



Vitamins & Minerals

Unit 4th & 5th

INTRODUCTION

- ❖ **Nutrition may be defined as the science of food and its relationship to health. It is concerned primarily with the part played by nutrients in body growth, development and maintenance .**
- ❖ **The word nutrient or “food factor” is used for specific dietary constituents such as proteins, vitamins and minerals. Dietetics is the practical application of the principles of nutrition; it includes the planning of meals for the well and the sick. Good nutrition means “maintaining a nutritional status that enables us to grow well and enjoy good health.”**

❖ Protein, carbohydrate and fat had been recognized early in the 19th century as energy-yielding foods and much attention was paid to their metabolism and contribution to energy requirements.

CLASSIFICATION OF FOODS

❖ *Classification by origin:*

- Foods of animal origin
- Foods of vegetable origin

❖ *Classification by chemical composition:*

Proteins

Fats

Carbohydrates

Vitamins

Minerals

CLASSIFICATION BY PREDOMINANT FUNCTION

- ❖ **Body building foods:**

Meat, Milk, Poultry, Fish, Eggs, Pulses etc

- ❖ **Energy giving foods:**

Cereals, Sugars, Fats, Oils etc.

- ❖ **Protective foods:**

Vegetables, Fruits, Milk, etc

NUTRIENTS

- ❖ Organic and inorganic complexes contained in food are called nutrients. They are broadly divided in to:
- ❖ **Macronutrients:**
 - proteins
 - fats
 - carbohydrates
- ❖ **Micronutrients:**
 - vitamins
 - minerals

PROTEINS

- ❖ Proteins are complex organic nitrogenous compounds
- ❖ They also contain sulfur and in some cases phosphorous and iron
- ❖ Proteins are made of monomers called amino acids
- ❖ There are about 20 different amino acids which are found in human body
- ❖ Of this 8 aa are termed “essential” as they are not synthesized in human body and must be obtained from dietary proteins

FUNCTIONS OF PROTEINS

- ❖ **Body building**
- ❖ **Repair and maintenance of body tissues**
- ❖ **Maintenance of osmotic pressure**
- ❖ **Synthesis of bioactive substances and other vital molecules**

EVALUATION OF PROTEINS

The parameters used for net protein evaluation are:

- ❖ **Biological value**
- ❖ **Digestibility coefficient**
- ❖ **Protein efficiency ratio**
- ❖ **Net protein utilization (NPU)**

ASSESSMENT OF PROTEIN NUTRITION STATUS

- ❖ Protein nutrition status is measured by Serum Albumin Concentration.
- ❖ It should be more than 3.5 g/dl.
- ❖ Less than 3.5 g/dl shows mild malnutrition.
- ❖ Less than 3.0 g/dl shows severe malnutrition.

FAT

- ❖ Most of the body fat (99 per cent) in the adipose tissue is in the form of triglycerides, in normal human subjects, adipose tissue constitutes between 10 and 15 per cent of body weight. One kilogram of adipose tissue corresponds to 7700 kcal of energy.

FATS YIELD FATTY ACIDS AND GLYCEROL ON HYDROLYSIS

❖ Fatty acid content of different fats (in per cent)

	Saturated	Monounsaturated	Polyunsaturated
Fats	fatty acids	fatty acids	fatty acids
❖ Coconut oil	92	6	2
❖ Palm oil	46	44	10
❖ Cotton seed oil	25	25	50
❖ Groundnut oil	19	50	31
❖ Safflower oil	10	15	75
❖ Sunflower oil	8	27	65
❖ Corn oil	8	27	65
❖ Soya bean oil	14	24	62
❖ Butter	60	37	3

ESSENTIAL FATTY ACIDS ARE THOSE THAT CANNOT BE SYNTHESIZED BY HUMANS

- ❖ *Dietary sources of EFA*
- ❖ *Linoleic acid*
- ❖ Sunflower oil Corn oil Soya bean oil Sesame oil
Groundnut oil Mustard oil Palm oil Coconut oil
- ❖ *Arachidonic acid*
- ❖ Meat, eggs, milk
- ❖ *Linolenic acid*
- ❖ Soya bean oil, Leafy greens

FUNCTIONS OF FATS

- They are high energy foods, providing as much as 9 kcal for every gram
- Fats serve as vehicles for fat-soluble vitamins
- Fats in the body support viscera such as heart, kidney and intestine; and fat beneath the skin provides insulation against cold

THE “NON-CALORIE” ROLES OF FAT

- ❖ vegetable fats are rich sources of essential fatty acids which are needed by the body for growth, structural integrity of the cell membrane and decreased platelet adhesiveness.
- ❖ Diets rich in EFA have been reported to reduce serum cholesterol and low-density lipoproteins.
- ❖ Polyunsaturated fatty acids are precursors of prostaglandins.

