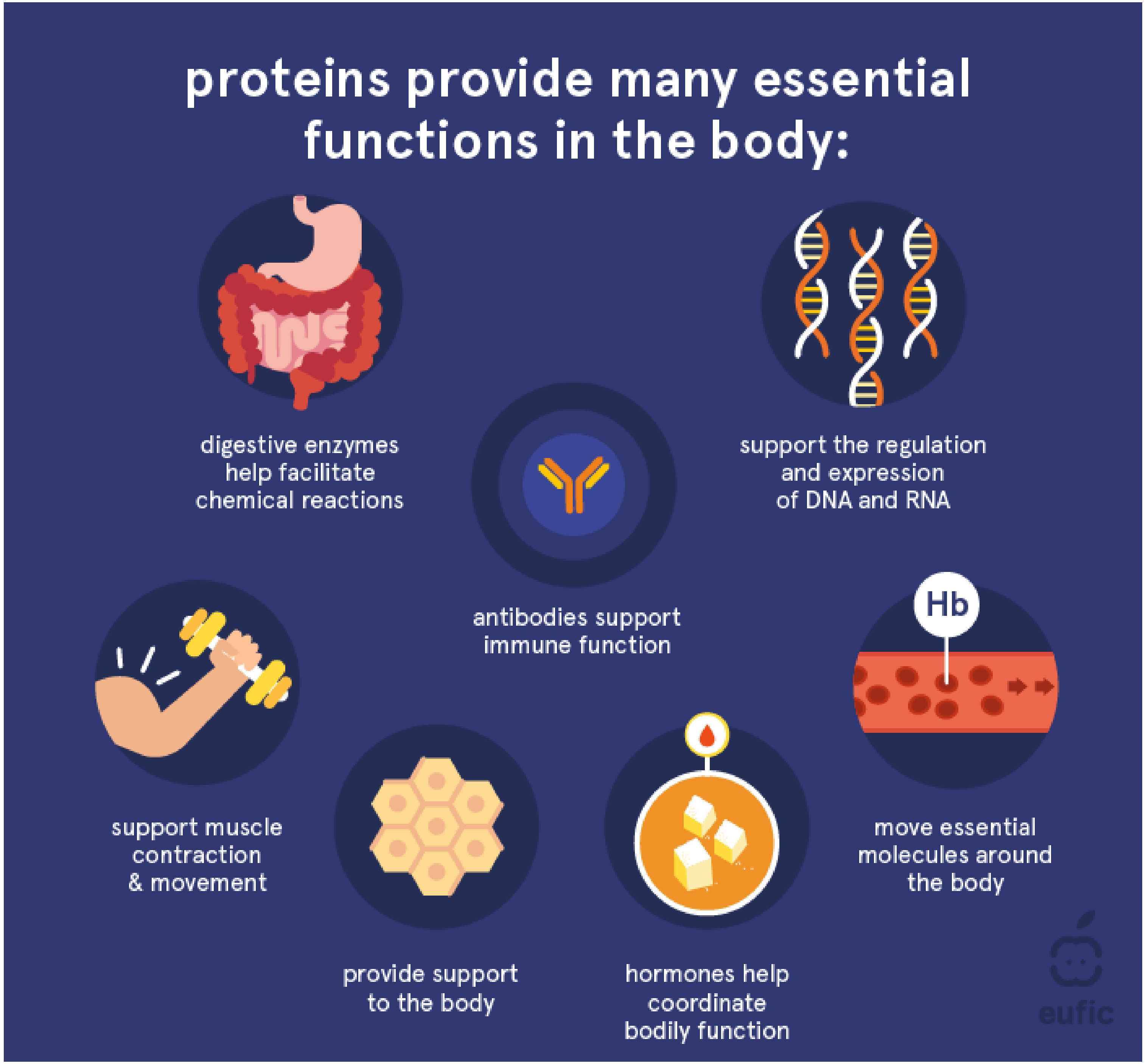
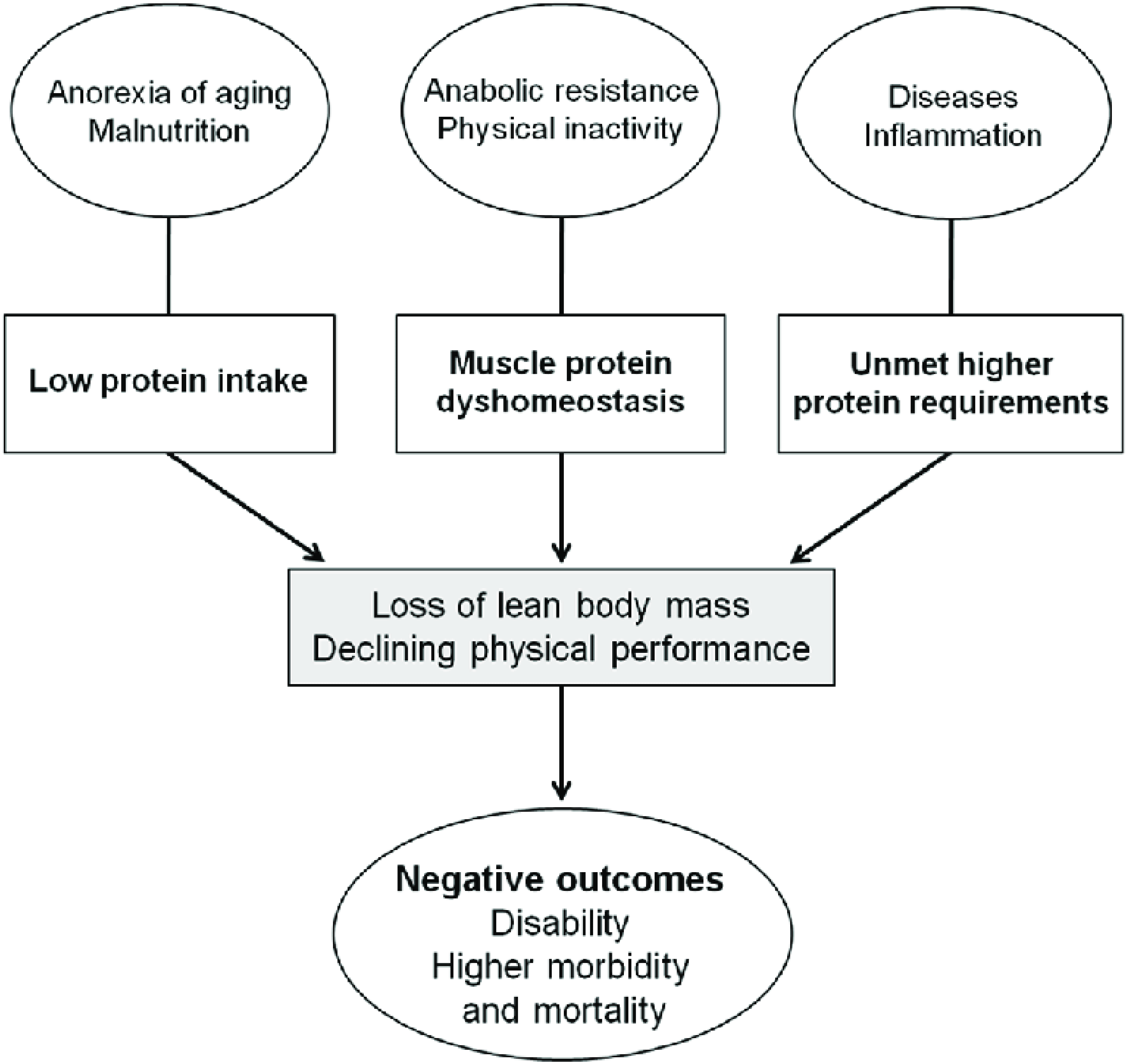
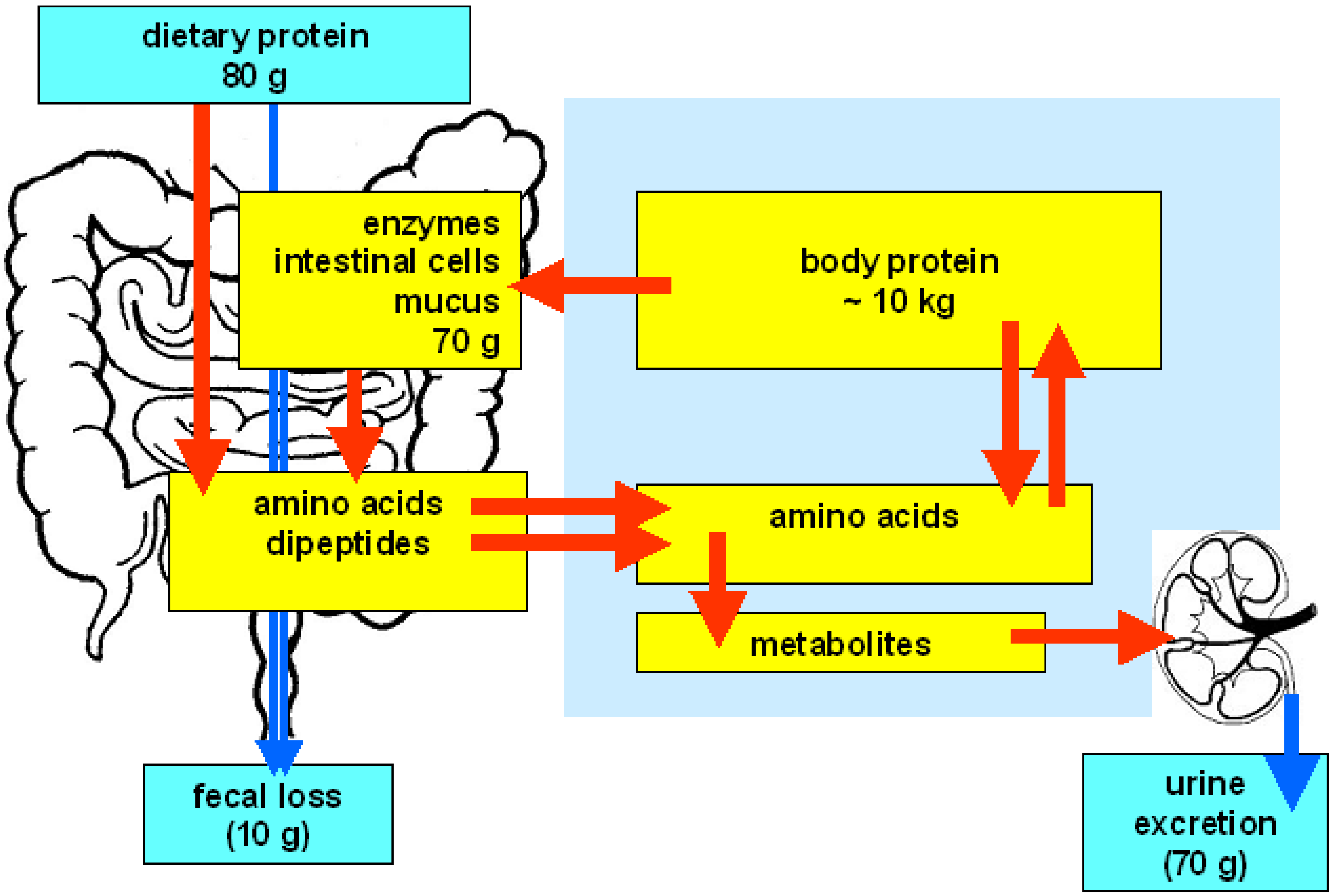
