

➤ **General information to keep in mind ,We have 3 layers (germinal layers):**

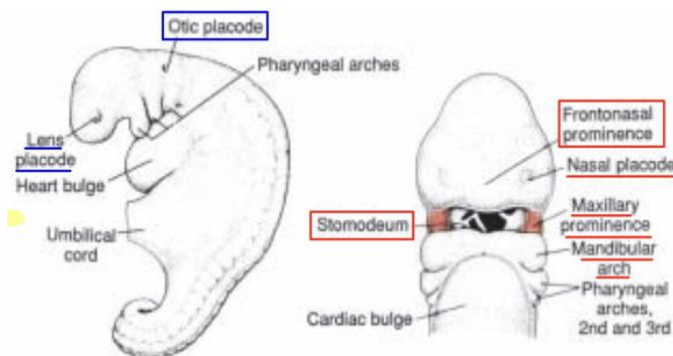
- 1- Endoderm gives lining epithelium, ex: GI,RS lining.
- 2-Mesoderm gives bone, cartilage, muscles, blood, lymph.
- 3-Ectoderm gives outer layers like skin.

## Development of the nose

- At the end of the fourth week, facial prominences consisting primarily of neural crest-derived mesenchyme and formed mainly by the first pair of pharyngeal arches appear
- The frontonasal prominence, (Will give a septum) formed by proliferation of mesenchyme ventral to the brain vesicles, constitutes the upper border of the stomodeum.

• **Notes on the picture:**

- Prominence = placode=site where the genesis starts.
- Otic placode : beginning of the ear.
- Lens placode : beginning of the eye.
- Stomodeum : related to oral cavity (extra info: depression in the ectoderm develops oral cavity)
- Prominence:eminence
- Frontonasal prominence: from frontal bone descending to the nasal cavity, to form the septum of the nose).
- Nasal placode makes nostrils.
- Maxillary prominence (upper jaw) , grow toward the midline, participates in forming the upper lip.
- Mandibular arch (lower jaw).
- stomodeum:first part of the oral cavity.
- During the fifth week, the nasal placodes invaginate to form nasal pits (nostril) , then Invagination of cells gives vestibule.
- The prominences on the outer edge of the pits are the lateral nasal prominences; those on the inner edge are the medial nasal prominences



- During the following 2 weeks(7<sup>th</sup> week),the maxillary prominences continue to increase in size medially
- Simultaneously,they grow medially,compressing the medial nasal prominences toward midline.

❖ Medial nasal prominence gives:

- 1-tip of the nose. 2-septum.
- 3- medial part of upper lip (philtrum).

❖Lateral nasal placode gives lateral wall of the nose (blue in the picture

❖ Philtrum: vertical depression of the upper lip.

❖ Maxillary prominence gives lateral part of upper lip

Note:

- 1-If fusion fails to occur between medial nasal prominence, and maxillary prominence, cleft will be formed.
- 2-Normally two maxillary prominences fused with medial nasal prominence **lateral** to the midline (bilateral fusion)

### Development of the nose

- The nose is formed from five facial prominences
- the frontonasal prominence gives rise to the bridge; and nasal septum
- the merged medial nasal prominences provide the crest and tip;
- the lateral nasal prominences form the sides (alae)
- Olfactory pit forms the nostril and then becomes deeper to form a blind sac( the vestibule),[so Olfactory pit—>invagination of mucosa —> vestibule ].

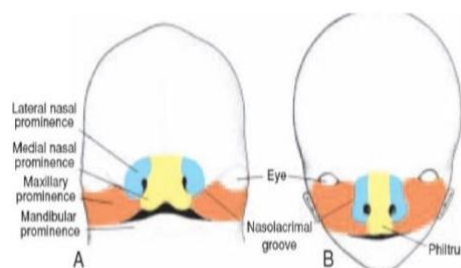
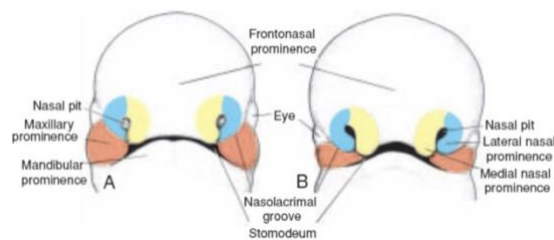


