Pharyngeal arches

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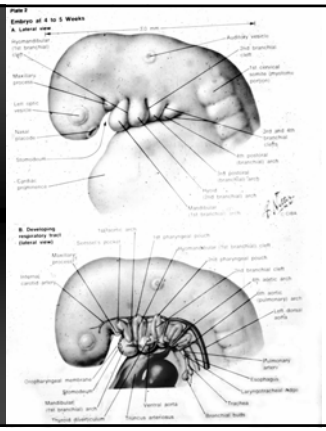
Pharyngeal arches: a definition

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

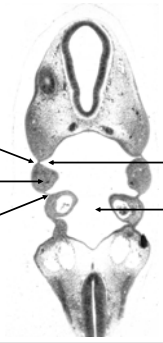


5 Pharyngeal arches

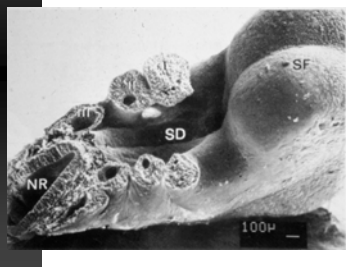
5 Aortic arches

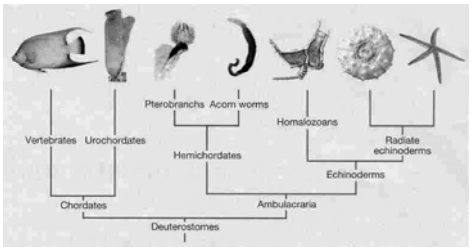
Arches numbered 1-6

Arches, grooves, pouches, and membranes

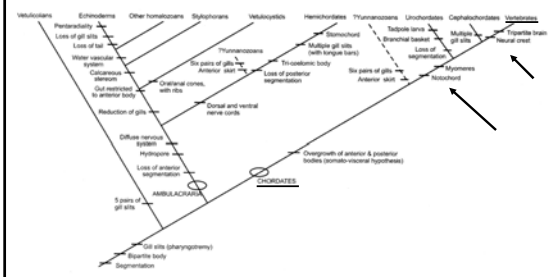


Pharyngeal cleft transient "gill-slit"

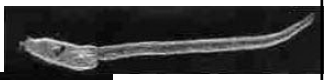




Phylogeny of early deuterostomes



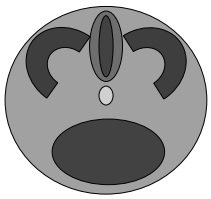
Pharyngeal arches are unique to vertebrates (subphylum of chordates)



Sedentary

Passive, filter-feeding

Basic body plan of all chordates (incl. vertebrates)



Dorsal hollow neural tube

Segmented lateral mesoderm

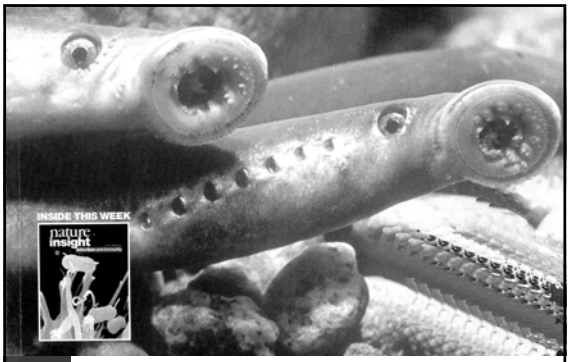
Central notochord

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.

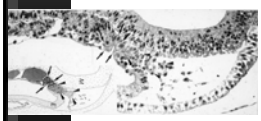


Jawless fishes - lampreys

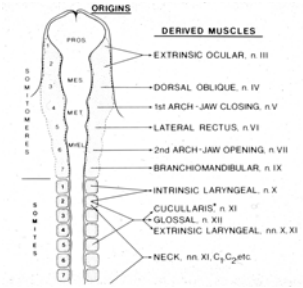
Mesenchyme in cephalic region derived from:

- Mesoderm
- Neural crest

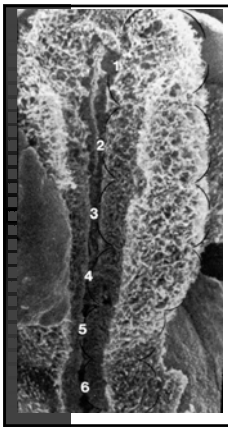
Cephalic mesoderm



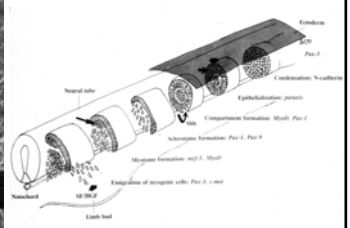
Prechordal plate origin ?



