

Shri Swami Vivekanand Shikshan Sanstha's  
Vivekanand College, Kolhapur (Empowered Autonomous)  
**Department of Zoology**  
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# PROTEINS

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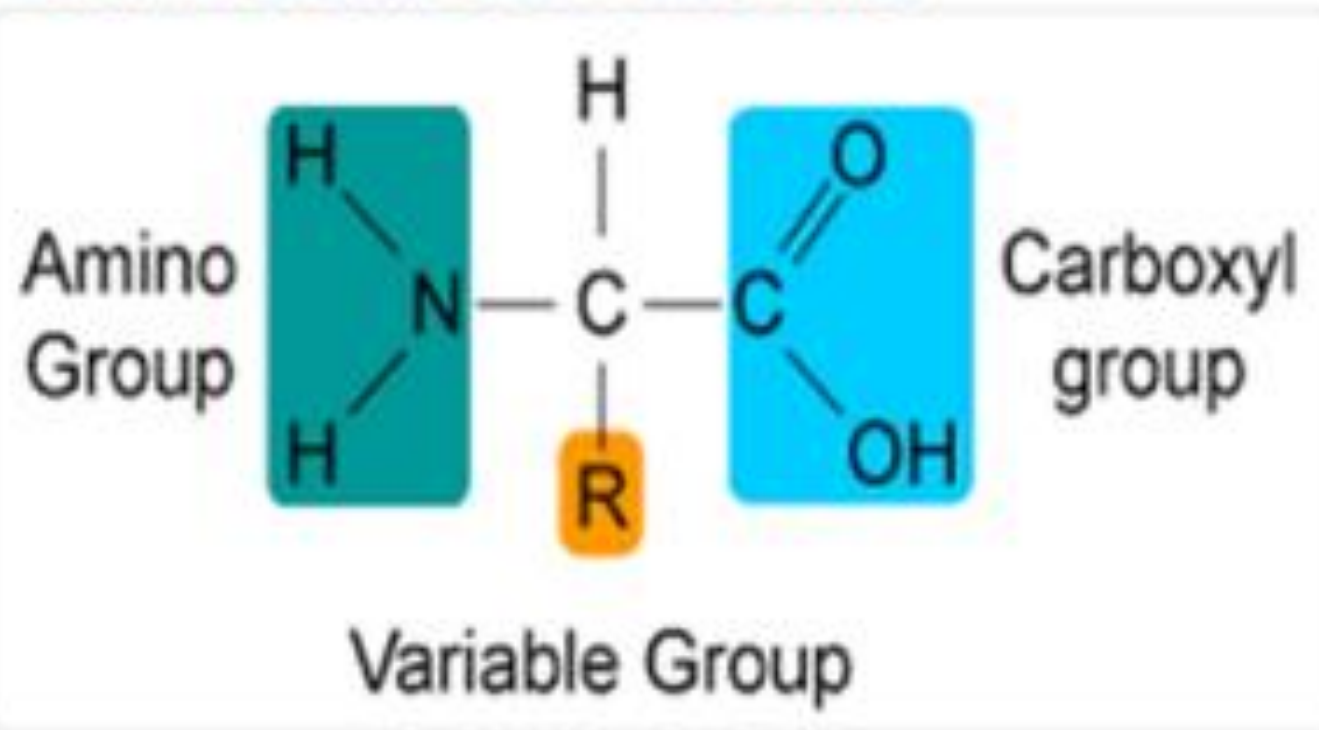
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- ▶ All proteins are macromolecules having very high molecular weights.
- ▶ These are the polymers, i.e., chain-like molecules produced by joining several small units of amino acids called monomers.
- ▶ Amino acids are ‘building blocks of proteins.
- ▶ Peptide bonds connect amino acids.

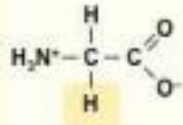
# Structure of amino acids

General structure of Amino Acids

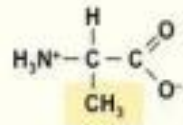


- ▶ Each amino acid has acidic carboxyl ( $-\text{COOH}$ ) and a basic amino ( $-\text{NH}_2$ ) group.
- ▶ R stands for the side chains that are different for each amino acid.
- ▶ The first carbon is the part of the carboxyl group. The second carbon, to which is attached the amino group, is called the  $\alpha$  carbon.
- ▶ The  $\alpha$ -carbon of most amino acids is joined by covalent bonds to 4 different groups.
- ▶ Zwitterions - amino acids exist as structures known as zwitterions.
- ▶ All 20 of the common amino acids are alpha-amino acids.

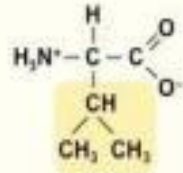
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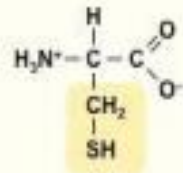
**Glycine**  
(Gly / G)



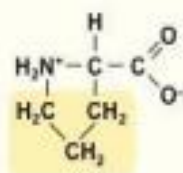
**Alanine**  
(Ala / A)



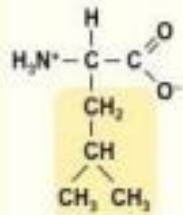
**Valine**  
(Val / V)



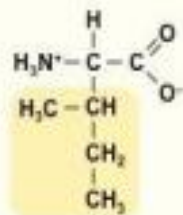
**Cysteine**  
(Cys / C)



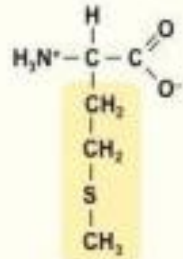
**Proline**  
(Pro / P)



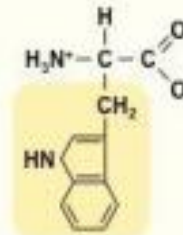
**Leucine**  
(Leu / L)



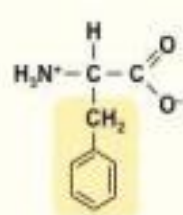
**Isoleucine**  
(Ile / I)



**Methionine**  
(Met / M)

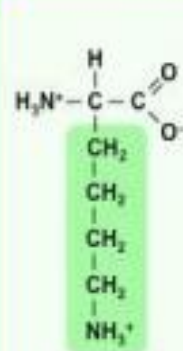


**Tryptophan**  
(Trp / W)

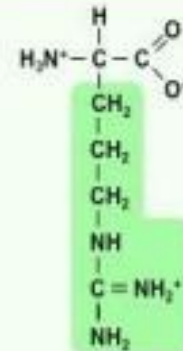


**Phenylalanine**  
(Phe / F)

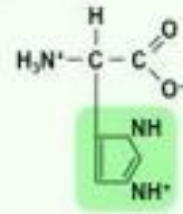
## + CHARGE



**Lysine**  
(Lys / K)

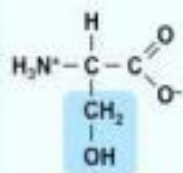


**Arginine**  
(Arg / R)

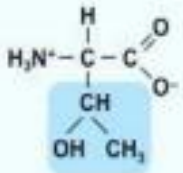


**Histidine**  
(His / H)

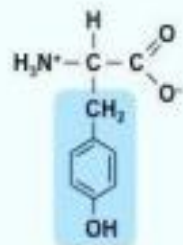
## POLAR



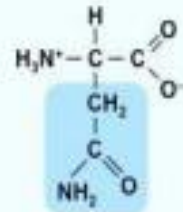
**Serine**  
(Ser / S)



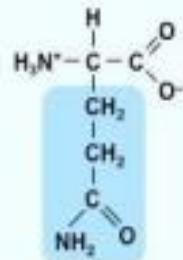
**Threonine**  
(Thr / T)



