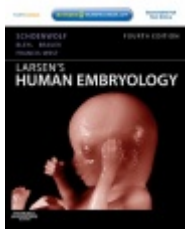
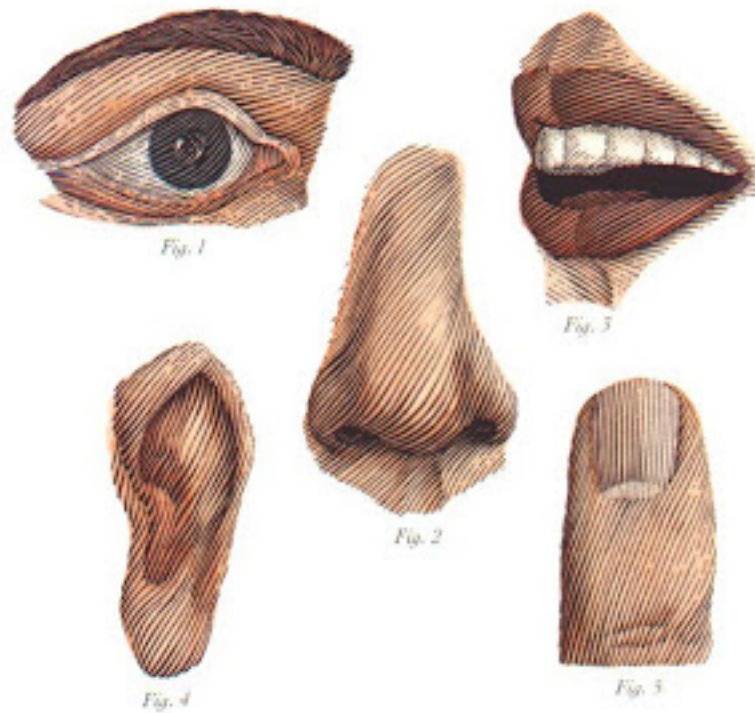
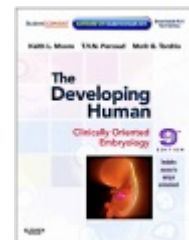


Development of the Sensory Systems



Resources:
<http://php.med.unsw.edu.au/embryology/>
Larsen's Human Embryology
The Developing Human: Clinically Oriented Embryology



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Development of the Sensory System

The 5 Sense Organs

Embryonic origins of the sensory system

The Auditory System

The Olfactory System

The Visual System

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Development of the Sensory System

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Embryonic origins of the sensory system

The Auditory System

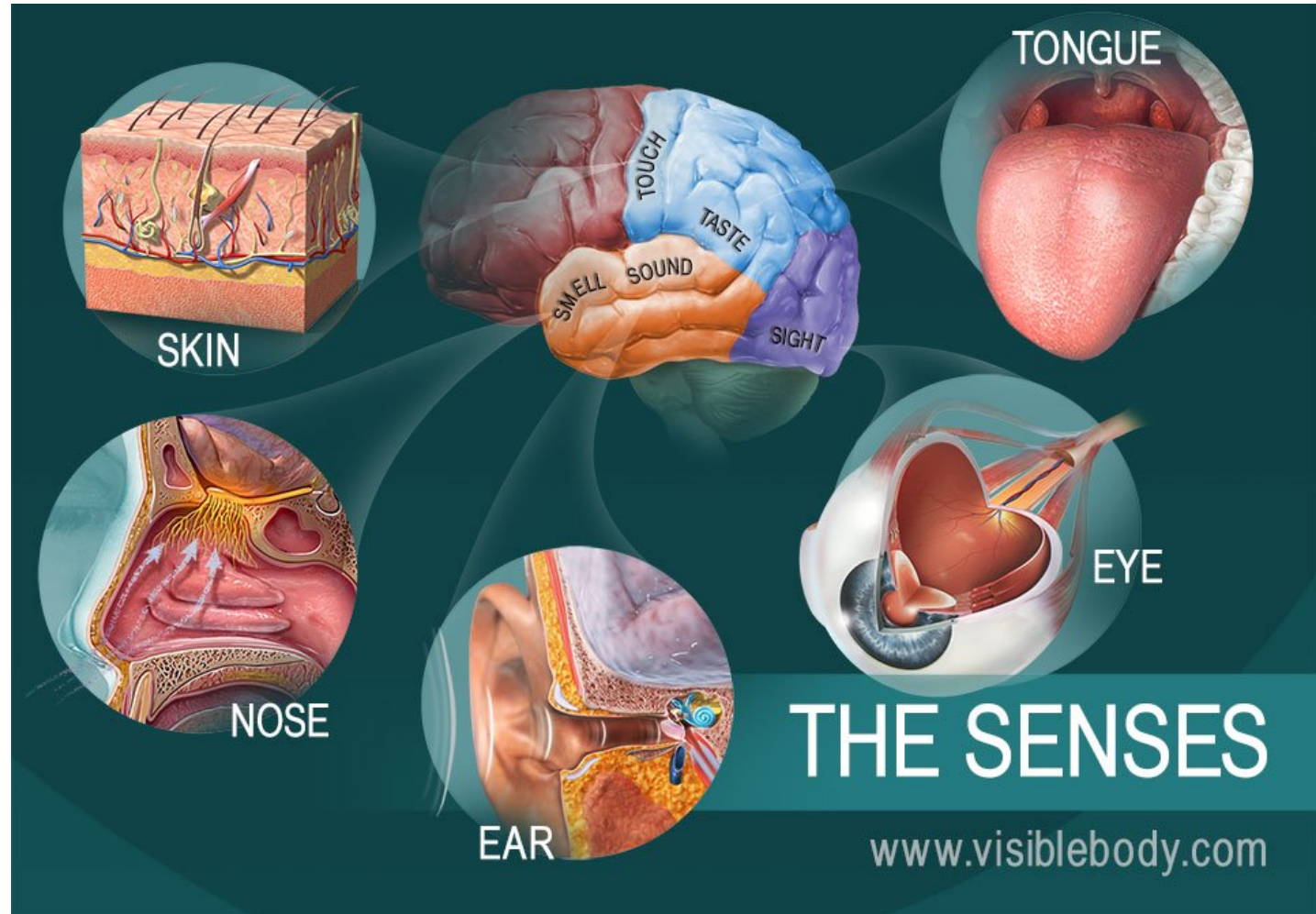
The Olfactory System

The Visual System

The 5 Sense Organs

5 senses:

- Hearing
- Seeing
- Smelling
- Tasting
- Feeling

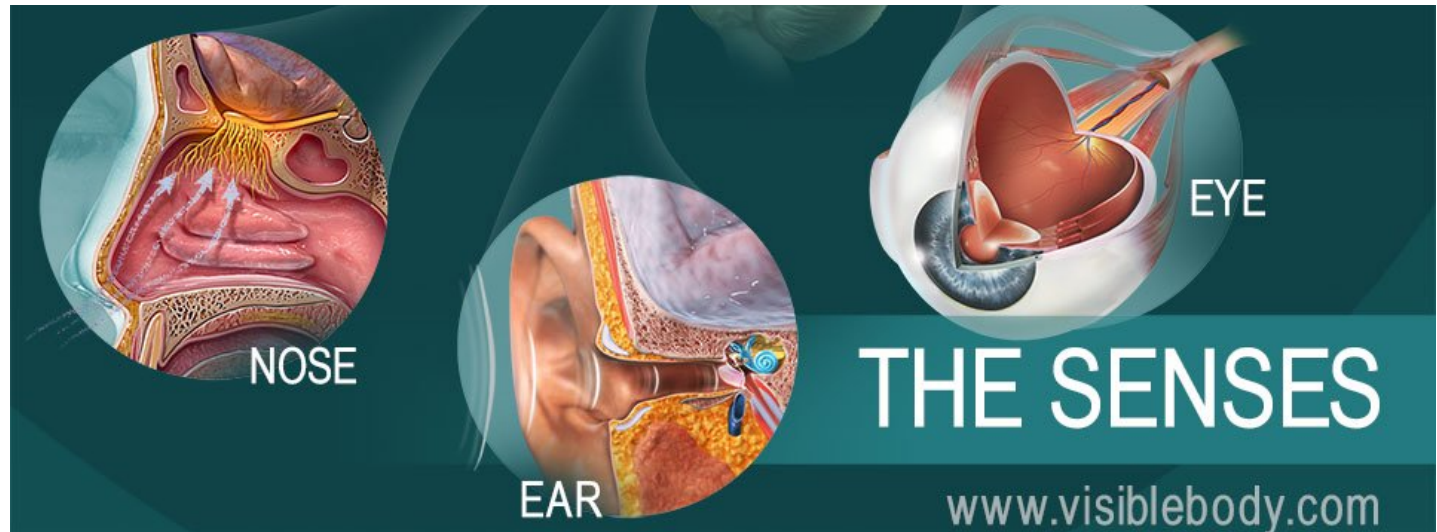


The 5 Sense Organs

Today's lecture

3 senses:

- Hearing
- Seeing
- Smelling



Development of the Sensory System

The 5 Sense Organs

Embryonic origins of the sensory system

The Auditory System

The Olfactory System

The Visual System

Embryonic origins of the sensory system

Trilaminar embryo

Ectoderm (Neural crest)

brain, spinal cord, **eyes, external and inner ear,**
peripheral nervous system
epidermis of skin and associated structures, *melanocytes,*
cranial connective tissues (dermis) and middle ear ossicles

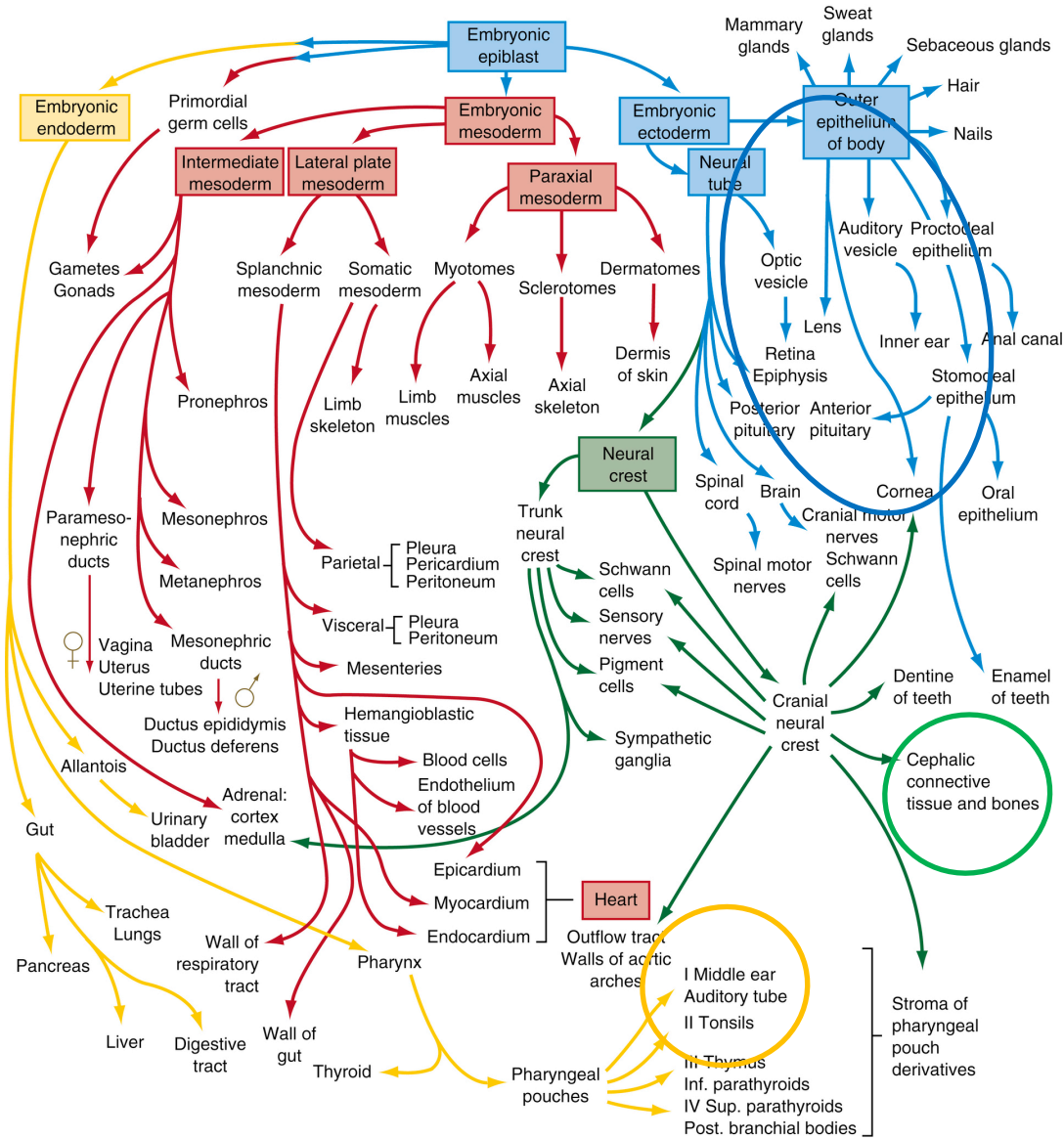
Mesoderm

musculo-skeletal system
limbs
connective tissue of skin and organs
urogenital system, heart, blood cells

Endoderm

epithelial linings of gastrointestinal and respiratory tracts
lining of the auditory tube

Embryonic origins of the sensory system



Embryonic origins of the sensory system

Ectoderm

1. Surface ectoderm

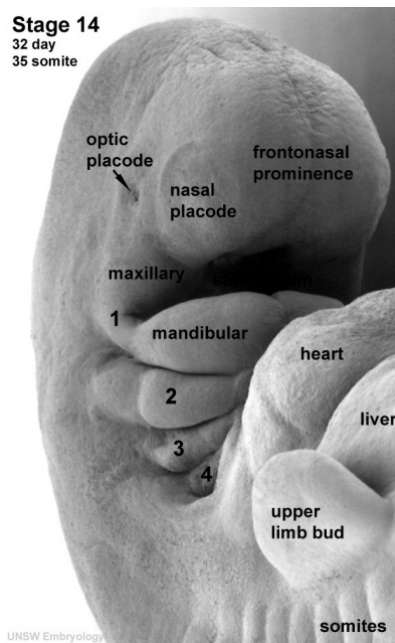
- Sensory placodes: thickened ectoderm
- Otic placodes, Optic placodes, Nasal placodes
- Common developmental pathway: placode -> pit -> vesicle

- epidermis of external ear,
- lens and cornea of the eye

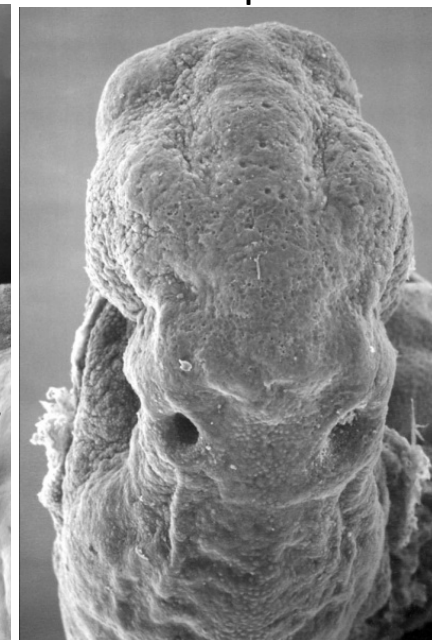
2. Neurectoderm of diencephalon:

- retina of the eye

Stage 14
32 day
35 somite



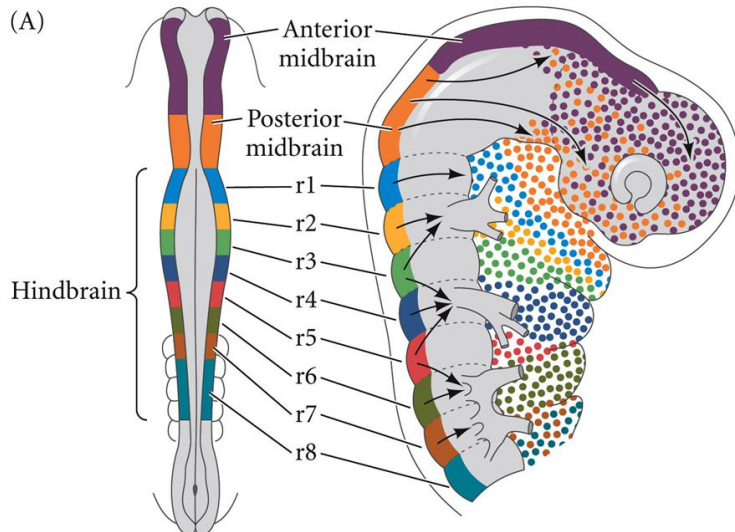
Otic pits



Embryonic origins of the sensory system

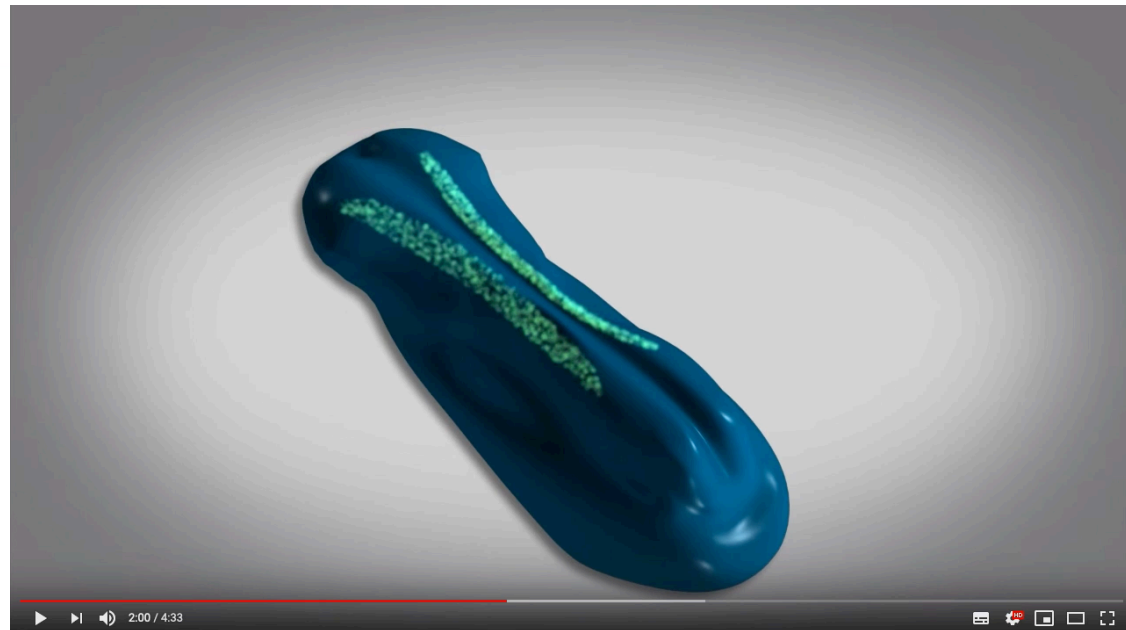
Neural crest

Neural crest populating frontonasal process and 1st and 2nd pharyngeal arches
Middle ear ossicles, external ear, nasal labyrinth



DEVELOPMENTAL BIOLOGY, 9e, Figure 10.10 (Part 1)

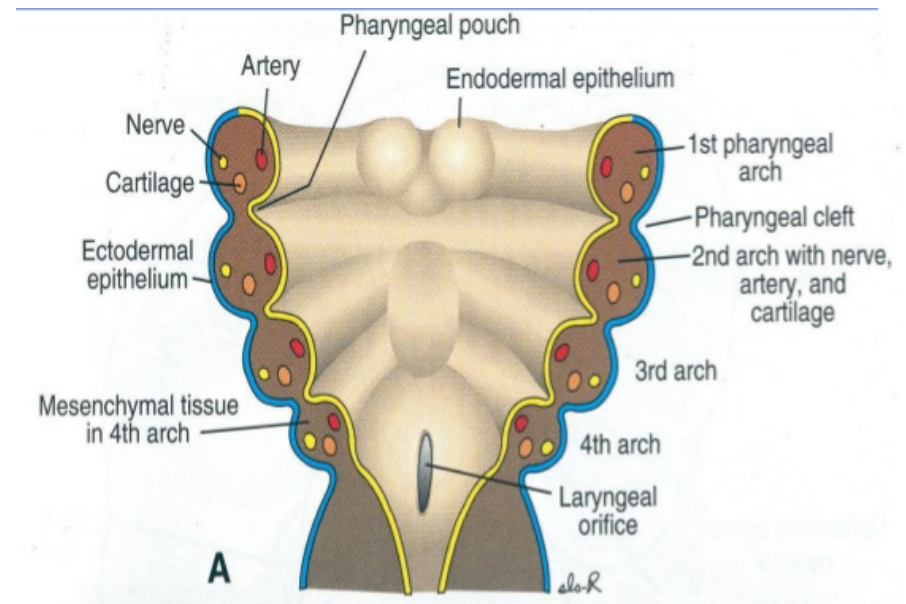
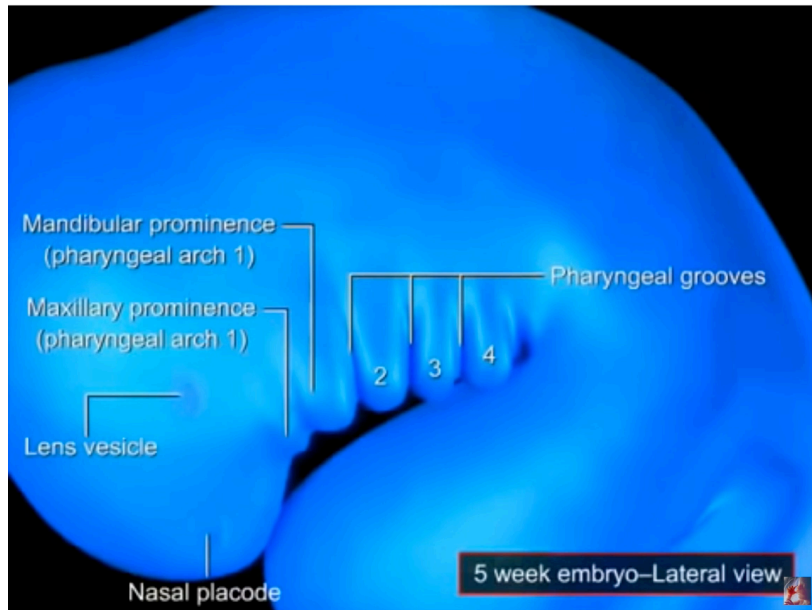
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Embryonic origins of the sensory system

Endoderm

Endodermal lining of the first pharyngeal pouch
Epithelium lining the auditory tube



Development of the Sensory System

The 5 Sense Organs

Embryonic origins of the sensory system

The Auditory System

The Olfactory System

The Visual System

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The auditory system

Anatomy

Function: hearing and balance

Three main regions:

1. Outer ear

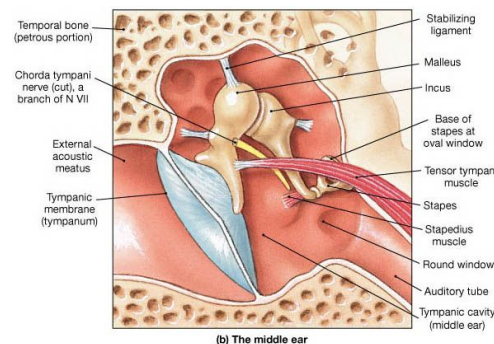
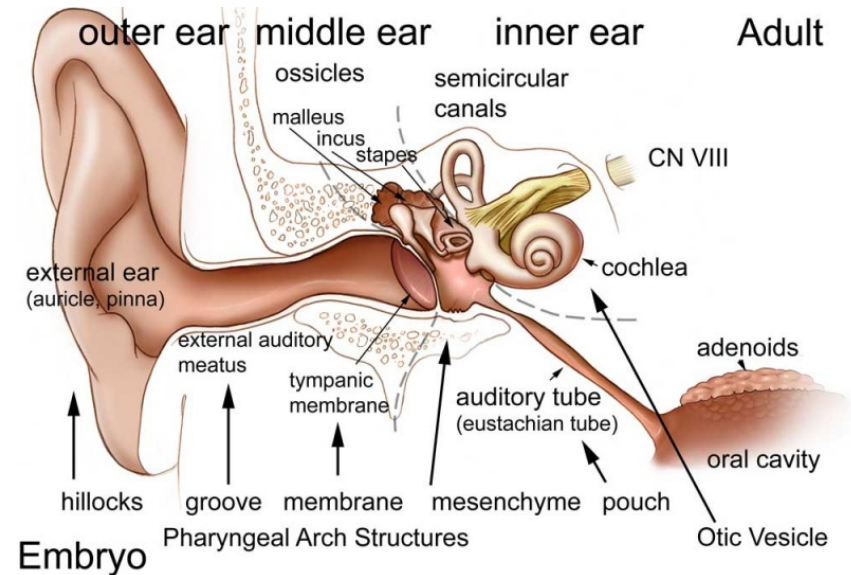
- External ear
- External auditory meatus
- Tympanic membrane

2. Middle ear

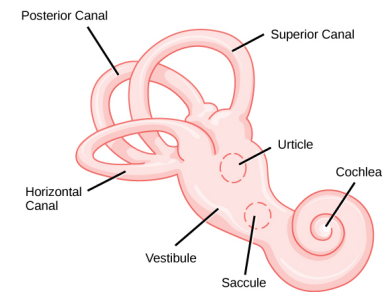
- Malleus, incus, stapes
- Auditory tube

3. Inner ear

- Semicircular canals
- Cochlea
- Saccule and utricle



Middle ear

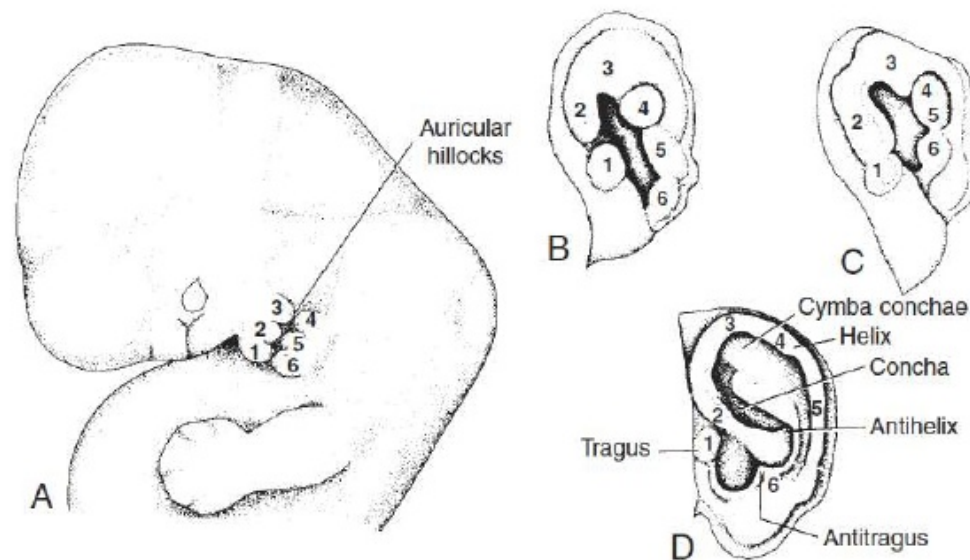


Inner ear

The auditory system

The external ear

- External ear develops from 6 auricular hillocks around 1st pharyngeal cleft
- Ectoderm and neural crest-derived mesenchyme
- External acoustic meatus: ectoderm of first cleft
- Tympanic membrane: ectoderm/endoderm of 1st cleft/pouch



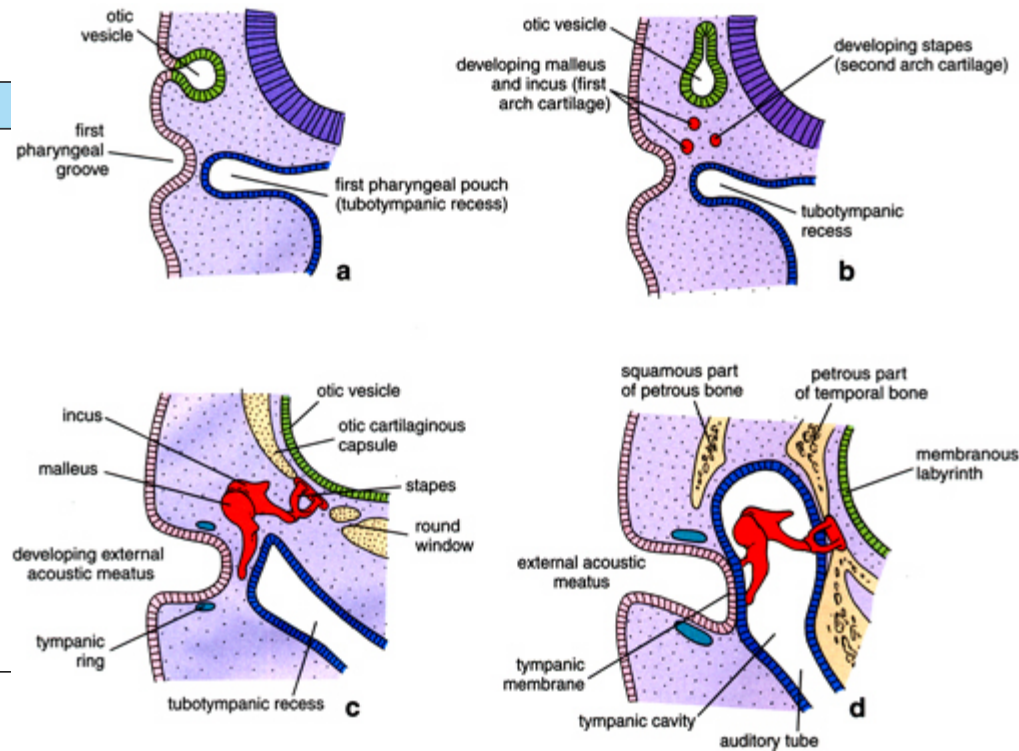
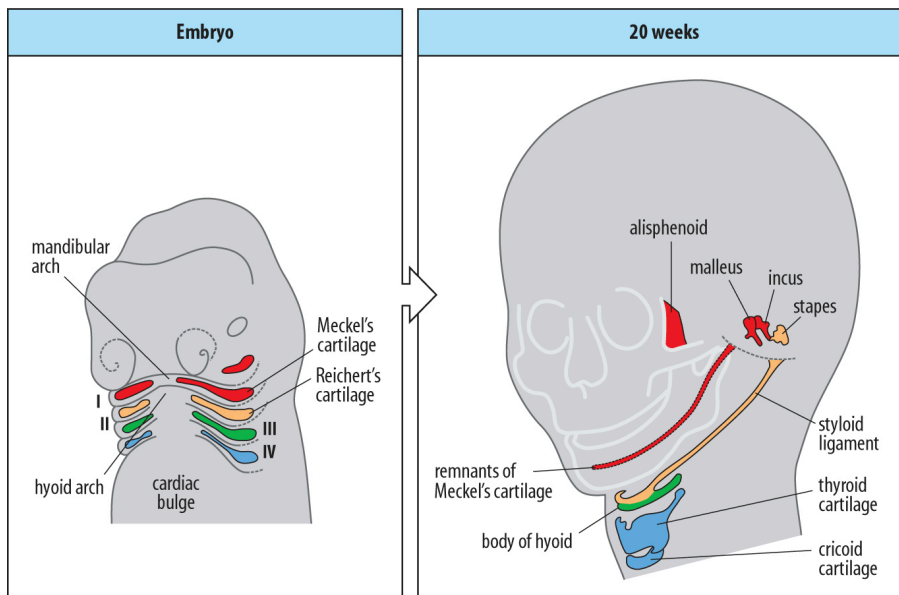
A. Lateral view of the head of an embryo showing the six auricular hillocks surrounding the dorsal end of the first pharyngeal cleft