TABLE 15.2 Structures Contributing to Formation of the Face

Prominence	Structures Formed
Frontonasal <sup>a</sup>	Forehead, bridge of nose, medial and lateral nasal prominences
Maxillary	Cheeks, lateral portion of upper lip
Medial nasal	Philtrum of upper lip, crest and tip of nose
Lateral nasal	Alae of nose
Mandibular	Lower lip

<sup>a</sup> The frontonasal prominence is a single unpaired structure; the other prominences are paired.

...Mandibular prominence doesn't contribute nose formation.

## Nasal Cavities

1. During the sixth week, the nasal pits deepen considerably, partly because of growth of the surrounding nasal prominences and partly because of their penetration into the underlying mesenchyme, [ nasal pit deepens the mucosa → cavity ]. forming the vestibule

Note: the oronasal membrane is in the position of the hard palate which separates the oral cavity from the nasal cavity.

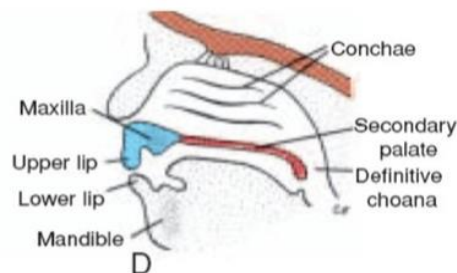
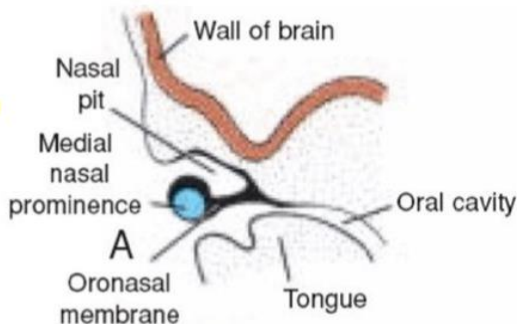
2. At first the oronasal membrane (floor of the nose) separates the pits from the primitive oral cavity by way of the newly formed foramina, the primitive choanae above the primary palate.

• Firstly, oronasal membrane ruptures, when formation of the septum (1<sup>st</sup> palate) begins, which will separate both cavities.

❖ the definitive choanae (related to 2<sup>nd</sup> palate) will lie at the junction of the nasal cavity and the pharynx (nasopharynx).

**Remember** : conchae, which is an extension of bones in the lateral wall of the nose where the superior and middle are from ethmoid bone, and inferior are from maxilla.

...meatuses: openings of air sinuses beneath the conchae.



## Paranasal air sinuses

• Paranasal air sinuses develop as diverticula of the lateral nasal wall and extend into the maxilla, ethmoid, frontal, and sphenoid bones.

Each sinus has a duct opening in the lateral wall of the nose.

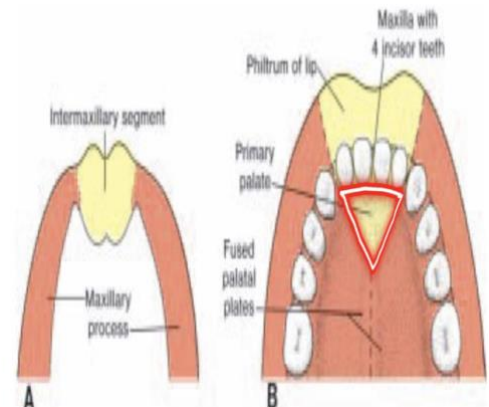
In the development, the proliferation begins from the opening of the lateral wall of the nasal cavity. Invagination in mesenchymal cells → canal formation → forming a cavity at the end of the canal (in cranial bones) lined by thin layer of epithelium and contains air → sinus formation.

Sinus is very small in size at the beginning, but with the development of the face at puberty, Paranasal sinuses reach their maximum size.

