FISIOLOGI HIDUNG DAN SINUS PARANASAL

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Physiology of Nose

The interior of nose are specialized for 3 functions:

1. **Incoming air is warmed, moistened, and filtered**
2. **Olfactory stimuli are received**
3. **Large, hollow resonating chambers modify speech sounds**

.....Physiology of Nose

When air enters the nostrils, it passes:

- **Through vestibule which is lined by skin containing coarse hairs that filter out large dust particles**
- **Then passes into upper nasal cavity :**
  - **3 conchae: superior, middle, inferior**
  - **3 meatuses: superior, middle, inferior**

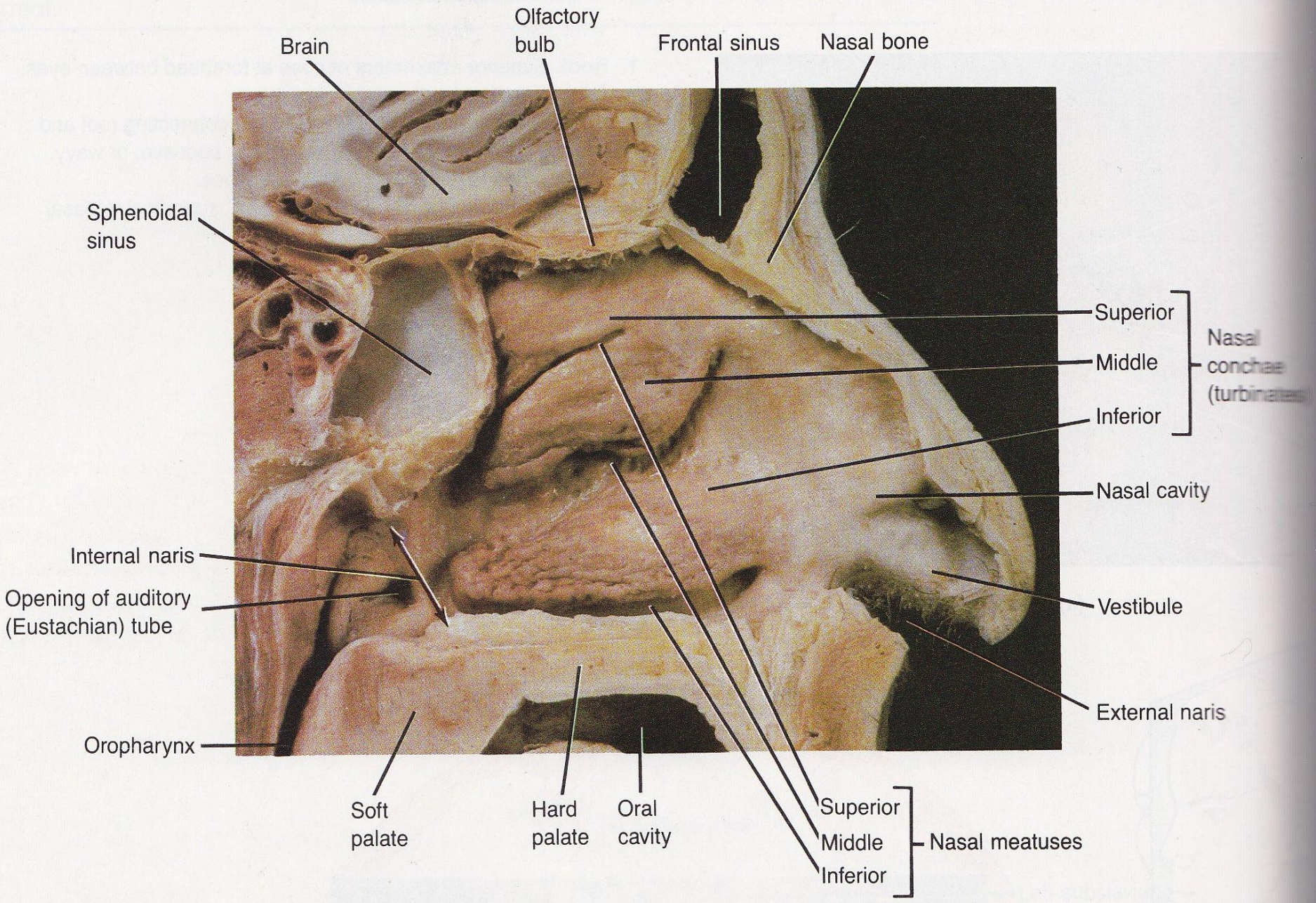
  All lined by mucous membrane

……Physiology of Nose

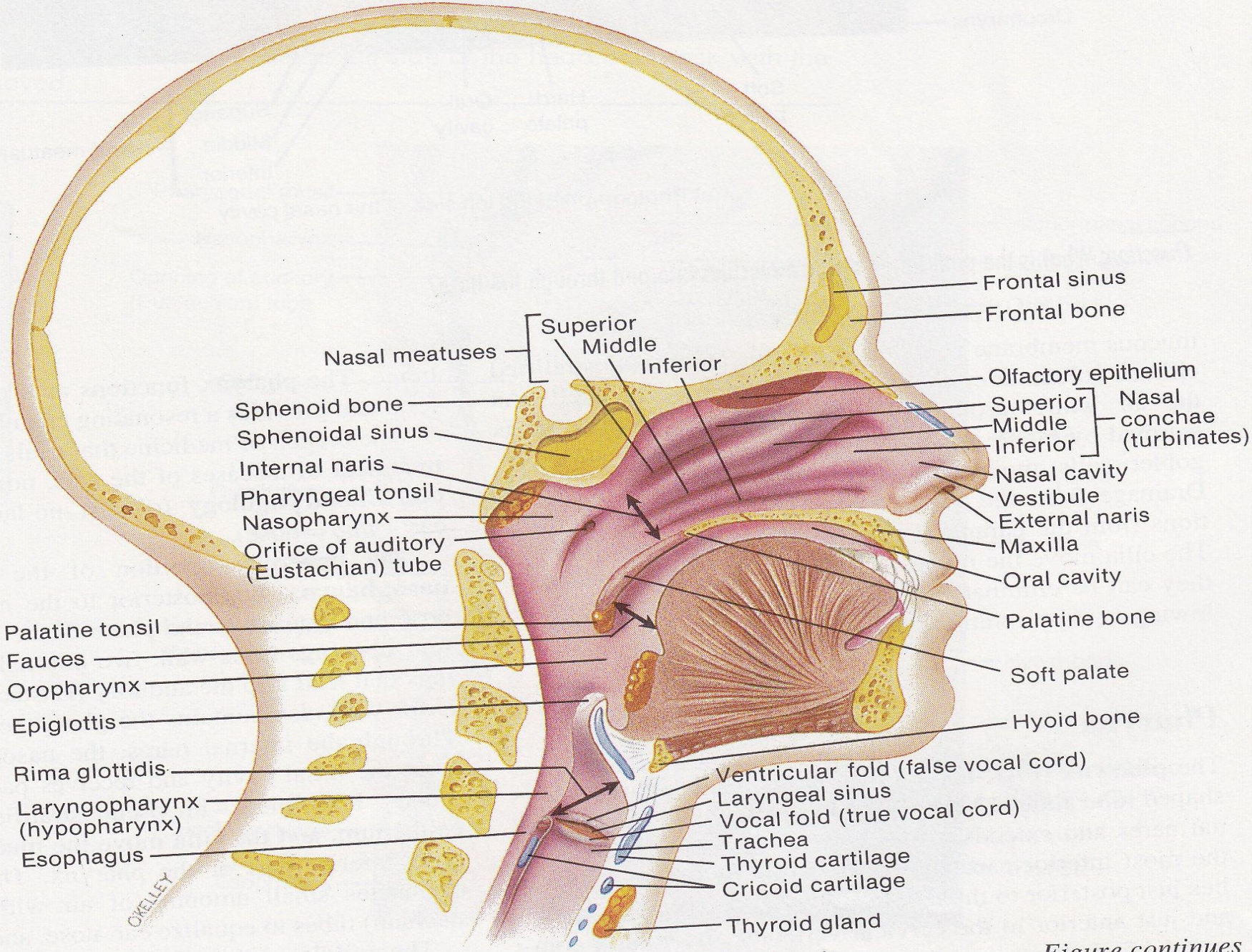
- Olfactory receptors lie in the membrane lining superior concha and adjacent septum, called olfactory epithelium
- Below olfactory epithelium, mucous membrane contains capillaries; air which is whirls around conchae and meatus warmed by blood in capillaries
- Mucous membrane also contains epithelial cells with many goblet cells; mucus secreted by goblet cells moistens the air and traps dust particles

