

Pharyngeal arches and pouches

L.Moss-Salentijn

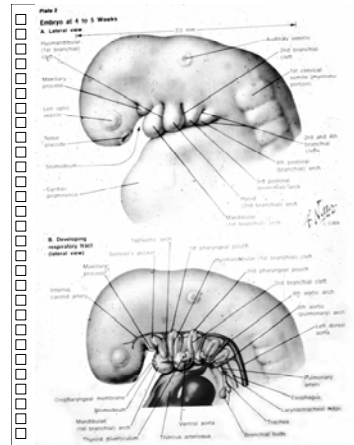
Pharyngeal arches: a definition

A segmental series of five paired swellings that surround the foregut between days 20 to 35 of embryonic development. These segments, which are unique to vertebrates, are “wedged” between the developing forebrain and heart.



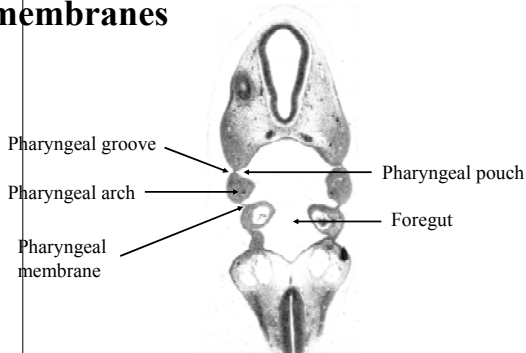
Pharyngeal arches

- a.k.a. visceral or branchial arches
- Develop (and disappear as distinctively visible structures) in a rostro-caudal sequence
- Require neural crest cells for their development
- Even after they are no longer visible externally, they have a lasting impact on the anatomy of the head and neck and of the great vessels

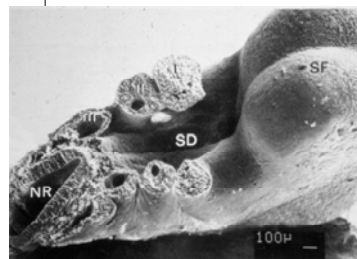


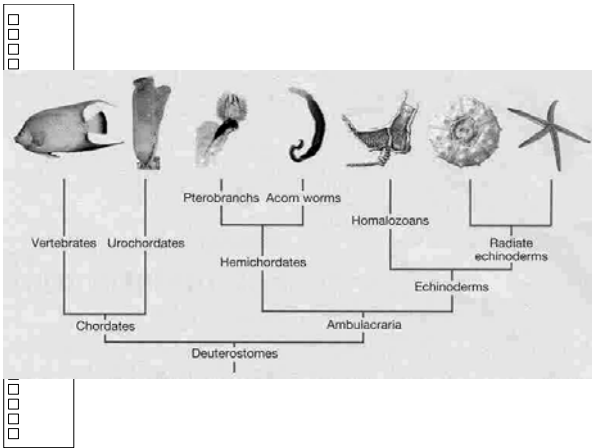
5 Pharyngeal arches
5 Aortic arches
Arches numbered 1-6

Arches, grooves, pouches, and membranes



Pharyngeal cleft transient “gill-slit”

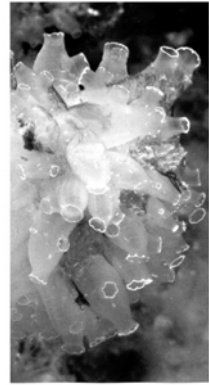




CIONA INTESTINALIS. PHOTOGRAPHS AT MARINE BIOLOGICAL LABORATORY, WOODS HOLE

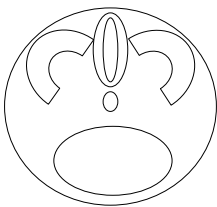
SEA SQUIRT

photograph by Purcell R, National Geographic November 2006

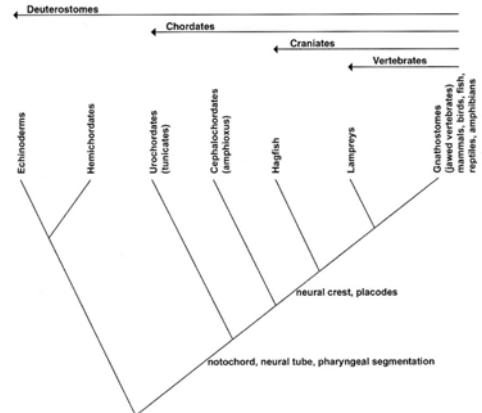


K. TELNES/IMAGE QUEST MARINE Dell H (2006)

Basic body plan of all chordates (incl. vertebrates)



