PDB-101

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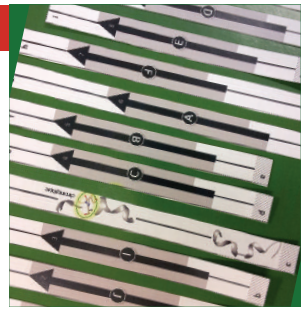
Build a Paper Model of Green/Red Fluorescent Protein

Fluorescent proteins exhibit light and are widely used in biotechnology. These proteins assume the shape of the beta barrel with a self-assembled chromophore threaded through the center of the protein.

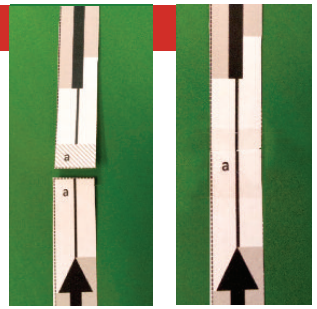
Step1

Cut out the 12 strips of paper (outlined in dotted line) representing the 11 beta strands and 1 helical region of the fluorescent proteins (FPs).



Step2

Tape together the strips so that the lowercase letter on the light-colored background (e.g., a) is taped on top of the same letter on the patterned background. Repeat this for letters b through k to create a long strip.

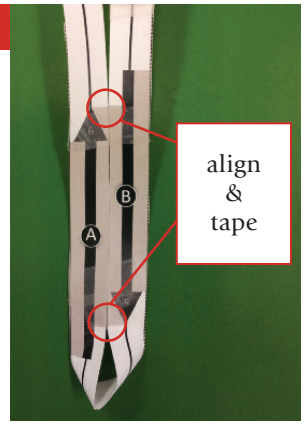


The Primary Structure

The long strip of paper from amino (NH_3^+) to carboxy (COO^-) represents the primary structure of the FP. Regions of secondary structure (beta strands and alpha helices) are marked.

Step 3

Lay the strand labeled **A** on the table so that the arrow is pointing upwards, place strand **B** to the right of A and orient it so that the arrow points to the bottom. Align the shaded areas between the strands (representing the hydrogen bonds between them), and tape top to bottom on the aligned shaded area.

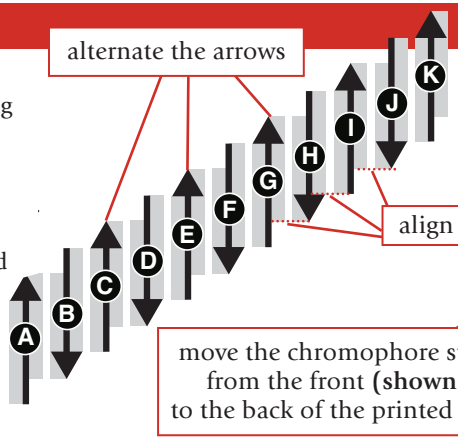


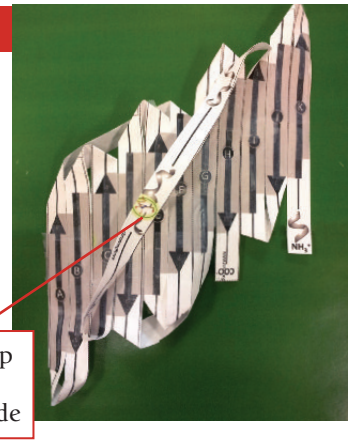
Step 4

Next tape strand **C** next to **B**, **D** next to **C** and so on till strand **K**, in each case aligning the shaded areas between the strands and making sure the arrows in these strands point up and down alternately as shown in the diagram on the right.

At the end of this step the beta sheet should have strands labeled **A-K reading from left to right**.

At this point make sure the chromophore strip is behind the printed side of the beta sheet.



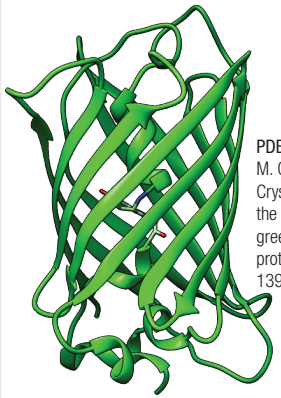


Step 5

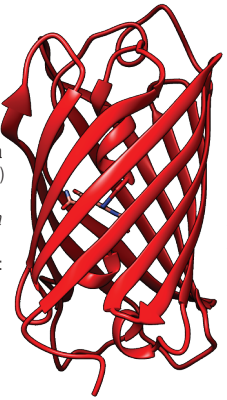
Close the FP beta barrel by aligning the gray area between strands A and K and taping them together. The chromophore should be inside the barrel.

Exploring the Model

1. Can you trace the polymer chain from the amino to carboxy terminus?
   Hint: the order of the strands from amino to carboxy terminal are marked with the numbers 1-11 (in the arrowheads of each strand).
2. What is the relationship between the strand labels A-K and 1-11? Comment also on the loops between the strands and location of the chromophore.
3. Identify one example each of parallel and antiparallel strands in the FP barrel.



PDB Structure 1ema
M. Ormo *et al.* (1996) Crystal structure of the *Aequorea victoria* green fluorescent protein. *Science* **273**: 1392-1395



PDB Structure 1g7k
D. Yarbrough *et al.* (2001) Refined crystal structure of DsRed, a red fluorescent protein from coral. *Proc Natl Acad Sci U S A* **98**: 462-467.