B to D. Fusion and progressive development of the hillocks into the adult auricle

The auditory system

Middle ear

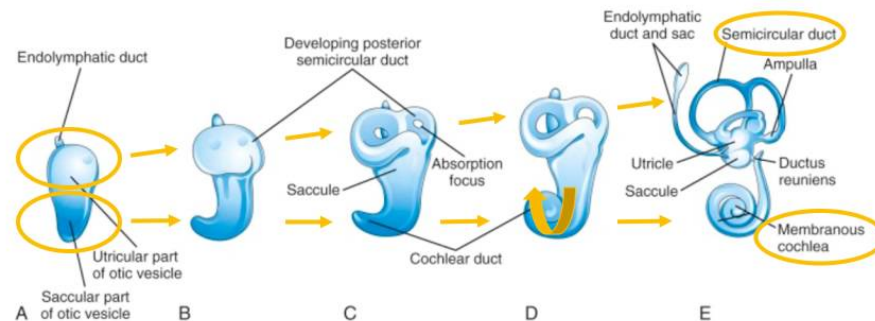
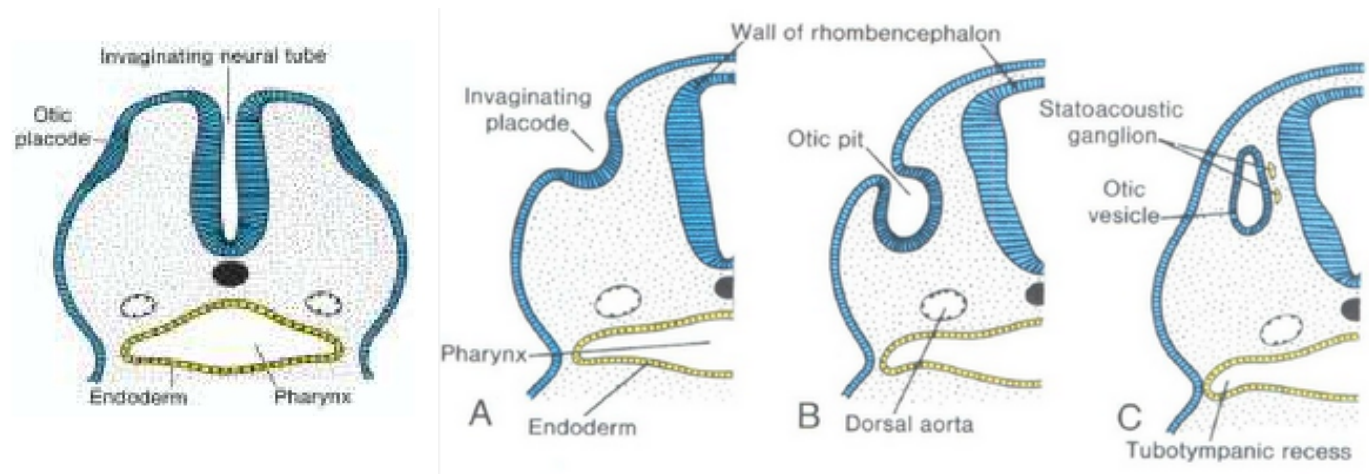
- Neural crest derived mesenchyme of 1st and 2nd branchial arches:
- Proximal region of Meckel's and Reichert's Cartilages
- Middle ear ossicles: malleus, incus and stapes
- Auditory tube develops from 1st pharyngeal pouch



The auditory system

Inner ear

- Inner ear develops from otic placode (ectoderm)
- Placodes invaginate to form otic pit and then pinch off from surface to form otic vesicle/otocyst
- Otocyst generates endolymphatic duct and sac, semicircular canals and cochlea



Development of the Sensory System

The 5 Sense Organs

Embryonic origins of the sensory system

The Auditory System

The Olfactory System

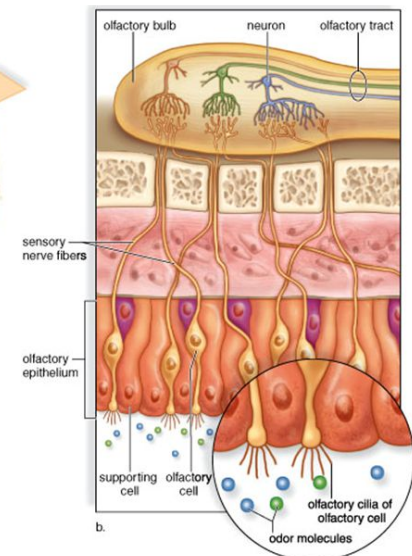
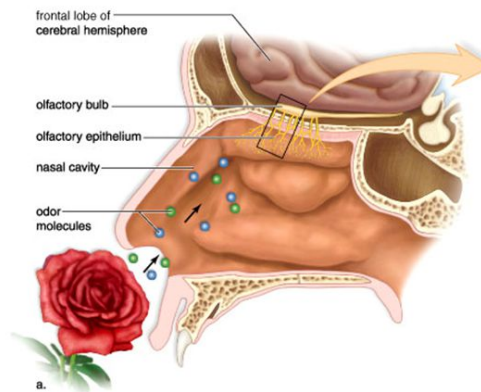
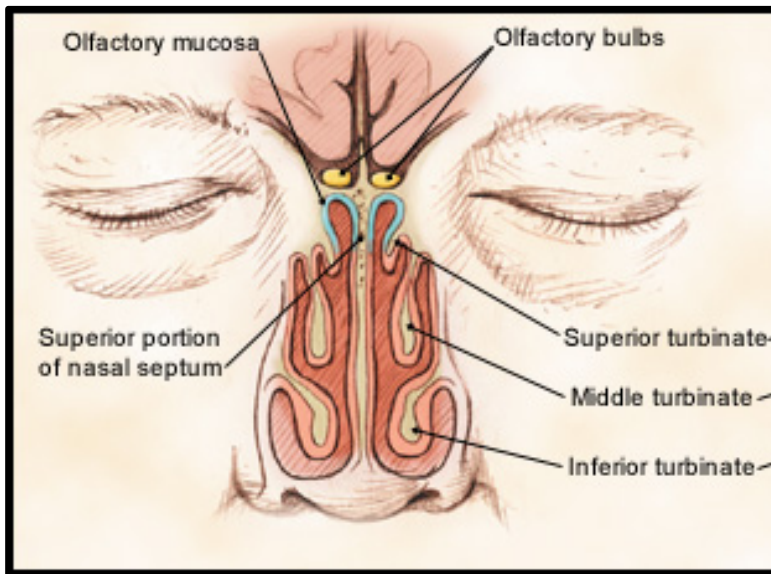
The Visual System

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The olfactory system

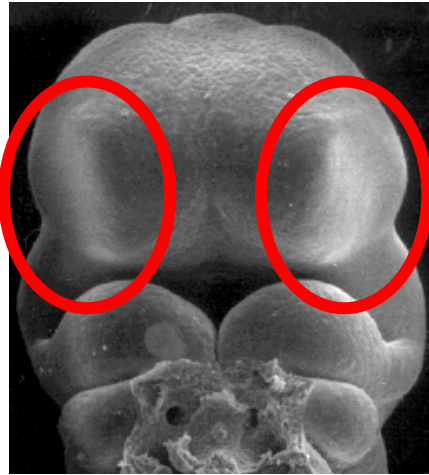
Anatomy

- Function: perception of smell and pheromones, breathing: filter and humidify
- External: nose, naris, philtrum
- Nasal cavity: nasal labyrinth, nasal septum: olfactory neuroepithelium
- Brain: Olfactory bulb
- Olfactory sensory neurons:
- Dendrites contain smell receptors
- Axons project through cribriform plate to olfactory bulb



