



# Vitamins B<sub>6</sub> and B<sub>12</sub>



## •OBJECTIVES:

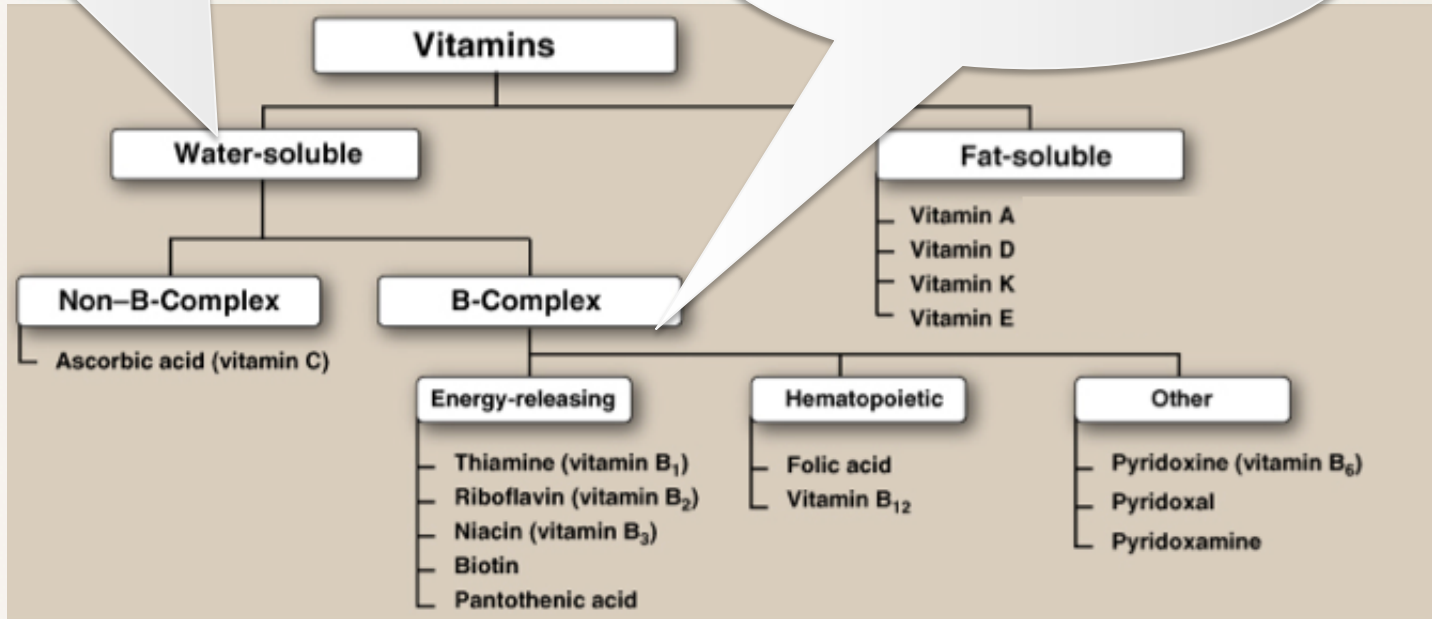
- General biochemistry
- Functions
- Deficiency diseases



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- Not significantly stored in the body
- Must be supplied regularly in the diet
- Excess excreted

- Present in small quantities in different types of food
- Important for growth and good health
- Help in various biochemical processes in cell
- Function as coenzymes



# Vitamin B<sub>6</sub>

## Forms:

Three forms (inactive)

- Pyridoxine
- Pyridoxal
- Pyridoxamine

Active form :

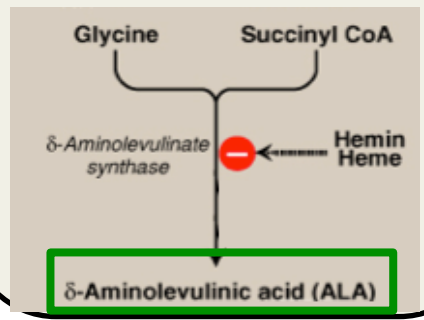
All 3 are converted to **Pyridoxal phosphate (PLP)**

(PLP) acts as a **coenzyme** for the following reactions:

