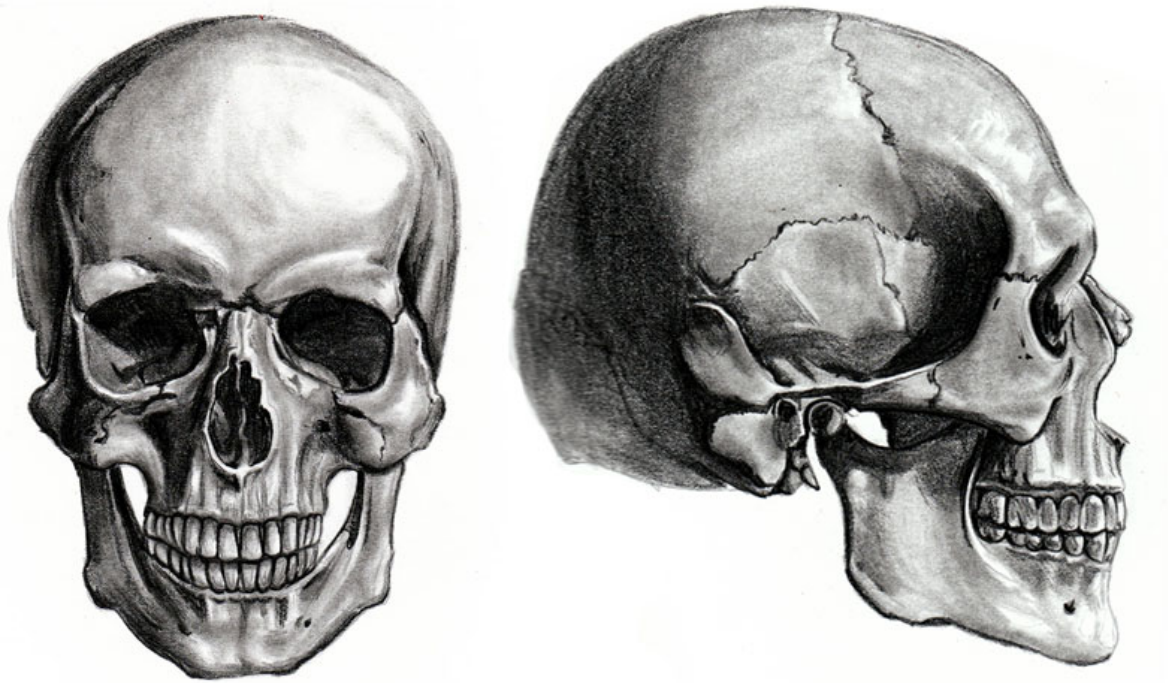
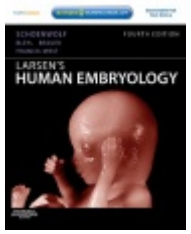
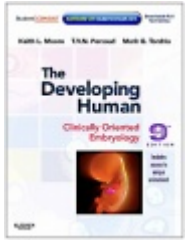
Head and Face Development





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



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Lecture overview
Head and Face Development

Embryonic tissues contributing to cranial development

Craniofacial Development

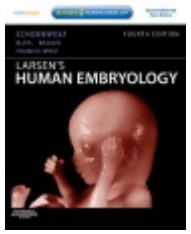
Branchial/Pharyngeal Arch Derivatives:

- Skeleton
- Arteries
- Muscles
- Cranial Nerves
- Clefts/pouches

Development of the Pituitary

Development of the Tongue

Craniofacial abnormalities



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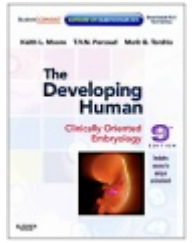

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End product gastrulation:

Trilaminar embryo

Ectoderm *(Neural crest)*
brain, spinal cord, eyes, *peripheral nervous system*
epidermis of skin and associated structures,
melanocytes, cranial connective tissues (dermis)

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

Endoderm
epithelial linings of gastrointestinal, liver, pancreas,
thyroid and respiratory tracts

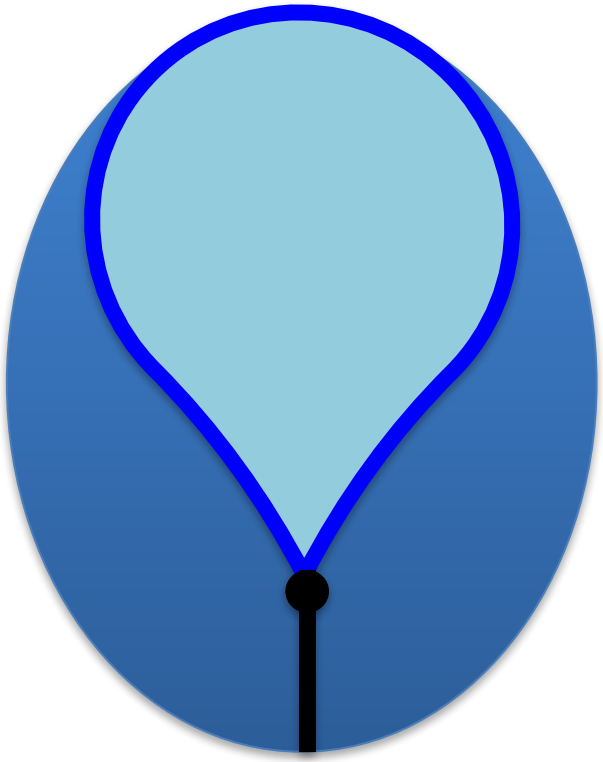
Embryonic tissues contributing to cranial development

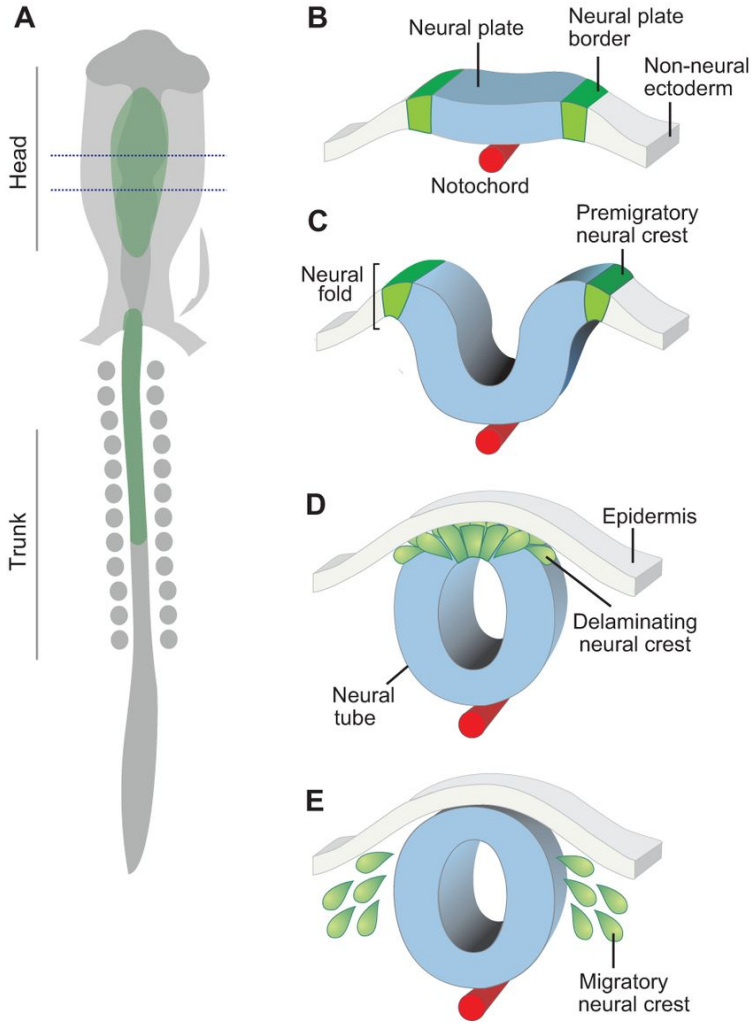
Ectoderm and Neural Crest
Paraxial Mesoderm
Endoderm

Week 4 embryo

Embryonic tissues contributing to cranial development

Cranial Ectoderm and Neural Crest





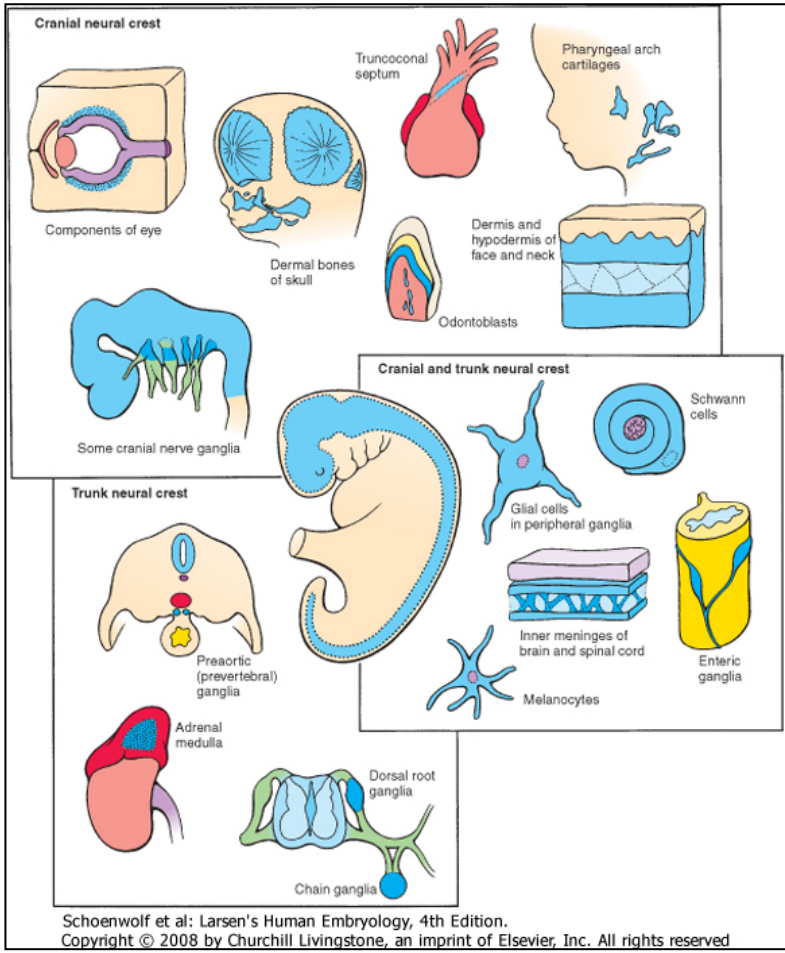
Embryonic tissues contributing to cranial development
Cranial Neural Crest

Cranial neural crest:
Cranial mesenchyme, facial skeleton,
cranial nerve ganglia

Cardiac neural crest:
Melanocytes, cartilage, connective tissue
and neurons of some pharyngeal arches,
Contributes to formation of regions of the heart

Trunk neural crest:
Melanocytes, dorsal root ganglia, sympathetic ganglia,
adrenal medulla,
nerves surrounding aorta

Vagal and Sacral neural crest:
Melanocytes, ganglia of the enteric nervous system
Parasympathetic ganglia

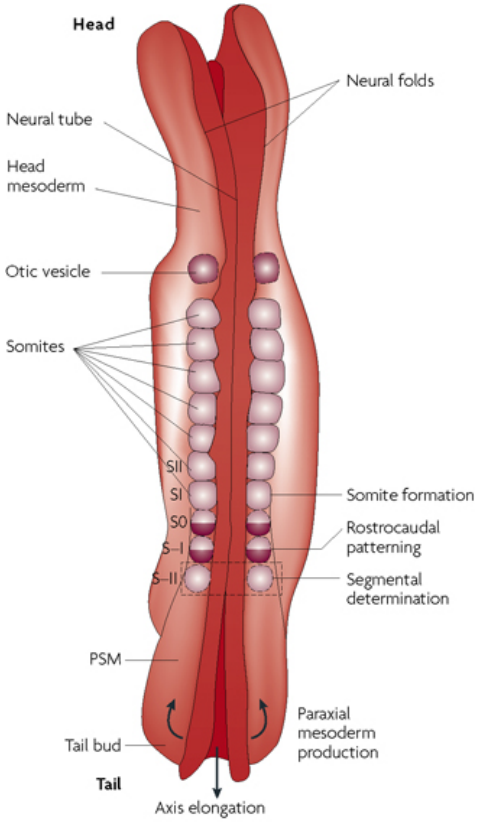


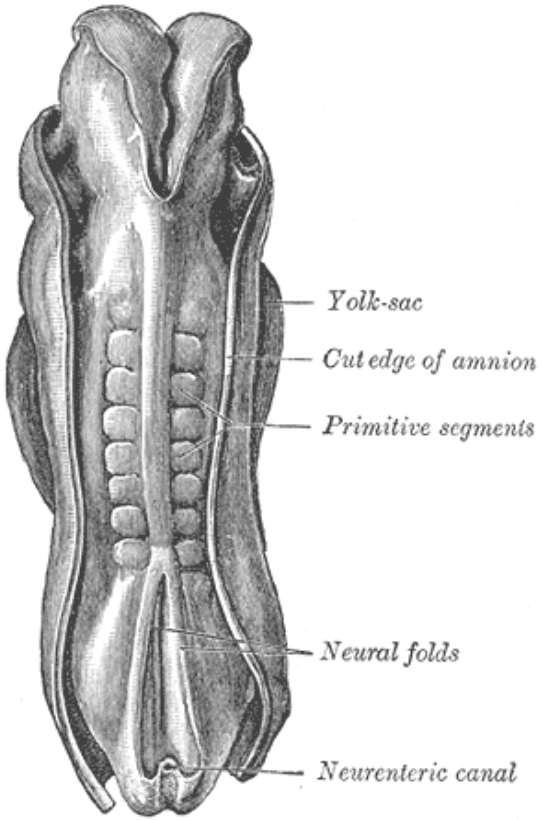
Embryonic tissues contributing to cranial development