The olfactory system

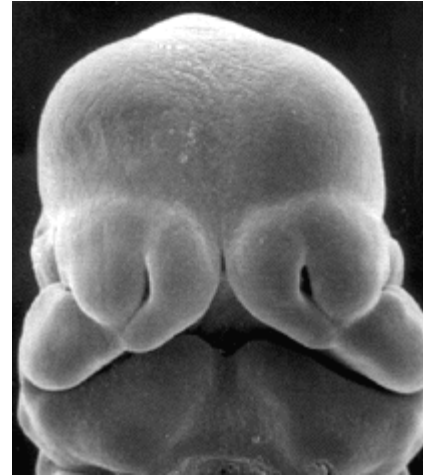
Development



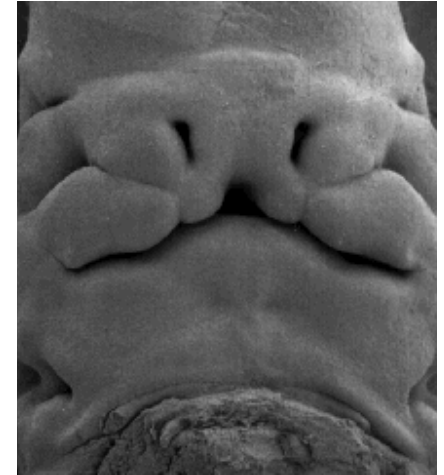
Nasal placodes



Nasal pits



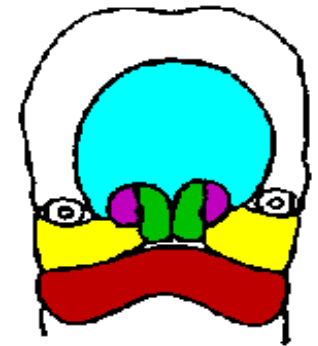
Nasal processes



Growth and fusion



W5



W7

The olfactory system

Development

Ectoderm:

Nasal placodes

Nasal pits

Nasal cavities

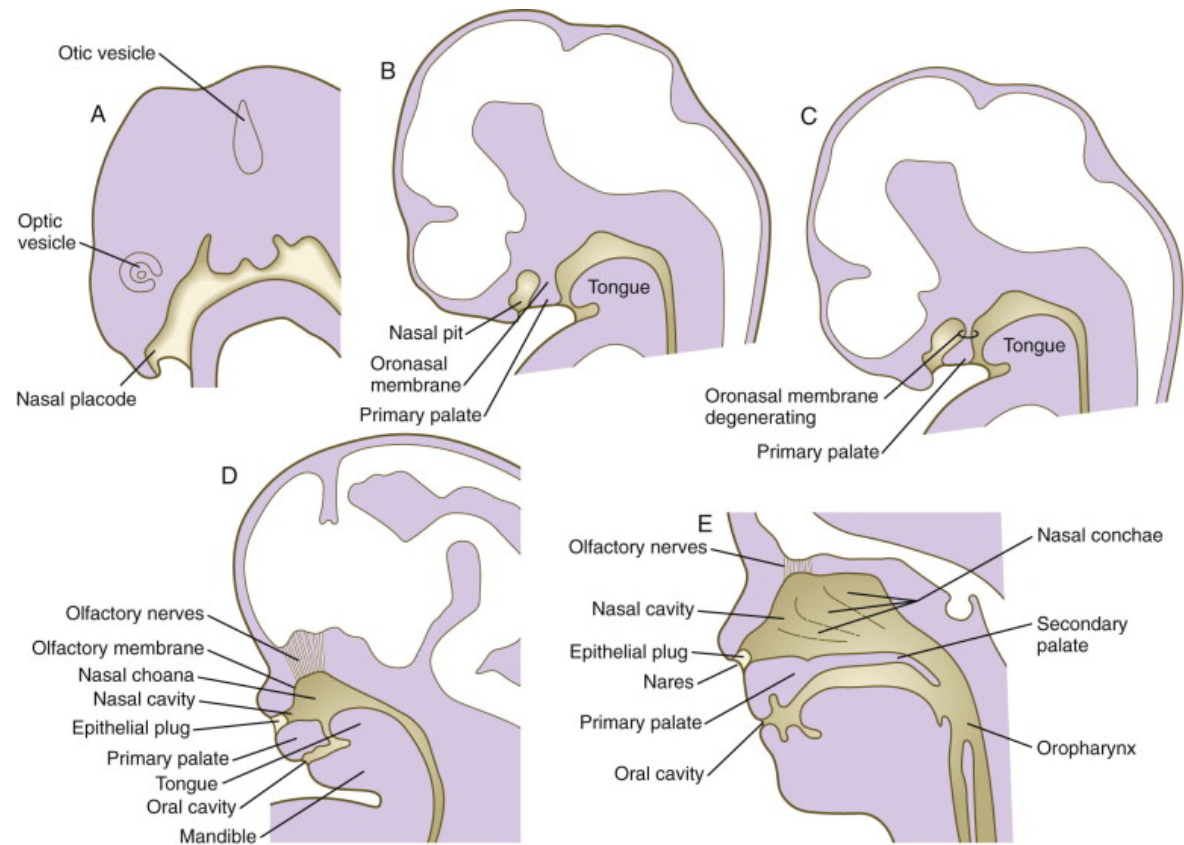
Olfactory neuroepithelium

Neural crest:

Frontonasal process

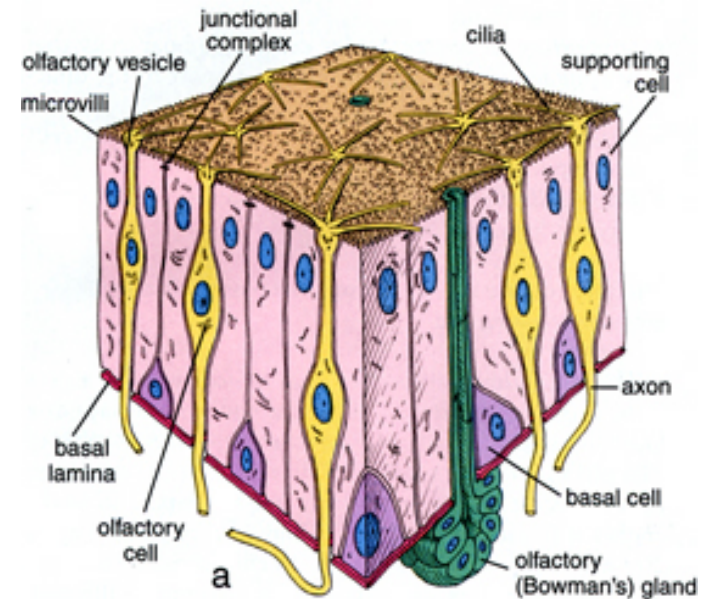
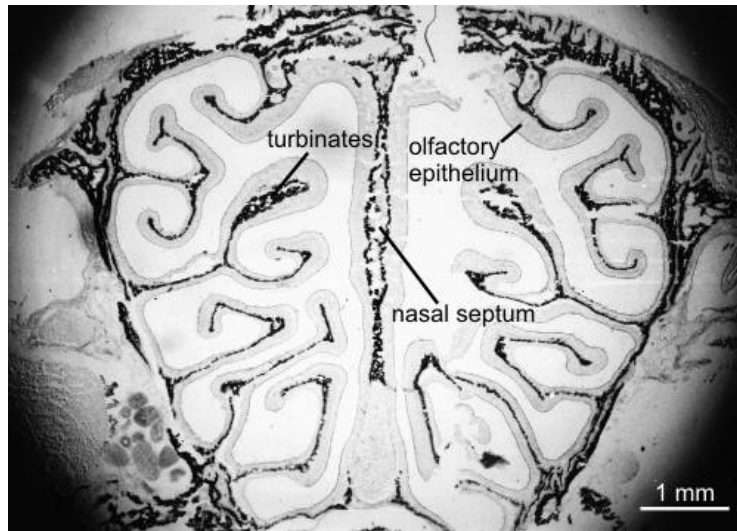
Nasal processes

