

# Embryology Team 430

## Respiratory Block

### Development of Respiratory System

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#### The doctor said that everything is important but here are some important points :

- 1-All the periods(the duration) are important.
- 2-The words in red are very important and the doctor said you have to focus on it more than anything (it is colored in the lecture and that's what we did here).
- 3- to have fun when you study imagine that it is a story, then you will enjoy it-Dr.Saeed Vohra =).

# Respiratory System

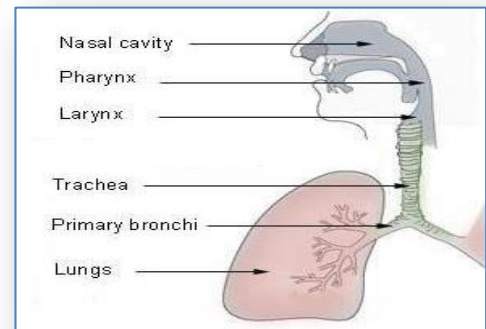
## Upper respiratory tract:

1-Nose. 2-Nasal cavity and paranasal sinuses.

3-Pharynx.

## Lower respiratory tract:

1-larynx. 2-Trachea. 3-Bronchi. 4-lung.



## Development of the Lower Respiratory Tract

Begins to form during the 4<sup>th</sup> week of \*development

Begins as a median outgrowth(laryngotracheal groove) from the caudal part of the ventral wall of the primitive pharynx

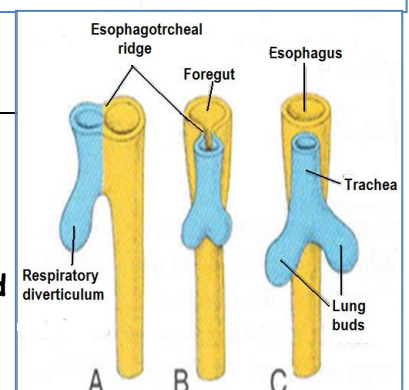
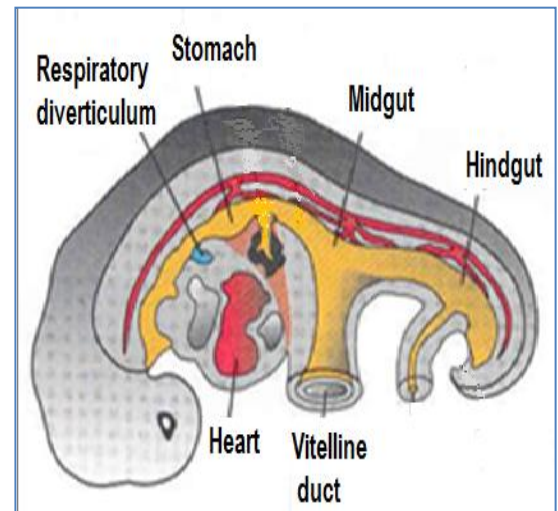
\*The groove evaginates and forms the laryngotracheal (respiratory) diverticulum

The diverticulum grows in size and becomes surrounded by the splanchnic mesoderm

\*A longitudinal tracheo-esophageal septum develops separating the diverticulum from the primitive pharynx.

\*This region of the pharynx gives rise to the oropharynx and the esophagus

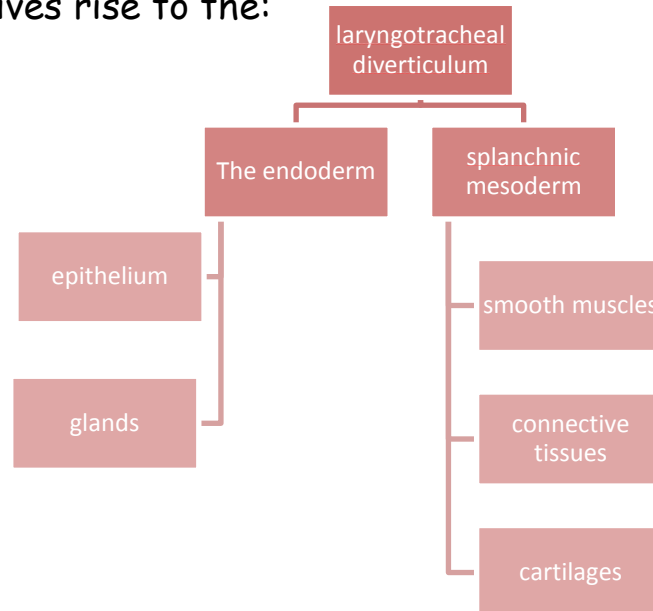
\*The diverticulum is the primordium of larynx, trachea, bronchi and lungs.



