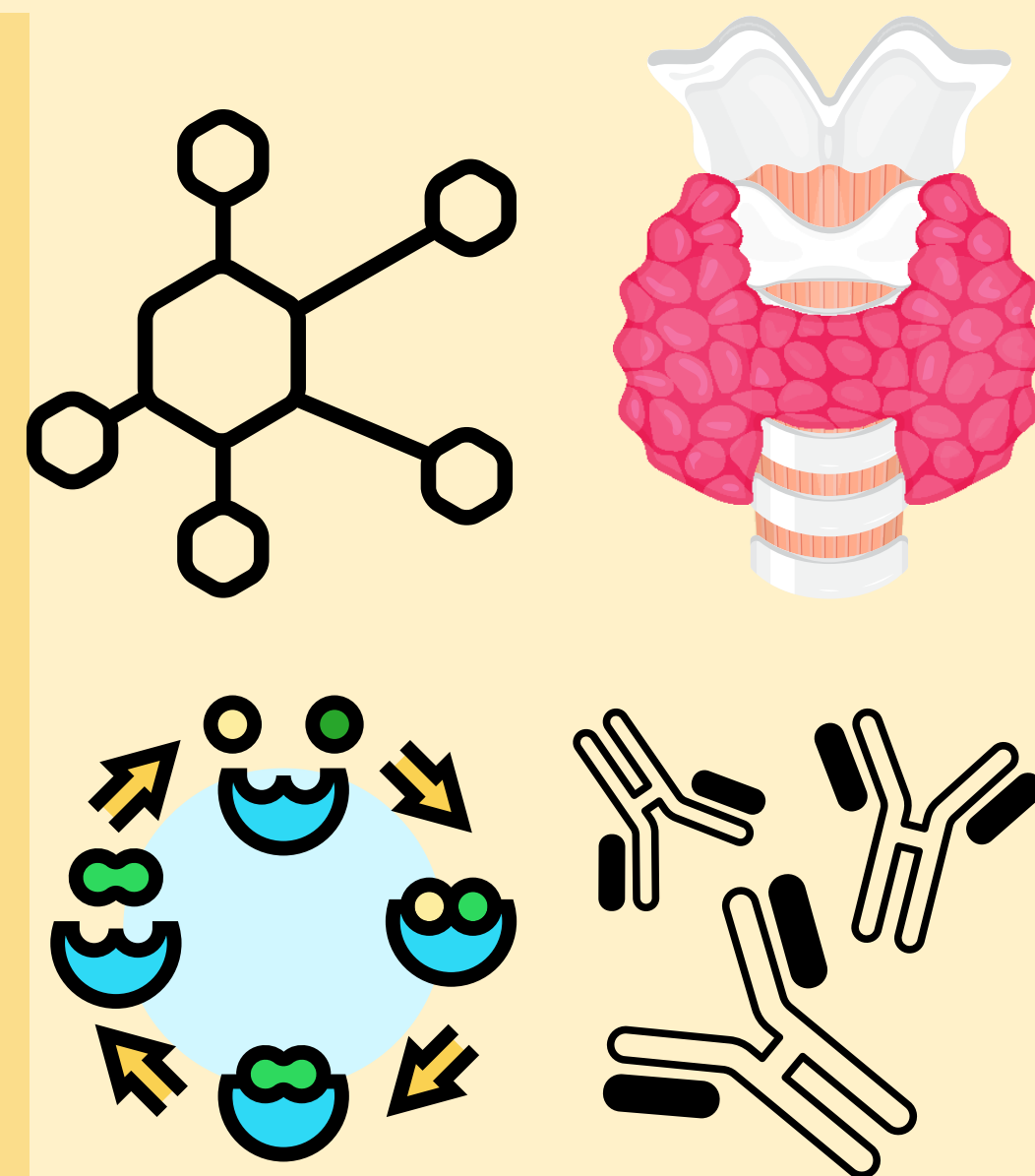


ALL ABOUT PROTEIN



THE FUNCTIONS OF PROTEIN:

- protein is a **fundamental macronutrient** essential for body's structure, function & regulation of the human body.
- Protein serve as **building blocks of tissues, muscles, organs and providing structural integrity** and support.
- Enzymes** functions also vital for **metabolic processes, facilitating chemical reactions** within the body.
- Hormones**, critical for body **regulation**, are protein-based and influenced metabolism and growth.
- Antibodies** are essential for **immune defense**, antibodies also recognized and neutralized harmful substances.
- Protein serve in **transport of molecules** across cell membranes and act as carriers for oxygen and nutrients.



