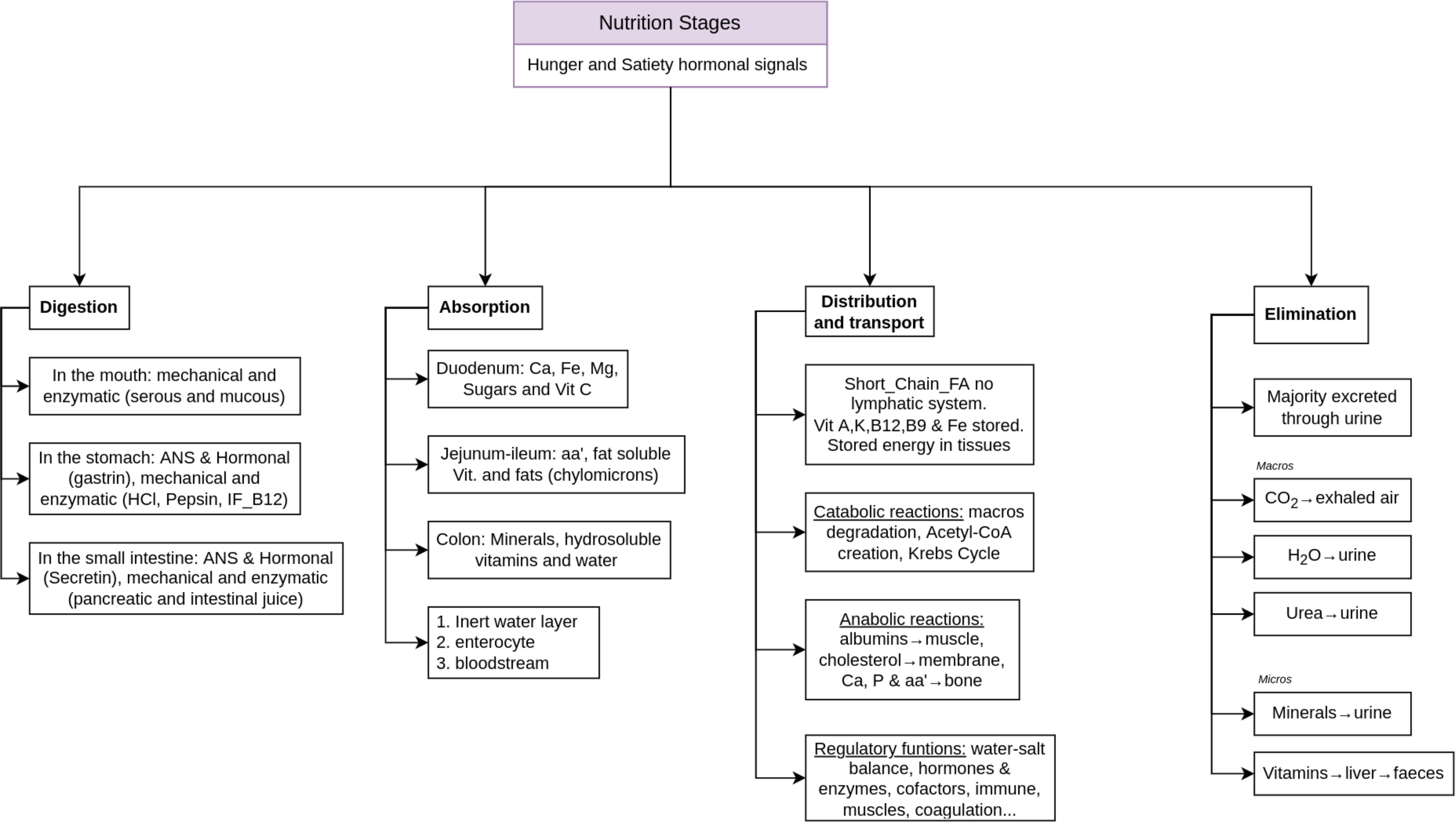
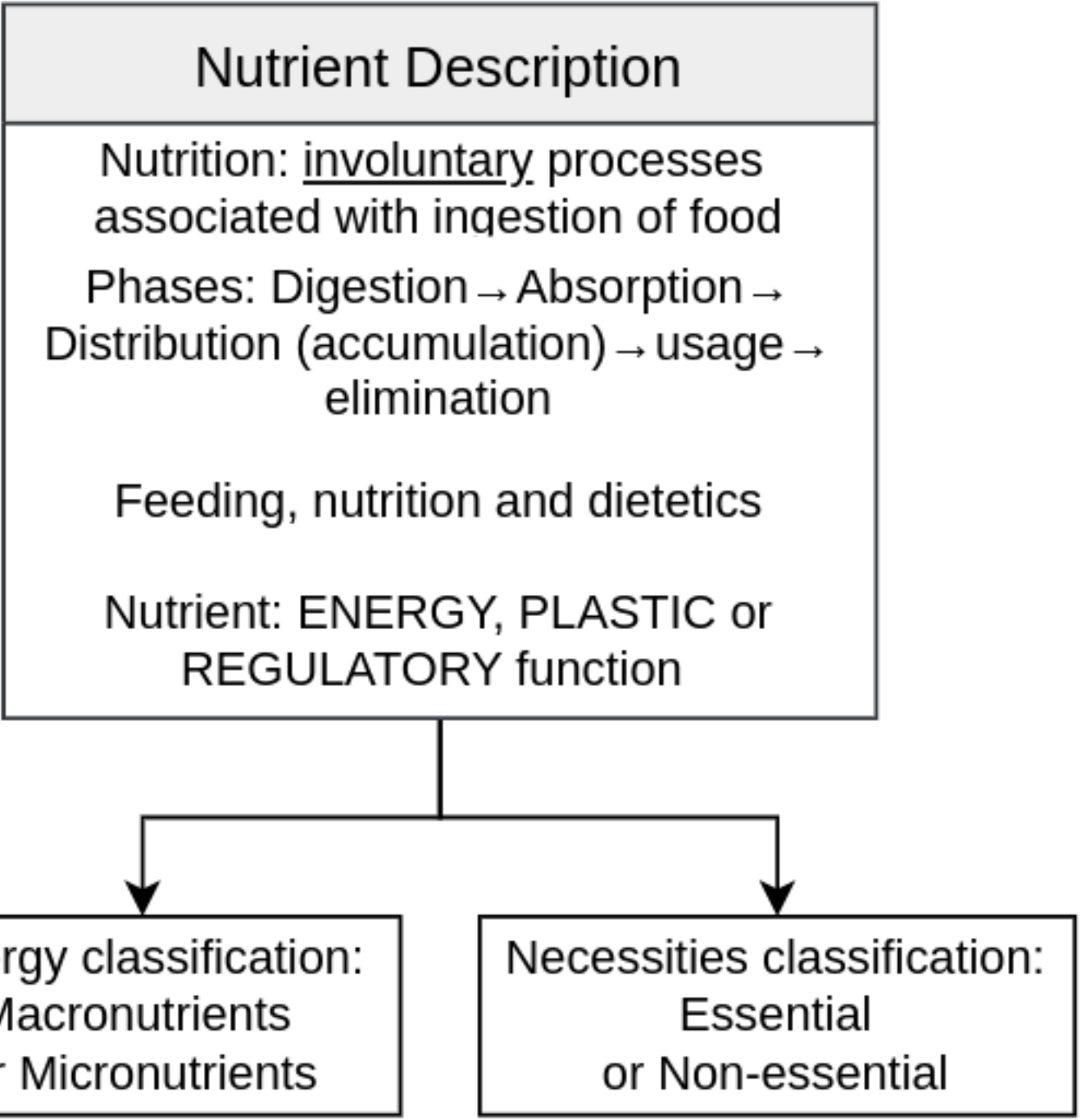
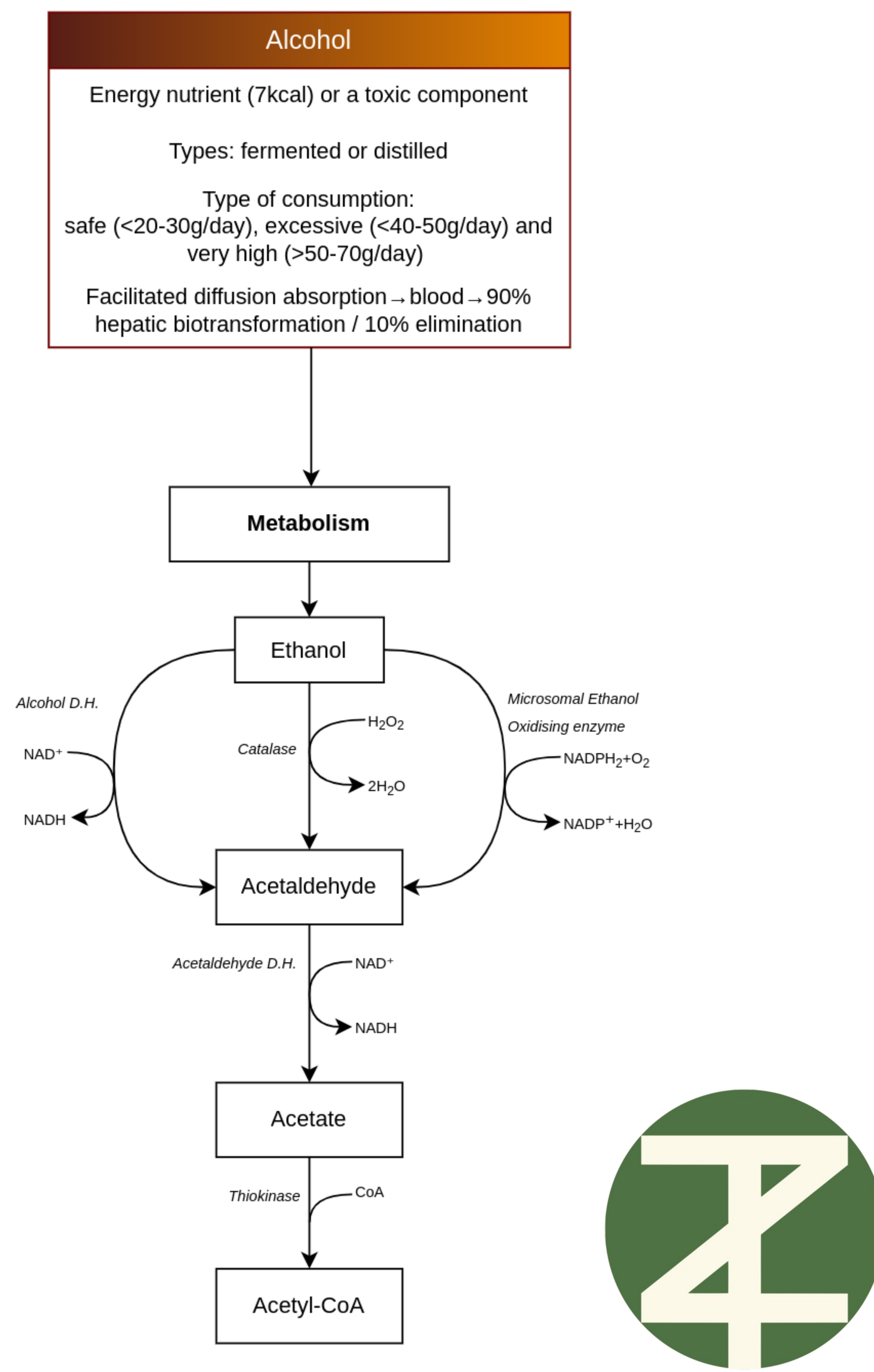
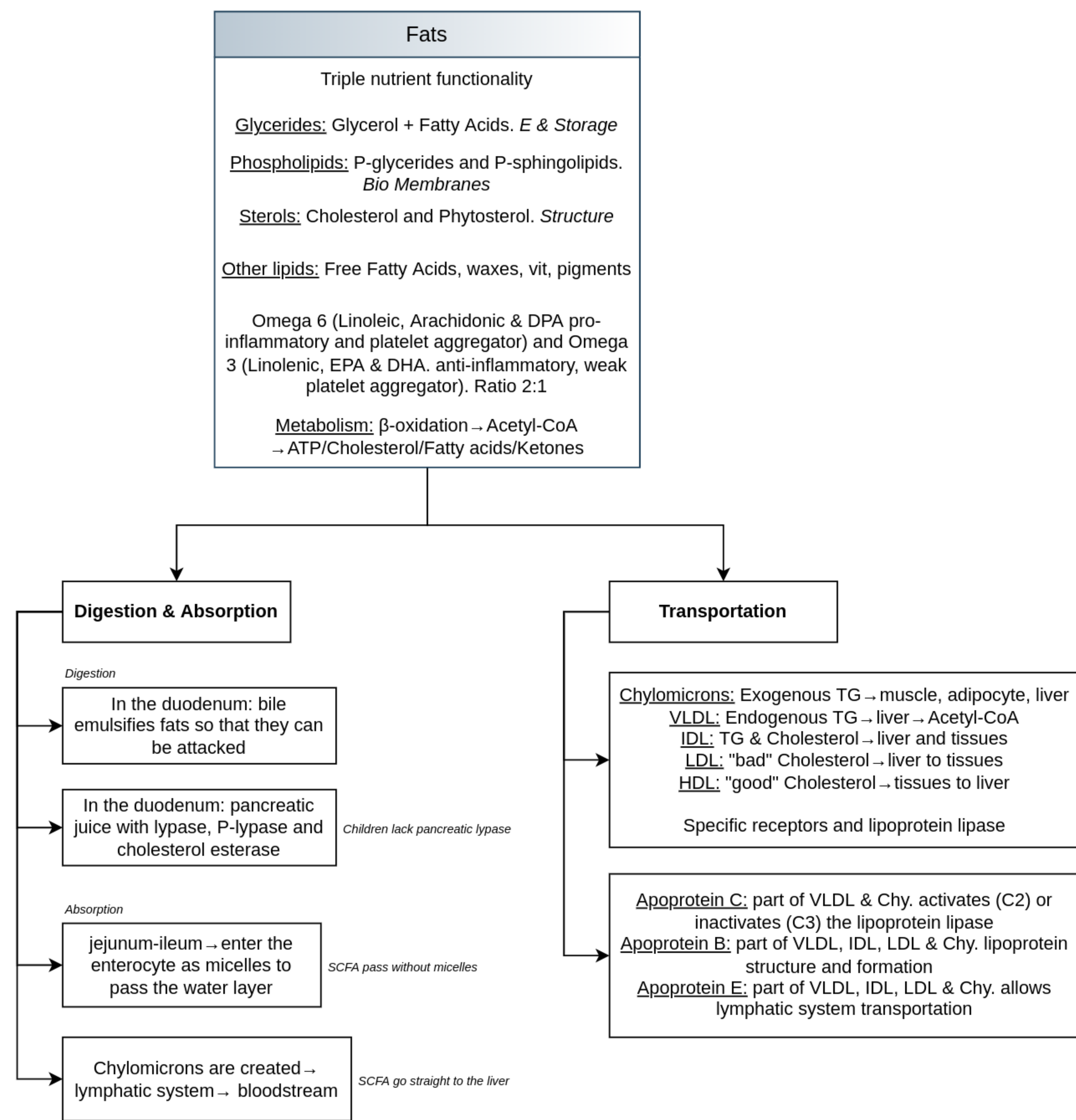
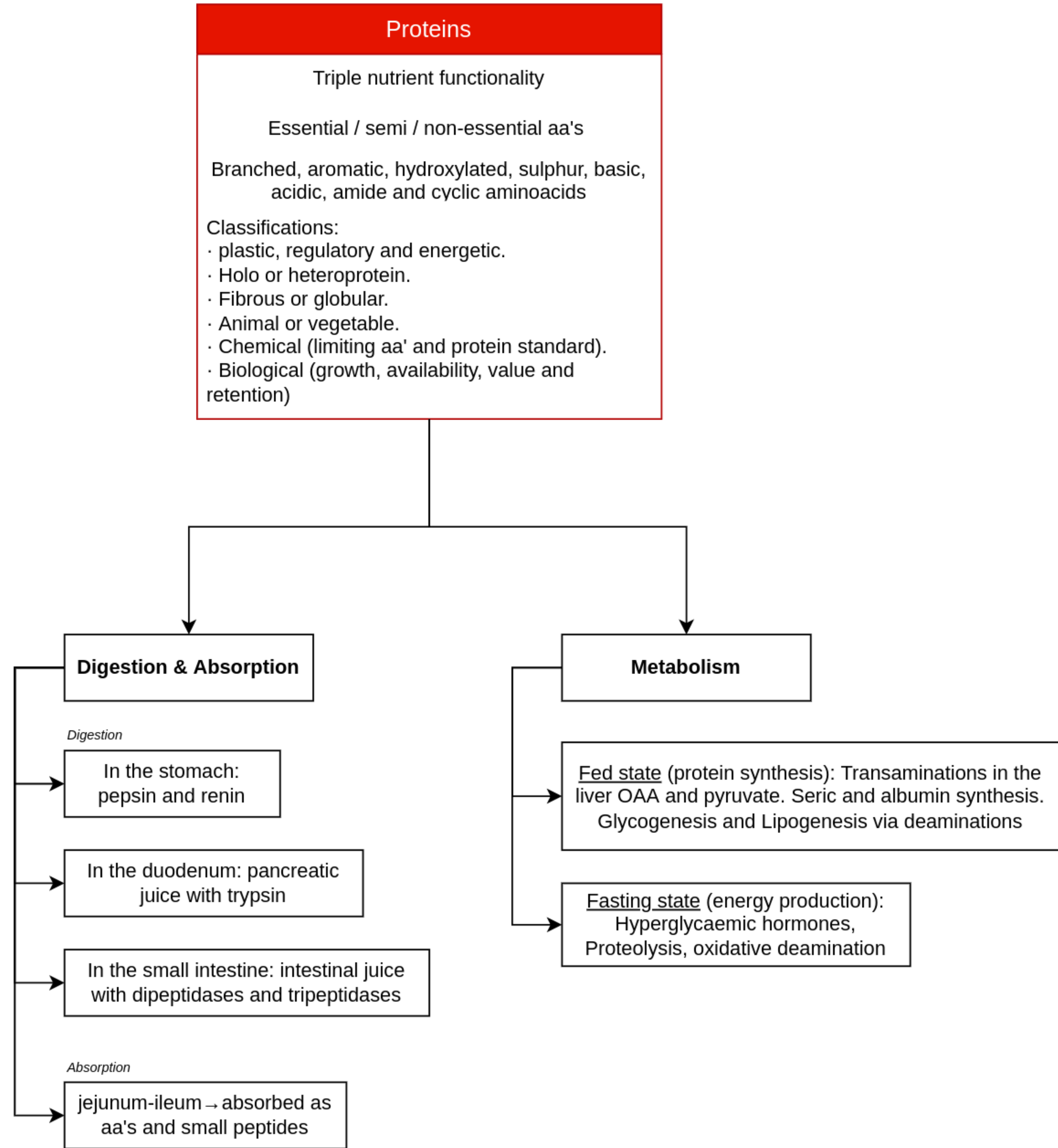
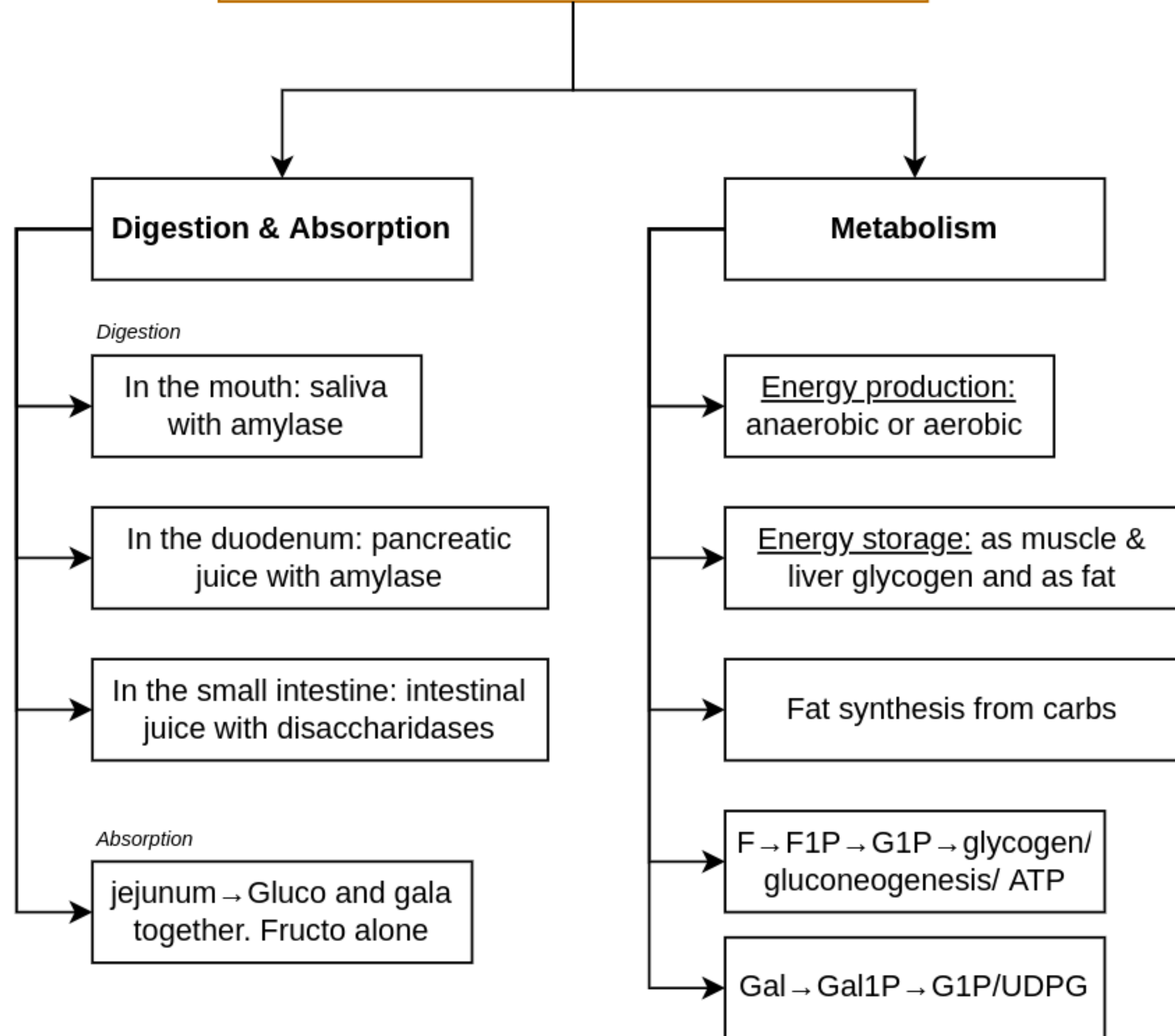
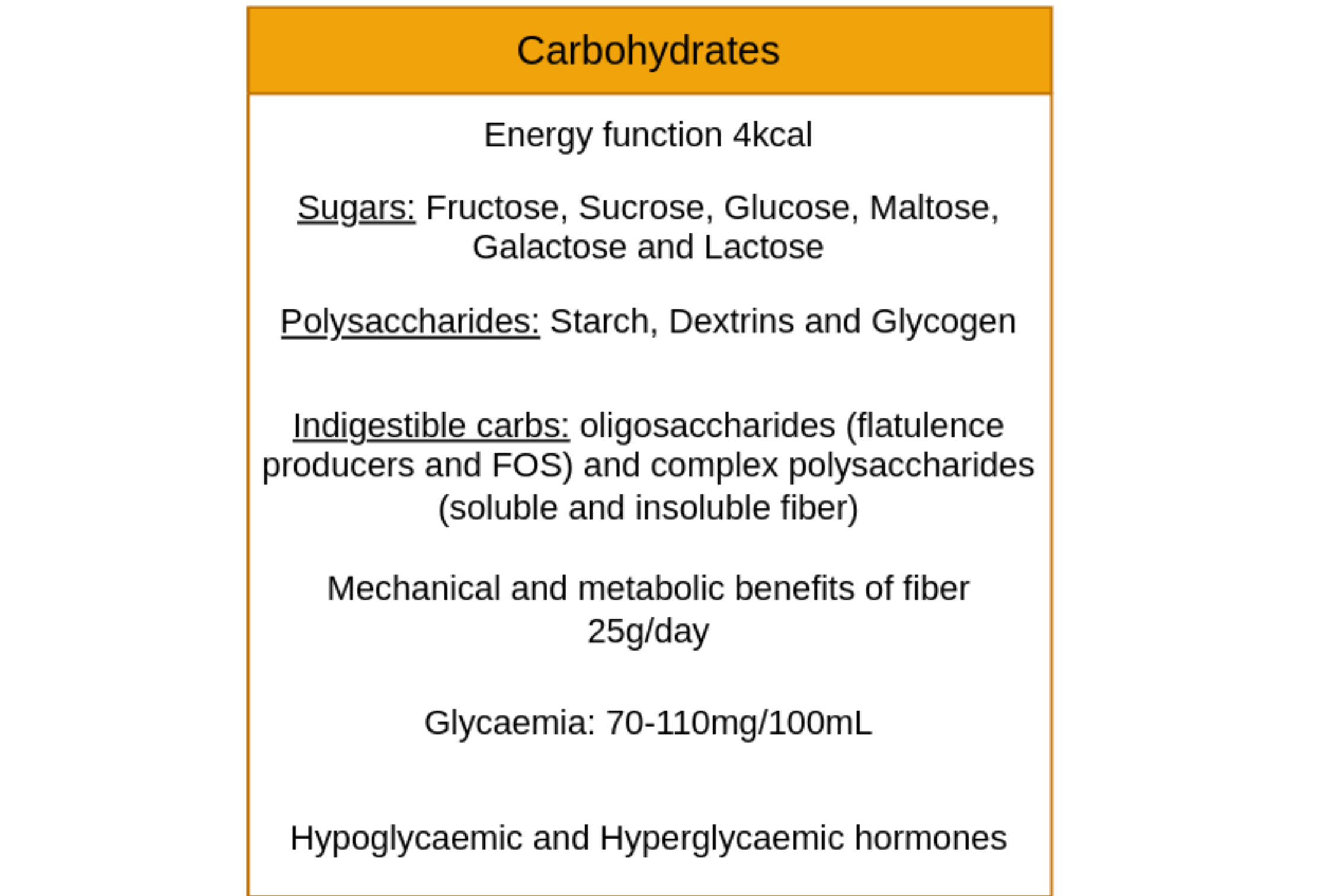
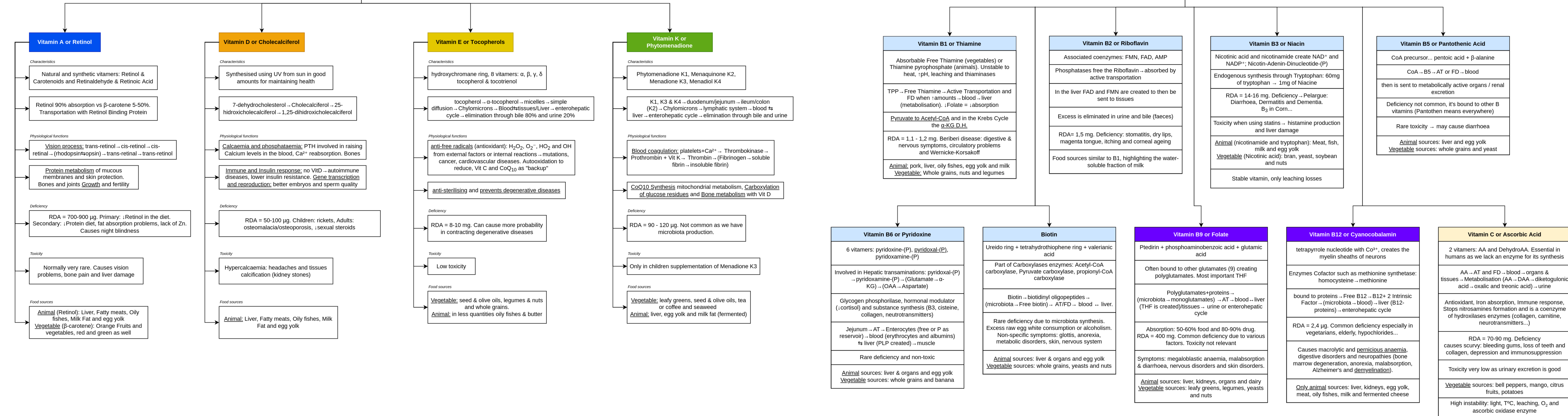
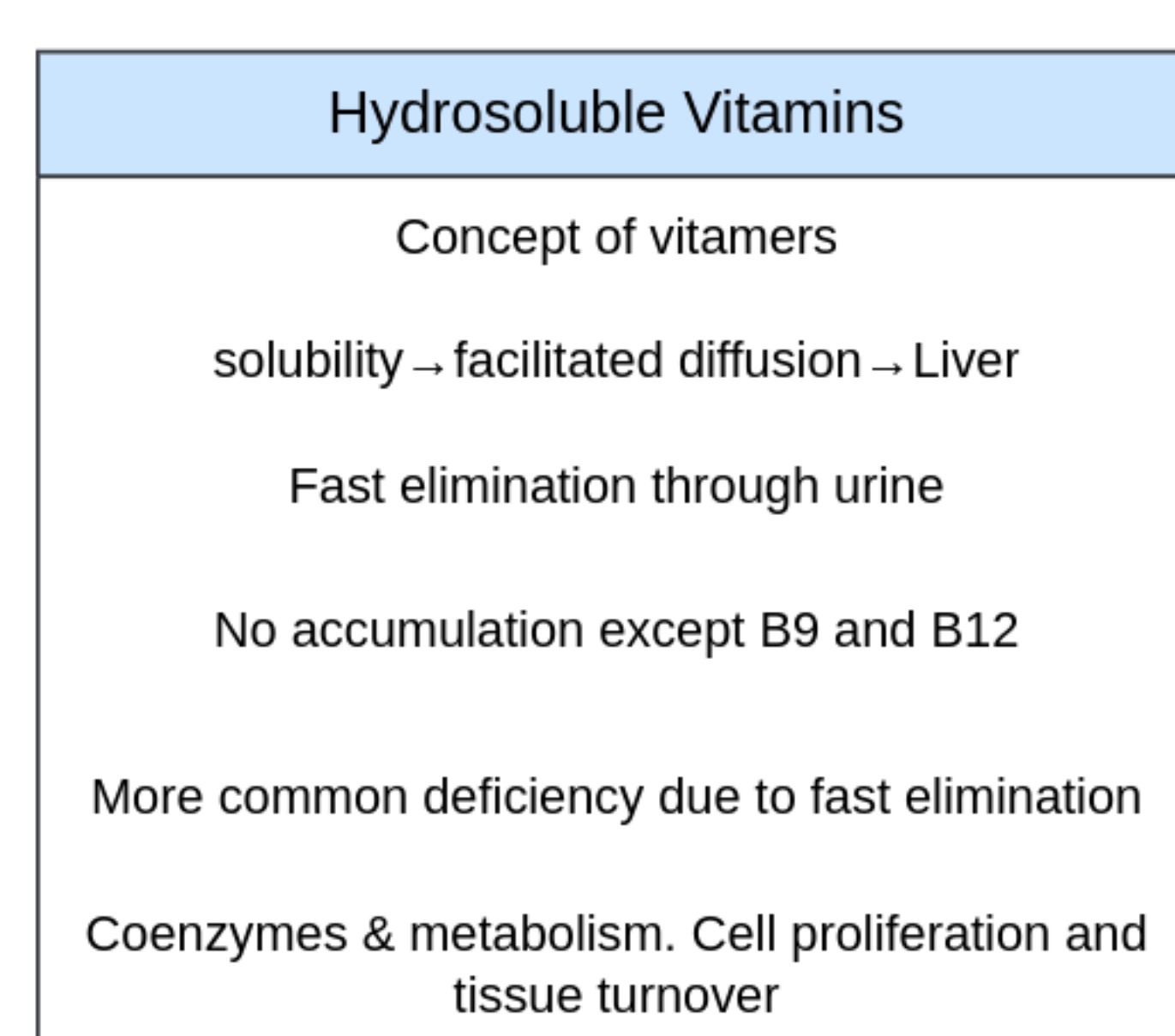
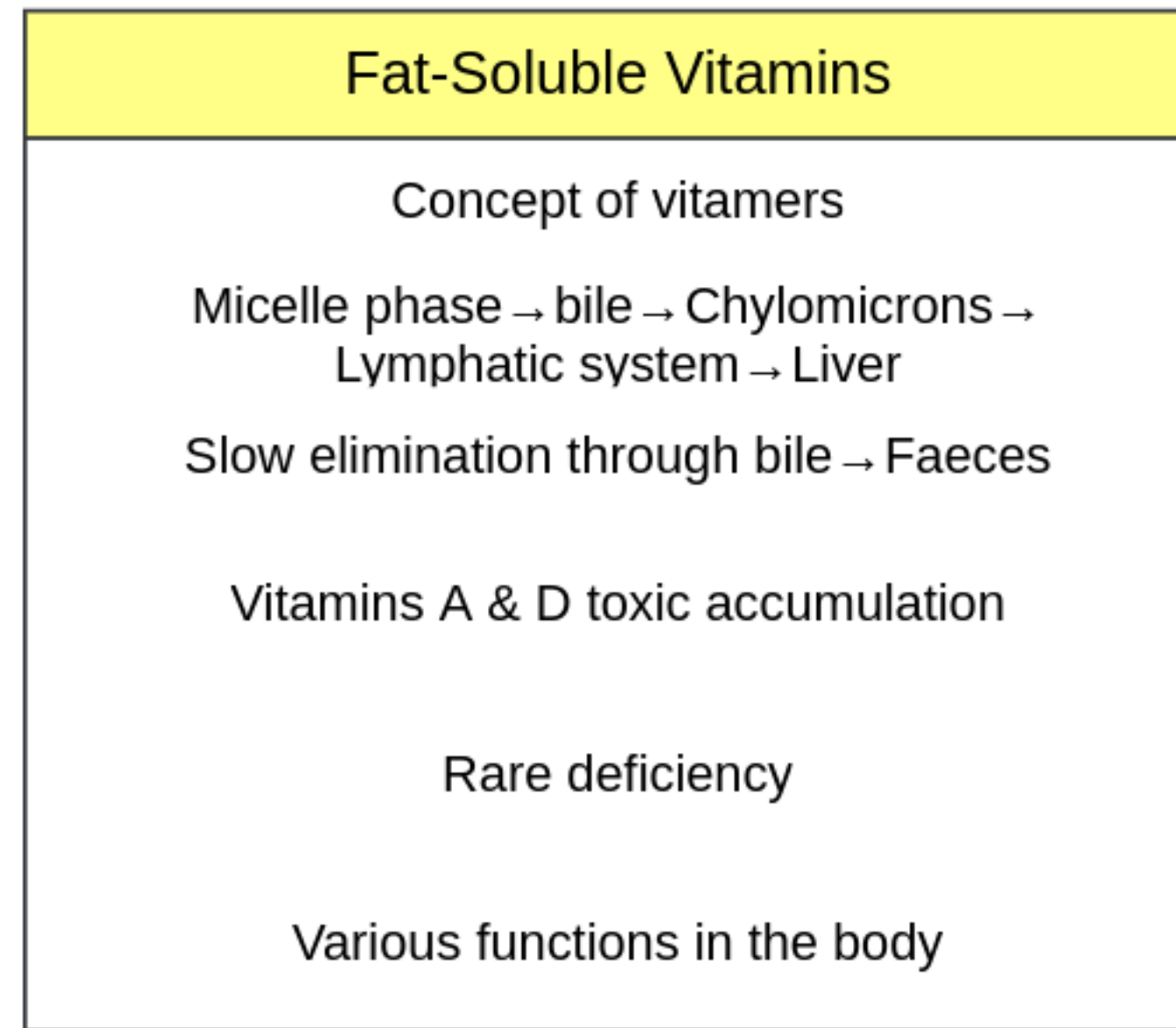










Minerals
Non-energetic micronutrient with plastic and regulatory function
Absorption: intraluminal, translocation and mobility to blood
Elimination: blood (urine) or bile
Macroelements: electrolytes (Na, K, Cl) plastic (Ca, P, Mg)
Microelements: organic (Fe, I), metalloenzymes (Cu, Zn, Se, Mn, Cr)

Water and Electrolytes (Na, K, Cl)
Non-energetic macronutrient with plastic and regulatory function
BW x 35 g/kg/day = mL
Water and beverages, food and oxidative reactions
Negative balance: dehydration Positive balance: Rehydration, possible edemas