Paraxial Mesoderm

Cranial: Unsegmented paraxial mesoderm: head mesenchyme

Trunk: Segmented paraxial mesoderm: somites

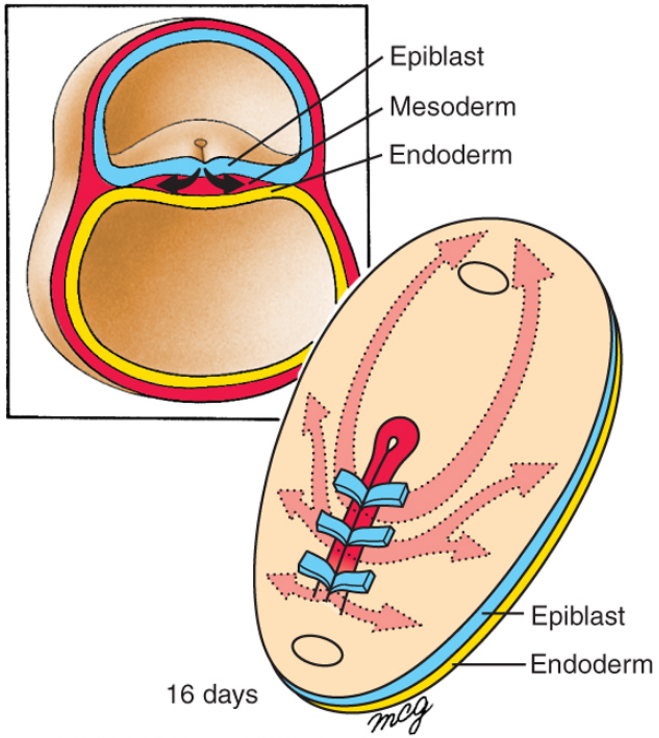


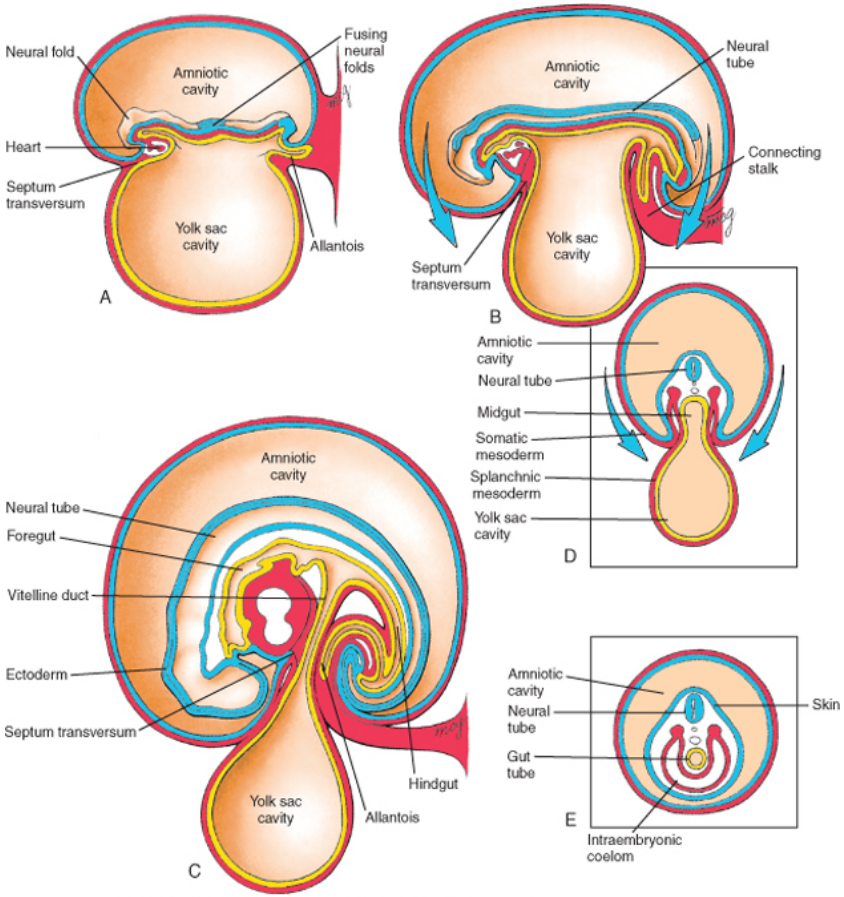


Embryonic tissues contributing to cranial development

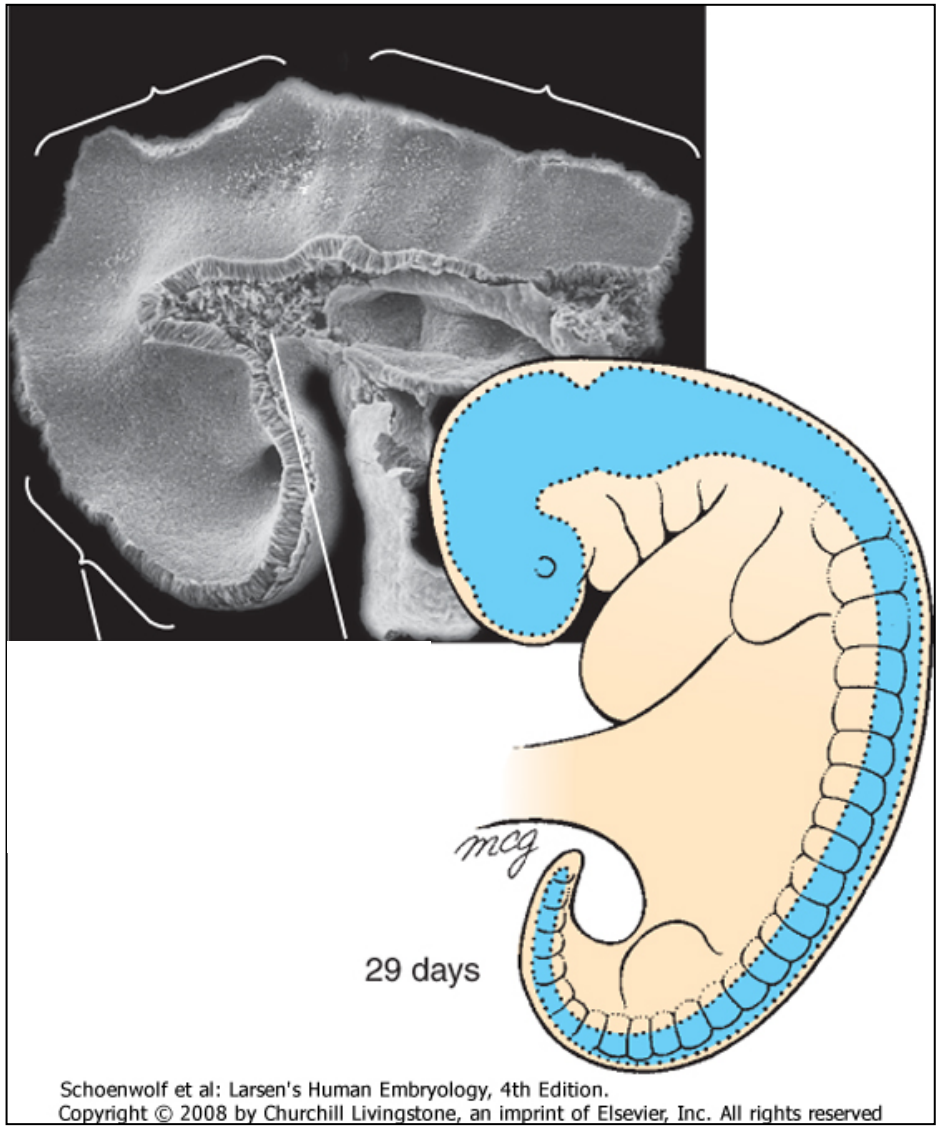
Endoderm

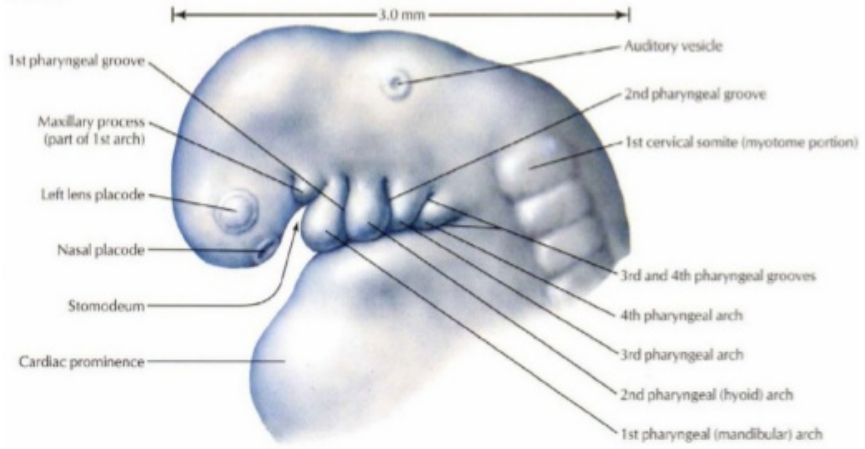
Bucchopharyngeal membrane
Lining of the pharyngeal and laryngeal cavities



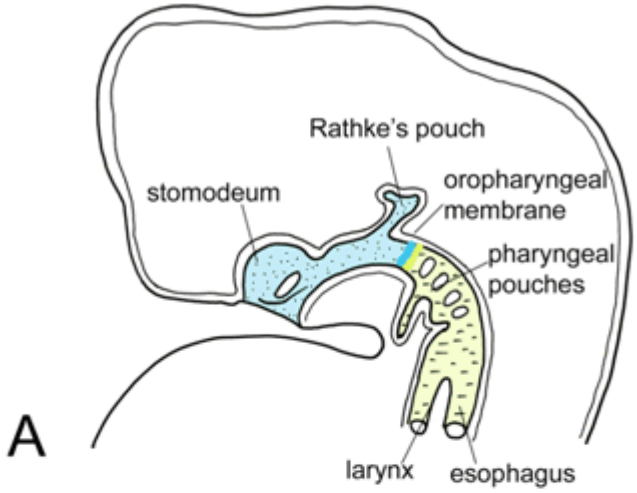


Craniofacial Development



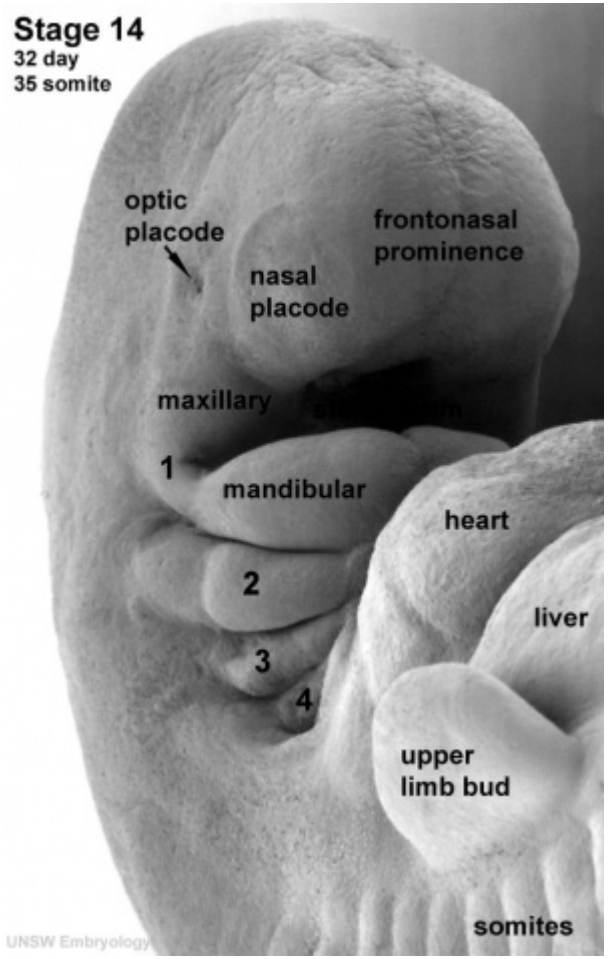


Embryo at 4 - 5 weeks (Lateral view)