**Tyrosine**  
(Tyr / Y)

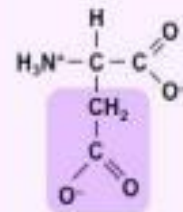


**Asparagine**  
(Asn / N)

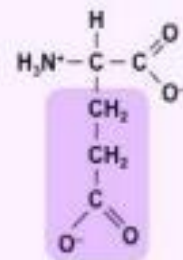


**Glutamine**  
(Gln / Q)

## - CHARGE



**Aspartic Acid**  
(Asp / D)



**Glutamic Acid**  
(Glu / E)

# Classification of protein based on Functions

1. Enzymatic protein - E.g. – Amylase, lipase
2. Hormonal protein - E.g. – Insulin
3. Structural protein - E.g. - Collagen, elastin
4. Defensive protein - E.g. – Immunoglobulins
5. Storage protein - E.g. - Albumin
6. Transport protein - E.g. – Hb
7. Receptor protein - E.g. - GPCR
8. Contractile protein - E.g. – Actin, myosin

THANK YOU



# TRANSAMINATION

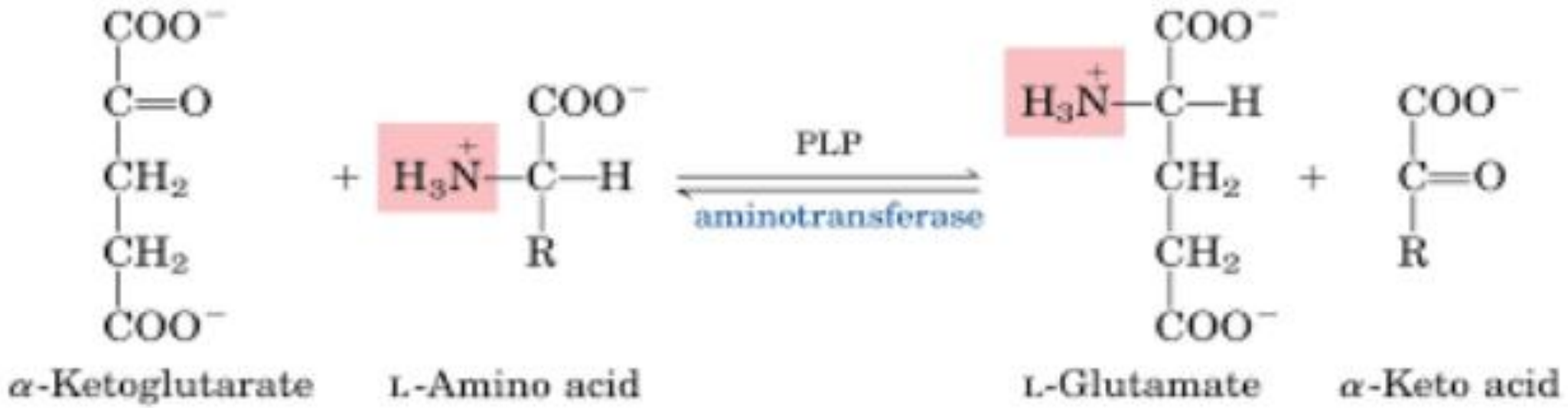
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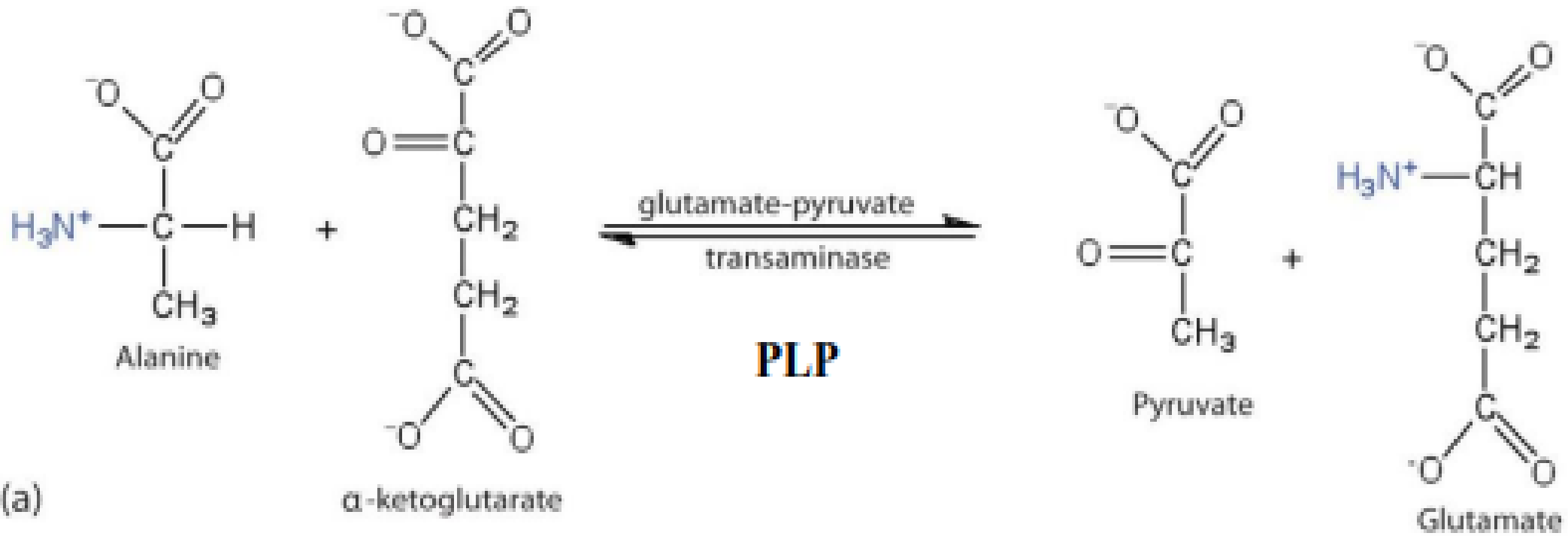
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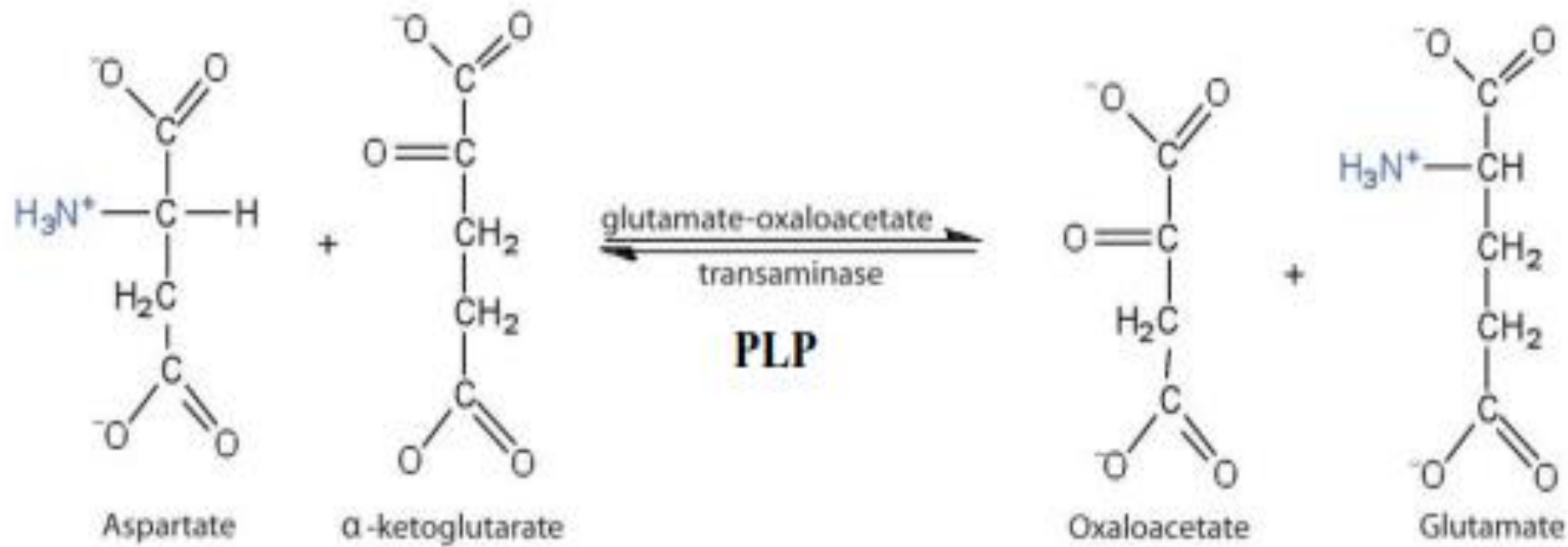
- ▶ **Transamination** - Exchange of the alpha-amino group between one alpha-amino acid and another alpha-keto acid, forming a new alpha-amino acid.
- ▶ Amino acid 1 + Keto acid 2  $\rightarrow$  Amino acid 2 + Keto acid 1
- ▶ The enzyme catalyzes the reaction - aminotransferases or transaminase.
- ▶ Prosthetic group- pyridoxal phosphate
- ▶ The reaction is readily reversible.
- ▶ Exceptions -Lysine, threonine and proline.



