Chemorecepter signaling

Srikanta Guria, Asst. Professor
Barasat Govt. College

The sensory cells used to detect odors and tastes are the chemorecepters. Olfactory neurons have a number of long thin cilia extending from one end of the cell into a mucous layer that overlay the cell. These cilia present a large surface area for interaction with olfactory signals. The receptors for olfactory stimuli are ciliary membrane proteins with the familiar serpentine structure of seven transmembrane helices. The olfactory signal can be any one of the many volatile compounds for which there are specific receptor proteins.

Odorant mediated pathway

- The olfactory stimulus arrives at the sensory cells by diffusion through the air. In the mucous layer overlaying the olfactory neurons, the odorant molecule binds directly to an olfactory receptor or to a specific binding protein that carries the odorant to a receptor (Fig. 1).

- Interaction between odorant and receptor triggers a change in receptor conformation that results in the replacement of bound GDP by GTP on a G protein, G_{olf}, analogous to transducin and to Gs of the β adrenergic system.

- The activated G_{olf} then activates adenylyl cyclase of the ciliary membrane, which synthesizes cAMP from ATP, raising the local [cAMP]. The cAMP-gated Na+ and Ca2+ channels of the ciliary membrane open, and the influx of Na+ and Ca2+ produces a small depolarization called the **receptor potential.**

- If a sufficient number of odorant molecules encounter receptors, the receptor potential is strong enough to cause the neuron to fire an action potential. This is relayed to the brain in several stages and registers as a specific smell. All these events occur within 100 to 200 ms. Some olfactory neurons may use a second transduction mechanism.

- They have receptors coupled through G proteins to PLC rather than to adenylyl cyclase. Signal reception in these cells triggers production of IP3, which opens IP3-gated Ca2+ channels in the

ciliary membrane. Influx of Ca2+ then depolarizes the ciliary membrane and generates a receptor potential or regulates Ca2+-dependent enzymes in the olfactory pathway.

- A cAMP phosphodiesterase returns [cAMP] to the pre stimulus level. G_{olf} hydrolyzes its bound GTP to GDP, thereby inactivating itself. Phosphorylation of the receptor by a specific kinase prevents its interaction with G_{olf}, by a mechanism analogous to that used to desensitize the β-adrenergic receptor and rhodopsin. And lastly, some odorants are enzymatically destroyed by oxidases.

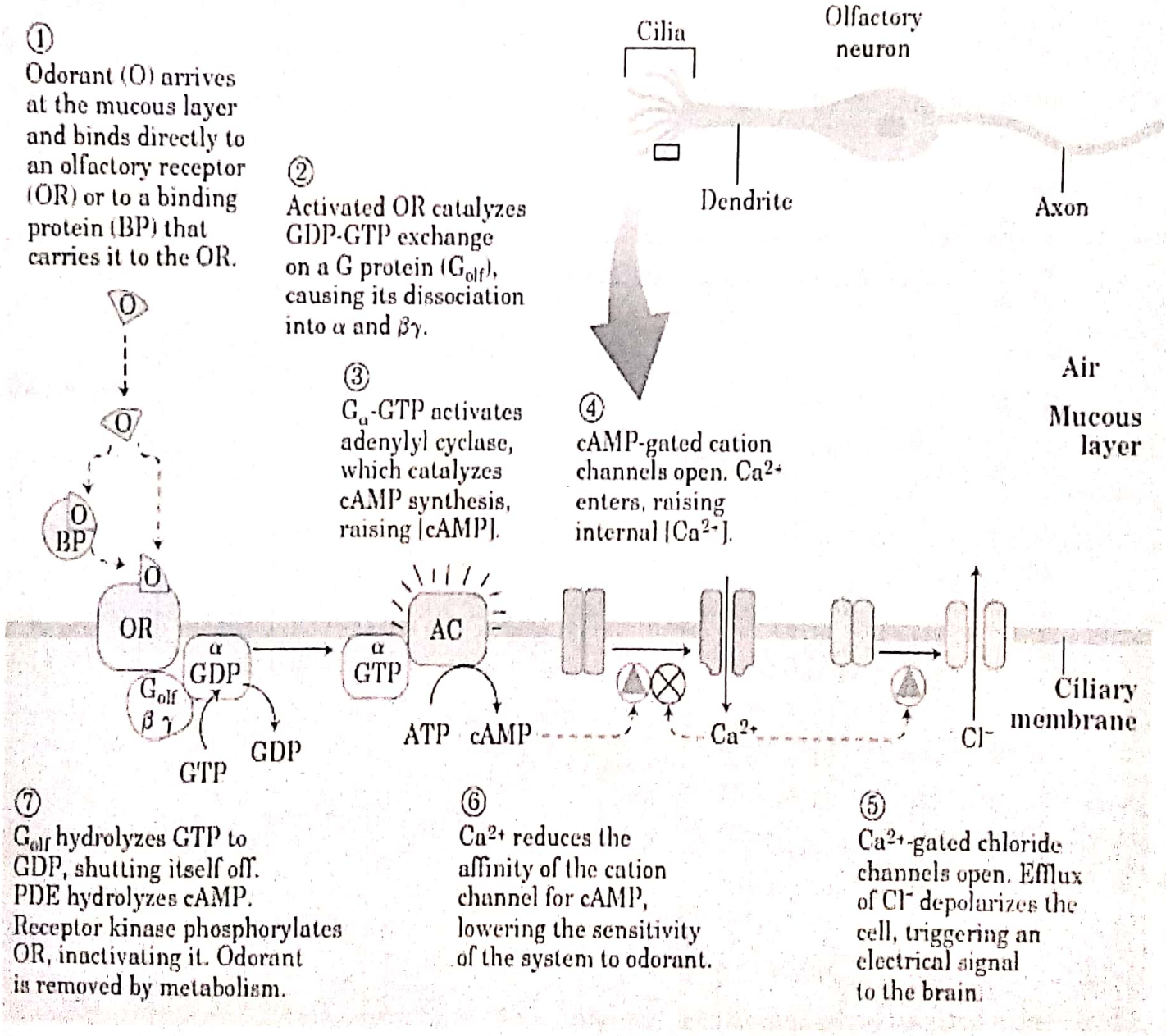

Fig 1.