- Dorsal hollow neural tube
- Segmented lateral mesoderm
- Central notochord
- Ventral digestive tube
- (Pharyngeal gill slits)



Evolution of vertebrates involved:

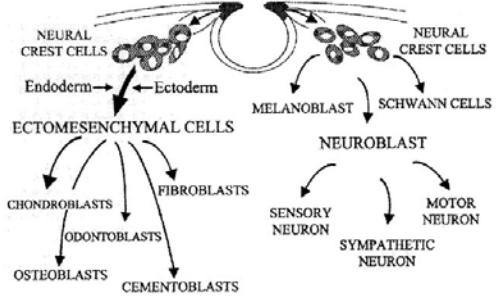
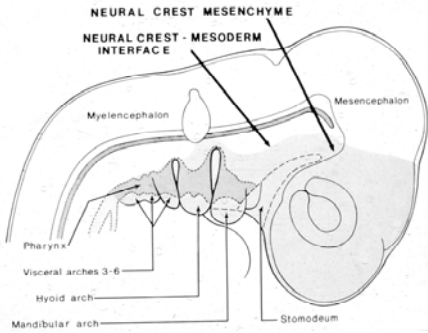
- Development of organs of special sense in head region to detect prey
- Development of a large neural circuitry (the brain) to integrate input and responses
- Development of an effective feeding apparatus (jaws: pharyngeal arch derivatives)
- Development of an improved respiratory apparatus (gills: pharyngeal arch derivatives).

This required the recruitment of an existing group of cells: neural crest cells, for a new role.

Mesenchyme in cephalic region is derived from:

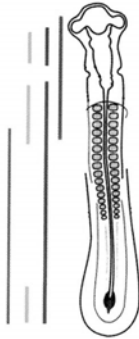
- Mesoderm
- Neural crest

Neural crest and mesoderm in H&N area



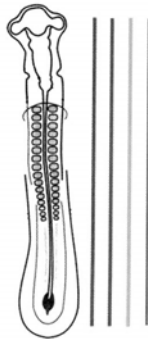
Chai Y, Ito Y, Han J (2003)

Fate



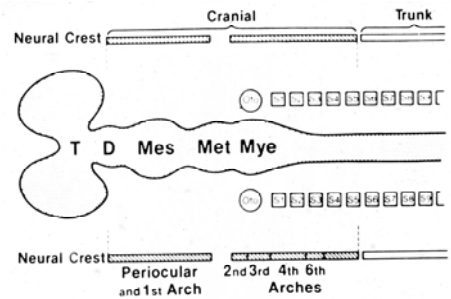
■ Ectomesenchyme
■ Sensory ganglia

Potential

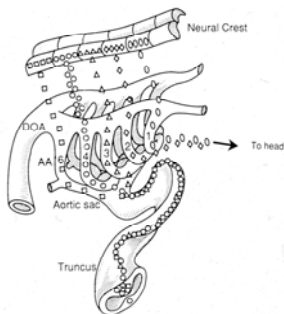


■ Parasymp. ganglia
■ Sympathetic ganglia

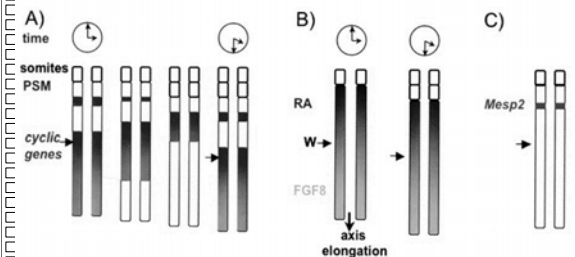
Extent of cephalic (cranial) neural crest



