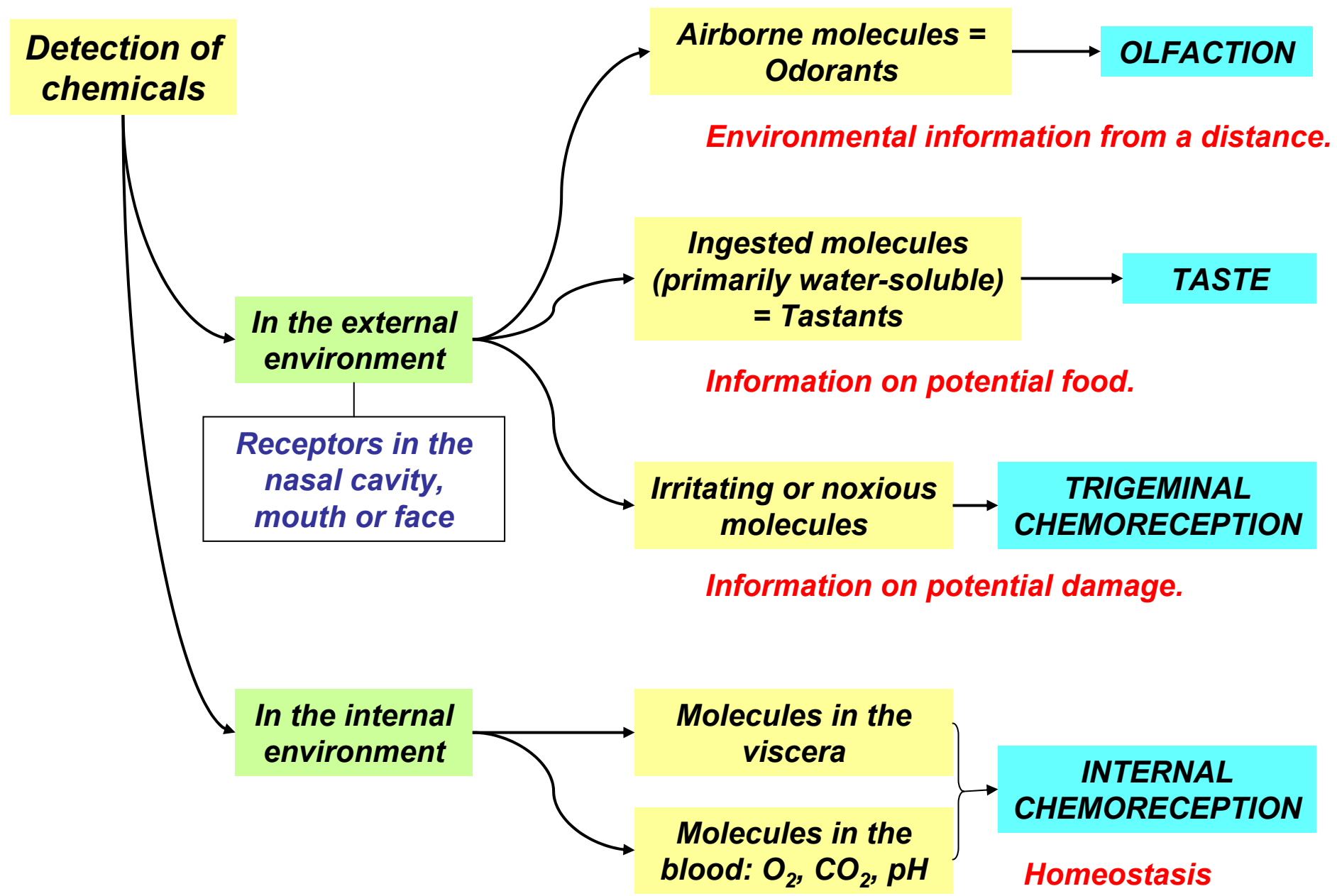
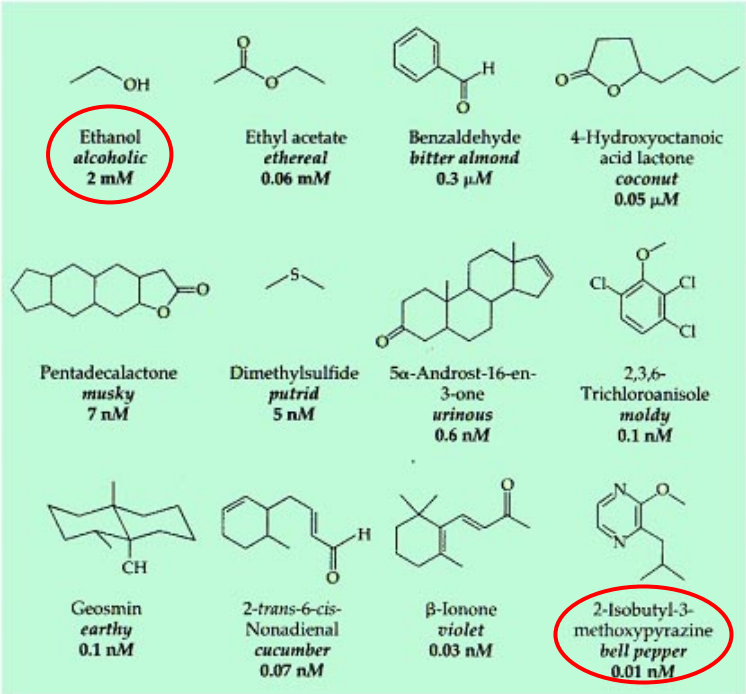


# Chemoreception



# Olfaction: The olfactory stimulus



## Odorants

Volatile, hydrosoluble or liposoluble

Many and diverse

Different thresholds

**Sensitivity** \*

Different quantity → different perception

Complex mixtures → sensed as single odor

Empirical classifications based on:

- perceived quality
- molecular structure
- anosmias

**Sensory submodalities**

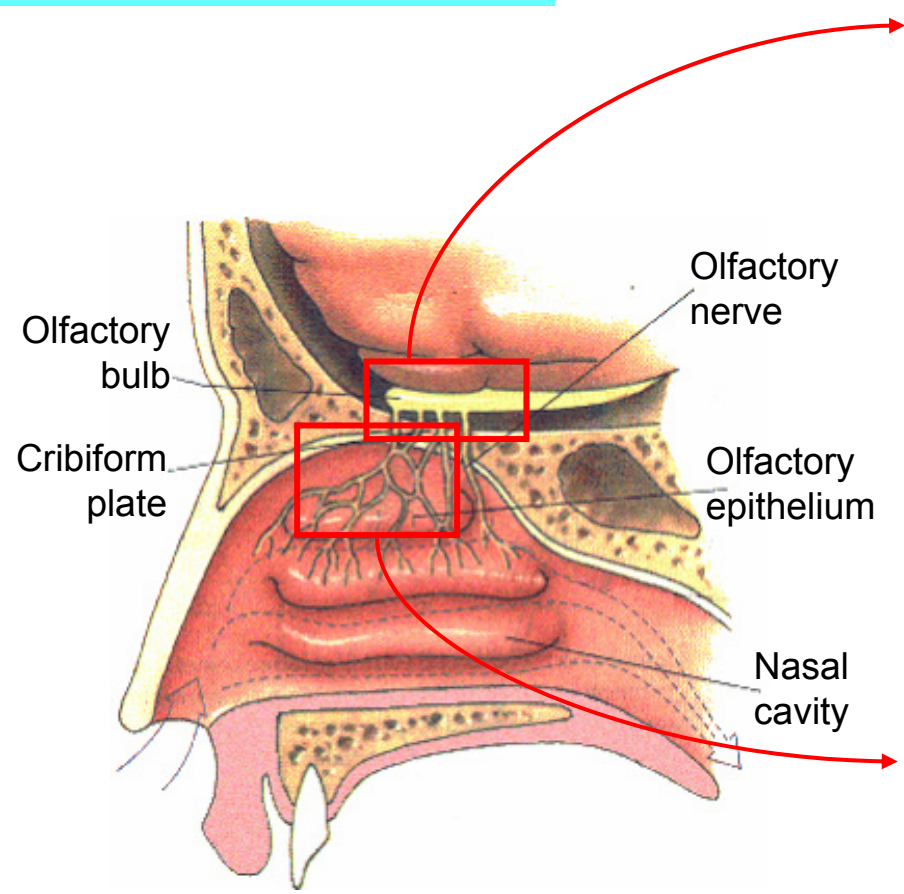
?