# # ALT and AST

- ▶ Alanine transaminase (ALT) and Aspartate transaminase (AST) are important transaminases/ amino transferases.
- ▶ They are also called as Glutamate pyruvate transaminase (GPT) and glutamate oxaloacetate transaminase (GOT) respectively.
- ▶ ALT and AST provide substrates for gluconeogenesis.
- ▶ They are activated by the hormones glucocorticoids and glucagon which favor gluconeogenesis.
- ▶ They are the markers of liver injury.





# **# BIOLOGICAL SIGNIFICANCE OF TRANSAMINATION**

- 1. First step of catabolism**
- 2. Synthesis of non-essential amino acids**
- 3. Interconversion of amino acids-**
- 4. Channelization of proteins in gluconeogenesis**

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# FATTY ACID OXIDATION

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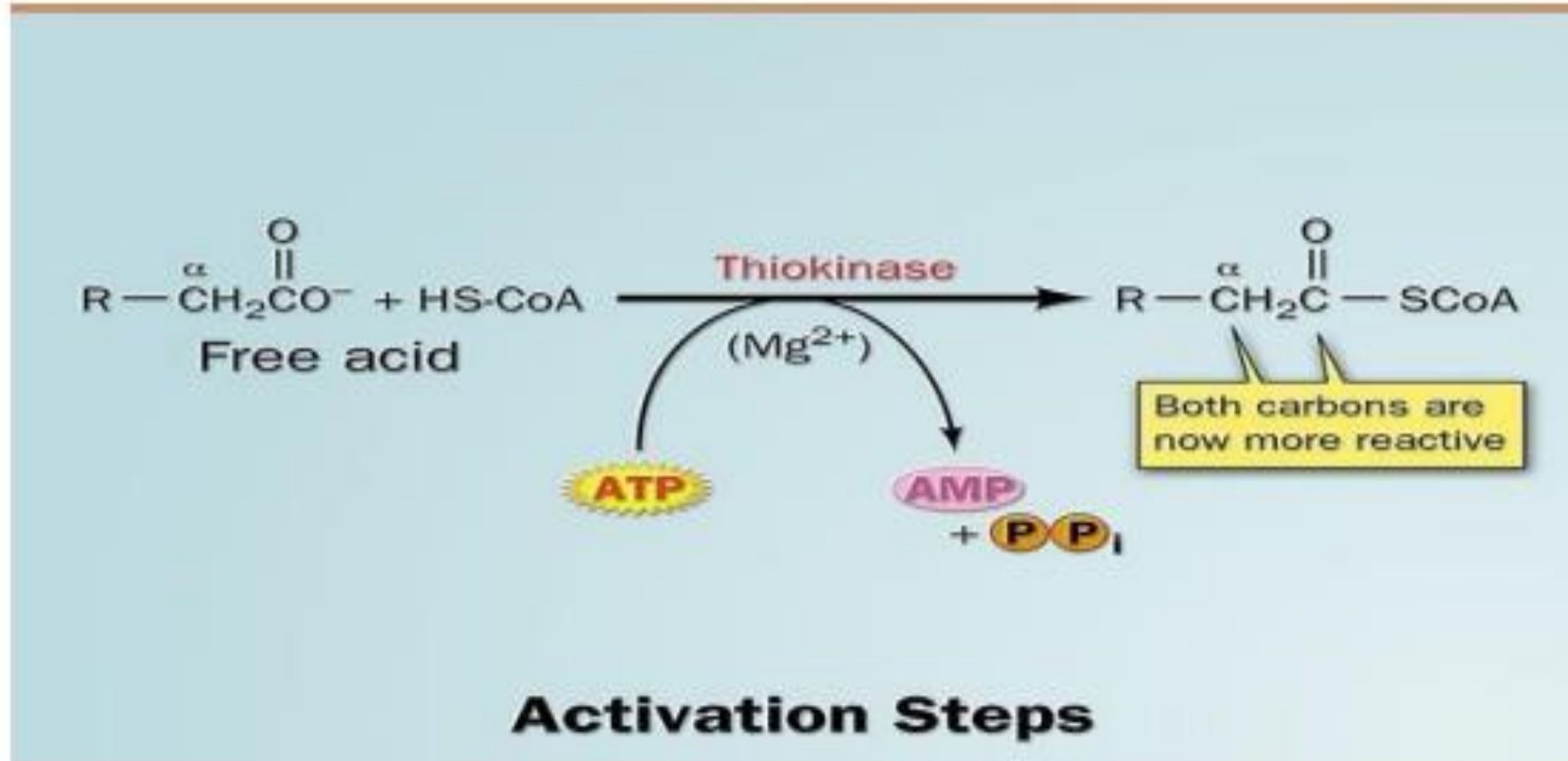
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- ▶ Oxidation of fatty acid (FA) releases a large amount of energy.
- ▶ In the mitochondria, the fatty acid undergoes a series of oxidation and hydration reactions, which results in the removal of a two-carbon group (in the form of acetyl CoA) from the fatty acid chain.
- ▶ Oxidation of fatty acid occurs in mitochondria.
- ▶ Cells lacking mitochondria (e.g., RBC) and brain cells (due to blood-brain barrier) cannot oxidize FA to release energy.
- ▶ Most of the fatty acids are oxidized by beta-oxidation. Cells

