

# **Growth and Development**

## ***Introduction:***

Growth can be defined as an increase in size while development is the increase in complexity.

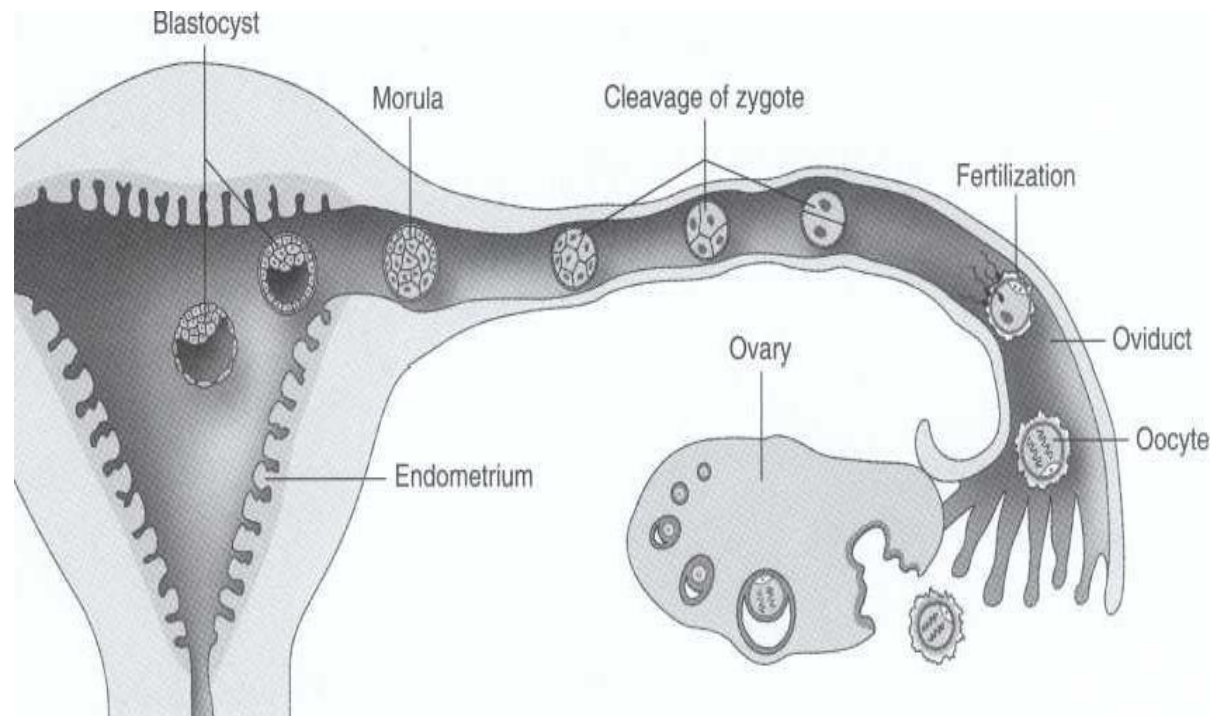
The knowledge about growth and development is very important for orthodontist since during this period any disturbances may give rise to certain congenital malformations, malocclusion and facial deformities ...etc. although the etiology of malocclusion is mainly based on genetic factors.

This category can be divided into two periods: prenatal and postnatal.

## *The prenatal (neonatal) period:*

It can be divided into three periods:

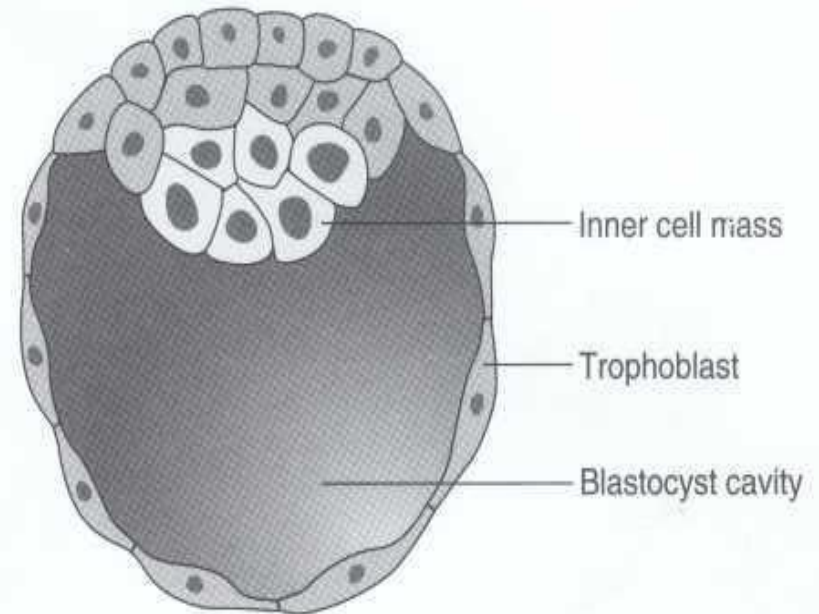
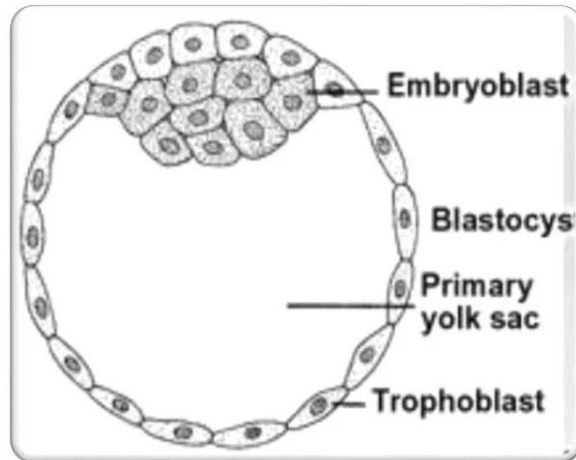
1. **period of ovum:** from the time of fertilization to the end of 2<sup>nd</sup> week: in this period human development begins when a sperm fertilize the oocyte resulting in the formation of a zygote. Fertilization occurs in the ampulla of the uterine tube ( oviduct ). The zygote undergo a series of mitotic divisions as it moves along the uterine tube toward the uterus. The cells resulting from this division are called blastomers they adhere to one another and form a ball of cells called a morula, which enters the uterus about three days after fertilization.



A fluid-filled space called the blastocyte cavity develops, within the morula, and the entire structure is called the blastocyst. Six days after fertilization, two distinct cell types comprise the blastocyst

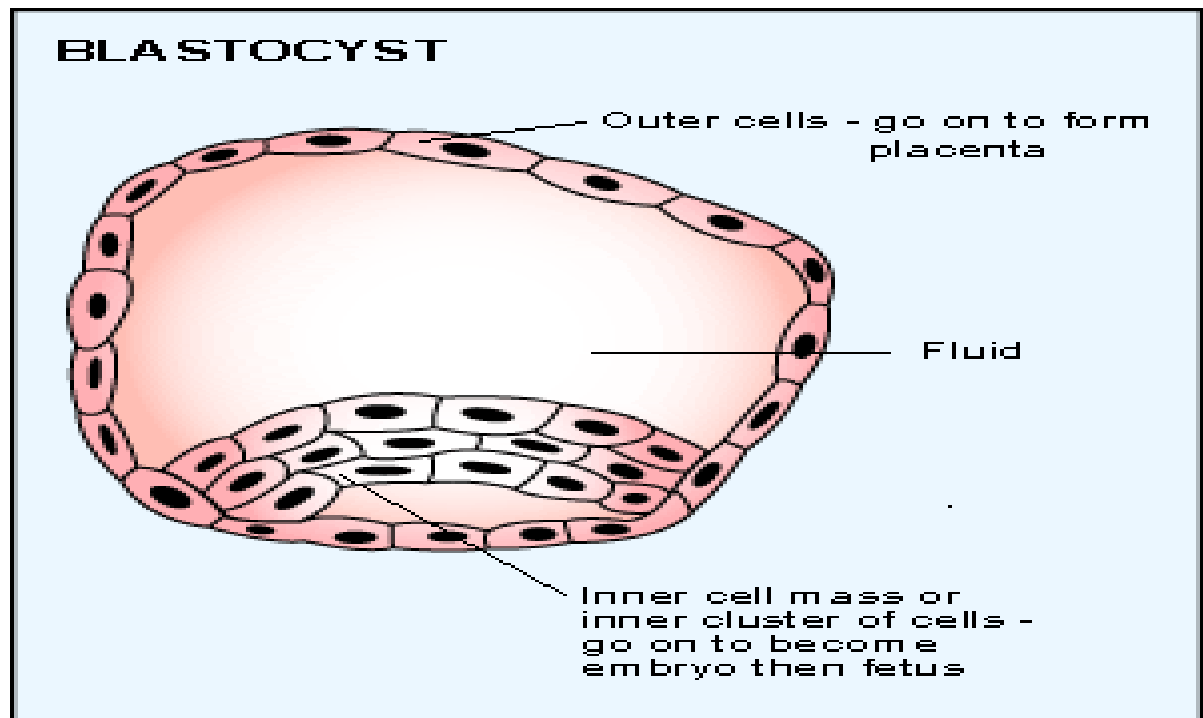
\*The trophoblast form a single layer of cells covering the outside of the blastocyst.