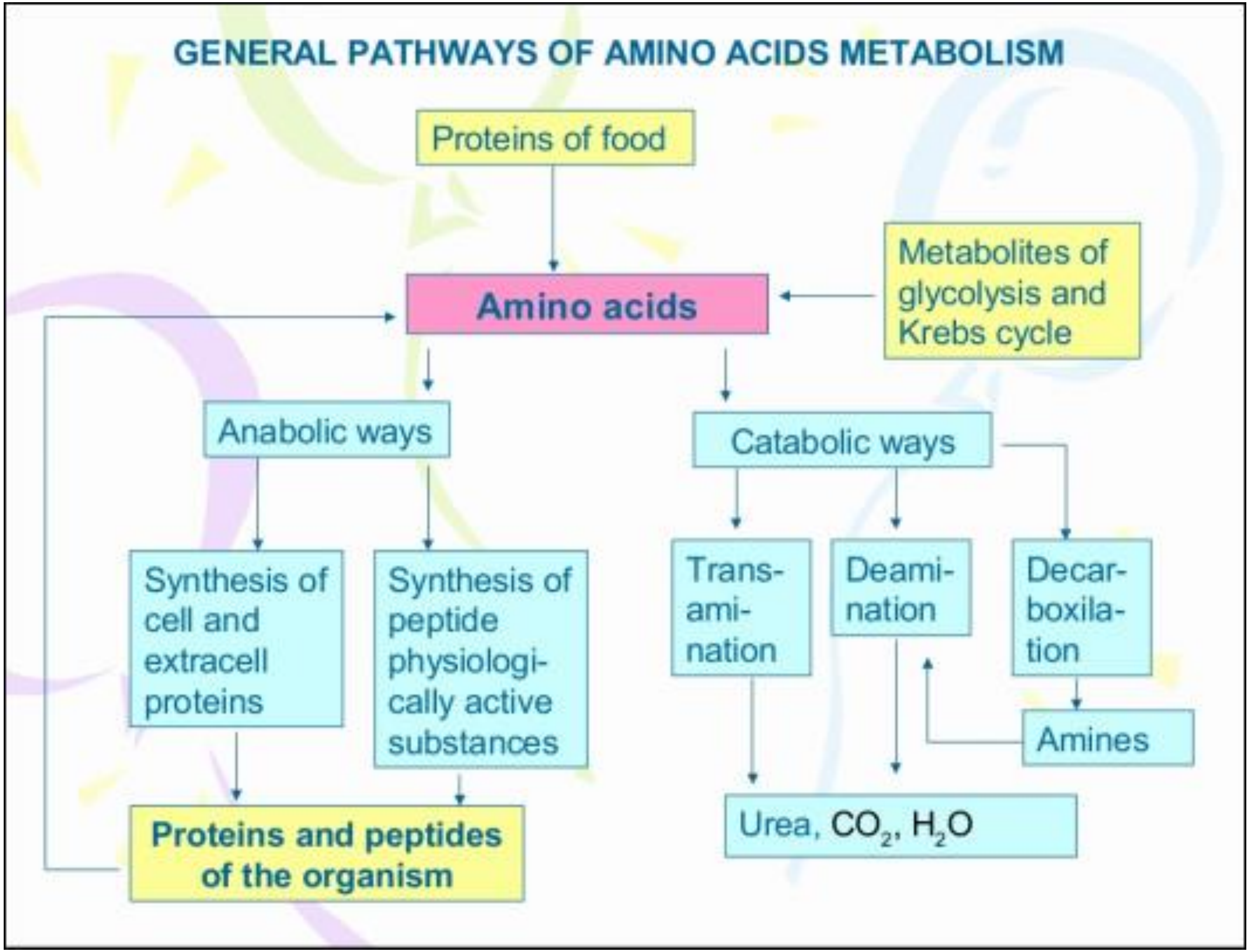
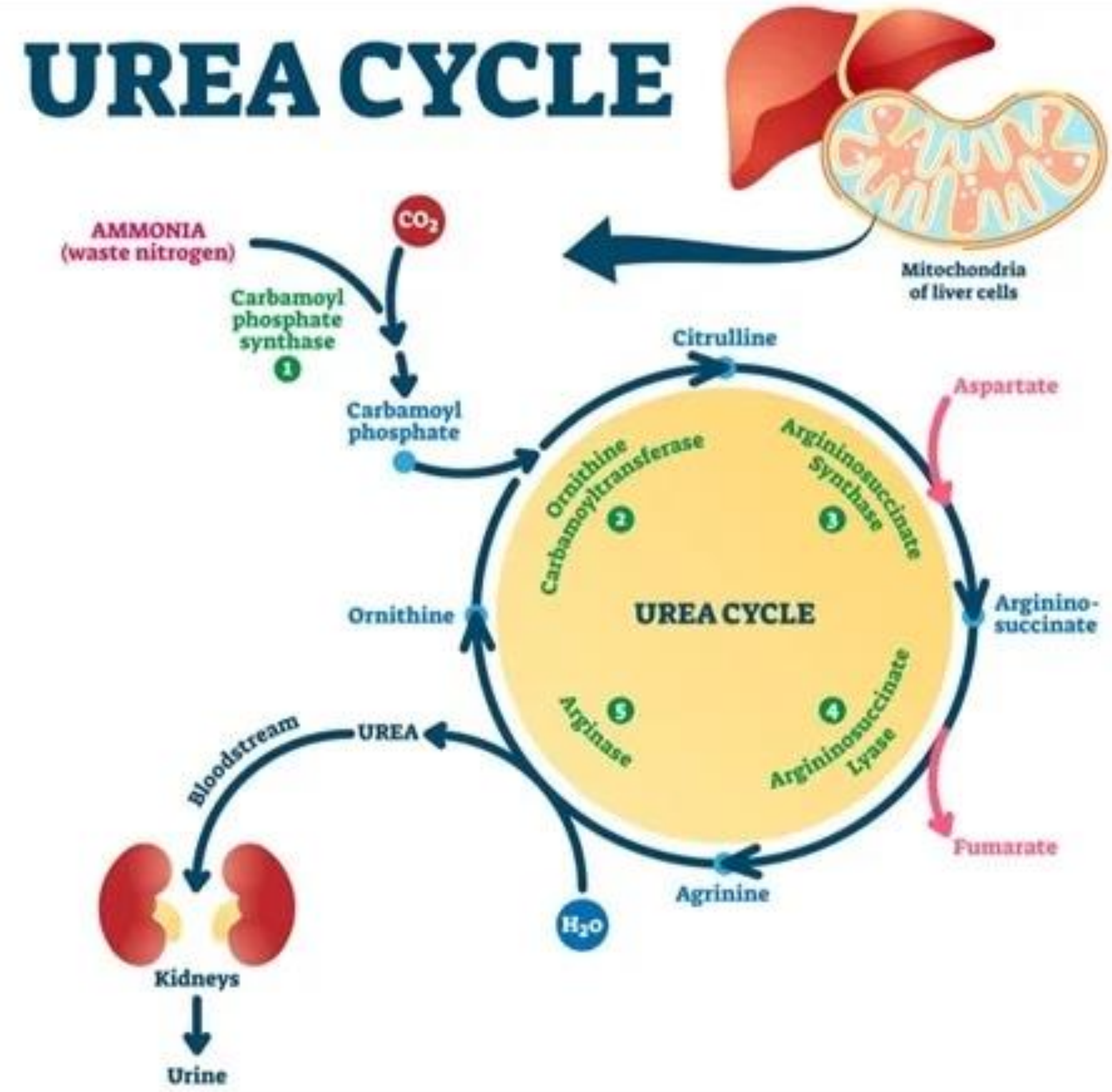
Protein dalam Sistem Urogenital


