

Micronutrients

- Vitamins
- Mineral & trace elements
- Other Nutrients



Vitamins are classified as water-soluble or fat-soluble

- Vitamins are **needed in small amounts** by the body, yet they are essential for good health.
- They serve as cofactors for **metabolic reactions & energy utilization**. However, vitamins do not provide energy.

Vitamins



- *Vitamins are classified into 2 groups: **water-soluble** & **fat-soluble**.*

Water-soluble vitamins

- **Water-soluble** vitamins include the **B vitamins** complex family and **vitamin C**

- B complex family includes mainly:
Thiamine (vitamin B₁), riboflavin (vitamin B₂),
niacin, vitamin B₆, vitamin B₁₂, folic acid,
biotin & pantothenic acid.

- Metabolism:

- The excess of water-soluble vitamins is excreted in the urine, while an excess intake of fat-soluble vitamins is potentially more toxic since they are stored in the body.

Fat-soluble vitamins

- **Fat-soluble** vitamins include **vitamins A, D, E & K₁**



Vitamins – General functions

- **Water-soluble vitamins:**
 - **Thiamine** is part of a coenzyme needed to oxidize carbohydrates.
 - **Riboflavin** is a part of enzymes and coenzymes needed to oxidize glucose & fatty acids. Riboflavin is also utilized for cellular growth.
 - **Niacin** is necessary to oxidize glucose & to synthesize protein, fat, and nucleic acids.
 - **Vitamin B₆** is a coenzyme needed to create protein, nucleic acids, and various amino acids.
 - **Vitamin B₁₂** is part of a coenzyme needed to synthesize nucleic acids and to metabolize carbohydrates.
 - **Folic acid** promotes the production of red blood cells and is a coenzyme needed to produce DNA.
 - **Pantothenic acid** is used in the synthesis of coenzyme A (CoA). CoA plays a key role in metabolism and the synthesis of fatty acids and other key compounds.
 - **Biotin** is necessary for cell growth, production of fatty acids, and metabolism of fats & amino acids.
 - **Vitamin C** promotes iron absorption, metabolizes certain amino acids, and synthesizes hormones from cholesterol. It also acts as an antioxidant to restore and extend vitamin E activity.
- **Fat-soluble vitamins:**
 - **Vitamin A** is necessary to synthesize visual pigments, promote the normal development of bones & teeth, and maintain epithelial cells.
 - **Vitamin D** is produced in skin exposed to ultraviolet light. It promotes the development of teeth and bone, and the absorption of calcium and phosphorus.
 - **Vitamin E** prevents the oxidation of vitamin A and polyunsaturated fatty acids (PUFA).
 - **Vitamin K** is necessary to synthesize prothrombin, a blood clotting factor.

Minerals & Trace elements and other nutritional substances

- **Minerals** (mg quantities) and **trace elements** (in µg quantities) are essential and fulfill various functions in the body as **electrolytes, enzyme constituent, building material**. They **do not provide any energy**
- “Other” nutritional compounds such as Taurine & Carnitine have other functions 
- Minerals and Trace Elements are naturally found in the body as **ions** but not as pure elements
 - **Electrolytes** are salts that dissolve and dissociate in water into positive and negative ions.
Salt dissolves in water: $\text{NaCl} \rightarrow \text{Na}^+ + \text{Cl}^-$
 - **Electrolytes** attract water & control its movement in and out of cells
 - **Cations** (positively charged ions) include sodium (Na^+), potassium (K^+), calcium (Ca^{2+}), and magnesium (Mg^{2+}).
 - **Anions** (negatively charged ions) include chloride (Cl^-), bicarbonate (HCO_3^-), phosphate (PO_4^{2-}), and sulfate (SO_4^{2-}).

Other nutrients	Trace elements	Minerals
Taurine	Copper (Cu)	Calcium (Ca)
Carnitine	Chromium (Cr)	Chlorine (Cl)
Inositol	Iodine (I)	Magnesium (Mg)
Choline	Selenium (Se)	Phosphorous (P)
Nucleotides	Zinc (Zn)	Potassium (K)
		Sodium (Na)
		Fluoride (F)
		Iron (Fe)
		Manganese (Mn)
		Molybdenum (Mo)