Somitomeres, not somites



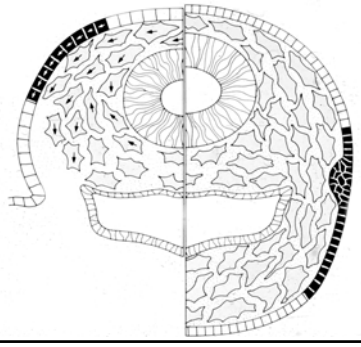
Somitomeres



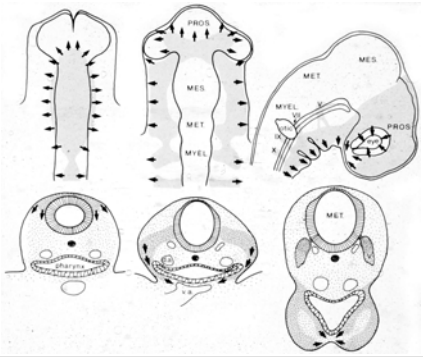
Somitogenesis

Cephalic somitomeres

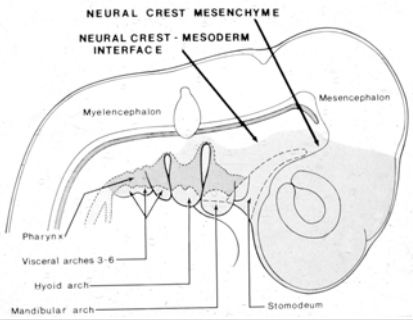
Neural crest migration



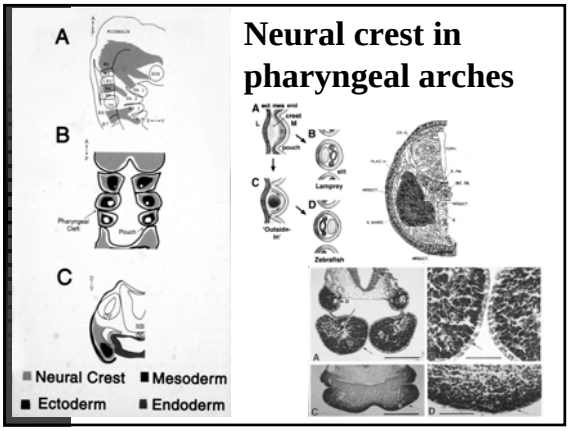
Cephalic neural crest migration

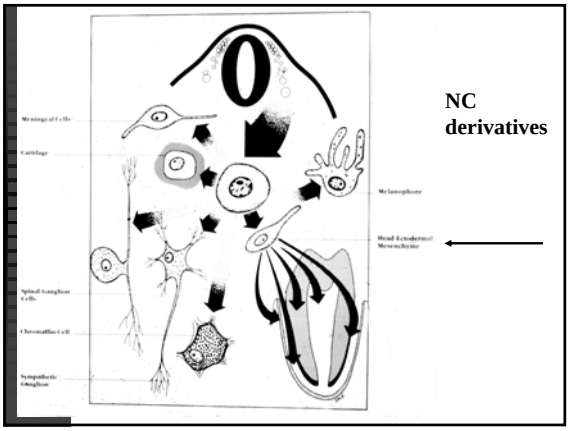


Neural crest and mesoderm in H&N area



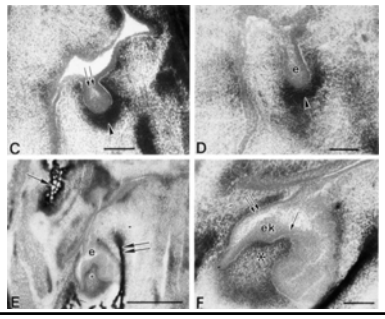
Neural crest in pharyngeal arches



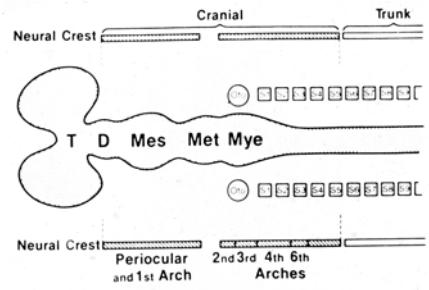


NC derivatives

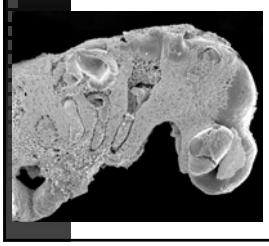
Neural crest involvement in the development of teeth