Nasal septum and labyrinths



The olfactory system

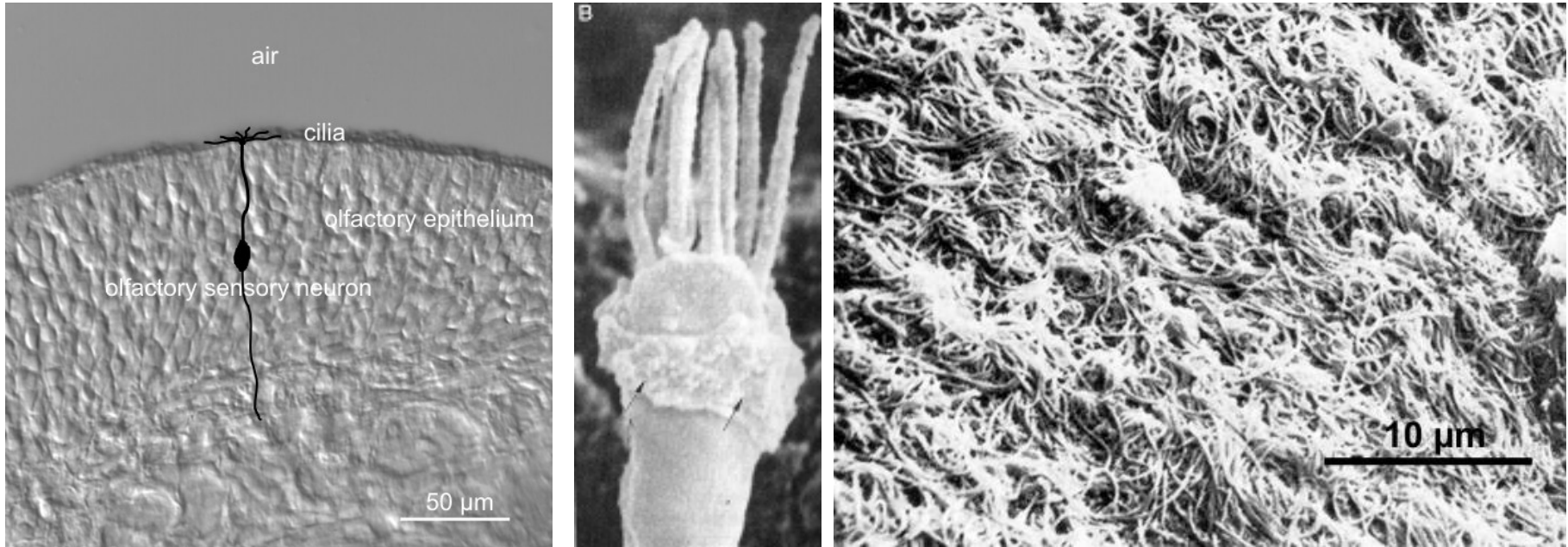
Olfactory neuroepithelium



- 1 Mature olfactory sensory neurons
- 2 Sustentacular cells (supporting cells)
- 3 Bowman glands (lubrication)
- 4 Basal stem cells (stem cells)
- 5 Olfactory ensheathing cells (glial cells)

The olfactory system

Olfactory neuroepithelium

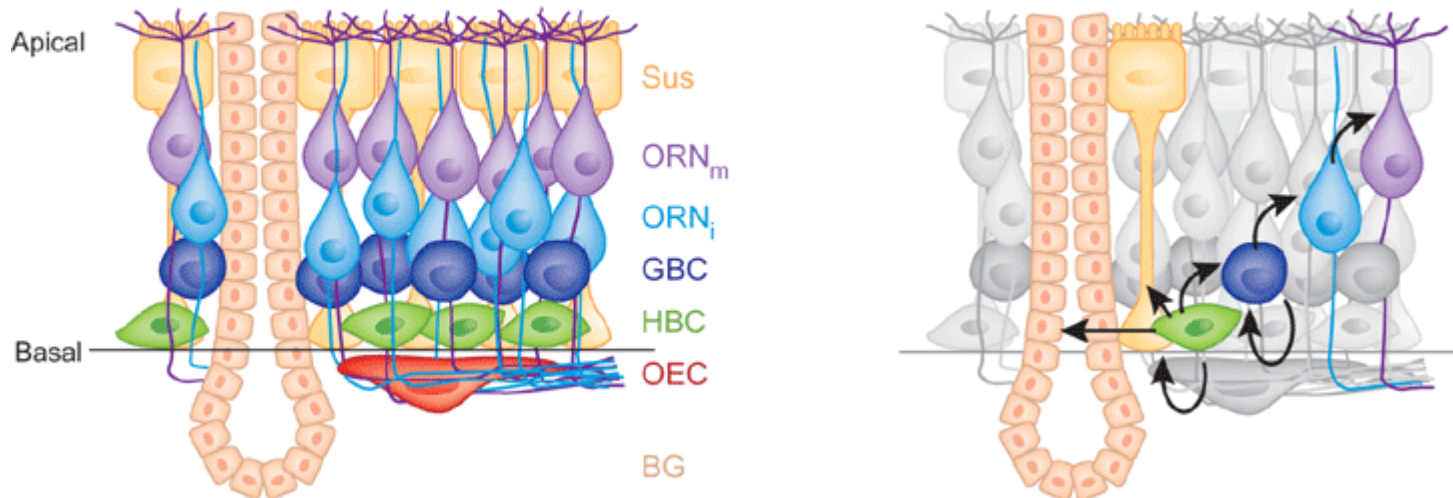


- Olfactory sensory neuron:
- Odour detection
- Bipolar:
 - Apical: Ciliated dendrites with odour receptors
 - Basal: Axons that project to main olfactory bulb
- Limited life span
- Replaced by basal stem cell population

The olfactory system

Olfactory neuroepithelium

Basal stem cells



Horizontal basal cells = true stem cells (mostly dormant)

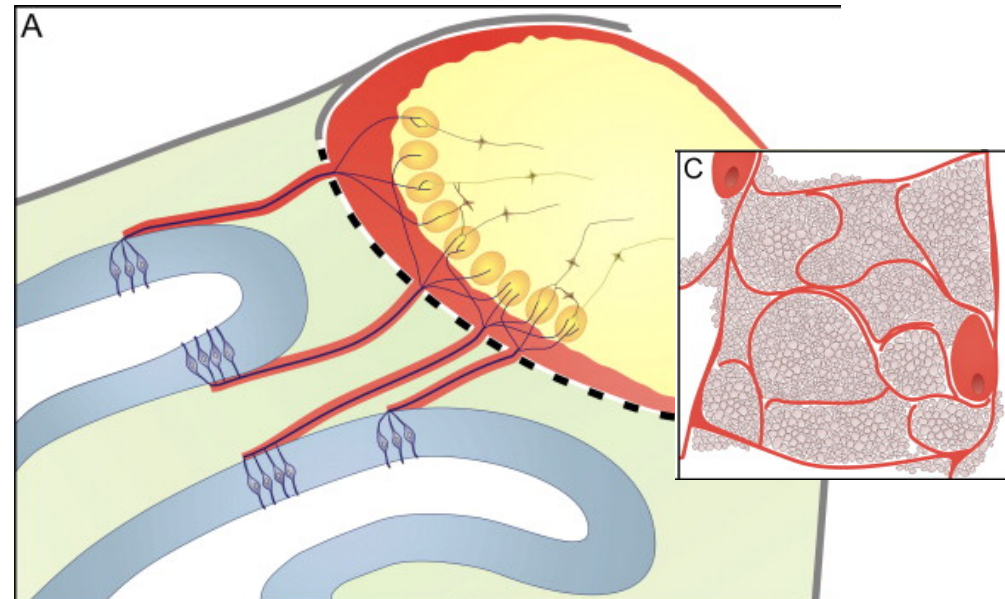
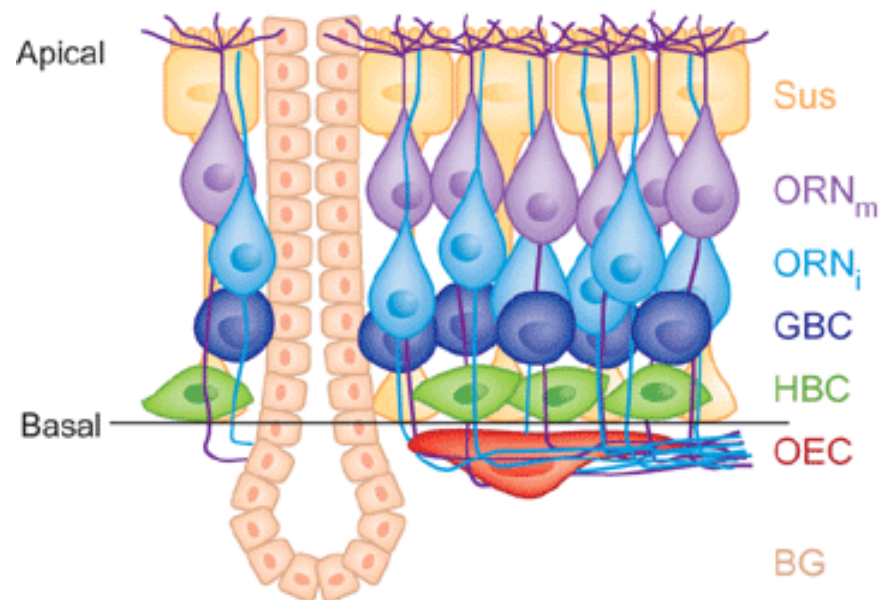
Globose basal cells

