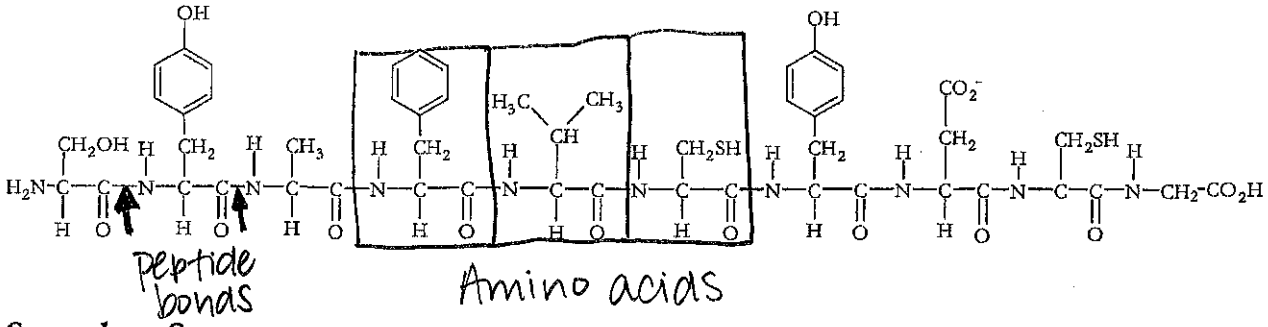
Key

Model 2 – Protein Structure (Part A)

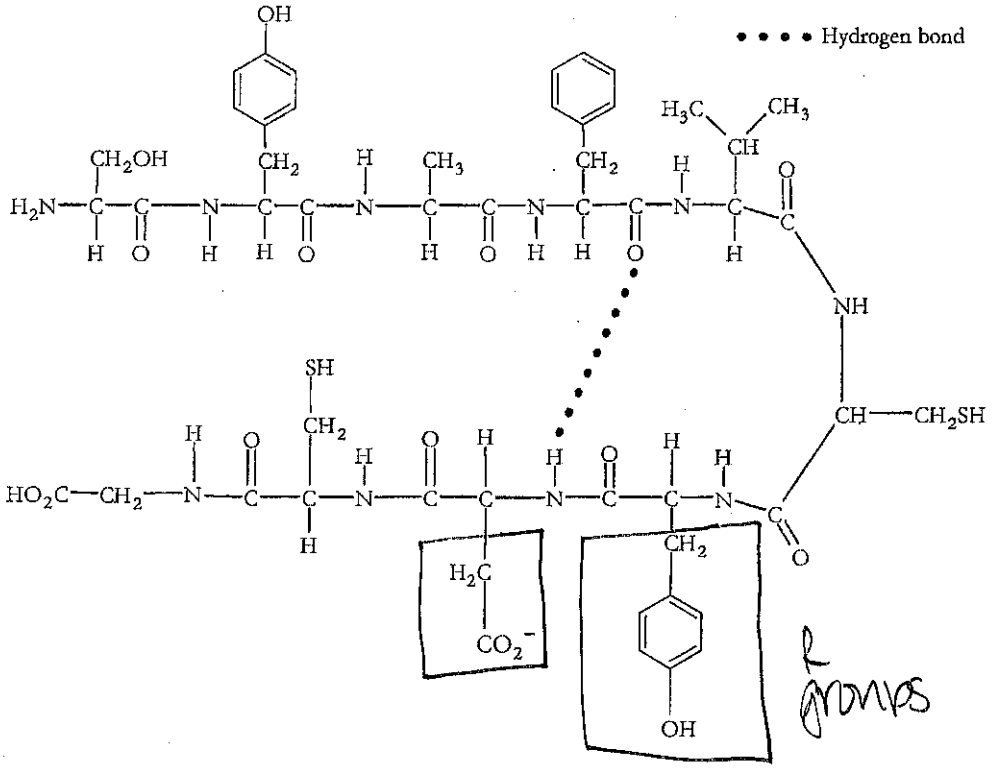
Primary Structure

Amino acid sequence: Ser – Tyr – Ala – Phe – Val – Cys – Tyr – Asp – Cys – Gly

Peptide structure:



Secondary Structure



9. Locate the **primary structure** of the polypeptide in Model 2.
   a. Draw an arrow to two different peptide bonds in the diagram.
   b. ~~Circle~~ Box three separate amino acids that were joined together to make the polypeptide.

