

Protein dalam Sistem Urogenital

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proteins provide many essential functions in the body:



digestive enzymes
help facilitate
chemical reactions



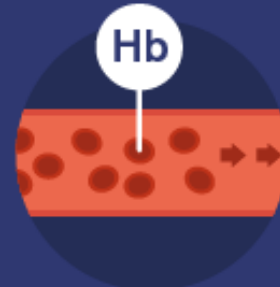
support the regulation
and expression
of DNA and RNA



antibodies support
immune function



support muscle
contraction
& movement



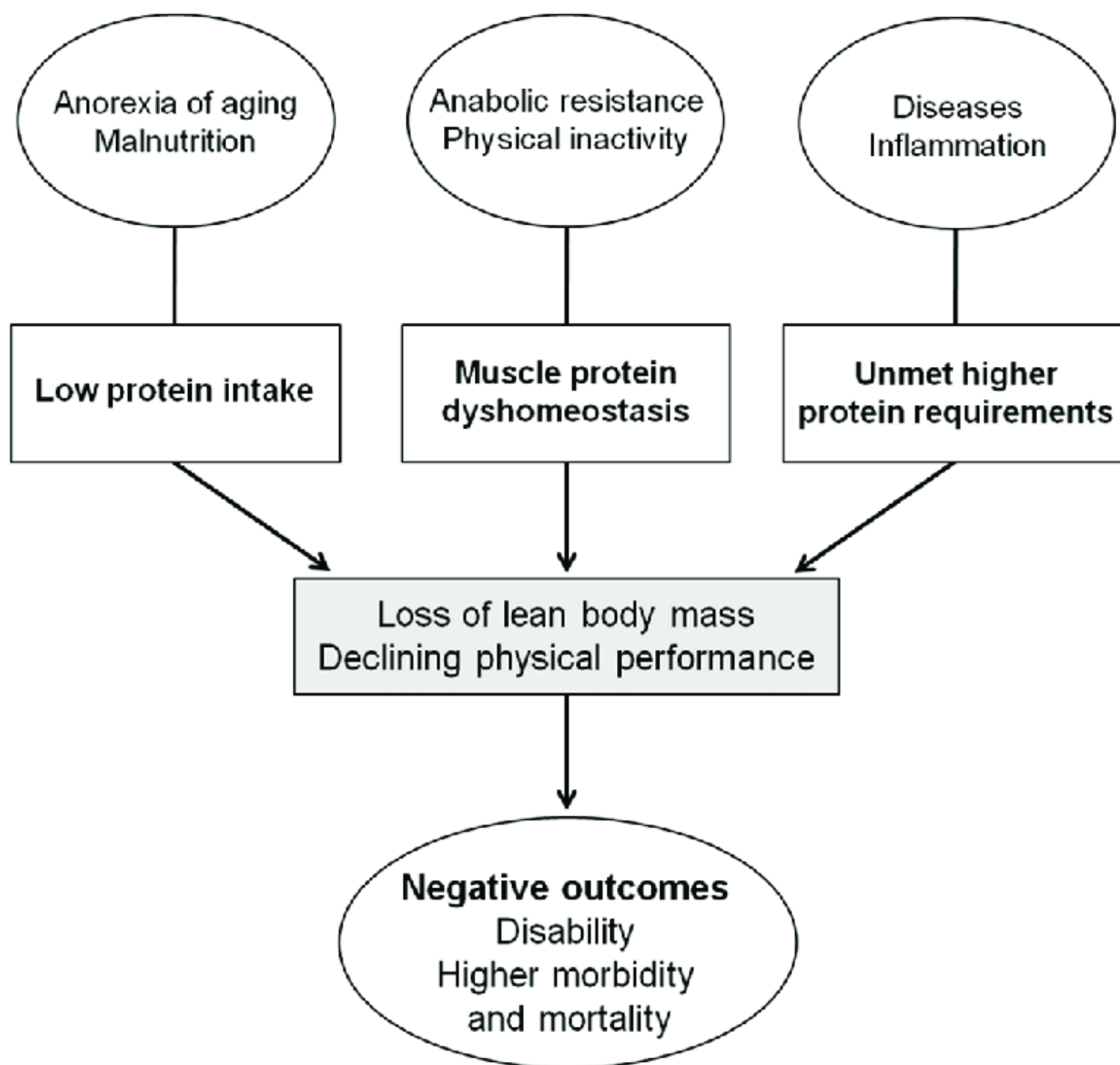
move essential
molecules around
the body