## 1. Condensation Reaction

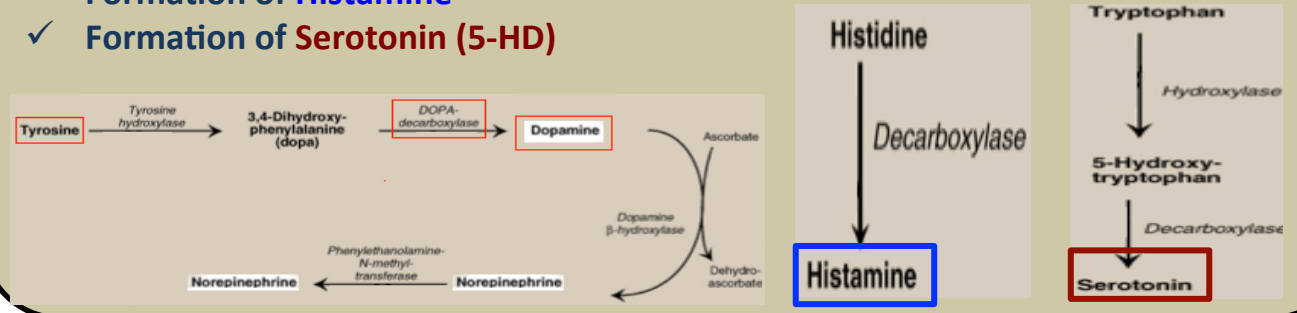
Formation of **aminolevulinic acid (ALA)** by **ALA synthase**

The regulatory step in **hemoglobin synthesis**



## 2. Decarboxylation Reaction

- ✓ Formation of **Chatecholamines**: Dopamine, norepinephrine and epinephrine
- ✓ Formation of **Histamine**
- ✓ Formation of **Serotonin (5-HD)**



## 3. Transamination Reaction

- ✓ In conversion of **alanine to pyruvate** by **ALT** (Alanine aminotransferase)



## 4. Deamination Reaction

# Vitamin B<sub>6</sub> deficiency

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leads to poor activity of PLP-dependent enzymes  
Causing:

- ✓ Deficient amino acid metabolism
- ✓ Deficient lipid metabolism
- ✓ Deficient neurotransmitter synthesis such as;  
[serotonin, epinephrine, norepinephrine and gamma amino butyric acid (GABA)]

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Mild deficiency leads to:

- Irritability
- Nervousness
- Depression

Severe deficiency leads to:

- Peripheral neuropathy
- Convulsions

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Dietary deficiency

✧ Rare, but it was observed in:

1. Newborn infants fed on formulas low in B6
2. Women on oral contraceptives
3. Alcoholics

• Isoniazid treatment for TB can lead to vitamin B6 deficiency by forming inactive derivative with PLP

Because PLP is involved in the synthesis of sphingolipids



Its deficiency leads to demyelination of nerves and consequent peripheral neuritis

**Start from here**

### Forms:

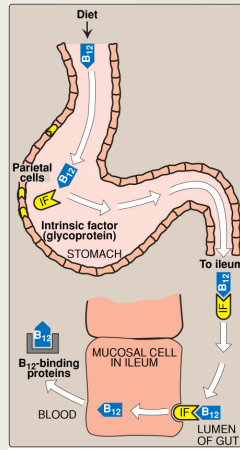
- ✓ Cyanocobalamin
- ✓ Hydroxycobalamin
- ✓ Adenosylcobalamin  
(major storage form in the liver)
- ✓ Methylcobalamin  
(mostly found in blood circulation)

Both act as Coenzymes for metabolic reactions.

# Vitamin B<sub>12</sub>

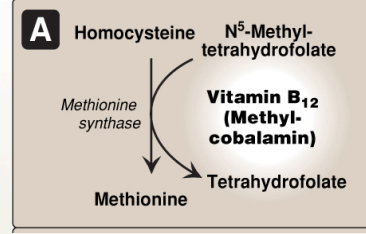
### Sources:

- ❑ Not synthesized in the body and must be supplied in the diet.
- ❑ Mainly found in animal liver bound to protein as Methylcobalamin or 5'-deoxyadenosylcobalamin



