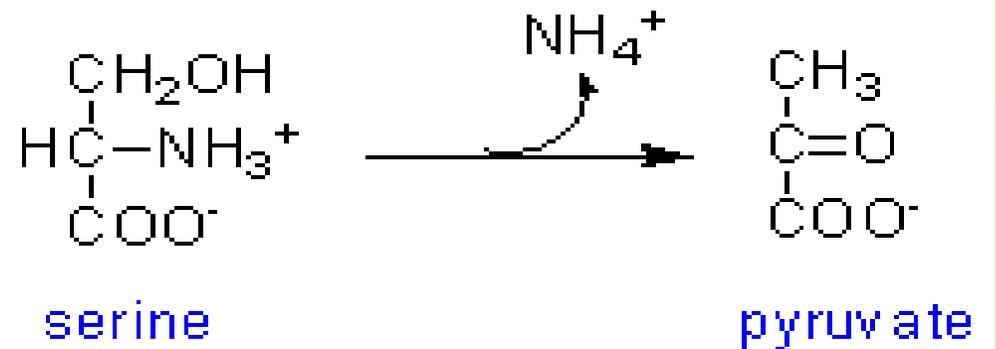
- amino groups are removed from excess proteins.
 - liver, kidneys
 - convert excess amino acids into usable resources such as hydrogen and carbon.
- 