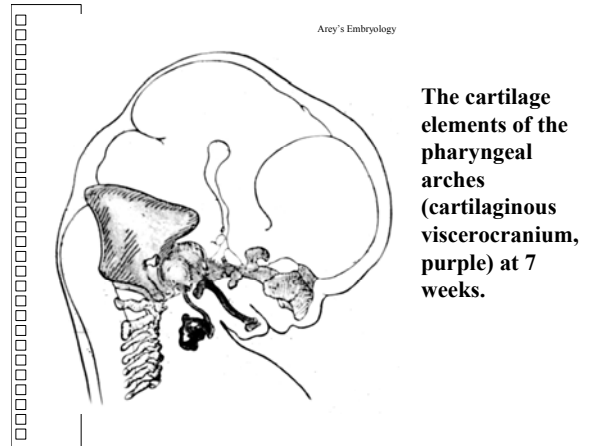
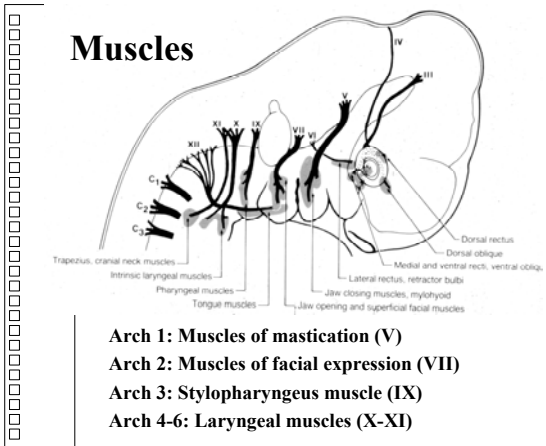
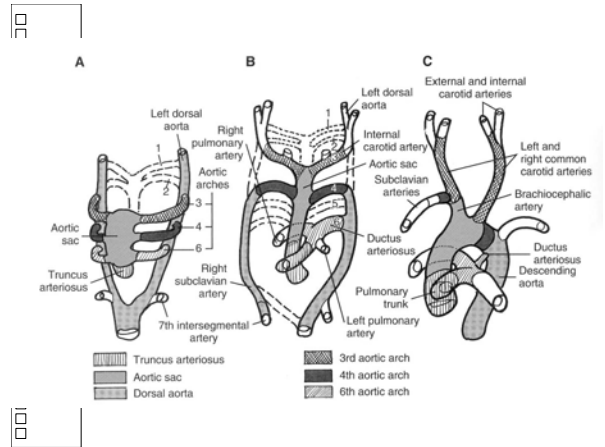
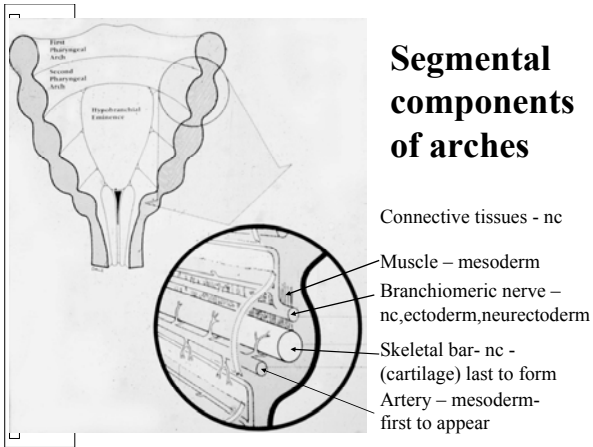
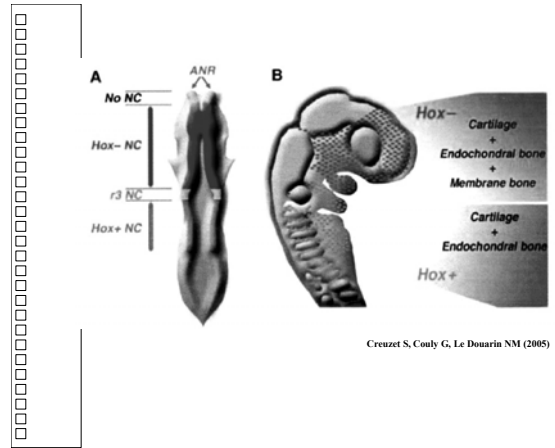
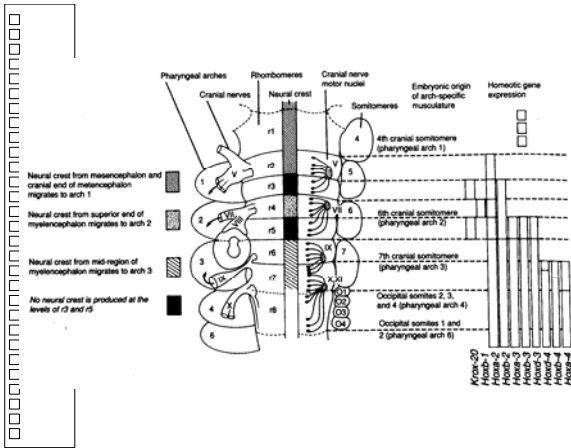
Neural crest involvement in the development of the heart



