Build a Paper Model of a G Protein-Coupled Receptor (GPCR)

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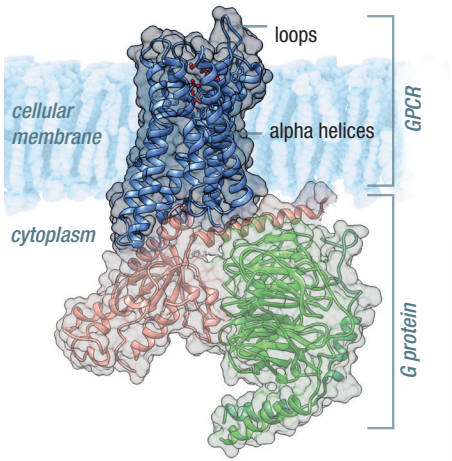


GPCRs (example shown above in dark blue from PDB structure 6dde) are a large family of membrane-embedded receptors, with structural features that have been preserved through the course of evolution. **With the extracellular N-terminus, the protein chain folds to form a bundle of seven transmembrane alpha helices connected by 3 intracellular and 3 extracellular loops with the C-terminus reaching inside the cell.**

On the extracellular side, the helices form a cavity where ligands (e.g. endorphins, morphine, serotonin) bind. On the intracellular side, the receptor is coupled to G protein (peach and green). When the receptor is activated by a ligand, the G protein splits in two parts which then activate other proteins in the internal signal transduction pathways.

Examples of GPCRs are opioid receptors, rhodopsin or adrenergic receptors. Read the *Molecule of the Month* features on each of these receptors to learn more about the signaling pathways they control.

Video instructions for this model are available at bit.ly/2098Muw

Preparation

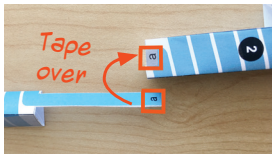
In this model, the solid blue line represents the polymer chain. The dark gray and the semi-transparent gray areas will be hidden in the final model. Use tape or glue to connect the elements.

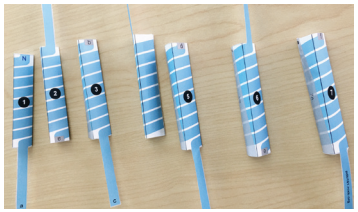
Cut out the 7 paddle-shaped pieces along the *dotted lines*.

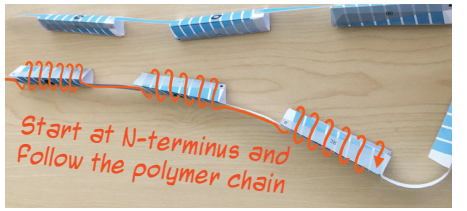
Alpha Helices and Polymer Chain

Alpha helices are numbered ❶ - ❼. For each, fold along the *solid lines* to create a **triangular prism**. Hide the dark gray flap inside.

The tail ends of the paddles will represent loops in the final model. Connect each loop with the next helix by matching and taping over lower-case letters **a**-**f**.





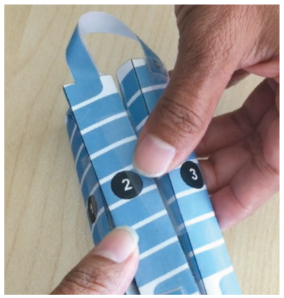


Now, by following the thick blue line, you can see how the full polymer chain folds into alpha helices.

Tertiary Structure

Connect helices ❶ and ❷

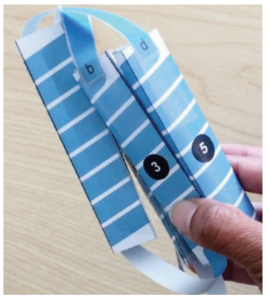
Align the **semi-transparent gray area** marked **1B** with the **semi-transparent gray area** marked **2A** (outlined orange on the image on the left), matching the position of the ◆ and tape them together. Notice the first *intracellular* loop forming.



Connect helices ❷ and ❸

Align the areas **2B** and **3A**, matching the position of the ●. Now you will notice the first *extracellular* loop forming.

In many GPCRs, the 7-helix bundle is not perfectly symmetrical, and helix ❹ is found towards the outside of the bundle. Form the *intracellular* loop between helix 3-4 and the *extracellular* one between helix 4-5 but let helix **4** dangle on the side.



Connect helices ❸ and ❺

Align area **3B** to **5A**, matching the position of the ❖.

Connect helices ❺ and ❻

Align areas **5B** and **6A**, matching the position of the ♦. Now you will notice the last *intracellular* loop forming.