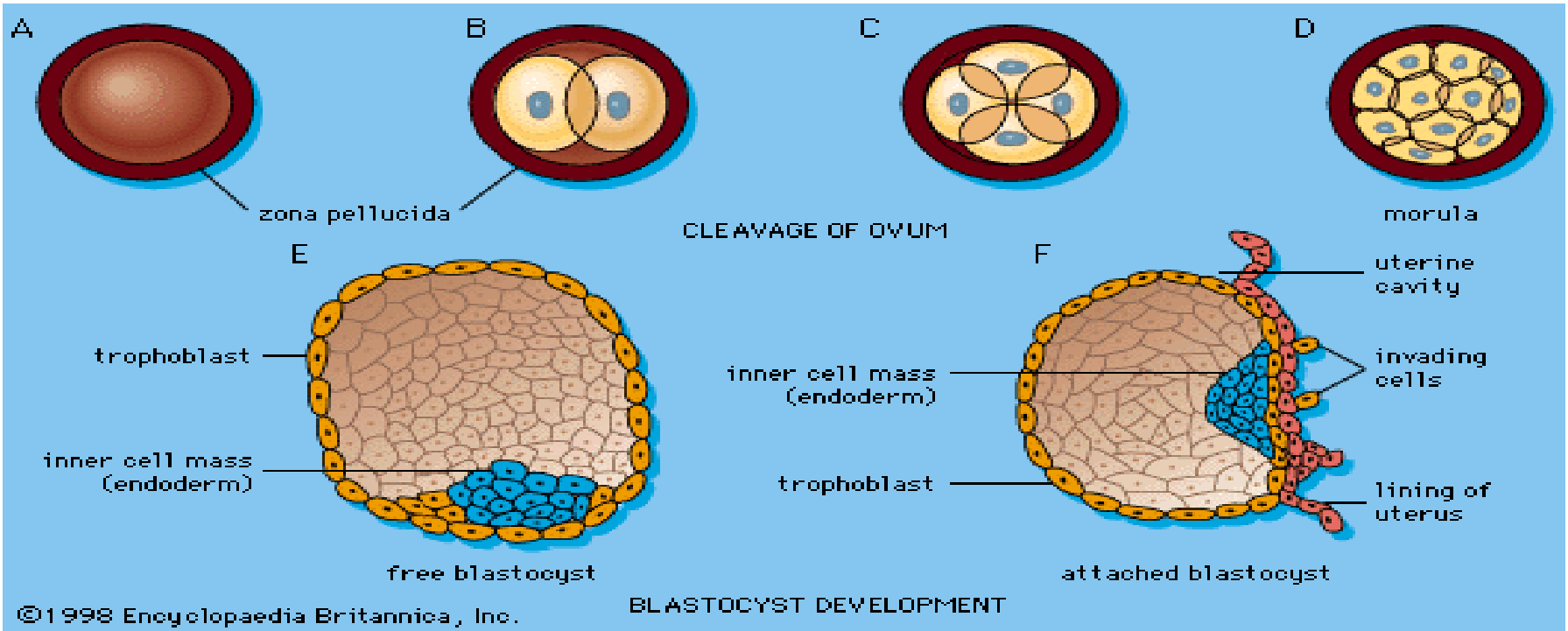
## structure



\*the inner cell mass which is a cluster of cells located inside the trophoblast

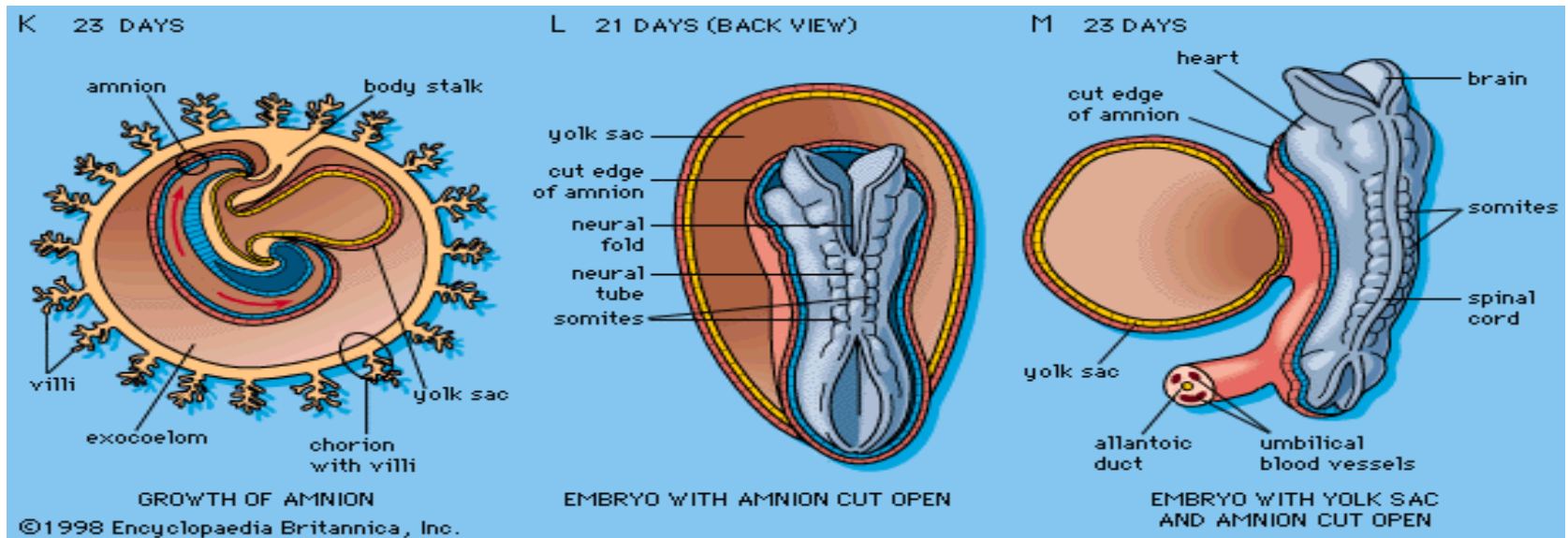
The inner cell mass develops into embryo whereas the trophoblast forms the embryonic part of the placenta and other peripheral structures associated with the embryo.





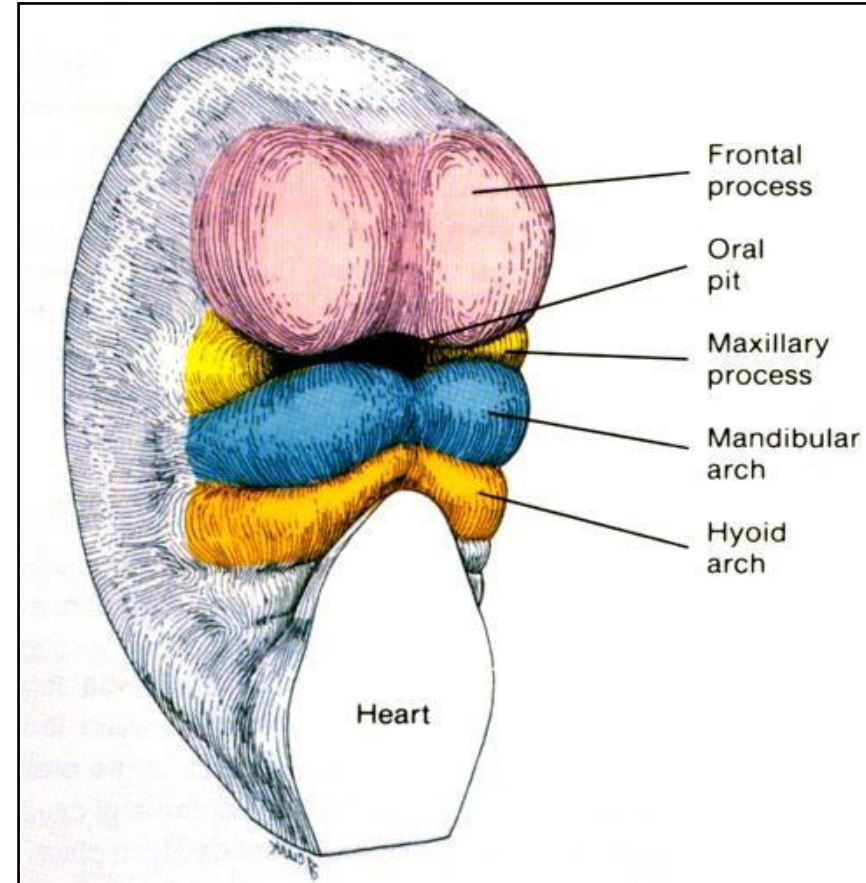
**2-period of embryo:** from the 2<sup>nd</sup> week to the 8<sup>th</sup> week : in this period most organs and organ systems are formed, it is the period of differentiation and most congenital malformations developed during this period. At the end of this period the developing individual has a recognizable human appearance.

**3- period of fetus:** from 8<sup>th</sup> week to 40 week.



Most of the cranio facial structures are formed in the first trimester of pregnancy.