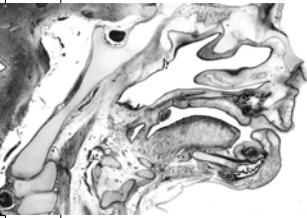
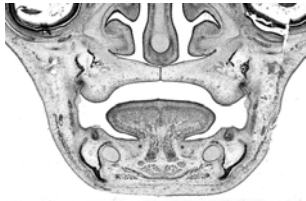
Somite segmentation clock and wavefront (chick embryo)



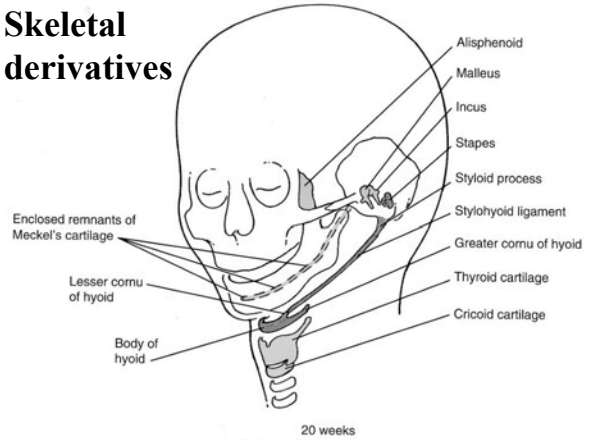
Kieffer, JC (2005)



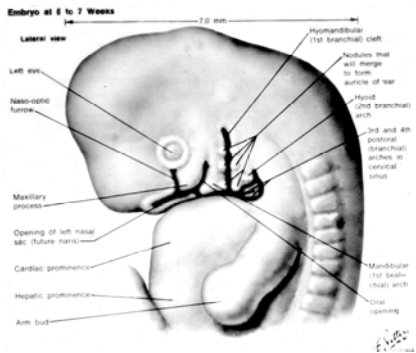
Skeletal elements



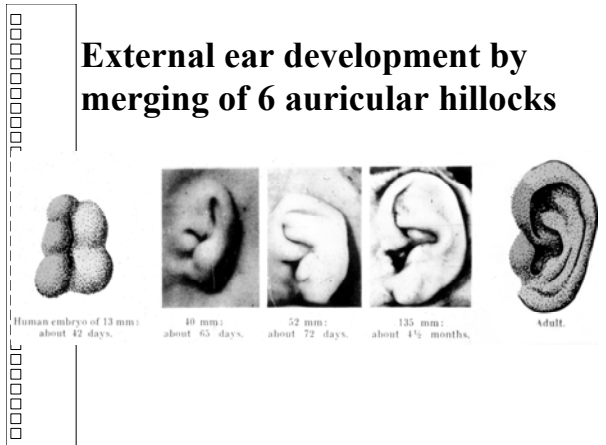
Skeletal derivatives



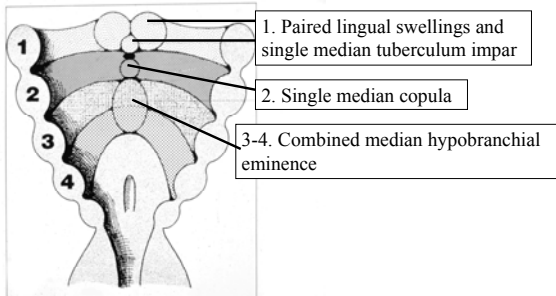
External ear receives contributions from arches 1 and 2



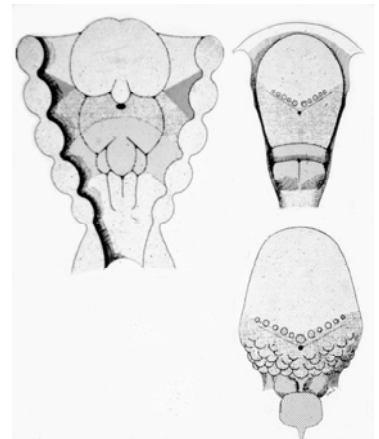
External ear development by merging of 6 auricular hillocks