Craniofacial Development

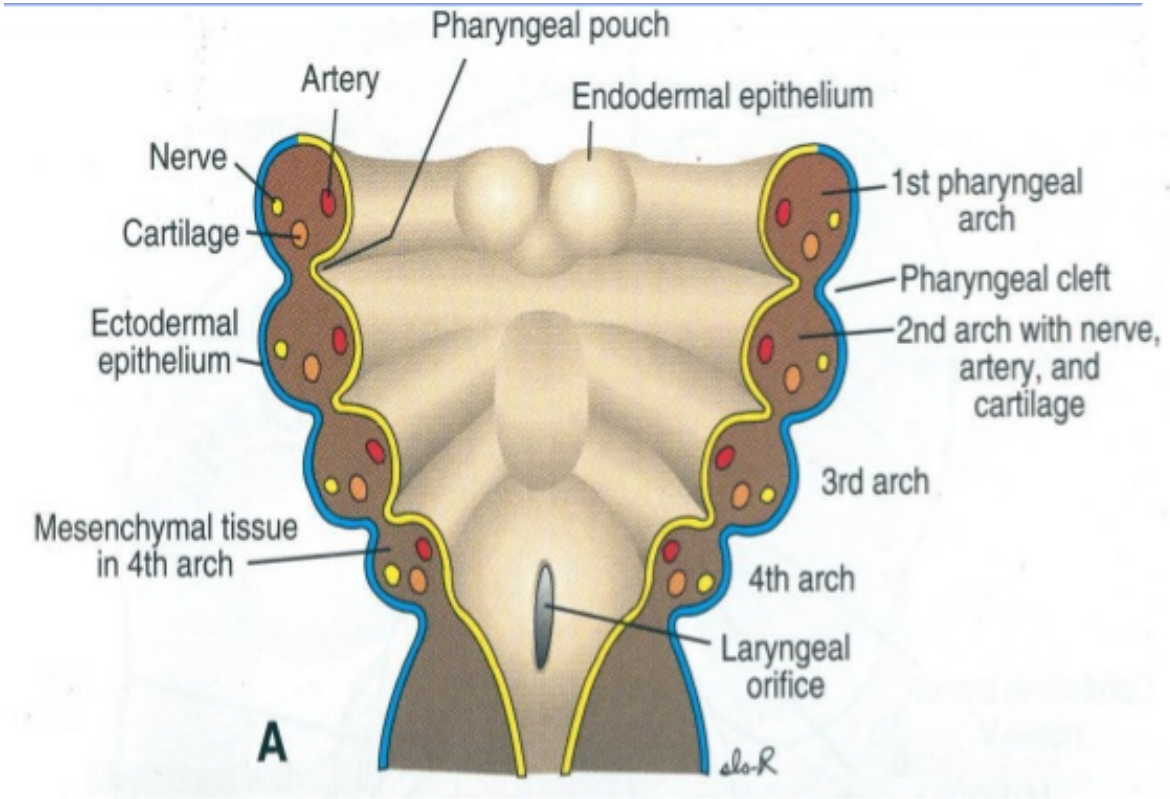
Humans develop 6 pharyngeal or branchial arches (BA)
Form from rostrally to caudally
BA1 gives rise to maxillary and mandibular process
BA5 disappears



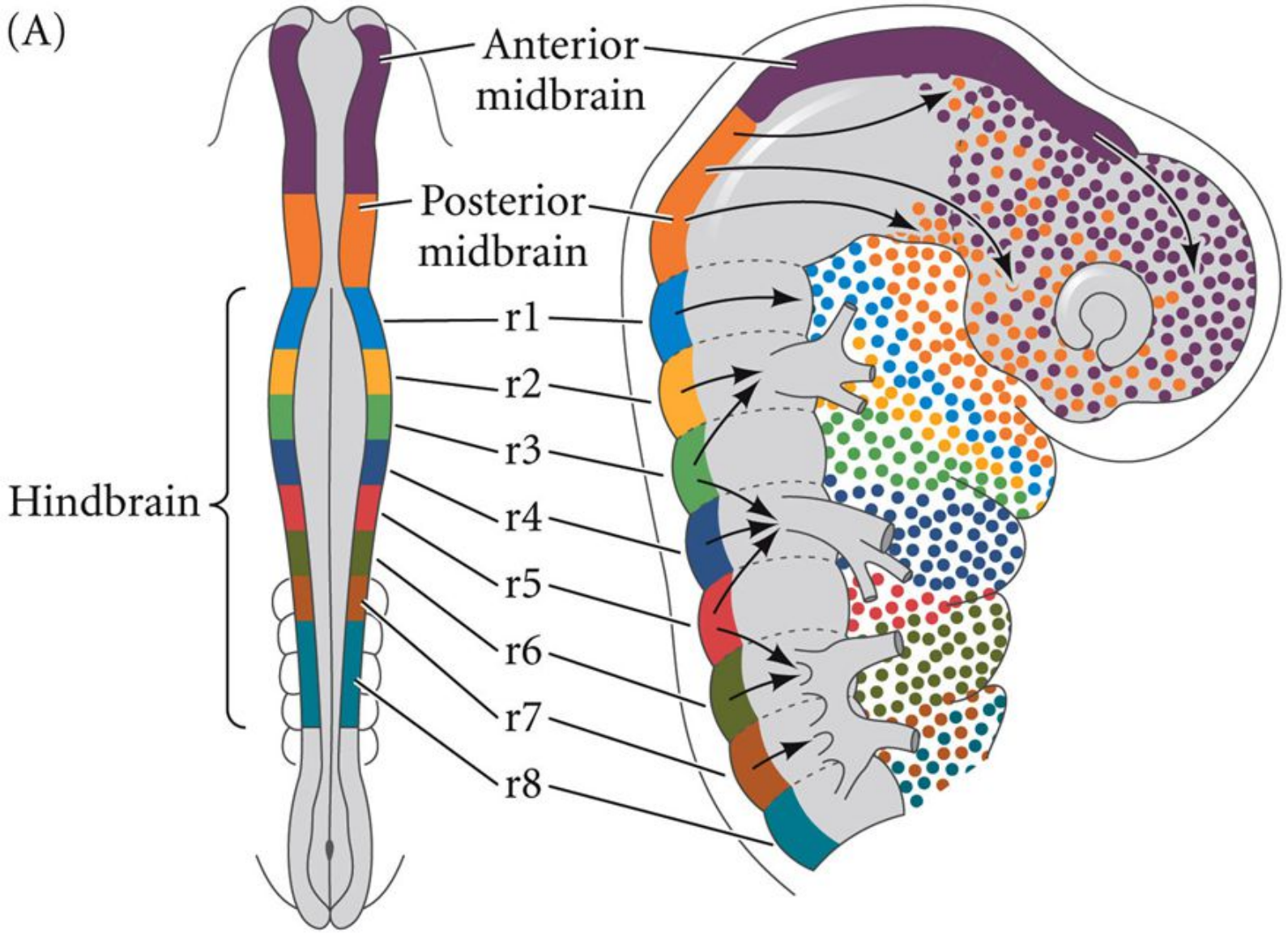
Craniofacial Development

Each branchial arch initially consists of:
Ectoderm, endoderm and mesoderm
Pharyngeal pouch (endoderm)
Pharyngeal groove/cleft (ectoderm)

Each arch gives rise to: Cartilage, Artery, Muscle, Cranial Nerve



Craniofacial Development



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

Craniofacial Development

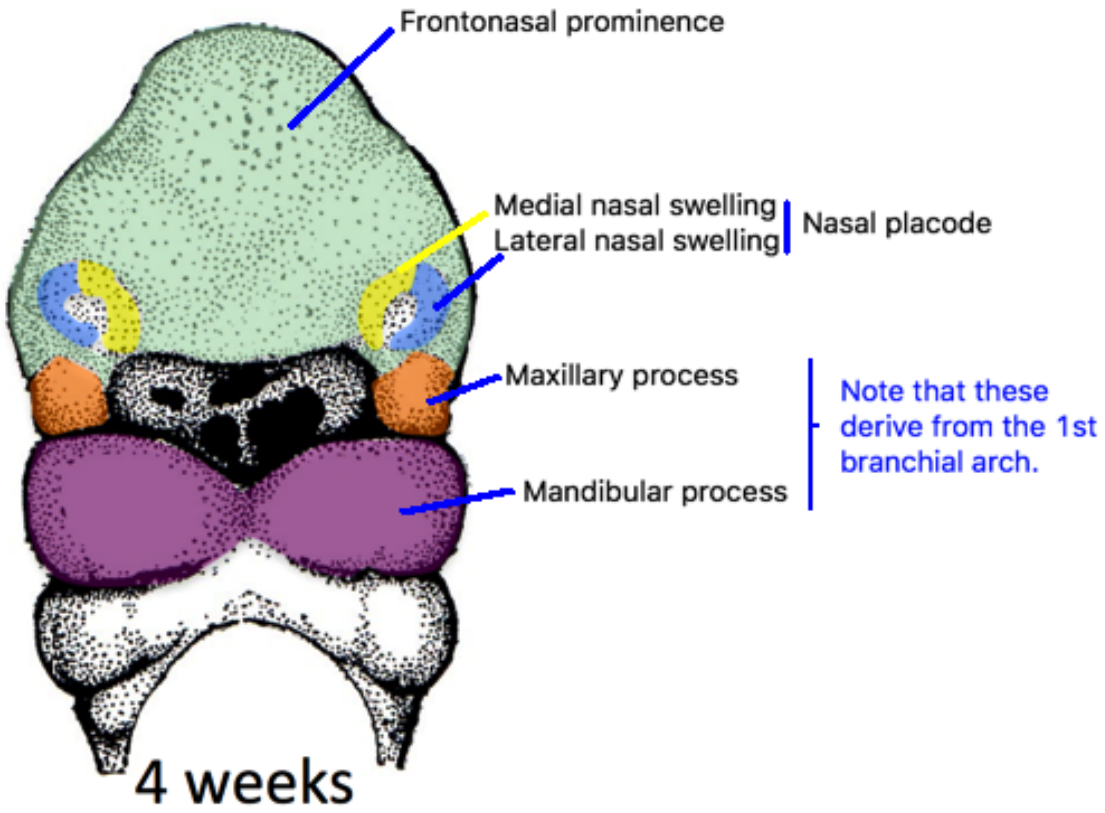
Facial Development

Facial primordia appear in week 4

Frontonasal process and nasal placodes

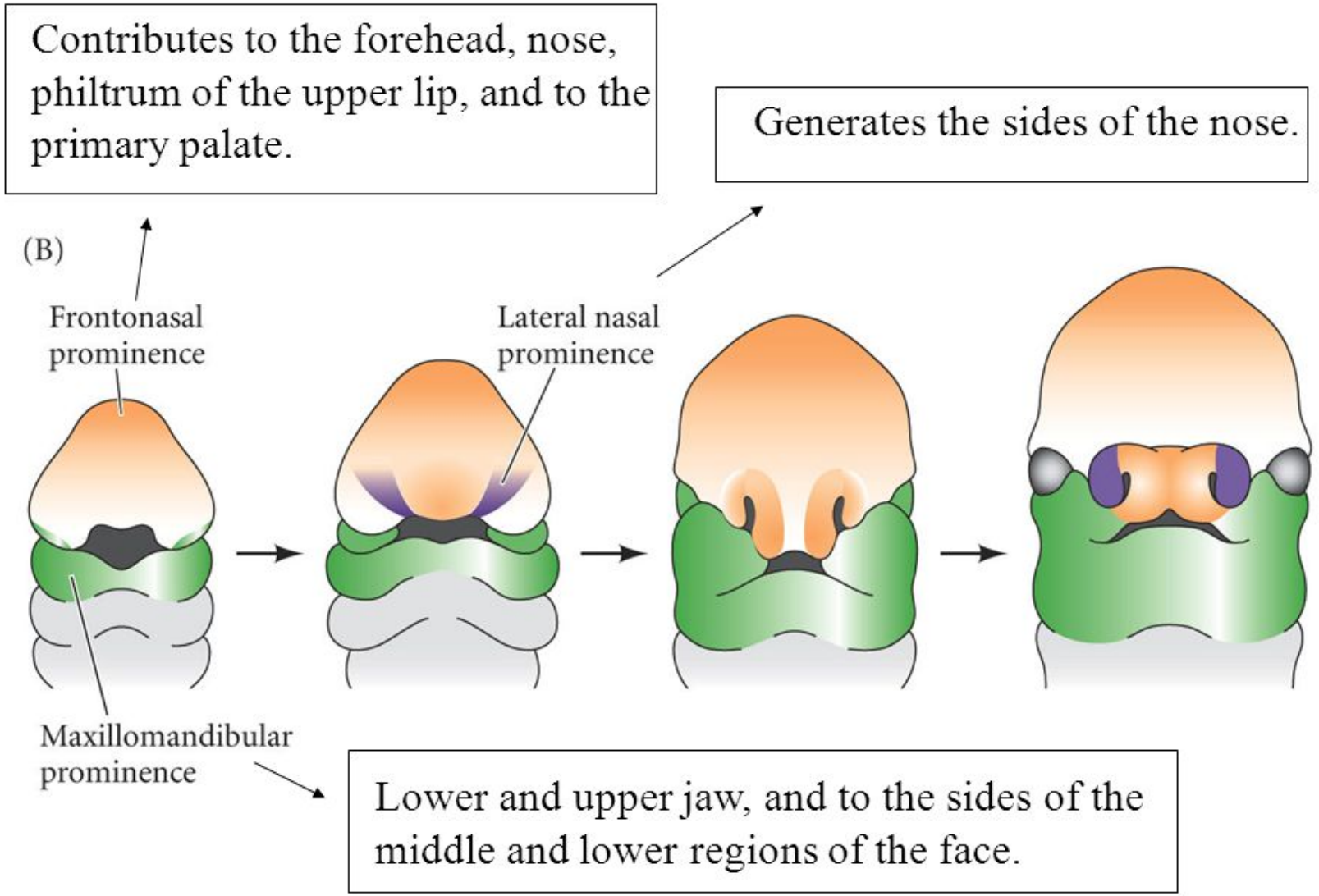
1st branchial arch: mandibular and maxillary processes