RECOMMENDATION INTAKE:

- Recommended Dietary Allowance (RDAs)** for protein consumption very based on factors such as age, sex and physical activity level.
- general guidelines recommended **0.8 grams of protein per kilogram of body weight for adults (19+)**.
- Athletes may require high protein intake** and **older adults may also have higher intake (1-1.5 grams per kilogram)** based on age-related muscle loss level.

Daily Protein Foods Table

*These are general recommendations by age. Find the right amount for you by getting your [MyPlate Plan](#).

Daily Recommendation* in Ounce-Equivalents (oz-equiv)		
Toddlers	12 to 23 months	2 oz-equiv
Children	2-3 yrs	2 to 4 oz-equiv
	4-8 yrs	3 to 5½ oz-equiv
Girls	9-13 yrs	4 to 6 oz-equiv
	14-18 yrs	5 to 6½ oz-equiv
Boys	9-13 yrs	5 to 6½ oz-equiv
	14-18 yrs	5½ to 7 oz-equiv
Women	19-30 yrs	5 to 6½ oz-equiv
	31-59 yrs	5 to 6 oz-equiv
	60+ yrs	5 to 6 oz-equiv
Men	19-30 yrs	6½ to 7 oz-equiv
	31-59 yrs	6 to 7 oz-equiv
	60+ yrs	5½ to 6½ oz-equiv

BIOCHEMISTRY

Protein Structure

Primary structure: Linear sequence of amino acids connected by peptide bonds.

Secondary structure: Local folding motifs including the Alpha-helix and Beta-plated sheet, stabilized by hydrogen bonds.

Tertiary structure: The overall 3D shape of a single chain, stabilized by disulfide or Van der Waals bonds.

Quaternary structure: The assembly of multiple polypeptide chains into a functional protein complex.

TYPES OF PROTEIN SOURCES:

COMPLETE PROTEIN

- Contains all nine essential amino acids.
- Found in animal products; meat poultry, fish, eggs and dairy.