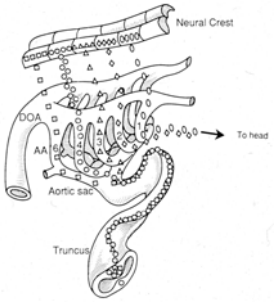


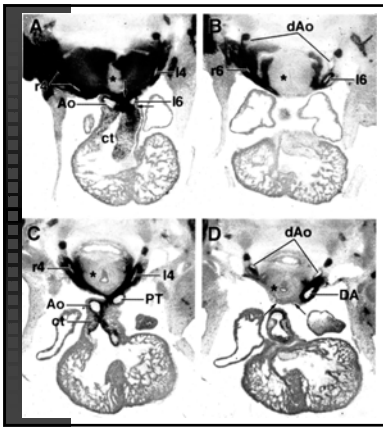
Extent of cephalic (cranial) neural crest



Neural crest involvement in the development of the heart

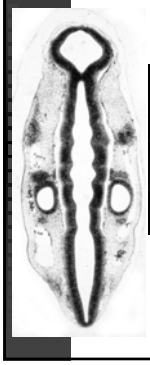


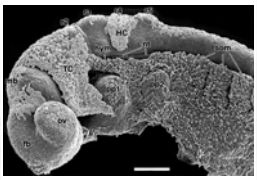


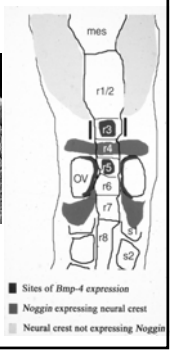


Neural crest cell contribution to the early development of the truncoconal septum

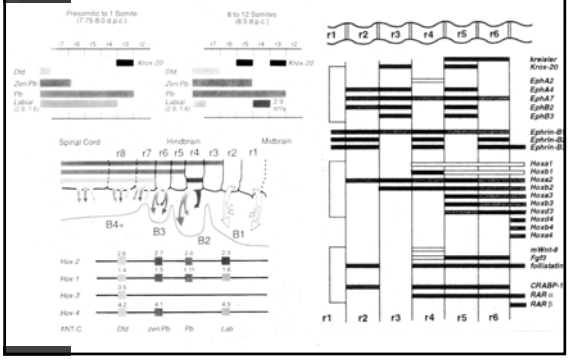
Arch segmentation and rhombomeres



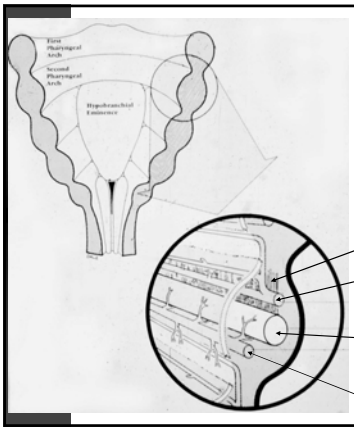




Expression of homeotic genes



Segmental components of arches



Connective tissues - nc

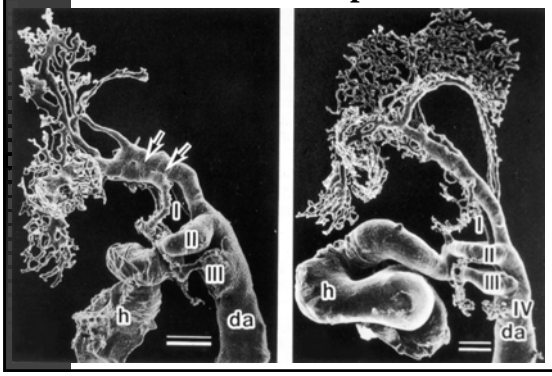
Muscle – mesoderm

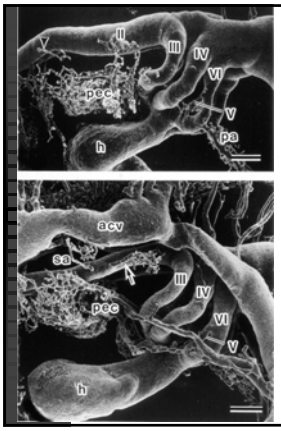
Branchiomeric nerve – nc,ectoderm,neurectoderm