Deamination

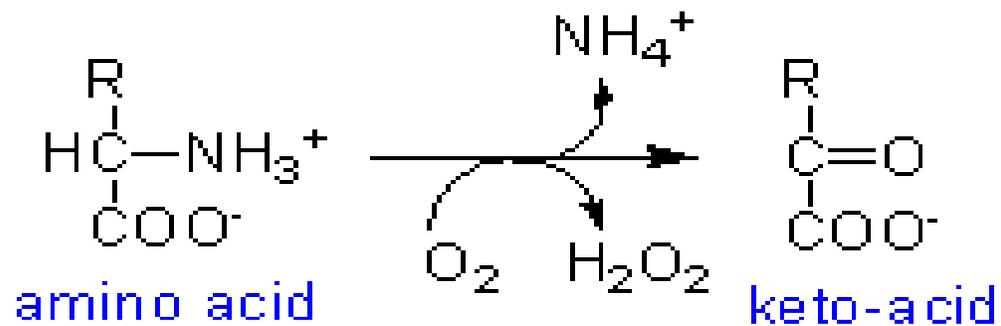
glutamate dehydrogenase



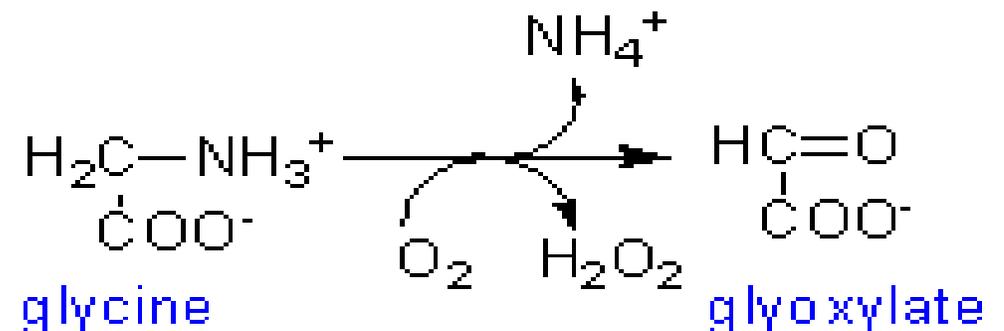
serine deaminase



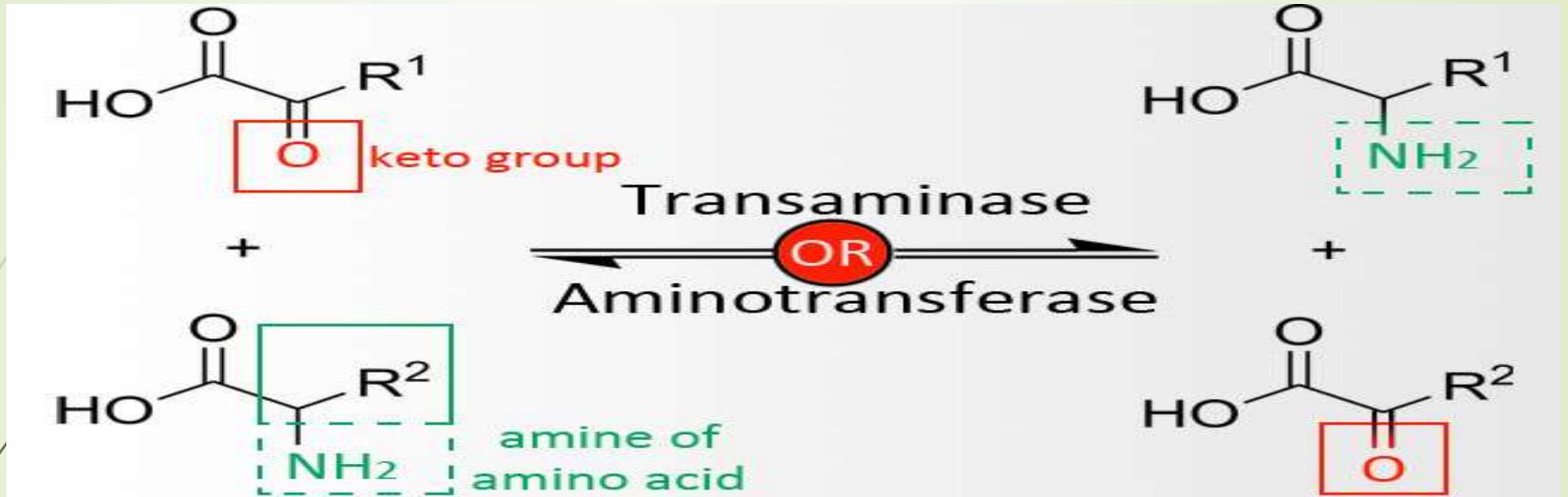
amino acid oxidase



glycine oxidase



Transamination



Transamination is the process of *transferring* an amino acid (R-NH₂) from a molecule with an amino acid to a molecule that has a keto(=O) group.

Main Site : Liver



Essential	Nonessential
	Alanine
Isoleucine	Arginine
Leucine	Aspartic acid
Lysine	Cysteine
Methionine	Glutamic acid
Phenylalanine	Glutamine
Threonine	Glycine
Tryptophan	Proline
Valine	Serine
	Tyrosine
	Asparagine
	Selenocystein



L-Tyrosine

O_2 , Tetrahydro-
biopterin

Tyrosine hydroxylase

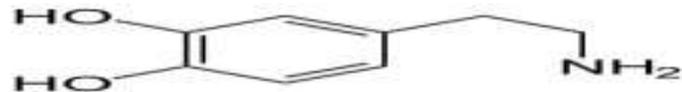
H_2O , Dihydro-
biopterin



L-Dihydroxyphenylalanine (L-DOPA)