10. The first five amino acids in this **polypeptide** are serine, tyrosine, alanine, phenylalanine, and valine, in that order (Ser-Tyr-Ala-Phe-Val). If the amino acids were changed or rearranged (i.e., to Val-Phe-Ala-Ser-Tyr), the polypeptide would have a different name and identity. With your group, use this information to write a definition of the primary structure of a protein.

Primary structure of a protein is the chain of amino acids which will determine how the protein folds... which determines the function.

11. Locate the **secondary protein structure** in Model 2.

a. What types of bonds are holding the secondary structure in place?

hydrogen bonds

b. What groups on the amino acids are always involved in these bonds?

the amino group & carboxyl group
↓ ↓
partial charge on H(+) partial charge on O(-)

12. Draw a rectangle around two different R groups on the amino acids in the secondary structure in Model 2.

13. Is there any interaction between R groups in the secondary structure in Model 2?

No!

14. Secondary protein structure can take the form of an alpha(α)-helix or a beta(β)-pleated sheet, as illustrated below.

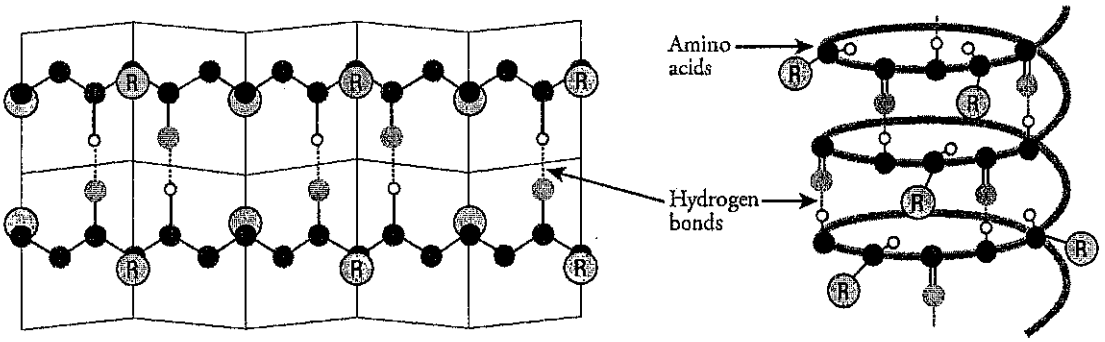
a. Which drawing represents an α-helix, Molecule 1 or Molecule 2? Explain your reasoning.

molecule 2 b/c it has a helical structure

b. Which drawing represents a β-pleated sheet? Explain your reasoning.