CARBOHYDRATE

- Carbohydrate is the main source of energy, providing 4 Kcals per one gram Carbohydrate is also essential for the oxidation of fats and for the synthesis of certain non-essential amino acids

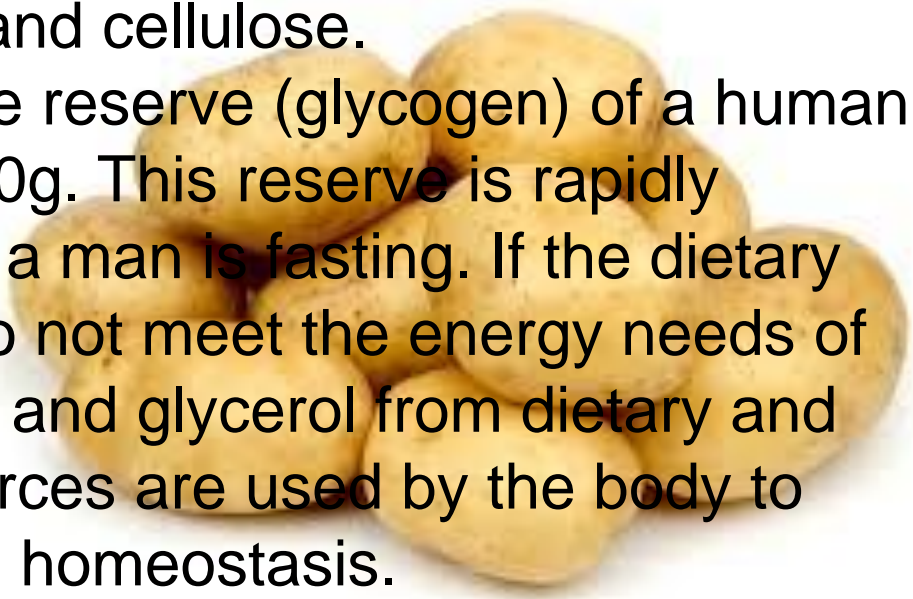


SOURCES OF CARBOHYDRATES



There are three main sources of carbohydrate, viz. starches, sugar and cellulose.

The carbohydrate reserve (glycogen) of a human adult is about 500g. This reserve is rapidly exhausted when a man is fasting. If the dietary carbohydrates do not meet the energy needs of the body, protein and glycerol from dietary and endogenous sources are used by the body to maintain glucose homeostasis.



DIETARY FIBER

- ❖ Dietary fiber which is mainly non-starch polysaccharide is a physiologically important component of the diet. It is found in vegetables, fruits and grains. It may be divided broadly into cellulose and non-cellulose polysaccharides which include hemicellulose, pectin, storage polysaccharides like inulin, and the plant gums and mucilage. These are all degraded to a greater or lesser extent by the microflora in the human colon.



VITAMINS

Vitamins are a class of organic compounds categorized as essential nutrients. They are required by the body in a very small amounts. They fall in the category of micronutrients.

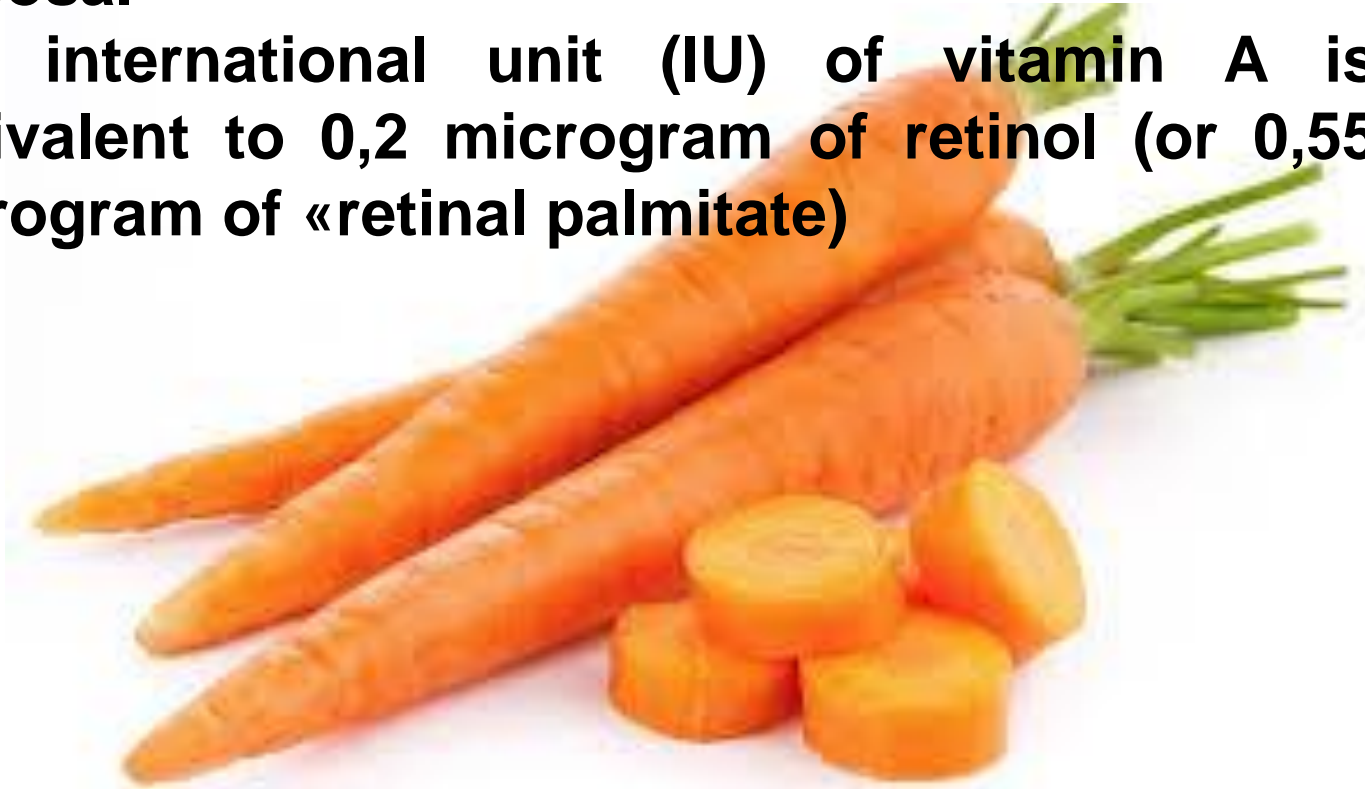
Vitamins are divided in to two groups: fat soluble vitamins- A, D, E and K and water soluble vitamins: vitamins of the B-group and vitamin C.