Stomodeum



Craniofacial Development

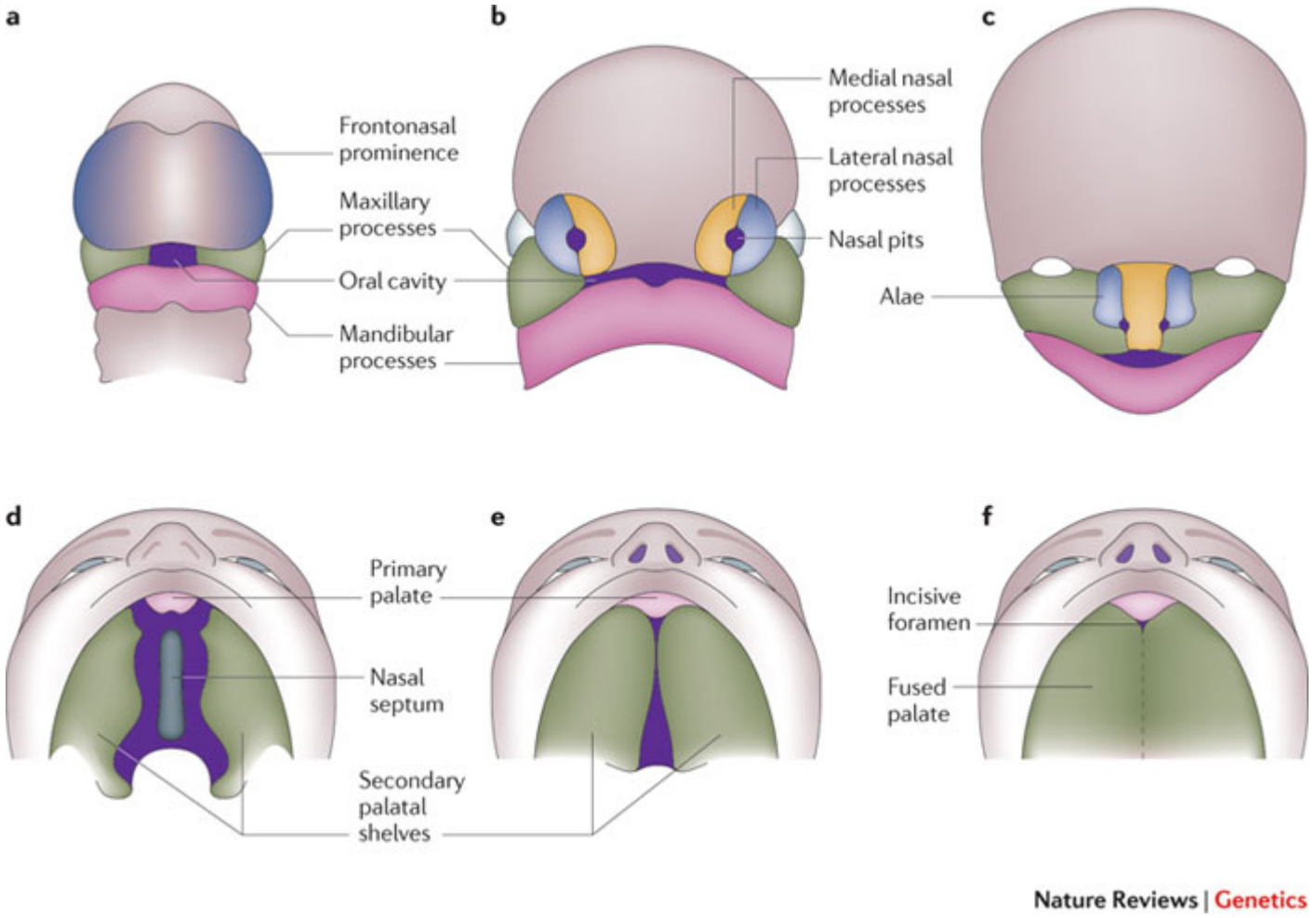
Facial development



https://embryology.med.unsw.edu.au/embryology/images/d/dd/Face_001.mp4

Craniofacial Development

Palate and nasal cavities



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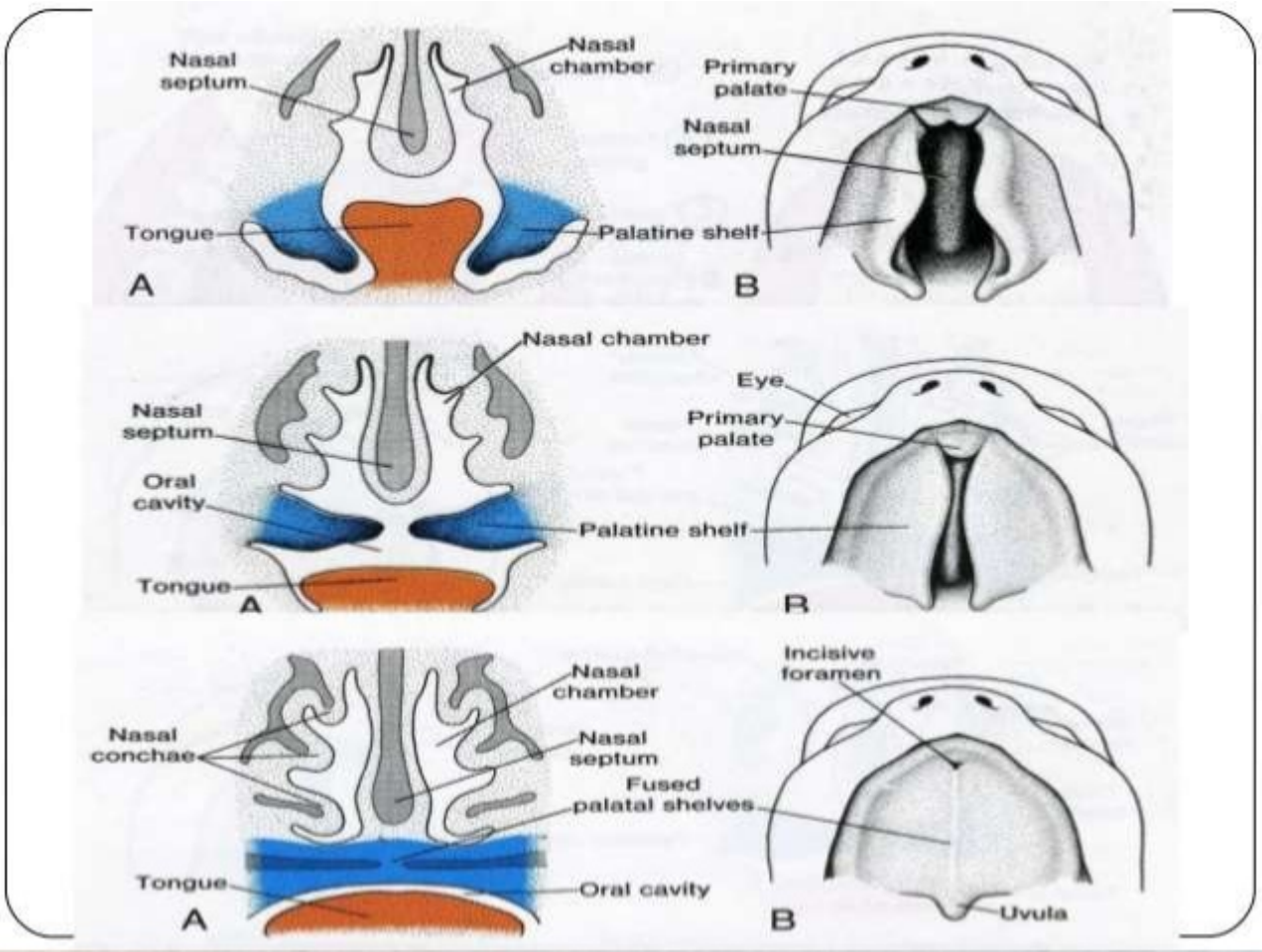
https://embryology.med.unsw.edu.au/embryology/images/7/78/Palate_002.mp4

Facial Development

Palate and nasal cavities



https://www.youtube.com/watch?v=DgZ_tqucdI4

Pharyngeal/Branchial Arch Derivatives

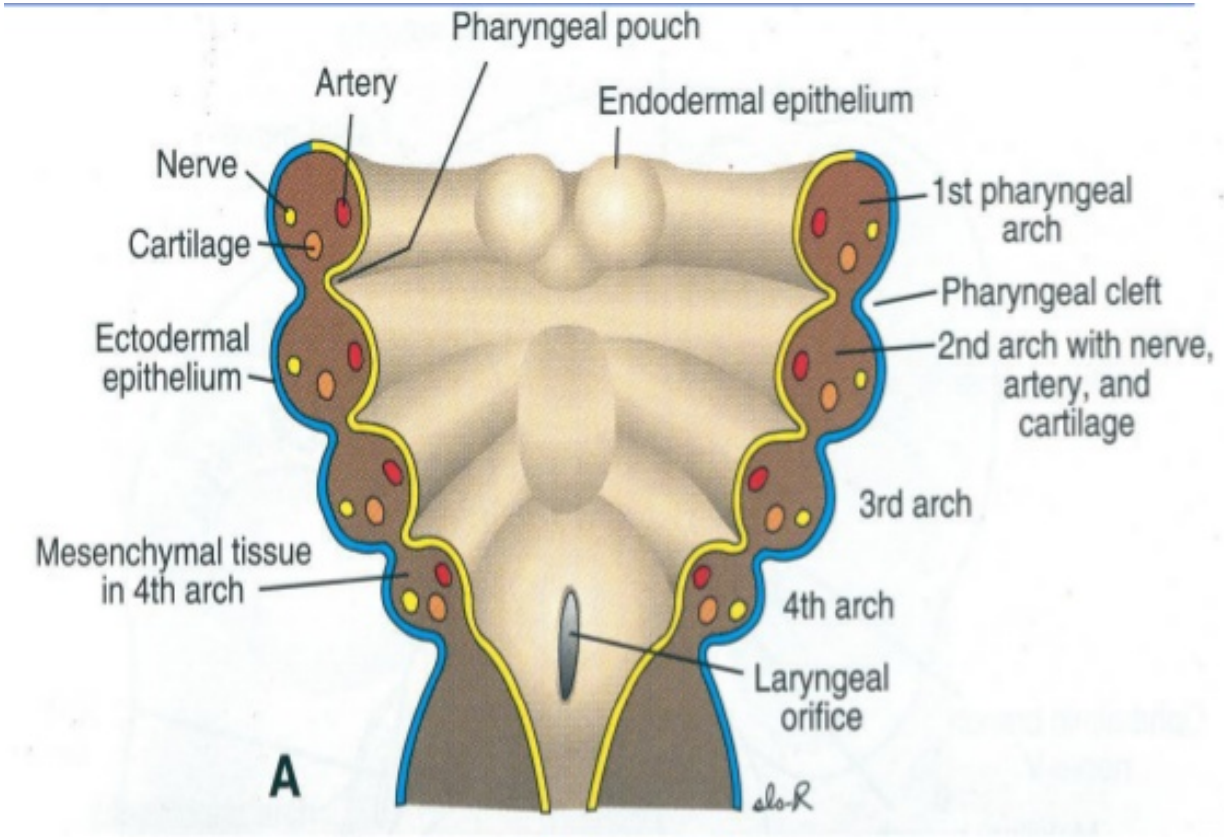
Skeletal derivatives

Arteries

Muscle

Nerve

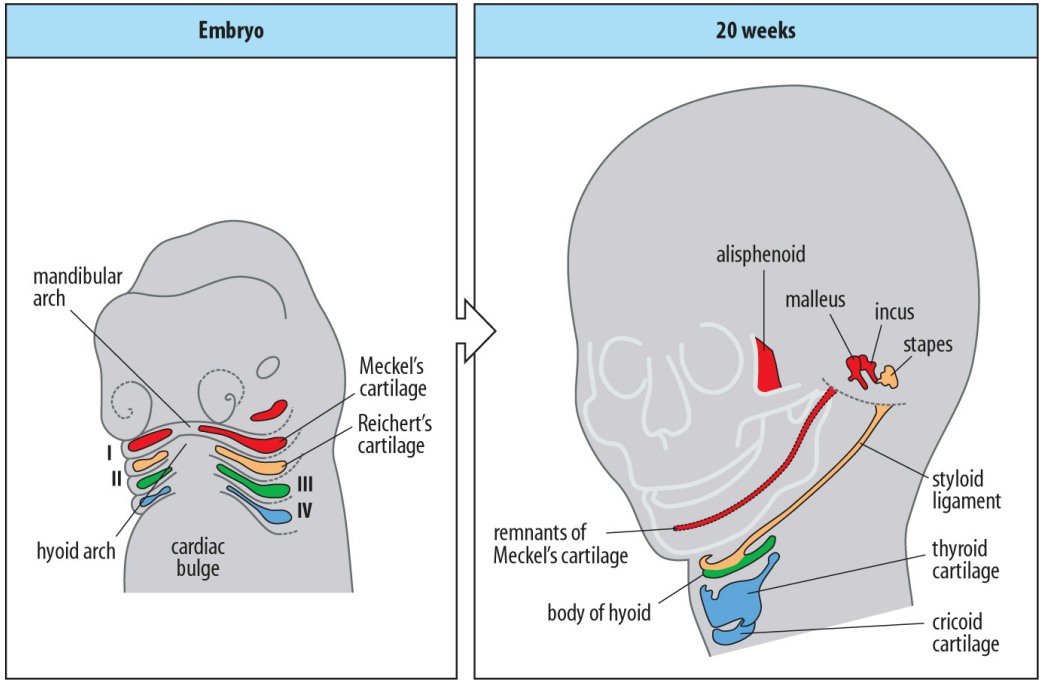
Cleft/Pouches

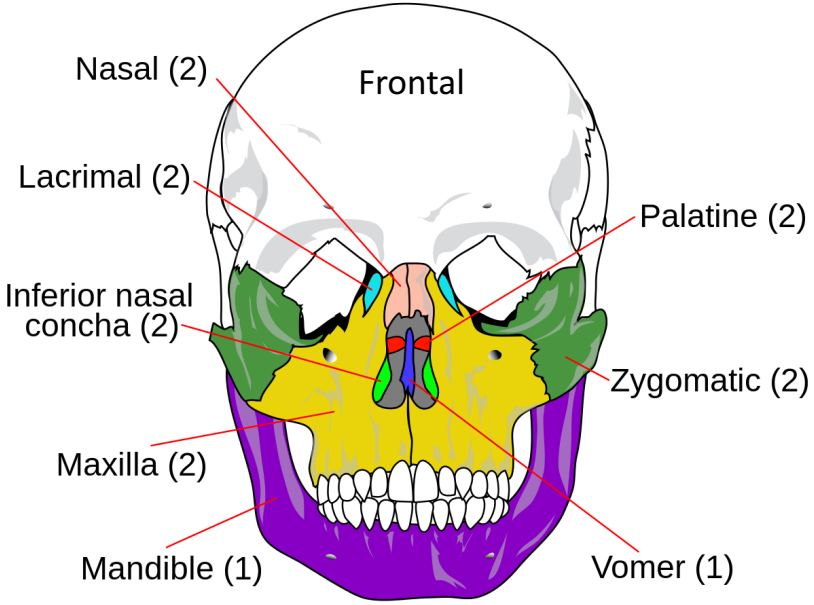


Pharyngeal/Branchial Arch Derivatives

Skeletal derivatives

Frontonasal process: frontal bone, nasal bones and septum, lacrimal bones, nasal labyrinths
BA1 Maxillary process: maxilla, palatine, vomer, zygomatic bone, part temporal bone
BA1 Mandibular process: Meckel's cartilage and mandible, malleus and incus
BA2: Reichert's cartilage and hyoid (superior part), and stapes
BA3: Hyoid (inferior part)
BA4: laryngeal cartilages: thyroid and cricoid cartilage