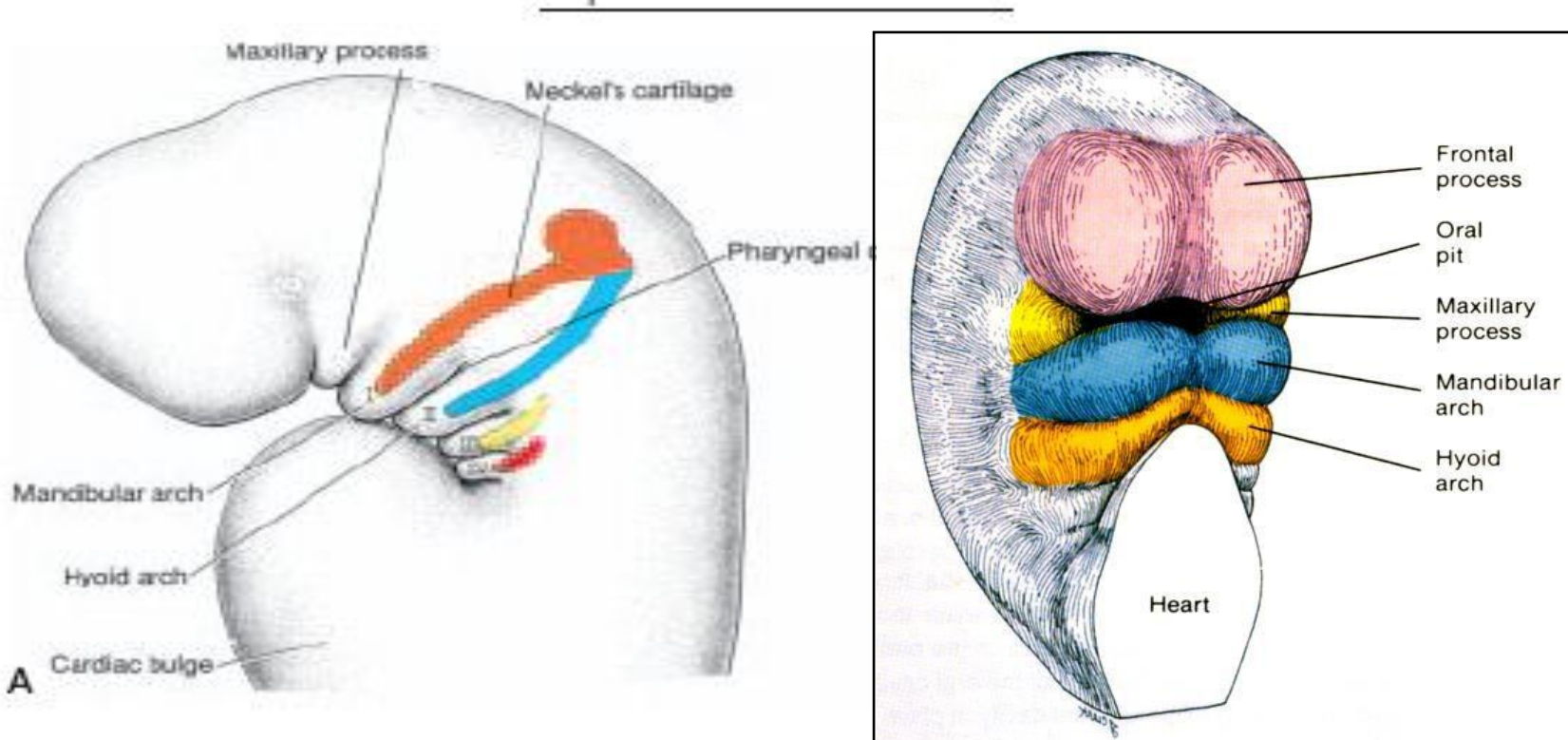
In the 3<sup>rd</sup> week the head is composed mainly of the pros-encephalon (frontal prominence) which represents the most caudal portion of the pros-encephalon, overhangs the developing oral groove.





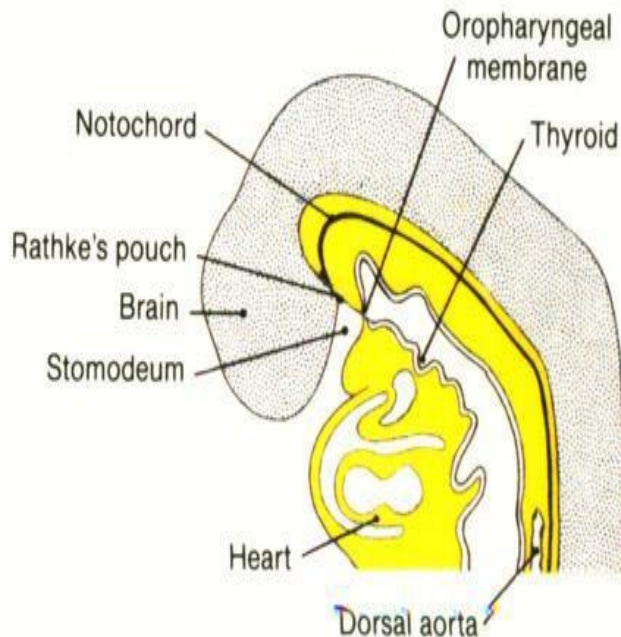
This oral groove is bounded on its lateral sides by the rudimentary maxillary processes, the mandibular arch is below the groove while the frontal process is above.

The frontal prominence, mandibular arch and the maxillary processes are called together the stomodeum.

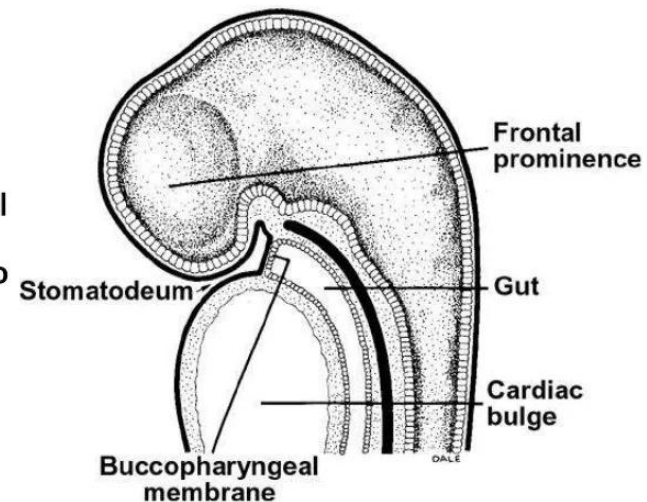


During the following few weeks the oral groove deepens and the oral plate ( bucco pharyngeal membrane ) which consists of an ectodermal floor of the stomodeum and endodermal lining of the foregut, ruptures to establish the oral opening.