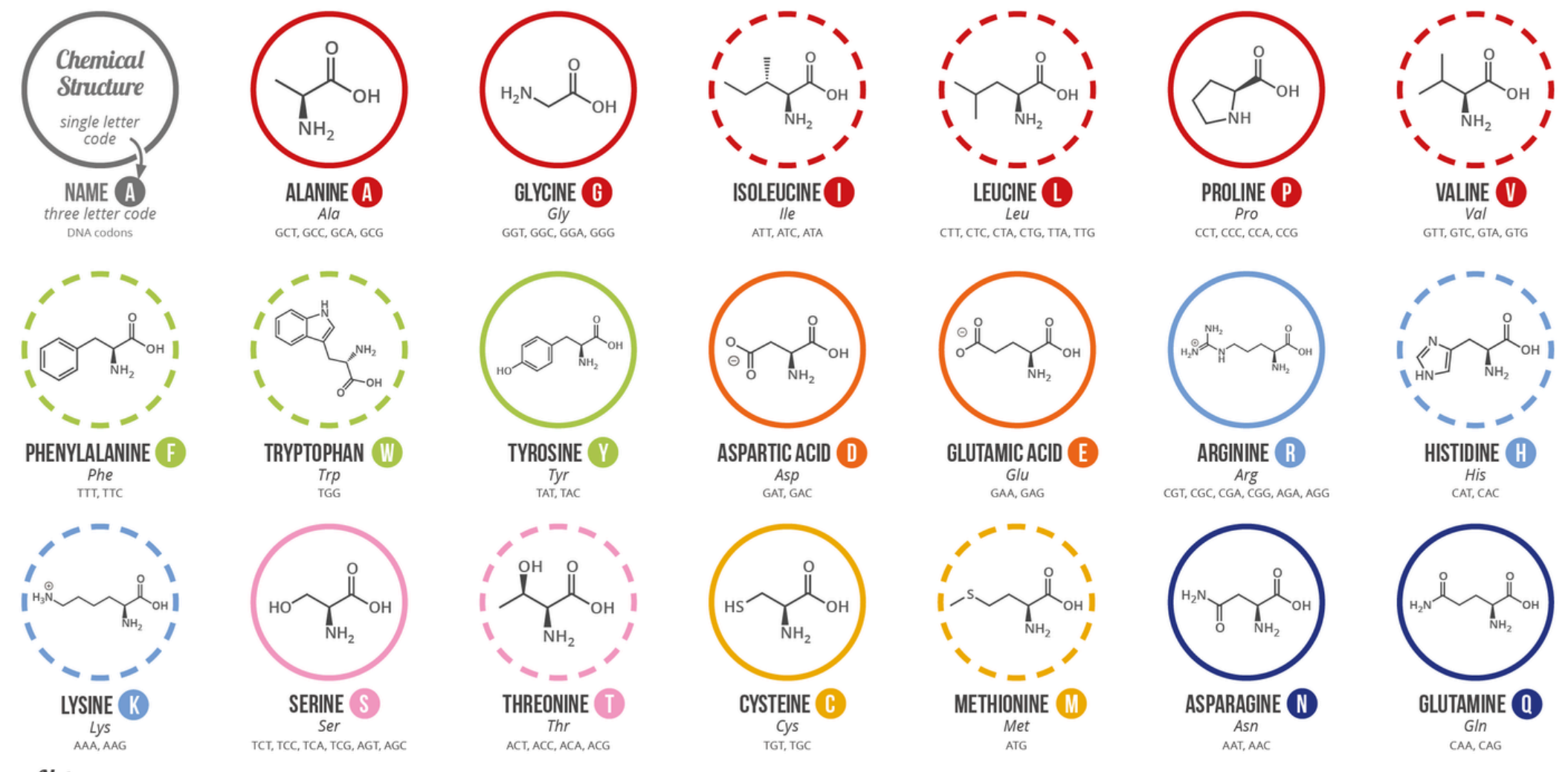
INCOMPLETE PROTEIN

- Lack one or more nine essential amino acids.
- Common in plant-based sources like beans, lentils, nuts and grains,

A GUIDE TO THE TWENTY COMMON AMINO ACIDS

AMINO ACIDS ARE THE BUILDING BLOCKS OF PROTEINS IN LIVING ORGANISMS. THERE ARE OVER 500 AMINO ACIDS FOUND IN NATURE - HOWEVER, THE HUMAN GENETIC CODE ONLY DIRECTLY ENCODES 20. 'ESSENTIAL' AMINO ACIDS MUST BE OBTAINED FROM THE DIET, WHILST NON-ESSENTIAL AMINO ACIDS CAN BE SYNTHESISED IN THE BODY.

Chart Key: ● ALIPHATIC ● AROMATIC ● ACIDIC ● BASIC ● HYDROXYLIC ● SULFUR-CONTAINING ● AMIDIC ○ NON-ESSENTIAL ○ ESSENTIAL



Note: This chart only shows those amino acids for which the human genetic code directly codes for. Selenocysteine is often referred to as the 21st amino acid, but is encoded in a special manner. In some cases, distinguishing between asparagine/aspartic acid and glutamine/glutamic acid is difficult. In these cases, the codes asx (B) and glx (Z) are respectively used.

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PROTEINS SOURCES AND AMOUNTS

Protein Content of Foods

Meat, Poultry, Eggs:

Food (Cooked)	Serving Size	Calories	Protein (g)
Chicken, skinless	3 oz	141	28
Steak	3 oz	158	26
Turkey, roasted	3 oz	135	25
Lamb	3 oz	172	23
Pork	3 oz	122	22
Ham	3 oz	139	14
Egg, large	1 egg	71	6

Seafood:

Food (Cooked)	Serving Size (oz)	Calories	Protein (g)
Salmon	3	155	22
Tuna	3	99	22
Shrimp	3	101	20
Lobster	3	76	16
Scallops	3	75	14

Legumes, Grains, Vegetables:

Name of Food (Cooked)	Serving Size (cup)	Calories	Protein (g)
Pinto Beans	½	197	11
Adzuki Beans	½	147	9
Lentils	½	101	9
Edamame	½	95	9
Black Beans	½	114	8
Red Kidney Beans	½	112	8
Chickpeas	½	134	7
Black-eyed Peas	½	100	7
Fava Beans	½	94	7
Wheat Berries	½	151	6
Kamut	½	126	6
Lima Beans	½	105	6
Quinoa	½	111	4
Peas, Green	½	59	4
Spinach, cooked	½	41	3

Protein Content of Foods

Nuts and Seeds:

Food	Serving Size	Calories	Protein (g)
Soy Nuts	1 oz	120	12
Pumpkin Seeds	1 oz	159	9
Peanuts	1 oz	166	7
Peanut Butter	1 Tbsp	188	7
Almonds	1 oz	163	6
Pistachios	1 oz	161	6
Flax Seeds	1 oz	140	6
Sunflower Seeds	1 oz	140	6
Chia Seeds	1 oz	138	5
Walnuts	1 oz	185	4
Cashews	1 oz	162	4

Dairy Products:

Food	Serving Size	Calories	Protein (g)
Greek Yogurt	6 oz	100	18
Cottage Cheese (1% fat)	4 oz	81	14
Regular Yogurt (nonfat)	1 cup	100	11
Milk, Skim	1 cup	86	8
Soy milk	1 cup	132	8
Mozzarella (part skim)	1 oz	72	7
String Cheese (nonfat)	1 piece (0.75 oz)	50	6

- Encouraging a diverse diet incorporating both animal & plant-based sources ensures a balance of essential amino acids.

HEALTHIER VS. LESS HEALTHY FOOD SOURCES

HEALTHIER

- **Lean Animal Proteins:**
 - Chicken, turkey, fish, and lean cuts of beef provide high-quality protein with lower saturated fat content, supporting heart health
- **Plant- Based Proteins:**
 - Incorporating beans, lentils, nuts, and seeds offers protein with added fiber, vitamins, and minerals, contributing to overall health.
- **Low-Fat Dairy:**
 - Greek yogurt & low-fat dairy products provide protein while minimizing saturated fat intake.

LESS HEALTHY

- **Processed Meats:**
 - Bacon, sausages, and deli meats are high in sodium (Na⁺) and saturated fats, linked to increased risks of heart disease.
- **Fried and Breaded Proteins :**
 - Deep-frying or breading adds unhealthy fats and excess contributing to weight gain and metabolic issues.
- **Fatty Cuts of Meat:**
 - High fat cuts can elevate saturated fat intake, impacting cardiovascular health.



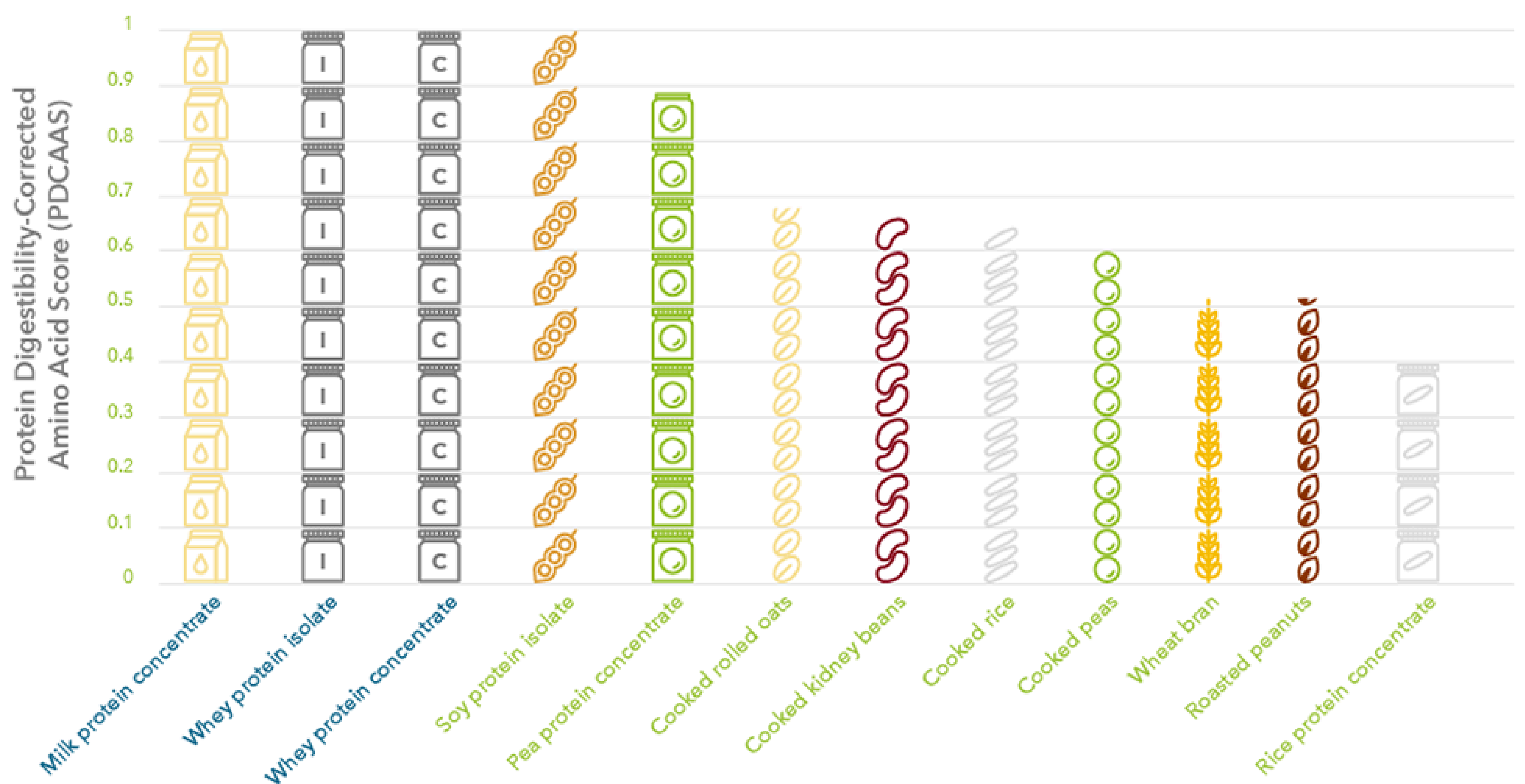
THE ASSESSMENT OF PROTEIN QUALITY BIOLOGICAL VALUE (BV)

