

Odorant receptors and the organization of the olfactory system

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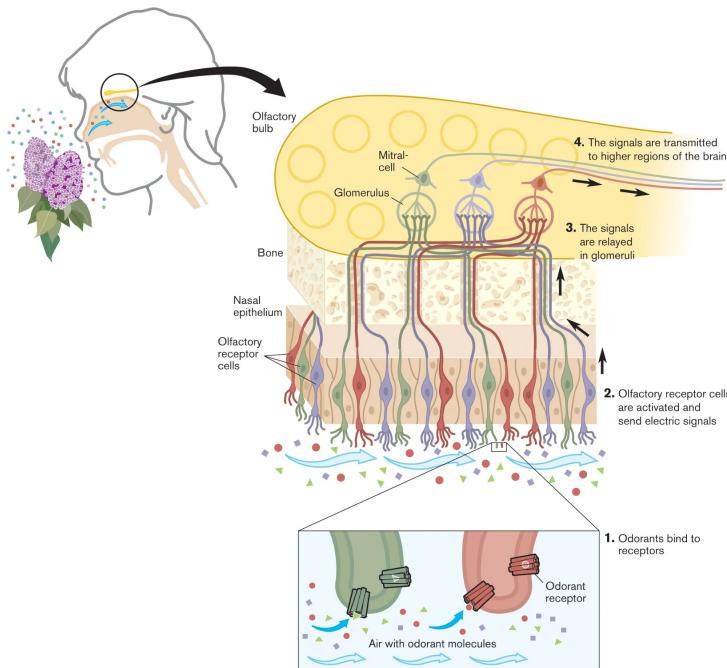
Motivation

Why study the olfactory system?

- Principles for recognizing & remembering odours were not understood
- Odour can trigger memories.
- Of central importance for survival in most species.
- Some examples:
 - In fish, the olfactory system senses amino acids as odors.
 - Male silk moths use their olfactory system to detect female pheromones.

Outline of the study

Odorant Receptors and the Organization of the Olfactory System

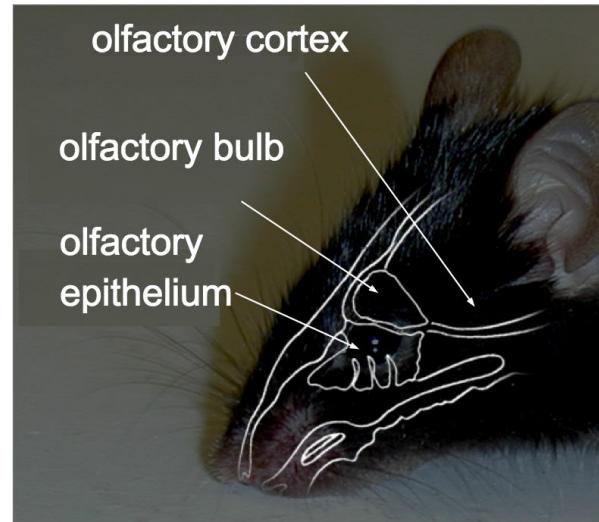


„A novel multigene family may encode odorant receptors: a molecular basis for odor recognition“ - Buck & Axel, 1991

Buck & Axel wanted to test an idea of connecting a huge, previously unknown gene family with odor recognition

Experiment: procedure

1. Isolated mRNA from rat **olfactory epithelium** (only active genes)
2. **Degenerate primers** were added — sequences flexible enough to bind to **many similar genes**.
3. **PCR** was used to amplify cDNA fragments.
4. Used the fragments as probes in **expression tests**.



Adapted from <https://explore.psl.eu/en/discover/focus/mice-and-smells>

Experiment: results

1. The PCR with primers reaction produced **many different DNA fragments**, all about the size expected for GPCR genes.
2. The extracted genes were expressed only in olfactory epithelium - sign of **specialised olfactory receptors**.
3. Genomic library screens revealed **100 to several hundred genes** in the family.

