D.PHARM • SECOND YEAR

Biochemistry & Clinical Pathology

CHAPTER 9

Minerals



ENGLISH CHAPTER NOTES

DIPLOMA IN PHARMACY

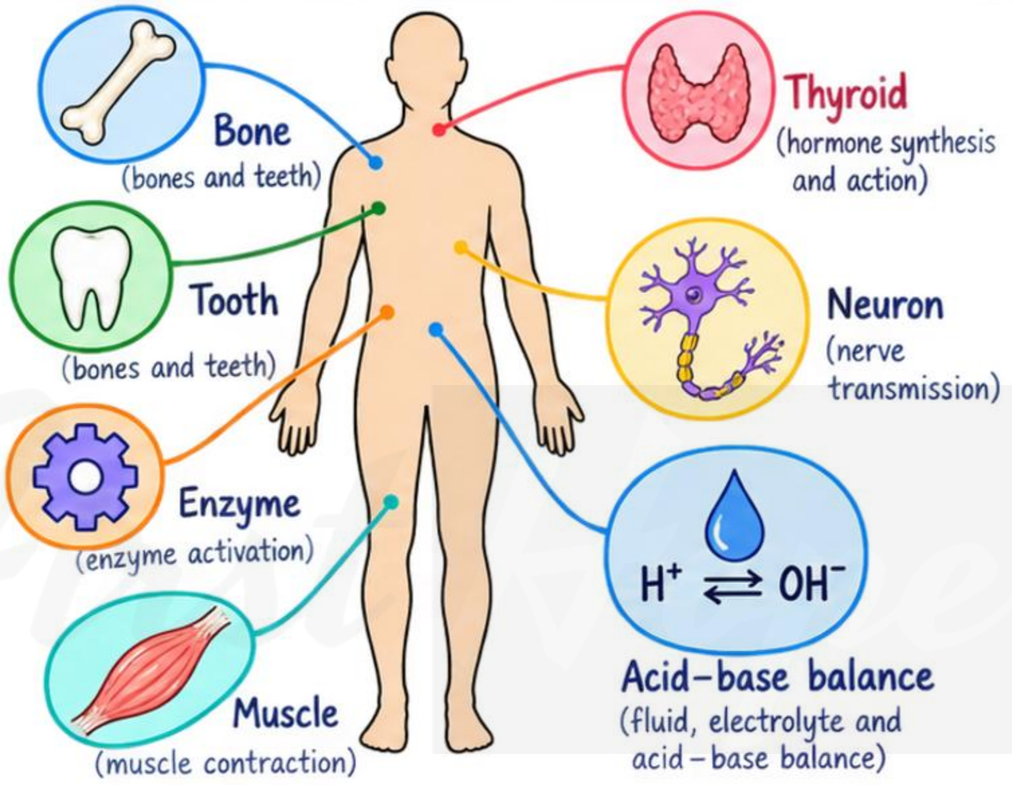
MINERALS: DEFINITION & CLASSIFICATION

DEFINITION

Minerals are inorganic elements required for normal physiological and biochemical functions. The body cannot manufacture them, so they must be obtained from food, water or suitable supplements.

WHY MINERALS ARE NEEDED

- bones and teeth
- enzyme activation
- hormone synthesis and action
- nerve transmission and muscle contraction
- fluid, electrolyte and acid–base balance
- oxygen transport and cellular respiration



PHARMACY LINK

Minerals are used in oral supplements, antacids, oral rehydration salts and intravenous fluids. Both deficiency and excess may be harmful.

REMEMBER

Classification is based on the amount required—not on biological importance.

CLASSIFICATION BY DAILY REQUIREMENT

MACROMINERALS / MAJOR MINERALS

Needed in amounts greater than 100 mg/day.

Calcium · phosphorus · potassium · sodium · chloride · magnesium · sulfur

MICROMINERALS / TRACE ELEMENTS

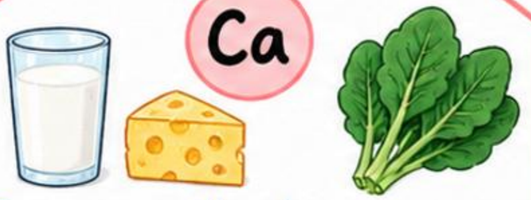
Needed in amounts less than 100 mg/day.

