



Respiratory system

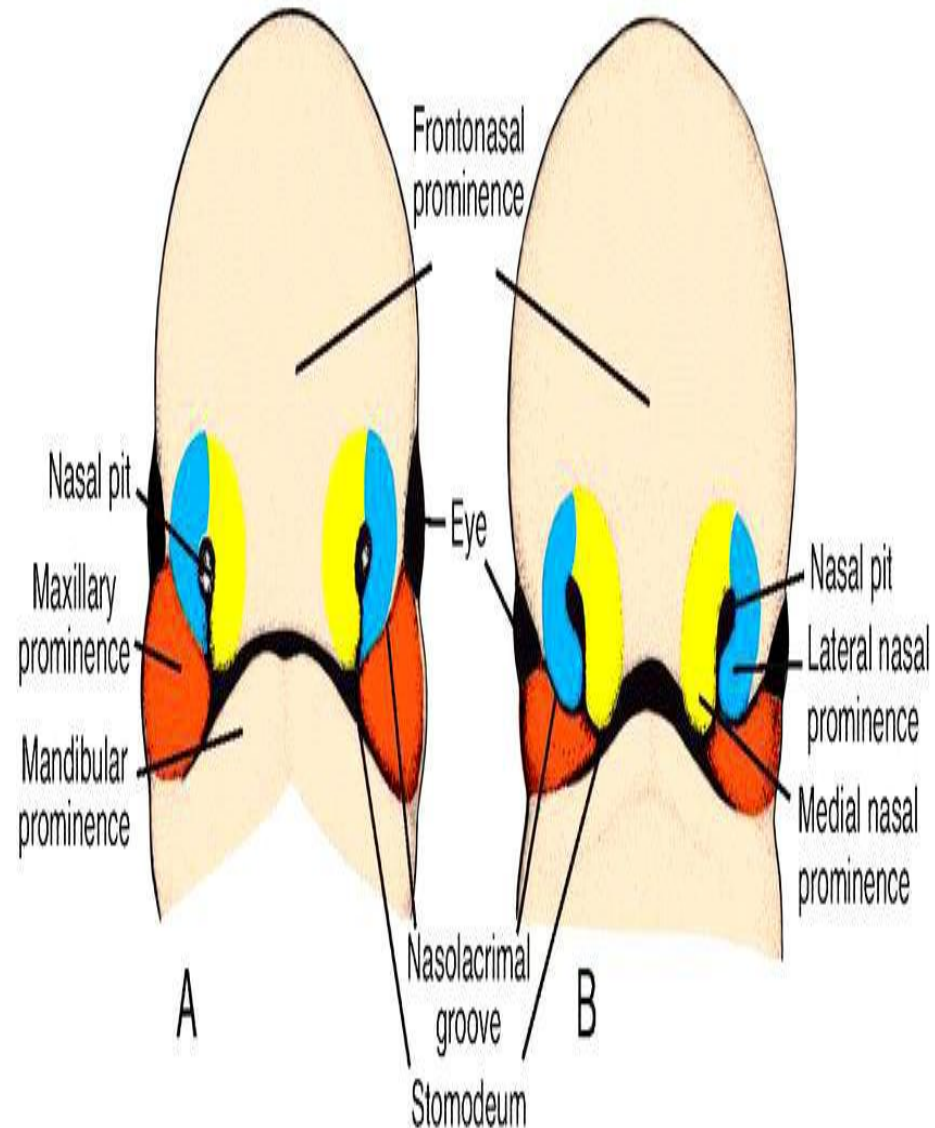
Development of respiratory system

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Development of the nose

- During the **5th week**, two **ectodermal thickenings** called **nasal placodes** appear on each side of the **frontonasal prominence**.
- - Each placode becomes depressed at its center to form **nasal pit**. The margins of the placodes proliferate to form the **medial and lateral nasal prominences**.

