Create a 3-D Protein

Proteins play key roles in the structure and functions of a cell. Some of the proteins that a cell produces determine the shape and structure of the cell. Other proteins aid in the recognition of certain molecules or the catalyzing of certain chemical reactions. Think about how a cell on your eye is different from a cell on your tongue—they are very different and perform different functions.

Proteins are made of amino acids. There are 20 amino acids, and each has its own chemical properties. An amazing diversity of proteins results from their combination. The proper sequence of the amino acids is crucial to forming a stable and functional protein. Since each amino acid will attract and repel other amino acids in predictable ways, the result is a stable, three-dimensional structure.

Two basic structural units are commonly found in the 3-D structures of proteins:

- The beta sheet is an amino acid sequence that folds back and forth on itself to form very rigid and strong protein sections.
- The alpha helix is an amino acid sequence that folds into a helix that spirals to the right. This direction is a result of the bonds between amino acids inside the helix.

Try making your own 3-D protein structure. The first one is easy and the second is a little harder. Good luck!

Making a Beta Sheet

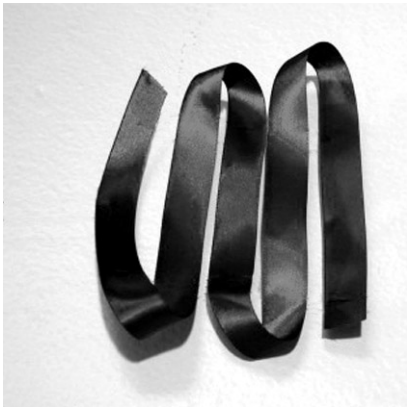
Materials:

50 centimetres of red ribbon
15 ml of craft glue
125 ml of warm water
A bowl for mixing water and glue
80 cm of translucent string (such as fishing line)
Red sewing thread and needle
1 craft stick (such as a Popsicle stick)
Waxed paper

Step 1: Mix the craft glue with the warm water in the mixing bowl until all the glue is dissolved.

Step 2: Dip the red ribbon in the water-and-glue mixture. Once the ribbon is thoroughly soaked, remove it and squeeze out any excess liquid.

Step 3: Lay 10 cm of this ribbon onto a sheet of waxed paper, then fold back the next 10 cm and lay it on the waxed paper beside to the first part of the ribbon. Do not cut the ribbon. Keep folding back and forth until you have five lengths of folded ribbon lying side-by-side on the waxed paper.



Step 4: Allow the ribbon to dry for at least an hour.

Step 5: If the structure needs to be made more rigid, sew a running stitch from a point near one of the free ends of the ribbon, through each of the lengths. Keep the line of stitching near the edge of the structure. Imagine the lengths of ribbon are the steps of a ladder, and the thread is one side of the vertical supports. Repeat on the other side.

Step 6: Cut a piece of string that is 20 cm long. Attach one end of the string to the middle of the first length of ribbbon. The mobile will hang from this point, so make sure the structure is balanced when it is suspended.

Step 7: Attach the free end of the string to the centre of the craft sticks.

Step 8: To hang your mobile, attach an end of the remaining string to each end of the craft stick and hang it from the centre-point of the string.

Making the Protein Cytochrome b562 with Alpha Helices

Materials:

1 metre of green ribbon
21 cm of yellow ribbon
15 ml of craft glue
125 ml of warm water
A bowl for mixing water and glue
1 cm-diameter dowel or knitting needles
8 elastic bands
1.2 m of translucent string (such as fishing line)
1 craft stick (such as a Popsicle stick)

Step 1: If you have not already done so, mix the craft glue with the warm water in the mixing bowl until all the glue is dissolved.

Step 2: Dip the green ribbon in the water-and-glue mixture. Once the ribbon is thoroughly soaked, remove it and squeeze out any excess liquid.

Step 3: Attach one end of the ribbon to the dowel (or knitting needle) with an elastic band and wrap the ribbon around the dowel 6 times. Attach another elastic at the point where the wrapping ends. Use about a quarter of the ribbon in this wrapping. Cut the unwrapped portion of the ribbon off. Make two ribbons like this. Their spiral shape mimics that of a helix.

Step 4: Make a third ribbon the same way with the green ribbon, but wrapping 7 times around the dowel. Use about a quarter of the ribbon in this wrapping.

Step 5: Make a fourth ribbon the same way with the remainder of the green ribbon, but wrapping 5 times around the dowel.

Step 6: Allow the ribbons to dry for at least an hour.

Step 7: Cut the yellow ribbon into three pieces that are each 7 cm long.

Step 8: Remove the green ribbons from the dowels without damaging their shape.

- Glue the end of the 5-turn helix to the end of a length of yellow ribbon.
- Glue the other end of this first yellow ribbon to the end of one of the 6-turn helices.
- Glue the free end of this 6-turn helix to the end of a second piece yellow ribbon.
- Glue the free end of this yellow ribbon to the end of the 7-turn helix.
- Glue the free end of the 7-turn helix to one end of a third length of yellow ribbon.
- Glue the free end of this yellow ribbon to the second 6-turn helix.

Step 9: Cut three pieces of string that are each 20 cm long. Tie or sew a piece of string to each of the two free ends of the green ribbon. Tie the third piece to the yellow ribbon in the centre.

Step 10: Attach the string that is connected to the yellow ribbon to the centre of the craft stick. Attach each of the remaining two strings to either end of the stick without crossing the strings.

Step 11: To hang your mobile, attach an end of the remaining string to each end of the craft stick and hang it from the centre-point of the string.