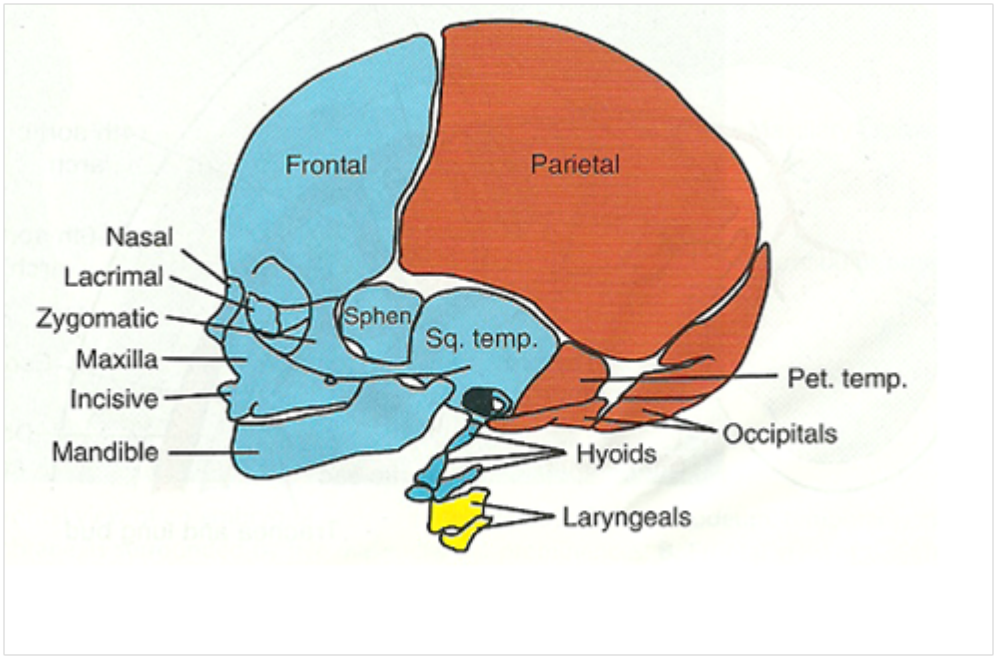


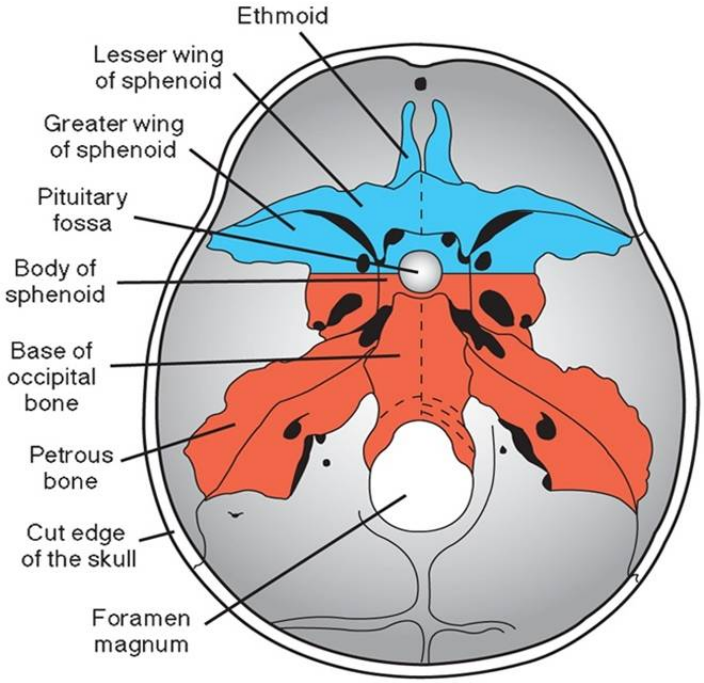


Pharyngeal/Branchial Arch Derivatives

Skeletal derivatives

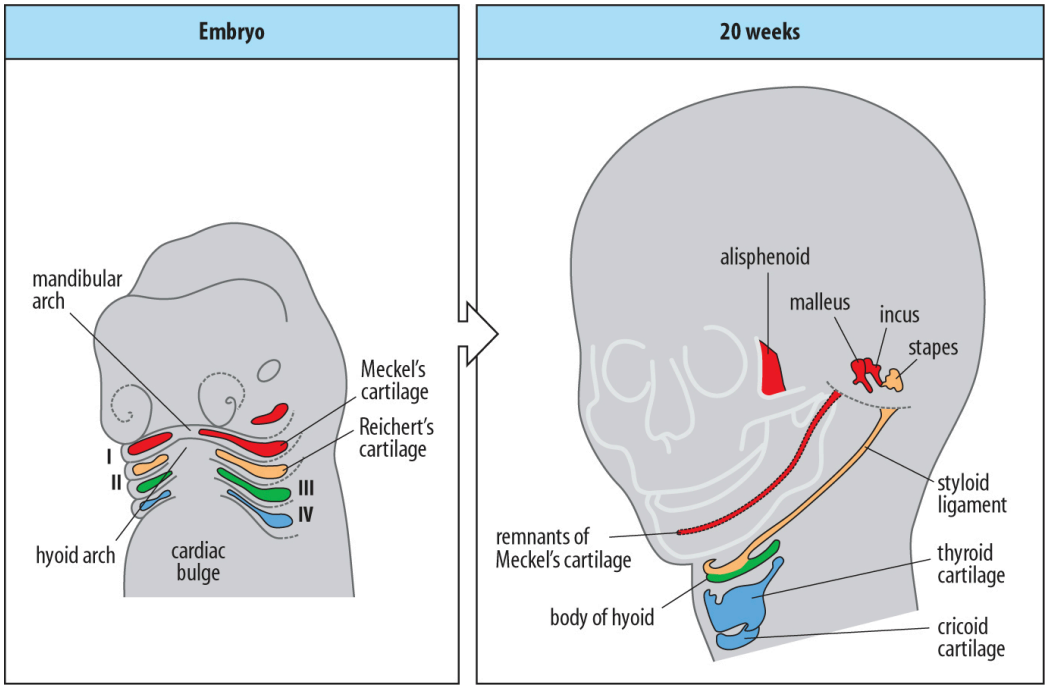
Blue: Cranial neural crest-derived bones (FNP, BA1 and BA2): most of viscerocranium
Red: Paraxial mesoderm derived bones: most of neurocranium
Yellow: BA2-derived

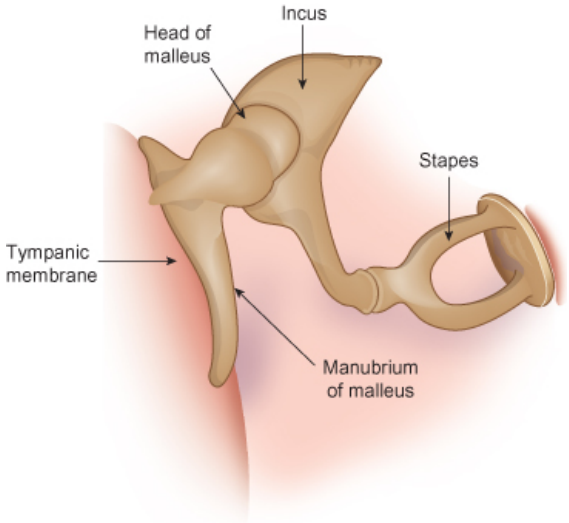


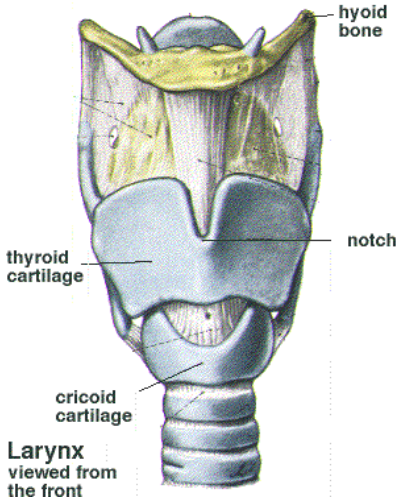


Pharyngeal/Branchial Arch Derivatives

Middle ear ossicles and laryngeal cartilages



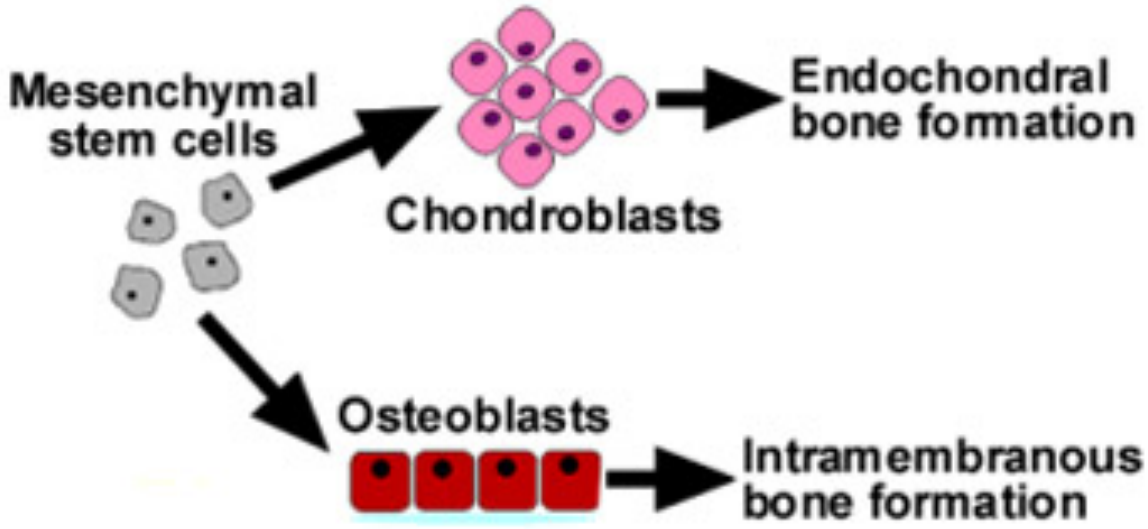




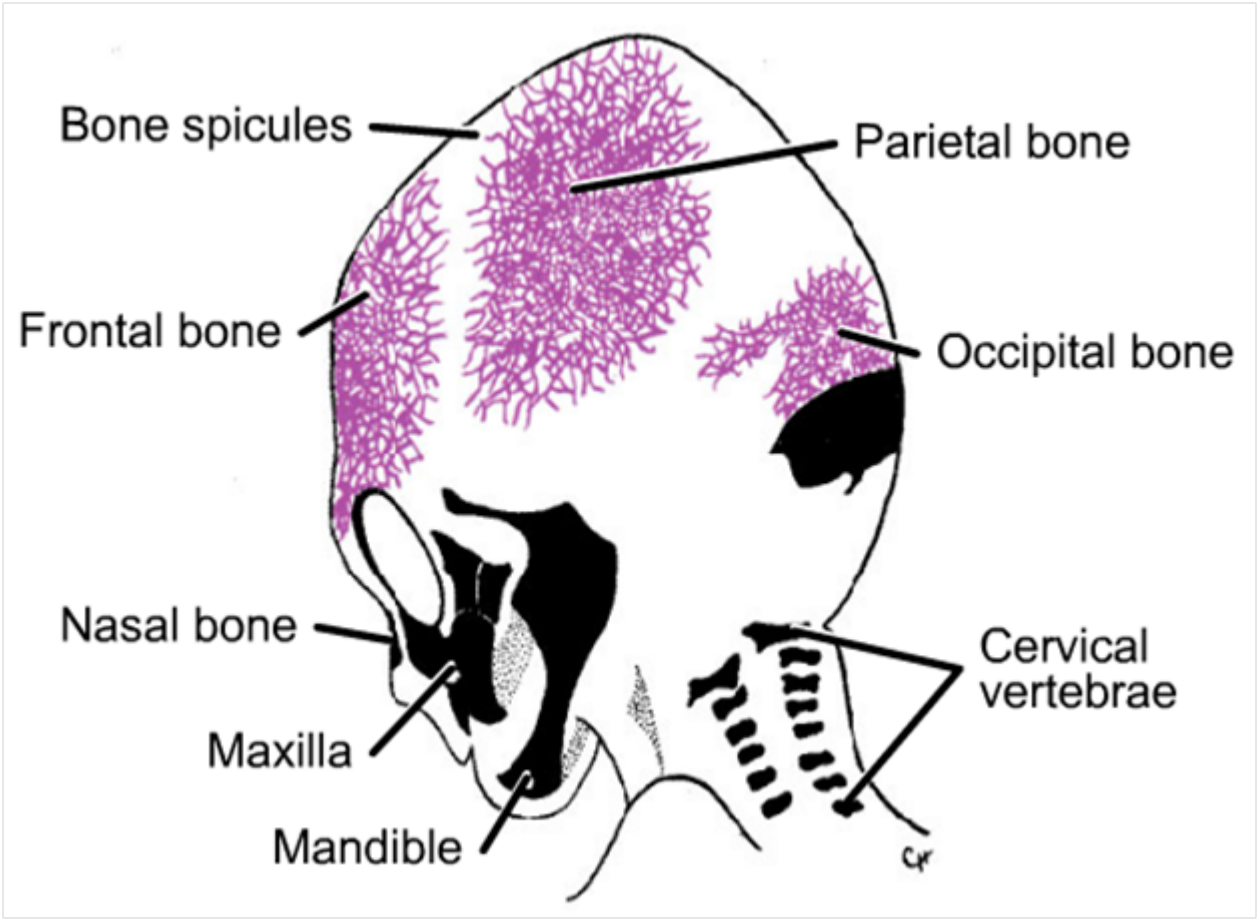
Ossification

Two types :