Iron · zinc · iodine · copper · selenium · fluoride · chromium · manganese · molybdenum · cobalt

MACROMINERALS: SOURCES & FUNCTIONS

CALCIUM

Ca



Sources: milk, cheese, leafy greens.

Bones and teeth; muscle contraction; blood clotting; neurotransmitter release.

PHOSPHORUS

P



Sources: meat, dairy, legumes.

Bones; ATP, DNA, RNA and phospholipids; acid-base buffering.

MAGNESIUM

Mg



Sources: nuts, whole grains, legumes.

Cofactor in hundreds of enzyme reactions; ATP use; nerve and muscle function.

SODIUM

Na



Sources: table salt and processed foods.

Major extracellular cation; fluid balance, nerve impulses and acid-base balance.

POTASSIUM

K



Sources: bananas, potatoes, spinach.

Major intracellular cation; muscle function, nerve impulses and cardiac rhythm.

CHLORIDE

Cl



Sources: salt, tomatoes and olives.

Major extracellular anion; fluid and acid-base balance; formation of gastric HCl.

SULFUR

S



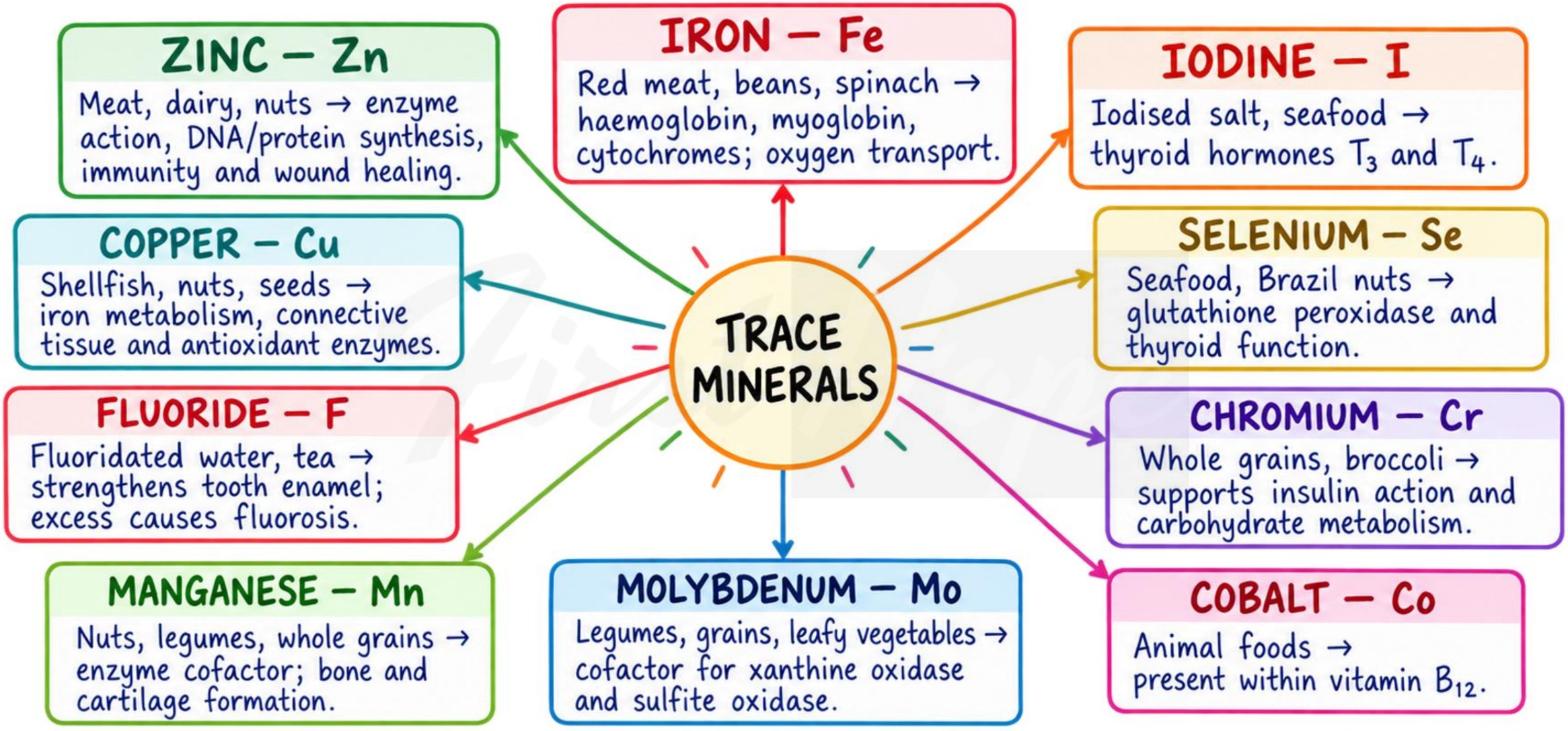
Sources: protein-containing foods.