Na ⁺ and K ⁺ →Simple diffusion→blood→Na ⁺ to interstitial liquid, k ⁺ to intracellular liquid→urine excretion and non-absorbed through faeces
Natraemia = 140 mM; Potassaemia = 4 mM Vegetables better Na ⁺ /K ⁺ ratio
<u>Renin-Angiotensin-Aldosterone</u> = sodium reabsorption activation, thirst inhibition and vasoconstriction when ↓natraemia
Sodium Na ⁺ : extracellular cation 90%, electrolyte, sodium potassium pump, ↑homeostatic control, ↑sodium may cause arterial hypertension. RDA = 6g of salt a day
<u>Potassium K⁺</u> : intracellular cation, it's an hypotensive, promoting Na ⁺ elimination. Hypokalaemia (diarrhoea, vomits, exercise, Cushing disease) / Hyperkalaemia (necrosis, renal failure, diuretics). 150mg K ⁺ /70kg.

Plastic Elements (Ca, P, Mg, F)
<u>Calcium</u> : 1,2kg in the body, 40% of minerals
Plastic: hard tissues (hydroxyapatite) bones & teeth Regulatory: electrolyte, muscle, coagulation, metabolism. Calcaemia controlled by PTH and Vitamin D Ca ²⁺ →AT or SD 30%→blood (10mg/dL) free or bound →bones and teeth 99%→elimination through urine and faeces (+) Important the ratio with P. Vit D. Proteins (-) Phytates, oxalates, fiber, ageing or drugs 1 g/day in adults. Same as Vit D deficiencies: bones, muscle and hypertension problems. Toxicity same as Vit D but rare Dairy, fish & seafood. Brassicas (↑oxalates), sesame seeds, legumes, nuts and citric fruits
<u>Phosphorus</u> : 800 g in the body, 80% of hard tissues
Plastic: hard tissues (hydroxyapatite) bones & teeth Regulatory: electrolyte (buffer), metabolism. RDA = 700 mg/day. Deficiency is rare, toxicity maybe due to kidney problems→Kidney stones or via ↑P↓Ca diet→nutritional hyperparathyroidism Dairy, eggs, fish & meat. Vegetables contain less quantities. ↑Amounts in Additives
<u>Magnesium</u> : 60% of hard tissues
Plastic: hard tissues (reservoir) bones & teeth Regulatory: electrolyte (intracellular cation), muscle recovery and metabolism. RDA = 320-420 mg/day. Deficiency→kidney stones, muscle spasms, hypertension and general tiredness (-) Phytates, oxalates, fiber, Ca ²⁺ or drugs. <u>Majority of the elimination is through faeces</u> Whole grains, legumes, nuts, leafy greens. ↓in animals