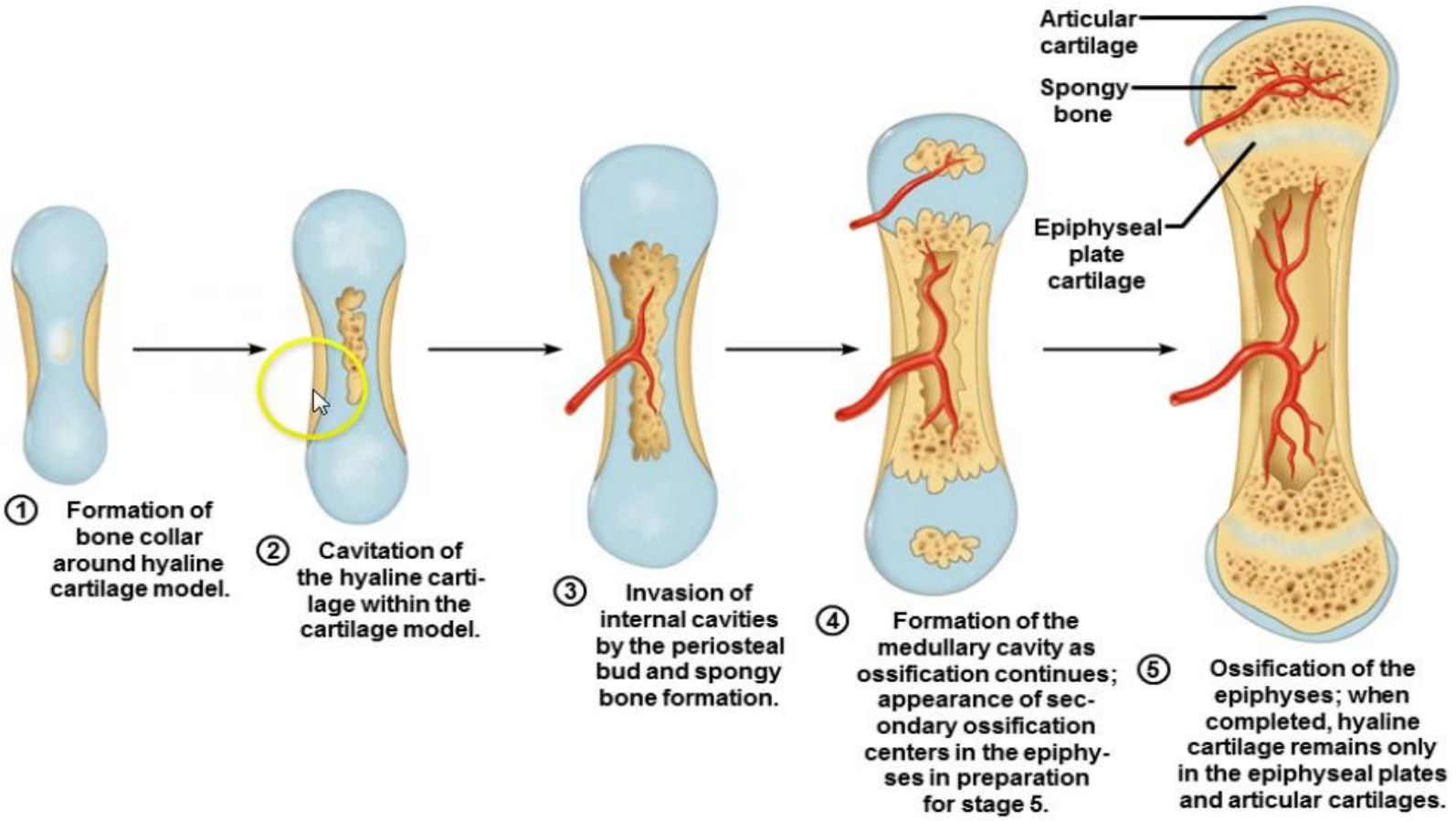
1. Endochondral ossification:
   - Most of our skeleton
   - Bone replaces cartilage template
2. Intramembranous ossification:
   - Flat bones (calvaria)
   - Direct ossification from mesenchyme



Intramembranous Ossification

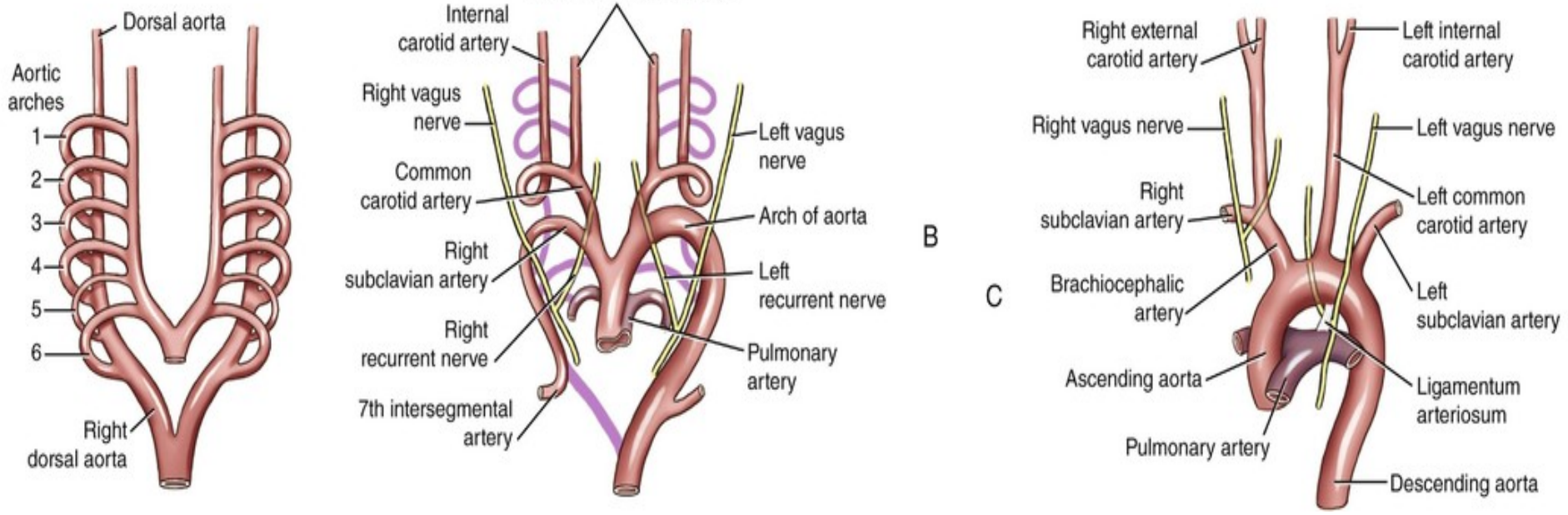


Endochondral Ossification



Pharyngeal/Branchial Arch Derivatives

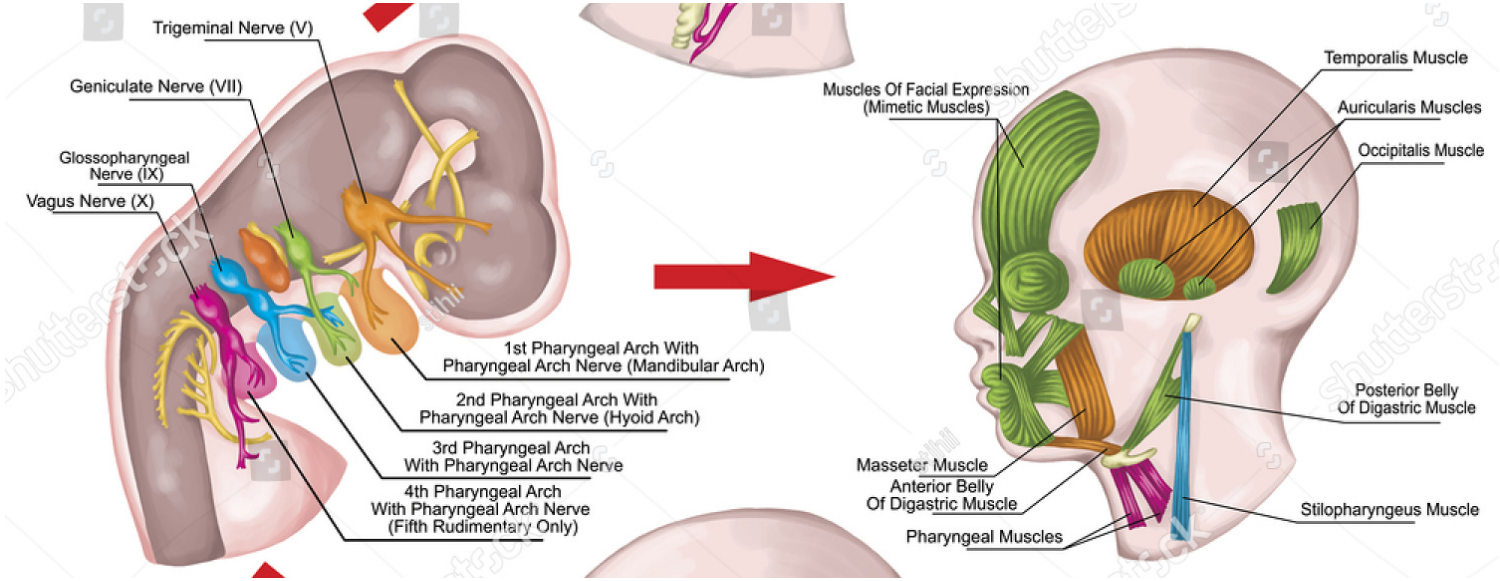
Arteries



BA1 - mainly lost, form part of maxillary artery
BA2 – mainly lost, stapedial arteries
BA3 - common carotid arteries, internal carotid arteries
BA4 - left forms part of aortic arch, right forms part right subclavian artery
BA5 - mainly lost
BA6 - left forms part of left pulmonary artery , right forms part of right pulmonary artery

