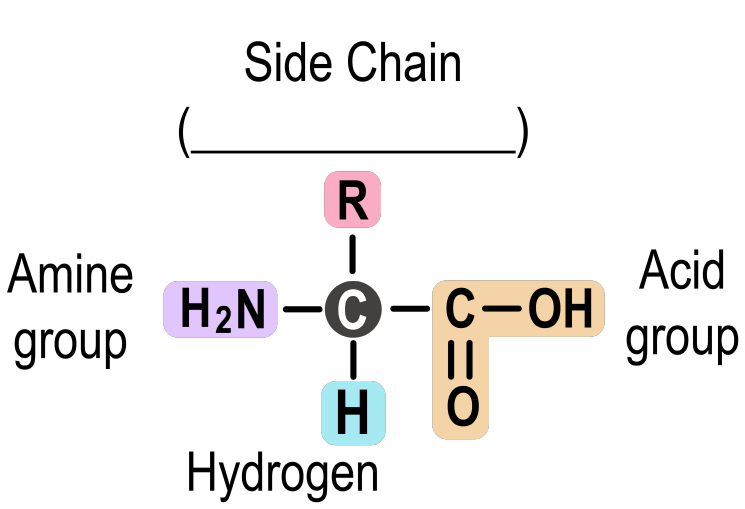
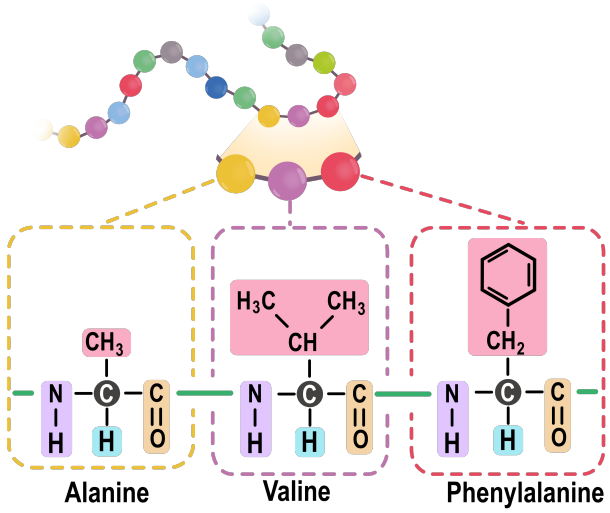
TOPIC: PROTEIN STRUCTURE

Amino Acid Structure

◆ All life primarily uses _____ different amino acids to build proteins, all of which have a similar basic structure.

- The side chain (or _____ Group) *differentiates* amino acids & gives each *unique* properties.





NOTE: 9 out of 20 amino acids are essential in our diet & the other 11 are not.

EXAMPLE

True or false? If false, select the answer option that best corrects the statement.

All amino acids contain an amine group, an acid group and a universal side chain.

a) True.

b) False; not all amino acids have a specific acid group.

c) False; amino acids can contain either 1 or 2 amine groups.

d) False; each of the 20 different types of amino acids has a *unique* side chain.

PRACTICE

Which of the following statements is unique to proteins, & doesn't apply to either carbohydrates or lipids?

a) Proteins are composed of a chain of similar molecules bonded together.

b) Proteins contain an abundance of nitrogen.

c) Proteins have a carbon-based backbone.

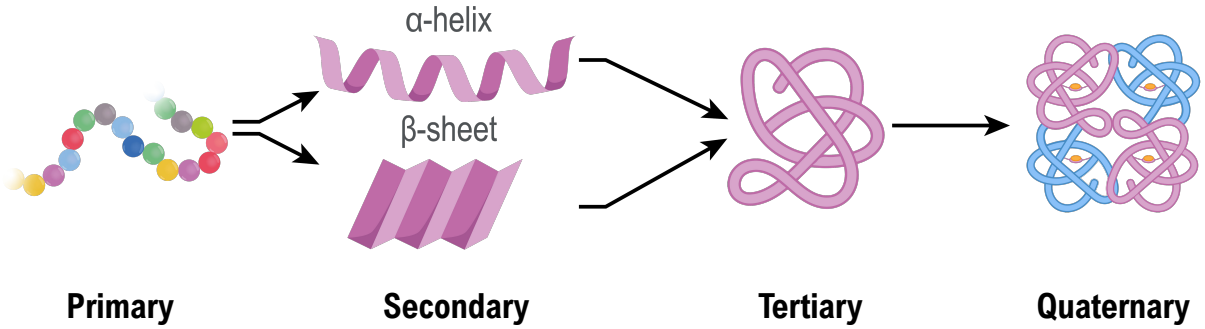
d) Proteins contain carbon, hydrogen, and oxygen.

TOPIC: PROTEIN STRUCTURE

Levels of Protein Structure

◆ A protein's _____ is *critical* because it dictates its *function*. Proteins have _____ levels of structure:

1. **Primary:** the _____ (order, type, & quantity) of amino acids. Determines all other levels of structure.
2. **Secondary:** the twisting, folding &/or bending of the protein backbone (forms α-helices & β-sheets).
3. **Tertiary:** overall _____-shape of a *polypeptide* chain (determined by R-group interactions).
4. **Quaternary:** _____ polypeptide chains *associate* to form a single, functional protein.



NOTE: A protein's final shape may be _____ (spherical) or _____ (elongated).

EXAMPLE

Sickle cell anemia is a genetic disorder caused by a change to one amino acid in hemoglobin, a protein found in red blood cells. This change in the sequence causes the red blood cells to become sickle-shaped, which creates several health complications. Based on this information, which of the following statements is true?

a) Sickle cell anemia is caused by a defect that can only be seen in its tertiary & quaternary structure.
b) Sickle cell anemia is caused by a change in hemoglobin's primary structure, which ultimately impacts its secondary, tertiary, & quaternary structure.
c) Sickle cell anemia is caused by a mutation in the red blood cell's primary structure, which has a knock-on effect on its secondary, tertiary, & quaternary structure.
d) Sickle cell anemia is a disease that is commonly caused by a bacterial infection.

PRACTICE

A scientist is studying a protein that consists of two polypeptide chains. She finds that the protein loses its function when the two chains are separated. What is the highest level of structure that is directly responsible for this protein's functionality?

a) Primary structure.
b) Secondary structure.
c) Tertiary structure.
d) Quaternary structure.
e) Impossible to tell.

TOPIC: PROTEIN STRUCTURE

Protein Denaturation

- **Denaturation:** *alteration* of a protein's structure/shape, causing it to _____ its *function*.
  - _____ protein structure is NOT affected by denaturation.

  - Proteins can be denatured in a variety of ways:

Heat	Mechanical Agitation	Acids/Bases	Salts
			

EXAMPLE

Mark the following statements with a checkmark (✓) if it can cause proteins in the food to denature, or an "X" if it will not cause protein denaturation.

- Frying an egg _____
- Storing milk in the refrigerator _____
- Storing milk in the freezer _____
- Grilling a steak _____
- Marinating chicken in lemon juice _____
- Sprinkling sugar & maple syrup on yogurt _____

PRACTICE

Which of the following is not an example of proteins being denatured?

a) Bacon shrinking in the pan as it's fried.

b) Melting cheese to make a panini.

c) Boiling an egg.

d) All of the above answers are examples of protein denaturation.