- A method to assess quality of dietary proteins, measures the proportion of absorbed protein that the body retains for various physiological functions.
- **Retention Efficiency:**
 - BV indicates how efficiently the body retains and utilized the absorbed protein for building and repairing tissues, enzymes, and other essential proteins.
- **Higher BV, Better Quality:**
 - A higher BV suggests better protein quality, as more of the absorbed protein contributes to the body's protein pool
- **Direct relationship:**
 - There is a direct relationship between BV and the amino acid profile of a protein.
 - Proteins with well-balanced and complete set of essential amino acids tend to have a higher BV.

PROTEIN DIGESTIBILITY: PDCAAS (PROTEIN DIGESTIBILITY-CORRECTED AMINO ACID SCORE)

- A method to assess protein quality, considering amino acid composition and digestibility.
- **Amino Acid Composition:** PDCAAS accounts for the essential amino acids present in a protein. Essential amino acids are those that the body cannot produce on its own and must be obtained through the diet.
- **Digestibility factor:** The digestibility factor in PDCAAs takes into account how efficiently the body can break down and absorb the proteins. This factor is crucial in determining the actual availability; ability of amino acids for bodily functions.

Protein Quality of Different Foods, Measured by PDCAAS



Source: Protein Digestibility-Corrected Amino Acid Scores and Digestible Indispensable Amino Acid Scores Differently Describe Protein Quality in Growing Male Rats. Rutherford et al, The Journal of Nutrition, Volume 145, Issue 2, February 2015, Pages 372-379.

Protein quality varies between different protein sources due to their amino acid content and digestibility. Plant proteins (green text) are typically lacking in one or more essential amino acids.