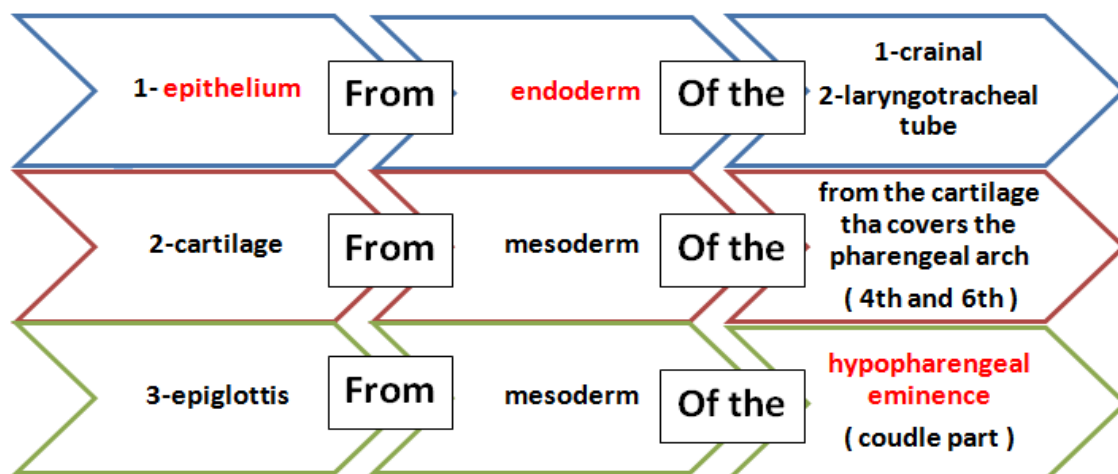
The proximal part of the respiratory diverticulum remains tubular and forms trachea

The distal end of the diverticulum dilates to form lung bud, which divides to give rise to **two lung buds (primary brochial buds)**.

- The endoderm lining the laryngotracheal diverticulum gives rise to the:



### Developing of the larynx:



### Epiglottis:

A flap of elastic cartilage tissue covered with a mucus membrane, attached to the entrance of the larynx.

The rapid proliferation of the laryngeal epithelium will cause  
 temporary occlusion of the laryngeal lumen by the 10<sup>th</sup> week

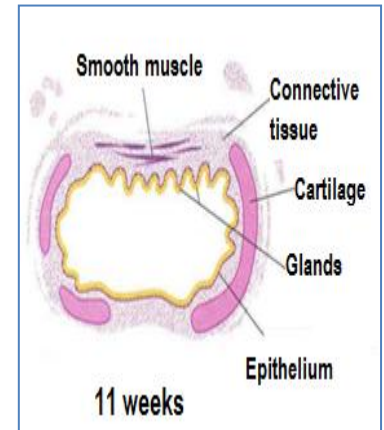
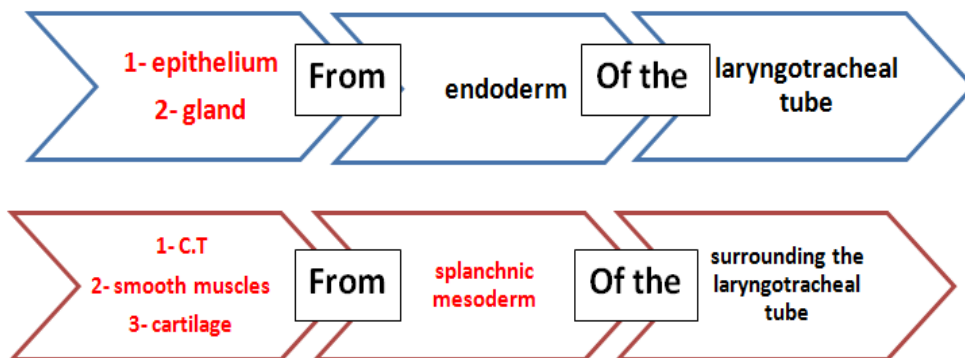
Recanalization during it →

- 1- Laryngeal ventricles
- 2- vocal folds
- 3- vestibular folds

( **will be formed** )

**Growth of the larynx and epiglottis is rapid during the first **three years after birth**. By this time the epiglottis has reached its adult form**

### Development of the Trachea :



### Development of the Bronchi & Lungs:

- ✗ In the pericardioperitoneal canals (part of the intraembryonic celome) → 2 primary bronchial buds grow laterally, they divide repeatedly to give the bronchial tree.
- ✗ The right bud is larger and oriented more vertically than the left one.
- ✗ They subdivide into secondary and tertiary (segmental) bronchi which give rise to further branches. ( **10 in the right lung, and 8 or 9 in the left lung** → begin to form by the 7<sup>th</sup> week).
- ✗ The surrounding mesenchyme also divides.
- ✗ Each segmental bronchus with its surrounding mass of mesenchyme is the primordium of a bronchopulmonary segment (the doctor said that it is very important because it is a functional and a structural unit, like the nfron in the kidney )

× By 24<sup>th</sup> week:

1. **17** orders of branches have formed.
2. respiratory bronchioles have developed.