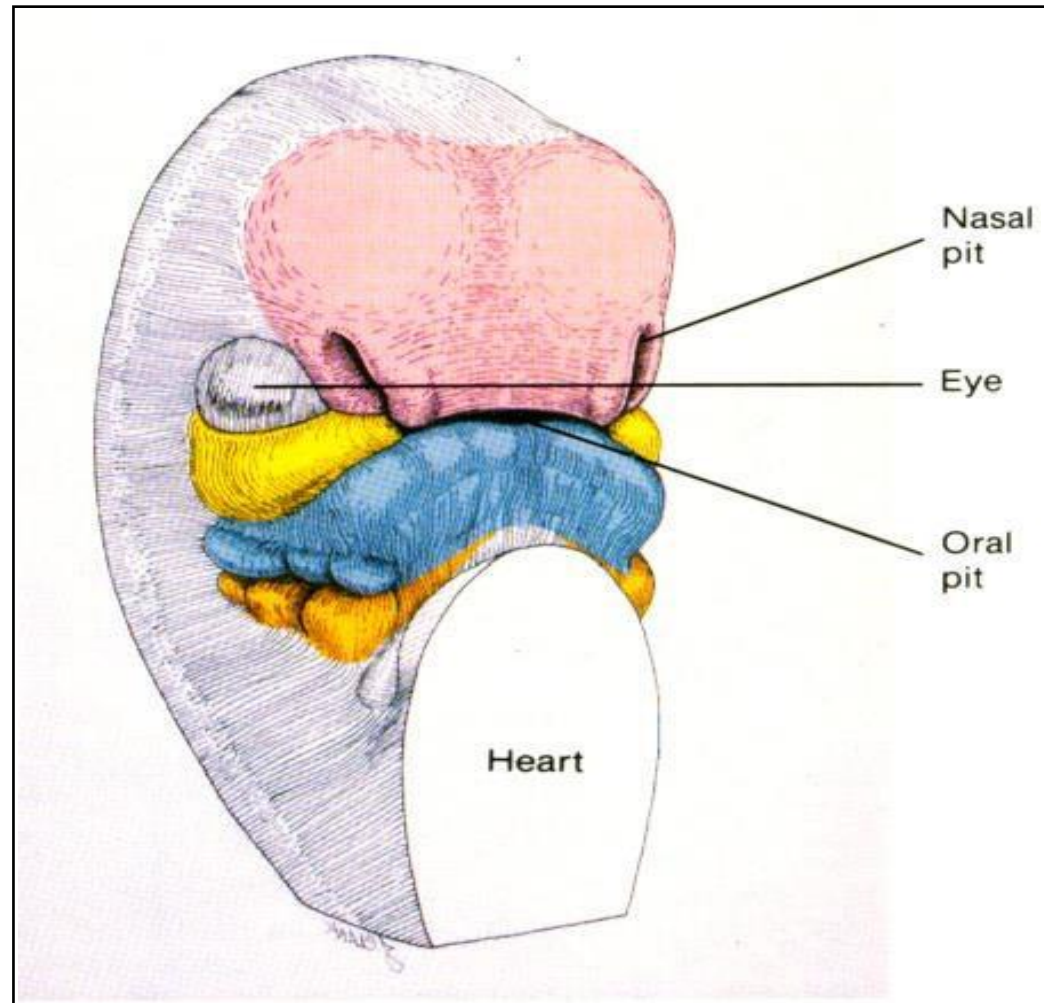
## SAGITTAL SECTION



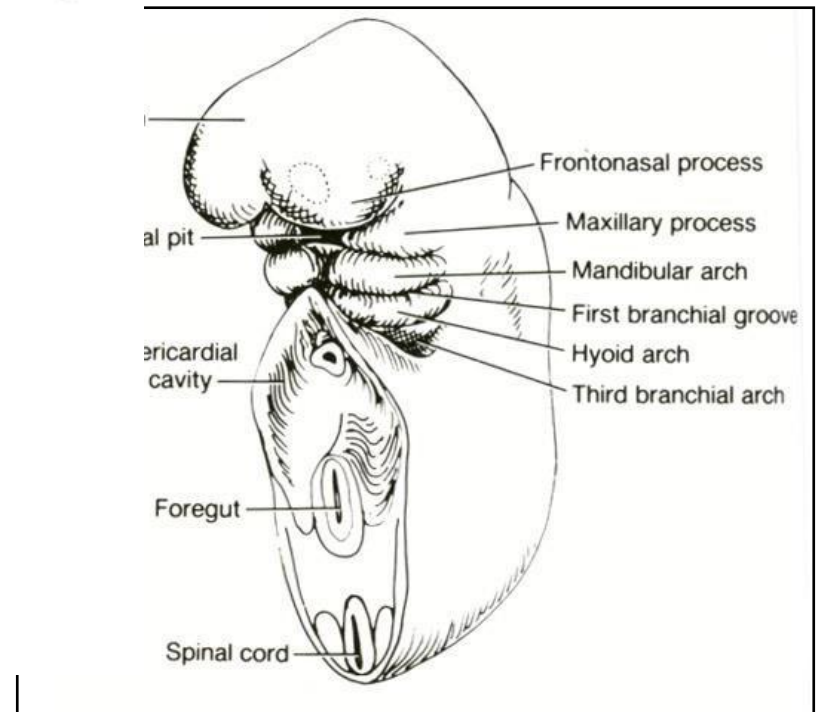
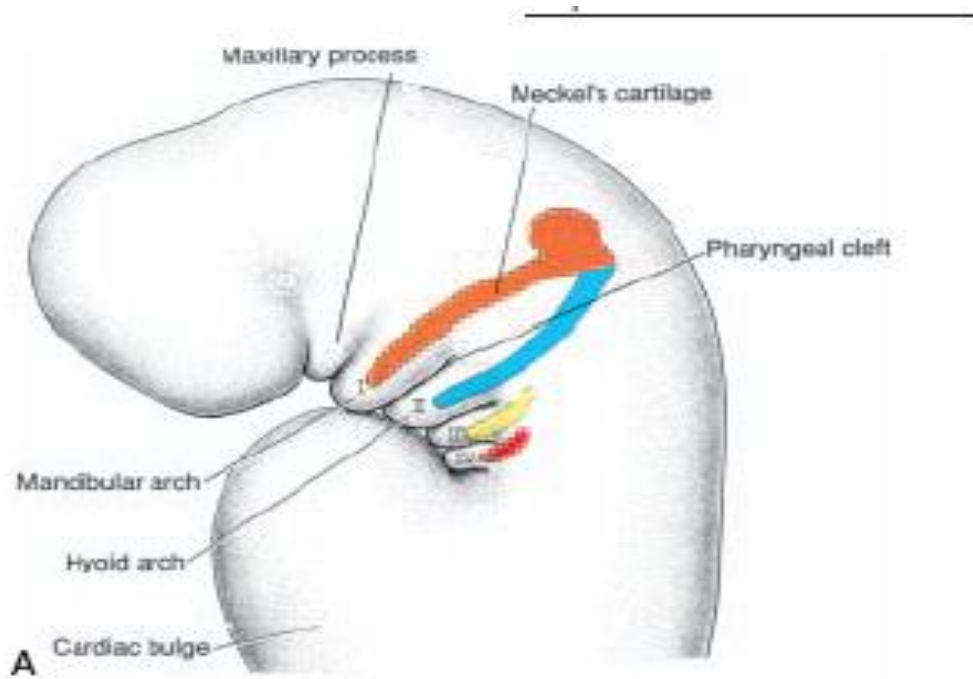
**Buccopharyngeal membrane ruptures at 24 to 26 days**



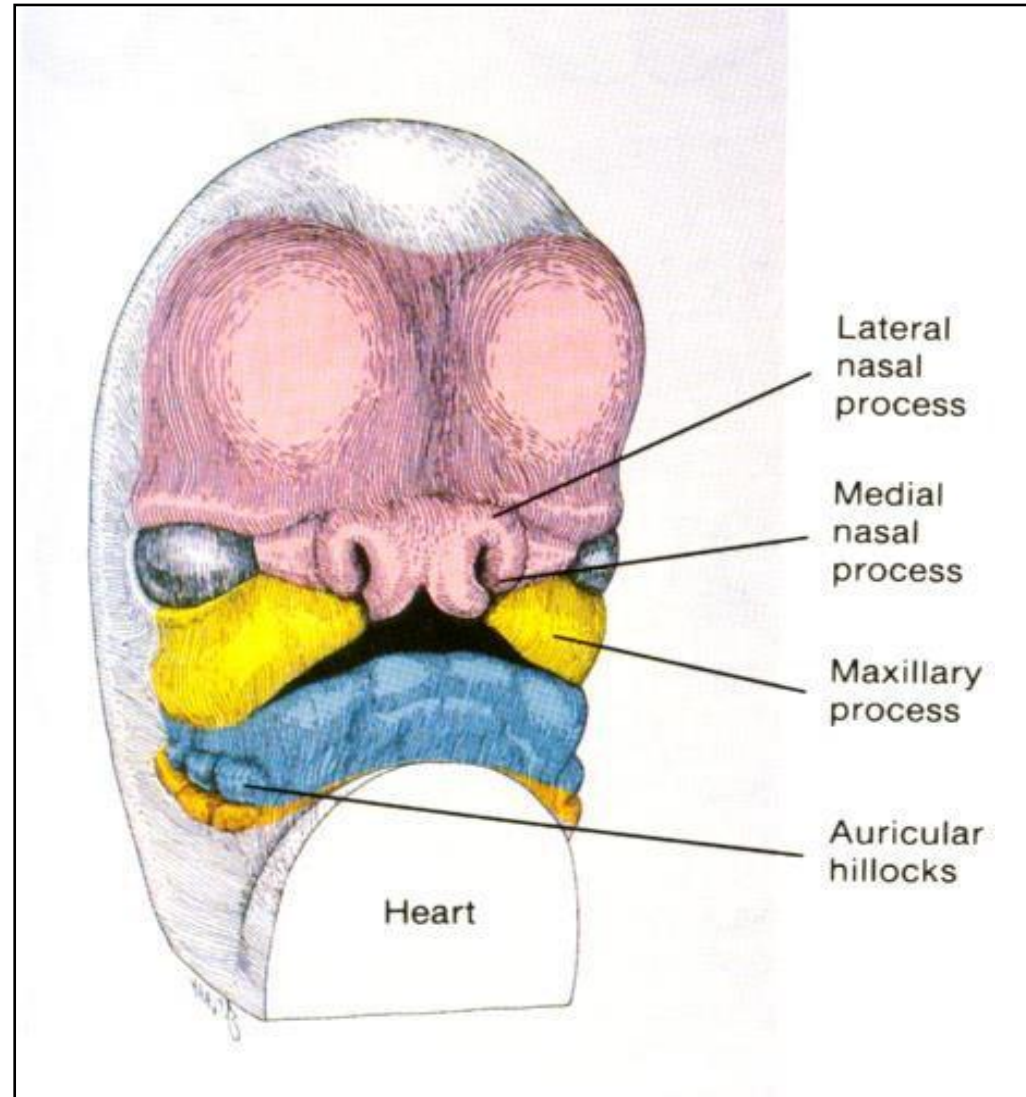
In the 4<sup>th</sup> week we can notice two ectodermal proliferations on either side of the frontal process. These later on will give rise to the nasal placodes, which develop to nasal pits and the olfactory epithelium.



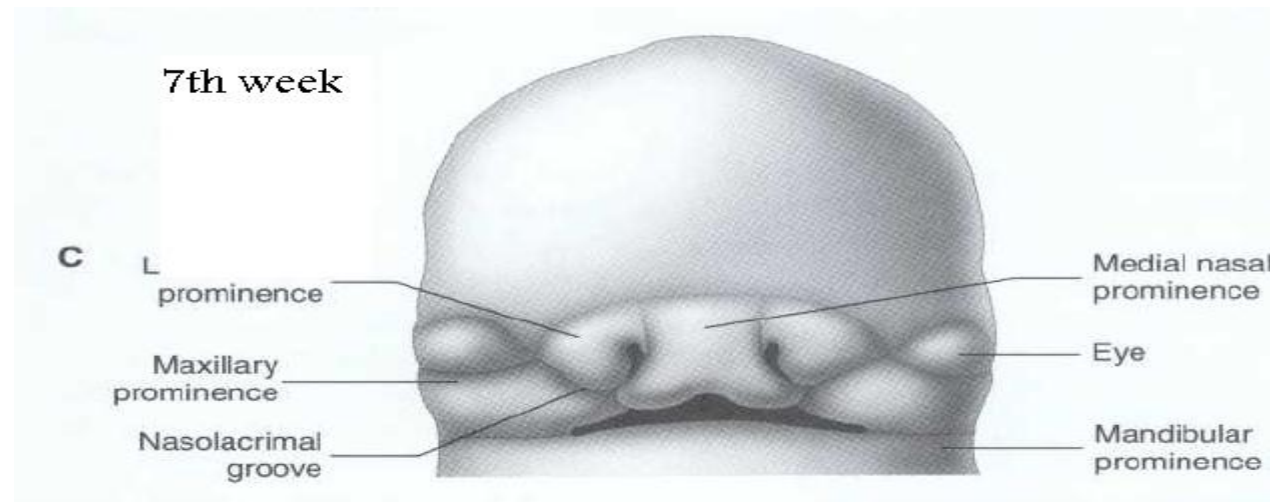
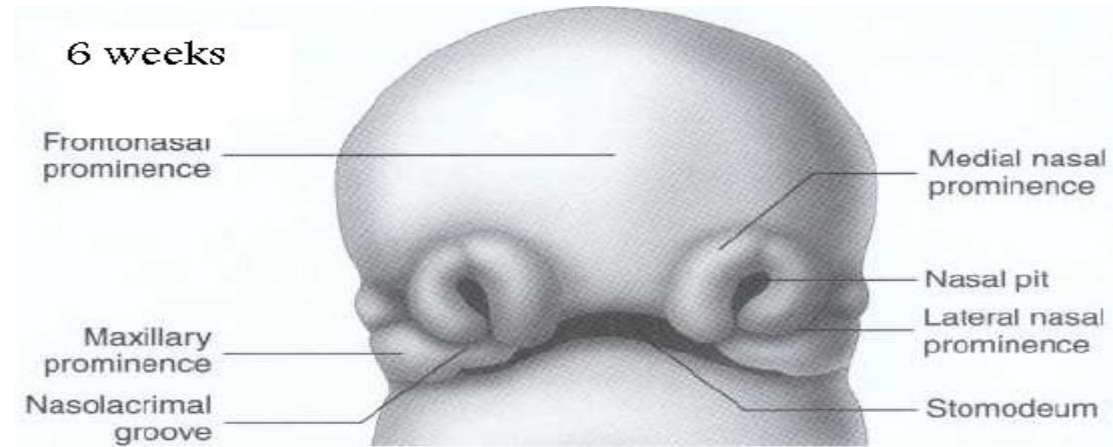
At this time we can also see the brachial arches, which are distinguished as four arches with a fifth transitory brachial arch. The first arch is called the mandibular arch while the second is called the hyoid arch.