**Discrimination** \*

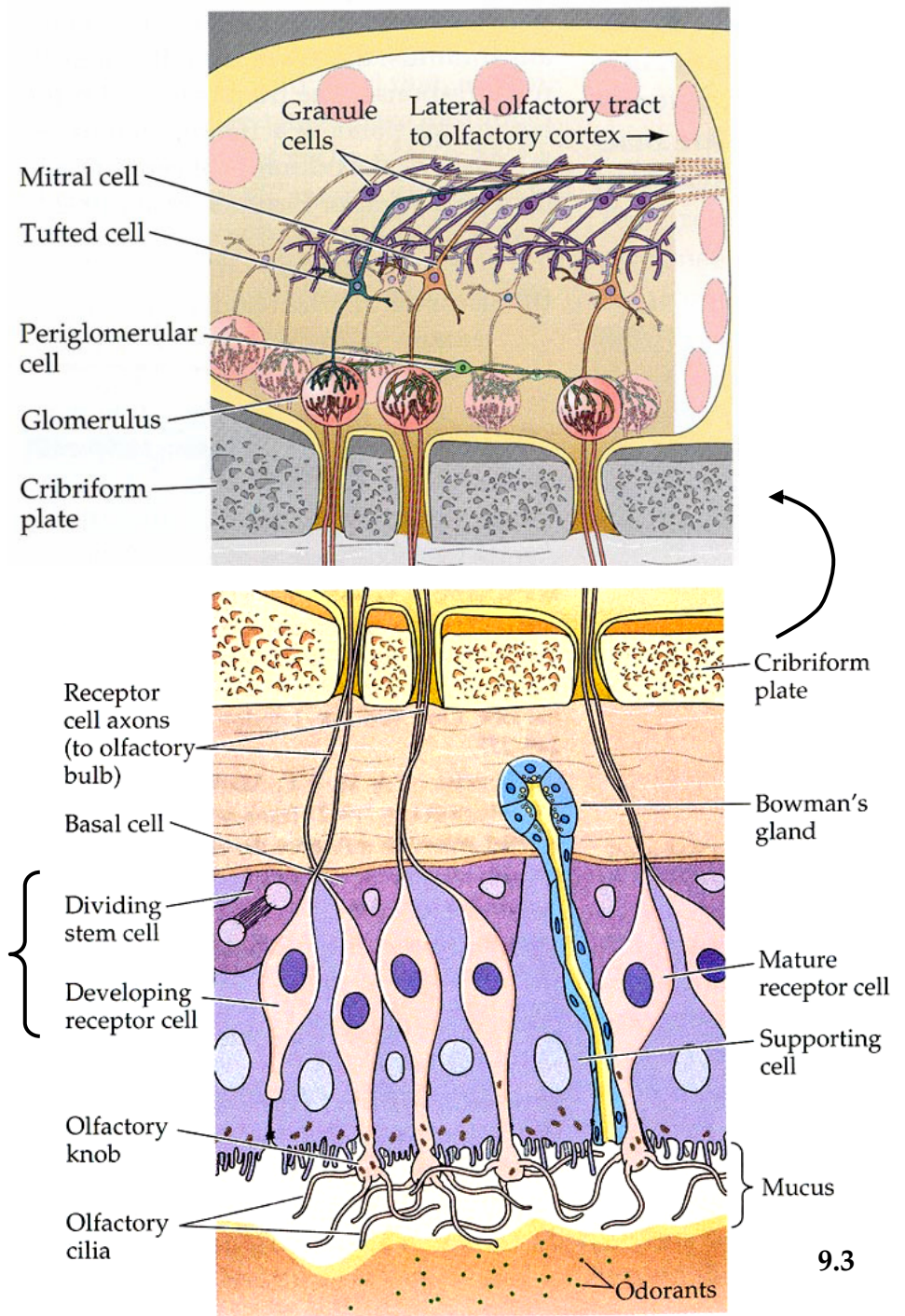
(10,000 perceived odors)