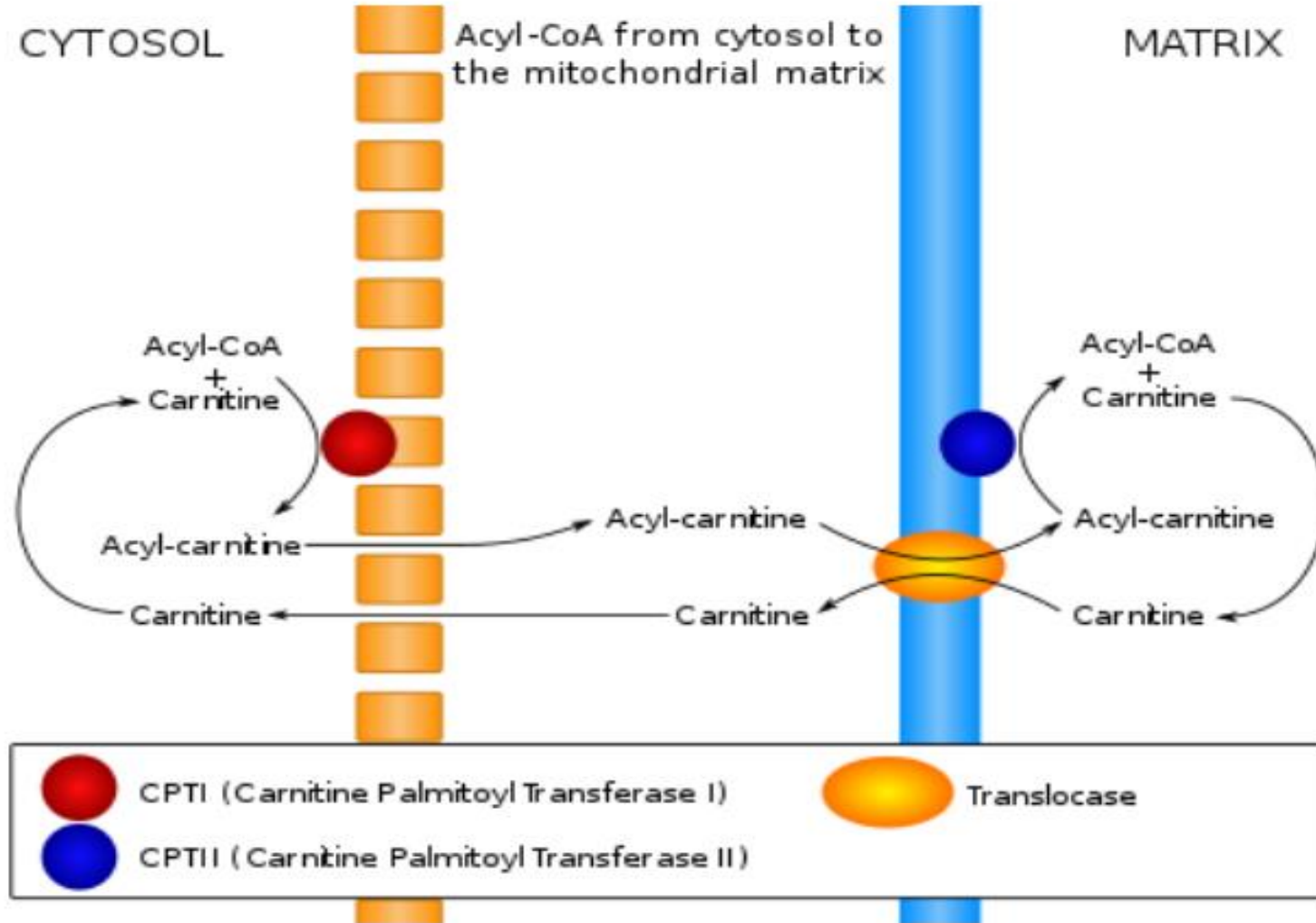
# Steps in beta-oxidation of fatty acids

1. Activation of Fatty acid
2. Transport of fatty acyl CoA into mitochondria
3. Beta- oxidation

# Step I: Activation of fatty acid

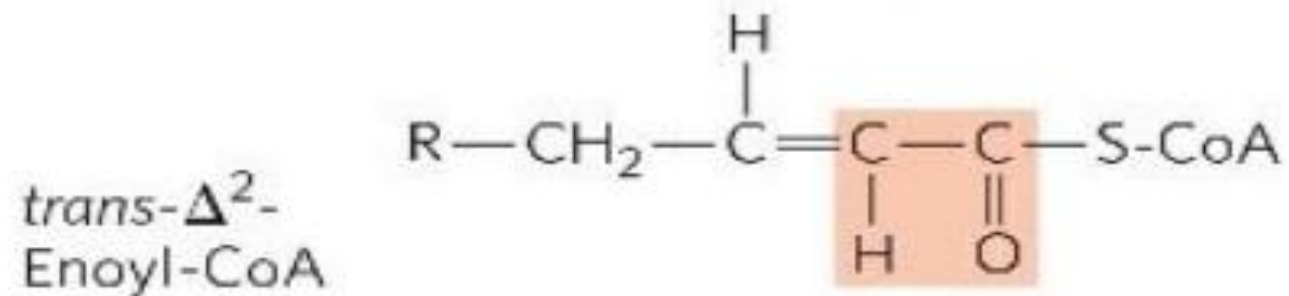
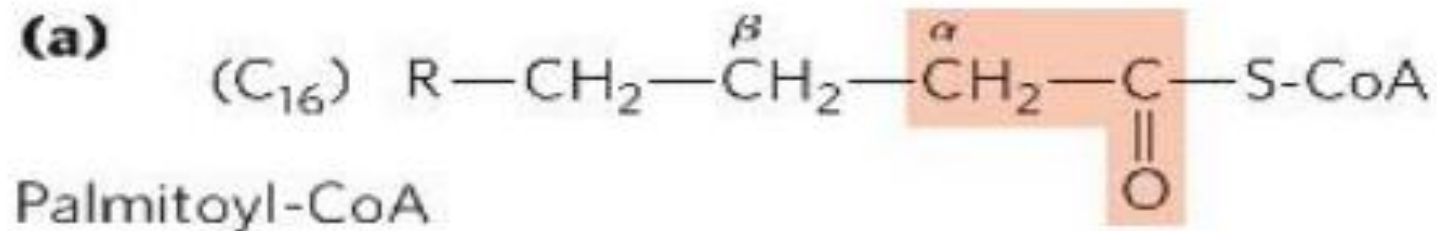