## Primary palate

- The structure formed by the two merged prominences is the intermaxillary segment
- Maxillary prominences grow towards the midline.
- It is composed of:

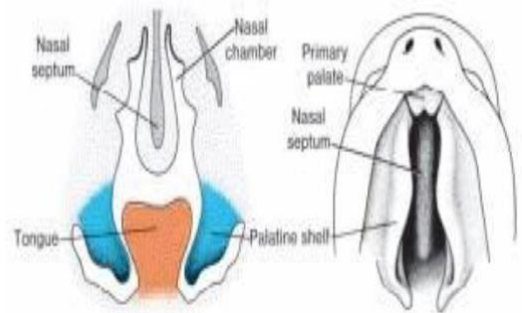
- (a) a labial component, coming from the nasal part, completed by the intermaxillary segment, which forms the philtrum of the upper lip.
- (b) an upper jaw component, which carries the four incisor teeth;
- (c) a palatal component, which forms the triangular primary palate, 1ry palate from Intermaxillary segments form maxillary prominence [the part labelled by laser in the picture].



- The intermaxillary segment is continuous with the rostral portion of the nasal septum, which is formed by the frontal prominence to make two cavities.

## Secondary Palate

- The main part of the definitive palate is formed by two shelflike outgrowths from the maxillary prominences.
- These outgrowths, the palatine shelves, appear in the sixth week of development and are directed obliquely downward on each side of the tongue
- The Palatine shelves, which are outgrowths from the two sides of the maxillary prominence, grow medially and directed above the tongue to form the hard palate (secondary palate).
- Secondary shelves meet in the midline.
- secondary palate is formed above the tongue.
- There is a fusion between primary and secondary palates in midline.



Incisive foramen will be formed between 1ry & 2ry palates :

- forming connection between oral cavity and nasal cavity
- formed due to fusion between primary and secondary palate
- Septum of the nose is descending downwards ( which meets and fuses with the secondary palate at the midline).
- In the seventh week, however, the palatine shelves ascend to attain a horizontal position above the tongue and fuse, forming the secondary palate

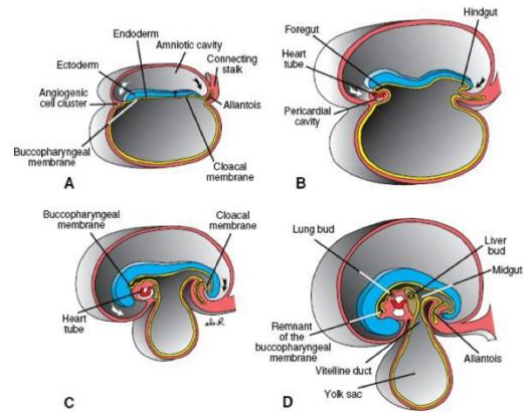
**Note:** If 1ry & 2ry palate fusion fails → cleft ( unilateral or bilateral).

- 2 folds grow posteriorly from the edge of the palatine process to form the soft palate and the uvula.
- The union of the 2 folds of the soft palate occurs during the 8th week
- The 2 parts of the uvula fuse in the midline during the 11th week (failure of this fusion would result in a cleft formed between uvula, uvula appears as it is divided into 2 parts Like W)
- Unilateral cleft lip can extend to the nose, ( a cleft lip might be unilateral or bilateral / complete or incomplete).

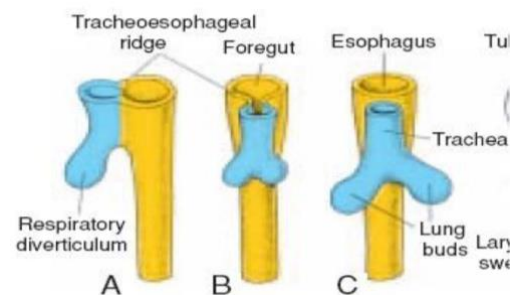
## Primitive gut

• Development of the primitive gut and its derivatives is in four sections:

- (a) The pharyngeal gut, or pharynx, extends from the buccopharyngeal membrane to the tracheobronchial diverticulum
- (b) The foregut lies caudal to the pharyngeal tube and extends as far caudally as the liver outgrowth (Mid duodenum).
- (c) The midgut begins caudal to the liver bud and extends to the junction of the right two-thirds and left third of the transverse colon in the adult.
- (d) The hindgut extends from the left third of the transverse colon to the cloacal membrane, ending at Upper half of the anal canal.