\* Very high, but less than other animals

**Functional morphology**

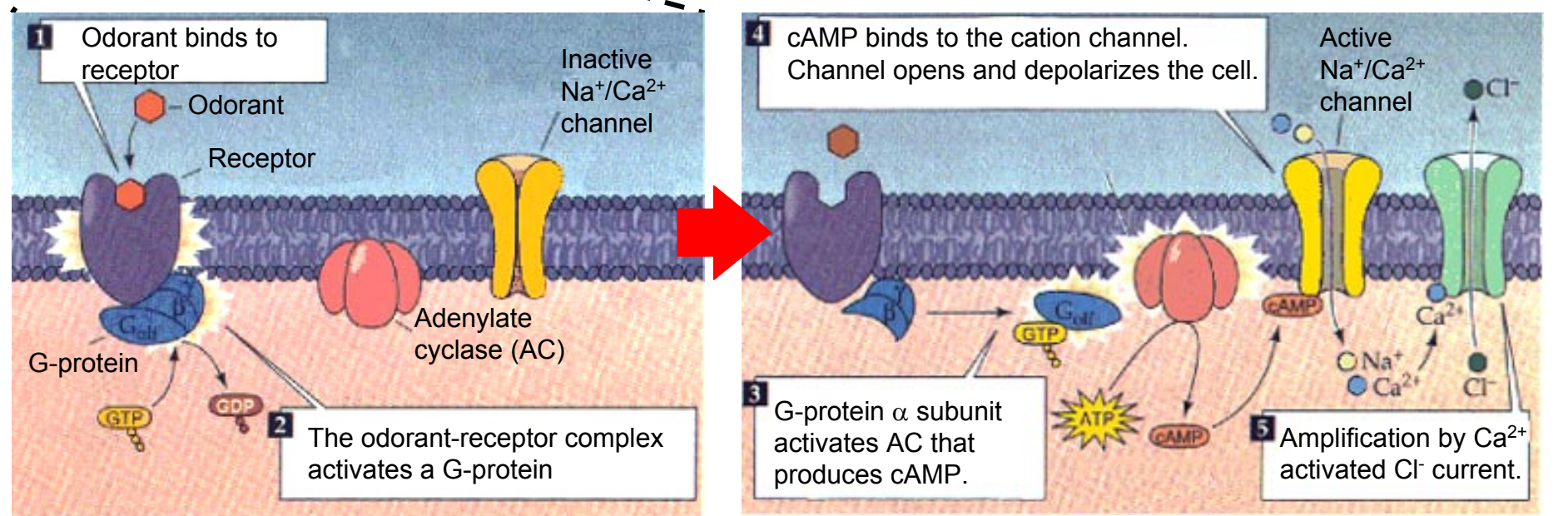
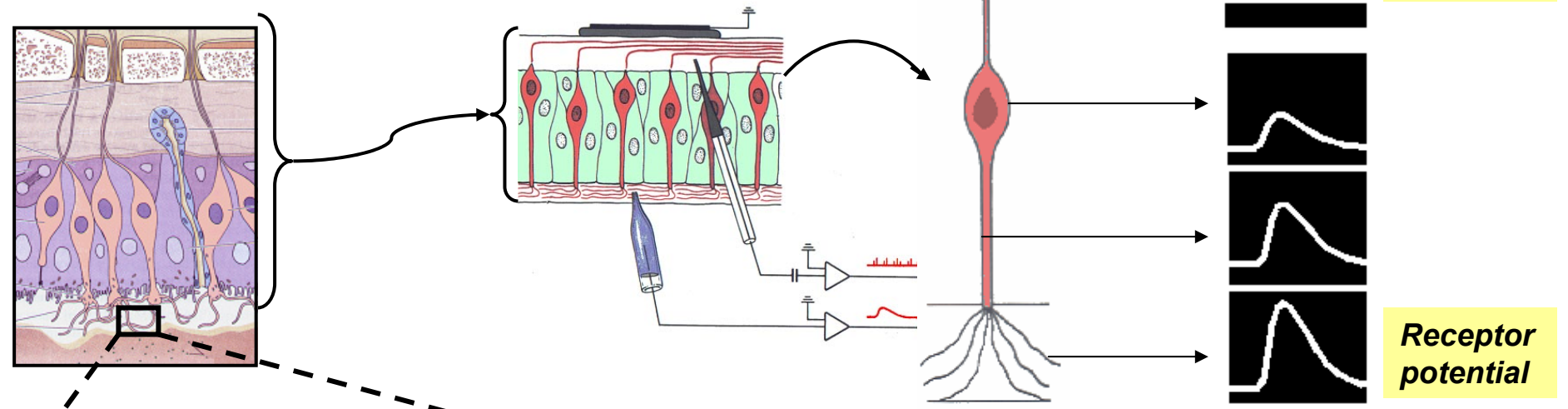


**Regeneration:**  
average life span  
1-2 months





**Chemoelectrical transduction of odors in receptor cells**

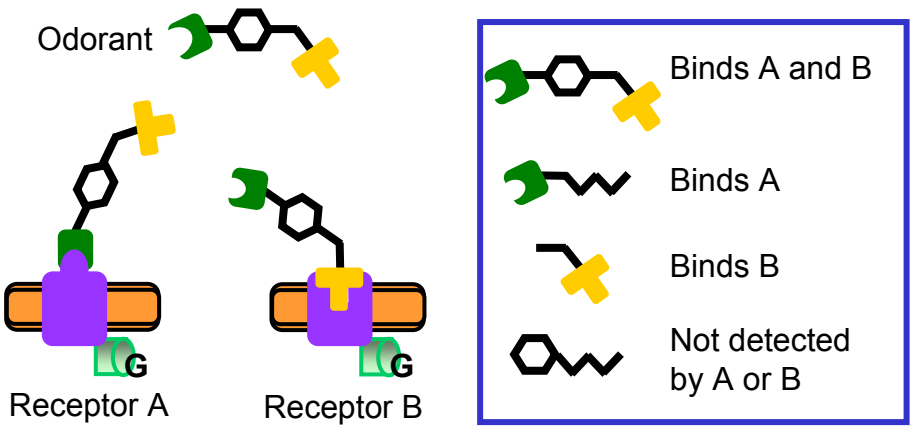
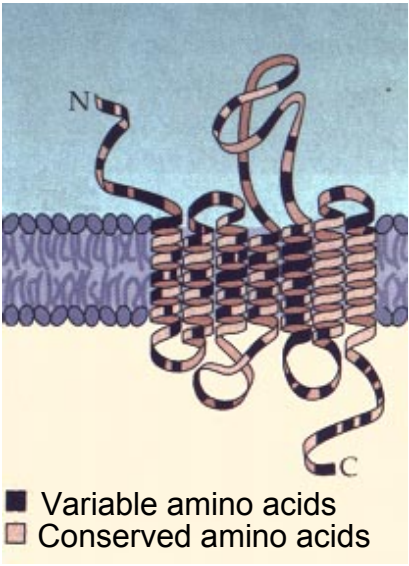


Coding the olfactory information...

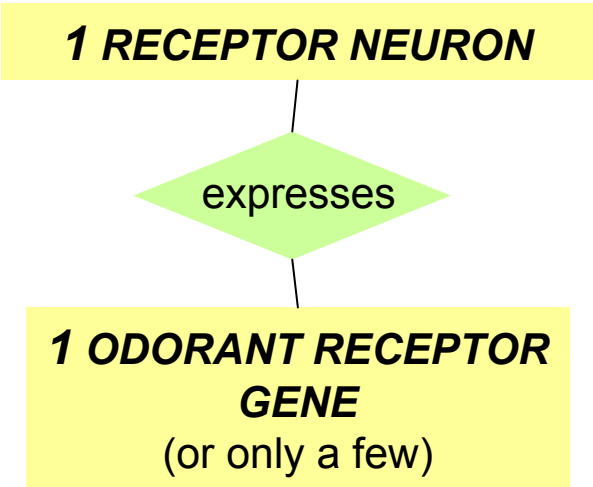
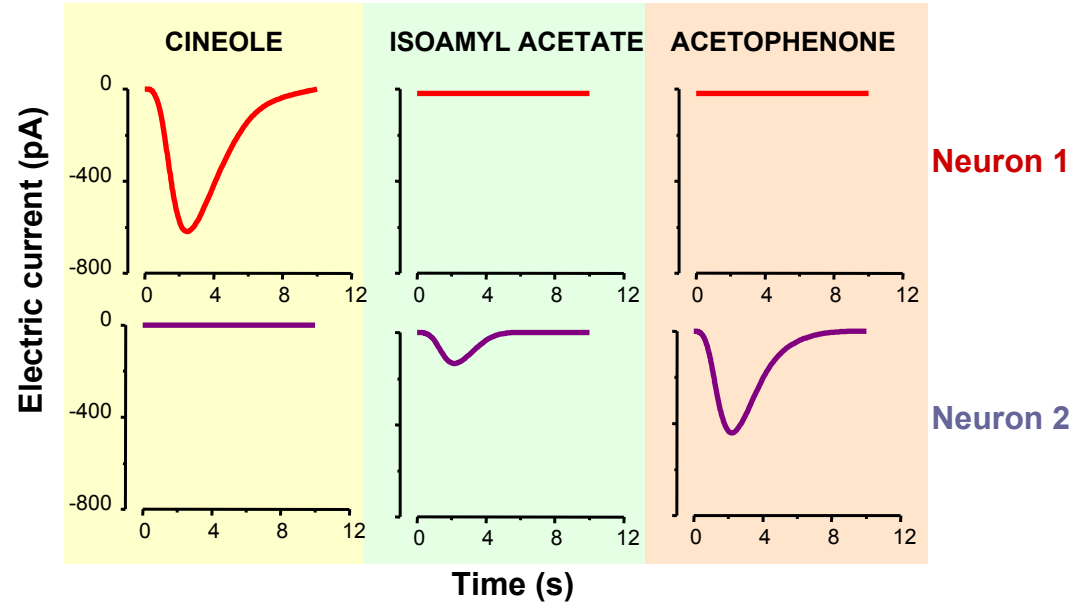
...in receptor neurons