# Step II: Transport of acyl CoA into mitochondria

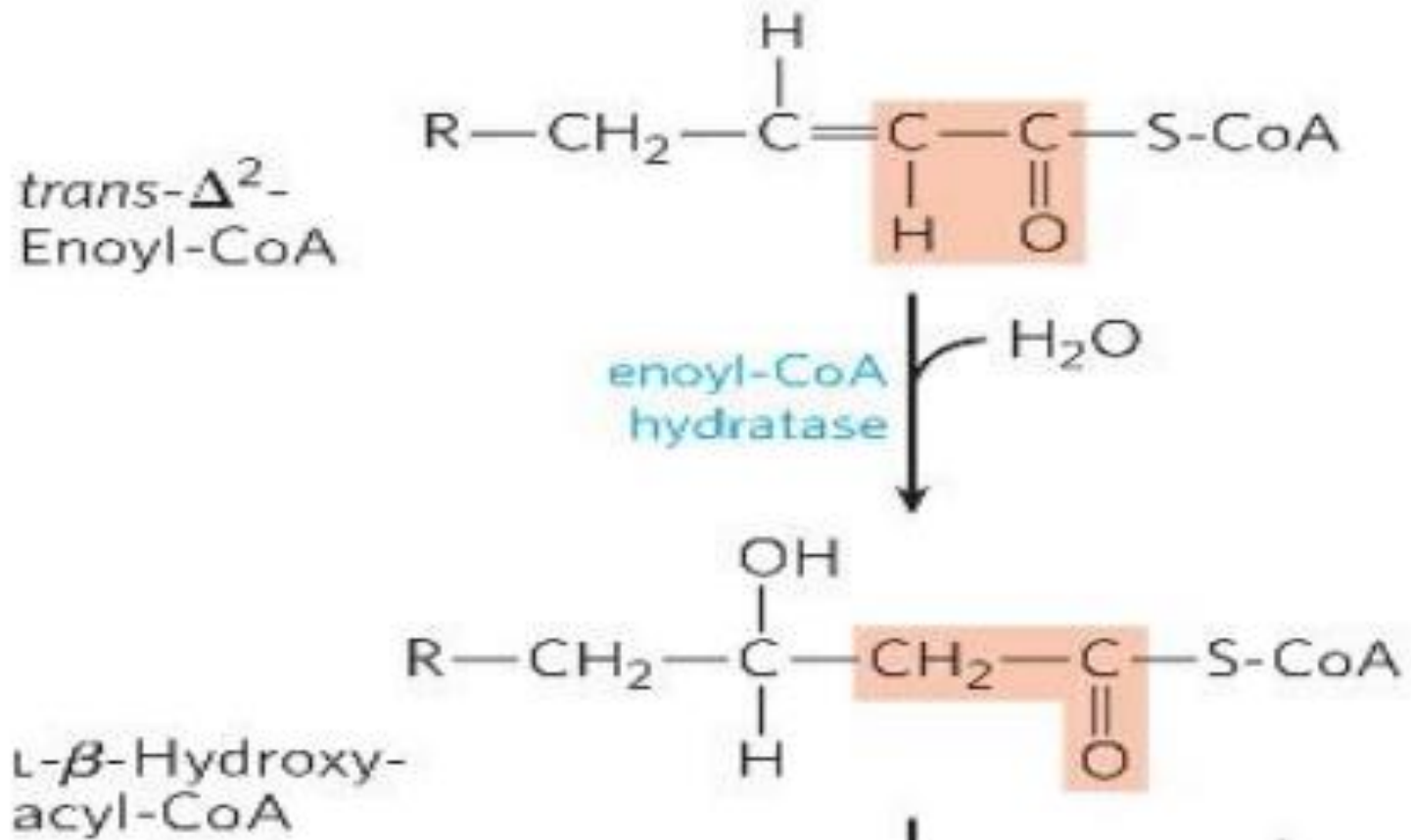


# Step III: Beta-oxidation

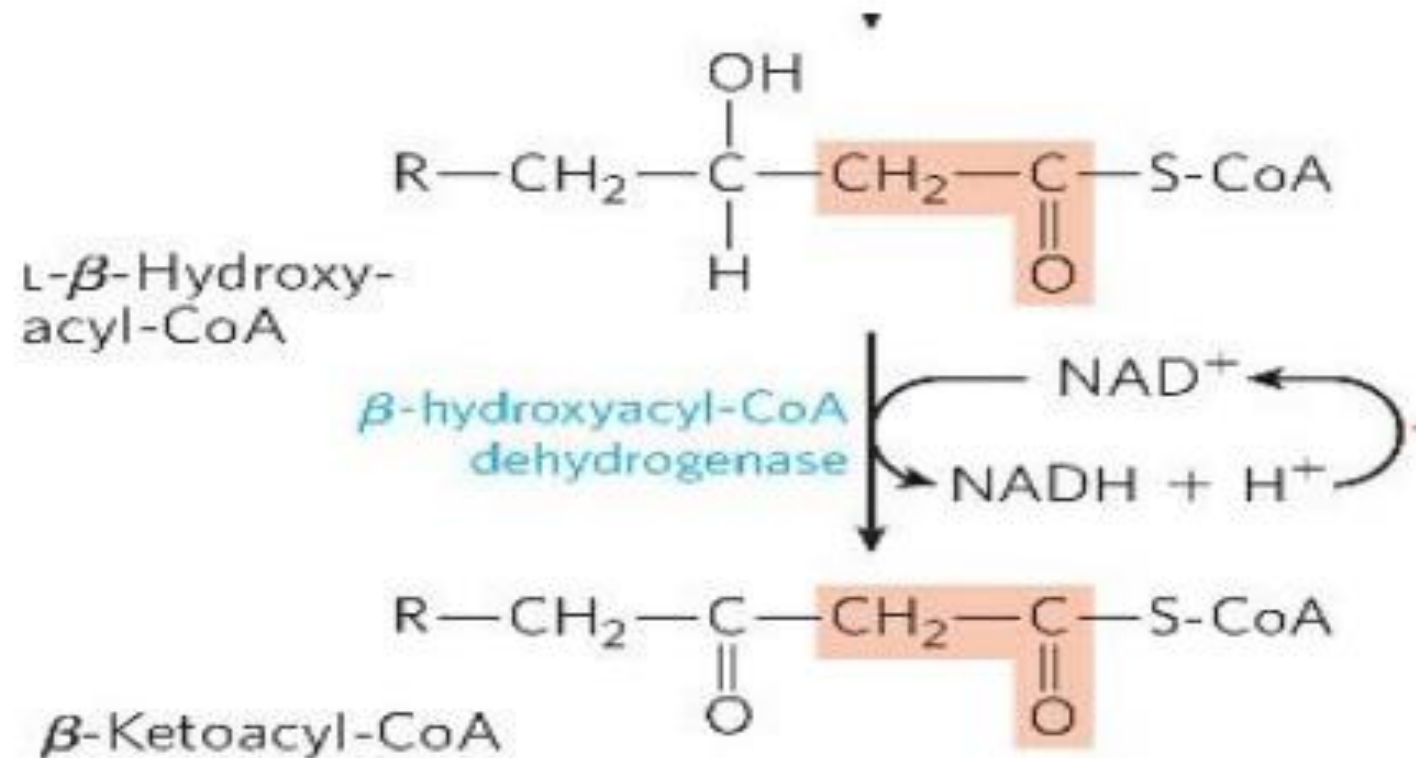
## 1. Dehydrogenation/ Oxidation



## 2. Hydration

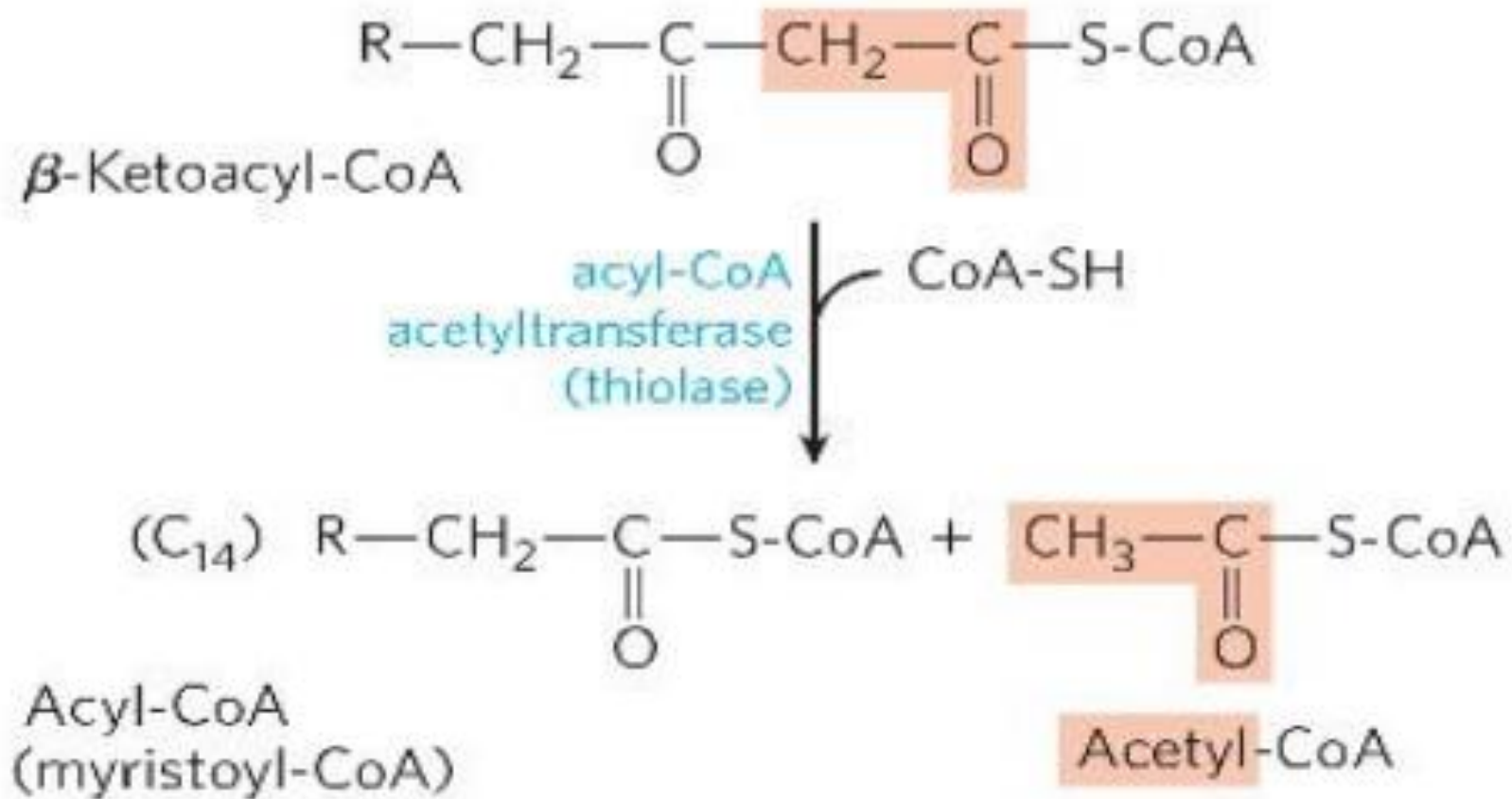


### 3. Dehydrogenation/ Oxidation





## 4. Thiolysis



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# EXTRA EMBRYONIC MEMBRANES

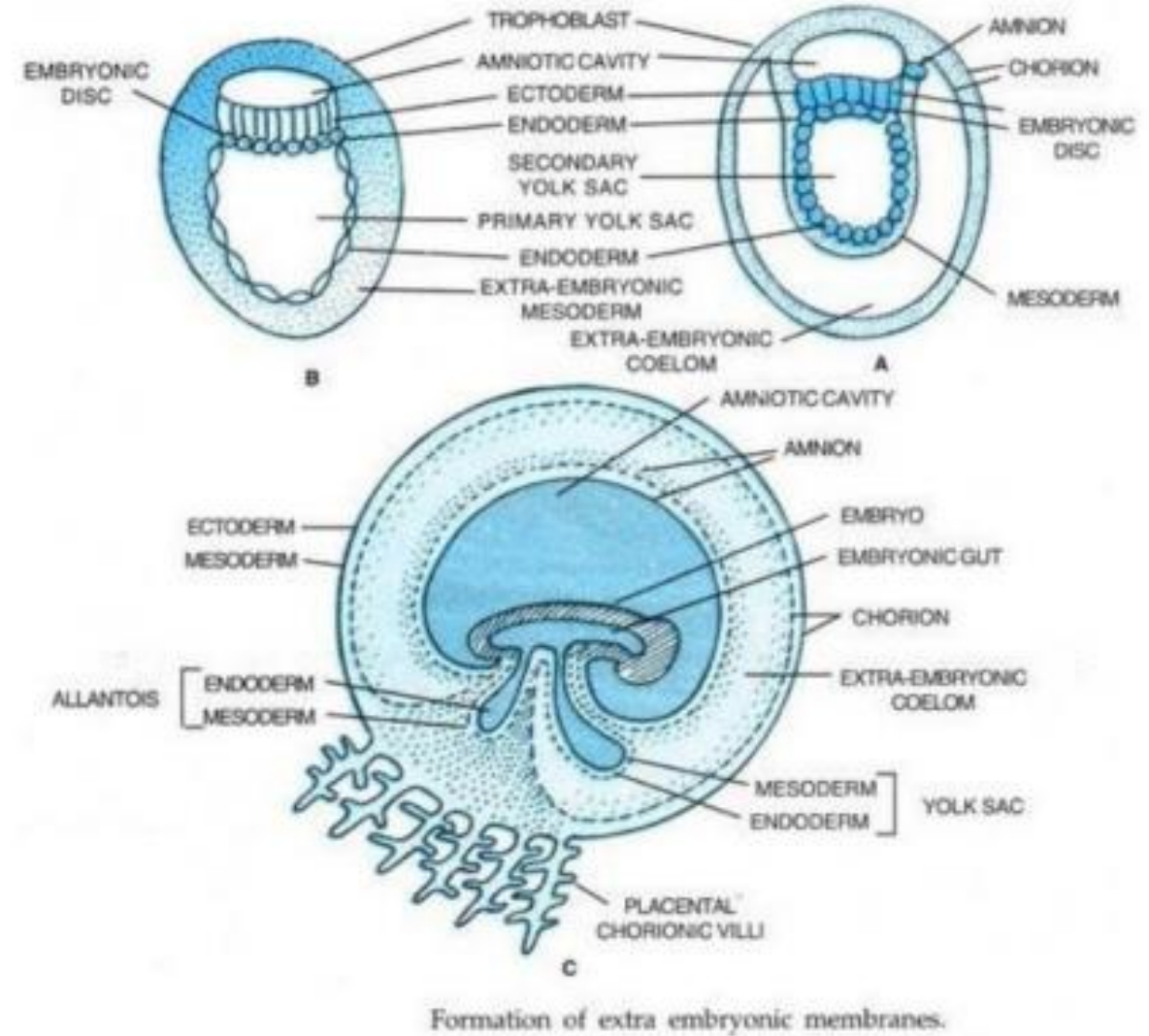