……Physiology of Nose

- Drainage from the nasolacrimal ducts and perhaps secretions from paranasal sinuses also help moistens the air
- The cilia move the mucus-dust packages to the pharynx so they can be eliminated from respiratory tract by swallowing or expectoration (spitting)



(c) Photograph of the left side of the nasal cavity



(b) Diagram of the left side of the head and neck

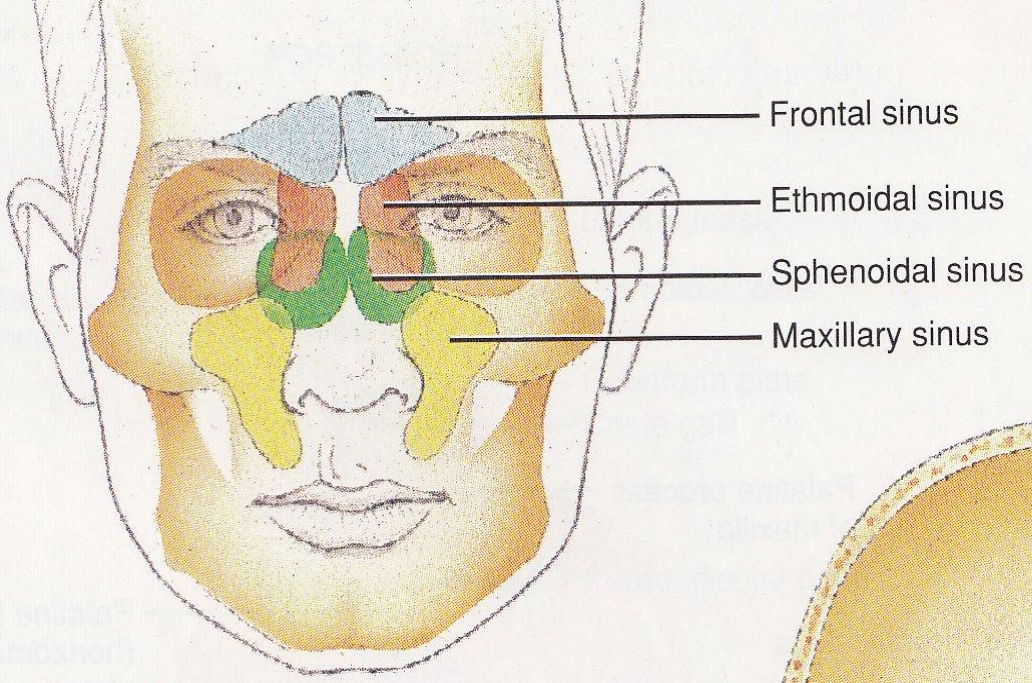
Figure continues

Physiology of Paranasal Sinuses

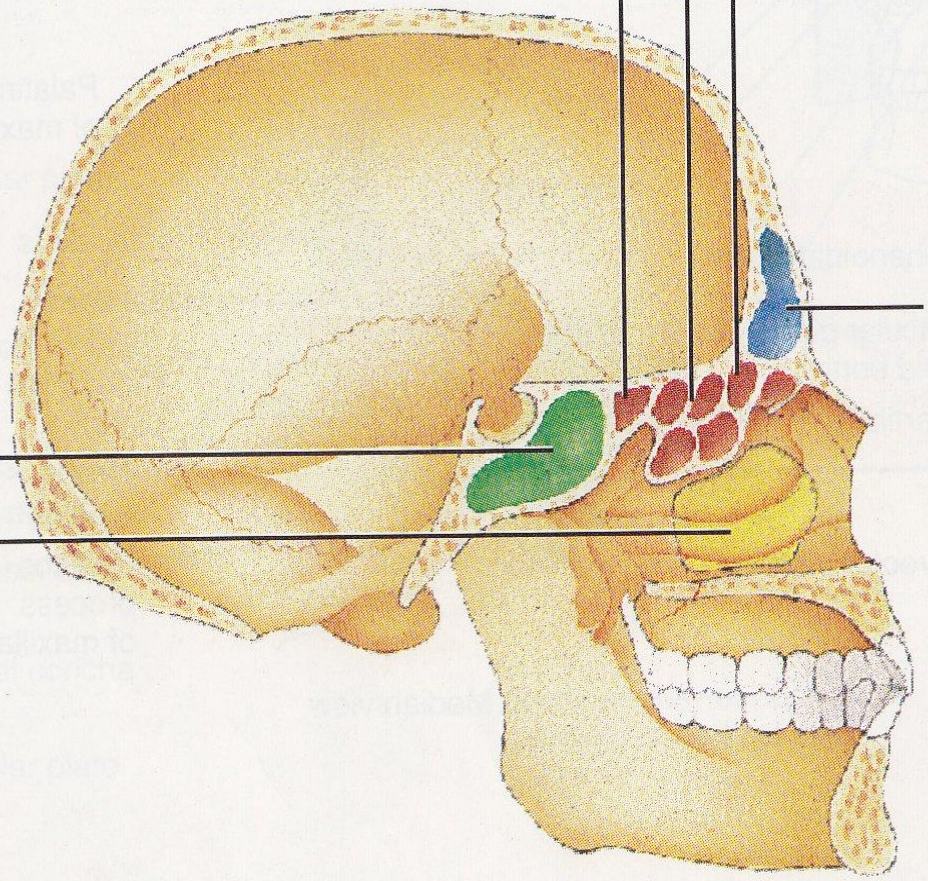
- **Paired cavities in certain cranial and facial bones near nasal cavity:**

  frontal, sphenoid, ethmoid, maxillae

- **Lined with mucous membranes that are continuous with the lining of the nasal cavity**
- **Producing mucus**
- **Lighten the skull bones**
- **Serve as resonating chambers for sound as we speak or sing**



(a) Anterior view



(b) Median view

OLFACTORY SENSATION (SMELL)

Introduction

- Smell and taste are generally classified as visceral sense because of their close association with gastrointestinal function
- Physiologically they are related to each other
- Flavors of various foods are in large part a combination of their taste and smell
- Food may taste “different” if one has a cold that depresses sense of smell

.....Introduction

- Both smell and taste receptors are chemo-receptors that are stimulated by molecules in solution in mucus in the nose and saliva in the mouth
- However, anatomically quite difference:

  - Smell receptors are distance receptors (teleceptors), and its pathways have no relay in thalamus