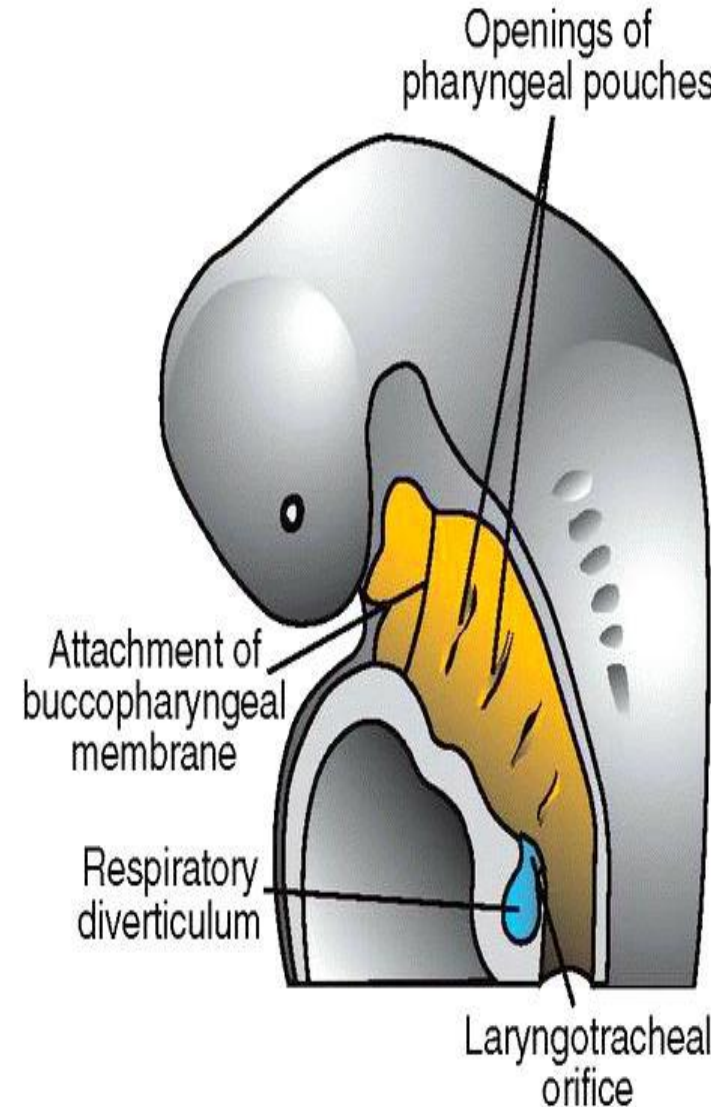


- **Deepening of the nasal pits (by growth of the nasal folds and penetration into the underlying mesenchyme). forming 2 primitive nasal cavities which are separated from each other by a *nasal septum*.**

- **3 conchae** develop as elevations on the lateral wall of the nasal cavity
- The *paranasal sinuses* develop as diverticula from the lateral wall of the nose. At birth, they are either very small or absent; their enlargement continues through *childhood* and contributes to the shape of the face.
- 1. **The maxillary and ethmoid sinuses** are present **at birth** , but are small; the development of the maxillary is not completed until the eruption of all adult teeth; while the ethmoid is developed by about 8 years.
- 2. **The frontal and sphenoid sinuses** develop postnatally; the **frontal** during the **7th year** & the **sphenoidal** around the **2nd year**.