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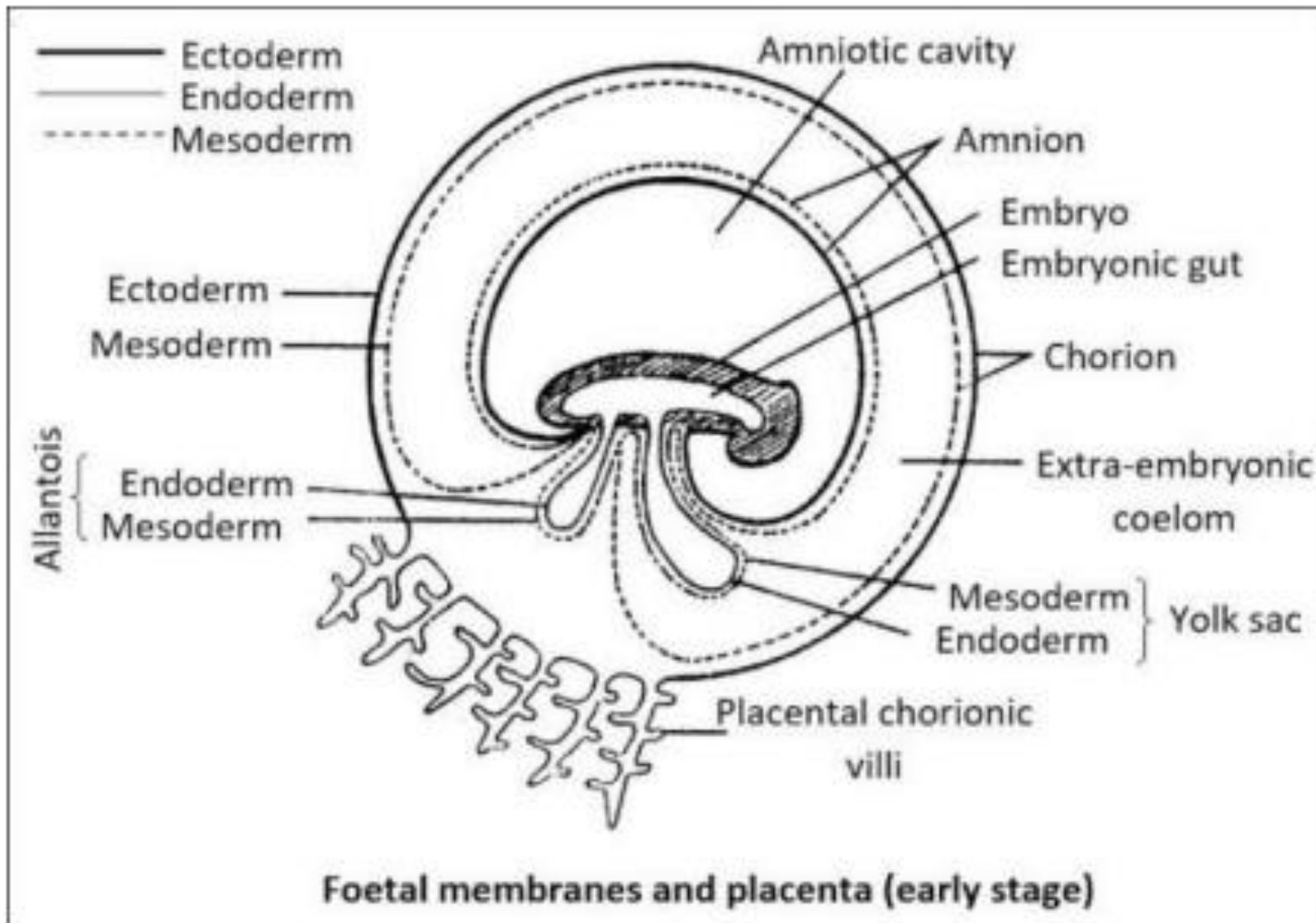
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- ▶ The embryos of reptiles, birds, and mammals produce 4 extraembryonic membranes- Yolk sac, Amnion, Allantois and Chorion.
- ▶ These membranes are formed outside the embryo from the trophoblast only in amniotes (reptiles, birds and mammals) and perform specific functions