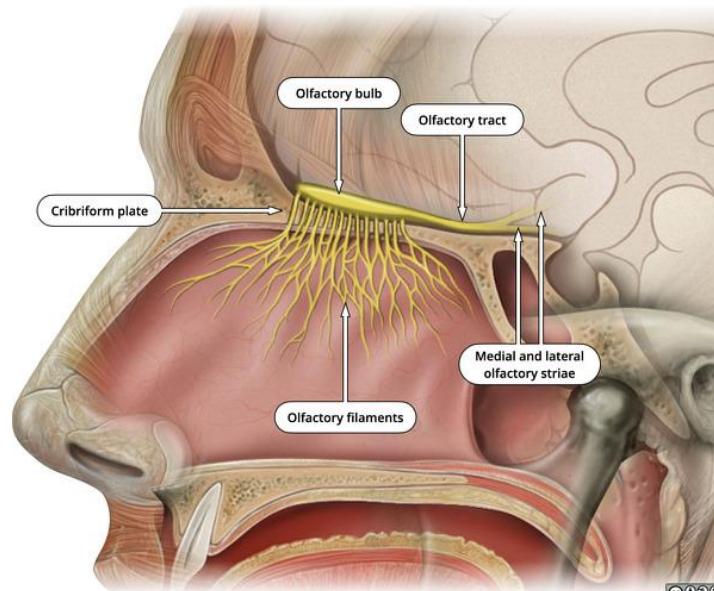
Implications/follow-up

- Smell uses the largest receptor repertoire of any sense.
- Each olfactory sensory neuron has only one type of the receptor gene.
- Each receptor can detect many different odors, and each odor can activate multiple receptors with varying intensity of response.
- This way different odorant stimuli can be processed uniquely - creating a **olfactory map**

Olfactory map

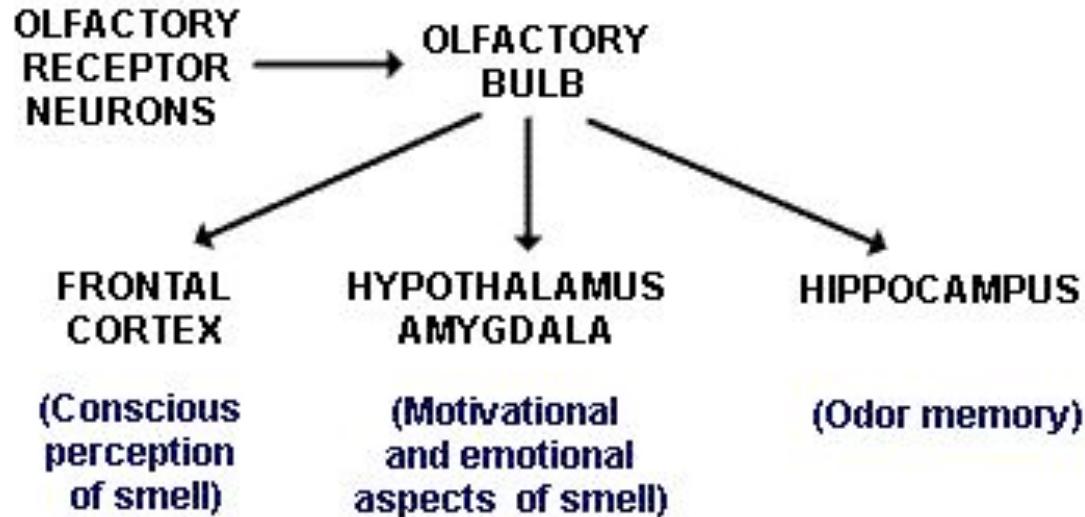
- Receptor cells with same receptor converge on same glomeruli in olfactory bulb.
- Creates a spatial map: different odors activate specific glomeruli patterns.
- Brain interprets these patterns to recognize and differentiate odors.

Olfactory nerve



Adapted by Frank Gaillard from the original illustration by Patrick J. Lynch Creative Commons Attribution 2.5 License 2006





Adapted from <https://faculty.washington.edu/chudler/chems.html>