VITAMIN A

Vitamin A» covers both a pre-formed vitamin, retinol, and a pro-vitamin, beta carotene, some of which is converted to retinol in the intestinal mucosa.

The international unit (IU) of vitamin A is equivalent to 0,2 microgram of retinol (or 0,55 microgram of «retinal palmitate)



Vitamin overview



FUNCTIONS OF VITAMIN A

- ❖ It is indispensable for normal vision.
- ❖ It contributes to the production of retinal pigments which are needed for vision.
- ❖ It is necessary for maintaining the integrity and the normal functioning of glandular and epithelial tissue which lines intestinal, respiratory and urinary tracts as well as the skin and eyes.
- ❖ It supports growth, especially skeletal growth.
- ❖ It is anti-inflammatory.
- ❖ It may protect against some epithelial cancers such as bronchial cancers.

DEFICIENCY OF VITAMIN A

The signs of vitamin A deficiency are predominantly ocular. They are:

- ❖ Nightblindness
- ❖ Conjunctival xerosis
- ❖ Bitot's spots
- ❖ Corneal xerosis
- ❖ Keratomalacia

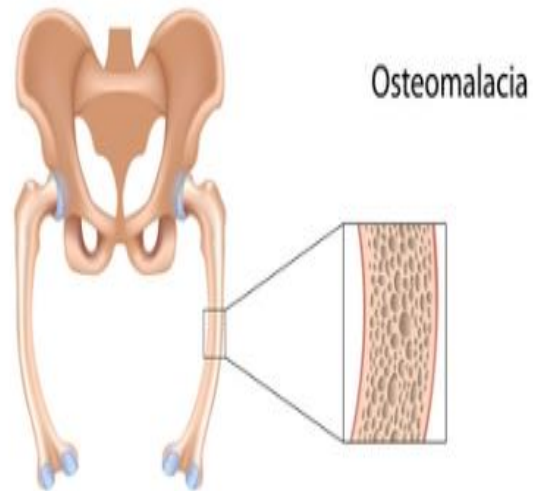
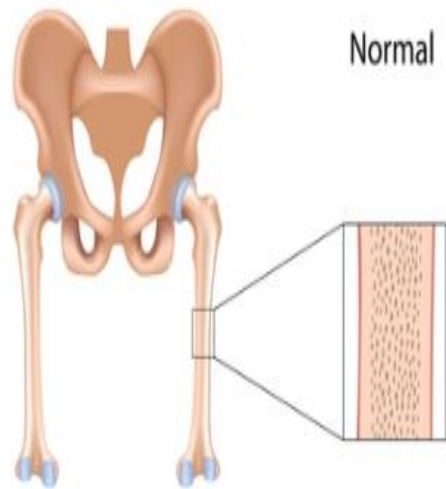
VITAMIN D

- ❖ The nutritionally important forms of Vitamin D in man are Calciferol (Vitamin D₂) and Cholecalciferol (Vitamin D₃).

FUNCTIONS OF VITAMIN D AND ITS METABOLITES

- ❖ **Intestine: Promotes intestinal absorption of calcium and phosphorus**
- ❖ **Bone: Stimulates normal mineralization, Enhances bone reabsorption, Affects collagen maturation**
- ❖ **Kidney: Increases tubular reabsorption of phosphate**

DEFICIENCY OF VITAMIN D



Rickets

Normal

Rickets



Deficiency of vitamin D leads to:

Rickets

Osteomalacia

THIAMINE

- ❖ Thiamine (vitamin B1) is a water soluble vitamin. It is essential for the utilization of carbohydrates. Thiamine pyrophosphate (TPP), the coenzyme of cocarboxylase plays a part in activating transketolase, an enzyme involved in the direct oxidative pathway for glucose.