<u>Fluorine</u> : tooth enamel
Plastic: Protects teeth from decay. Sugar is fermented to lactic acid that lowers pH causing corrosion of the enamel In water with < 0,8 mg/L → cavities In water with > 0,8 mg/L → dental fluorosis Water, fish and seafood, liver and tea

Organic Elements (Fe, I)
<u>Iron</u> : Haemoglobin and Myoglobin
Funtions: Hb in blood and myo in the muscle. Fe ²⁺ →Fe ³⁺ (meta- inactive form brown colour. Ceruloplasmin involved) Metalloenzyme: oxidative phosphorylation, FAD, Krebs cycle, Purines and catecholamines metabolism, detox processes and immune response. Active iron: muscles/lungs/bone marrow Iron reservoir: liver, enterocytes and blood vessels (Inorganic iron→FD)/(Iron hemo→vesiculosis) →Fe ²⁺ /(Hemo→Fe ²⁺ + bilirubin)↔Fe ³⁺ (Ferritin)→AT→transferrin (blood) (+) inorganic iron absorption: Vit C, reducing sugars, proteins (sulphur) (-) inorganic iron absorption: phytic acid, fiber, tannins, oxalates 8-18 mg/day. Iron deficiency anaemia. Haemochromatosis. Liver, kidneys, red meat, oily fishes & seafood. Legumes (soy), sesame seeds, whole grains, nuts, watercress and spinach
<u>Iodine</u> : Thyroid Hormones T ₃ and T ₄
Basal metabolism regulation: aerobic respiration (fatty acids) and heat production (electron transport chain). Hyperglycaemic, ↓HMG-reductase = ↓Cholesterol RDA = 150 µg/day. Deficiency causes hypothyroidism: endemic goitre→genetic and dietary factors involved (↓I ₂ , ↑mucinogenic substances→thiocyanate = thyroid confusion) Cretinism and Myxedema Toxicity causes the hyperthyroidism→Graves' disease Iodised Salt, Seafood, Dairy, meats & eggs and fruits & veggies

Metalloenzymes Elements (Zn, Cu, Mn, Mo, Se, Cr)	Metalloenzymes Elements (Zn, Cu, Mn, Mo, Se, Cr)
<u>Zinc</u> : 1,5-2,5 g in the body	<u>Molybdenum</u> : 6-16 g in the body