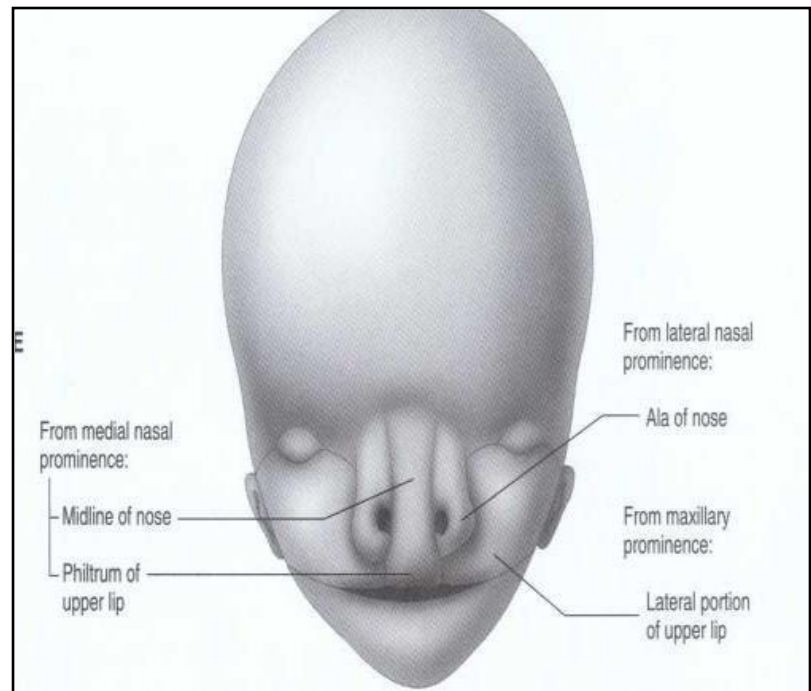
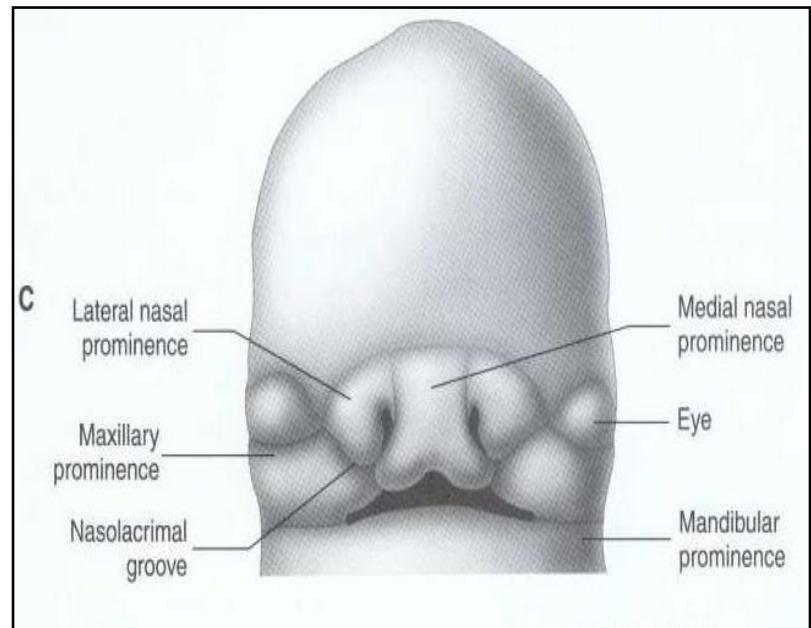
On the 5<sup>th</sup> week the nasal pits widen and the medial and lateral walls of the nasal pits start to proliferate and grows downward giving rise to the medial nasal and lateral nasal processes.



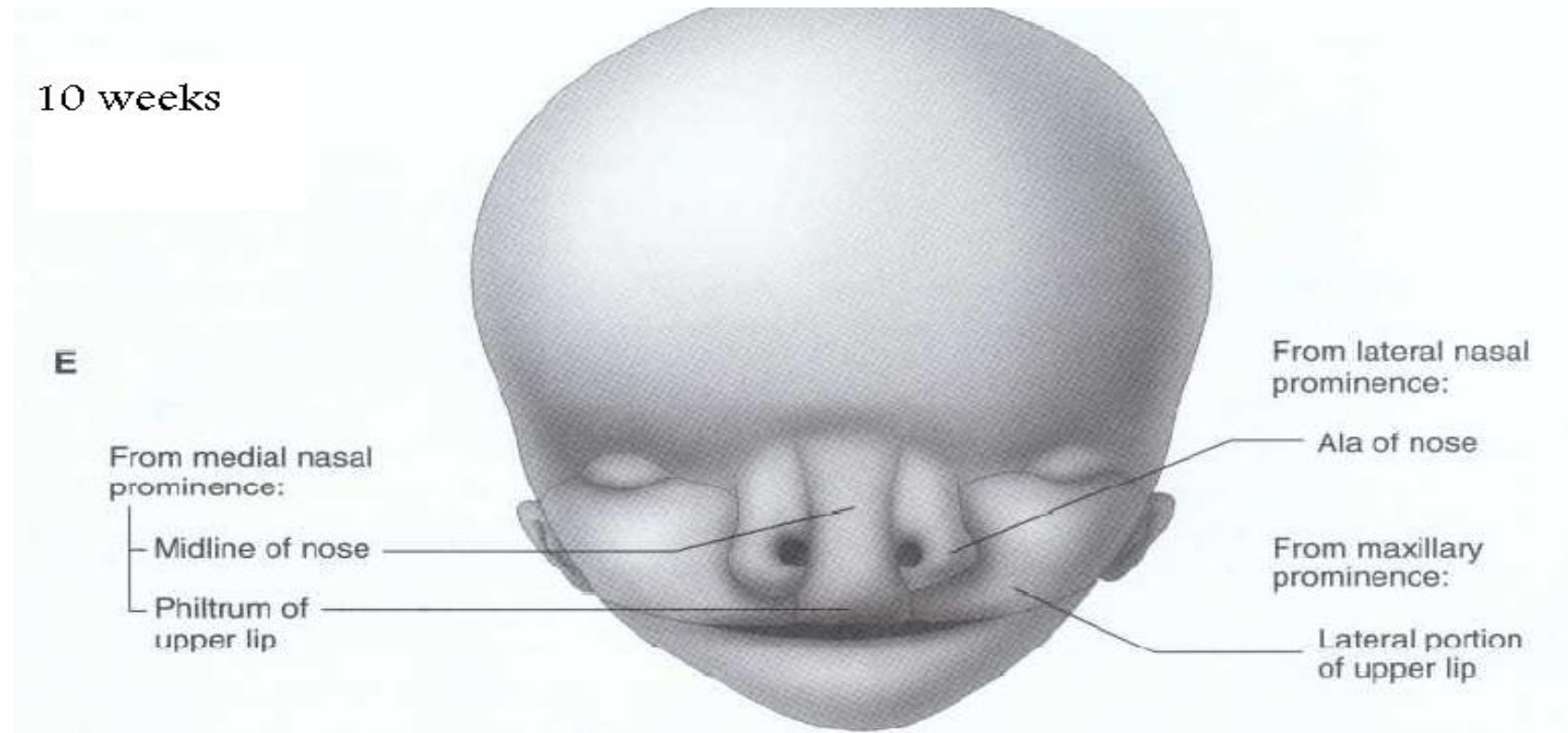
The maxillary processes on either side start to proliferate toward the medial nasal processes and the union between the medial nasal and the maxillary processes give rise to the maxilla, palate, upper lip and the lower central part of the nose.



The line of fusion of the the two medial nasal processes is represented by a depression on the upper lip called the philtrum, the fusion of the medial nasal processes and the maxillary processes completes during the 7<sup>th</sup> week. Cleft lip develops if failure of fusion of these two processes takes place. This cleft may be a unilateral or a bilateral, it is also can be a complete or an incomplete one.