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
Hb
support muscle contraction & movement
move essential molecules around the body
provide support to the body
hormones help coordinate bodily function
eufic


Anorexia of aging
Malnutrition
Anabolic resistance
Physical inactivity
Diseases
Inflammation
Low protein intake
Muscle protein
dyshomeostasis
Unmet higher
protein requirements
Loss of lean body mass
Declining physical performance
Negative outcomes
Disability
Higher morbidity
and mortality


dietary protein
80 g
enzymes
intestinal cells
mucus
70 g
body protein
~ 10 kg
amino acids
dipeptides
amino acids
metabolites
fecal loss
(10 g)
urine
excretion
(70 g)


GENERAL PATHWAYS OF AMINO ACIDS METABOLISM
Proteins of food
Amino acids
Metabolites of glycolysis and Krebs cycle
Anabolic ways
Catabolic ways
Synthesis of cell and extracell proteins
Synthesis of peptide physiologically active substances
Trans-amination
Deamination
Decarboxilation
Amines
Proteins and peptides of the organism
Urea, CO_2, H_2O


UREA CYCLE
AMMONIA
(waste nitrogen)
CO_2
Carbamoyl phosphate synthase
1
Carbamoyl phosphate
Mitochondria of liver cells
Citrulline
Aspartate
Ornithine Carbamoyltransferase
2
Argininosuccinate Synthase
3
Ornithine
UREA CYCLE
Arginino-succinate
Arginase
5
Argininosuccinate Lyase
4
UREA
Bloodstream
Fumarate
Agrinine
H_2O
Kidneys
Urine