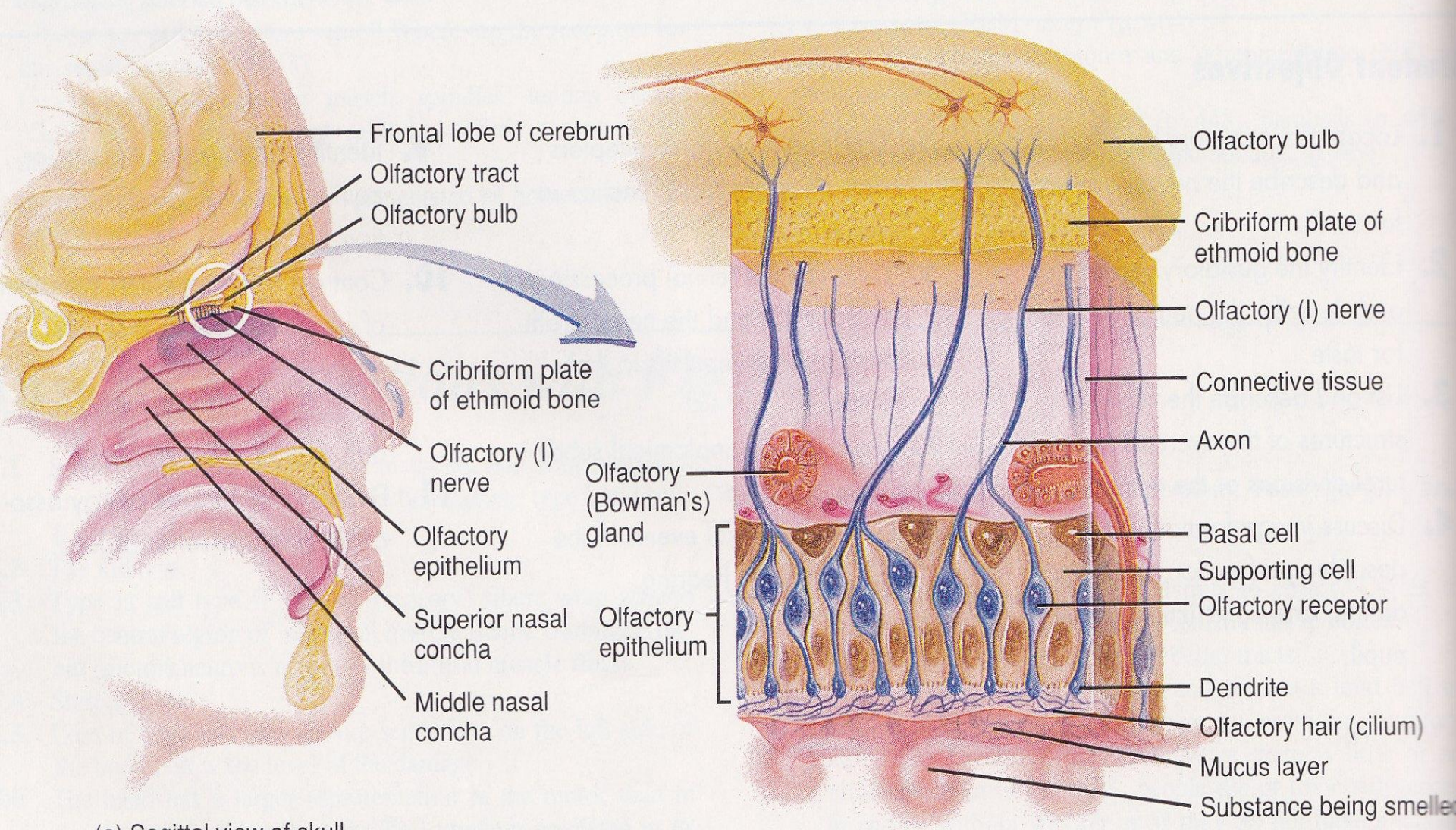
  - Taste pathways pass up brainstem to thalamus and project to postcentral gyrus

Olfactory Mucous Membrane

- Is specialized portion of nasal mucosa
- With yellowish pigmented
- In which olfactory receptor cells are located
- Is constantly covered by mucus which is produced by Bowman's glands
- In dogs and other animals in which sense of smell is highly developed (macrosmatic animals)
- Contains supporting cells and progenitor cells for olfactory receptors