By the 8<sup>th</sup> week, the facial structures are apparent, the nose is more prominent and the nasal septum elongates and become more narrowed, the eyes migrate toward the midline and the ears begin to develop, the nostrils are formed by an opening in the nasal pit area which communicates with the upper part of the oral cavity.





The nasal septum is forming from the cells of the medial nasal process and of the frontal prominence, the demarcation between the lateral nasal process and the maxillary process creates a furrow, which is converted into the naso-lacrimal duct when it closes over.

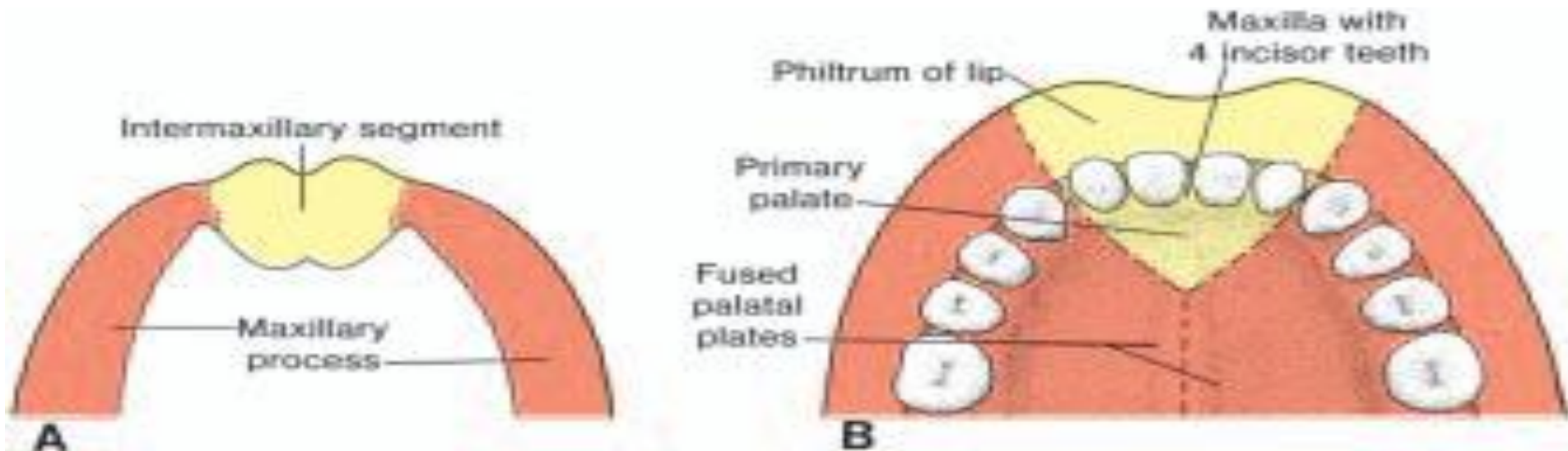
By the 12<sup>th</sup> week the eyelids and nostrils have formed and subsequent intra-uterine changes lead to little further differentiation, these intrauterine changes involve increasing in size and changes in proportions.

## Development of palate

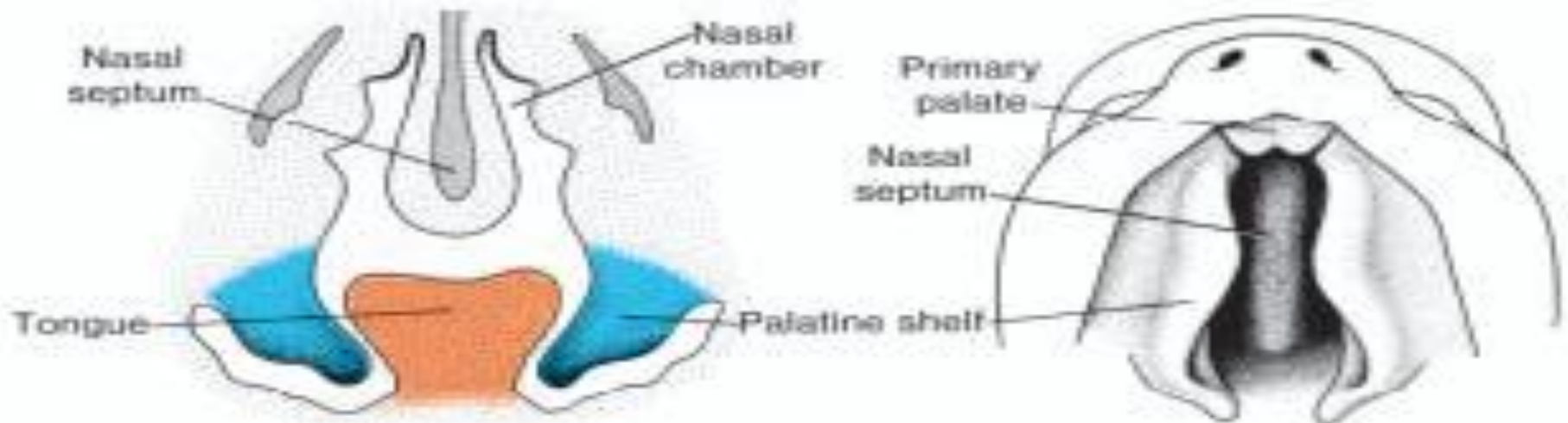
The palate begins to develop early in the 6<sup>th</sup> week, but the process is not completed until 12<sup>th</sup> week. The most critical period during palatal development is the end of the 6<sup>th</sup> week to the beginning of the 9<sup>th</sup> week.

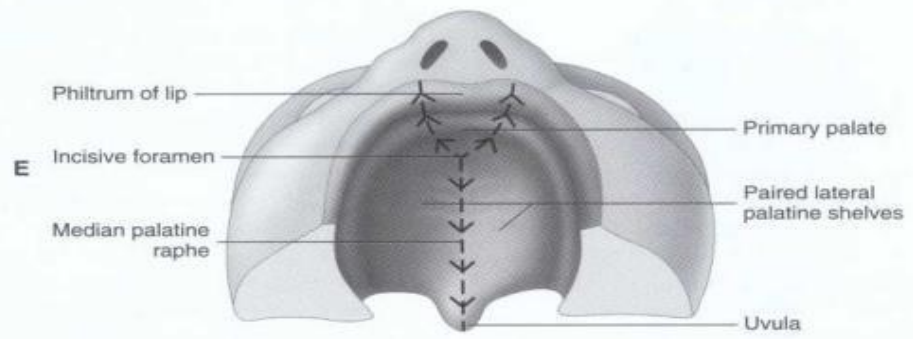
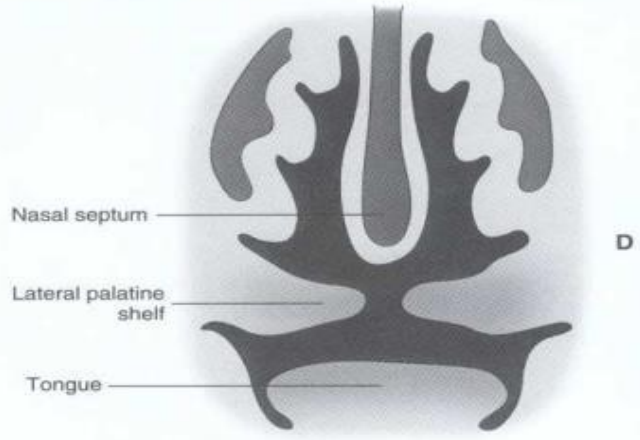
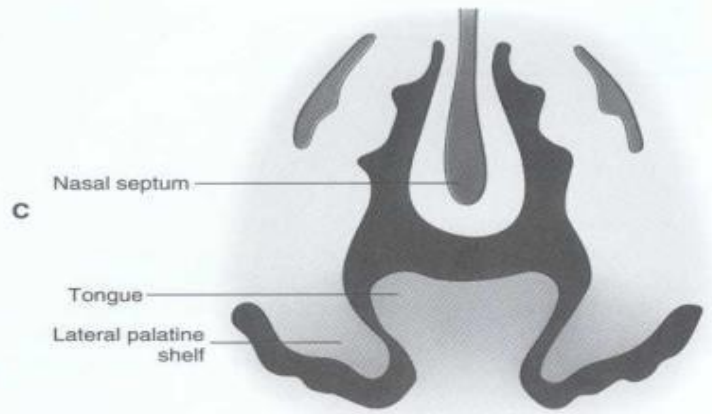
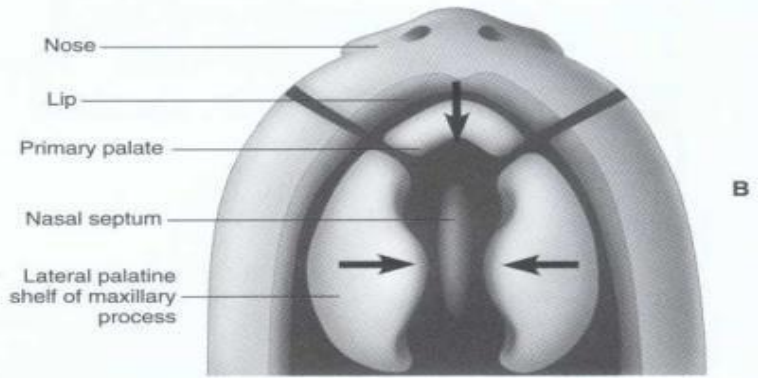
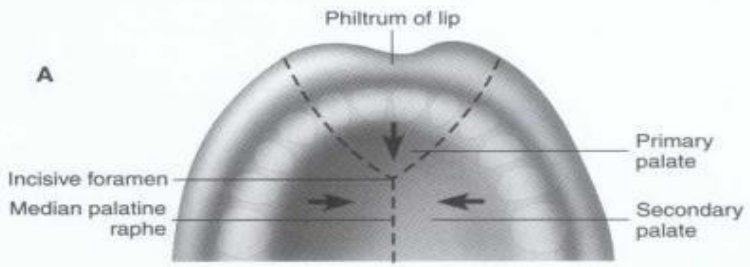
The entire palate develops from:

1. the primary palate (premaxilla): is the triangular-shaped part of the palate anterior to the incisive foramen. Its origin is the deep portion of the intermaxillary segment, which arises from the fusion of the two medial nasal prominences.



