

DEVELOPMENT OF THE HEAD AND NECK

Placodes and the development of organs of special sense

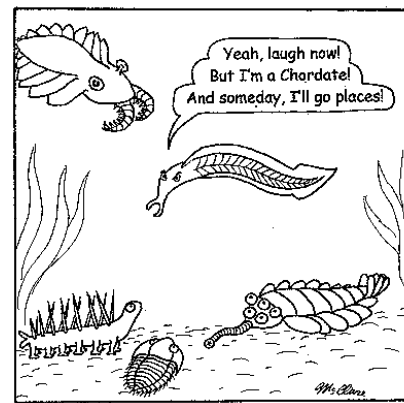
L. Moss-Salentijn

PLACODES

Localized thickened areas of specialized ectoderm, lateral to the neural crest, at the border between neural plate and the future epidermis

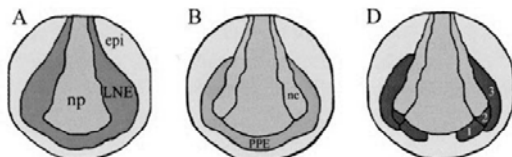
Placodes give rise to several evolutionary novelties in the “new heads” of vertebrates:

- Specialized paired sense organs. However, structures analogous to placodes are present in non-vertebrate chordates.
- Cranial ganglia of the branchiomic nerves in pharyngeal arches.



Life in the Lower Cambrian Period

Panplacodal ectoderm



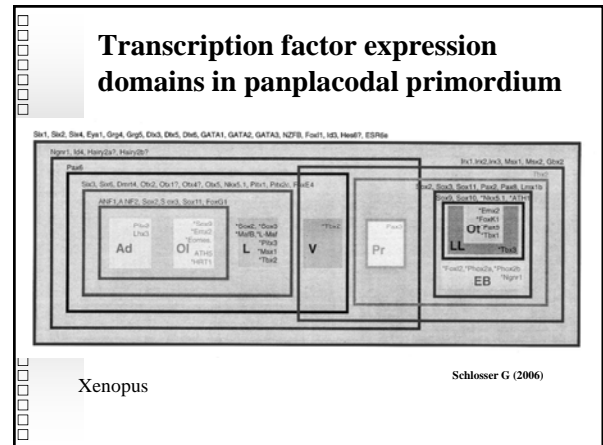
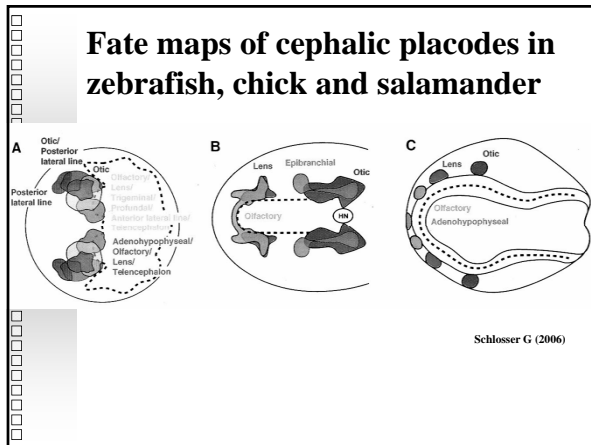
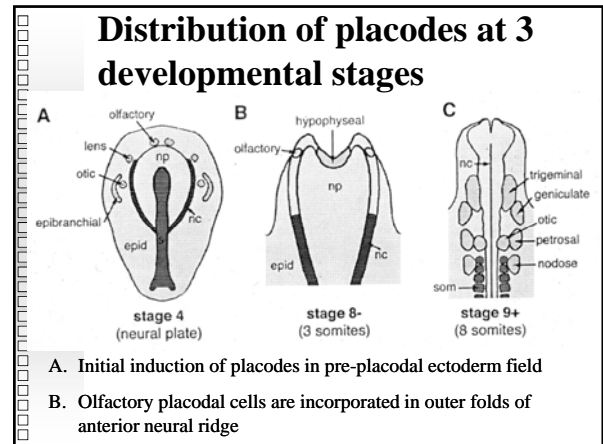
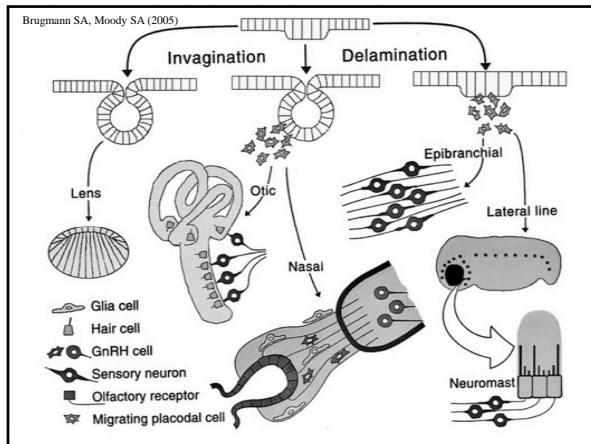
Expression of genes for generic placodal development:

Six1/2, Six4/5, Eya

Brugmann SA, Moody SA (2005)

Different kinds of placodes

- Contributing to organs of special sense:
 - ◆ Olfactory
 - ◆ Lens (only placode that does not have neural fate)
 - ◆ Otic
- Contributing to distal ganglia of branchiomic nerves:
 - ◆ Trigeminal (profundal + V 2/3)
 - ◆ Epibranchial (3)
- Hypobranchial (2) (contribute to hypobranchial ganglia - frog only; not in chick, mouse, zebrafish)



Development of placodes: similarities

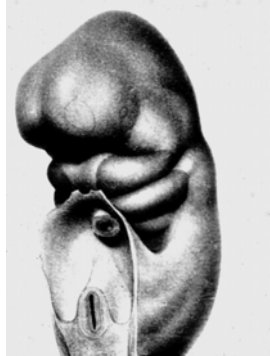
- Under influence of surrounding tissues – **no evidence for role of neural crest in this process**
- All express one or more members of Pax family of genes early in development

Development of placodes - differences

- Epibranchial placodes: pharyngeal endoderm (BMP-7 signal), Pax2 and Sox3
- Ophthalmic placode of V: neuroectoderm of mesencephalon (diffusible signal ?), Pax3
- Otic placode: initially axial and non-axial mesoderm, Pax 8; later hindbrain (FGF-3,-8,-10 signals), Pax2, Sox3, Notch
- Lens placode: forebrain & anterior mesoderm (BMP-4, later BMP-7 signals), Pax6, later Pax2
- Olfactory placode: anterior mesoderm (and forebrain? – no signal identified as yet), Pax6

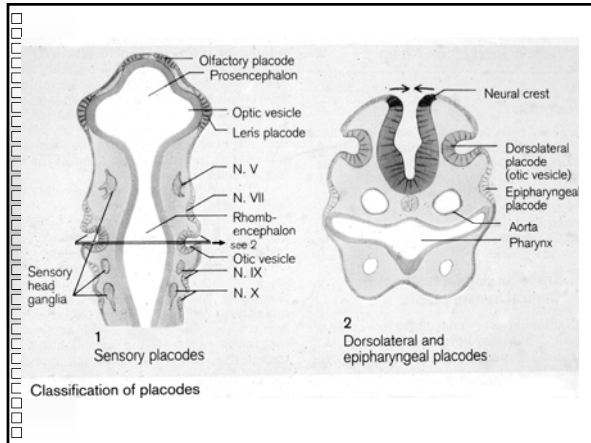
Location of placodes (1)

- *Near forebrain :*
 - ◆ Olfactory placode
 - ◆ Lens placode



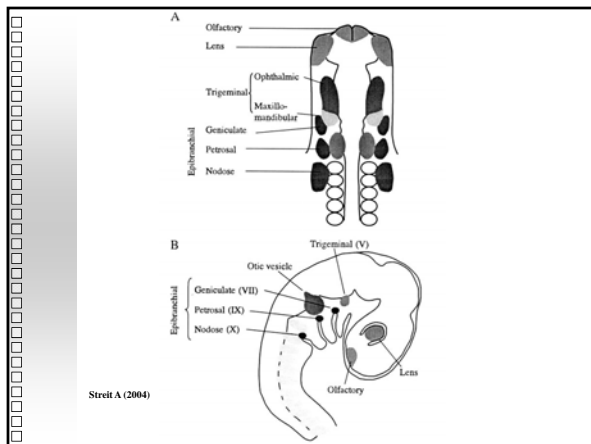
Location of placodes (2)