# Yolk sac

- ▶ formed of splanchnopleur (inner endoderm and outer mesoderm)
- ▶ It is well-developed in reptiles and birds.
- ▶ Mainly digestive in function so acts as an extra embryonic gut.
- ▶ Absorbs the dissolved yolk and passes it to the developing embryo.
- ▶ In human beings, it is vestigial and acts as the site of blood cell formation

# Amnion

- ▶ It is an innermost fold of somatopleur (inner ectoderm and outer mesoderm) above the embryo.
- ▶ there is an amniotic cavity between the amnion and embryo
- ▶ This cavity is filled with amniotic fluid secreted by both embryo and amnion.
- ▶ It protects the embryo.
- ▶ Amniotic fluid acts as a shock absorber and also prevents the desiccation of the embryo.

# Allantois

- ▶ It is a fold of splanchnopleure (inner endoderm and outer mesoderm) developed from the hindgut of the embryo.
- ▶ Stores the nitrogenous wastes of the embryo so acts as an extra embryonic kidney.
- ▶ In most eutherian, it combines with chorion to form allantochorion which takes part in placenta formation (Allantoic placenta).
- ▶ It is reduced in human beings.



# Chorion

- ▶ It is outermost fold of somatopleur (inner mesoderm and outer ectoderm) and surrounds the embryo.
- ▶ In reptiles, birds and prototherians, allantochorion acts as extra embryonic lung and helps in exchange of gases.
- ▶ But in primates including human beings, only chorion forms the placenta (chorionic placenta) for metabolic exchange between the foetus and mother

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# CLASSIFICATION OF PLACENTA

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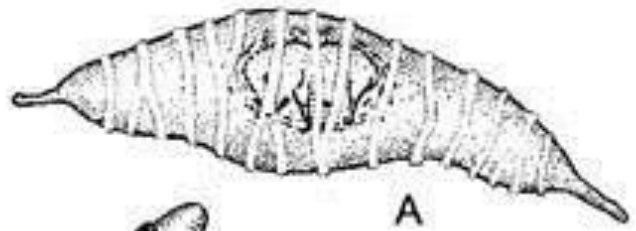
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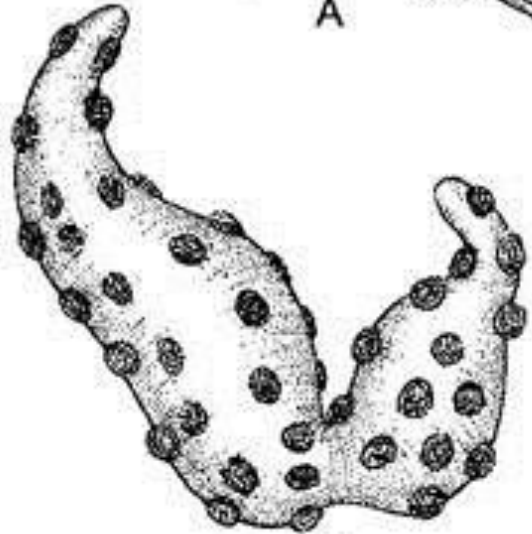
## # CLASSIFICATION BASED ON THE DISTRIBUTION OF VILLI

- ▶ **Diffused Placenta:** villi are numerous and are scattered uniformly over the whole of the chorion. e.g., pig, horse etc.
- ▶ **Cotyledonary Placenta:** villi become aggregated in special regions or patches to form small tufts. It is seen in ruminants e.g., cattle, sheep, deer etc.
- ▶ **Intermediate Placenta:** villi are scattered and are also arranged in cotyledons. e.g., camel and giraffe.

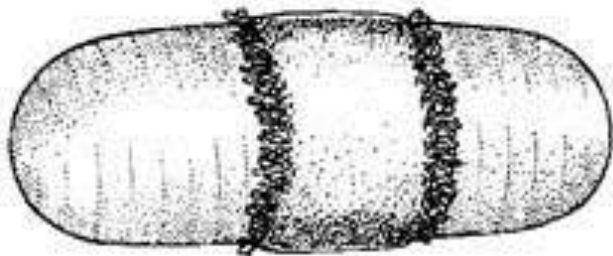
- ▶ **Zonary Placenta:** villi are confined to an annular zone on the chorion. It may be of either incomplete zonary (e.g., raccoon) or complete zonary (e.g. dog, cat, seal, etc.) type.
- ▶ **Discoidal Placenta:** villi become restricted to a circular disc or plate area on the dorsal surface of the blastocyst. e.g., rodents (rats, mice) and rabbit.
- ▶ **Meta-Discoidal Placenta:** villi are at first scattered all over the chorion but later becomes restricted to one or two discs. The mono-discoidal (single disc) - human, bi-discoidal type (two disc-shaped) - monkeys.