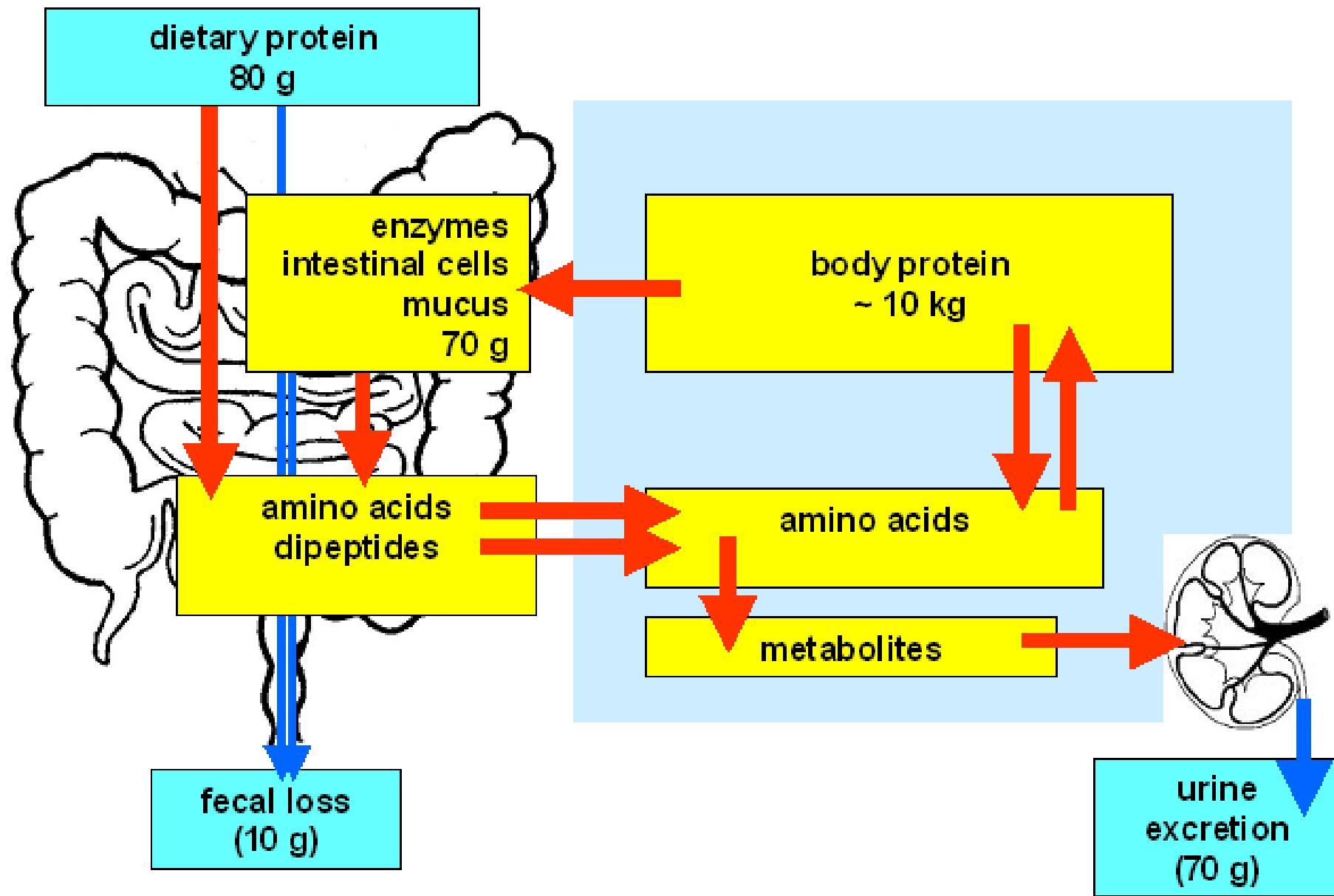


provide support
to the body

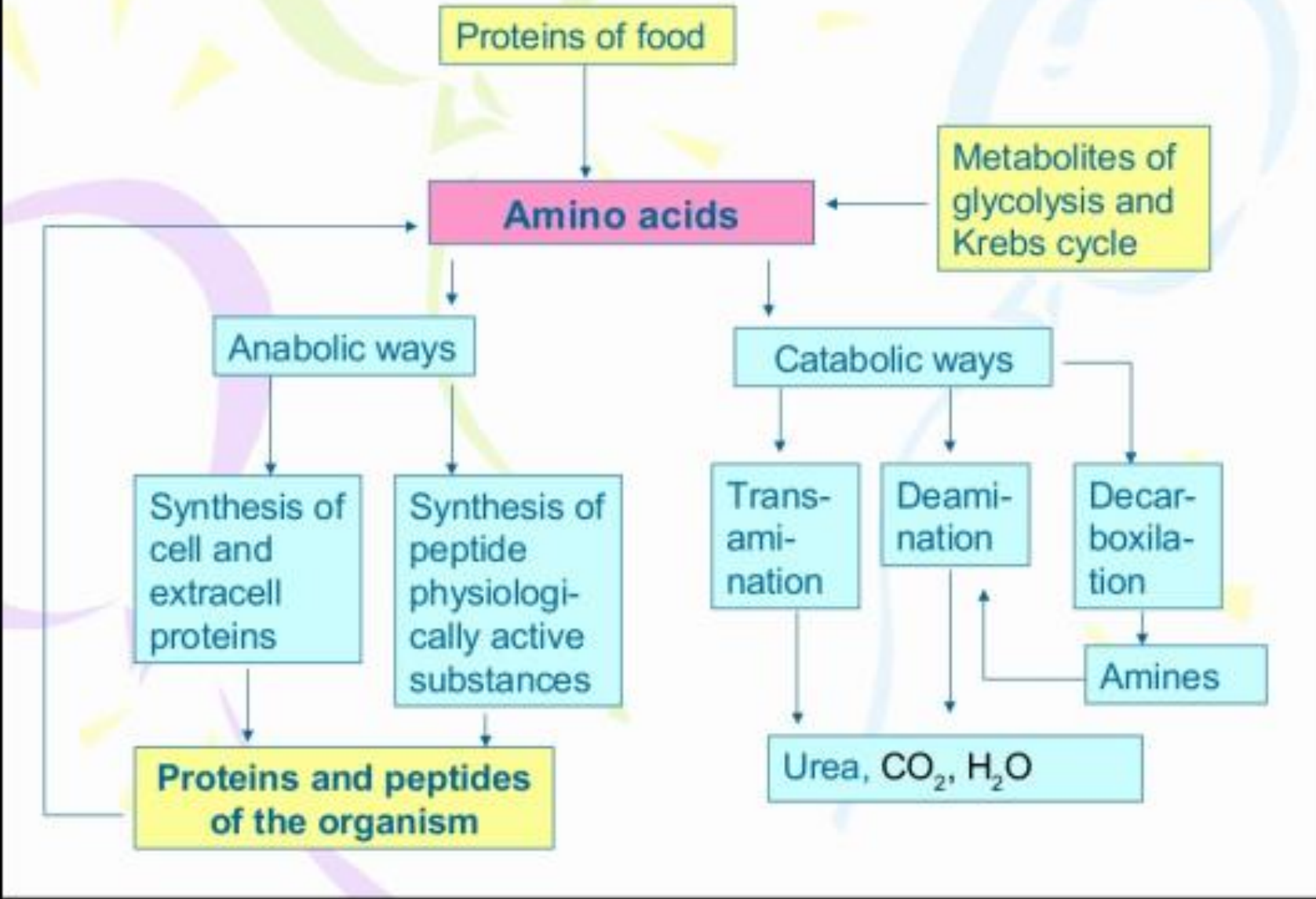


hormones help
coordinate
bodily function

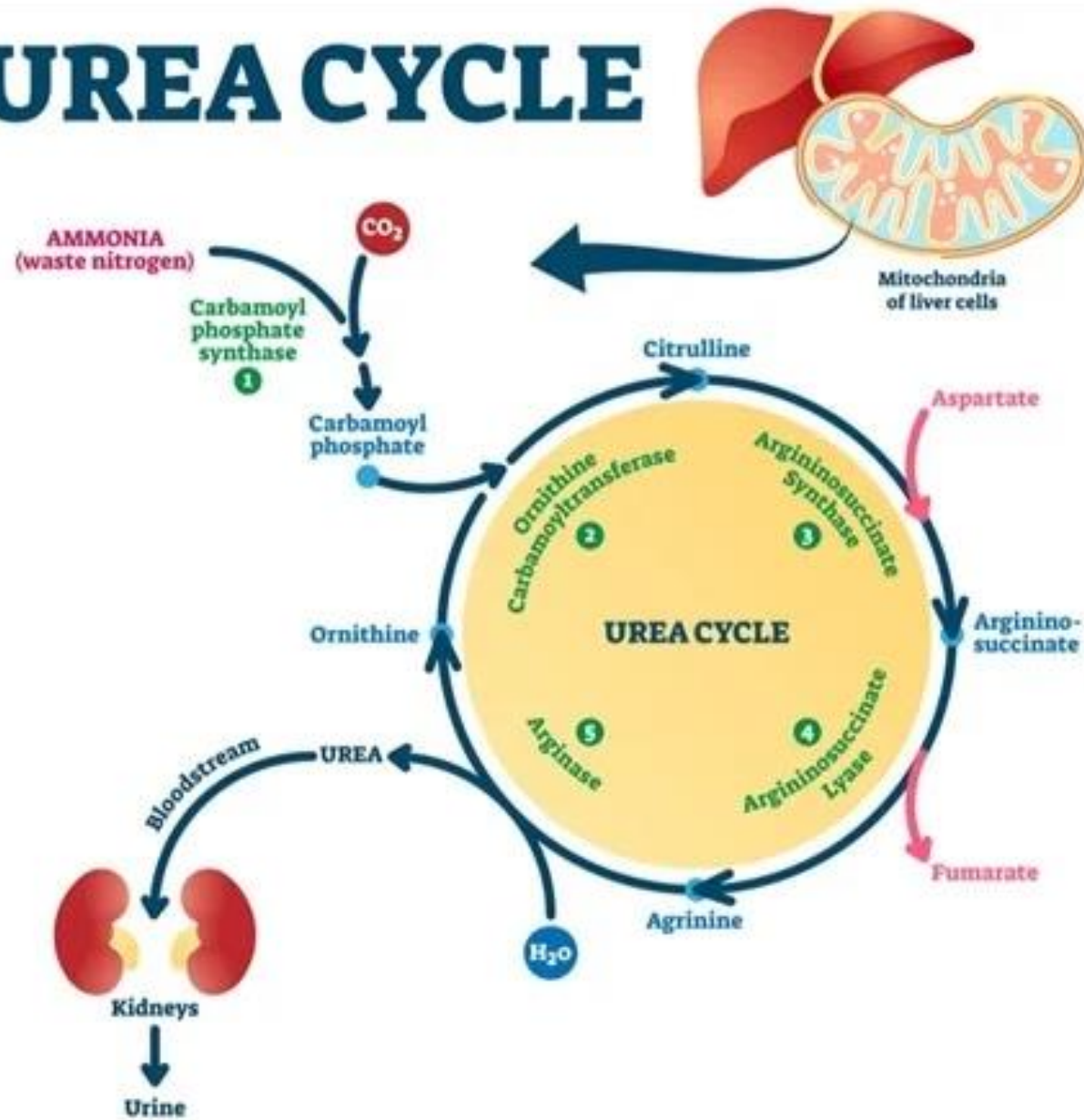




GENERAL PATHWAYS OF AMINO ACIDS METABOLISM