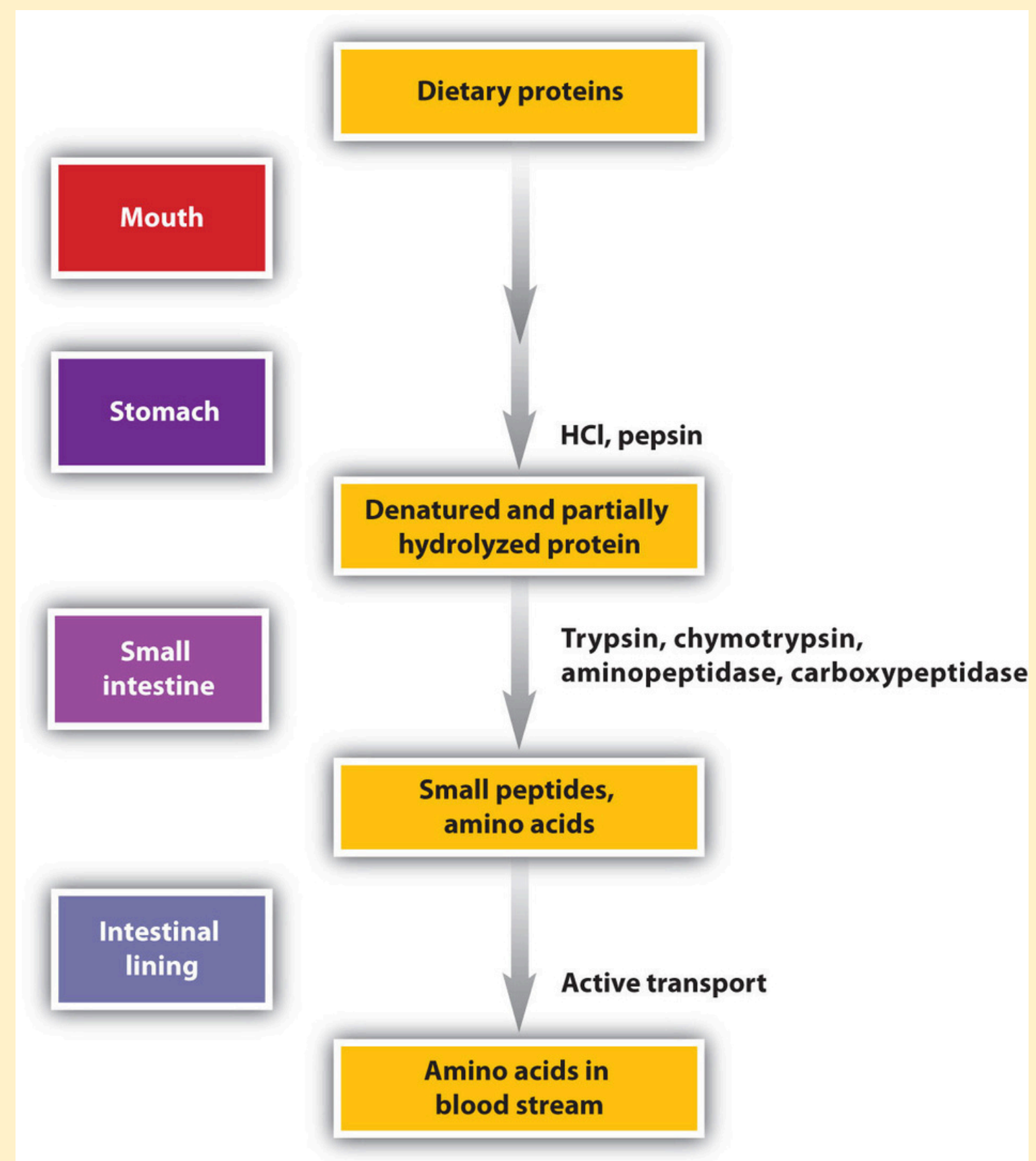