- *Dorsolateral :*
 - Otic placode: related to (= evolved from or having common origin with) lateral line system



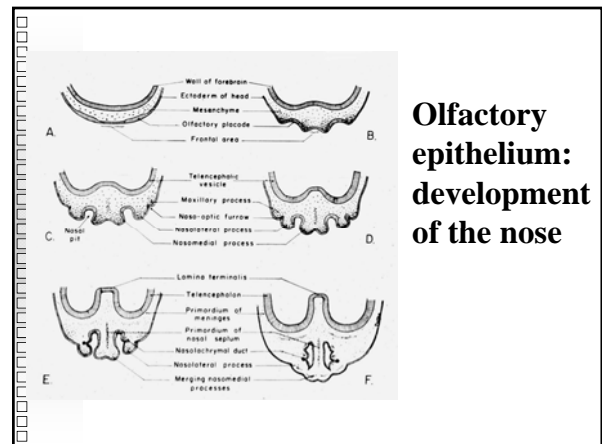
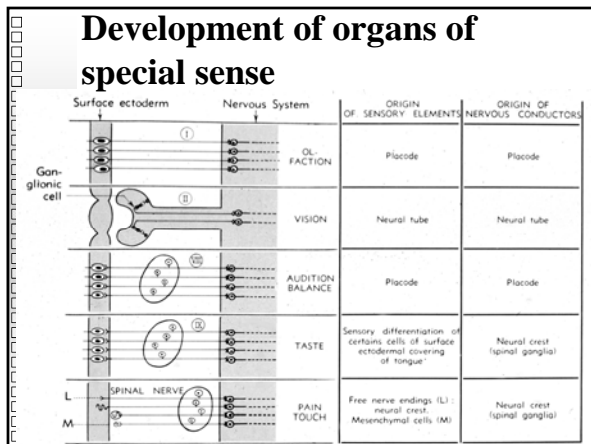
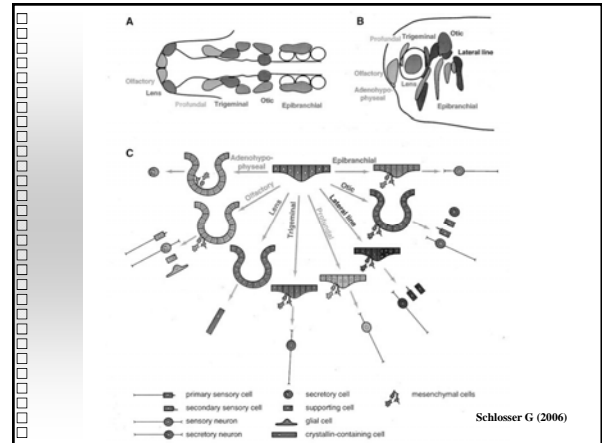
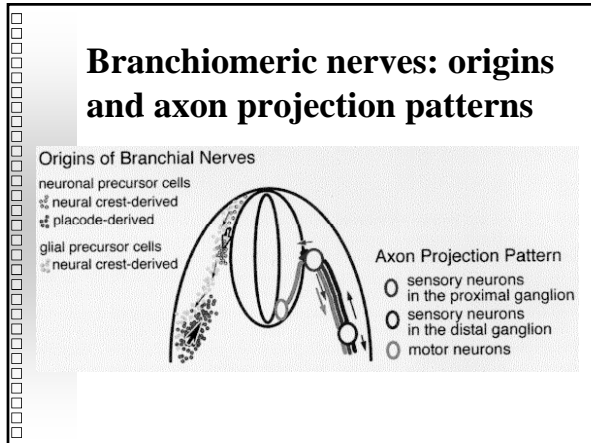
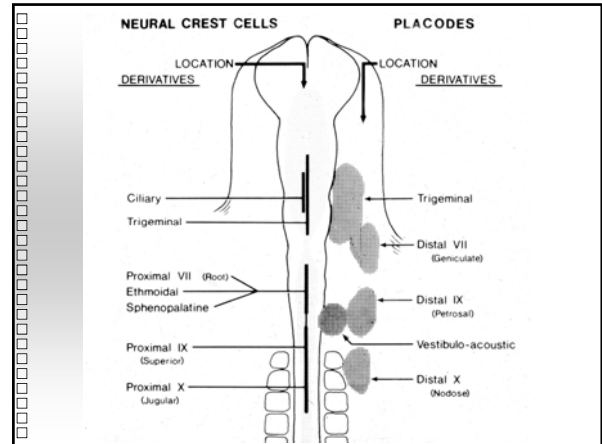
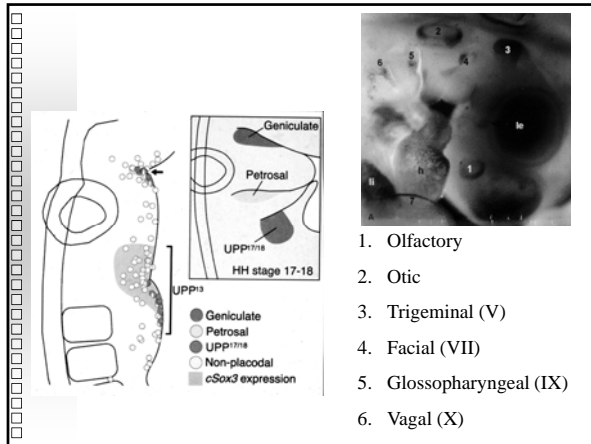
Location of placodes (3)