molecule 1 b/c its structure is folded

Molecule 1 Molecule 2

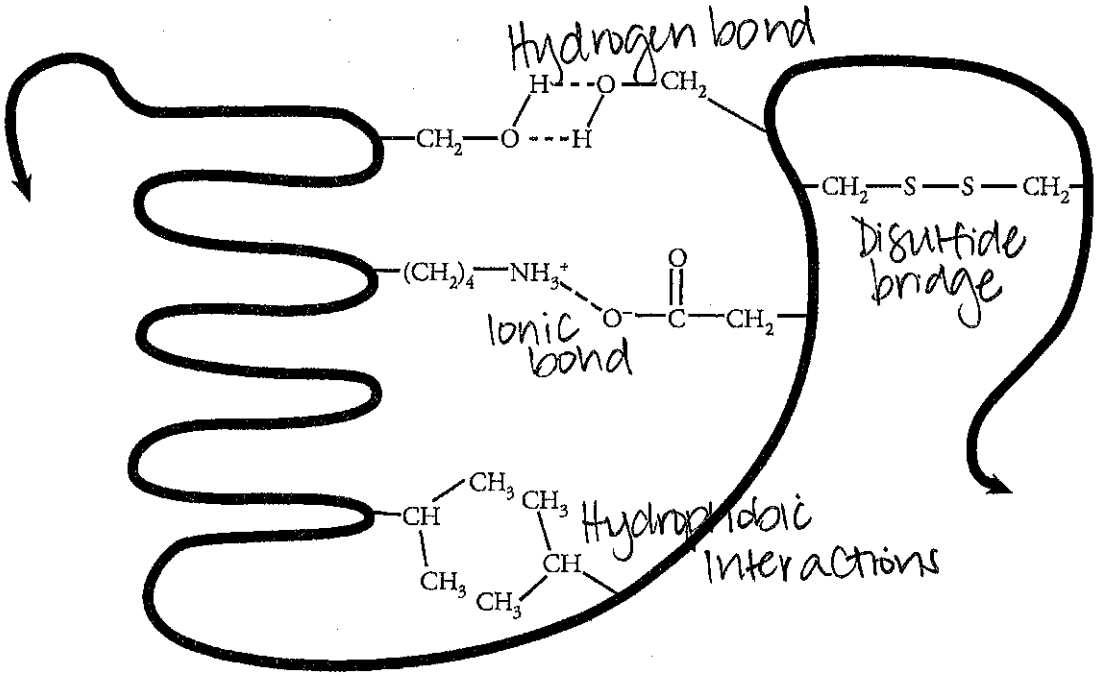


15. With your group, write a grammatically correct sentence that summarizes how the secondary protein structure is formed from the primary structure.

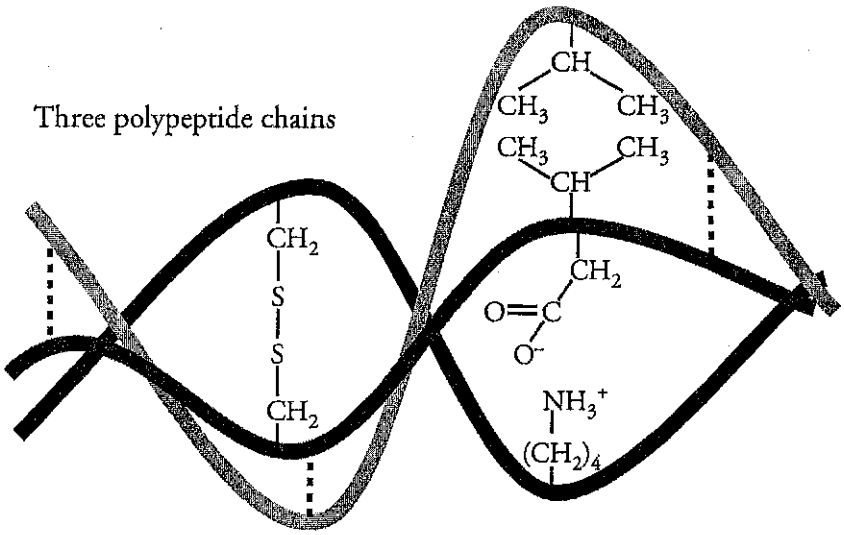
Secondary structure results in interactions from the basic amino acid functional groups (amino & carboxyl) that are present due to primary structure.

Model 3 – Protein Structure (Part B)

Tertiary Structure



Quaternary Structure



16. Examine the **tertiary structure** in Model 3 and note the interactions that hold this level of structure in place.

a. Four types of bonds or interactions are shown. Label them with the following terms.

Disulfide bridge ✓ Hydrogen bond ✓

Hydrophobic interactions ✓ Ionic bond ✓

b. Describe the part of the amino acid that participates in these interactions.

R groups are responsible for tertiary structure

c. How does your answer in part *b* differ from the bonds that stabilize the secondary structure?

The R groups are the part of the amino acid that are unique for each of the 20 amino acids.

17. What type of functional groups or atoms would need to be present in the R-groups for hydrogen bonding to occur between two amino acids in a protein chain?

Polar functional groups are needed for hydrogen bonding.

18. What type of functional groups or atoms would need to be present in the R-groups for hydrophobic interactions to occur between two amino acids in a protein chain?