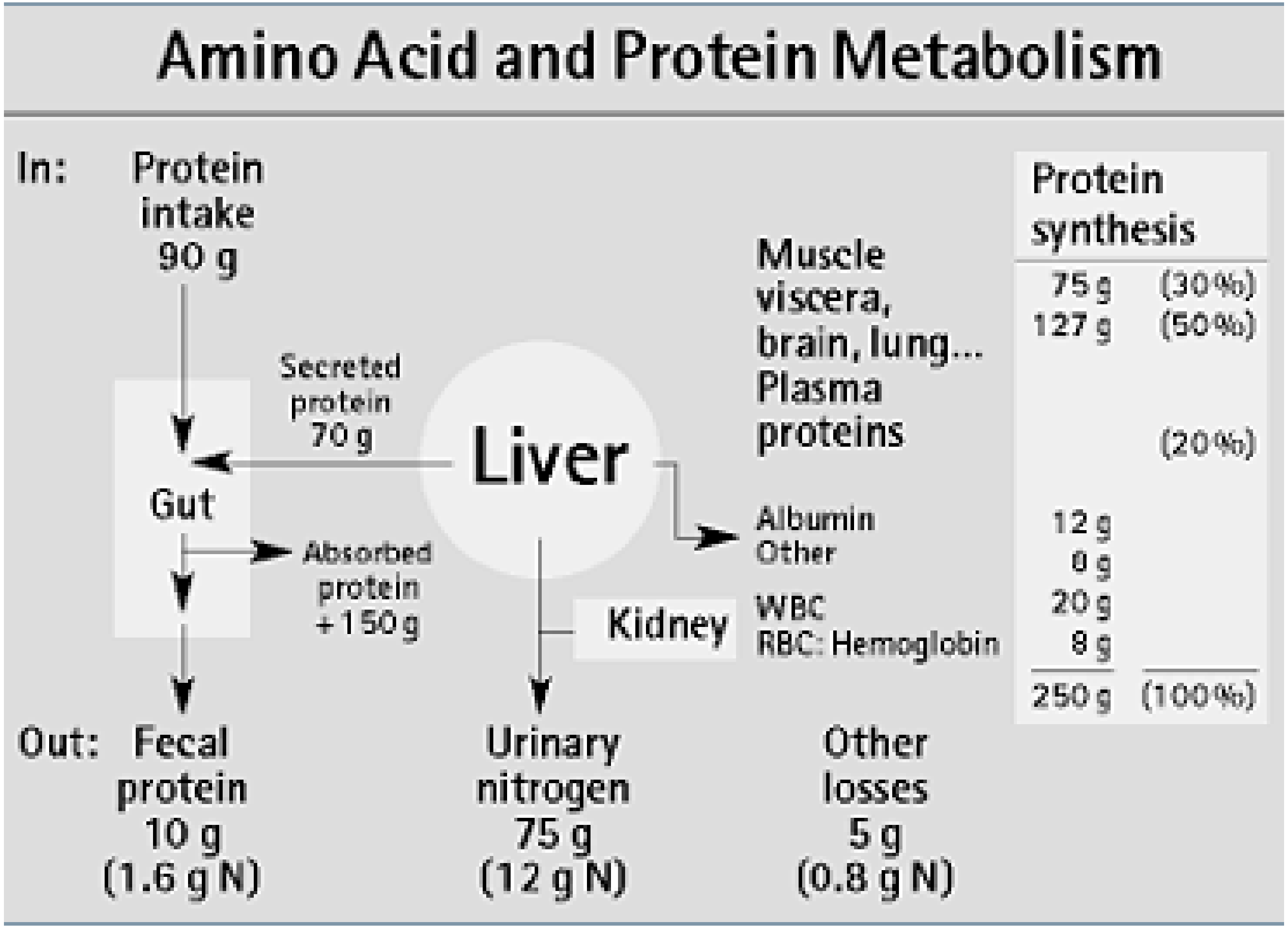
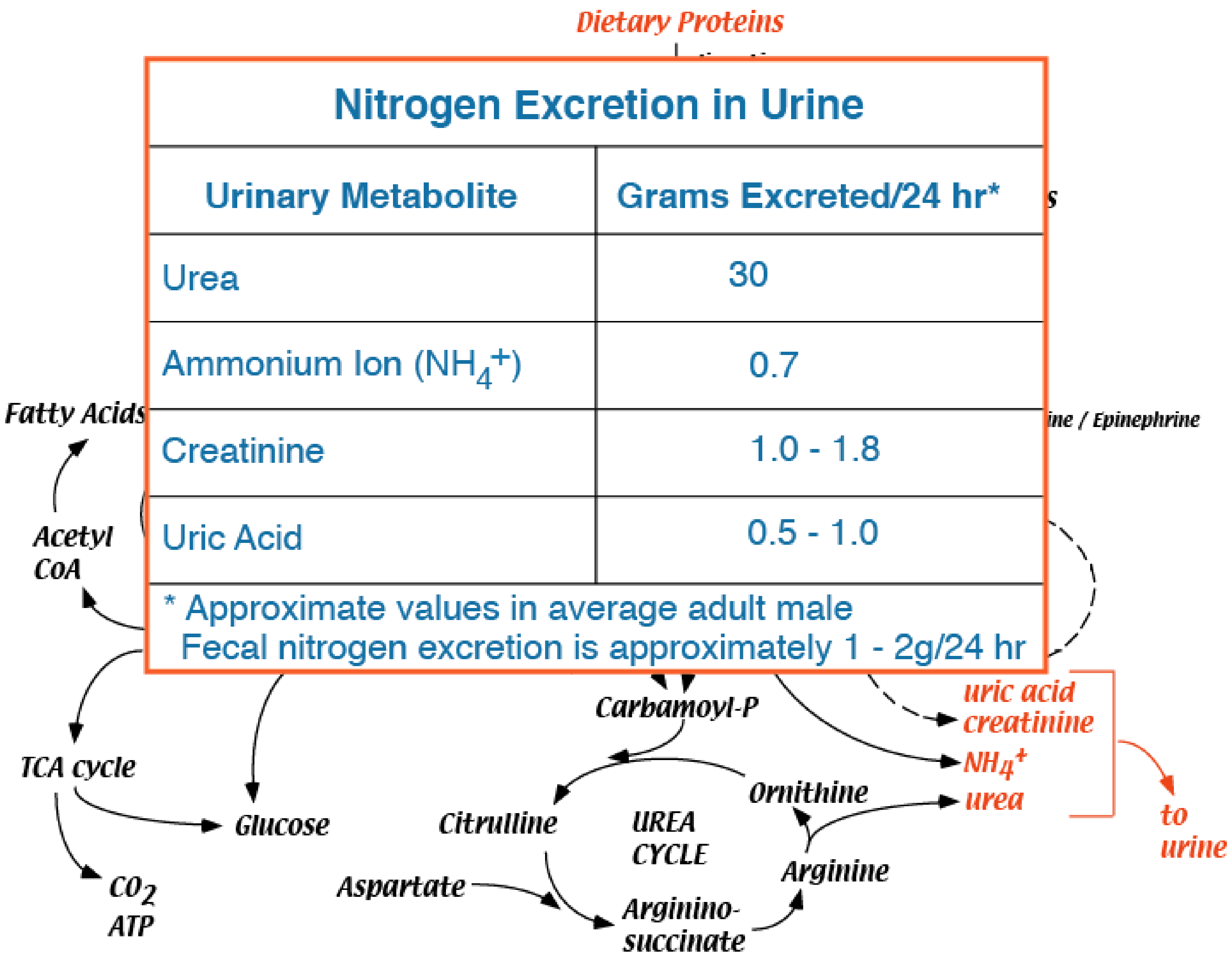