Pharyngeal/Branchial Arch Derivatives

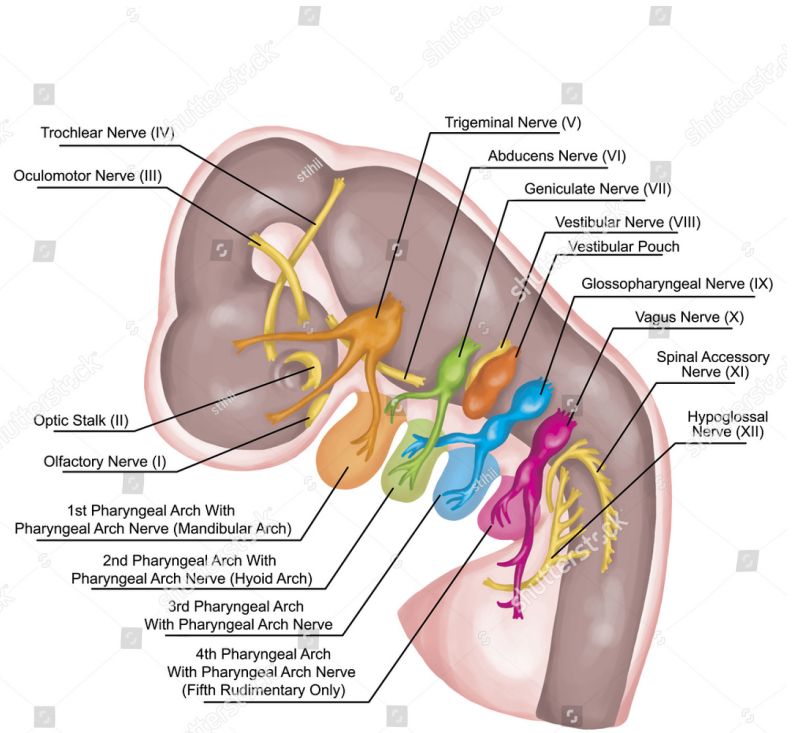
Branchial muscles

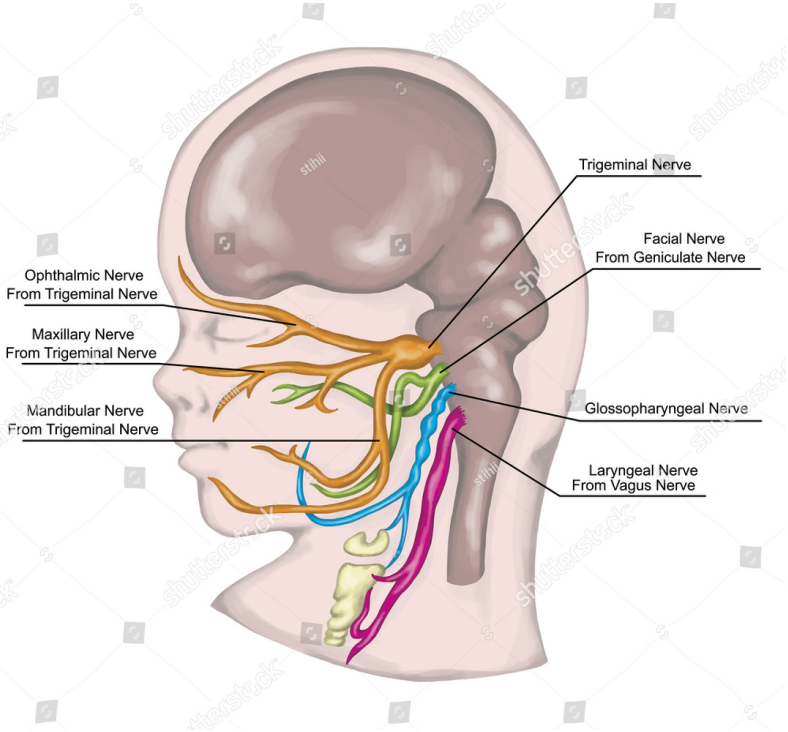


BA1 - muscles of mastication, mylohyoid, tensor tympanic, ant. belly digastric
BA2 - muscles of facial expression, stapedius, stylohyoid, post. belly digastric
BA3 - stylopharyngeus
BA4&6 - crycothyroid, pharynx constrictors, larynx muscles, oesophagus (st. muscle)

Pharyngeal/Branchial Arch Derivatives

Cranial nerves

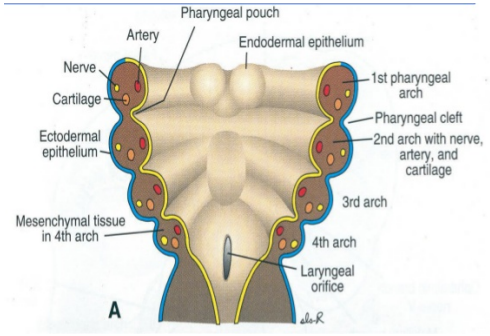




BA1 - Cranial Nerve V: trigeminal nerve
BA2 - Cranial Nerve VII: facial nerve
BA3 - Cranial Nerve IX: glossopharyngeal nerve
BA4&6 - Cranial Nerve X: vagus nerve

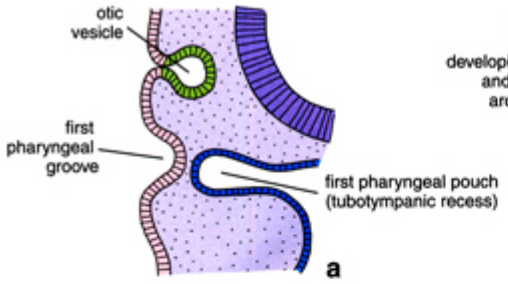
Pharyngeal/Branchial Arch Derivatives

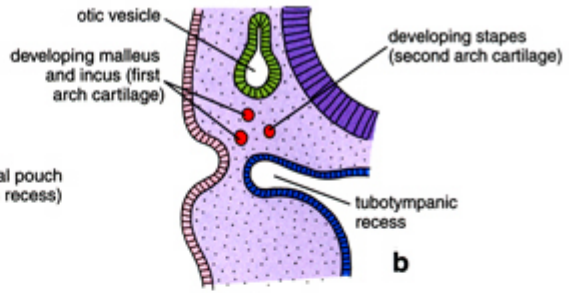
1st branchial cleft/pouch

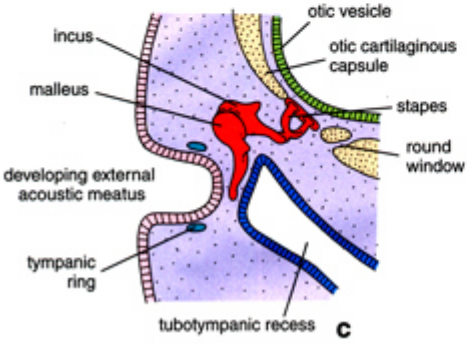


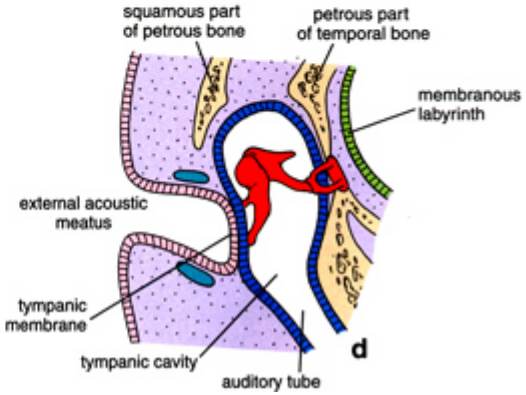
1st pouch: tubotympanic recess: tympanic cavity, eustachian tube

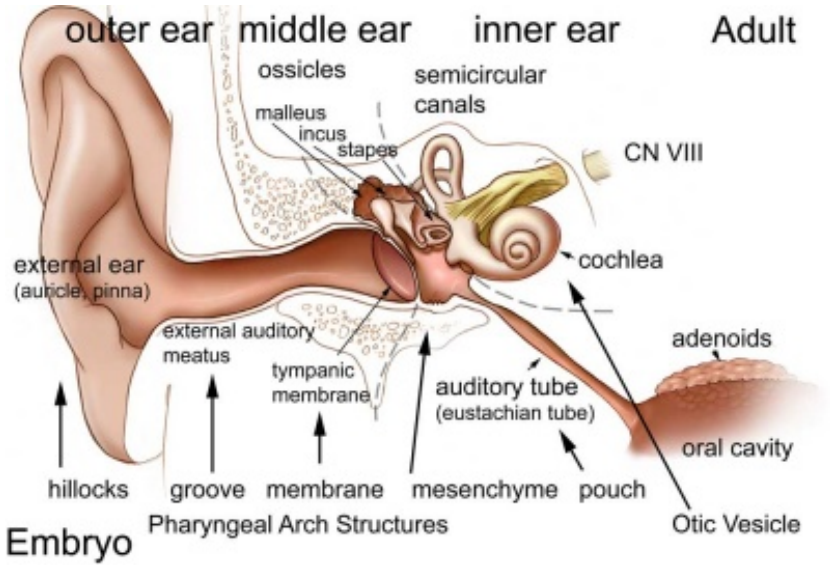
1st cleft: external acoustic meatus





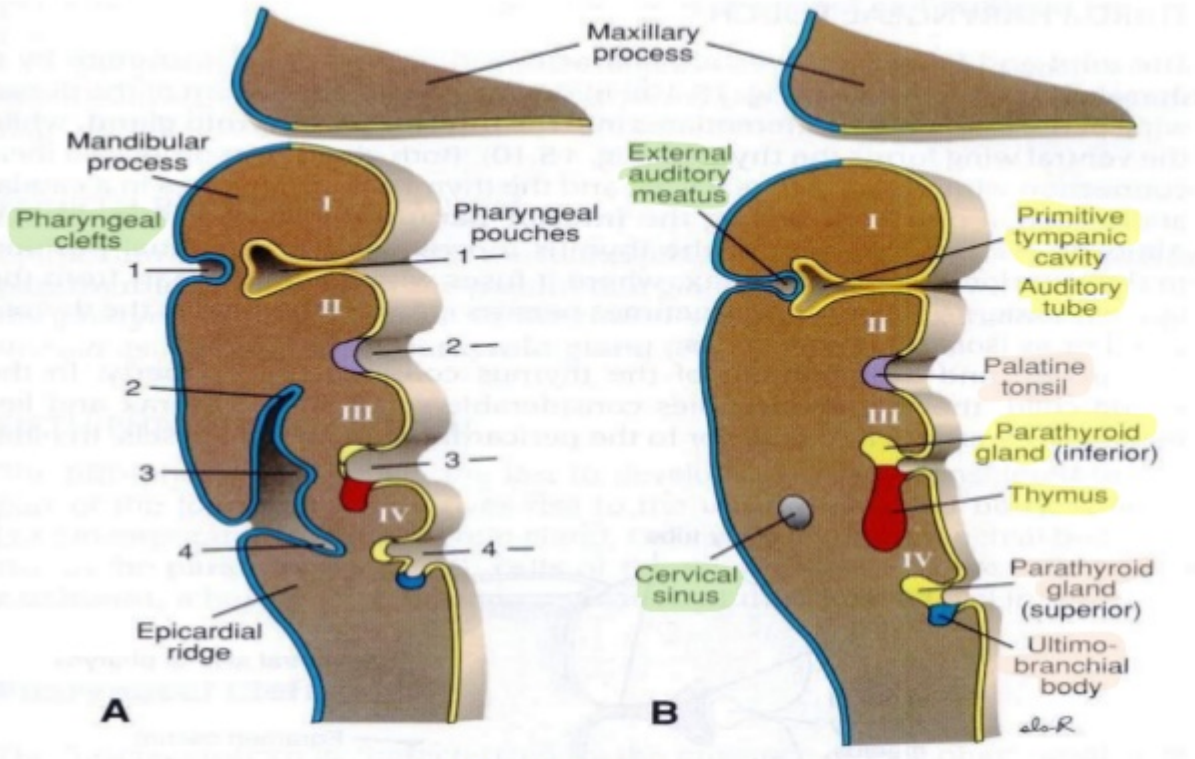






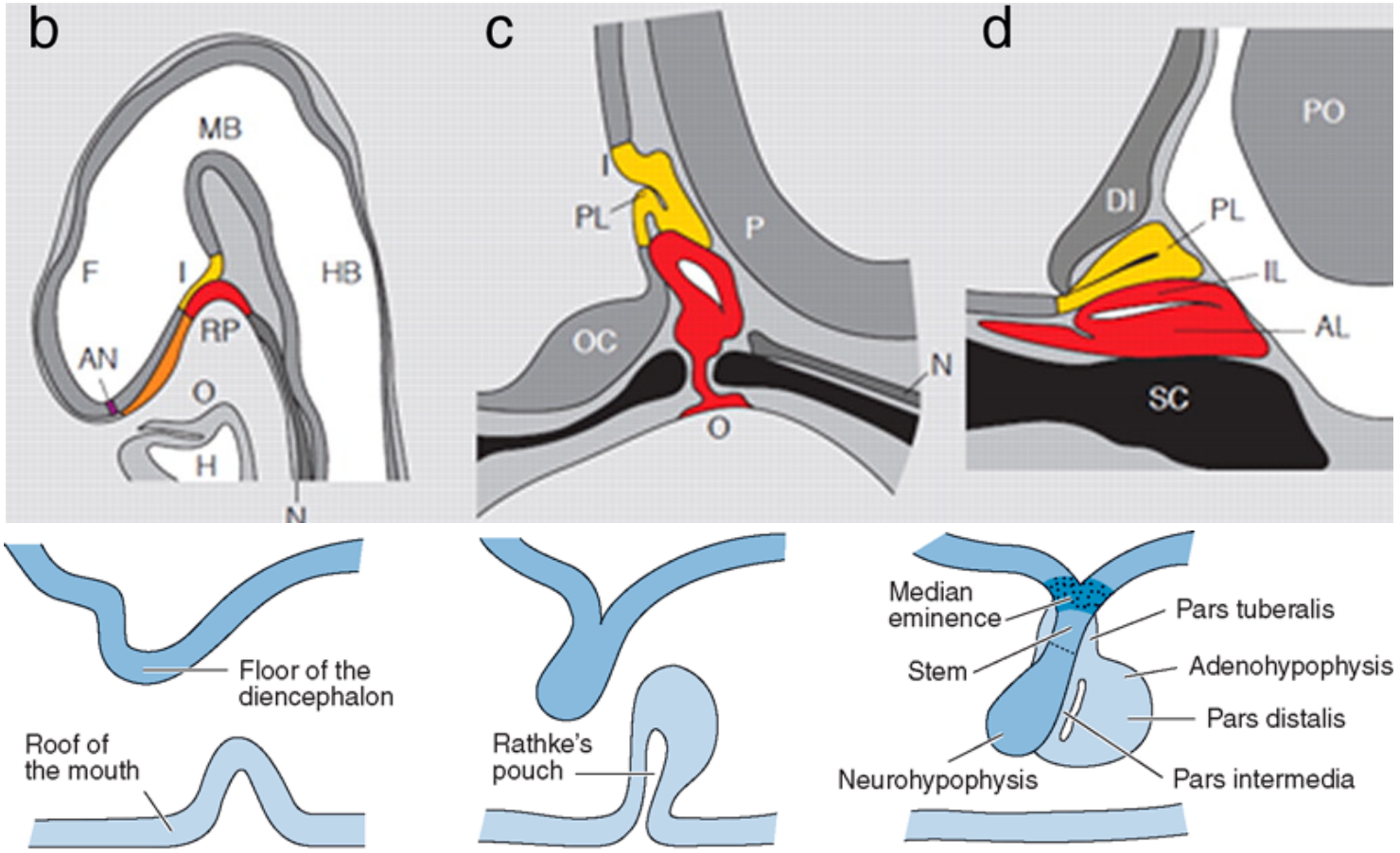
Pharyngeal/Branchial Arch Derivatives

1st branchial cleft/pouch



BA1 - elongates to form **tubotympanic recess**, tympanic cavity, mastoid antrum, eustachian tube
BA2 - forms **tonsillar sinus**, mostly obliterated by palatine tonsil
BA3 - forms **inferior parathyroid** and **thymus**
BA4 - forms **superior parathyroid**, parafollicular cells of thyroid