Many odorant membrane receptors  
(200 genes in humans, 1000 in mice)

Highly variable protein family

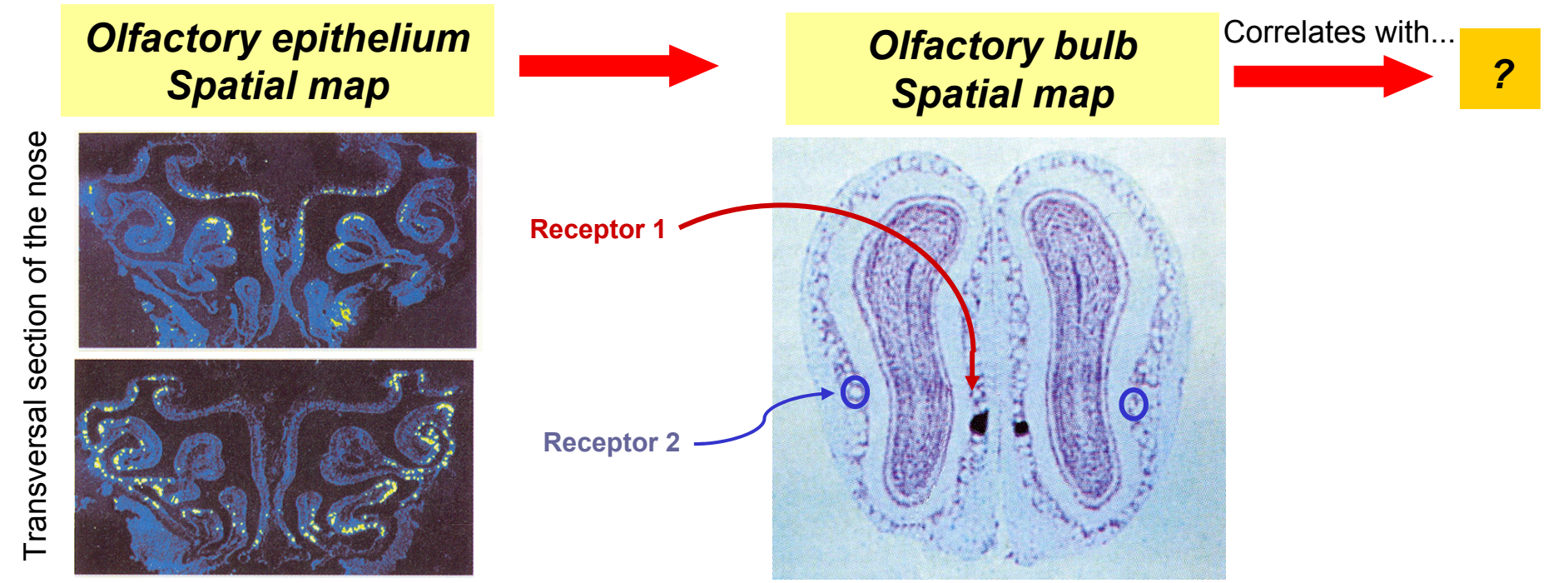


Ligand specificity



**Coding the olfactory information...**

**...in the olfactory bulb**



**Coding the olfactory information...**

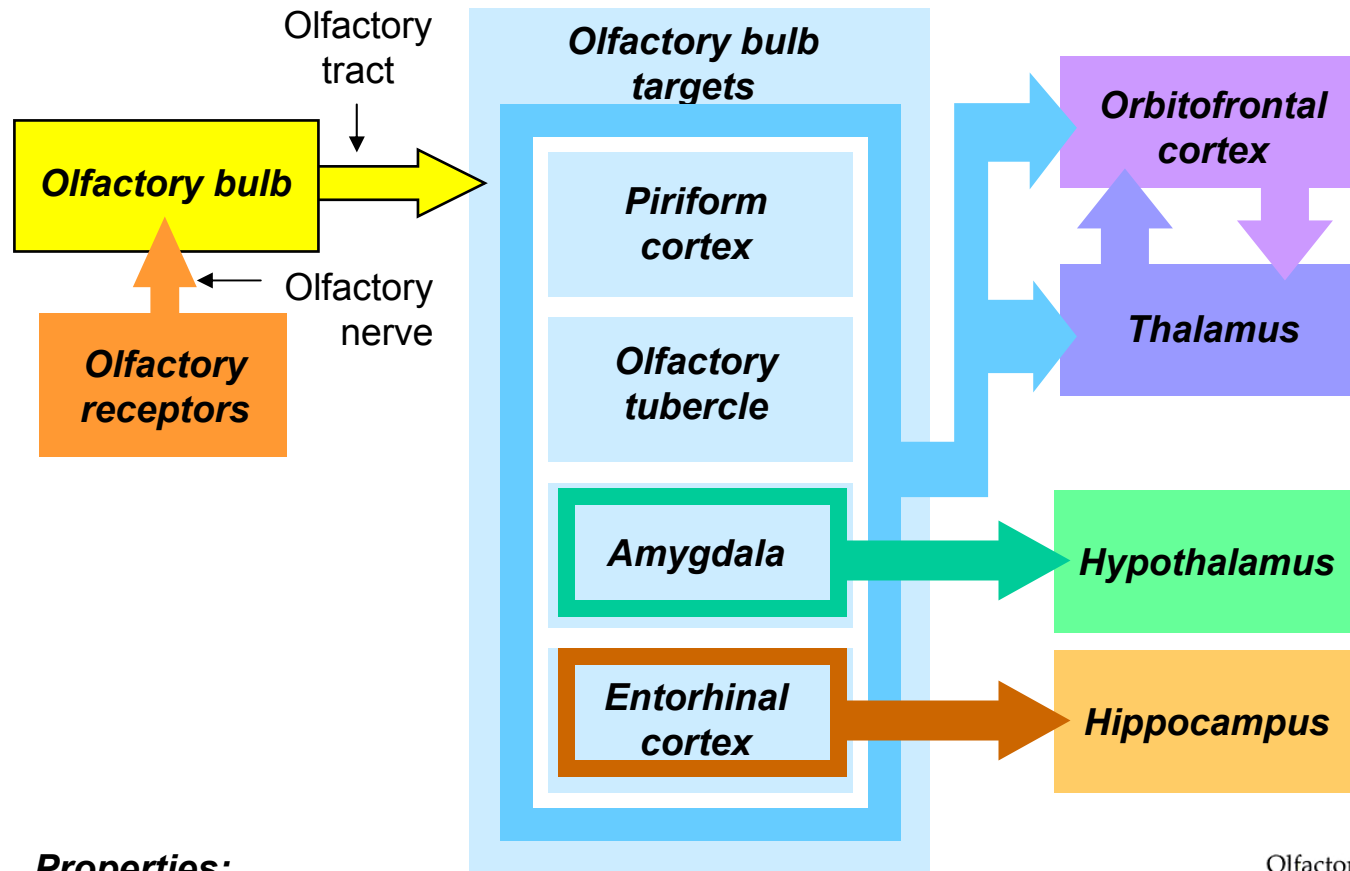
Poor stimulus localization → { Body movement  
Sniffing → synchronizes activity

