

# Protein Folding Demo

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## Materials needed:

Pony beads (available at craft stores)

Chenille Sticks (colorful pipe cleaners, available at craft stores)

Students have a difficult time visualizing the 3-D nature of a protein. It is a valuable demo to do with students of all levels. When you later discuss enzymes, they can take out their proteins and "see" what it means to denature a protein, occupy the active site in an enzyme, etc.

Each student will need 12-18 pony beads (different colors) and a chenille stick.

1. Place the pony beads on the chenille stick. There should be space between each bead. Just put a little crimp in the chenille stick. This represents primary structure in the protein. Each bead represents a different aa. So each student holds a different protein as each has a different sequence of aa.
2. Demonstrate the two types of secondary structure a protein can take. Show alpha-helix, by wrapping your aa sequence around a pencil. Show the beta-sheet sequence by folding your aa sequence back and forth. Explain that most proteins are 100 times longer than the model they are making and would have both alpha-helix and beta-sheets present. Have the students pick alpha-helix or beta-sheet and fold their protein accordingly. Tell them the helices and sheets are held in place by hydrogen bonds.
3. To demonstrate tertiary structure, pick a color (green). Beads of this color represent cysteine. Cysteine will seek other cysteine aa to form disulfide bonds. Explain that some aa are hydrophobic (nonpolar) and some are hydrophilic (polar). Pick 3 or 4 colors and make them hydrophobic. Pick 3 or 4 colors and make them hydrophilic. Tell the students to now fold their protein so the hydrophobic aa are towards the inside and the hydrophilic aa are toward the outside. At this point their protein should have a distinct and unique structure. Look around and point out how many different proteins there are in the room. Reinforce "Structure determines function".
4. To demonstrate quaternary structure, you must first discuss that most proteins consist of two or more polypeptide chains. Quaternary structure is a result of the interaction between the polypeptide chains that the protein is made of. Have your students partner up and have them now put their protein together. Remind them of the rules of #3 and have them adjust their strands. This is difficult, let them try. This is now a functional protein.

Whenever the structure is altered, the protein can become nonfunction. Temperature, pH, salt concentration can alter shape. You can also discuss what happens when even one aa is changed in the sequence. (Sickle cell

anemia is an example where only one aa is changed)

I tell my student this is an important part of their notes and they should have it with them. Later when discussing an enzyme, and they get confused, I tell them to pull out the model and then try to explain what is going on.