UREA CYCLE



Amino Acid and Protein Metabolism

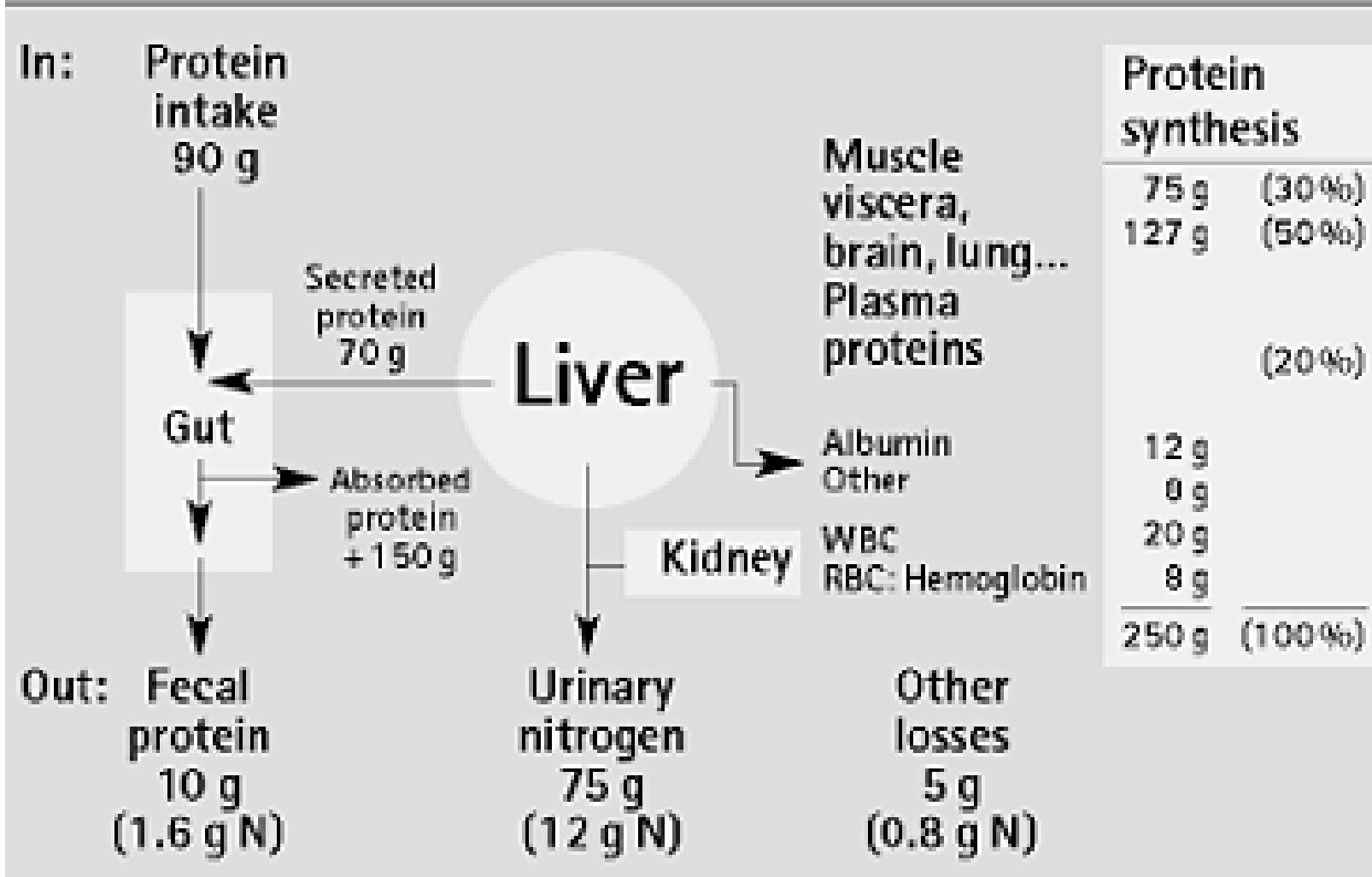


Fig. 2: Amino acid and protein metabolism (Modified from: Matthews and Fong, 1993)

Dietary Proteins

Nitrogen Excretion in Urine	
Urinary Metabolite	Grams Excreted/24 hr*
Urea	30
Ammonium Ion (NH ₄ ⁺)	0.7
Creatinine	1.0 - 1.8
Uric Acid	0.5 - 1.0
* Approximate values in average adult male Fecal nitrogen excretion is approximately 1 - 2g/24 hr	