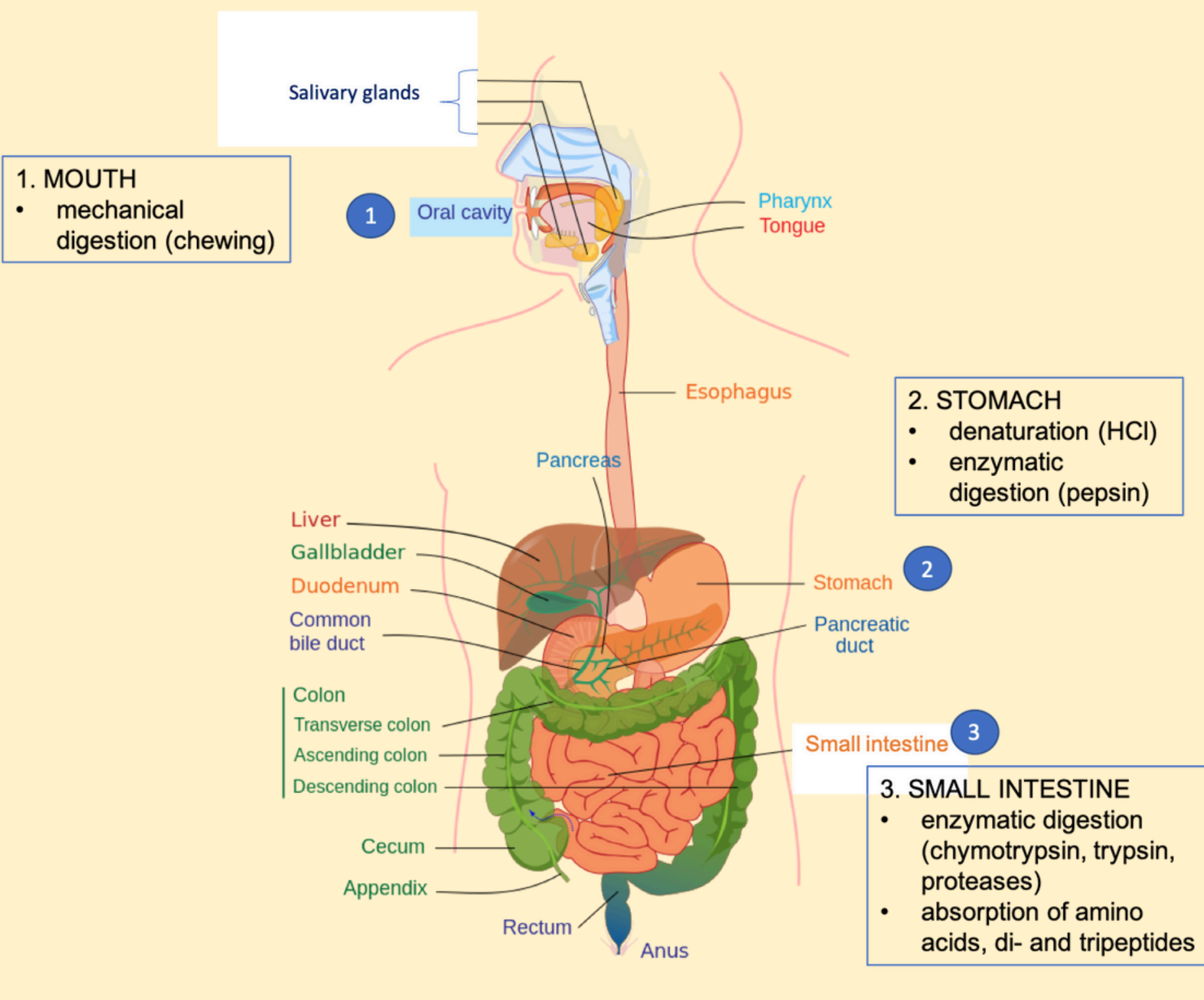
PROTEIN METABOLISM