1. the secondary palate : give rises to the hard and soft palate posterior to the incisive foramen. It arises from paired lateral palatine shelves of the maxilla. These shelves are oriented in a superior-inferior plane with the tongue interposed. Later they become elongated and the tongue becomes smaller and moves inferiorly. This allows the shelves to orient horizontally, to approach one another, and to fuse in to midline. Later on these lateral palatal shelves fuse with the primary palate and nasal septum. Cleft palate results if the lateral palatal shelves failed to fuse with each other, with the nasal septum, or with the primary palate.

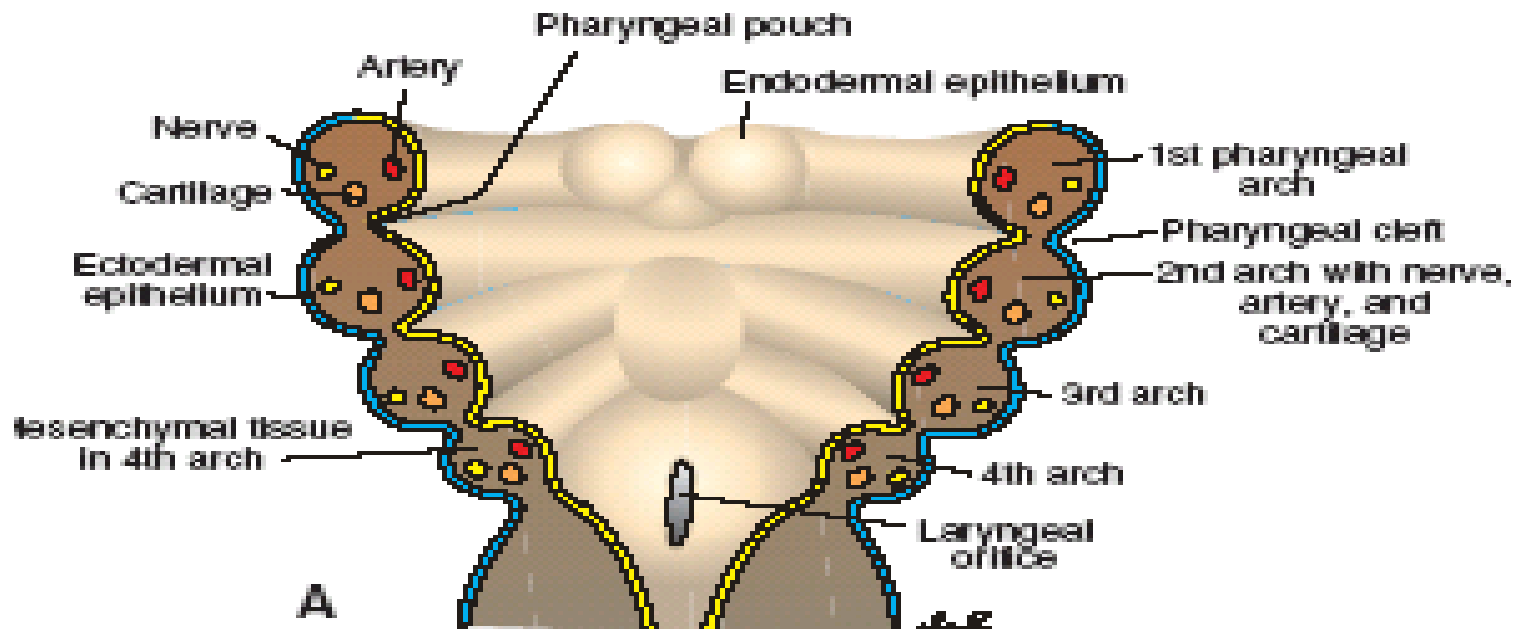




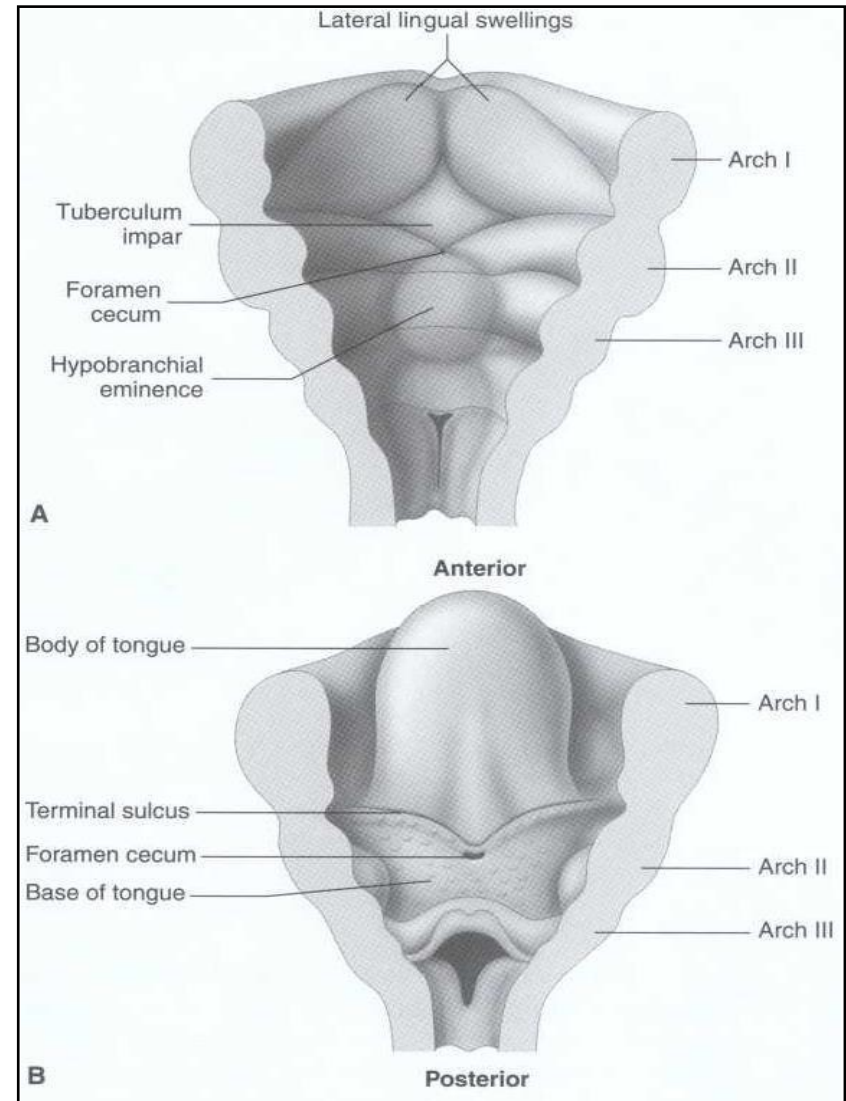
## Development of the tongue

The tongue develops from several different sources. The body of the tongue or anterior two thirds develops from the first pharyngeal arch, Whereas the base of the tongue or posterior one third develops from the third arch.

The tongue begins its development near the end of the fourth week as a midline enlargement in the floor of the primitive pharynx cranial to the foramen cecum



The enlargement is called the tuberculum impar. Two lateral lingual swellings form adjacent to the tuberculum impar. All three structures form as a result of proliferation of first arch mesenchyme. The lateral lingual swellings rapidly enlarge, fuse with one another, and overgrow the tuberculum impar. These three structures give rise to the body of the tongue.

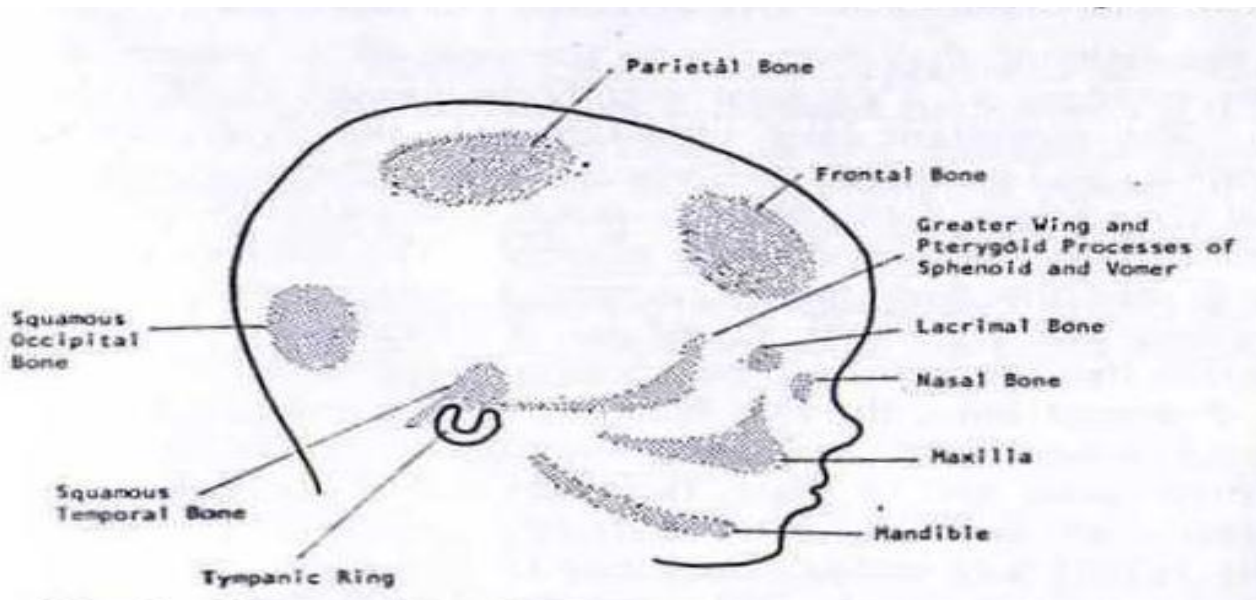


The posterior third, or base, of the tongue develops from the hypobranchial eminence, which is a midline swelling caudal to the foramen cecum. The hypobranchial eminence is composed primarily from third arch.