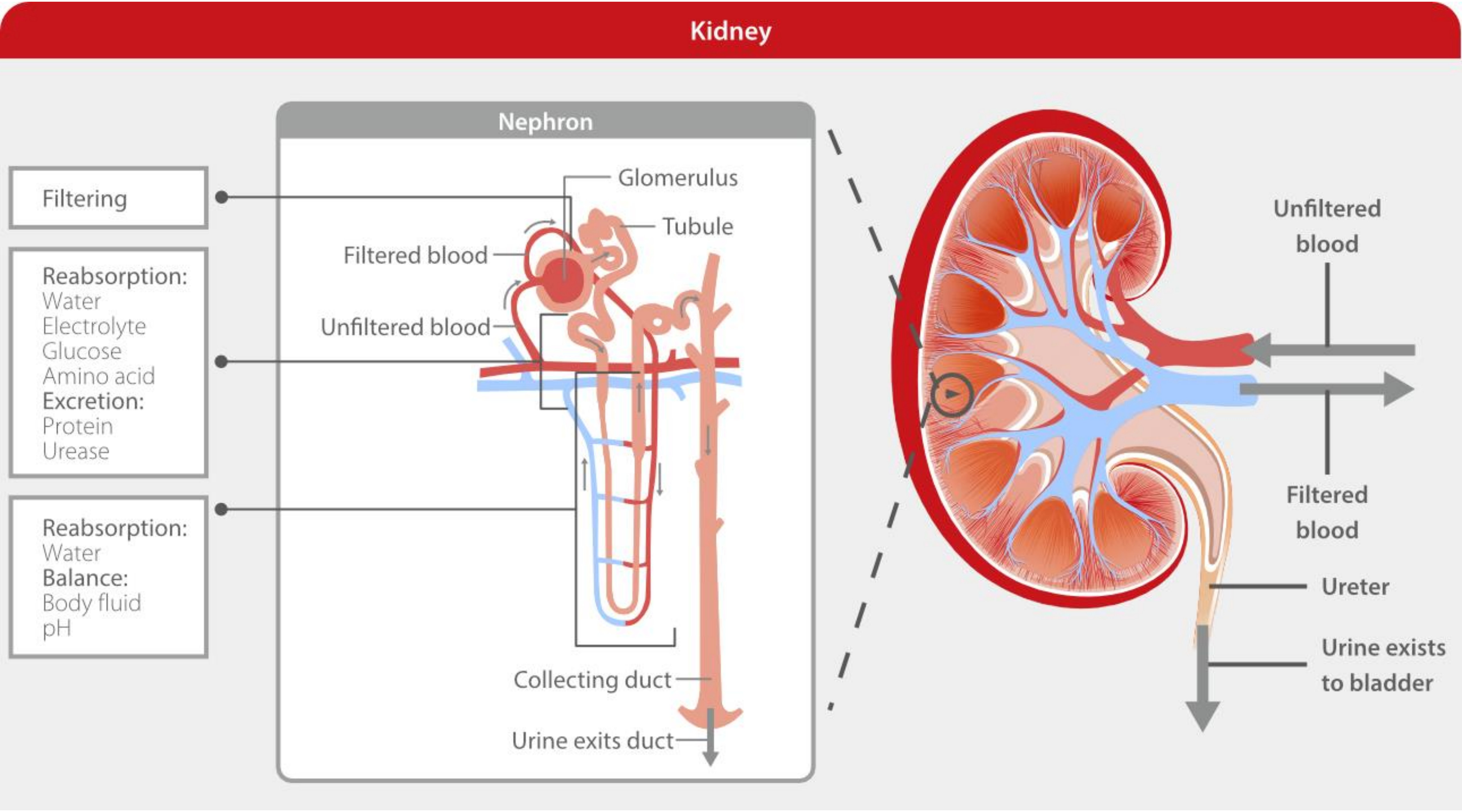
Fig. 2: Amino acid and protein metabolism (Modified from: Matthews and Fong, 1993)



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


Kidney
Nephron
Filtering
Reabsorption:
Water
Electrolyte
Glucose
Amino acid
Excretion:
Protein
Urease
Reabsorption:
Water
Balance:
Body fluid
pH
Glomerulus
Tubule
Filtered blood
Unfiltered blood
Collecting duct
Urine exits duct
Unfiltered blood
Filtered blood
Ureter
Urine exists to bladder

