

- Chapter 4

- Proteins

- Chapter 4

Lesson 4.1

- Key Concepts

- Food proteins provide the amino acids necessary for building and maintaining body tissue.

- Protein balance, both within the body and in the diet, is essential to life and health.

- The quality of a protein food and its ability to meet the body's needs are determined by the composition of amino acids.

- Amino Acids: Basic Building Material

- Each protein is composed of hundreds of amino acids

- Amino acids form unique chain sequences to form specific proteins

- When protein foods are eaten, proteins are broken down into amino acids

- Amino acids are reassembled in the body to form a variety of proteins

- Amino Acid Structure

- Classes of Amino Acids

- Indispensable amino acids

- Body cannot manufacture in sufficient quantity

- Dispensable amino acids

- Body can synthesize from indispensable

- Conditionally indispensable amino acids

- Normally synthesized but some health conditions may require dietary intake

- **A Healthy Balance**
- **Protein balance**
  - **Catabolism: breakdown**
  - **Anabolism: resynthesis**
- **Nitrogen balance (intake = excretion)**
  - **Positive nitrogen balance: body stores more than it excretes**
  - **Negative nitrogen balance: body takes in less than it excretes**
- **Functions of Protein**
- **Tissue building**
- **Energy**
- **Water balance**
- **Metabolism**
- **Body defense system**
- **Tissue Building**
- **Fundamental structural material of every cell**
- **Comprises bulk of:**
  - **Muscles**
  - **Internal organs**
  - **Brain**
  - **Nerves**
  - **Blood plasma**
- **Protein repairs worn-out, wasted, or damaged tissue**

- Energy
- May provide body fuel if the supply of carbohydrate and fat is insufficient for needs
- Less efficient
- Water Balance
- Plasma proteins attract water, resulting in maintenance of normal circulation
- Proteins have a unique structure to act as buffering agents
- Metabolism
- Enzymes
  - Digestive enzymes: amylases, lipases, proteases
- Transport agents
  - Lipoproteins
  - Hemoglobin
- Hormones
  - Insulin and glucagon
- Body Defense
- Immune system defends against disease and infection
  - White blood cells
  - Antibodies
- Balance between Protein Compartments and Amino Acid Pool
- Chapter 4

## Lesson 4.2

- **Key Concepts**
- **Food proteins provide the amino acids necessary for building and maintaining body tissue.**
- **Protein balance, both within the body and in the diet, is essential to life and health.**
- **The quality of a protein food and its ability to meet the body's needs are determined by the composition of amino acids.**
- **Food Sources of Protein**
- **Complete proteins**
  - **Meat, fish, poultry, seafood**
  - **Soy**
- **Incomplete proteins**
  - **Plant-origin foods**
    - **Grains**
    - **Legumes**
    - **Nuts**
    - **Seeds**
    - **Fruits and vegetables**
- **Vegetarian Diets**
- **Must combine foods to cover all amino acid needs**
- **Types of vegetarian diets**
  - **Lacto-ovo vegetarian**
  - **Lacto-vegetarian**
  - **Ovo-vegetarian**

- Vegan
- Lacto-Ovo Vegetarian Diet Pyramid
- Digestion of Proteins
- Mouth
- Stomach: enzymatic breakdown of protein by proenzymes (zymogens)
  - Pepsin
  - Hydrochloric acid
  - Rennin
- Small intestine
  - Pancreatic secretions
    - Trypsin, chymotrypsin, carboxypeptidase
  - Intestinal secretions
    - Aminopeptidase, dipeptidase
- Summary of Protein Digestion
- Body Needs for Protein
- Tissue growth
- Dietary protein quality
  - Chemical score (CS)
  - Biologic value (BV)
  - Net protein utilization (NPU)
  - Protein efficiency ratio (PER)
- Additional needs caused by disease

- Dietary Deficiency or Excess
- Protein energy malnutrition
  - Kwashiorkor
  - Marasmus
- Excess protein
  - Usually also means excess fat intake
  - Protein displaces other healthy foods in diet
  - Extra burden on kidneys
- Dietary Guides
- Recommended Dietary Allowances (RDAs)
  - Relate to age, sex, weight
  - Highest at birth and slowly decline into adulthood
  - Men and women: 0.8 g/kg of desirable weight
- Dietary Guides, cont'd
- Dietary Reference Intakes (DRIs) from National Academy of Sciences
  - 10% to 35% of total caloric intake from protein (children and adults)
- Calculating Protein Needs
- RDA:
  - 70 kg (~150 lb) adult
  - $70 \text{ kg} \times 0.8 \text{ g/kg} = 56 \text{ g/day}$
- Calculating Protein Needs, cont'd

- **DRI:**
  - Assumes individual consumes 2200 kcal/day; based on recommendation of 10% to 35% of total kilocalories from protein
  - $2200 \text{ kcal} \times 0.10-0.35 = 220-770 \text{ kcal/day}$  from protein
  - $220-770 \text{ kcal}, 4 \text{ kcal/g} = 55-192.5 \text{ g/day}$  of protein

- **Summary**

- Protein provides the body with its primary tissue-building units, amino acids

- 20 common amino acids

- Nine of the 20 amino acids are indispensable in the diet

- Body can manufacture the remaining 11 amino acids

- Complete proteins are foods that supply all the indispensable amino acids

- **Summary, cont'd**

- Complete proteins are usually of animal origin

- Plant foods are considered incomplete proteins because they lack one or more of the indispensable amino acids (with the exception of soy)

- Vegetarian diets can be strict with only plant proteins (vegan), whereas other variations include dairy, egg, and sometimes fish

- **Summary, cont'd**

- Adequate dietary protein and a reserve “pool” of amino acids help maintain overall protein balance

- A powerful digestive team of six protein-splitting enzymes acts to break down the protein to amino acids for vital tissue-building tasks

- Protein requirements are influenced by growth needs and nature of diet in terms of protein quality and energy intake

- **Summary, cont'd**

- **Clinical influences on protein include fever, disease, surgery, or other trauma to the body**
- **Protein needs are calculated based on RDA standards related to age, sex, and weight, which for both men and women is set at 0.8 g of high quality protein per kilogram of body weight per day**
- **Summary, cont'd**
- **Adjustments for protein intake are required for infants and pregnant and breastfeeding women**
- **Adjustments also may be necessary for individuals following a vegan diet**
- **Adjustments are made for critical illness**