Temporal coding → Adaptation to continuous smell

- Modality
- Location
- Intensity
- Timing

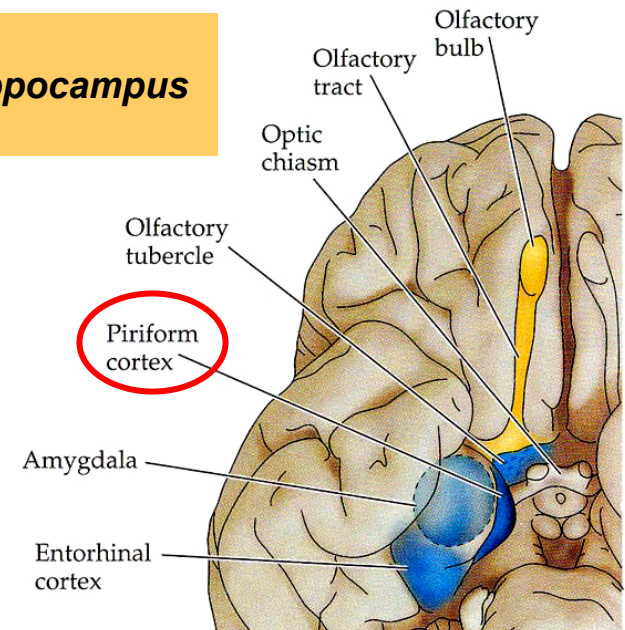


# Central processing of olfactory information



## Properties:

- 1) Direct pathway to cortex (Phylogenetically **old functional system**)
  - 2) Pathway to cortex through thalamus
  - 3) Limbic projections → **Emotive aspects**
  - 4) Hippocampus → **Memory aspects**
- These pathways are associated with **Conscious Discrimination of odors**.



**Gustation: The gustatory stimulus**

- Salt** → Electrolyte balance (NaCl 10 mM)
- Acids** → Food palatability (Citric acid, 2 mM)
- Sugars** → Energy (Sucrose, 20 mM)
- Glutamate** → Protein synthesis
- Bitter tasting molecules** → Poison signaling  
Alkaloids: atropine, quinine (0.008 mM),  
strychnine ( 0.0001 mM)...

Spatial coding

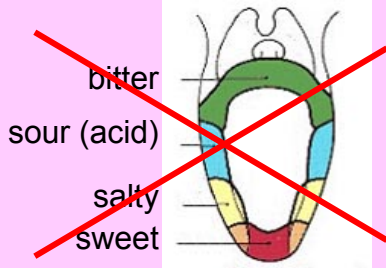
Temporal coding → Adaptation to continuous taste

**Tastants**

- Non-volatile, soluble in saliva
- Many and diverse
- Stimulus concentration
- Classifications

**Sensitivity**

**Sensory submodalities ?**



More taste sensations

Complex mixtures → sensed as single flavor

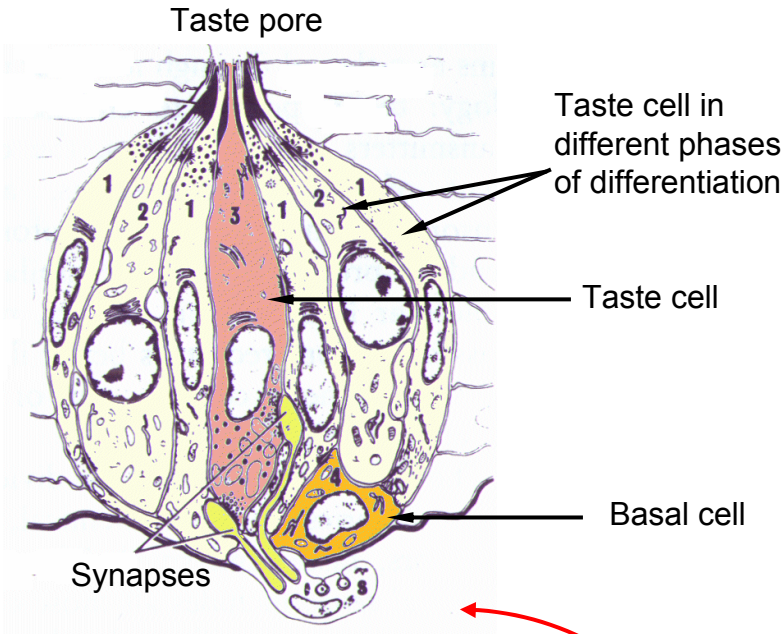
Number of tastes?

<b>Modality</b>	<b>Location</b>	<b>Intensity</b>	<b>Timing</b>
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Functional morphology

Taste bud



➡ Epiglottis (cranial nerve X)

- Sucrose
- NaCl
- HCl
- Quinine
- Water

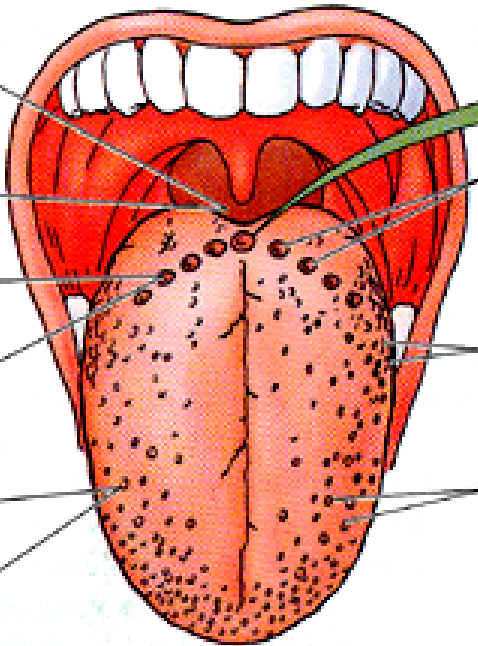
tongue

Circumvallate papillae (cranial nerve IX)

- Sucrose
- NaCl
- HCl
- Quinine

Fungiform papillae (cranial nerve VII)

