Alpha-Helix and Beta-Sheet Collection (AH1)

TEACHING POINTS
The linear amino acid sequence defines the primary structure of a protein. Regions of the linear polypeptide chain fold into the stable alpha-helix and beta-sheet structures to form the protein secondary structure. The tertiary protein structure is the overall three-dimensional shape of the protein. With this model collection, students can assemble an alpha-helix or anti-parallel beta-sheet, compare the phi-psi angles of the two secondary structures, and explore the contribution of hydrogen bonding to the stability of the structure. Models of the alpha-helix and beta-sheet, with and without side chains, allow comparison of the features of the two secondary structures. Two protein models display tertiary protein structure. The beta-globin protein consists predominantly of alpha-helices while the green fluorescent protein (GFP) consists predominantly of a beta-sheet.

MODELS IN THIS COLLECTION
- Alpha-helix without sidechains
- Alpha-helix with sidechains
- Beta-sheet without sidechains
- Beta-sheet with sidechains
- Alpha-helix building kit
- Beta-sheet building kit
- Beta-globin protein
  Green fluorescent protein (GFP)
MODEL DETAILS

- Alpha-helix without side chains
  - 17 amino acids without side chains
  - Ball and stick format
  - Derived from Helix E of beta-globin (amino acids 58-74)
  - Pitch is 3.6 amino acids per turn of helix
  - Hydrogen bonds (white) between nitrogen and carbonyl oxygen
  - CPK colors (carbon is gray, nitrogen is blue, oxygen is red)
  - Identical helix to the model Alpha-helix with side chains
  - Model made of plaster with ZCorp printer

- Alpha-helix with side chains
  - 17 amino acids with side chains
  - Ball and stick format
  - Derived from Helix E of beta-globin (amino acids 58-74)
  - Pitch is 3.6 amino acids per turn of helix
  - Hydrogen bonds (white) between nitrogen and carbonyl oxygen
  - The amino acid side chains are CPK colors (carbon is gray, nitrogen is blue, oxygen is red, sulfur is orange)
  - The amino acid backbone atoms are colored green with the nitrogen colored blue (facilitates counting amino acids in the helix)
  - Model made of plaster

- Beta-sheet without side chains
  - 30 amino acids without side chains
  - Ball and stick format
  - Made from amino acids 14-32, 120-127 of GFP (the pattern of hydrogen bonds can be used to identify the location in the GFP model)
  - Hydrogen bonds (white) between nitrogen and carbonyl oxygen
  - Two strands are parallel
  - Two strands are anti-parallel
  - CPK colors (carbon is gray, nitrogen is blue, oxygen is red)
  - Identical to beta-sheet with sidechains
  - Model made of plaster

- Beta-sheet with sidechains
  - 30 amino acids with side chains
  - Ball and stick format
  - Amino acid sequence:
    - NH$_2$ (120)-Val-Gln-Arg-Ile-Glu-Leu-Gly-CO$_2$H (127),
  - Hydrogen bonds (white) between nitrogen and carbonyl oxygen
  - Two strands are parallel
  - Two strands are anti-parallel
- Side chains are CPK colors (carbon is gray, nitrogen is blue, oxygen is red)
- Backbone atoms of each amino acid are colored alternating yellow and green
- Made from amino acids 14-32, 120-127 of GFP (the pattern of hydrogen bonds can be used to identify the location in the GFP model)
- Model made of plaster with the ZCorp printer

- Green fluorescent protein, GFP
  - 1EMB pdb file
  - 236 amino acids
  - Alpha carbon backbone format
  - Chromophore, Ser 65, Tyr 66, Gly 67 green
  - Amino acid contacts with the chromophore, His 148, Gln 94, Arg 96, Glu 222, Thr 203, Ile 167
  - Model made of plaster with the ZCorp printer

- Beta-globin
  - 1AN3 pdb file
  - Chain B
  - Alpha-carbon backbone format
  - Protoporphorin IX ring containing iron (Fe)
  - His 63 and His 92 bind the protoporphin ring
  - Glu 6 is the sidechain that is mutated to valine in sickle cell anemia
  - Model made of plaster with the ZCorp printer

- Alpha-helix Construction kit
  - Ball and stick format made as individual pieces that attach with magnets
  - Peptide backbone pieces (8)
  - Side chain pieces (13—shared with beta-sheet building kit)
  - Metal hydrogen bonds

- Beta-sheet Construction kit
  - Ball and stick format made as individual pieces that attach with magnets
  - Anti-parallel beta sheet
  - Peptide backbone pieces (12)
  - Side chain pieces (13—shared with the alpha-helix building kit)
  - Metal hydrogen bonds

RESOURCES