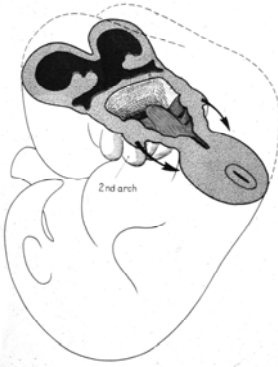
Endodermal swellings on arches 1-4 contribute to the tongue



Merging of lingual swellings

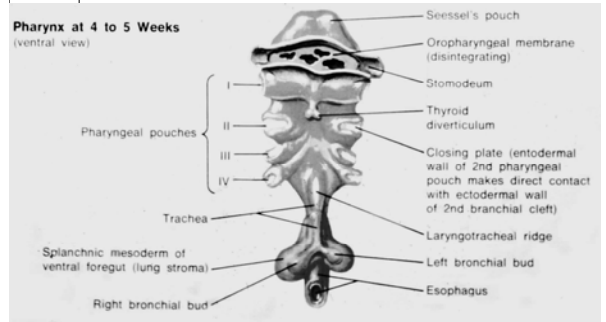


Fate of pharyngeal grooves 2-4

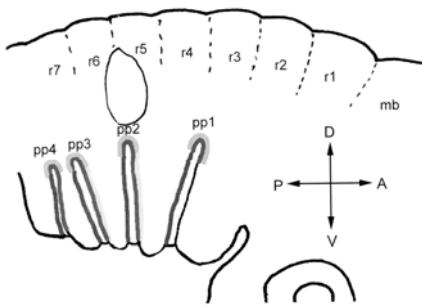


Covered by rapid outgrowth of 2nd arch "operculum."

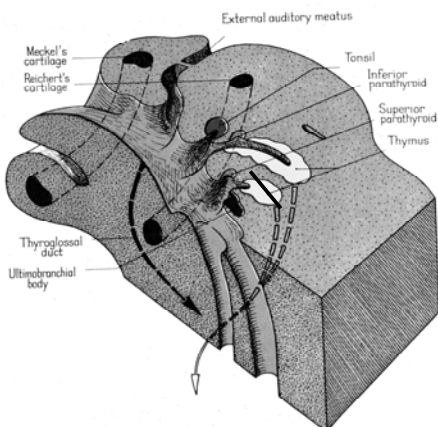
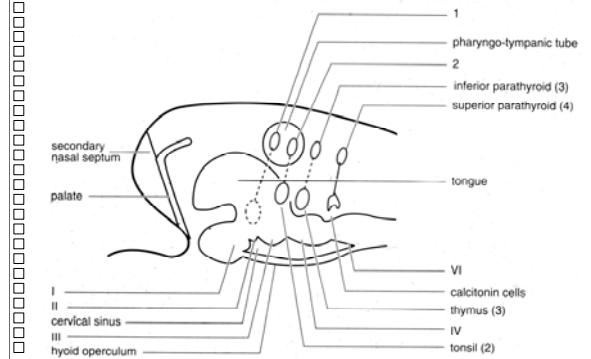
Pharynx at 4 to 5 Weeks (ventral view)



Endoderm plays key role in morphogenesis of pharyngeal region



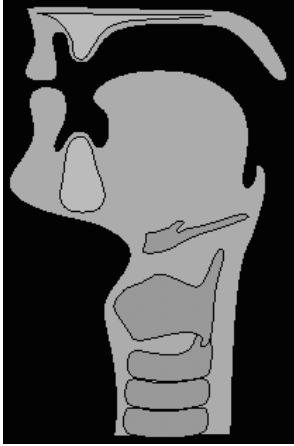
Derivatives of dorsal and ventral parts of pharyngeal pouches



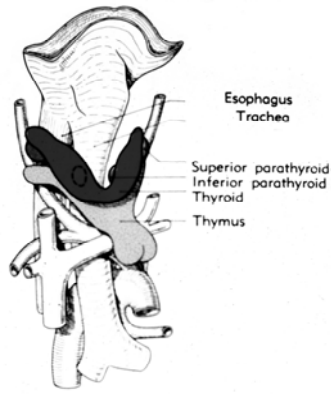
Thyroid gland development Thyroglossal duct



Vertical grid of 20 empty boxes for marking.



Vertical grid of 20 empty boxes for marking.



Superior and inferior parathyroid glands

Diagram showing thyroid in place.

Vertical grid of 20 empty boxes for marking.