- *Intermediate* between otic placode and epibranchial placodes :
 - Ophthalmic (profundal component) and trigeminal placode

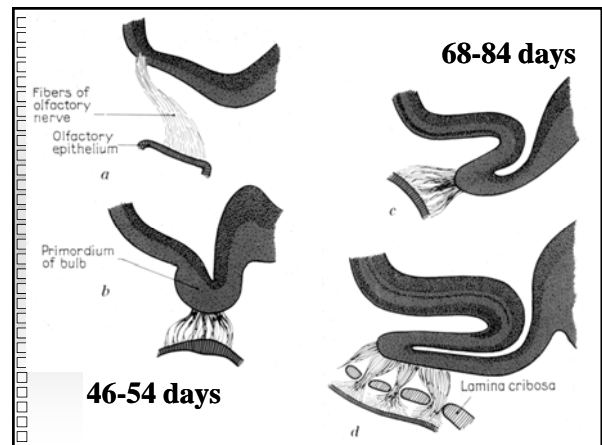
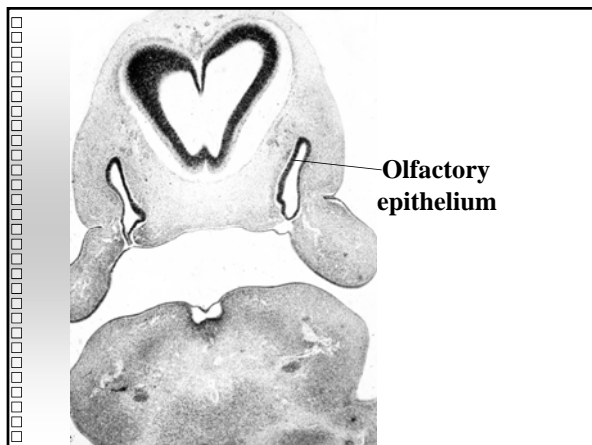
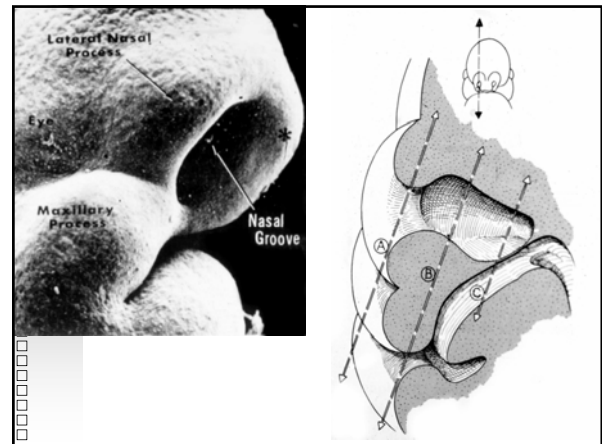
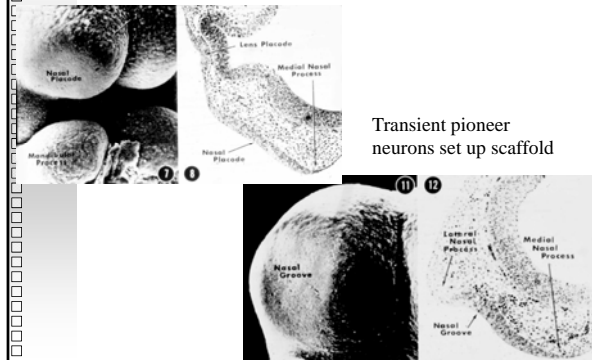


Location of placodes (4)

- *Epibranchial series* – dorsal ends of 2nd – 4th pharyngeal grooves
- *Hypobranchial series* in frogs – ventral ends of 2nd – 3rd pharyngeal grooves ?