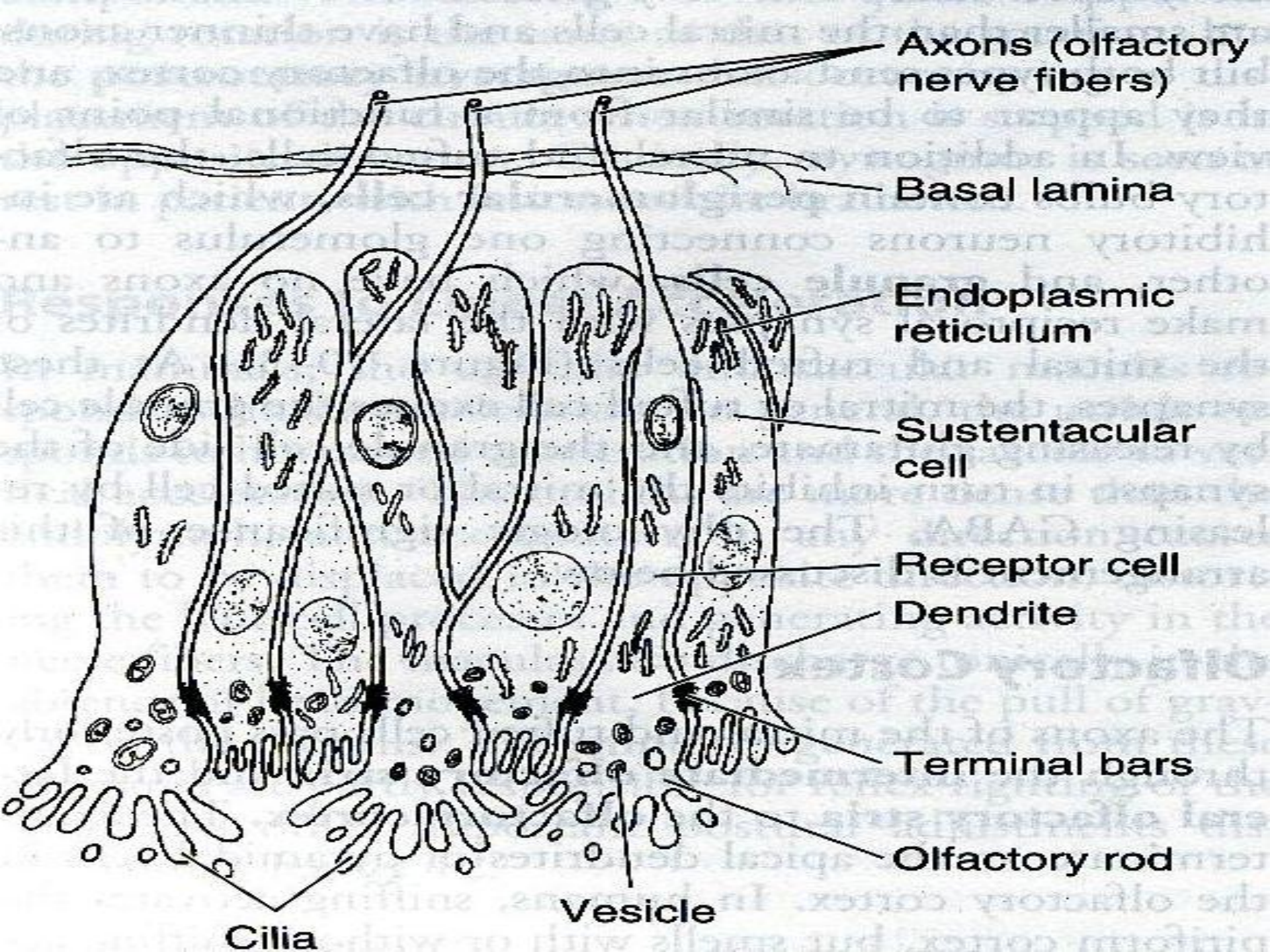
Olfactory Receptors

- Each olfactory receptor is a neuron
- Each neuron has a short thick dendrite with expanded end called an olfactory rod
- From the rods, cilia project to surface of mucus
- Each receptor has 10-20 cilia
- Axon of the neurons pierce cribriform plate of ethmoid bone and enter olfactory bulbs
- Olfactory neurons are constantly being replaced with a half-time of a few weeks