Immediate neuronal precursors

Mature olfactory sensory neurons

The olfactory system

Olfactory neuroepithelium



Olfactory ensheathing cells

Glial cells

Ensheat olfactory sensory neuron axons

Guide axons from lamina propria of OE to brain

Provide substrate for growth

Required for regeneration after lesion

Development of the Sensory System

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Embryonic origins of the sensory system

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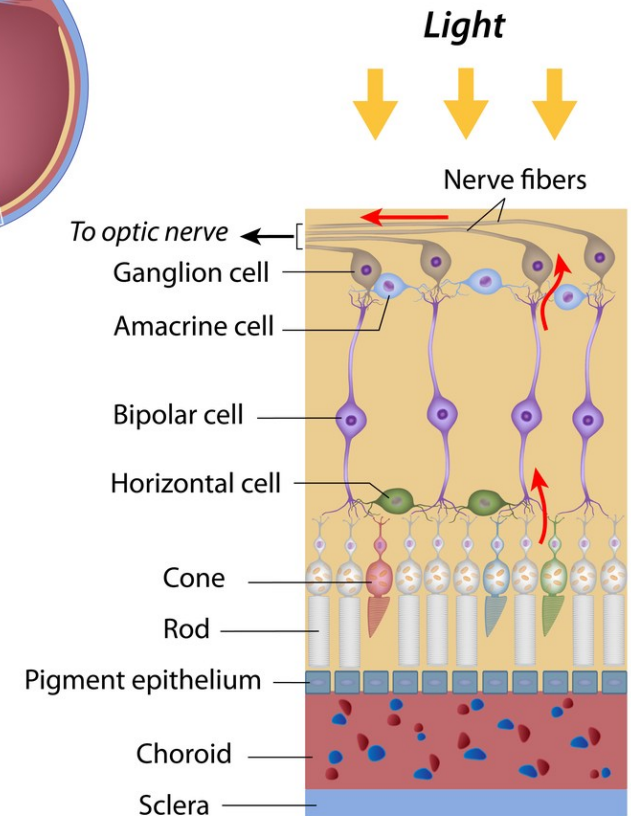
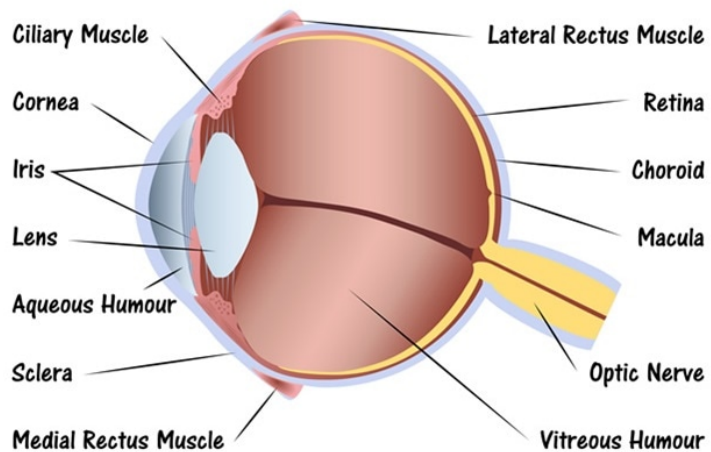
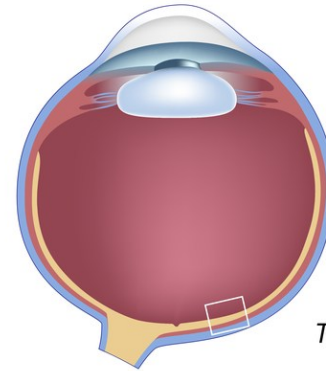
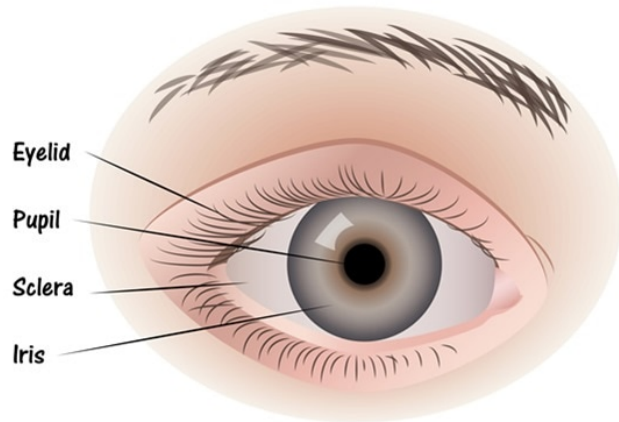
The visual system

Anatomy

Function: vision

Photoreceptor cells in retina: rods and cones

Structure of the Retina



The visual system

Development

Derived of neurectoderm and surface ectoderm:

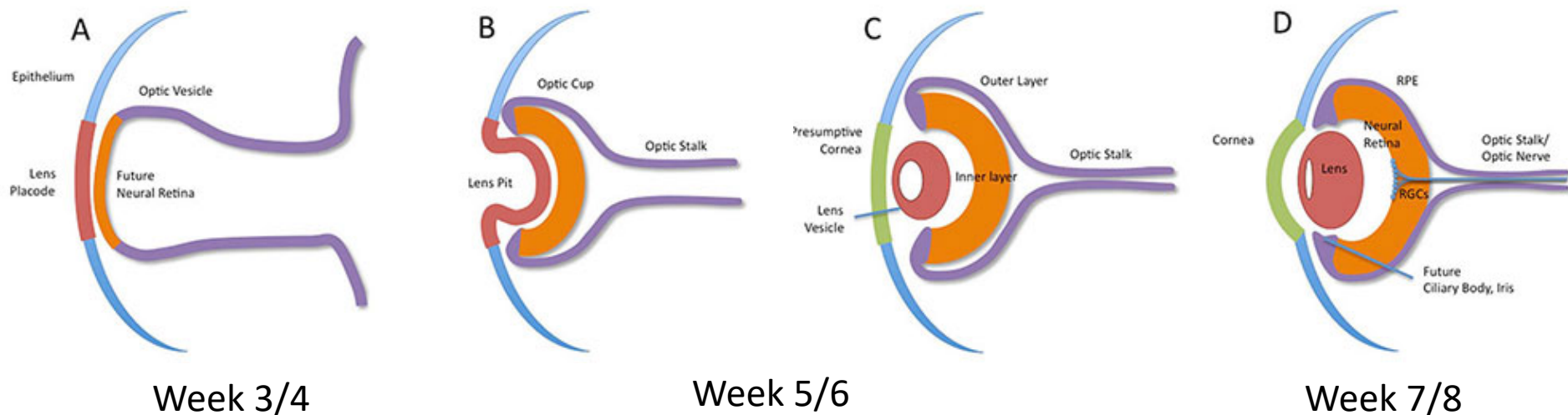
Neurectoderm: optic vesicles develop from diencephalon (week3/4)

Surface ectoderm: formation of optic/lens placode (where optic vesicle contact surface ectoderm)

Optic/lens placode will form lens pit, lens vesicle, and eventually the lens, and cornea of the eye

Optic vesicle will envelop optic pit to form optic cup

Optic cup will form retina, pigment epithelium and optic stalk/nerve



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