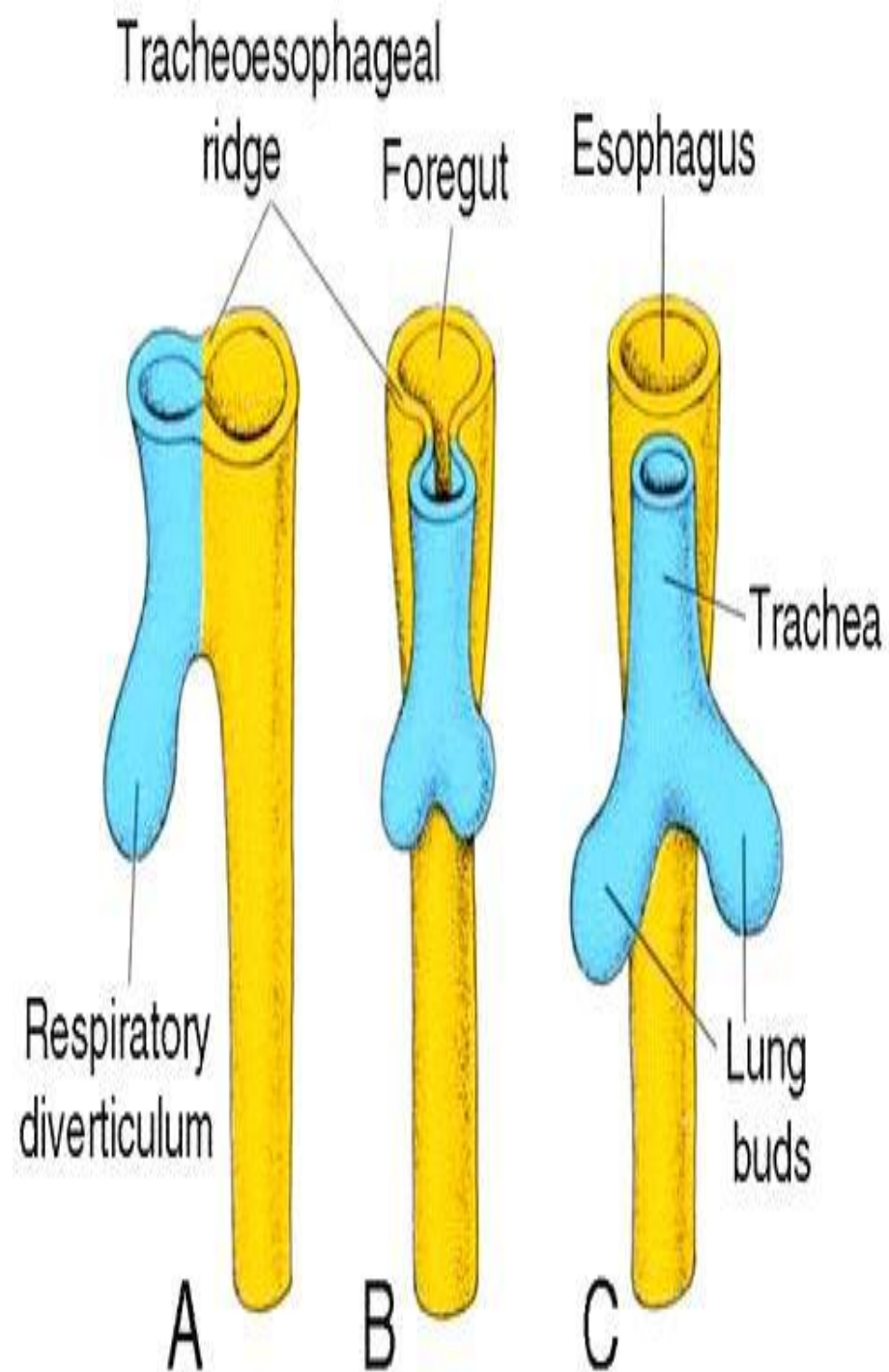
DEVELOPMENT OF THE RESPIRATORY SYSTEM

- **Time:** Middle of the 4th week.
- **Development:**
- **The laryngo-tracheal groove** appears as a median longitudinal groove in the floor of the primitive pharynx
- * The 2 margins of the laryngo-tracheal groove (called the *tracheo-oesophageal* folds or ridges) fuse together in a caudo-cranial