Fungsi ekskresi ginjal

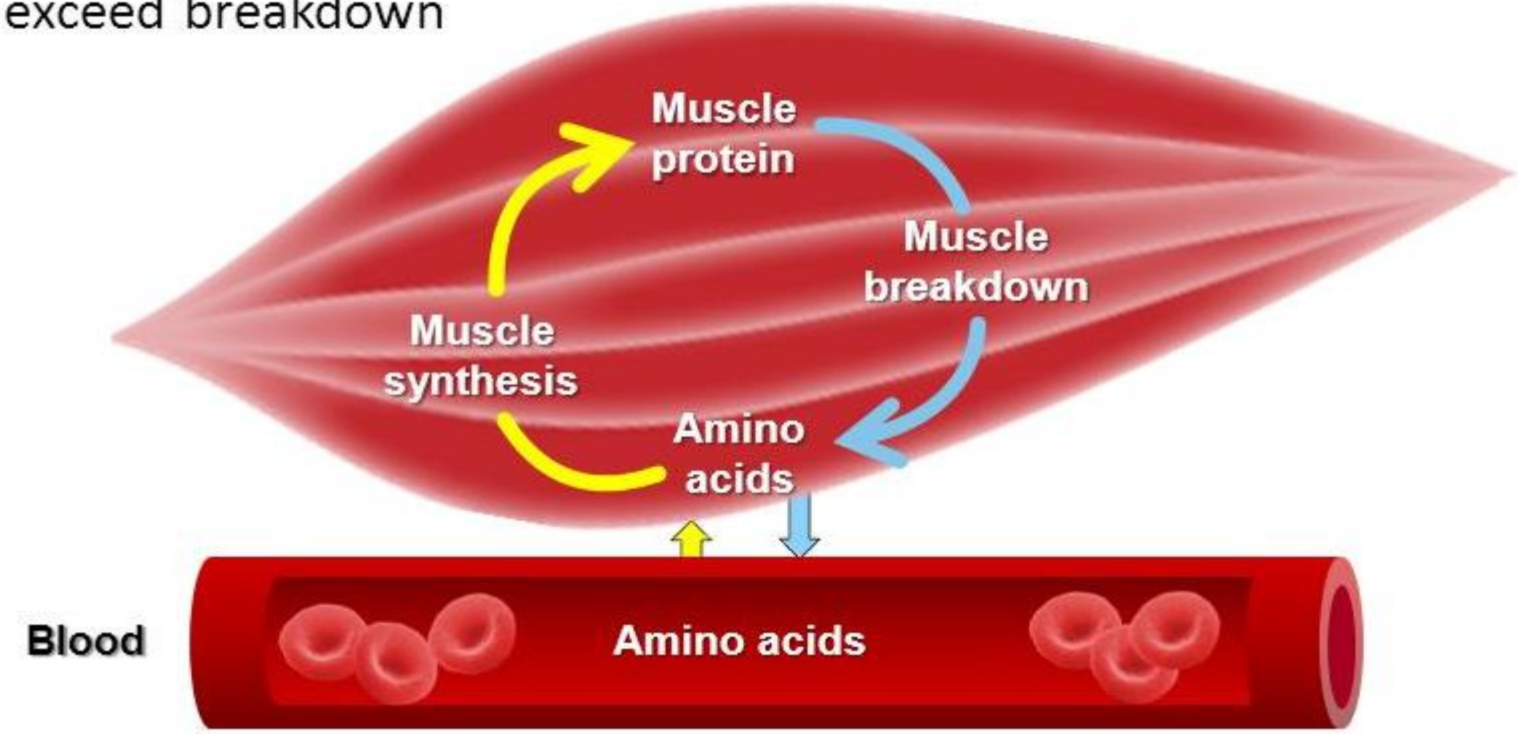
	Daily load in adults	Effects in renal failure
Metabolit nitrogen		Peningkatan konsentrasi plasma (azotemia)
Urea	(dietary prot x 1/3) g	
Asan urat	4 mmol	
kreatinin	10 mmol	
Metabolit lain		
Sulfat	25 – 40 mmol	Asidosis
Ion hidrogen	40 – 80 mmol	Asidosis
Metabolit obat		Keracunan obat
Zat gizi lebih		
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	Erytropoetin
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 reabsorbsi air	Konversi vit D menjadi bentuk aktif 1,25-dihydroxy vit D di tubulus proksimal	Berperan untuk pembentukkan 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



Lecker SH, et al. *J Nutr*. 1999;129:227S-237S.
Waterlow JC. *Q J Exp Physiol*. 1984;69:409-438.

Muscle Protein Balance

Protein Balance =

Protein Synthesis (PS) – Protein Breakdown (PB)