Gustducin mediated pathway

- The sense of taste in vertebrates reflects the activity of gustatory neurons clustered in taste buds on the surface of the tongue. In these sensory neurons, serpentine receptors are coupled to the heterotrimeric G protein **gustducin** (very similar to the transducin of rod and cone cells).

- Sweet-tasting molecules are those that bind receptors in "sweet" taste buds. When the molecule (tastant) binds, gustducin is activated by replacement of bound GDP with GTP and then stimulates cAMP production by adenylyl cyclase.

- The resulting elevation of [cAMP] activates PKA, which phosphorylates K+ channels in the plasma membrane, causing them to close.

- Reduced efflux of K+ depolarizes the cell (Fig. 12–37). Other taste buds specialize in detecting bitter, sour, or salty tastants, using various combinations of second messengers and ion channels in the transduction mechanisms.

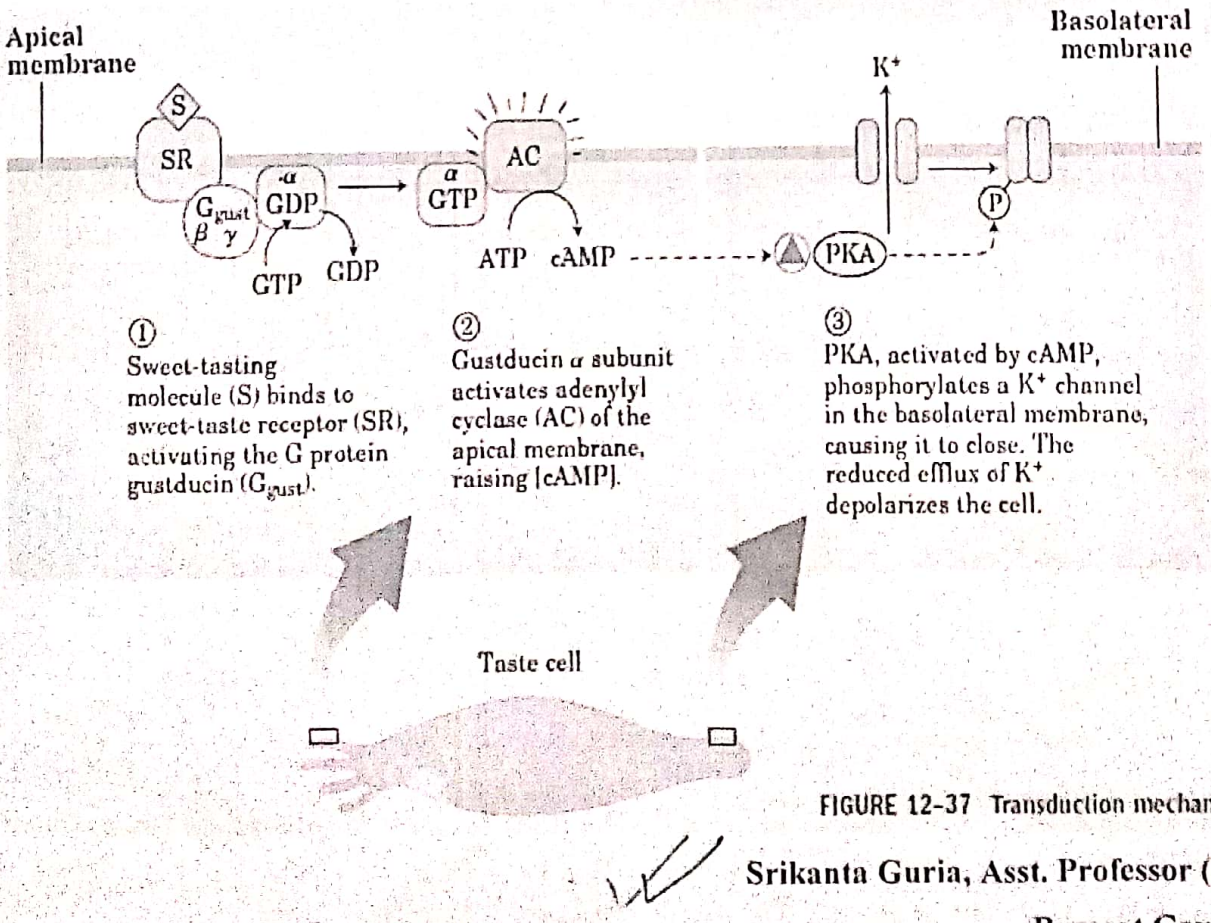

FIGURE 12-37 Transduction mechanism for sweet tastants.

Srikanta Guria, Asst. Professor (W.B.E.S)
Barasat Govt. College