Fatty Acids

Acetyl CoA

TCA cycle

*CO₂
ATP*

Glucose

Aspartate

Citrulline

Carbamoyl-P

Arginino-succinate

UREA CYCLE

Ornithine

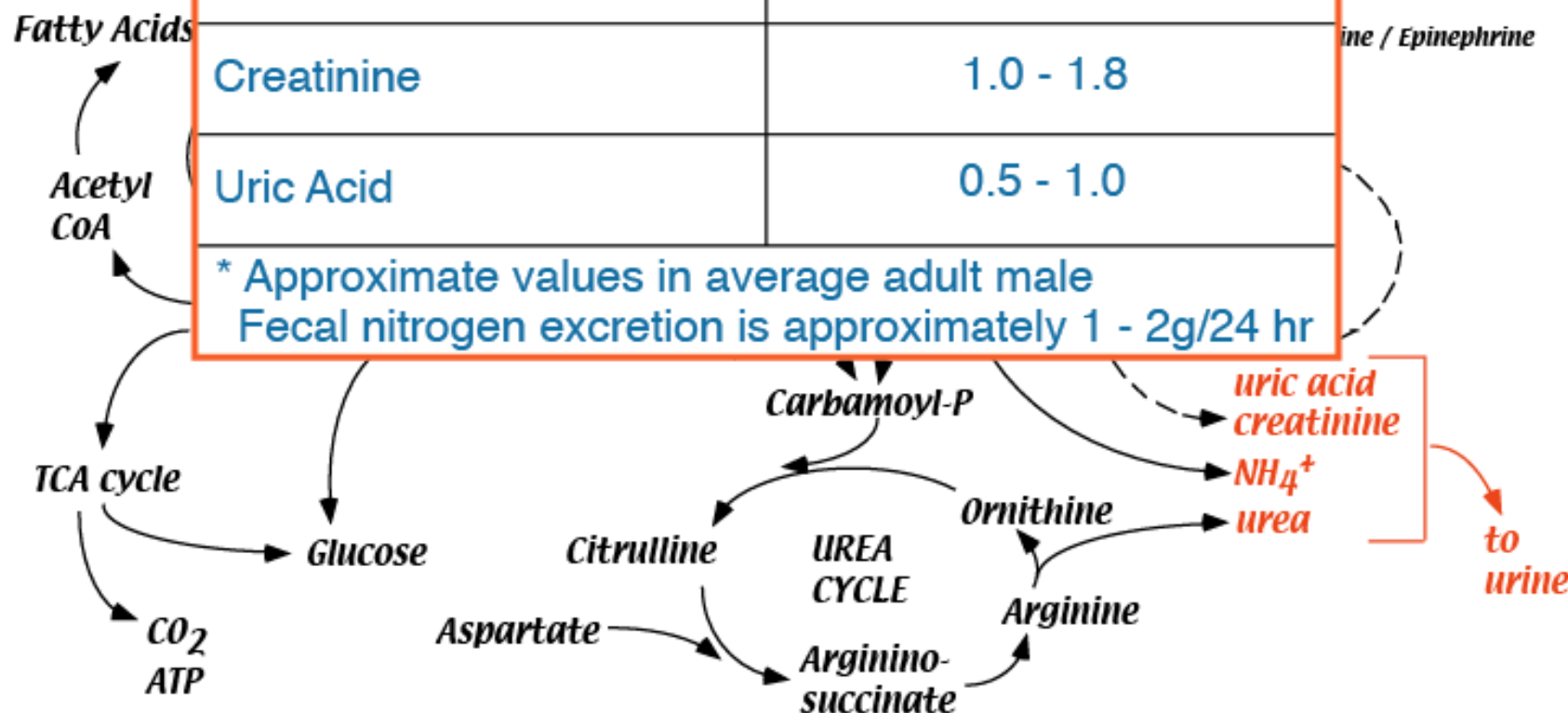
Arginine

*uric acid
creatinine*

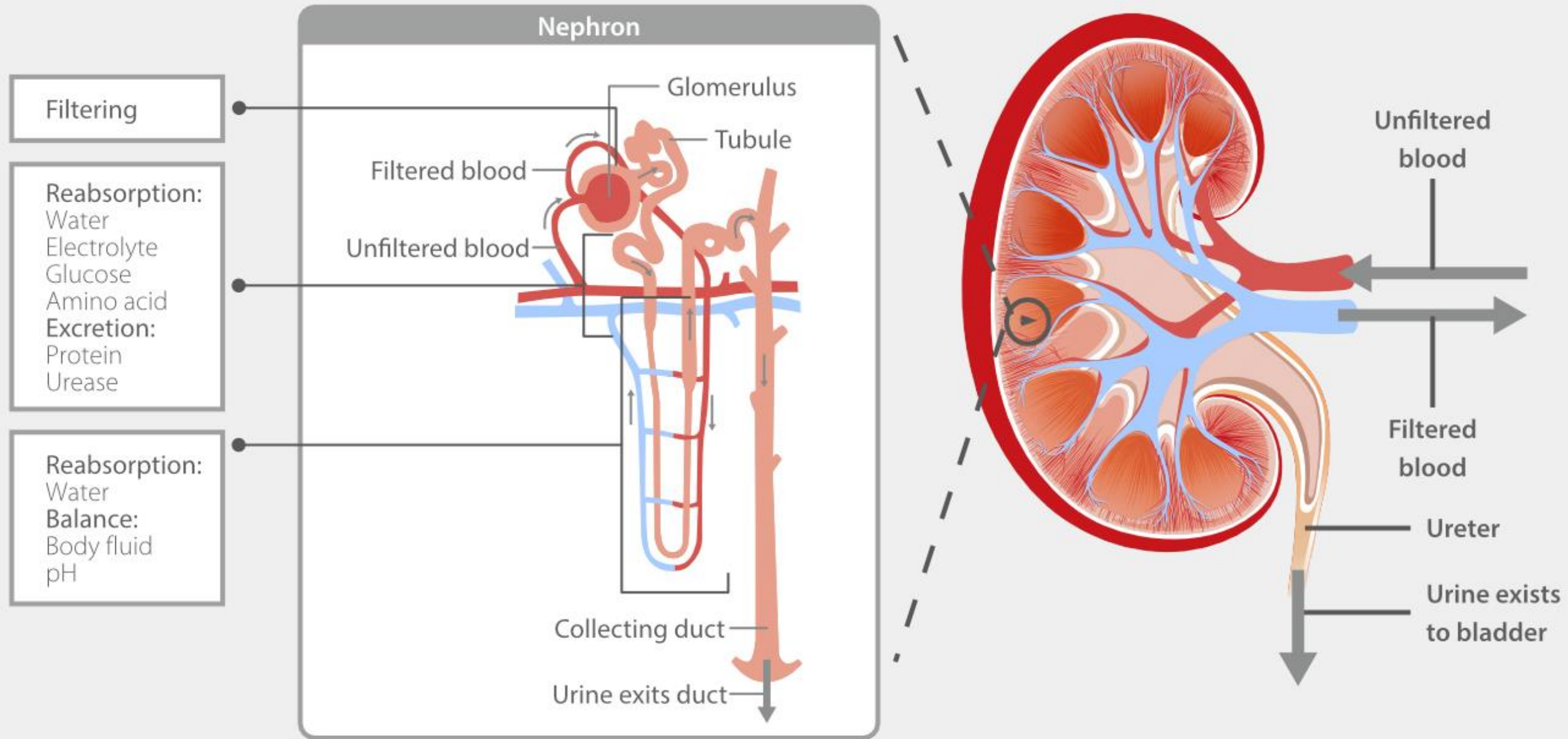
*NH₄⁺
urea*

*to
urine*

ine / Epinephrine



Kidney



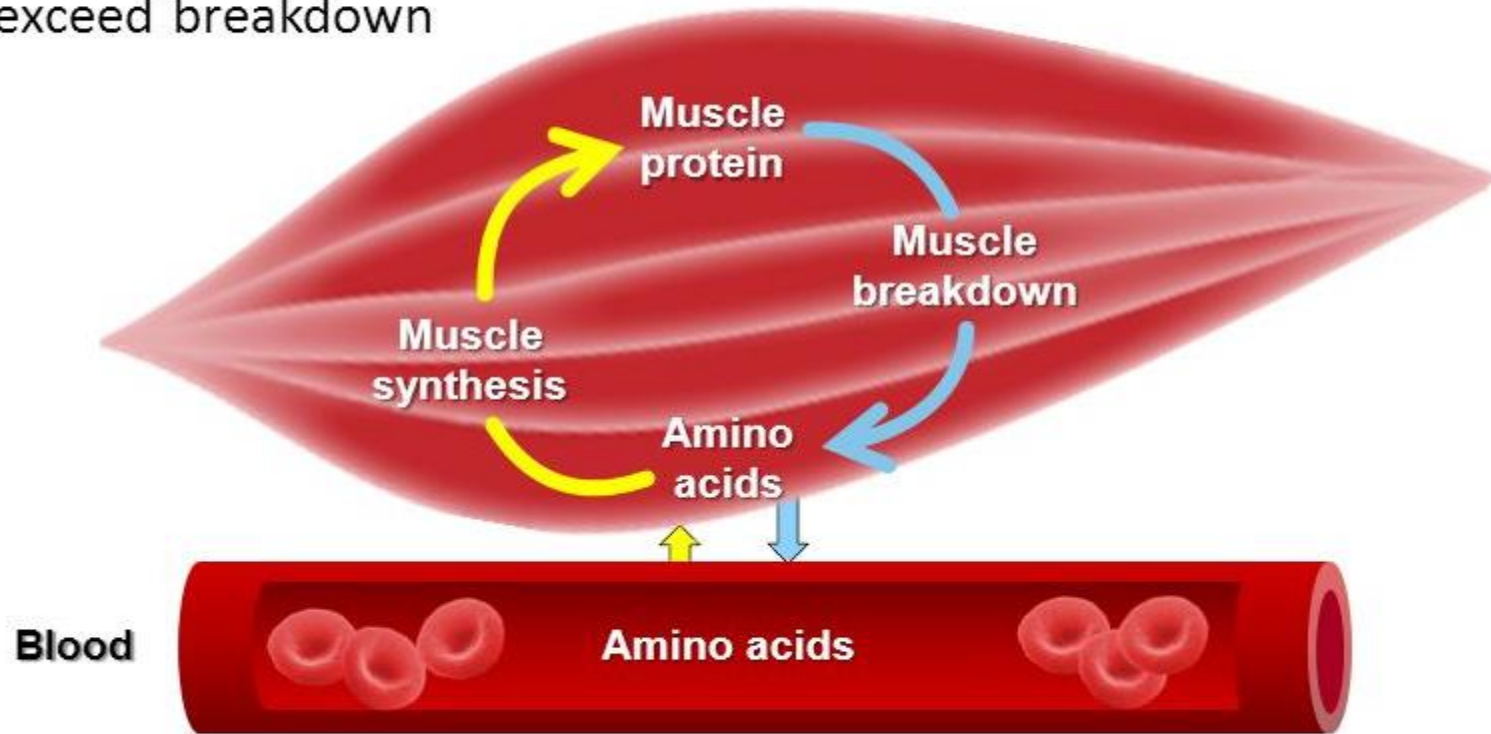
Fungsi ekskresi ginjal

	Daily load in adults	Effects in renal failure
Metabolit nitrogen		Peningkatan konsentrasi plasma (azotemia)
Urea	(dietary prot x 1/3) g	
Asan urat	4 mmol	
kreatinin	10 mmol	
Metabolit lain		
Sulfat	25 – 40 mmol	Asidosis
Ion hidrogen	40 – 80 mmol	Asidosis
Metabolit obat		Keracunan obat
Zat gizi lebih		
Air	1500-5000 ml	Kelebihan cairan dan edema
Sodium	100 – 200 ml	
Potasium	60 – 80 mmol	Hiperkalemia
Kalsium	2 – 7 mmol	Hipokalsemia
Klorida	100 – 200 mmol	
Fosfat	20 – 40 mmol	hiperfosfatemia

Pengaturan Hormon di Ginjal

Renin	ADH	Konversi vit D	Erythropoetin
Angiotensinogen → angiotensin I → dgn bantuan ACE → angiotensin II → stimulasi kelenjar adrenal → aldosteron → pe↑ reabsorpsi Na → pe↑ BP	Pe↑ permeabilitas tubulus distal dan tubulus kolektivus utk meningkatkan reabsorpsi air	Konversi vit D menjadi bentuk aktif 1,25-dihydroxy vit D di tubulus proksimal	Berperan untuk pembentukan RBC

- There is a constant flux in muscles between muscle protein synthesis and muscle protein breakdown
 - Net activity is turnover: ~ 4.6 g/kg body weight or ~ 300 g/day
- Goal for increasing muscle size is to have muscle protein synthesis exceed breakdown



Muscle Protein Balance

Protein Balance =

Protein Synthesis (PS) – Protein Breakdown (PB)