Digestion and Absorption:

- **Stomach:** Pepsin breaks down proteins into peptides.
- **Small Intestine:** Protease further break down peptides into amino acids for absorption.
- **Absorption:** Amino acids are transported to the liver via the bloodstream.

Urea Cycle:

- **Liver converts ammonia to urea:** Aids in the excretion of nitrogen, a byproduct of protein metabolism



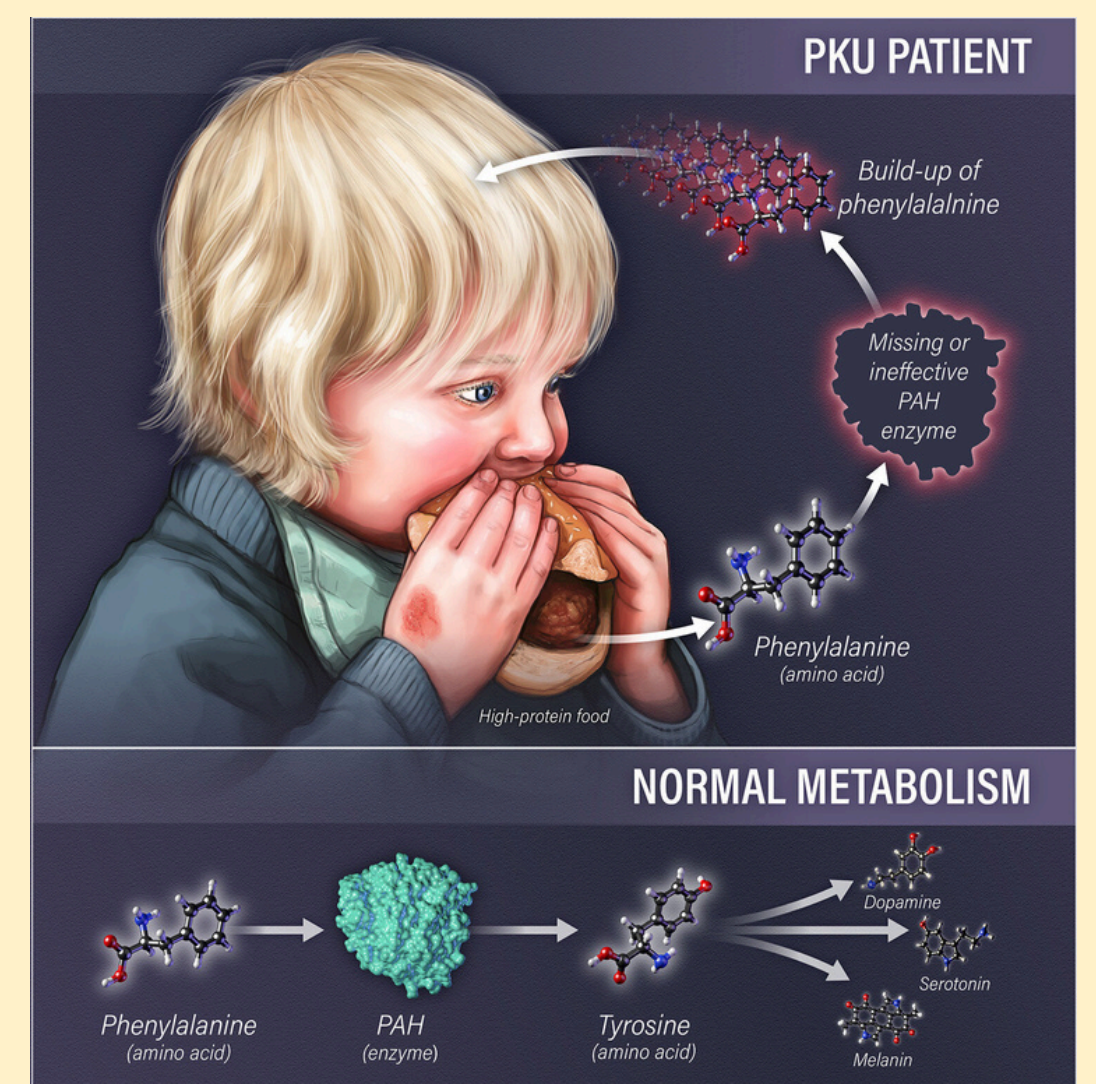
Amino Acid Inborn Errors of Metabolism:

• Maple Syrup Urine Disease (MSUD)

- raised from deficiency of enzyme complex responsible for breaking down branched-chain amino acids (leucine, isoleucine and valine)
- Autosomal recessive inheritance: Mutated genes are inherited from both parents, impacting body ability to process these amino acids.
- BCAA accumulate, leading to neurotoxins and metabolic crises.

• (PKU) Phenylketonuria and Maple Syrup Urine Disease.

- arises from deficiency of enzyme phenylalanine hydroxylase.
- Individual inherit mutated genes from both parents.
- causing potential cognitive and neurological issues.



EXCESS DIETARY PROTEIN

Concerns:

- **Bone Health Issue:** High in animal protein intake may increase calcium loss and affecting bone health.
- **Kidney Function:** Excessive protein intake may strain kidneys, especially in individual with pre-existing kidney issues population.
- **Digestive Issue:** Excessive protein may also cause digestive tract discomfort.

PROTEIN DEFICIENCY:

Concerns:

- **Muscle Loss:** Inadequate protein intake can lead to muscle wasting.
- **Immune Dysfunction:** Protein deficiency may compromise to immune function.
- **Edema and Malnutrition:** Severe deficiency can lead to edema and overall malnutrition.

CITATION

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BEST HIGH PROTEIN FOODS FOR OLDER ADULTS. BEST HIGH PROTEIN FOODS FOR OLDER ADULTS | ONE MEDICAL. (2021, JULY 15). [HTTPS://WWW.ONEMEDICAL.COM/BLOG/DIET-NUTRITION/BEST-SOURCES-OF-PROTEIN-FOR-OLDER-ADULTS/](https://www.onemedical.com/blog/diet-nutrition/best-sources-of-protein-for-older-adults/)

INTERACTIVE NUTRITION FACTS LABEL - VITAMINS AND MINERALS CHART. (N.D.-A). [HTTPS://WWW.ACCESSDATA.FDA.GOV/SCRIPTS/INTERACTIVENUTRITIONFACTSLABEL/ASSETS/INTERACTIVENFL_VITAMINS&MINERALSCHART_OCTOBER2021.PDF](https://www.accessdata.fda.gov/scripts/interactivenutritionfactslabel/assets/interactivenfl_vitamins&mineralschart_october2021.pdf) PROTEIN CONTENT OF FOODS - TODAY'S DIETITIAN. (N.D.-B).

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