- Sucrose
- NaCl
- HCl
- Quinine

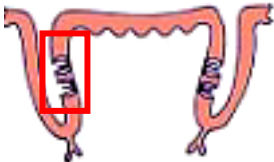


Circumvallate papillae

Foliate papilla

Fungiform papillae

Taste papillae



Circumvallate



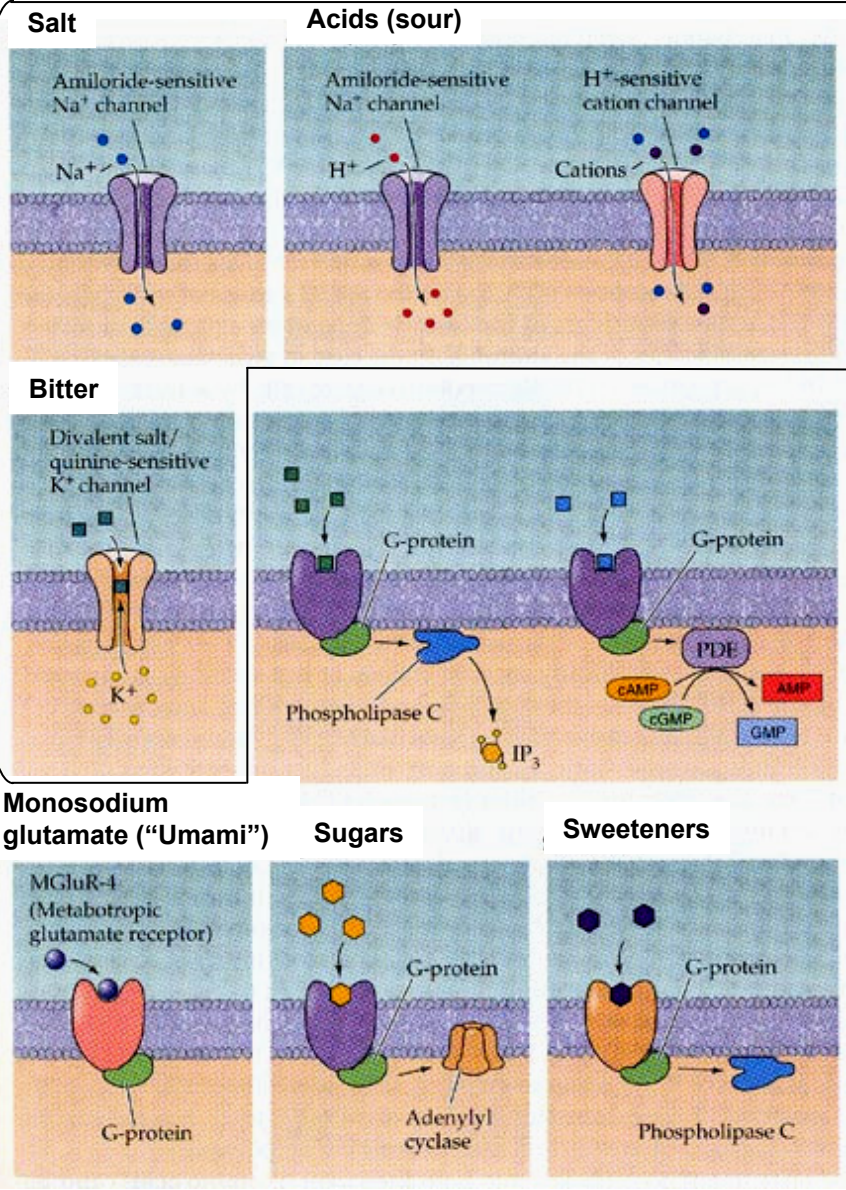
Foliate



Fungiform

# Chemoelectrical transduction of tastes in