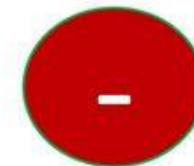
Positive Net Balance



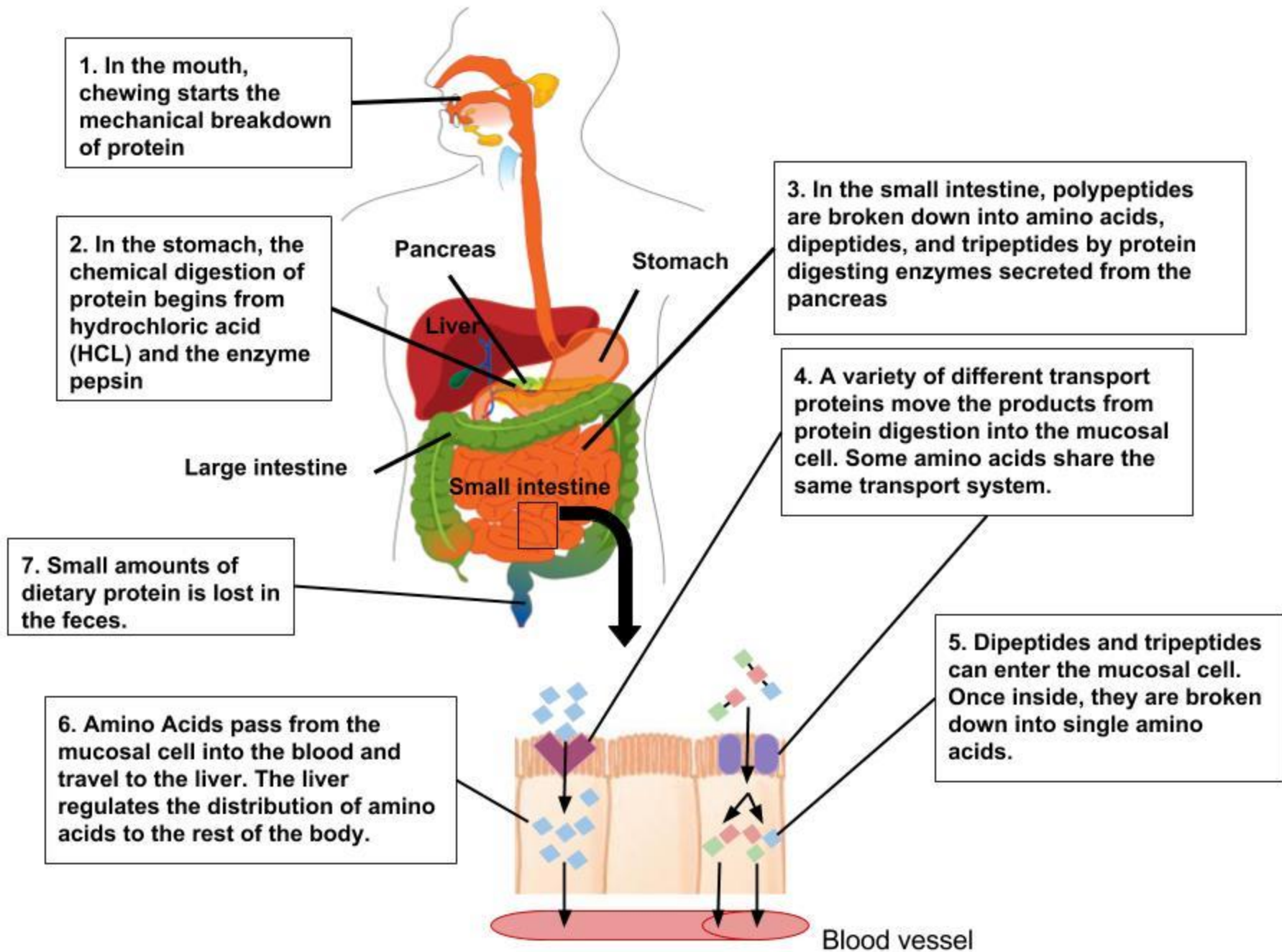
$PS > PB =$ lean body mass gain



$PB > PS =$ lean body mass loss



Negative Net Balance



Essential AA	Nonessential AA	Conditionally essential AA
Arginine	Alanine	Cysteine
Histidine	Asparagine	Glutamine
Isoleucine	Aspartate	Hydroxyproline
Leucine	Glutamate	Proline
Lysine	Glycine	Taurine
Methionine	Serine	
Phenylalanine	Tyrosine	
Threonine		
Tryptophan		
Valine		

Essential amino acids

These cannot be synthesized within the body

Threonine

Methionine

Histidine

Phenylalanine

Tryptophan

Lysine

Valine

Leucine

Isoleucine

These are included in protein that forms muscles.
They account for 30-40% of essential amino acids.