Olfactory epithelium: development of the nose

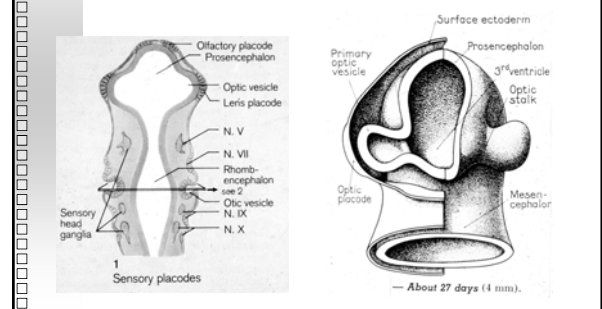


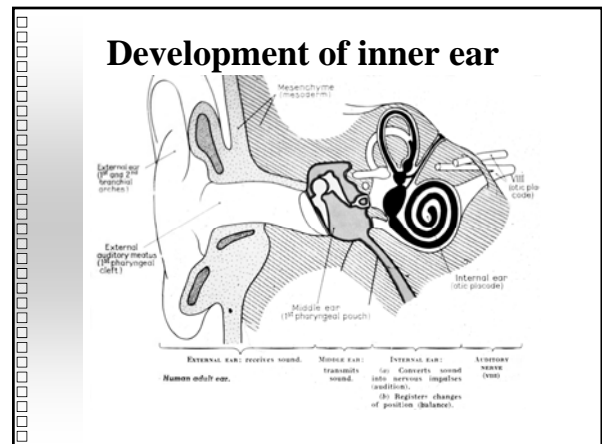
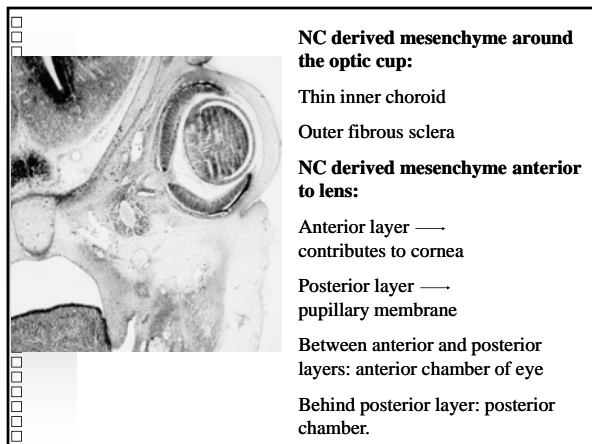
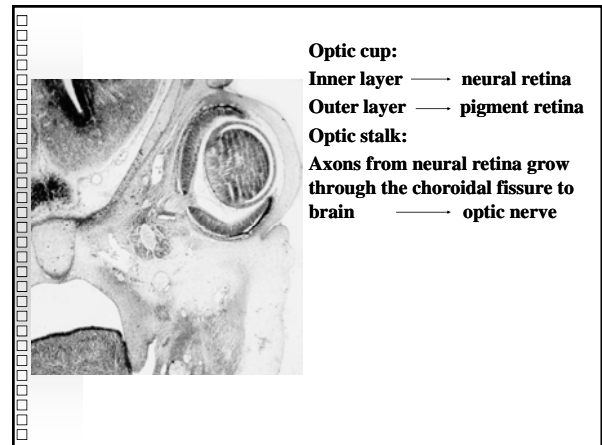
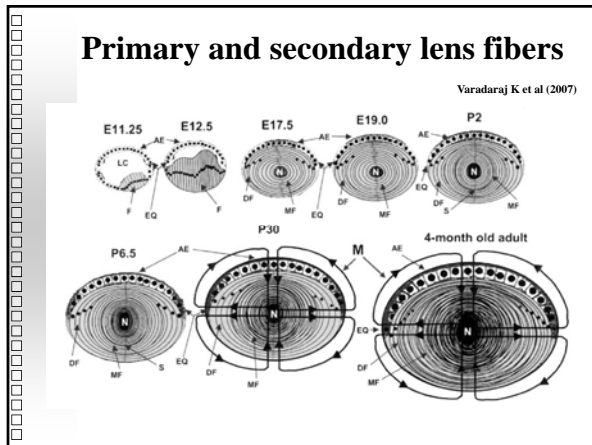
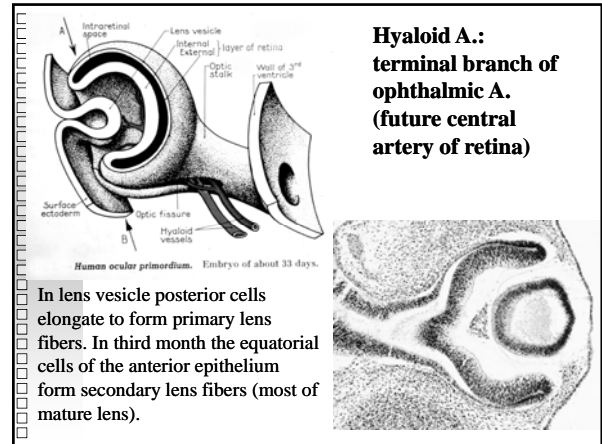
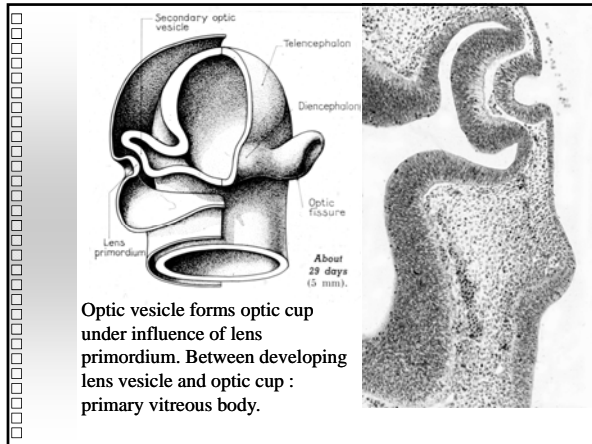
Olfactory placode gives rise to:

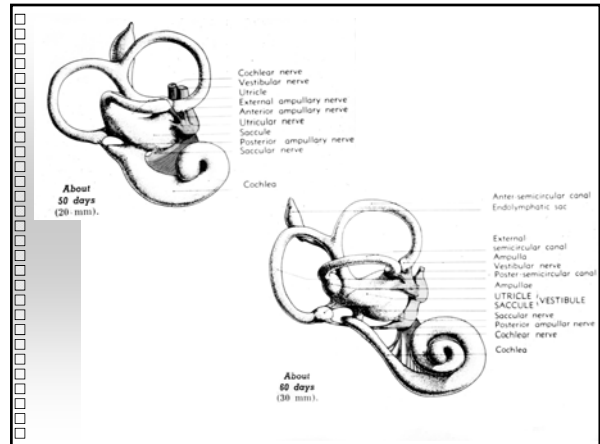
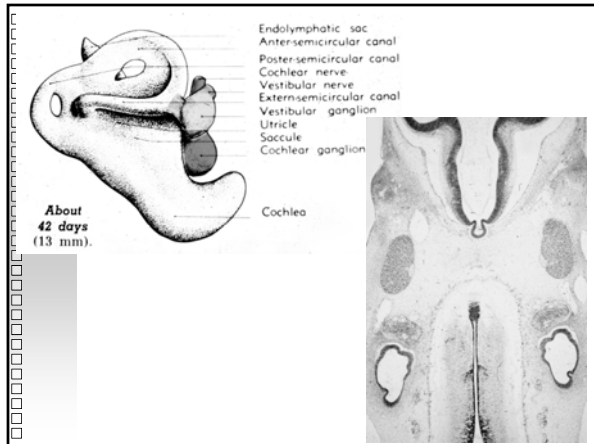
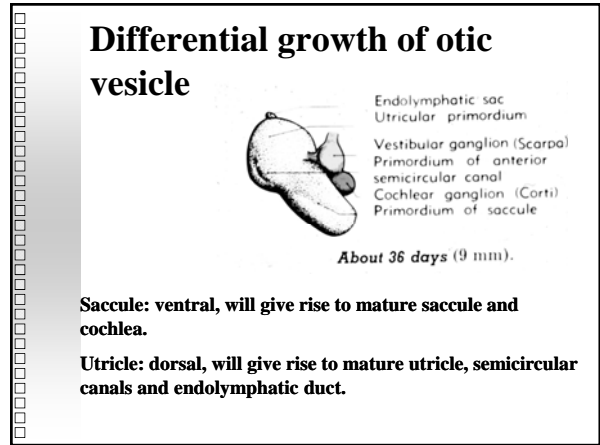
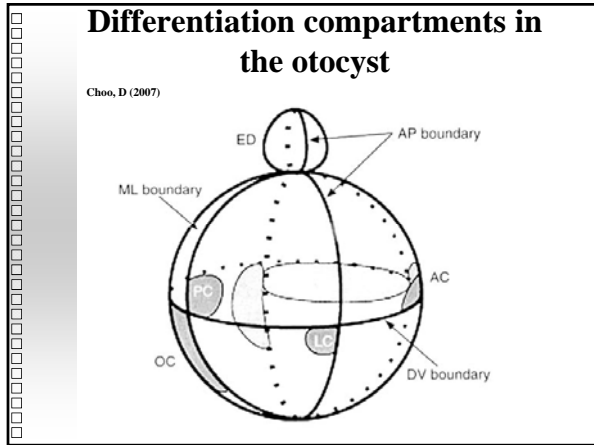
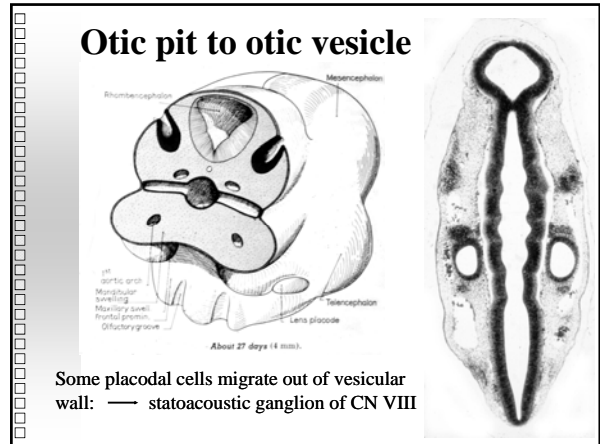
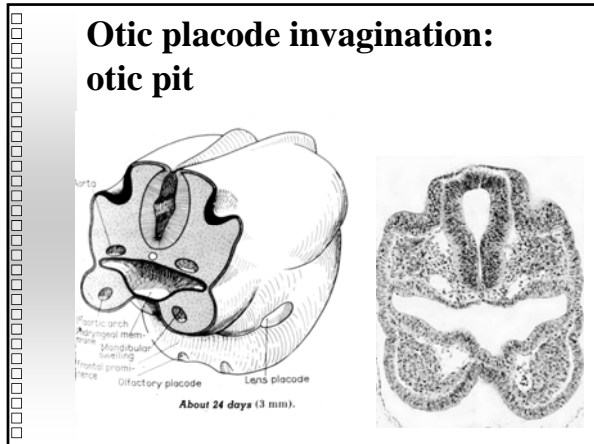
- Sensory receptor cells of olfactory epithelium of the nose (odorant sensing)
- Sensory receptor cells of vomeronasal epithelium (pheromone sensing)
- Basal cells and support cells (olfactory ensheathing cells - glia)

Development of the eye :

1. evagination of forebrain (optic vesicle)
2. invagination of lens placode







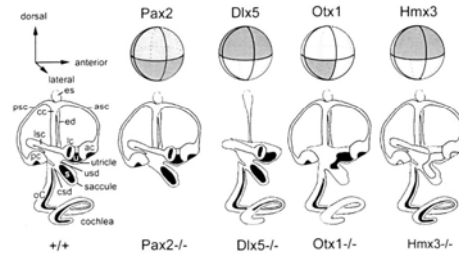
Animation of inner ear morphogenesis in chick embryos



Brigande JV et al (2000)

Movie produced by Donna Fekete & Laurie Iten (Purdue University)

Factors controlling the patterning of the otocyst



Choo, D (2007)

**Otic capsule:
future
petrous part
of temporal
bone**