A



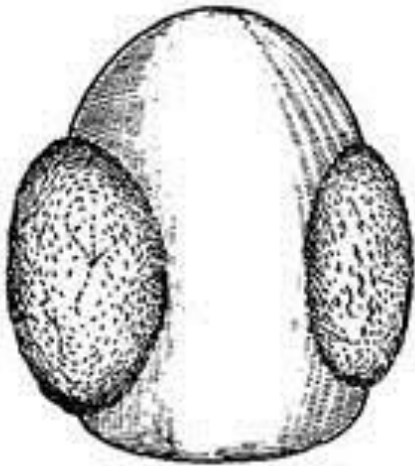
B



C



D

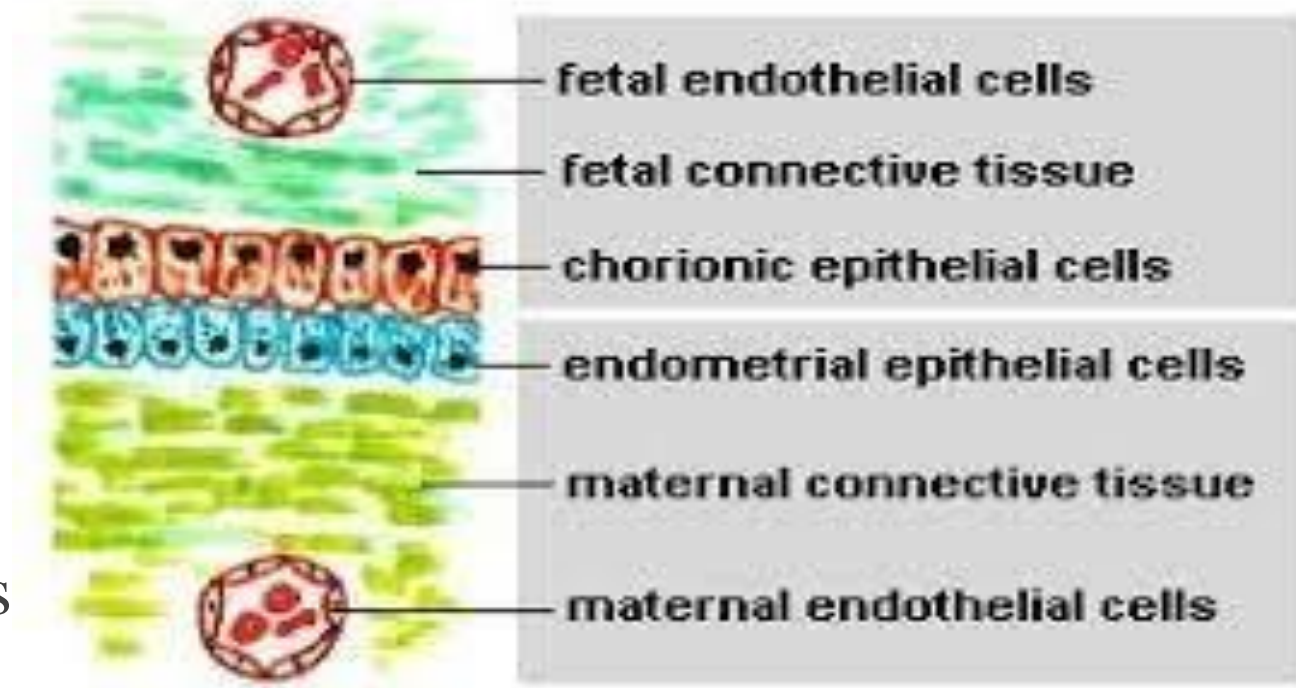


E

A – Diffuse placenta of pig; B – Cotyledonary placenta of calf; C – Zonary placenta of dog; D – Monodiscoidal placenta of man; and E – Bidiscoidal placenta of monkey.

## #CLASSIFICATION BASED ON THE DEGREE OF INVOLVEMENT OF FOETAL AND MATERNAL TISSUES:

- Histologically there are no less than six membranes or tissues that lie between the foetal and maternal bloodstreams.
- These membranes in order of their sequence, from foetus to mother are;
  1. endothelium of foetal blood vessel.
  2. chorionic connective tissue
  3. chorionic epithelium
  4. uterine epithelium
  5. endometrial connective tissue
  6. endothelium of maternal blood vess



- ▶ **Epitheliochorial Placenta:**
- ▶ **Syndesmochorial Placenta:**
- ▶ **Endotheliochorial Placenta:**
- ▶ **Haemochorial Placenta:**
- ▶ **Haemoendothelial Placenta:**



## #CLASSIFICATION BASED ON THE DEGREE OF INTIMACY:

### ▶ **Non-Deciduate Placenta:**

eg. Pigs, Cattles, Horse & other Ruminants

### ▶ **Deciduate Placenta:**

eg. Man, Rabbit, Dog, Cat, etc

### ▶ **Contra-Deciduate Placenta: –**

eg. Parameles and Talpa(mole)

## #CLASSIFICATION BASED TYPES OF EMBRYONIC TISSUES INVOLVED IN PLACENTA:

### ❑ **Choriovitelline:**

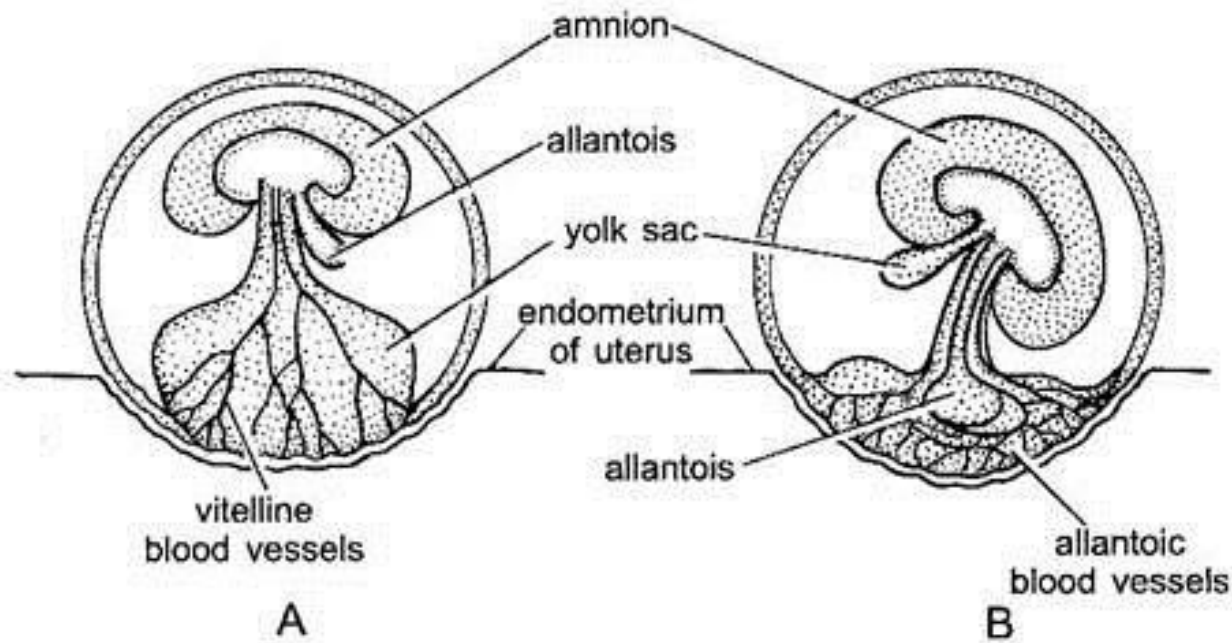
The yolk sac is large and unites with the chorion. This is also called yolk sac placenta.

eg. Some marsupials.

### ❑ **Chorioallantoic:**

allantois comes into contact and fuses with chorion.

eg. Cow, sheep, goat, horse, women and dog



Comparison of two types of mammalian placentae. A—Chorio-vitelline placenta; B—Chorio-allantoic placenta.

THANK YOU