direction forming the **tracheo-oesophageal septum** which separates the lumen of the primitive pharynx
- into 2 parts:
 - a. *Dorsal part* the pharynx & oesophagus.
 - b. *Ventral part* called *laryngo-tracheal tube*.



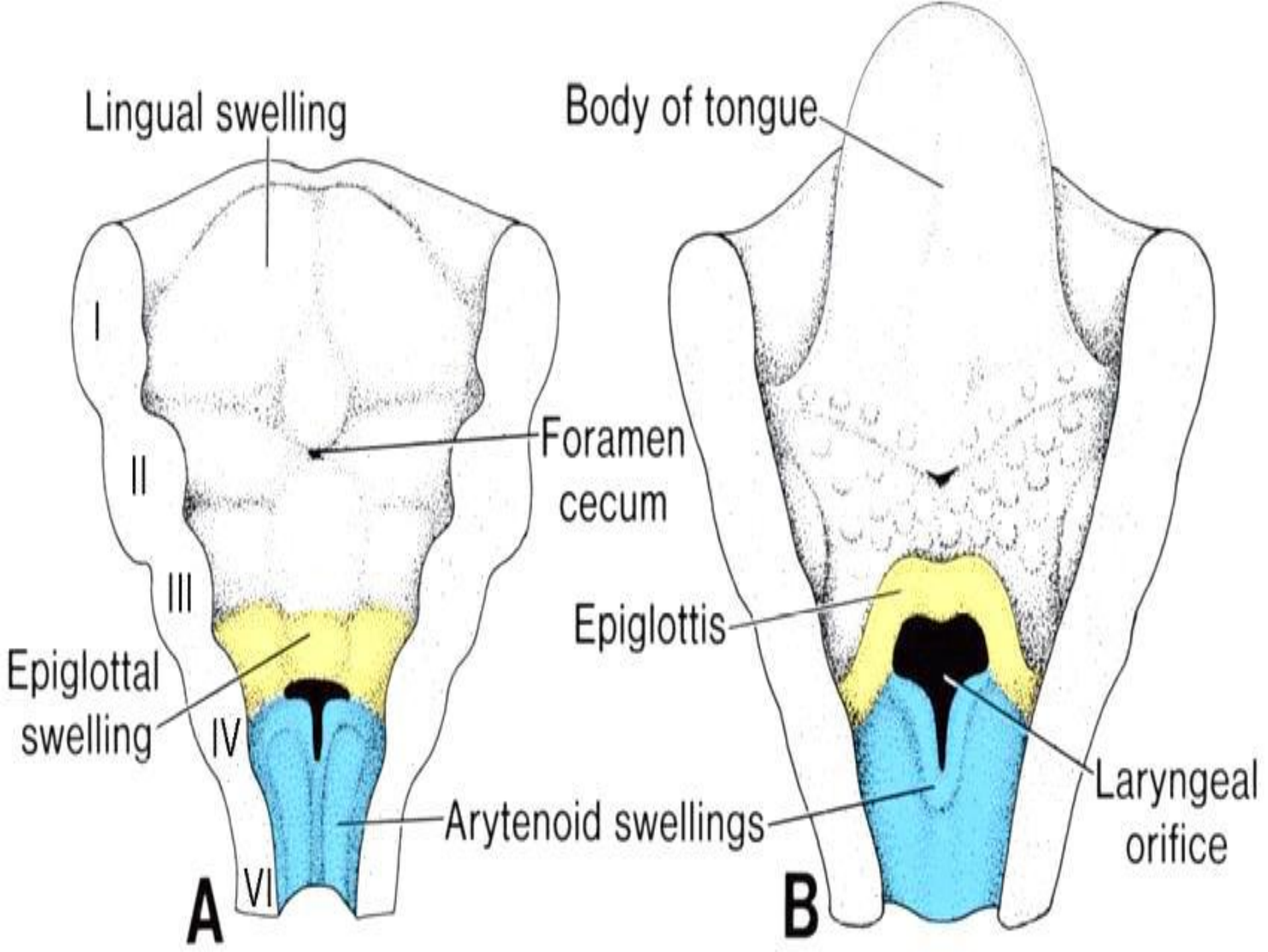
- The laryngo-tracheal tube gives the lining epithelium of the larynx, trachea, bronchial tree and alveoli.