Non polar functional groups are needed for hydrophobic interactions.

19. How many polypeptide chains are shown in the tertiary protein structure in Model 3?

one!

20. Many proteins, but not all, have a fourth level of structure termed **quaternary structure.**

a. How many polypeptide chains are shown in the quaternary structure of the protein in Model 3?

3

b. What types of bonds and interactions hold the quaternary structure in place?

hydrogen bonds, disulfide bridges, hydrophobic interactions, & ionic bonds

21. With your group, using grammatically correct sentences, define the following.

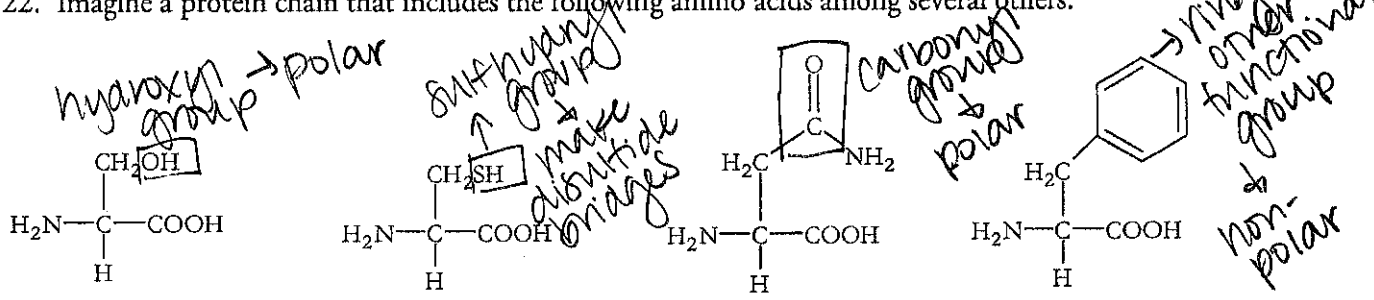
a. Tertiary protein structure.

Tertiary structure is when the secondary structure begins to fold due to the R groups on the amino acids creating a functional protein.

b. Quaternary protein structure.

Quaternary structure is when multiple polypeptide chains fold together to create one active protein.

22. Imagine a protein chain that includes the following amino acids among several others.



a. Which of the amino acids could form a hydrogen bond with another amino acid in the chain to stabilize the secondary structure of a β-pleated sheet?

Serine, cysteine, asparagine, & phenylalanine because the side groups (R groups) are not involved in the forming of B pleated sheets... just the basic amino acid structure which all contain

b. Which of the amino acids could form disulfide bonds with another amino acid in the chain to stabilize the tertiary structure of the protein?

Cysteine with another cysteine

c. Which of the amino acids could participate in hydrophobic interactions with another amino acid in the chain to stabilize the tertiary structure of the protein?

phenylalanine

d. What types of bonds or interactions could asparagine form with another amino acid in the chain in order to form a quaternary structure with another protein chain?

Asparagine could form hydrogen bonds with other polar amino acids to stabalize quaternary structure.

23. Fill in the following chart using what you've learned from Models 1–3.

Structure	Bond(s) or interactions holding the structure together	Short description	Number of polypeptide chains involved
Primary	peptide bond	peptide bonds used to link multiple amino acids	1
Secondary	hydrogen bonds	created btwn the amino group & carboxyl group of the amino acid	1
Tertiary	- ionic bonds - hydrogen bonds - disulfide bridges - hydrophobic interactions	folds in protein due to interactions between R groups of amino acids	1
Quaternary	same as tertiary	the interaction between R groups of multiple polypeptide chains	2 or more

Read This!

Heating and changing pH levels are two ways to disrupt the shape of a protein. High temperatures or pH levels that vary from the natural environment of the protein will break hydrogen bonds, ionic bonds, disulfide bridges, and hydrophobic interactions. Covalent bonds will usually remain undisturbed. This process of destroying the shape of a protein is called **denaturing**.

24. Which of the four levels of protein structure is maintained after denaturing? Explain your answer.