DOPA decarboxylase
Aromatic L-amino acid decarboxylase

CO_2



Dopamine

O_2 , Ascorbic
acid

Dopamine β -hydroxylase

H_2O , Dehydro-
ascorbic acid



Norepinephrine

S-adenosyl-
methionine

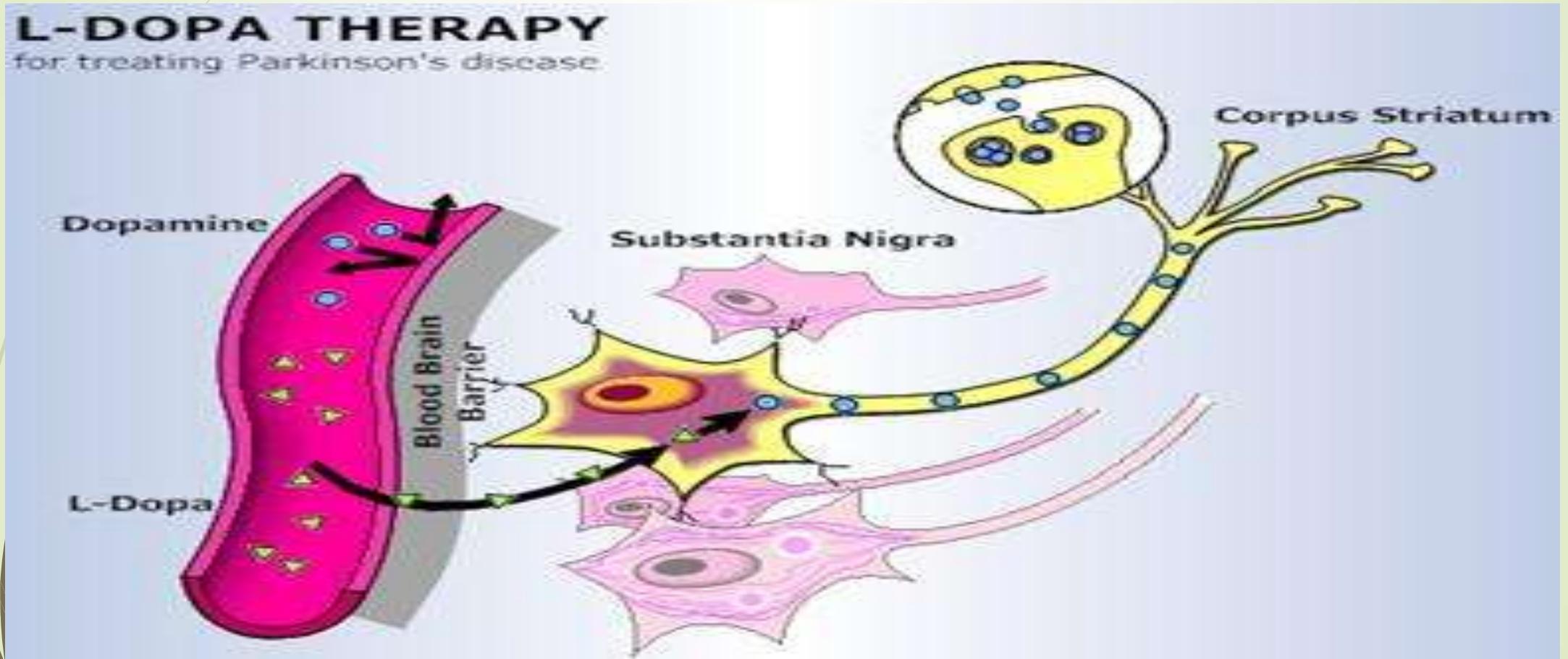
Phenylethanolamine
N-methyltransferase

Homocysteine



Epinephrine

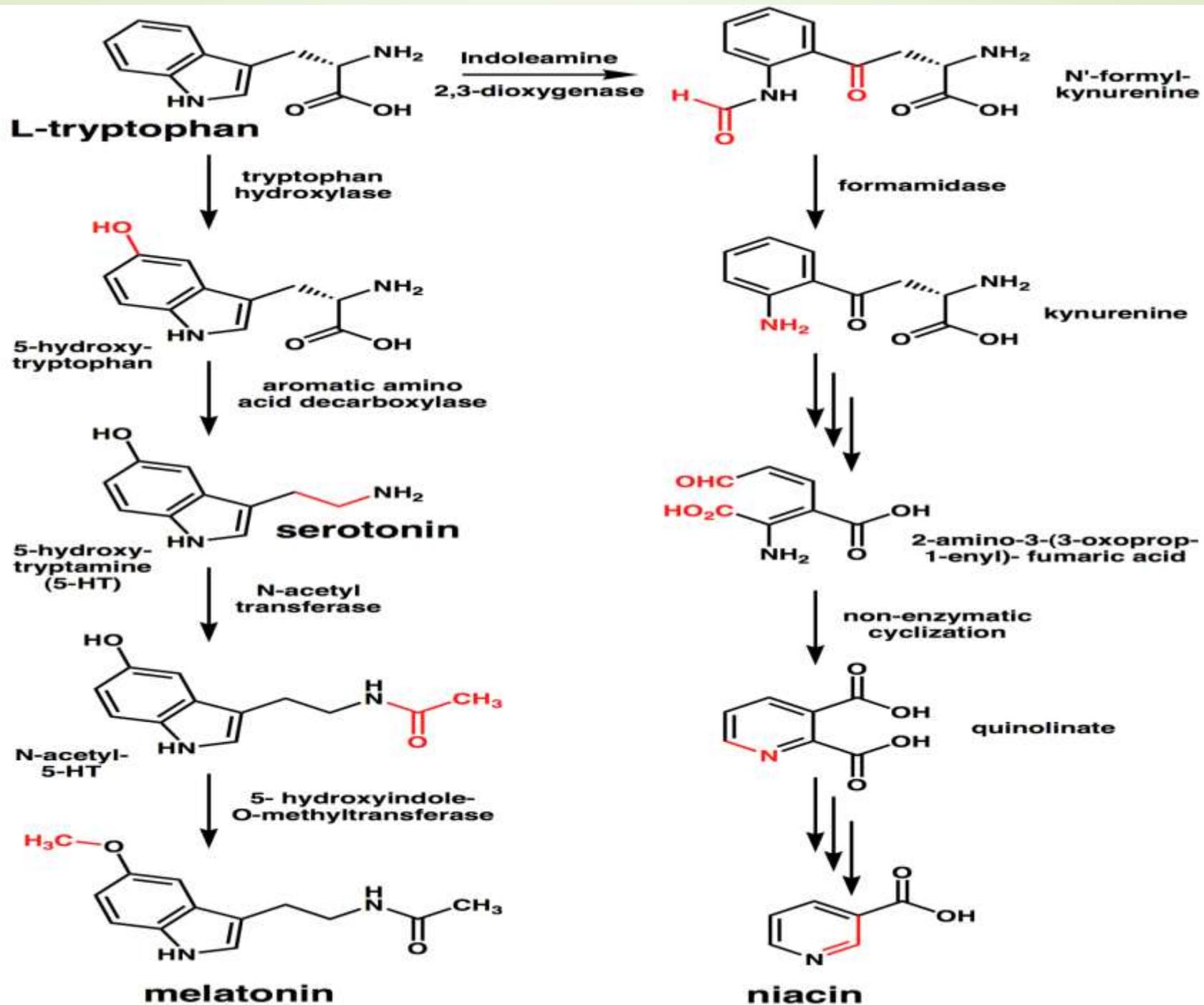
L-dopa therapy for treating Parkinson's disease