(a) Sagittal view of skull

(b) Enlarged aspect of olfactory receptors


Axons (olfactory nerve fibers)
Basal lamina
Endoplasmic reticulum
Sustentacular cell
Receptor cell
Dendrite
Terminal bars
Olfactory rod
Vesicle
Cilia

Olfactory Bulbs

- In olfactory bulbs, axons of receptors contact primary dendrites of mitral cells and tufted cells to form complex globular synapses called olfactory glomeruli
- Olfactory bulbs also contain periglomerular cells which are inhibitory neurons connecting one glomerolus to another
- Granule cells have no axons and make reciprocal synapses with lateral dendrites of mitral and tufted cells

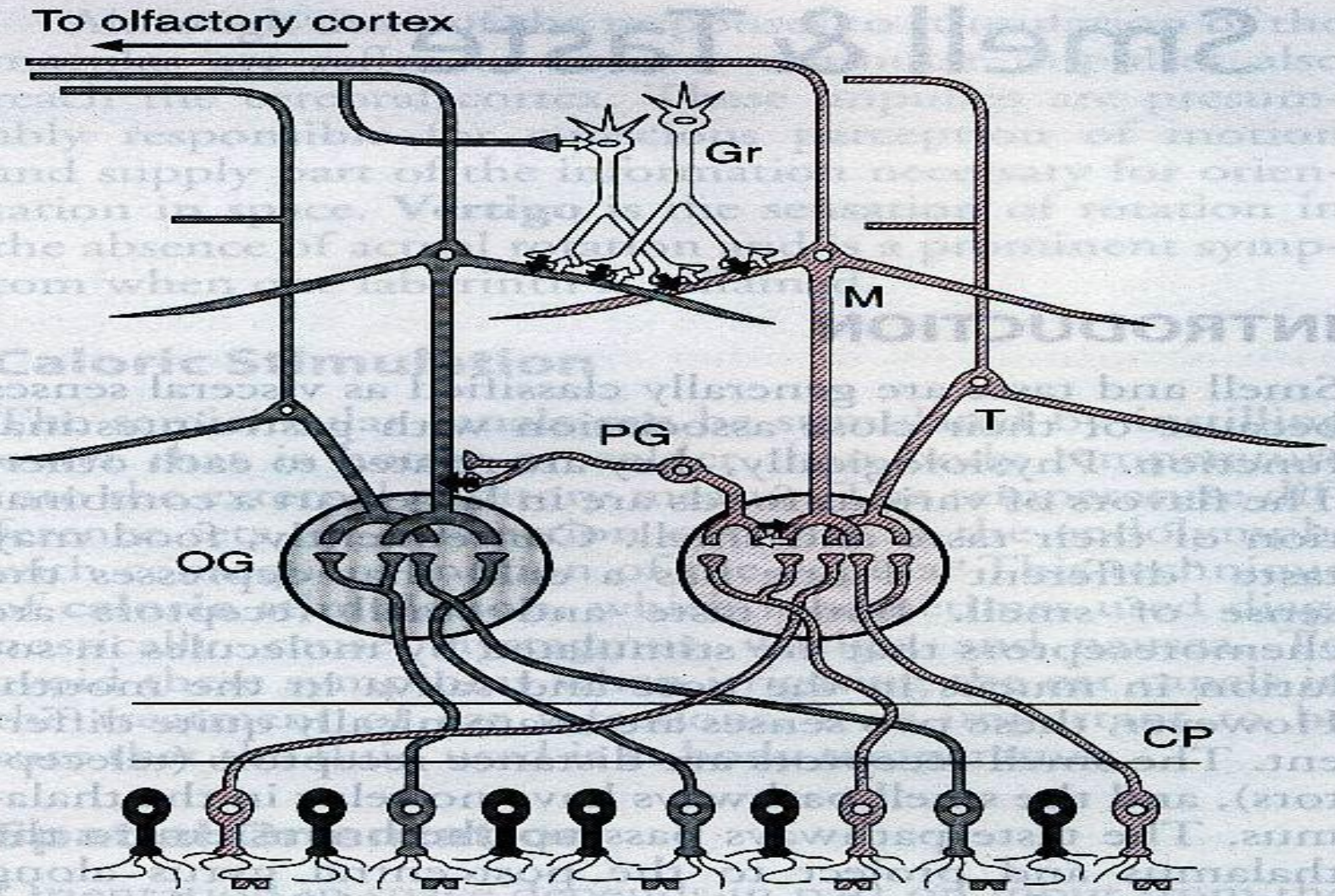


Figure 10–3. **Basic neural circuits in the olfactory bulb. Note that olfactory receptor cells with one type of odorant receptor project to one olfactory glomerulus (OG) and olfactory receptor cells with another type of receptor project to a different olfactory glomerulus. CP, cribriform plate; PG, periglomerular cell; M, mitral cell; T, tufted cell; Gr, granule cell.** (Modified from Mori K,

Olfactory Pathways

1. The very old olfactory system (medial olfactory area): concerning with basic olfactory reflexes to olfaction, such as licking the lips, salivation, and other feeding responses caused by smell of food
2. The less old olfactory system (lateral olfactory area): provides learned control of food intake (like / dislike certain foods)
3. The newer olfactory system: other cortical sensory systems and is used for conscious perception of olfaction

Olfactory Cortex

- Axons of mitral and tufted cells pass posteriorly through intermediate olfactory stria and lateral olfactory stria to olfactory cortex
- In humans, sniffing activates pyriform cortex
- Smells activate lateral and anterior orbitofrontal gyri of frontal lobe
- Orbitofrontal activation is generally greater on right side than left side