Cofactor of ↑300 enzymes: protein synthesis, Carboxipeptidase, Alcohol D.H., Alkaline Phosphatase, Pyruvate carboxylase, carbon anhydrase, Retinol D.H., Superoxide dismutase (cytoplasm) Absorption via FD and SD 25-50% (+) aa's, sugars (lactose) and citrate (-) fitates, fiber, oxalate, tannins, ↑alcohol, Fe, Cu, Ca It has a reservoir in the enterocytes as well as Fe. Uses AT to reach the bloodstream in where travels bound to albumins or transferrin→Muscle30% / Bone60% → excretion (bile→faeces) 15 mg/day. Various deficiency reasons: ↓growth, taste change, nervous disorders, immunosuppression. NO toxicity. Seafood & fish, meats & eggs, milk & dairy. Whole grains, Legumes and nuts	Meat & liver, fish & seafood and dairy. Yeast, whole grains, nuts, chocolate, coffee, tea, mushrooms Recommended doses = 25-35µg/day. Insulin problems. Toxicity only with Cr ⁶⁺ Cr ³⁺ →FD (ascorbate & oxalate facilitates, sugar inhibit)→ blood (plasmatic protein) → liver (reservoir). Renal excretion Not a metalloenzyme (glucose tolerance factor). 2 types (one toxic Cr ⁶⁺ one nutrient Cr ³⁺). Nicotinic acid, Insulin anabolic effect.
<u>Copper</u> : 50-120 g in the body	<u>Chromium</u> : 4-6 g in the body