- The surrounding splanchnic mesoderm gives the cartilages, smooth muscles, connective tissue and blood vessels of the respiratory system.



- **Fusion of the laryngo-tracheal folds stops cranially leaving a communication between the laryngo-tracheal tube and the pharynx. This opening is called the *laryngeal inlet*.**
- **The *inlet* is a vertical slit which ends cranially opposite a median elevation in the floor of the pharynx, called the *copula* (epiglottis).**
- **Later, the inlet becomes T-shaped and is obliterated transiently between the 8th and 10th weeks.**

- The laryngeal epithelium is derived from the endoderm of the cranial part of the laryngo-tracheal tube. During recanalization of the larynx, folds appear the *vocal cords* (true & false).
- The caudal end of the laryngo-tracheal tube grows down into the splanchnic mesoderm on the ventral aspect of the foregut, where it divides into *right and left lung buds*.

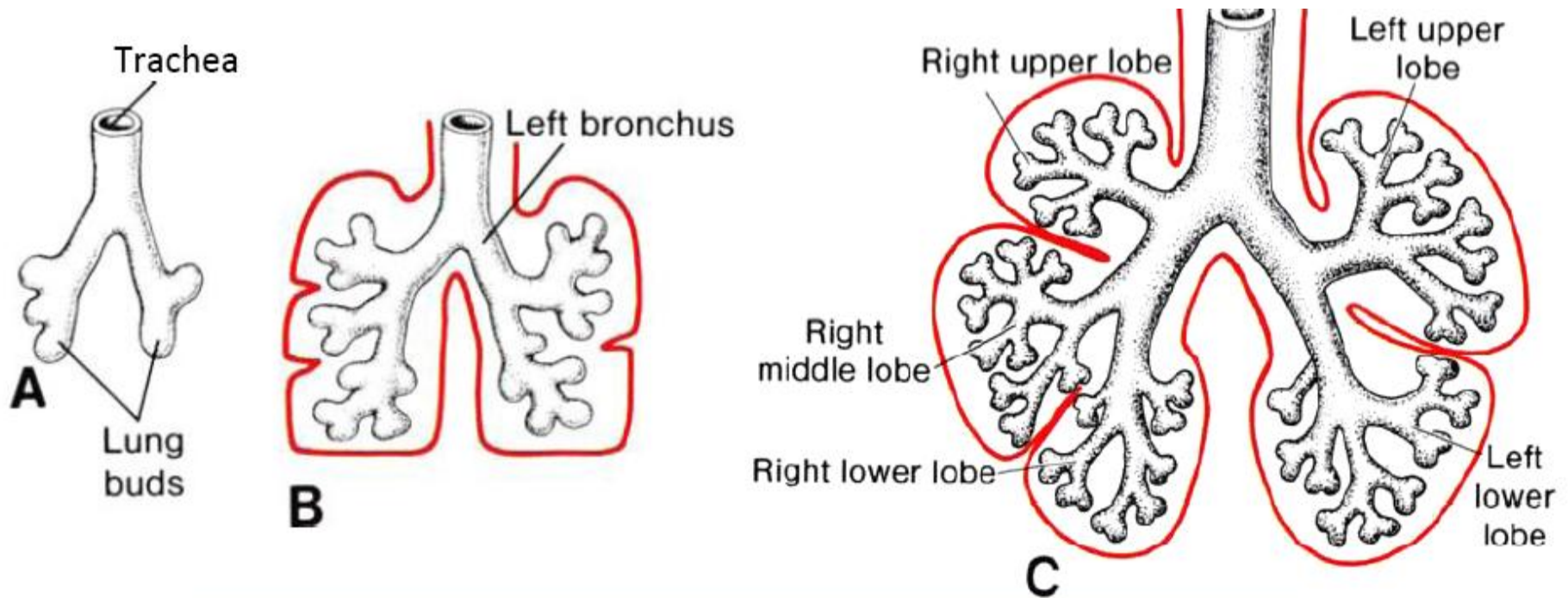


The lung buds undergo the following

A- Division:

- Each lung bud forms a *main bronchus*. The right bud is wider and more vertical than the left. Each main bronchus divides into *secondary* (lobar) bronchi (3 on the right side & 2 on the left side).
- The 2 ry. bronchi divide giving *tertiary* (segmental) bronchi, each becomes surrounded by a mass of splanchnic mesoderm a *broncho-pulmonary segment*.
- Repeated division by the 6th Month to 17 orders of branches ending in *terminal bronchioles*.
- Further division continues for sometime after birth (up to 8 years) till the *respiratory bronchioles* and *alveoli* are formed after 7 additional orders of divisions (i.e., total of 24 orders).

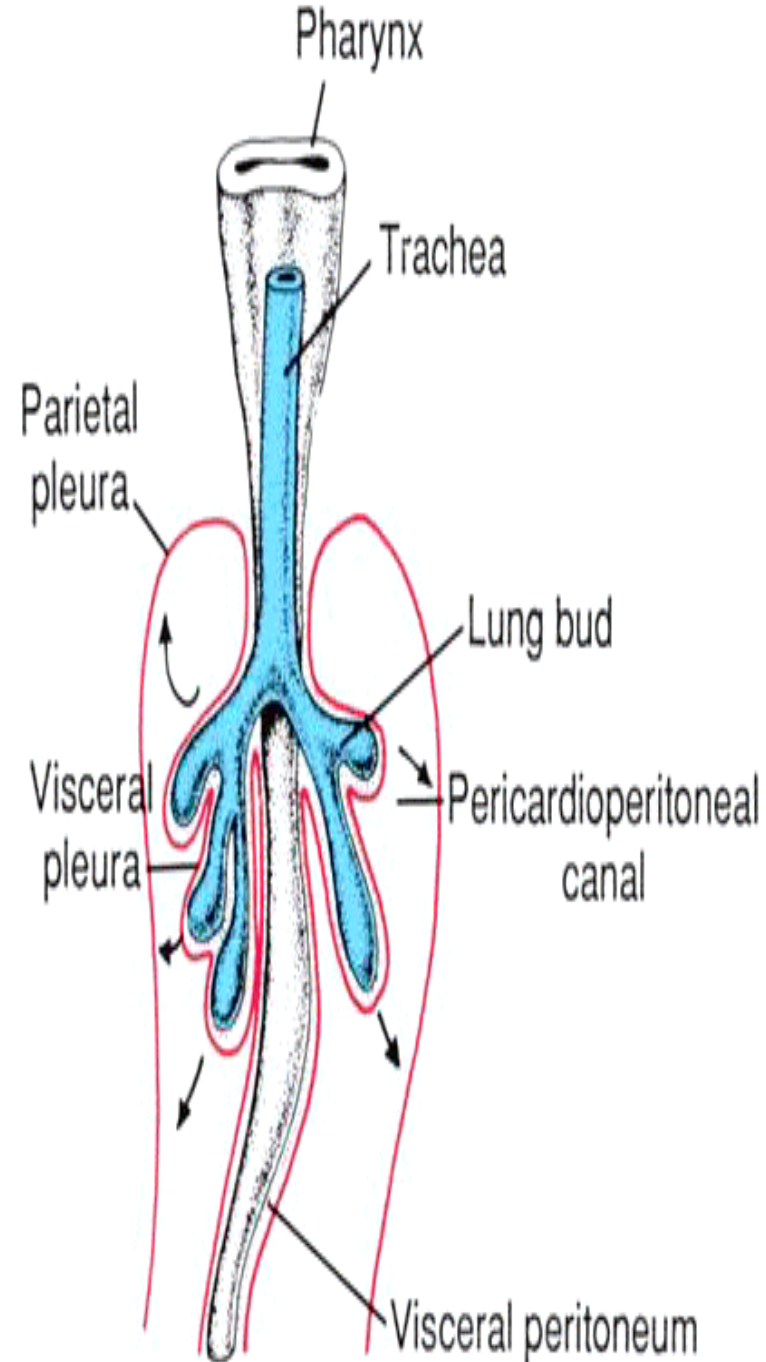
B- The surrounding splanchnic mesoderm cartilaginous plates, smooth muscles, connective tissue & blood capillaries (bronchial & pulmonary).