……Olfactory Cortex

- **Other fibers project:**

  - to amygdala, which is probably involved with emotional responses to olfactory stimuli,

  - to entorhinal cortex which is concerned with olfactory memories

Olfactory threshold & Discrimination

- Olfactory receptors respond only to substances that are in contact with olfactory epithelium and are dissolved in thin layer of mucus that covers it
- Olfactory threshold remarkable sensitive to some substances
- Olfactory discrimination is remarkable
- Humans can recognize ≥ 10,000 different odors

….Olfactory threshold & Discrimination

- Determination of differences in intensity of any given odor is poor
- Concentration of odor-producing substance must be changed by about 30% before a difference can be detected
- Comparable visual discrimination threshold is a 1% change in light intensity

Role of Pain Fibers in Nose

- Naked endings of many trigeminal pain fibers are found in olfactory mucous membrane
- They are stimulated by irritating substances, and an irritative
- Trigeminally mediated component is part of characteristic "odor" of such substances as peppermint, menthol, chlorine
- These endings also responsible for initiating sneezing, lacrimation, respiratory inhibition, and other reflex responses to nasal irritants

Adaptation

- When one is continuously exposed to even most disagreeable odor, perception of odor decreases and eventually ceases
- This phenomenon is due to fairly rapid adaptation, or desensitization that occurs in olfactory system
- Mediated by Calcium ion acting via calmodulin on cyclic nucleotide-gated (CNG)
- When CNG is knocked out, adaptation is slowed

Abnormalities

- **Anosmia : absence of sense of smell**
- **Hyposmia : diminished olfactory sensitivity**
- **Dysosmia : distorted sense of smell**

THANK YOU