Tryptophan is an essential amino acid

Acts as a biochemical precursor for the following compounds

- **Serotonin** a (neurotransmitter) synthesized via tryptophan hydroxylase.
- **melatonin** (a neurohormone), via N-acetyltransferase and 5-hydroxyindole-O-methyltransferase activities.
- **Niacin** is synthesized from tryptophan via kynurenine and quinolinic acids as key biosynthetic intermediates.





Tryptophan

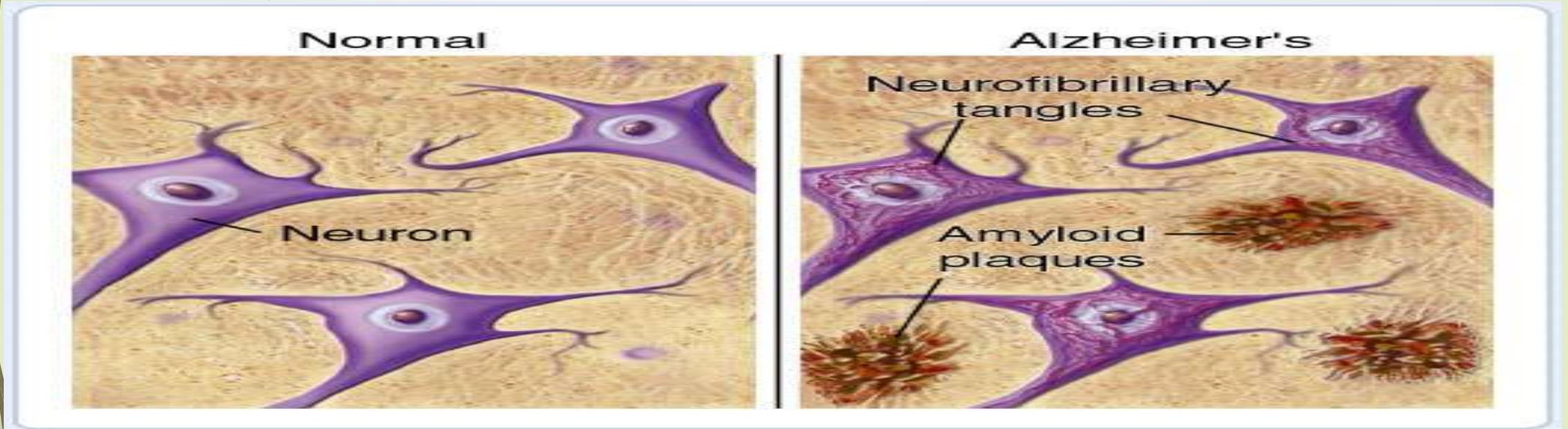
Sleep Disorders

Depression

Smoking Ceasation

5-hydroxytryptophan(5-HTP) for treatment for Epilepsy

Melatonin Therapy for Alzheimer's Disease



this neurohormone prevents neuronal death caused by exposure to the amyloid beta protein, a neurotoxic substance that accumulates in the brains of patients with the Alzheimer's disease.

Enteral Formulas Containing Glutamine

JUVEN

Is a therapeutic nutritional that contains Arginine, Glutamine and HMB(betahydroxy beta methylbutyrate)

JUVEN has been clinically shown

- to help build lean body mass
- Enhance immune response
- Collagen synthesis