(Fig.51): Development of trachea and lungs – A) 5 wks, B) 6 wks, C) 8 wks

C- Invasion of the pleura: each lung grows laterally around the foregut and invaginates the the intraembryonic coelom, (*i.e., the pericardio-peritoneal canal*) which gives the pleural sac.

- The visceral pleura is derived from the *splanchnic* mesoderm (autonomic innervation), whereas the parietal pleura is derived from the *somatic* mesoderm (somatic innervation).



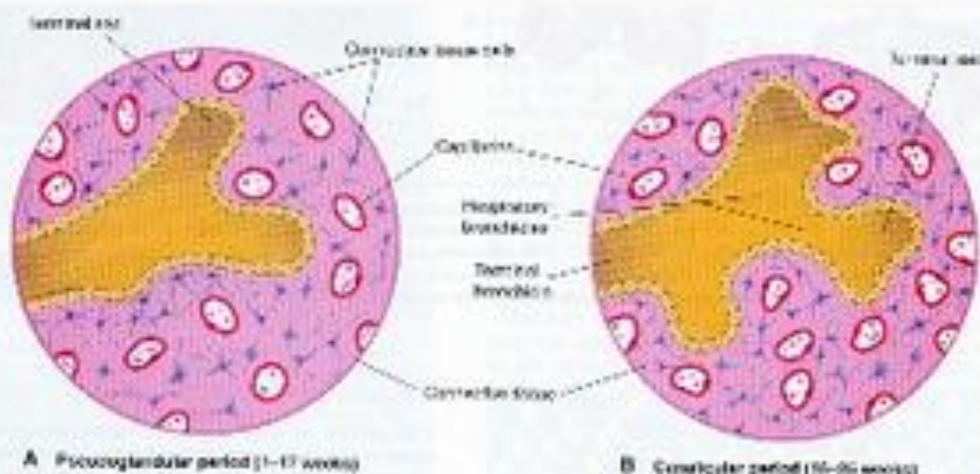
Stages of Lung maturation

Stage	time	Change formation	Baby survive
1- Pseudo glandular	5 to 16 weeks	Appear Bronchi and terminal bronchioles	Not (due to no element of gases exchange)
2- Canalicular	17 to 24weeks	Appear of respiratory bronchioles and alveolar ducts	Not (no element of gases exchange)
3- Terminal sac	24 to birth	Appear of alveoli lined by type I pneumocytes Appear of type II pneumocytes which secret surfactant (begin of secretion from 20 th week)	Can survive with intensive care
4- Alveolar period	From late perinatal period till 8 years after birth	The number of alveoli increases (95% of the alveoli develop after birth).	Survive

Stages of Maturation of the Lungs

Pseudoglandular Period (5-17 weeks):

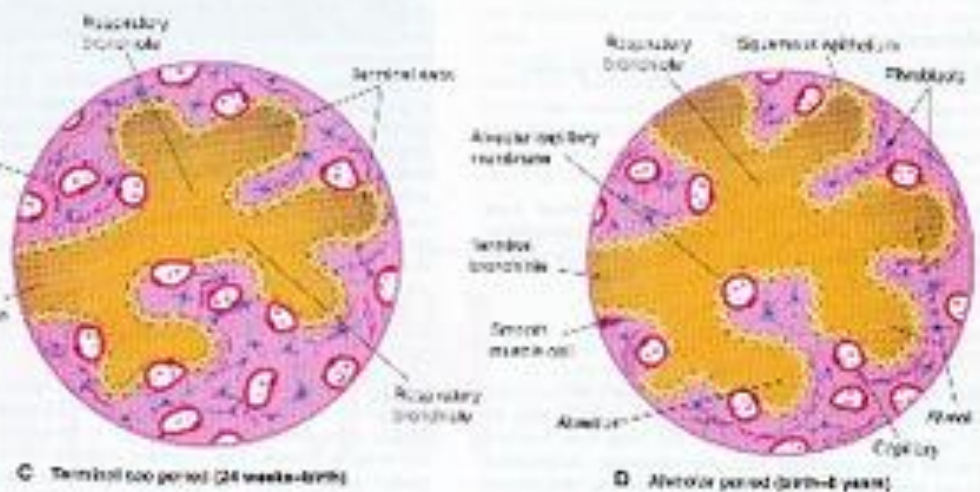
By 17 weeks, all major elements have formed, except those involved with gas exchange (fetuses unable to survive if born at this stage).