DEFICIENCY OF THIAMINE

- ❖ The two principal deficiency diseases are beriberi and Wernick's encephalopathy.
- ❖ Beriberi may occur in three main forms:
 - ❖ peripheral neuritis,
 - ❖ cardiac beriberi
 - ❖ infantile beriberi, seen in infants between 2 and 4 months of life. The affected baby is usually breast-fed by a thiamine-deficient mother who commonly shows signs of peripheral neuropathy.
- ❖ Wernick's encephalopathy is characterized by ophthalmoplegia, polyneuritis, ataxia and mental deterioration

VITAMIN B6

- ❖ Pyridoxine (vitamin B6) exists in three forms pyridoxine, piridoxal and pyridoxamine. It plays an important role in the metabolism of amino acids, fats and carbohydrate.
- ❖ The requirement of adults vary directly with protein intake. Adults may need 2 mg/day, during pregnancy and lactation, 2.5 mg/day. Balanced diets usually contain pyridoxine, therefore deficiency is rare.



VITAMIN B12

Vitamin B12 is a complex organo-metallic compound with a cobalt atom. The preparation which is therapeutically used is cyanocobalamin.

Vitamin B 12 cooperates with foliate in the synthesis of DNA.

Vitamin B 12 has a separate biochemical role, unrelated to folate, in synthesis of fatty acids in myelin



VITAMIN B12 DEFICIENCY

- ❖ Vitamin B₁₂ deficiency is associated with megaloblastic anemia (pernicious anemia), demyelinating neurological lesions in the spinal cord and infertility (in animal species). Dietary deficiency of B₁₂ may arise the subjects who are strict vegetarians and eat no animal product. At the present time there is little evidence that vitamin B₁₂ deficiency anemia represents an important public health problem.

VITAMIN C

Vitamin C (ascorbic acid) is a water-soluble vitamin. It is the most sensitive of all vitamins to heat. Man, monkey and guinea pig are perhaps the only species known to require vitamin C in their diet

Vitamin C has an important role to play in tissue oxidation it is needed for the formation of collagen, which accounts for 25 per cent of total body protein



DEFICIENCY OF VITAMIN C

- ❖ Deficiency of vitamin C results in scurvy, the signs of which are swollen and bleeding gums, subcutaneous bruising or bleeding into the skin or joints, delayed wound healing, anaemia and weakness. Scurvy which was once an important deficiency disease is no longer a disease of world importance.

MALNUTRITION

WHO defines Malnutrition as "the cellular imbalance between the supply of nutrients and energy and the body's demand for them to ensure growth, maintenance, and specific functions." Malnutrition is the condition that develops when the body does not get the right amount of the vitamins, minerals, and other nutrients it needs to maintain healthy tissues and organ function.

PROTEIN ENERGY MALNUTRITION

MARASMUS

Represents simple starvation . The body adapts to a chronic state of insufficient caloric intake

KWASHIORKOR

It is the body's response to insufficient protein intake but usually sufficient calories for energy

PROTEIN ENERGY MALNUTRITION

- ❖ PEM is also referred to as **protein-calorie malnutrition**.
- ❖ It is considered as the primary nutritional problem in India.
- ❖ Also called the **1st National Nutritional Disorder**.
- ❖ The term protein-energy malnutrition (PEM) applies to a group of related disorders that include **marasmus, kwashiorkor** or, and intermediate states of **marasmus-kwashiorkor**.
- ❖ PEM is due to “**food gap**” between the intake and requirement.



CAUSE OF PEM

- ❖ Social and Economic Factors
- ❖ Biological factors
- ❖ Environmental factors
- ❖ Role of Free Radicals & Aflatoxin
- ❖ Age of the Host

Amongst the **Social, Economic, Biological and Environmental Factors** the common causes are:

- ❖ Lack of breast feeding and giving diluted formula
- ❖ Improper complementary feeding
- ❖ Over crowding in family
- ❖ Ignorance
- ❖ Illiteracy, Lack of health education, Poverty, Infection & Familial disharmony

KWASHIORKOR

- ❖ The term kwashiorkor is taken from the Ga language of Ghana and means "the sickness of the weaning".
- ❖ Williams first used the term in 1933, and it refers to an inadequate protein intake with reasonable caloric (energy) intake.
- ❖ Kwashiorkor, also called wet protein-energy malnutrition, is a form of PEM characterized primarily by protein deficiency.
- ❖ This condition usually appears at the age of about 12 months when breastfeeding is discontinued, but it can develop at any time during a child's formative years.
- ❖ It causes fluid retention (edema); dry, peeling skin; and hair discoloration.

- ❖ **Kwashiorkor was thought to be caused by insufficient protein consumption but with sufficient calorie intake, distinguishing it from marasmus.**
- ❖ **More recently, micronutrient and antioxidant deficiencies have come to be recognized as contributory.**
- ❖ **Victims of kwashiorkor fail to produce antibodies following vaccination against diseases, including diphtheria and typhoid.**
- ❖ **Generally, the disease can be treated by adding food energy and protein to the diet; however, it can have a long-term impact on a child's physical and mental development, and in severe cases may lead to death.**

SYMPTOMS

- ❖ **Changes in skin pigment.**
- ❖ **Decreased muscle mass**
- ❖ **Diarrhoea**
- ❖ **Failure to gain weight and grow**
- ❖ **Fatigue**
- ❖ **Hair changes (change in colour or texture)**
- ❖ **Increased and more severe infections due to damaged immune system**
- ❖ **Irritability**
- ❖ **Large belly that sticks out (protrudes)**
- ❖ **Lethargy or apathy**
- ❖ **Loss of muscle mass**
- ❖ **Rash (dermatitis)**
- ❖ **Shock (late stage)**
- ❖ **Swelling (edema)**