+ **Positive Net Balance** +

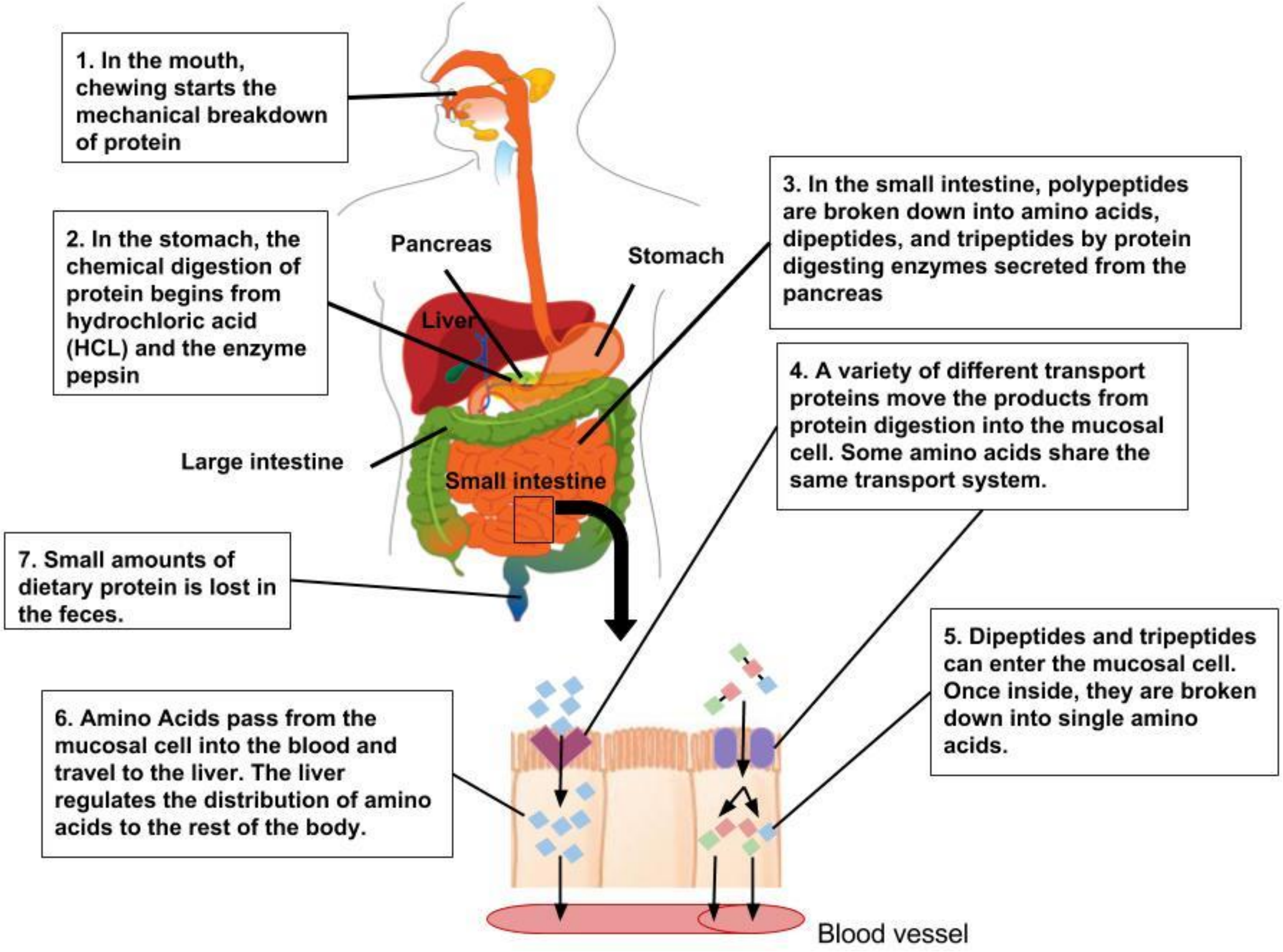
↑

PS > PB = lean body mass gain

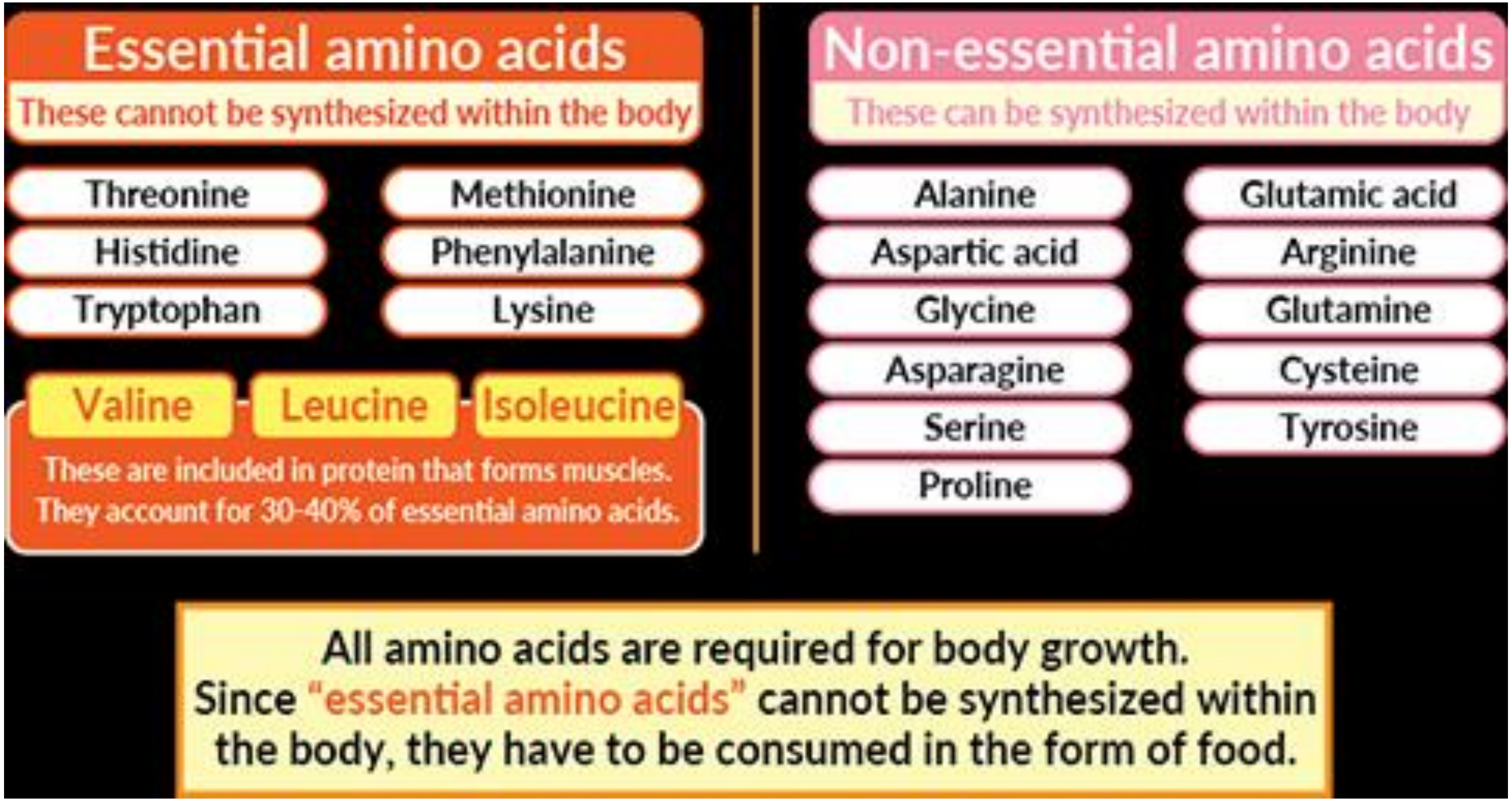
PB > PS = lean body mass loss

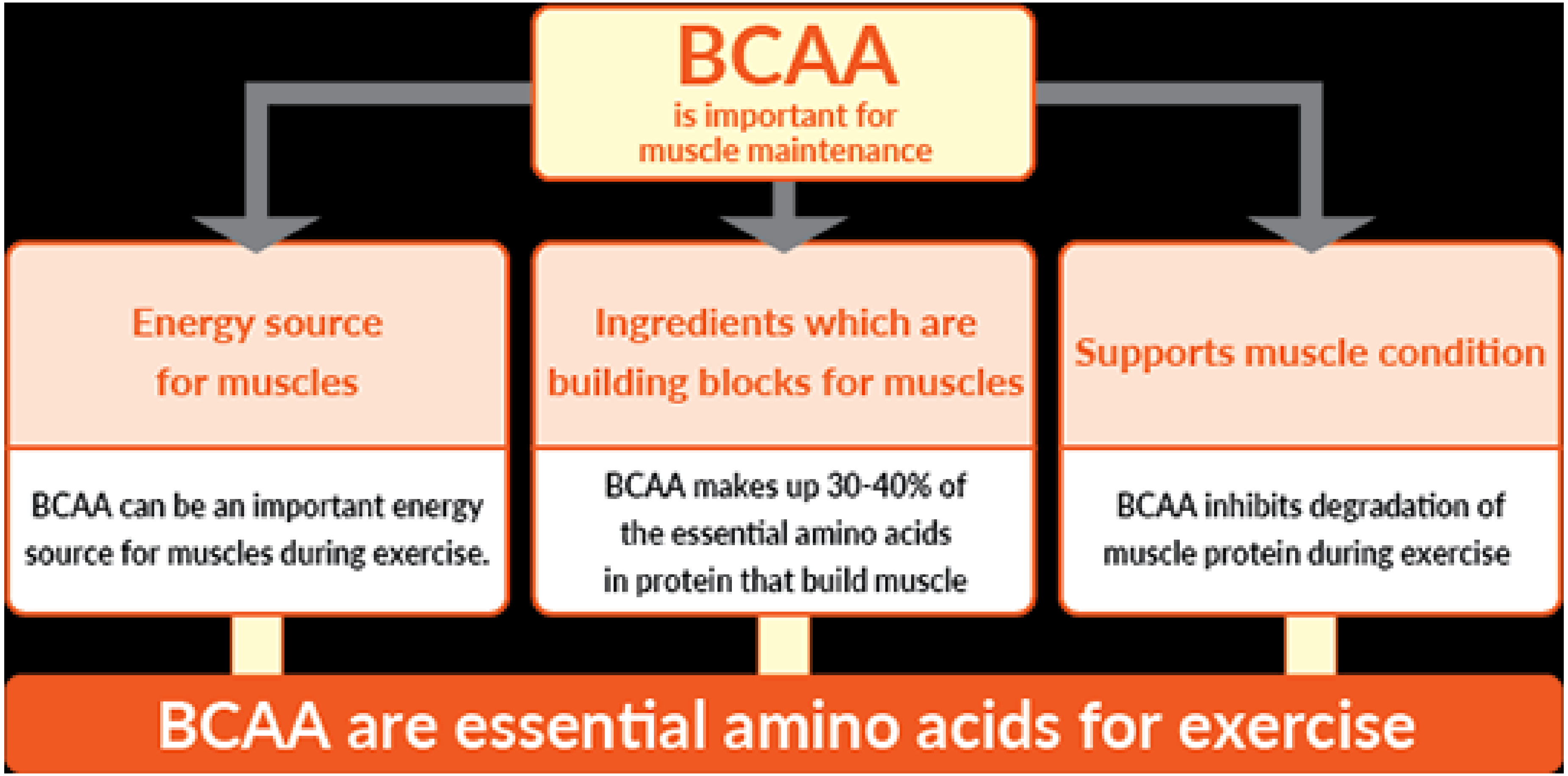
↓

- **Negative Net Balance** -


1. In the mouth, chewing starts the mechanical breakdown of protein
2. In the stomach, the chemical digestion of protein begins from hydrochloric acid (HCL) and the enzyme pepsin
Pancreas
Stomach
Liver
3. In the small intestine, polypeptides are broken down into amino acids, dipeptides, and tripeptides by protein digesting enzymes secreted from the pancreas
4. A variety of different transport proteins move the products from protein digestion into the mucosal cell. Some amino acids share the same transport system.
Large intestine
Small intestine
7. Small amounts of dietary protein is lost in the feces.
5. Dipeptides and tripeptides can enter the mucosal cell. Once inside, they are broken down into single amino acids.
6. Amino Acids pass from the mucosal cell into the blood and travel to the liver. The liver regulates the distribution of amino acids to the rest of the body.
Blood vessel

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.


BCAA
is important for
muscle maintenance
Energy source
for muscles
BCAA can be an important energy
source for muscles during exercise.
Ingredients which are
building blocks for muscles
