

# PROTEINS AND AMINO ACIDS

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## OBJECTIVES/RATIONALE

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Knowledge of nutrients is important in understanding energy production and use. The student will identify proteins and relate their use by the body to health and wellness.

TEKS 121.24 1C, 6A, 6D

TAKS ELA 1, 3, 4, 5, 6  
Science 2, 4

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## KEY POINTS

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### I. Amino Acids – building blocks of proteins

#### A. Chemical Structure

1. Made of a central C and it's H with an amino group ( $\text{CH}_3$ ), an acid group ( $\text{COOH}$ ) and a unique side group attached.
2. Side chains make proteins more complex than either carbohydrates or lipids.
3. Side chains give the amino acids their distinctive characteristics.
4. About 20 different amino acids, each with a different side chain.
  - a. glycine is the simplest with a H as its side chain.
5. Non-essential amino acids – those amino acids the body can make
6. Essential amino acids – the 9 amino acids that the body cannot make and must be obtained by eating food.

### II. Proteins

#### A. Made by linking amino acids together end to end with a peptide bond.

1. The peptide bond made between two amino acids is created by a condensation reaction. ( $\text{H}_2\text{O}$  is made)
  - a. dipeptide – two amino acids linked together
  - b. tripeptide – three amino acids linked together
  - c. polypeptide – many amino acids are linked together
    - aa. Bonding a few dozen to several hundred amino acids together makes most proteins.
2. Polypeptide chains (proteins) can twist and coil into complex shapes
  - a. Shapes of the peptide chain gives it stability in the body.
  - b. Shape also allows it to carry out its function.
    - aa. If a protein loses its shape, it will not function.
    - bb. Denaturation is the process of changing the shape of a protein through some process that makes it uncoil and lose its shape.

#### B. Functions

1. Structural materials
  - a. Used as building blocks as the body grows.
  - b. Collagen – the protein from which connective tissues are made. (Scars, tendons, ligaments and the foundation for teeth and bones)

2. Enzymes
  - a. Facilitate chemical reactions without being changed in the process.
  - b. Each is specific for a specific reaction.
  - c. Used in reactions that build up or break down substances.
3. Hormones
  - a. Chemical messengers that are secreted by endocrine glands.
  - b. Transported to target tissues by the blood.
4. plasma proteins - Regulate fluid and electrolyte balance.
5. Protein Buffer System - Regulates acid base balance.
6. Transporters – transport other substances (exp: hemoglobin)
7. Antibodies – large proteins made by the immune system.
8. Other
  - aa. form parts of body structures – skin and muscles
  - bb. participate in body functions – vision

### III. Use of proteins

#### A. Digestion

1. Proteins in food provide the amino acids that the body uses to make proteins.
2. Proteins in food do NOT become body proteins. They are broken down into amino acids, which are then broken down into smaller molecules.
3. Stomach
  - a. HCl denatures the protein's amino acid strands so digestive enzymes can break the peptide bonds. HCl activates pepsin
  - b. Pepsin breaks large polypeptide chains into smaller ones.
4. Small intestine
  - a. Pancreatic and intestinal proteases (enzymes) continue hydrolyzing the peptide chains into shorter chains until they are broken down into individual amino acids.
  - b. Peptidase enzymes – break specific peptide bonds
    - aa. tripeptidase– breaks tripeptides
    - bb. dipeptidase – breaks dipeptides
    - cc. endopeptidase – breaks bonds inside a peptide chain
    - dd. exopeptidase – breaks bonds at the ends of the chain which releases free amino acids.

#### B. Absorption

1. Whole proteins are broken apart.  
Enzyme supplements are broken down just like other proteins (unless they break down other proteins).
2. Most peptides are broken down into amino acids before being absorbed.
3. Protein carriers transport the protein pieces into the intestinal cells.
4. Amino acids are absorbed at rates optimal for the body's use.

### IV. Proteins and health

#### A. Protein metabolism

1. Protein turnover – the continuous process of breaking down and building proteins
  2. Cells can use amino acids to make proteins the body needs.
    - aa. Only complete proteins are made.
    - bb. All the amino acids needed to make a protein must be present.
    - cc. The body does not store partially complete proteins or amino acids.
    - dd. Limiting amino acid – an essential amino acid supplied in less than the amount needed to support protein synthesis.
  3. Cells can rearrange amino acids to make other amino acids. (Except for the essential ones)
  4. Amino acids can be used for energy if glucose or fatty acids are in short supply by breaking down tissue proteins.
  5. Amino acids can be converted into fat and stored as adipose tissue if more protein is taken in than the body needs.
- B. Health risk
1. Over consumption of protein offers NO benefit but may pose some health risks.
  2. Heart disease
    - a. Some indication that diets high in animal proteins may have some correlation with heart disease. This may be due to animal proteins being high in saturated fats.
    - b. Some research has linked the amino acid homocystine to heart disease.
      - aa. Males with elevated homocystine levels were three times as likely to experience heart attacks.
  3. Cancer - Any effect may be associated with fats.
  4. Osteoporosis
    - a. Condition in which Ca is lost from bones.
    - b. Ca excretion seems to rise with consumption of animal proteins but not with plant proteins.
  5. Protein energy malnutrition – occurs when an individual is deprived of protein. Most widespread form of malnutrition in the world.
    - a. Marasmus
    - b. Kwashiorkor
  6. Weight control
    - a. Weight loss plans that promote a high intake of protein are not usually effective. Foods high in protein are often high in fat
    - b. Diets high in protein may prevent adequate intake of nutrients from other foods.
- C. Protein supplements
1. Taken to develop muscles and gain weight
    - a. Protein sparing – to minimize tissue loss while losing weight
    - b. Strengthens nails
  2. Protein supplements are costly and not digested well
  3. They do not build muscles, only exercise does
- D. Amino acid supplements

1. Taken for many reasons
  - a. sleep aids
  - b. weight
  - c. pain relievers
  - d. cure herpes sores
2. Single amino acids do not occur in nature.
3. An excess of one amino acid may cause a deficiency in another.
4. Normal healthy people never need protein or amino acid supplements.

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### **ACTIVITIES**

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- I. Create a 3-D model of a protein.
- II. Research and report on the use or misuse of protein supplements.

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### **MATERIALS NEEDED**

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Assorted materials for model  
Library  
Internet

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### **ASSESSMENT**

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Completion of the model  
**Writing Rubric**

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### **ACCOMMODATIONS**

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For reinforcement, the student will identify possible health risks associated with protein imbalance.

For enrichment, the student will participate in a debate concerning the use and abuse of protein and amino acid supplements by athletes.

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### **REFLECTIONS**

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