MARASMUS

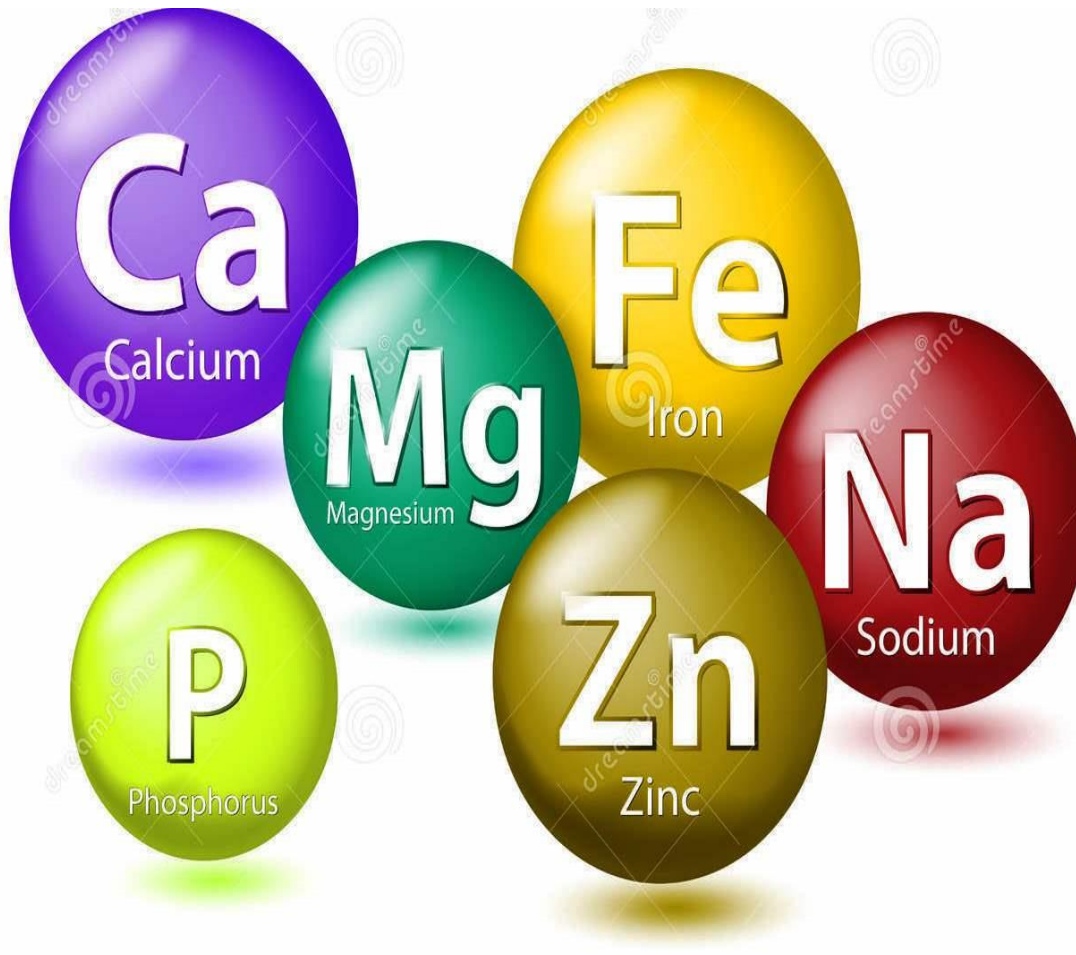
- ❖ The term marasmus is derived from the Greek
- ❖ word *marasmus*, which means withering or wasting.
- ❖ Marasmus is a form of severe protein-energy malnutrition characterized by energy deficiency and emaciation. Primarily caused by energy deficiency, marasmus is characterized by stunted growth and wasting of muscle and tissue.
- ❖ Marasmus usually develops between the ages of six months and one year in children who have been weaned from breast milk or who suffer from weakening conditions like chronic diarrhoea.

SYMPTOMS

- ❖ Severe growth retardation
- ❖ Loss of subcutaneous fat
- ❖ Severe muscle wasting
- ❖ The child looks appallingly thin and
- ❖ limbs appear as skin and bone
- ❖ Shriveled body
- ❖ Wrinkled skin
- ❖ Bony prominence
- ❖ Associated vitamin deficiencies
- ❖ Failure to thrive
- ❖ Irritability, fretfulness and apathy
- ❖ Frequent watery diarrhoea and acid stools
- ❖ Mostly hungry but some are anorectic
- ❖ Dehydration
- ❖ Temperature is subnormal
- ❖ Muscles are weak
- ❖ Oedema and fatty infiltration are absent