Skeletal bar- nc - (cartilage) last to form

Artery – mesoderm- first to appear

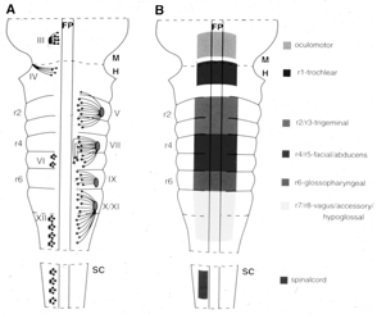
Aortic arch development



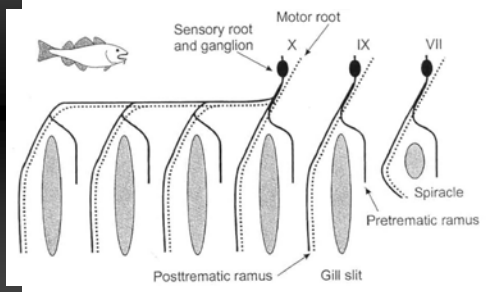


Aortic arch development cont'd

Branchiomeric nerves: rhombomeric origins

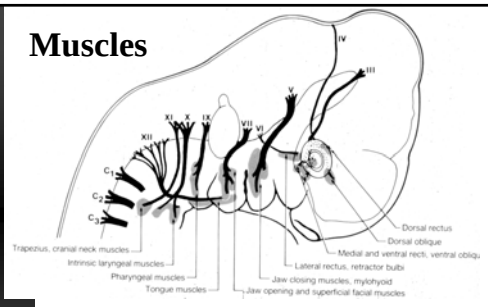


Branchiomeric nerves : pre- and posttrematic rami



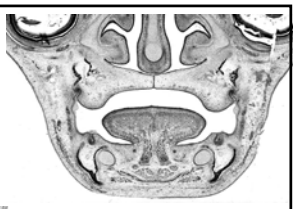
Dual afferent innervation in each arch

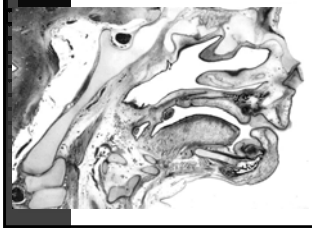
Muscles

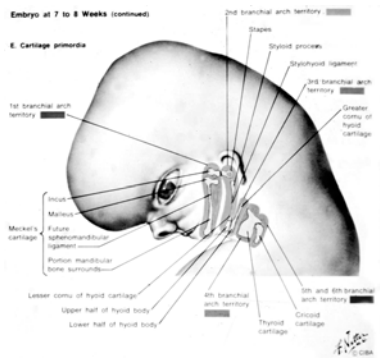


Arch 1: Muscles of mastication (V)
Arch 2: Muscles of facial expression (VII)
Arch 3: Stylopharyngeus muscle (IX)
Arch 4-6: Laryngeal muscles (X-XI)

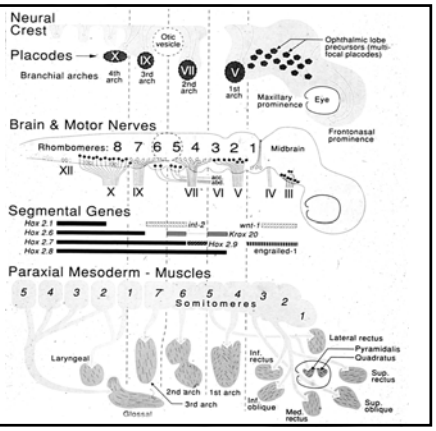
Skeletal elements

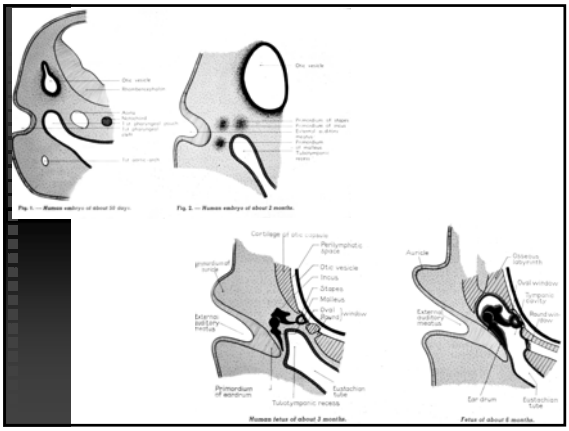


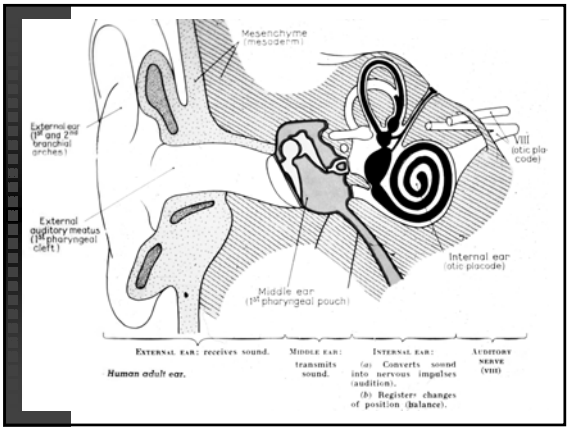




Skeletal derivatives







Human adult ear.