## 2- Conversion of homocysteine to methionine

Methionine synthase requires B12 in converting homocysteine to methionine

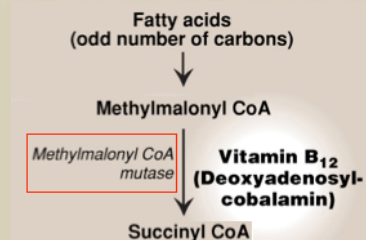


## Functions

Essential for normal CNS function and RBCs maturation

## 1- Conversion of methylmalonyl-CoA to succinyl-CoA

The enzyme in this pathway, methyl-malonyl-CoA mutase, requires B12



## Absorption & store

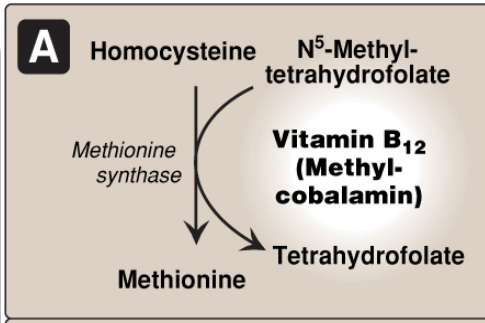
Binds to intrinsic factor (IF) which is a protein secreted by cells in the stomach and then absorbed by the ileum

Liver stores vitamin B12 (4-5 mg) and it is the only water-soluble vitamin that is stored in the body.

Homocysteine re-methylation reaction is the only pathway where N5-methyl TH4 can be returned back to tetrahydrofolate (TH4) pool

Otherwise folate will be trapped as N5-methyltetrahydrofolate (folate trap), which leads to => **deficiency of folate and other TH4 derivatives (N5-N10 methylene TH4 and N10 formyl TH4) required for purine and pyrimidine syntheses**

TH4: Tetrahydrofolate



## Vitamin B<sub>12</sub> deficiency

• Is observed in patients with (IF) deficiency due to autoimmunity or by partial or total gastrectomy

• Clinical deficiency symptoms develop in several years

### Neurological symptoms

- Paraesthesia (abnormal sensation) of hands and feet
- Reduced perception of vibration and position
- Absence of reflexes
- Unsteady gait and balance (ataxia)

### Psychiatric symptoms

- Confusion and memory loss
- Depression
- Unstable mood

## Disorders:

**Pernicious anemia: (Megaloblastic anemia):**  
is mainly due to the deficiency of intrinsic factor.

**Demyelination**  
Myelin sheath of neurons is chemically unstable and damaged

**Neuropathy**  
Peripheral nerve damage:

=> Deficiency of vitamin B12  
=> **accumulation of methylmalonyl CoA.**

=> **High levels of methylmalonyl CoA is used instead of malonyl CoA for fatty acid synthesis**

=> Myelin synthesized with these abnormal fatty acids is unstable and degraded causing neuropathy

**1) Which of the following is the active form of vitamin B<sub>6</sub>?**

- A- PLP**
- B- PLL**
- C- Pyridoxine**
- D- Pyridoxamine**

**2) An alcoholic was presented to the general practitioner with signs of severe vitamin B<sub>6</sub> deficiency, which of the following is NOT one of his presentations?**

- A- Vomiting**
- B- Convulsions**
- C- Depression**
- D- Irritability**

**3) Formation of ALA with the help of PLP is an example of which of the following?**

- A- Transamination Reaction**
- B- Condensation Reaction**
- C- Decarboxylation Reaction**
- D- Deamination Reaction**

**4) Which ONE of the following has the highest risk of developing vitamin B<sub>6</sub> deficiency?**

- A- PREGNANCY**
- B- Breast-feeding women**
- C- Women on contraceptives**
- D- MS patients**

**5) Which of the following vitamins is stored in the liver?**

- A- B<sub>6</sub>**
- B- B<sub>12</sub>**
- C- B<sub>3</sub>**
- D- B<sub>4</sub>**

**6) A patient suffering from pernicious anemia was presented to the GP, which of the following is the most likely cause of it?**

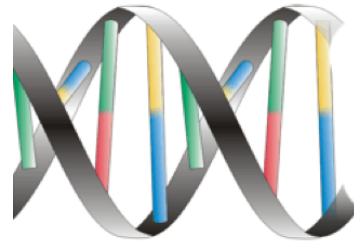
- A- vit. B<sub>12</sub> deficiency**
- B- vit. B<sub>6</sub> deficiency**
- C- vit. B<sub>3</sub> deficiency**
- D- vit. B<sub>4</sub> deficiency**

**7) Conversion of homocysteine to methionine requires which of the following vitamins?**

- A- B<sub>6</sub>**
- B- B<sub>12</sub>**
- C- B<sub>3</sub>**
- D- B<sub>4</sub>**

**8) Which of the following accumulates as a result of the folate trap?**

- A- Tetrahydrofolate**
- B- purine**
- C- pyrimidine**
- D- N<sup>5</sup>-methyltetrahydrofolate**



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# Thank You!

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