MINERALS

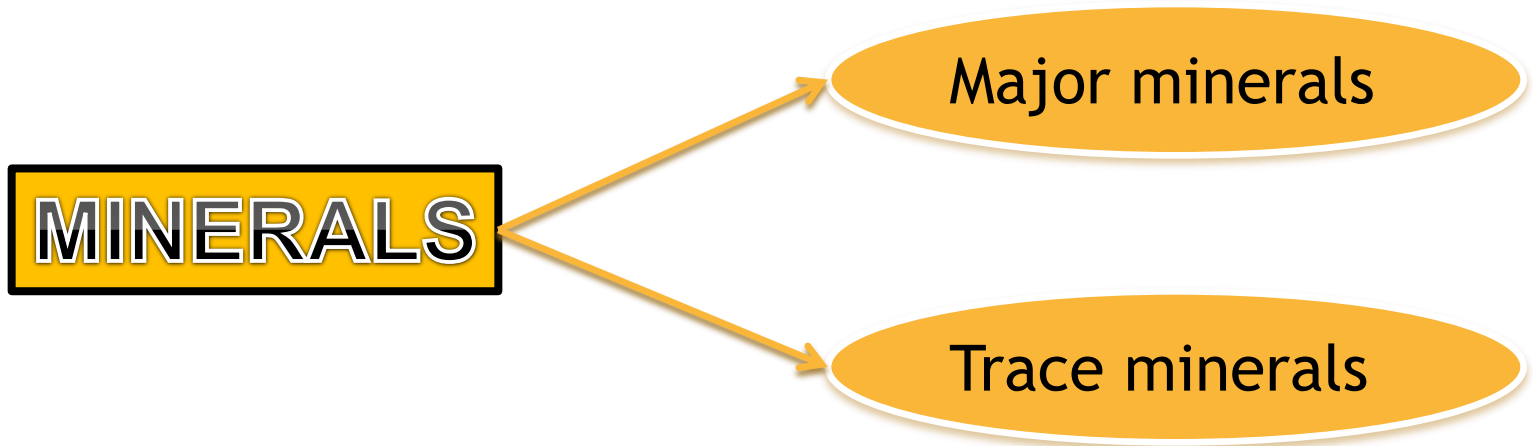


MINERALS

Inorganic element needed by the body for the following functions:

- ❖ **Build tissues**
- ❖ **Regulate body fluids**
- ❖ **Assist in body functions**
- ❖ **Help to form body structures**

Remains as ash when food is burned



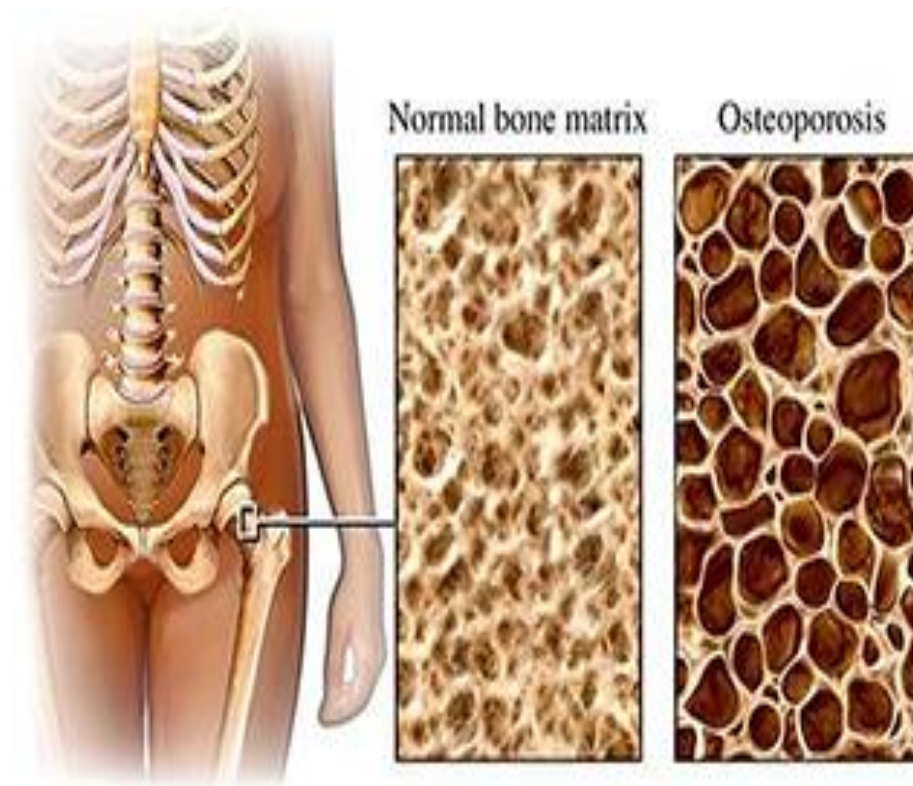
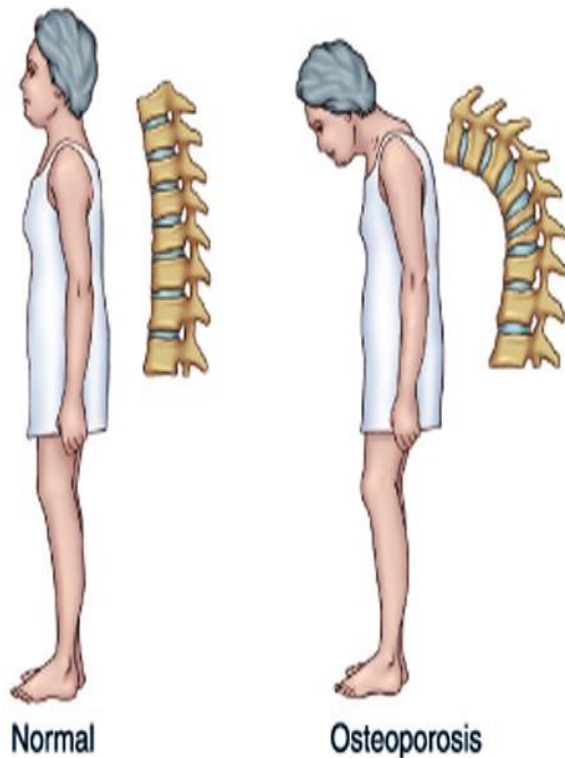
- **Major minerals**
 - required in amounts greater than 100mg a day
 - sometimes called as “macrominerals”
- **Trace minerals**
 - required in the diet in amounts lesser than 100mg a day
 - sometimes called as “microminerals”