The *copula* is a midline enlargement derived from second arch. The hypobranchial eminence overgrows the copula and fuses with the tuberculum impar and lateral lingual swellings. The copula disappears without contributing to the formation of the tongue. Thus the base of the tongue is derived from the third pharyngeal arch. The line of the demarcation between the body and the base is called *terminal sulcus*, and the foramen cecum is found in the midline of this structure.

## Development of the skull

The skull forms from mesenchymal connective tissue around the developing brain. The development of the skull is considered in: 1<sup>st</sup> The development of the *neurocranium*, which is the calvaria and base of the skull and 2<sup>nd</sup> the development of the *viscerocranium* which includes the skeleton of the face and associated structures. Each component has some structures that form by endochondral ossification ( cartilaginous component ) and other structures that form by intramembranous ossification ( membranous component ).

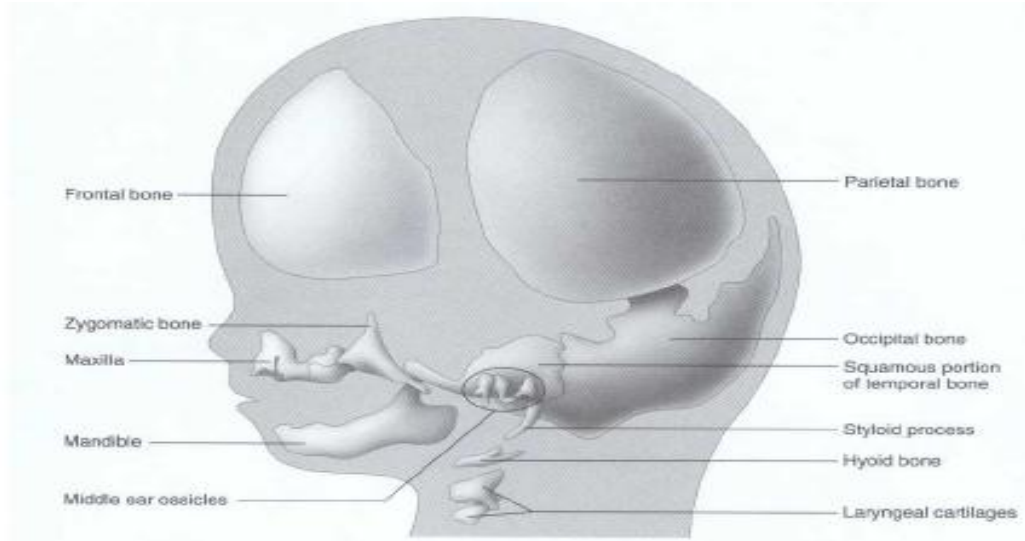




## Neurocranium (calvaria and base of the skull)

\*The cartilaginous neurocranium ( chondrocranium ) consist several cartilages that fuse and undergo endochondral ossification to give rise to the base of the skull. The cartilage junctions between two bones are called synchondroses. The occipital bone is formed first, followed by the body of the sphenoid bone and then the ethmoid bone. Also the vomer bone of the nasal septum and the petrous and mastoid parts of the temporal bone are formed by the cartilaginous neurocranium.

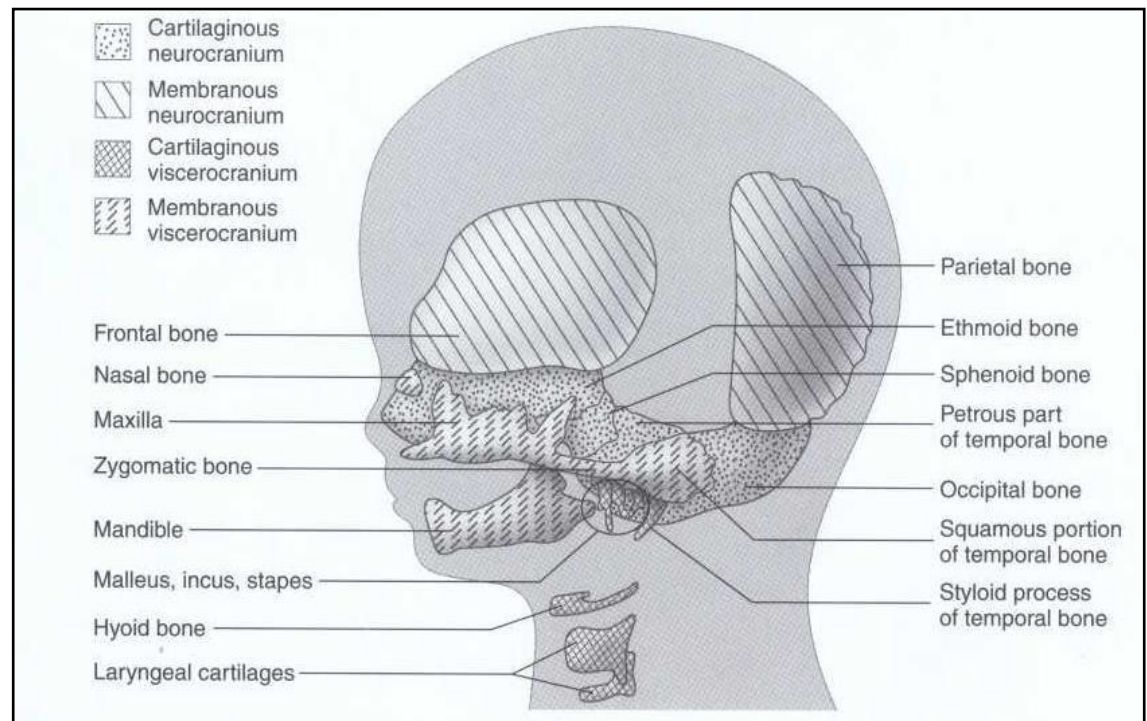
\*The membranous neurocranium, give rise to the flat bones of the calvaria, including the superior portion of the frontal, parietal, and occipital bones.



## Viscerocranium (the skeleton of the face and associated structures)

It arises from the pharyngeal arches. \*The cartilaginous viscerocranium includes the middle ear ossicles, the styloid process of the temporal bone, the hyoid bone, and the laryngeal cartilage.

\*The membranous viscerocranium includes the maxilla, zygomatic bones, the squamous temporal bones, and the mandible. These bones form by intramembranous ossification except for the mandibular condyle and the midline of the chin.



## The development of the mandible

In the mandibular brachial arch ( first brachial arch ) there is a cartilage called Meckels cartilage, which is during the 2<sup>nd</sup> month of intra- utrine life serve as a precursor of the mandibular mesenchyme, which forms around it and is responsible for mandibular growth activity. Bone begins to develop lateral to the Meckels cartilage during the 7<sup>th</sup> week and continues till the posterior aspect, which is covered with bone.

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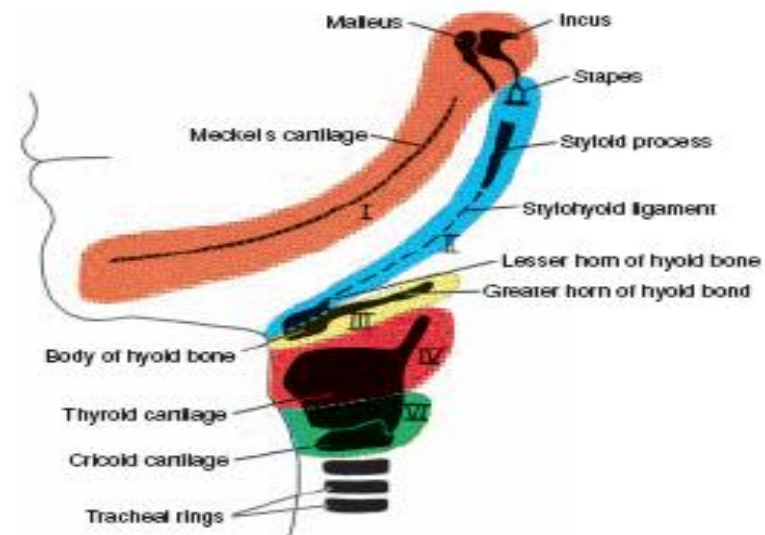


Figure 15.9 Definitive structures formed by the cartilaginous components of the various pharyngeal arches.

The part of the Meckel's cartilage that has been encapsulated, serving its purpose as a splint for the intramembranous ossification, then it will be largely deteriorates.

The activity of the condylar cartilage does not appear until the 4<sup>th</sup> or 5<sup>th</sup> month of postnatal life and continues until the age of 20 years so it has no role in the prenatal life.