A Pseudoglandular period (5-17 weeks)

Canalicular Period (16-25 weeks):

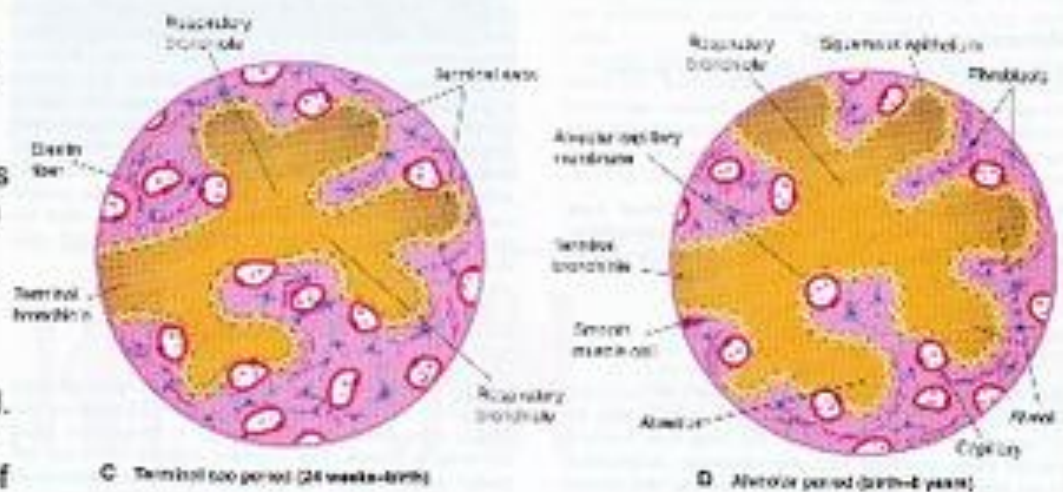
Bronchi, terminal bronchioles become larger, lung tissue becomes highly vascular. Alveolar ducts form by week 24. By end, some terminal sacs have formed so respiration is possible (small chance of survival at this stage).



B Canalicular period (16-25 weeks)

Terminal Sac Period (24 weeks to birth):

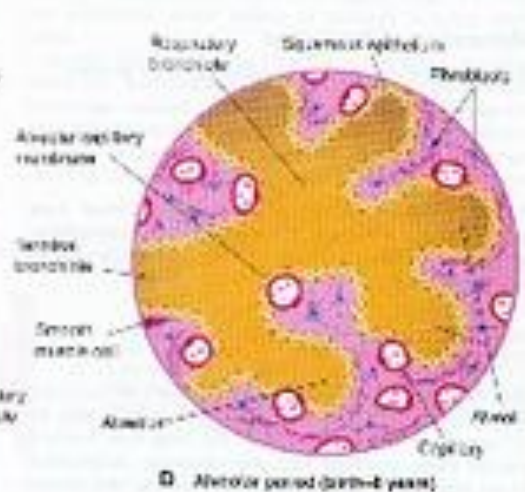
Many more terminal sacs develop, their epithelium becomes very thin and capillaries bulge into the developing alveoli. Blood-air barrier becomes well-developed. (By 26-28 wks, 1000 gr fetus has a sufficient # of sacs and surfactant to survive.)



C Terminal sac period (24 weeks to birth)

Alveolar Period (late fetal period to age 8):

Alveoli-like structures are present by 32 weeks. Epithelial lining of sacs attenuate to extremely thin squamous epithelia, capable of gas exchange. 95% of characteristic, mature alveoli develop after birth.



D Alveolar period (late fetal period to age 8)