**Mineral salts dissolve in water -> break into separate ions -
> electrolytes**

Major minerals

NAME FOOD	SOURCES	FUNCTIONS	DEFICIENCY/ TOXICITY
Calcium Ca ²⁺)	Milk, cheese, sardines, salmon, some dark green leafy vegetables	Development of bones and teeth Transmission of nerve impulses Blood clotting Normal heart action Normal muscle Activity	Osteoporosis Osteomalacia Rickets Tetany Retarded growth Poor tooth and bone formation

- Osteoporosis** - means “porous bones”
characterized by low bone density or mass
- (reduced amount of bone tissue) and fragile bones



- ❖ **Rickets** - softening of bones in children potentially leading to fractures and deformity
- ❖ **Osteomalacia** - bones lose calcium and become softer and may deform



Tetany - involuntary contraction of muscles

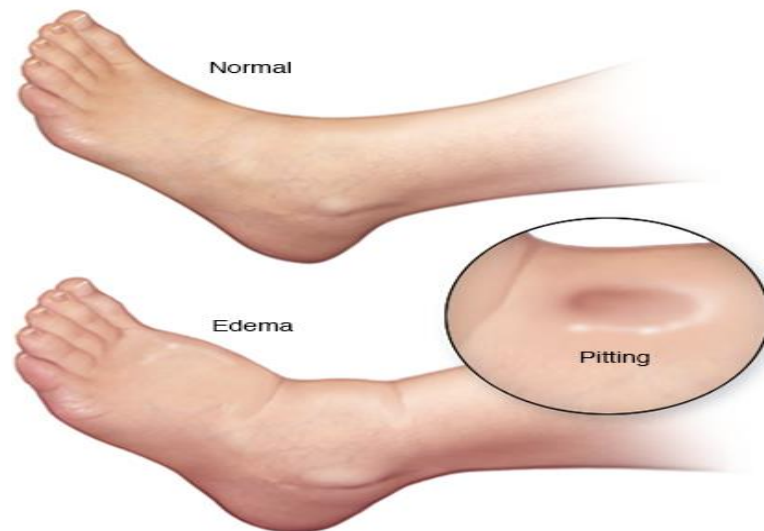


NAME	FOOD SOURCES	FUNCTIONS	DEFICIENCY/ TOXICITY
Phosphorus (P)	Milk, cheese, lean meat, poultry, fish, whole-grain cereals, legumes, nuts	Development of bones and teeth Maintains normal pH of the blood Constituent of all body cells CHO, CHON and fat metabolism	Poor tooth and bone formation Weakness Anorexia General malaise

NAME	FOOD SOURCES	FUNCTIONS	DEFICIENCY/ TOXICITY
Potassium (K ⁺)	Oranges, bananas, dried fruits, vegetables, legumes, milk, cereals, meat	Contraction of muscles Maintenance of fluid balance Transmission of nerve impulses Regular heart rhythm Cell metabolism	Deficiency: hypokalemia muscle weakness confusion abnormal heartbeat Toxicity: hyperkalemia potentially life-threatening irregular heartbeats

NAME	FOOD SOURCES	FUNCTIONS	DEFICIENCY/ TOXICITY
Sodium (Na ⁺)	Table salt, beef, eggs, poultry, milk, cheese, Soy sauce, moderate amounts in breads and vegetables, large amounts in processed foods	Maintenance of fluid balance Transmission of nerve impulses Acid-base balance Muscle contraction	Deficiency: nausea exhaustion muscle cramps Toxicity: hypertension edema

