Proteins

AP Biology · Unit 1: Chemistry of Life

The Teaching Analogy

"Think of a protein like an origami crane. The amino acid sequence is the fold lines already printed on the paper — before you even start folding. Secondary structure is those first creases: your alpha helices and beta sheets. Tertiary is the finished crane, crumpled into a three-dimensional shape. And quaternary is multiple cranes locking arms together."

Key Concept

Proteins are chains of amino acids that fold into precise three-dimensional shapes determined by their primary sequence. This shape is everything — it dictates function. Enzymes, antibodies, and structural proteins all work because of their specific folds. When folding goes wrong, proteins lose function (or become dangerous, as in prion diseases).

Guided Practice

1. Fold a piece of paper into a crane. Now unfold it. Point to where the "primary structure" information is stored (the crease lines). How does this mirror the role of a protein's amino acid sequence?
2. If you fold the crane wrong at step two, does it still look like a crane at the end? Relate this to what happens when a protein misfolds. What cellular problems might result?
3. Prions are misfolded proteins that convert normal proteins to the wrong shape. If one rogue crane could make every nearby crane fold incorrectly, how would this spread through the brain? Connect this to the progression of prion diseases like mad cow disease.

Extension Activity

Give students a set of origami instructions (available free online). Have them fold a simple crane together, then use colored markers to label each fold level: primary (the paper itself), secondary (first folds), tertiary (completed 3D shape). Then ask: what would happen if the paper got wet mid-fold (like high temperature denaturation)? Discuss how heat disrupts the hydrogen bonds that hold secondary structure together.