Superoxide dismutase (cytoplasm), Cytochrome C oxidase (ETC), collagen synthesis, Ceruloplasmin, Various enzymes Absorption 40-60%: SD and AT. Can stay in the enterocytes with metallothioneins. →blood (albumins or transcuprein)→ liver (reservoir with metallothioneins)→ tissues via ceruloplasmin →excretion bile to faeces RDA= 0,9mg/day. Deficiency similar to Menkes Disease and Toxicity causes Wilson Disease. Fish & seafood, Liver & meats. Whole grains, legumes, nuts, mushrooms and cocoa	Fish and Seafood, eggs, meats and liver, milk and dairy Whole grains, nuts (brazil nuts), mushrooms and garlic. RDA = 55µg/day. Bimodal effect. Deficiency→Keshan & Kashin-Beck. Adequate→Diseases prevention. Toxicity→seleniosis Bound to aa's (selenocysteine and selenomethionine)→ AT as aa's →blood (erythrocytes & selenoprotein P) ↔ liver (metabolisation) → bone, muscle, kidney and spleen. Bile and urine excretion Glutathione peroxidase (powerful antioxidant) and type I tetraiodothyronine deiodinase (T4 →T3 thyroid hormones)
<u>Manganese</u> : 10-20 g in the body	<u>Selenium</u> : 3-15 g in the body
Superoxide dismutase (mitochondrion), Pyruvate carboxylase (gluconeogenesis), Acetyl-CoA carboxylase (fat synthesis), Isocitrate D.H. (Krebs Cycle), collagen & bone, melanin & urea Peptidases free it in food → FD-AT→ blood (albumins)↔ liver (Mn ³⁺ bound to transferrin or transmanganin) → tissues → bile to faeces RDA = 1,8-2,3 mg/day. Rare deficiency because of Mg. Causes degenerative diseases, glycaemia, bone and reproductive problems. No dietary toxicity. Whole grains, legumes and nuts, tubers, coffee & tea and leafy greens	Whole grains, legumes and nuts RDA = 45µg/day. total parenteral nutrition, Associated to Se deficiency as well. Toxicity not common→ gout. AT/FD(↑amounts)90% →blood (erythrocytes)→ Liver, kidney, bone, skin →urine excretion mainly Xanthine D.H. oxidase (uric acid production), Aldehyde oxidase (dihydroxymandelic acid→catecholamines), Sulphite oxidase (treatment of sulphur from aa's→urine)