Proteins

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The name protein is derived from the Greek term proteos, which means “primary” or “to take place first.” Protein was first identified in a laboratory about a century ago at which time scientists described it as a nitrogen-containing part of food that is essential to human life. Protein content reaches in the adult level of about 18% of body weight. Proteins contain carbon, hydrogen, and oxygen, but in different proportions. In addition, and most important, they are the only nutrient group that contains nitrogen, and some contain sulfur.

Food Sources

Proteins are found in both animal and plant foods. The animal food sources provide the highest quality of **complete proteins:** proteins that contain all the essential amino acids such as meats, fish, poultry, eggs, milk, and cheese. Despite the high biologic value of proteins from animal food sources, they also provide saturated fats and cholesterol. The plant food sources provide the highest quality of **incomplete proteins:** proteins that lack one or more of the essential amino acids such as lentil, peas, soybeans, corn, grains and nuts.

Amino acids

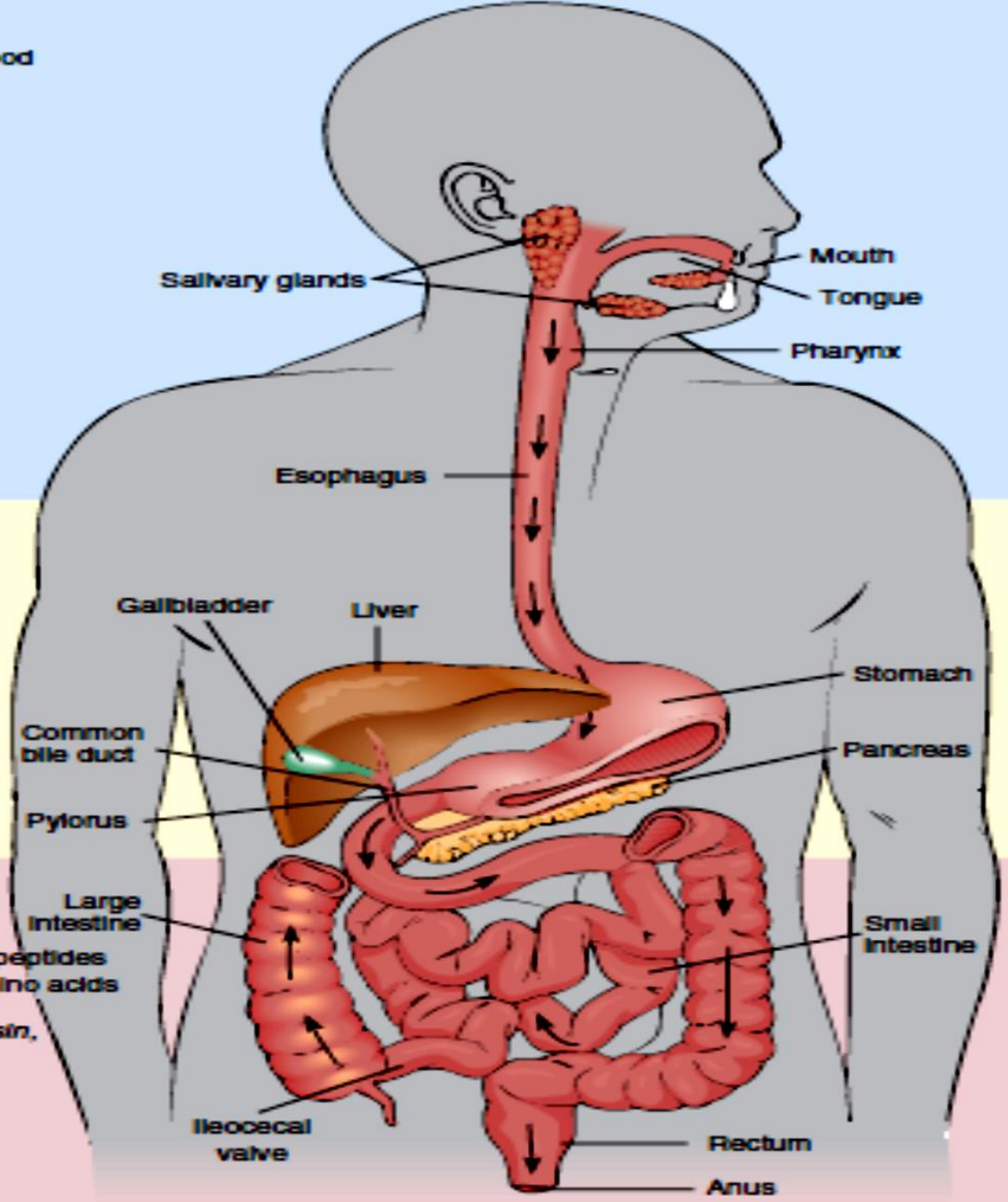
Proteins are composed of chemical compounds called amino acids which are sometimes called the building blocks of protein because they are combined to form the thousands of proteins in the human body. All amino acids have the same basic design, there is both a nitrogen-containing amino portion and carboxylic acid portion attached to a central carbon atom. There are probably hundreds of different amino acids found in nature, but only **twenty** are incorporated into the proteins found in living things

Essential Amino Acids that body cannot synthesize so must be obtained through food	Nonessential Amino Acids that body can manufacture with enough amount
Tryptophan	Alanine
Valine	Proline
Threonine	Tyrosine
Isoleucine	Cysteine
Leucine	Serine
Lysine	Glutamine
Phenylalanine	Glutamic acid
Methionine	Glycine
Arginine*	Asparagine
Histidine*	Aspartic acid

Functions

- Structural tissue building
- Water balance through osmotic pressure
- Buffer agent to help maintain pH balance
- Digestion and metabolism through enzymatic action
- Cell signaling (hormones) and transport (e.g., hemoglobin and transferrin)
- Immunity (antibodies)
- Source of energy (4 kcal/g)

Mouth
Mechanical digestion creates smaller food pieces that mix with saliva.