BCAA makes up 30-40% of
the essential amino acids
in protein that build muscle
Supports muscle condition
BCAA inhibits degradation of
muscle protein during exercise
BCAA are essential amino acids for exercise

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

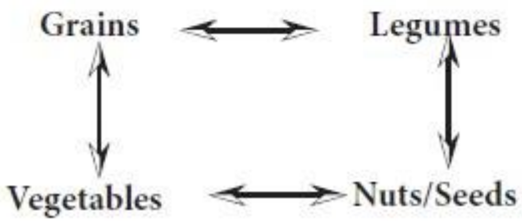


Fig 10.4: Complete Vs Incomplete protein

Calculating Nitrogen Balance

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

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

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

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

- UUN excretion may differ from 3 to 5 grams

Langkah yang dilakukan:

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

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

- 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:

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

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 adalah 62,5 gram.

Jawaban

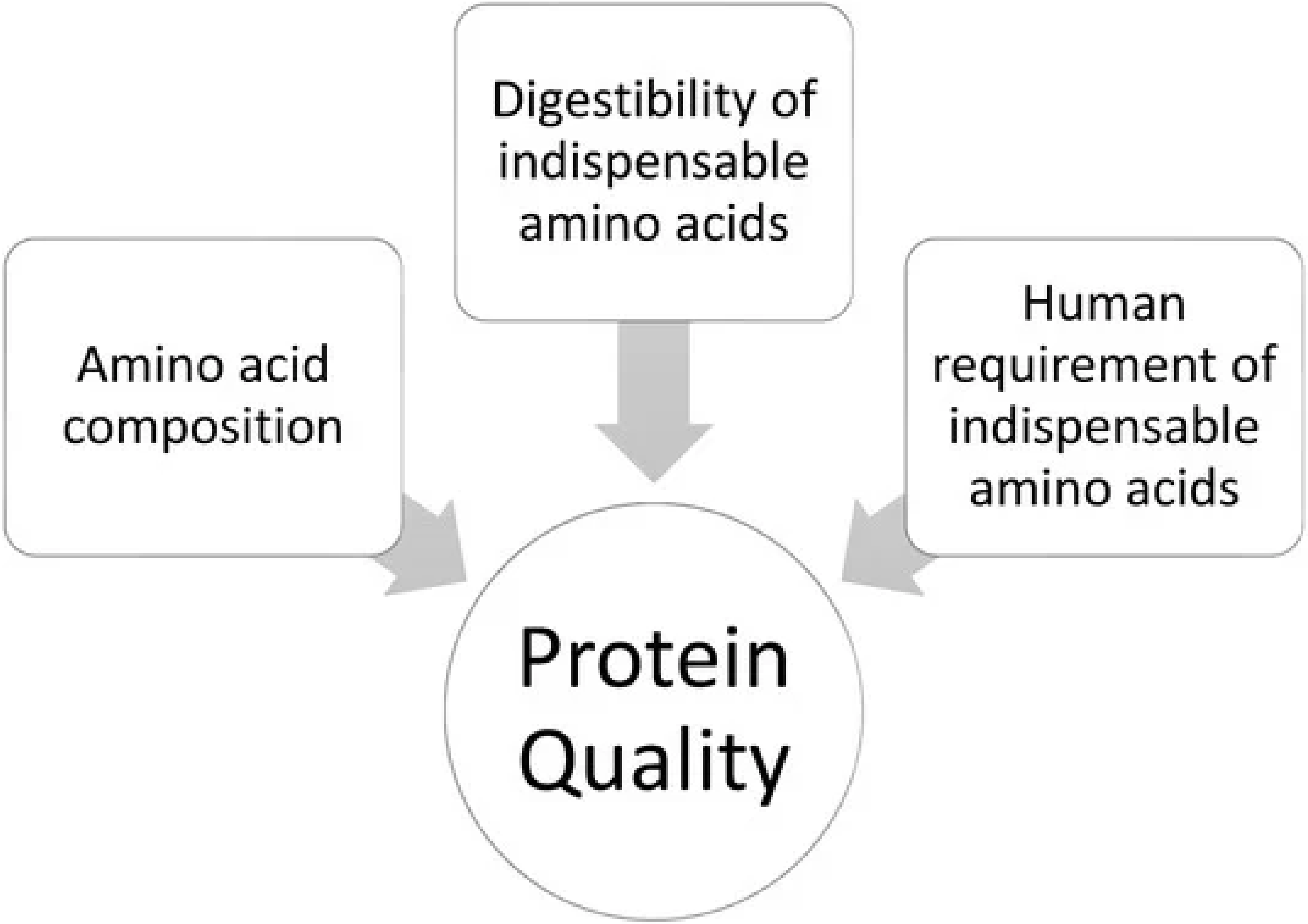
UUN total pasien = (500 x 2000)/ 100 = 10.000 mg = 10 gram

Besarnya asupan nitrogen = 62,5/6,25 = 10 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 x 6,25 = 25 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.


Digestibility of indispensable amino acids
Amino acid composition
Human requirement of indispensable amino acids
Protein Quality