Present in methionine, cysteine, thiamine and biotin; forms disulfide bonds in proteins.

KEY IDEA

Macromineral means a larger daily requirement, not a larger molecule.

TRACE MINERALS: SOURCES & FUNCTIONS



REMEMBER | Trace requirement is small, but deficiency or toxicity can have major effects.

CALCIUM, PHOSPHORUS & MAGNESIUM

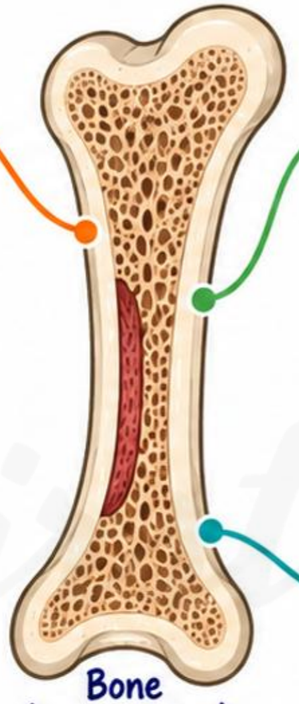
CALCIUM – Ca^{2+}

- Main roles: mineral of bones and teeth; blood clotting; muscle contraction; neurotransmitter release and enzyme regulation.
- Homeostasis: mainly controlled by parathyroid hormone, calcitriol and calcitonin.
- Deficiency: tetany; poor bone mineralisation; osteomalacia or osteoporosis.
- Pharmacy: calcium salts for supplementation, hypocalcaemia and selected antacid preparations.


Blood clotting


Muscle contraction


Neurotransmitter release


Bone (cross-section)

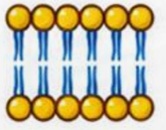
PHOSPHORUS – PHOSPHATE

- Main roles: hydroxyapatite in bone; ATP and energy transfer; DNA/RNA; phospholipids; buffering.
- Deficiency: hypophosphataemia, weakness and bone pain.
- Pharmacy: phosphate binders lower intestinal phosphate absorption in chronic kidney disease.



ATP and energy transfer


DNA/RNA


Phospholipids

MAGNESIUM – Mg^{2+}

- Main roles: cofactor for more than 300 enzymes; stabilises ATP; supports nerve, muscle and cardiac function.
- Deficiency: cramps, tremor, neuromuscular irritability and cardiac arrhythmias.
- Pharmacy: magnesium sulfate is used in eclampsia and magnesium deficiency; some magnesium salts act as laxatives or antacids.


Enzyme cofactor


Muscle function


Cardiac function

CALCIUM HOMEOSTASIS

PTH — raises blood Ca^{2+}

Calcitriol — increases intestinal Ca^{2+} absorption

Calcitonin — helps lower blood Ca^{2+}

NORMAL BALANCE

Kidney, intestine, bone and hormones work together to maintain mineral balance.


Kidney


Intestine


Bone


Hormones

PHARMACY

Calcium salts for supplementation | Phosphate binders in chronic kidney disease | Magnesium sulfate in eclampsia

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