➤ When the embryo is approximately 4 weeks old, the respiratory diverticulum (lung bud) appears as an outgrowth from the ventral surface of the foregut. Proliferation of cells makes the lung bud, which represents the beginning of trachea formation.



➤ When the diverticulum expands caudally, two longitudinal ridges, the tracheoesophageal ridges (between trachea & esophagus), separate it from the foregut

➤ Subsequently, when these ridges fuse to form the tracheoesophageal septum, the foregut is divided into a dorsal portion, the esophagus, and a ventral portion, the trachea and lung buds.

➤ The respiratory primordium maintains its communication with the pharynx through the laryngeal orifice

- The epithelium of the internal lining of the larynx, trachea, and bronchi, as well as that of the lungs, is entirely of endodermal origin.
  - The cartilaginous, muscular, and connective tissue components of the trachea and lungs are derived from splanchnic mesoderm surrounding the foregut.
- ✓ The inlet of the larynx connects between the GI and RS.



## Esophagus

- At first the esophagus is short
- but with descent of the heart and lungs it lengthens rapidly
- The muscular coat, which is formed by surrounding splanchnic mesenchyme, is striated in its upper two-thirds and innervated by the vagus the muscle coat is smooth in the lower third and is innervated by the splanchnic plexus
- Upper third—> striated /Middle third—> mixed /Lower third—> smooth

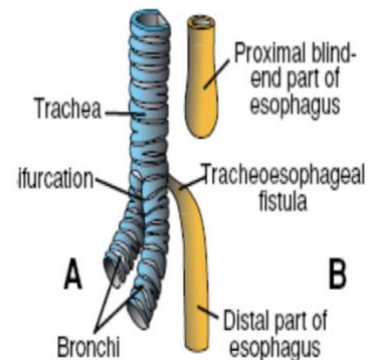
## Anomalies of the trachea and esophagus

### 1-Tracheoesophageal fistula (TEF)

✓proximal atresia(blind-end)and distal fistula is most common case representing 90% of cases.

✓double atresia

✓H shaped fistula



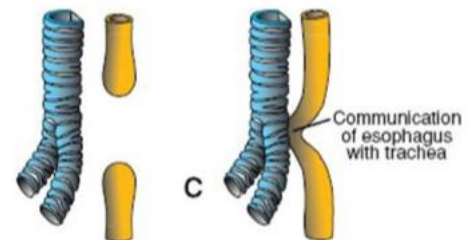
➤Baby with Tracheoesophageal fistula will have :

-Vomiting while breastfeeding, because the blind end, the Esophagus is blocked, food can't reach the stomach.

-abdominal distension, while crying, air can reach the stomach by the distal part of the Esophagus which is connected to the trachea.

-pneumonia, gastric contents travel to trachea to lungs, through the distal part of the Esophagus which is connected to the trachea.

-polyhydramnios ( extra amniotic fluid before birth) , [oligohydramnios is the opposite word] , normally amniotic fluid travels to the oral cavity to GI tract and leaves with urine, but fistula impedes this pathway.



➤Complications with tracheoesophageal fistula:

- These abnormalities are associated with other birth defects, including cardiac abnormalities [Fallot's tetralogy & atrial, ventricular septal defect] , which occur in 33% of these cases.
- In this regard TEFs are a component of the **VACTERL** association (**V**ertebral anomalies, **A**nal atresia, **C**ardiac defects, **T**racheoesophageal fistula, **E**sophageal atresia, **R**enal anomalies, and **L**imb defects)

### 2-Tracheal atresia and stenosis (Rare)

- In some case a web tissue may obstructs the airflow (incomplete tracheal atresia)
- Are uncommon anomalies and usually associated with one of the varieties of TEF.

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