Development of the Pituitary

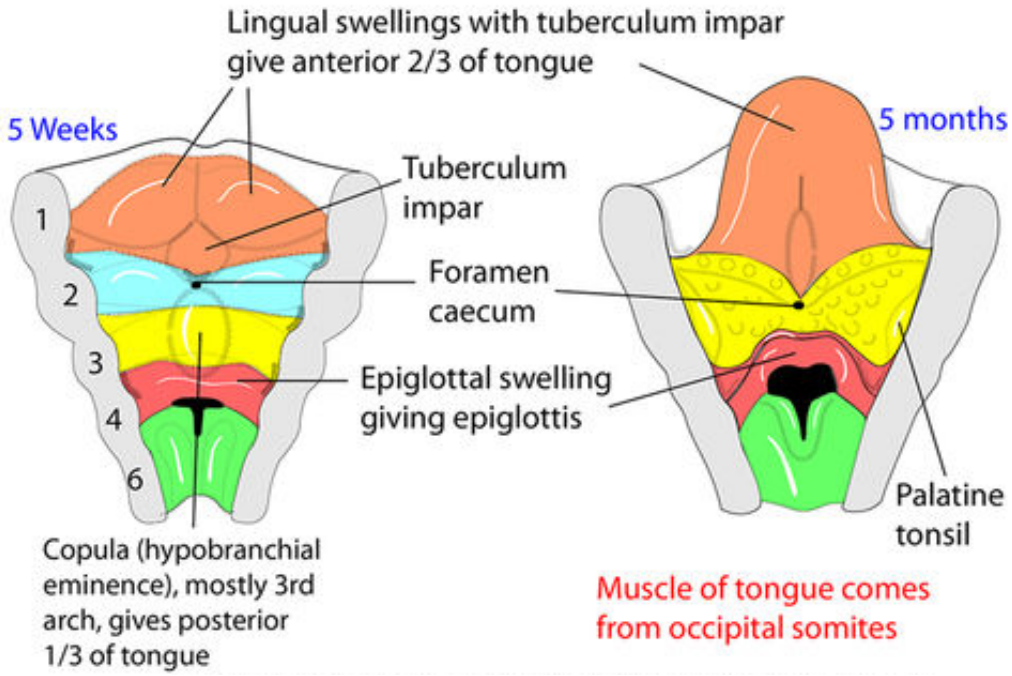


Source: Paulsen DF: *Histology & Cell Biology: Examination & Board Review*, 5th Edition: www.accessmedicine.com

Two embryonic origins:

1. Ectoderm of oral cavity: Rathke's pouch: adenohypophysis
2. Floor of diencephalon: neurohypophysis

Development of the Tongue

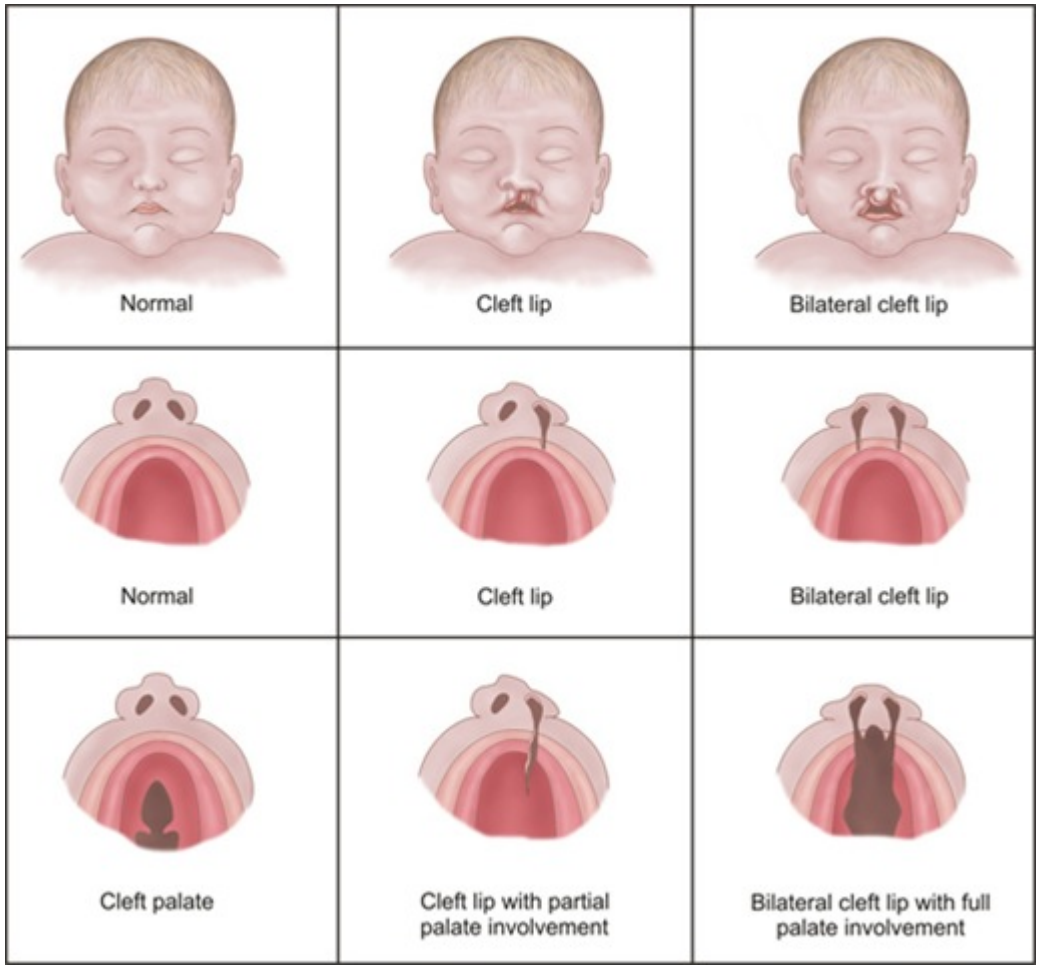


Contributions initially from all arches:
Arch 1 - oral part of tongue (ant 3/2) (lingual swelling and tuberculum impar)
Arch 2 - initial contribution to surface is lost
Arch 3 - pharyngeal part of tongue (post 1/3)
Arch 4 - epiglottis and adjacent regions

Tongue is innervated by muscles derived from sclerotomes

Craniofacial Abnormalities

Cleft Lip/Palate



Craniofacial Abnormalities

Treacher Collins Syndrome

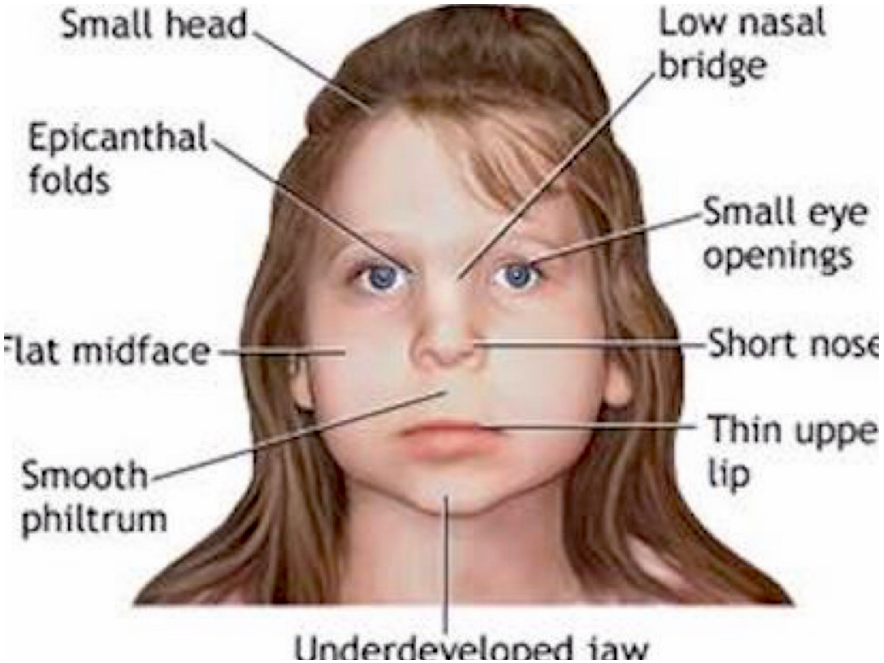
Autosomal Dominant
Affects Cranial neural crest migration
BA1 hypoplasia
Abnormal development of structures derived of BA1

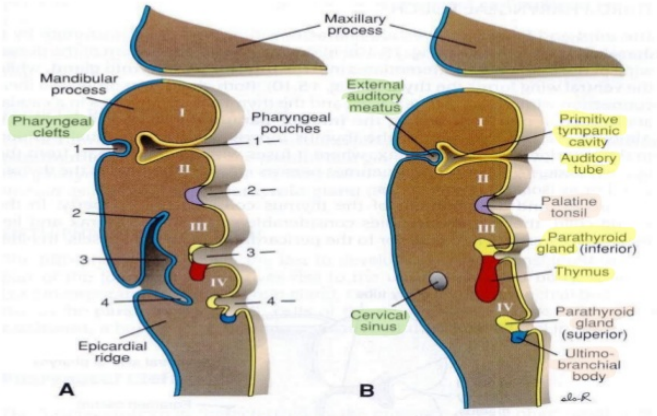
Craniofacial Abnormalities
Pierre Robin Syndrome

BA1 syndrome
Cleft Palate
Retrognathia

Craniofacial Abnormalities

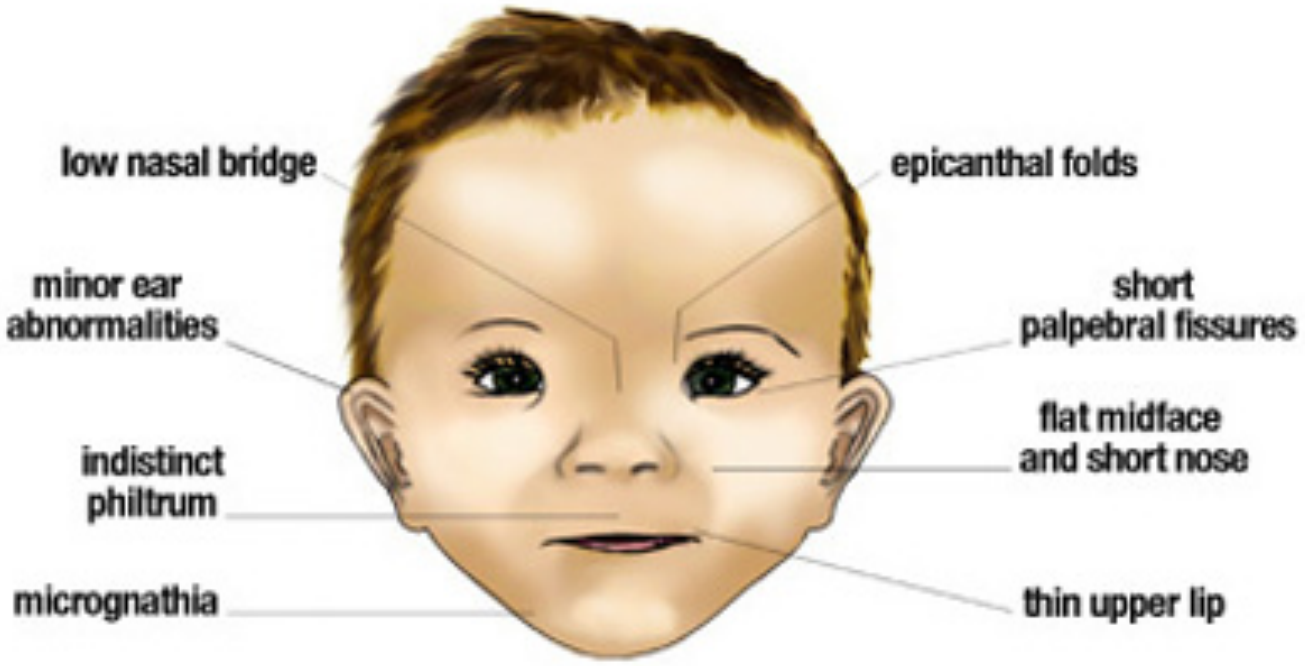
DiGeorge Syndrome





Disturbance of cervical neural crest migration:
3rd and 4th pouch do not form:
absence of thymus and parathyroid glands

Craniofacial Abnormalities
Fetal Alcohol Syndrome



Alcohol consumption in early development
Causes facial and neurological abnormalities

Lecture overview
Head and Face Development

Embryonic tissues contributing to cranial development

Craniofacial Development

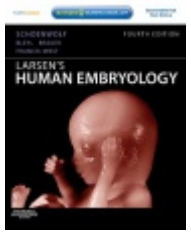
Branchial/Pharyngeal Arch Derivatives:

- Skeleton
- Arteries
- Muscles
- Cranial Nerves
- Clefts/pouches

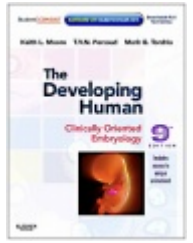
Development of the Pituitary

Development of the Tongue

Craniofacial abnormalities



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



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