receptor cells

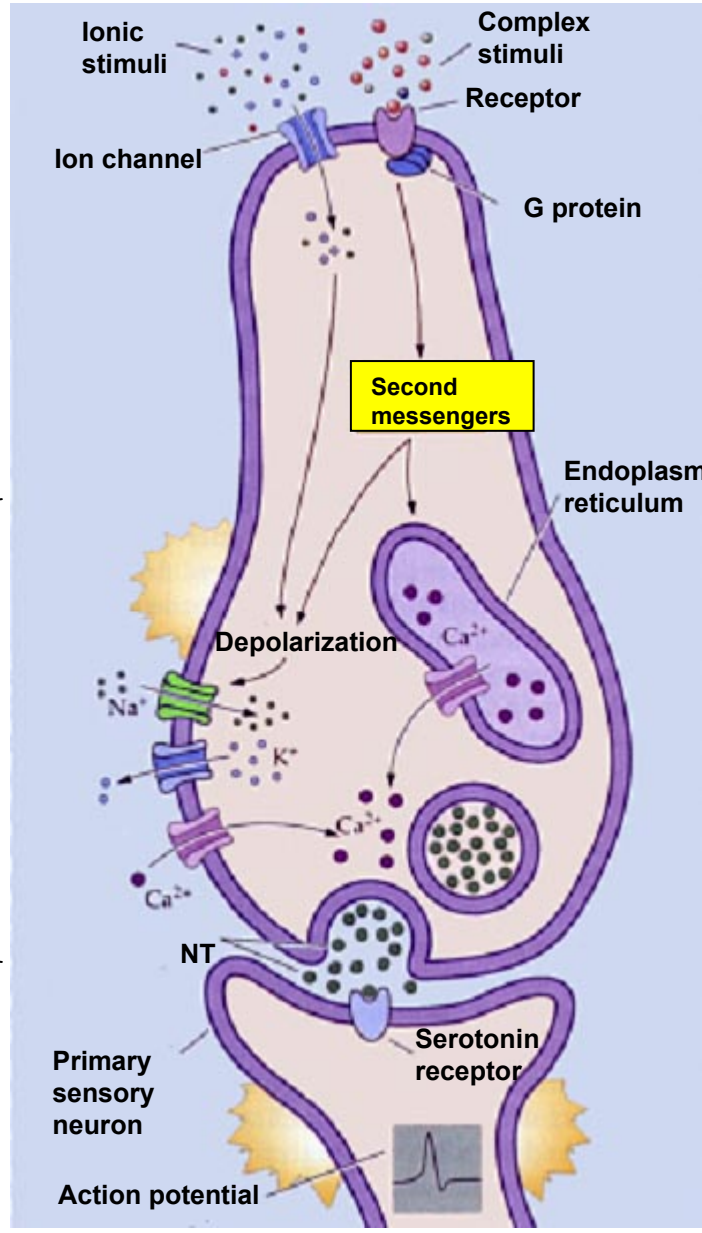
Ion channels



Membrane receptors

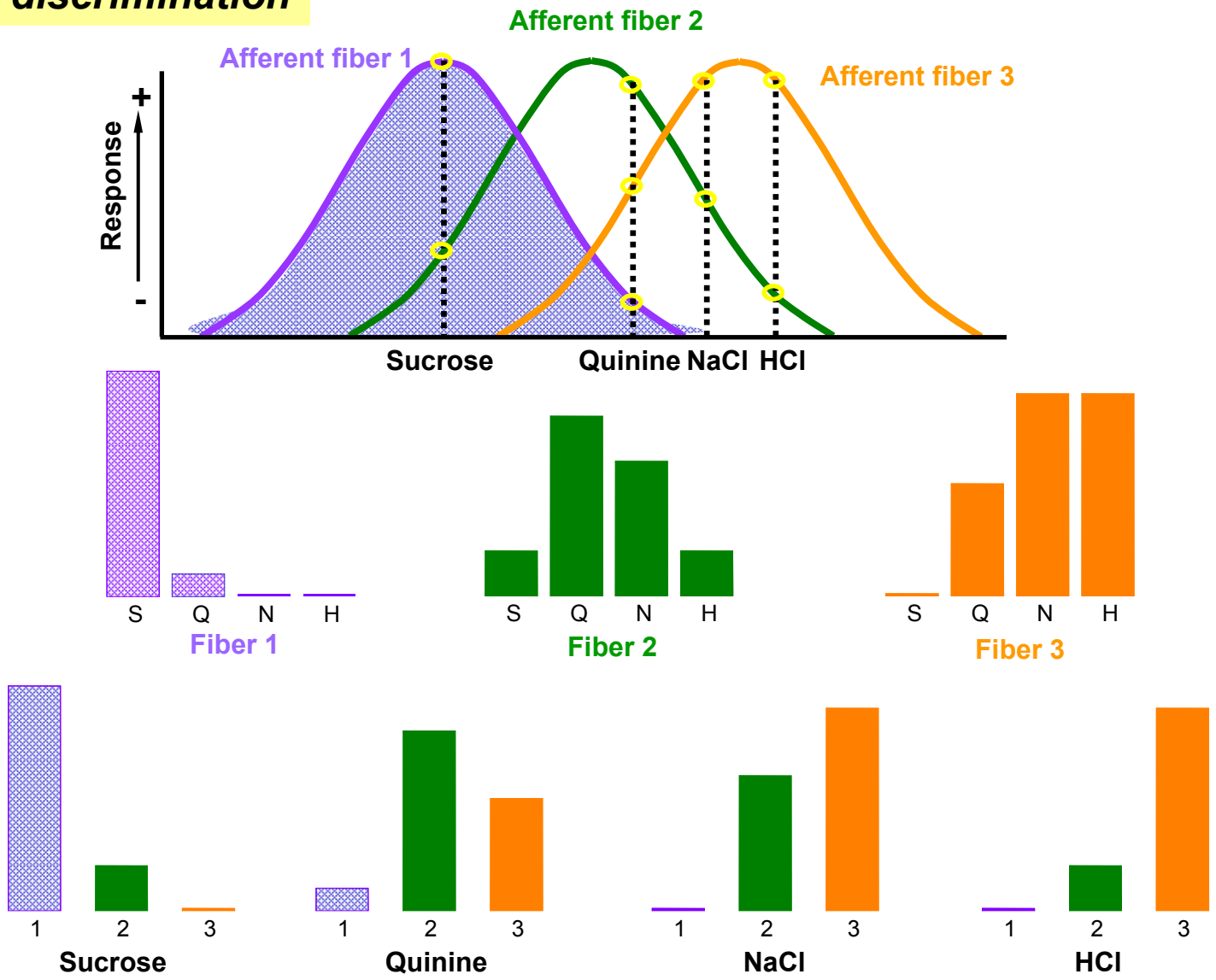
Apical surface

Basolateral surface



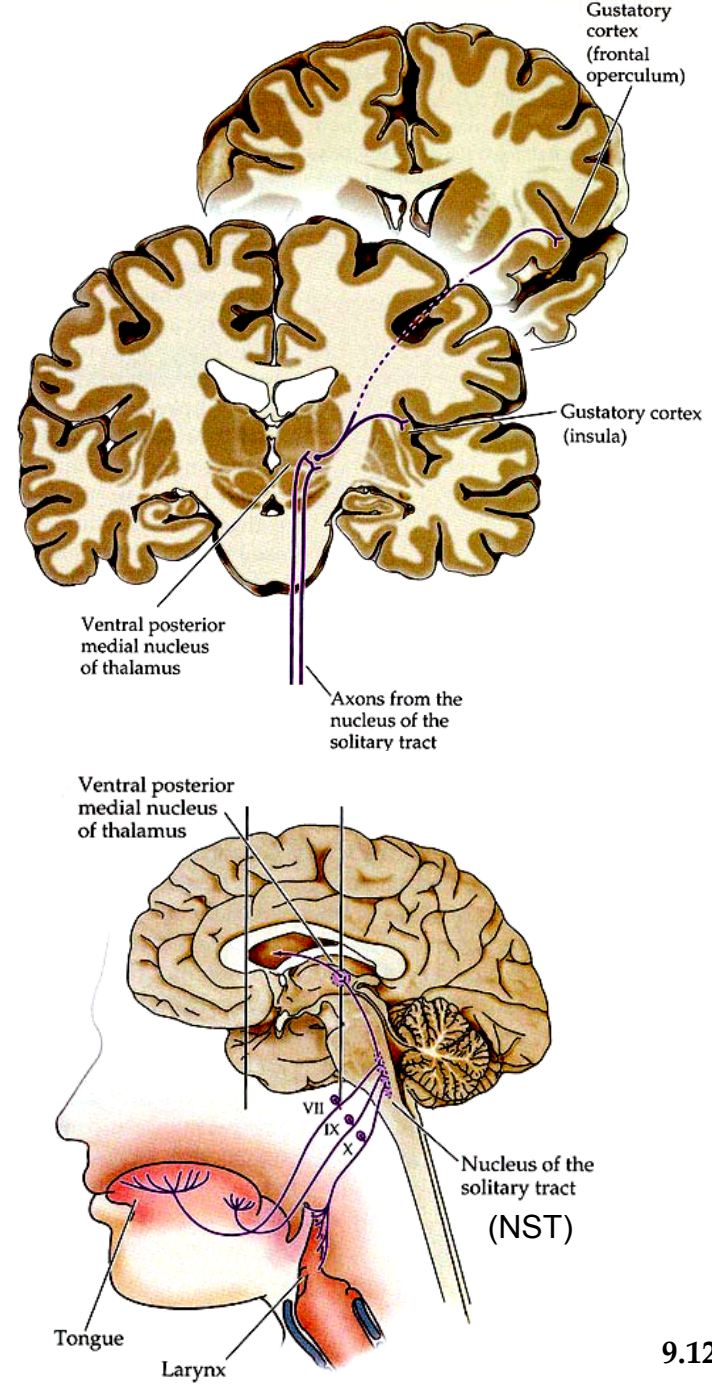
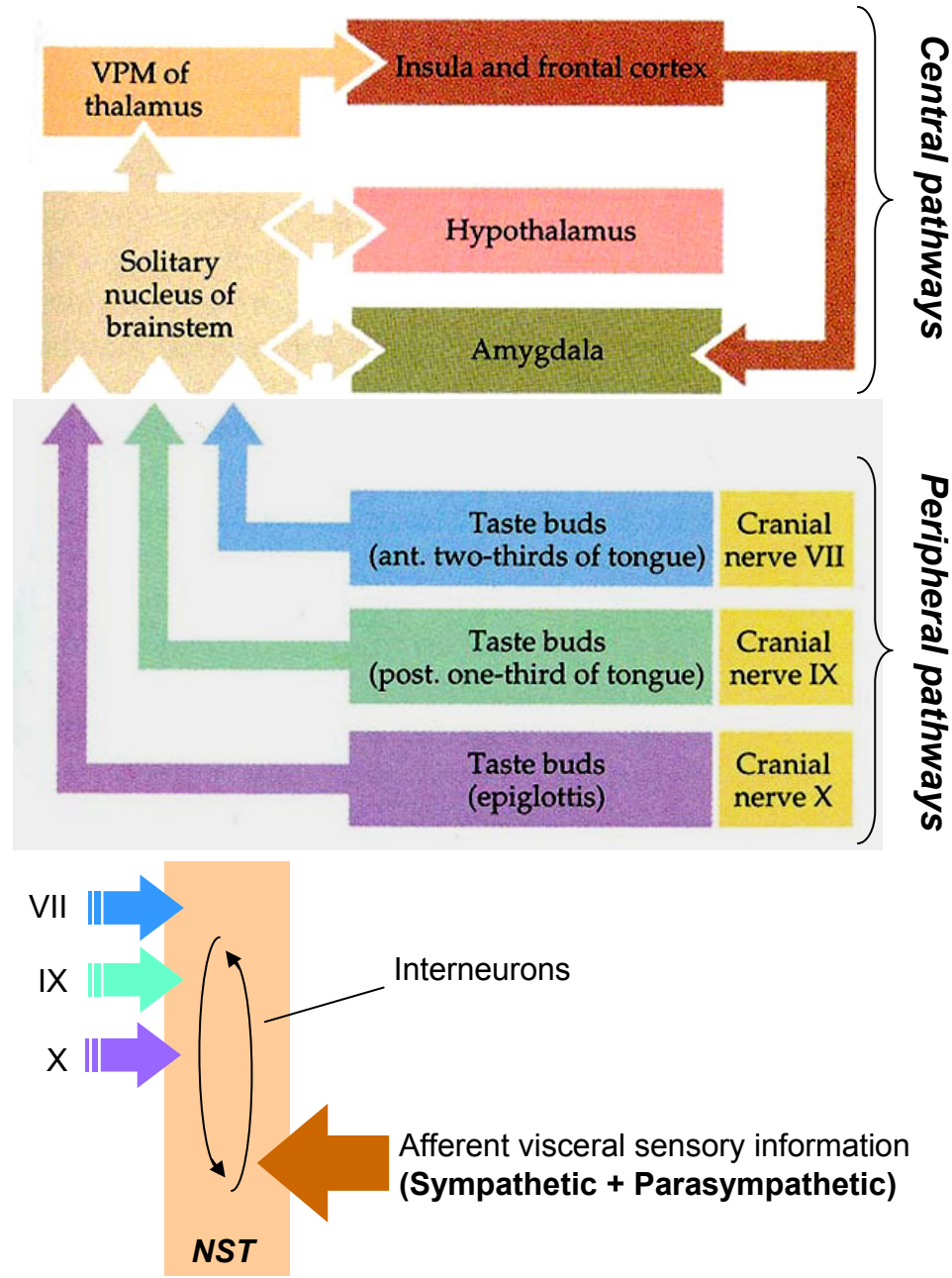
Coding the gustatory information