Non-essential amino acids

These can be synthesized within the body

Alanine

Glutamic acid

Aspartic acid

Arginine

Glycine

Glutamine

Asparagine

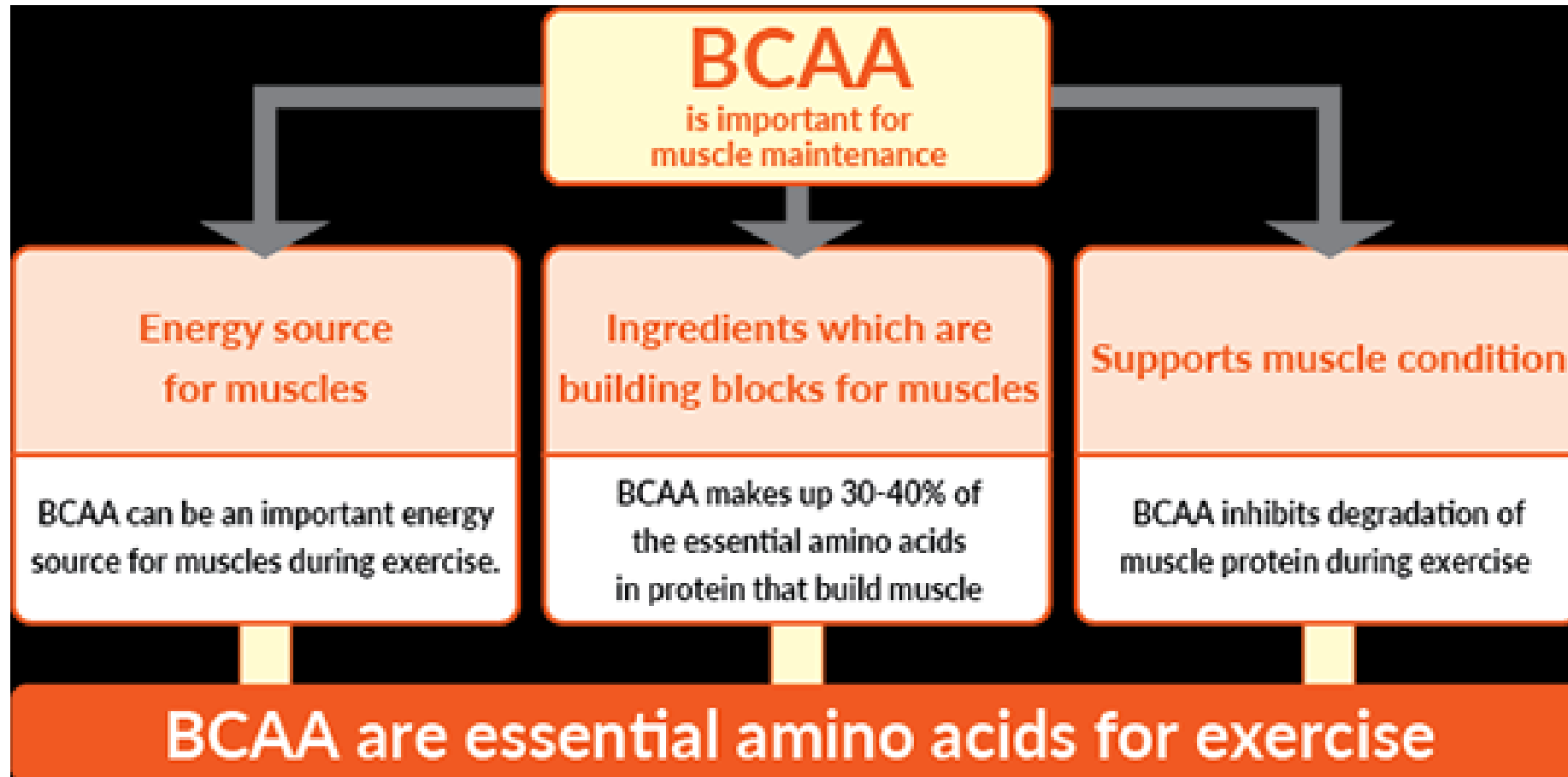
Cysteine

Serine

Tyrosine

Proline

All amino acids are required for body growth.
Since "essential amino acids" cannot be synthesized within the body, they have to be consumed in the form of food.



Amino Acid	Main Food Sources
Histidine	soy protein, eggs, parmesan, sesame, peanuts
Isoleucine	eggs, soy protein & tofu, whitefish, pork, parmesan
Leucine	eggs, soy protein, whitefish, parmesan, sesame
Lysine	eggs, soy protein, whitefish, parmesan, smelts
Methionine	eggs, whitefish, sesame, smelts, soy protein
Cysteine	eggs, soy protein, sesame, mustard seeds, peanuts
Phenylalanine	eggs, soy protein, peanuts, sesame, whitefish
Tyrosine	soy protein, eggs, parmesan, peanuts, sesame
Threonine	eggs, soy protein, whitefish, smelts, sesame
Tryptophan	soy protein, sesame, eggs, winged beans, chia seeds
Valine	eggs, soy protein, parmesan, sesame, beef

Complete Vs. Incomplete Proteins

- Dietary protein is required for the body as there are 9 essential amino acids the body cannot create and must obtain from ones diet. Complete proteins contain all 9 of these essential amino acids versus Incomplete proteins which do not.
Complementary proteins are combinations of two or more incomplete proteins that supply all 9 essential amino acids.

Complete Proteins:

Animal Based:

- Meat
- Poultry
- Dairy
- Eggs
- Fish

Incomplete Proteins:

plant Based

- Vegetables
- Grains
- Legumes/Beans
- Nuts/Seeds

Complementary Proteins:

- Grains+Legumes/Vegetables
- Nuts/Seeds+Vegetables/Legumes

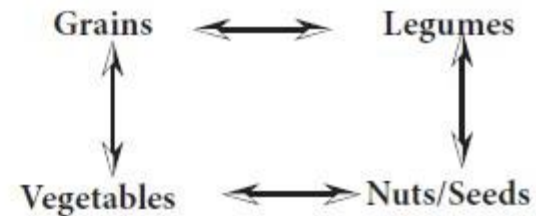


Fig 10.4: Complete Vs Incomplete protein

Calculating Nitrogen Balance

$$\text{Nitrogen Balance} = [\text{Nitrogen}]^{(\text{Intake})} - [\text{Nitrogen}]^{(\text{Output})}$$

$$[\text{Nitrogen}]^{(\text{Intake})} = \left[\frac{\text{g Protein}}{6.25 \text{ g Protein/g Nitrogen}} \right]$$

$$[\text{Nitrogen}]^{(\text{Output})} = \left[\text{UUN}^* \times \frac{1000 \text{ mL}}{\text{liter}} \times 24\text{-hr Urine Volume (liters)} \times \frac{\text{g Nitrogen}}{1000 \text{ mg Nitrogen}} + 3 \right]$$

$$*\text{UUN} = \frac{\text{mg Nitrogen}}{100 \text{ mL Urine}}$$

- UUN excretion may differ from 3 to 5 grams

Langkah yang dilakukan:

- Lakukan pemeriksaan kadar urinary urea nitrogen (UUN) dengan mengumpulkan urin 24 jam pasien
- Hitung besarnya UUN total dengan menggunakan rumus:

$$\text{UUN total} = \frac{(\text{kadar UUN 24 jam}) \times (\text{volume urin 24 jam})}{100}$$

- Hitung besarnya asupan nitrogen berdasarkan asupan protein pasien sesuai data recall 24 jam dengan membagi asupan protein dengan konstanta 6,25
- Hitung besarnya keseimbangan nitrogen dengan menggunakan rumus berikut:

$$\Delta N = (\text{asupan nitrogen total}) - (\text{UUN total} + 4)$$

Contoh soal

Bagaimana keseimbangan protein pasien pada praktikum 1, bila kadar UUN pasien adalah 500 mg/dl, dan volume urin 24 jam 2000 ml. Diketahui asupan protein dalam 24 jam terakhir adalah 62,5 gram.

Jawaban

UUN total pasien = $(500 \times 2000) / 100 = 10.000 \text{ mg} = 10 \text{ gram}$

Besarnya asupan nitrogen = $62,5 / 6,25 = 10 \text{ gram}$

Keseimbangan nitrogen = $(10) - (10 + 4) = - 4$. Keseimbangan protein pasien negatif, menunjukkan asupan protein pasien kurang dan tidak sesuai dengan kebutuhannya.

Oleh karena 1 gram protein = 6,25 gram nitrogen, maka bila pasien tersebut kekurangan 4 gram nitrogen, maka jumlah defisiensi protein untuk pasien tersebut adalah = $4 \times 6,25 = 25 \text{ gram}$.

Dengan perhitungan tersebut, maka dapat ditambahkan protein sebanyak 25 gram terhadap jumlah asupan protein sebelumnya. Namun, dalam beberapa keadaan, bila pemantauan UUN tidak dapat dilakukan, maka besarnya protein dapat diberikan sesuai ketentuan yang telah dijelaskan sebelumnya.