Breath Movements

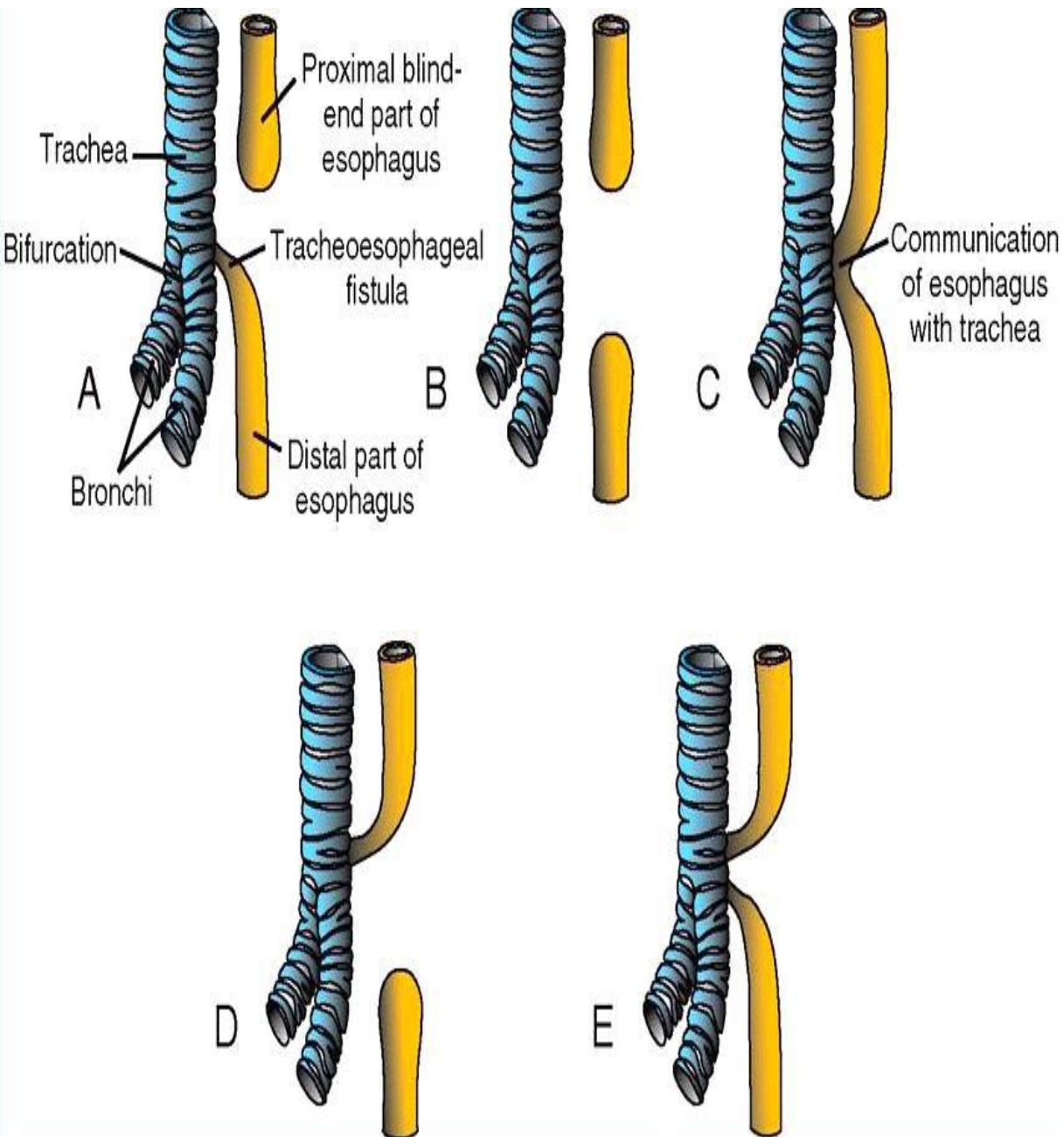
- **Before birth, they can be detected by ultrasonography. As the lung is not a respiratory organ before birth, these prenatal breath movements cause:**
 - 1. Suction of amniotic fluid into the airway.**
 - 2. Training of the respiratory muscles.**
- * **At birth, the fluid in the airways (amniotic fluid + bronchial secretions) becomes replaced by air via 2 mechanisms:**
 - 1. Some become expelled by pressure on the thorax during labour.**
 - 2. The majority is absorbed by pulmonary capillaries & more importantly by pulmonary lymphatics.**

- **Medically, the lungs of a baby who was born alive & died after birth contain air, thus can *float* on water. On the other hand, the lungs of a still born baby *sink*.**

Anomalies of respiratory system

- (1) Oesophageal atresia & tracheo-oesophageal fistula:** (*Atresia* = obliteration & *fistula* = abnormal communication). The tracheo-oesophageal fistula results from *incomplete fusion* of the tracheo-oesophageal folds. Four varieties may occur (the most common is atresia of the upper portion of esophagus & fistula of its lower portion with the trachea impossible feeding & aspiration of milk into the lungs. (before birth, it causes polyhydramnios).
- (2) Surfactant deficiency hyaline membrane disease (HMD)** which is the major cause of respiratory distress syndrome (RDS). Thyroxin and cortisone increase surfactant production.
- (3) Other lung problems:** include agenesis, hypoplasia (small lung), variation in lobes number, accessory lung, ectopic lung lobes (from the trachea or oesophagus) and congenital lung cyst.

Tracheo- esophageal fistula



**Radiological picture
of Tracheo-
esophageal fistula
“ Coiled Ryle tube”**