Stimuli discrimination



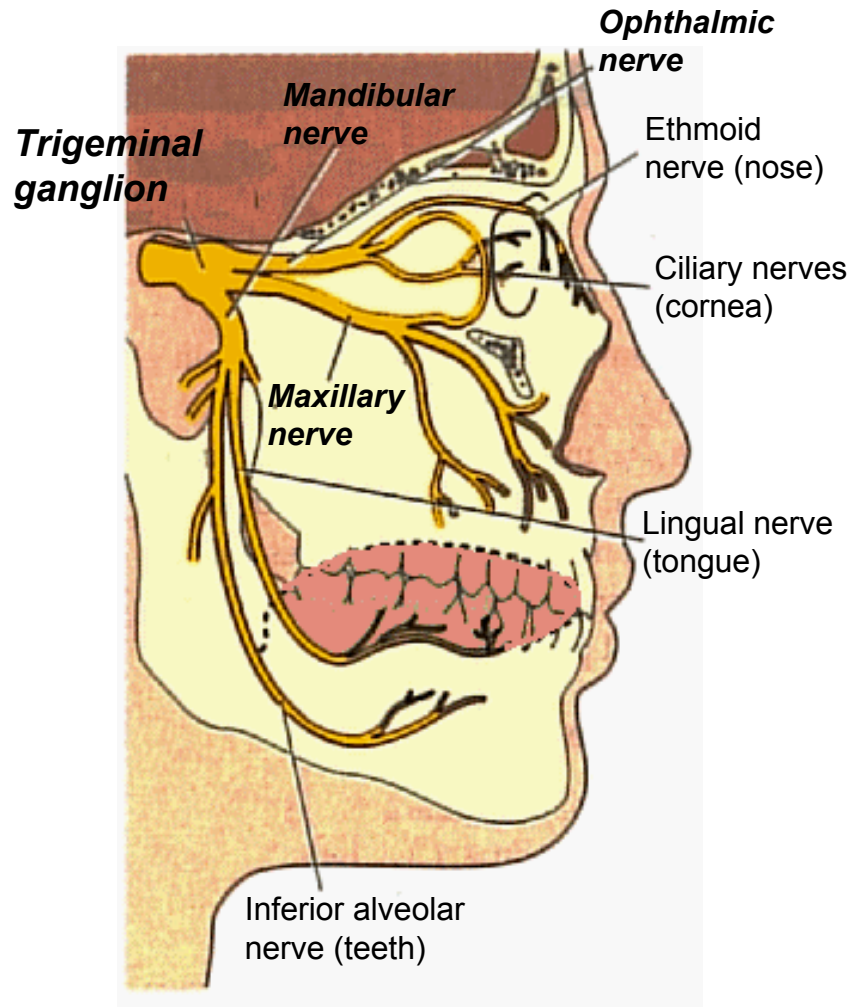


# Central processing of gustatory information





# Trigeminal chemoreception

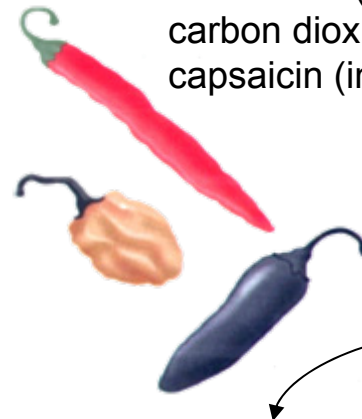
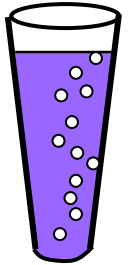


## Properties:

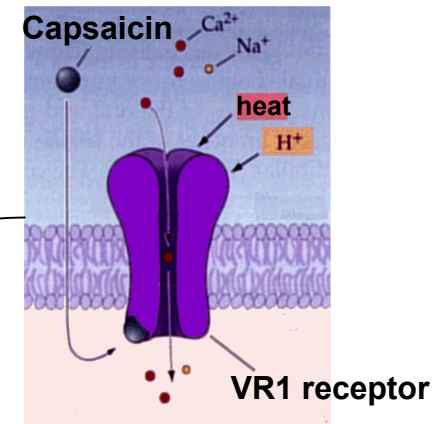
1) Mediated by **polymodal nociceptive neurons** (C fibers)

2) Activated by **irritants**:

air pollutants (sulfur dioxide)  
ammonia (smelling salts)  
ethanol (liquors)  
acetic acid (vinegar)  
carbon dioxide (in soft drinks)  
capsaicin (in chili peppers) → HOT food



Endogenous activators:  
acid and temperature



3) Higher thresholds than gustatory or olfactory receptors →  $\left\{ \begin{array}{l} \text{NaCl } 0.1 \text{ M} \rightarrow \text{salty taste} \\ \text{NaCl } 1 \text{ M} \rightarrow \text{irritant} \end{array} \right.$

4) Function: **Trigger protective reactions.**