EDEMA

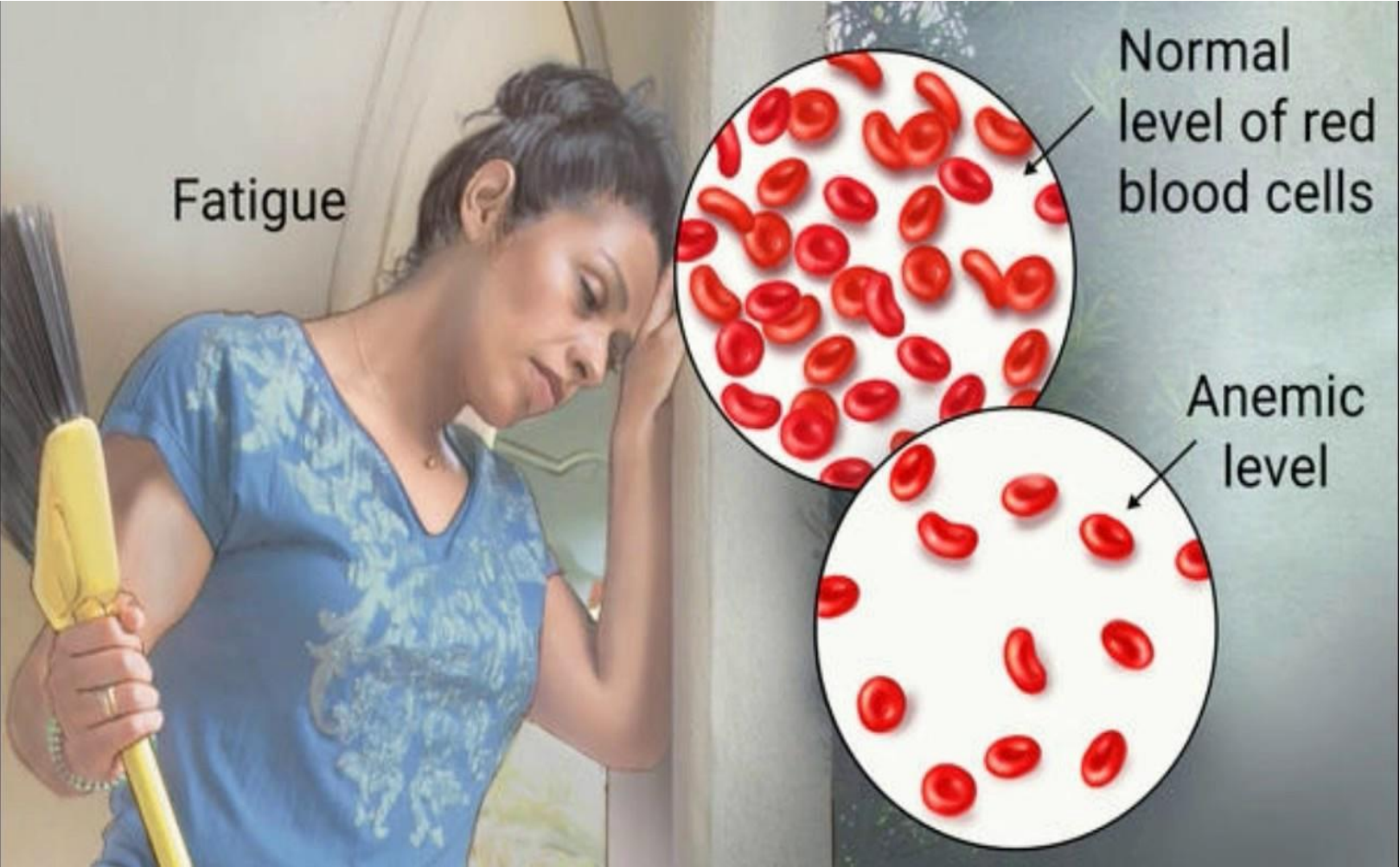


NAME	FOOD SOURCES	FUNCTIONS	DEFICIENCY/ TOXICITY
Magnesium (Mg ²⁺)	Green, leafy vegetables Whole grains, avocados, nuts, milk, legumes, bananas, nuts, seafood, chocolate, cocoa	Nerve transmission Synthesis of ATP Activation of metabolic enzymes Muscle activity Constituent of bones, muscles, and RBCs	Normally unknown Mental, emotional and muscle disorders

TRACE MINERALS

NAME	FOOD SOURCES	FUNCTIONS	DEFICIENCY/ TOXICITY
Iron (Fe ⁺)	Muscle meat Poultry Shellfish Liver Legumes Dried fruits Whole grain or enriches breads and cereals Dark green and leafy vegetables Molasses	Transports oxygen and CO ₂ Hemoglobin formation Component of cellular enzymes essential for energy production	Deficiency: iron deficiency anemia

ANEMIA



NAME	FOOD SOURCES	FUNCTIONS	DEFICIENCY/ TOXICITY
Iodine (I ⁻)	Iodized salt seafood	Regulation of basal metabolic rate	Goiter Cretinism Myxedema



Cretinism



Myxedema



Goiter

NAME	FOOD SOURCES	FUNCTIONS	DEFICIENCY/ TOXICITY
Zinc (Zn ⁺)	Seafood, esp. oysters	Formation of collagen	Dwarfism
	Liver		Anemia
	Eggs		Loss of appetite
	Milk	Wound healing	Skin changes
	Wheat bran	Taste acuity	Impaired wound healing
legumes	Essential for growth	Decreased taste acuity	
		Immune reactions	

Dwarfism



SKIN LESION



NAME	FOOD SOURCES	FUNCTIONS	DEFICIENCY/ TOXICITY
Fluoride (F ⁻)	Fluoridated water Seafood	Increases resistance to tooth decay Component of bones and teeth	Deficiency: Tooth decay Possibly osteoporosis Toxicity: Fluorosis - discoloration of teeth or mottling



**Thanking
you**