Stomach
Stomach mucosa secretes pepsinogen. Pepsinogen is activated to *pepsin* by HCl:

Protein $\xrightarrow[HCl]{pepsin}$ smaller polypeptides

Small Intestine
Pancreatic and intestinal proteases continue hydrolysis:

Polypeptides $\xrightarrow{pancreatic\ and\ intestinal\ proteases}$ dipeptides amino acids

Pancreatic enzymes: *trypsin*, *chymotrypsin*, and *carboxypeptidase*
Intestinal enzymes: *aminopeptidase* and *dipeptidase*

Peptides $\xrightarrow[dipeptidase]{aminopeptidase}$ amino acids

Absorbed amino acids enter the portal blood and travel to the liver

Summary of protein digestion

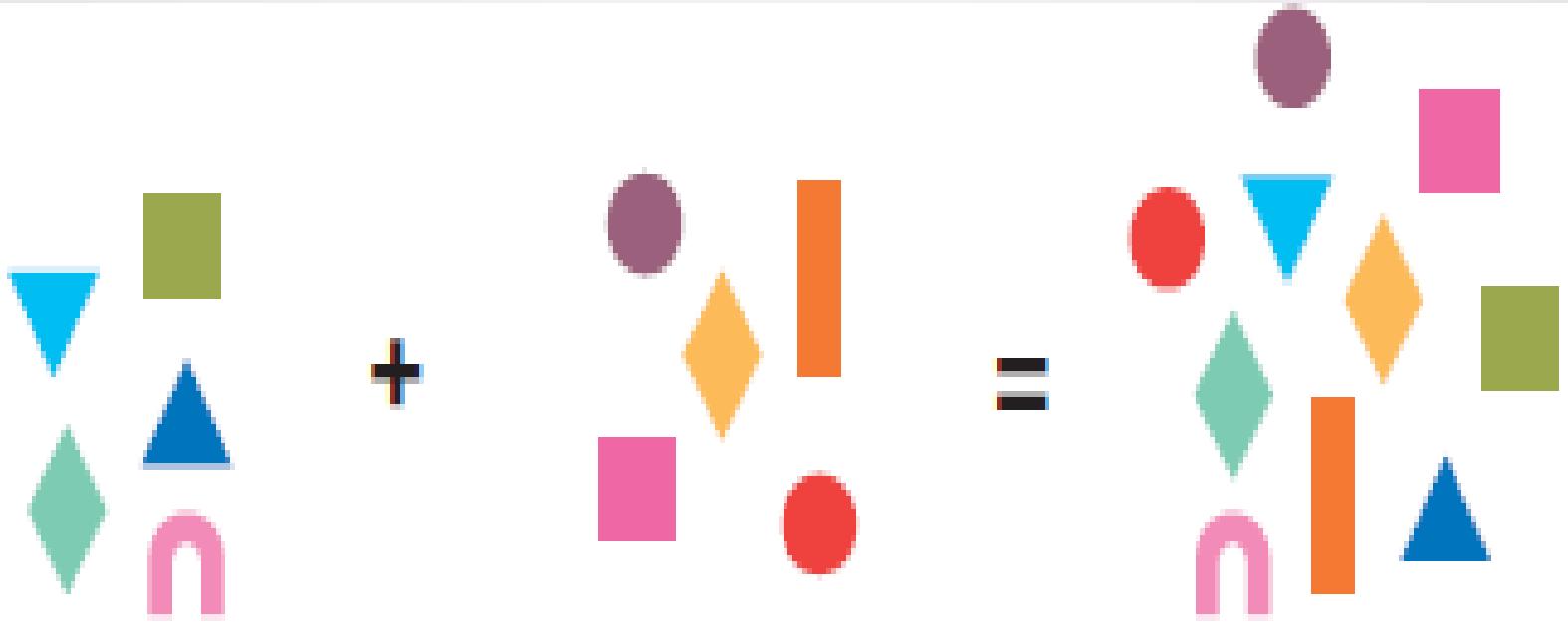


Figure 6-2 *All amino acids have a chemical backbone of a carbon atom; an amine group, which contains nitrogen; an acid group; and a side group. It is the chemical structure of the side group that gives each amino acid its unique identity.*

METABOLISM AND ELIMINATION

All essential amino acids must be present to build and repair the cells as needed. When amino acids are broken down, the nitrogen-containing amine group is stripped off. This process is called deamination. Deamination produces ammonia, which is released into the bloodstream by the cells. The liver picks up the ammonia, converts it to urea, and returns it to the bloodstream for the kidneys to filter out and excrete. The remaining parts are used for energy or are converted to carbohydrate or fat and stored as glycogen or adipose tissue.

LIFE STAGE GROUP	AGE	PROTEIN (GRAMS/DAY)
Infants		
	0–6 mo	9.1
	7–12 mo	11.0
Children		
	1–3 y	13
	4–8 y	19
Males		
	9–13 y	34
	14–18 y	52
	19–30 y	56
	31–50 y	56
	51–70 y	56
	> 70 y	56
Females		
	9–13 y	34
	14–18 y	46
	19–30 y	46
	31–50 y	46
	51–70 y	46
	> 70 y	46
Pregnancy		
	14–18 y	71
	19–30 y	71
	31–50 y	71
Lactation		
	14–18 y	71
	19–30 y	71
	31–50 y	71