Connect helices ❻ and ❼

Align areas **6B** and **7A**, matching the position of the ✿. Now you will notice the last *extracellular* loop forming.

Connect helices ❼ and ❶

Align the semitransparent gray areas **7B** and **1A**, matching the position of the ☼.

Your model is ready! The cavity at the top represents the ligand binding site. Notice that **this model represents the shared structural features of all GPCRs** and is not based on any particular PDB structure. To explore examples of GPCRs in 3D, visit **rcsb.org** and access the following structures: **4dkl, 6dde** (opioid receptor), **2rh1** (adrenergic receptor), and **1f88** (rhodopsin).

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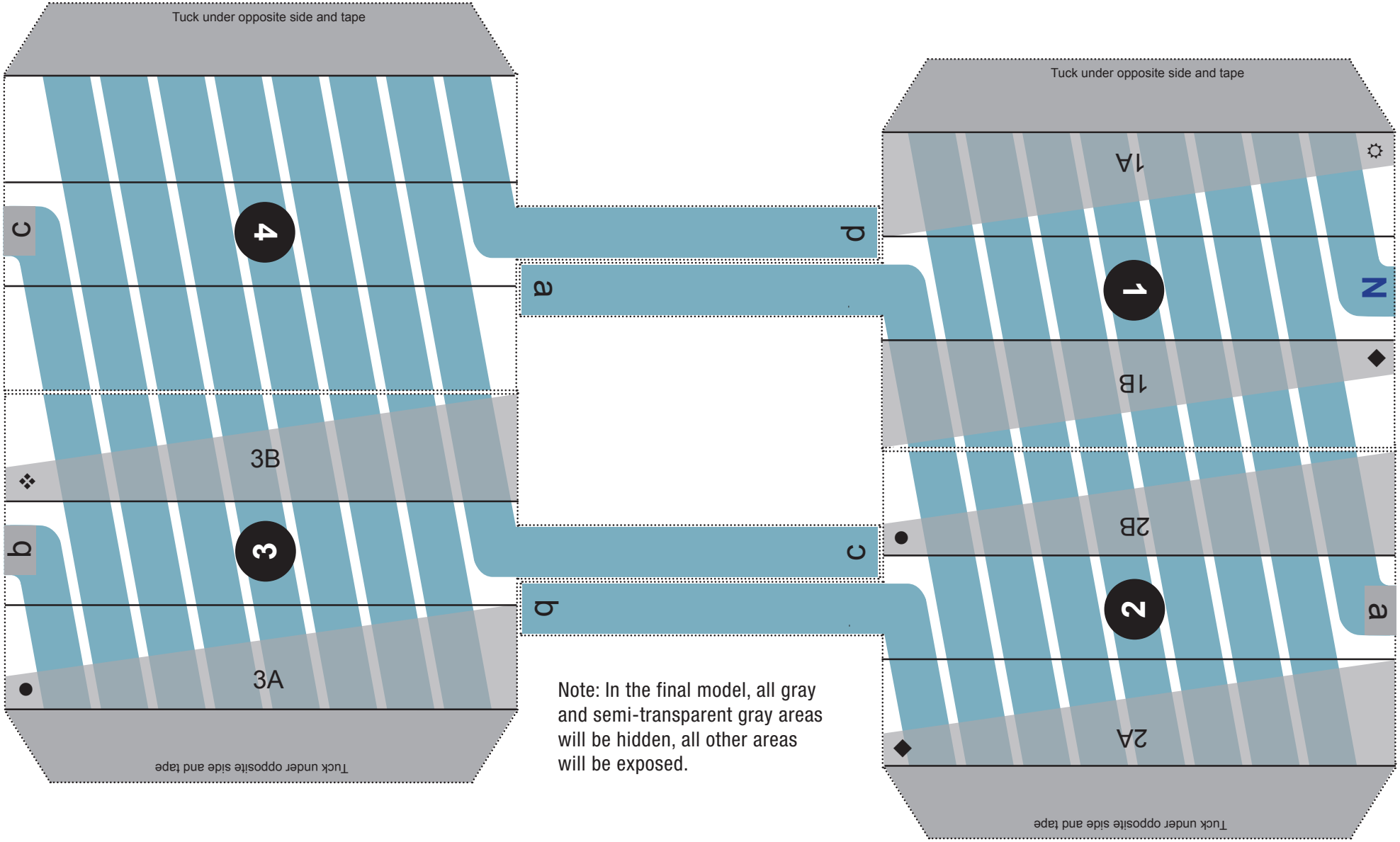

Note: In the final model, all gray and semi-transparent gray areas will be hidden, all other areas will be exposed.

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