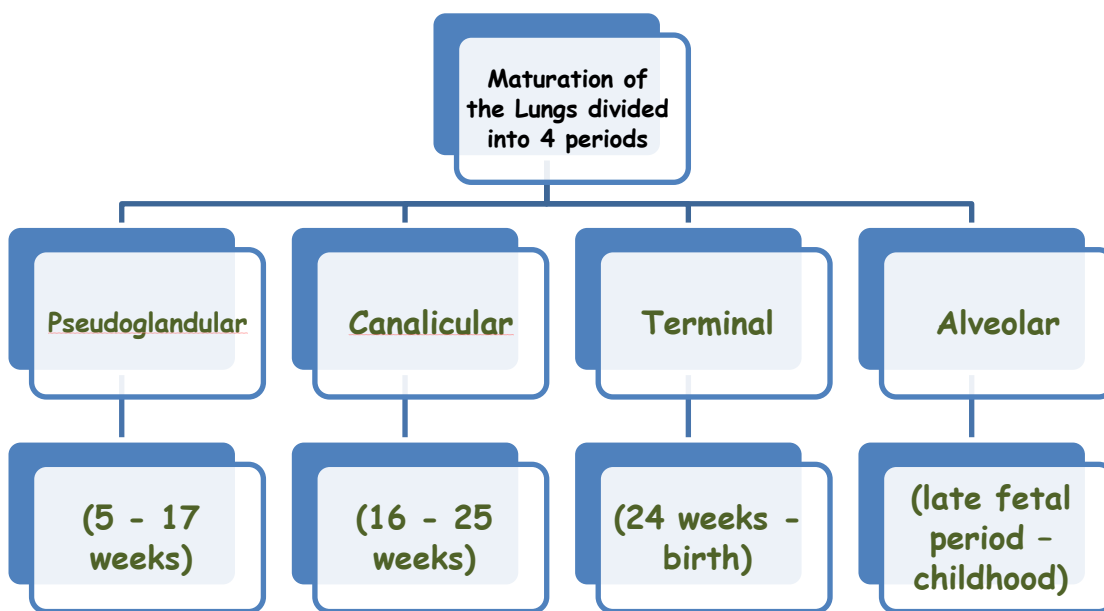
× An additional seven orders of airways develop after birth

× The lung is lined by a layer of (**visceral pleura**) → from splanchnic mesenchyme.

× The thoracic body wall is lined by a layer of (**parietal pleura**) → from the somatic mesoderm

### Maturation of the Lungs:

(the weeks are very important for each period)



These periods overlap each other because the **cranial segments of the lungs mature faster than the caudal ones.**

### 1-Pseudoglandular Period (5-17 weeks):

- Developing lungs somewhat resembles an exocrine gland.
- By **17 weeks** all major elements of the lung have formed except those involved with gas exchange.
- Respiration is **NOT** possible.

**\*Fetuses born during this period are unable to survive.**

### 2-Canalicular Period (16-25 weeks):

- Lung tissue **becomes highly vascular.**
- Lumina of bronchi and terminal bronchioles become larger.
- By **24 weeks** each terminal bronchiole has given rise to two or more **respiratory bronchioles.**
- The respiratory bronchioles divide into 3 to 6 tubular passages called **alveolar ducts.**
- Some thin-walled terminal sacs (primordial alveoli) develop at the end of respiratory bronchioles.

**\*Respiration is possible at the end of this period, Fetus born at the end of this period may survive if given intensive care (but usually die because of the immaturity of respiratory as well as other systems).**

### 3-Terminal Sac Period (24 weeks - birth):

- Many **more terminal sacs develop.**
- Their **epithelium becomes very thin.**

- Capillaries begin to bulge into developing alveoli.
- The epithelial cells of the alveoli and the endothelial cells of the capillaries come in intimate contact and establish the blood-air barrier.

\*Adequate gas exchange can occur which allows the prematurely born fetus to survive.

By 24 weeks, the terminal sacs are lined by:

- Squamous type I pneumocytes.
- Rounded secretory, type II pneumocytes (It secrete the surfactant)

Surfactant:

- Production begins by 20 weeks and increase terminal stages of pregnancy.
- Sufficient terminal sacs, pulmonary vasculature and surfactant are present to permit survival of a prematurely born infants.
- Fetuses born prematurely at 24-26 weeks may suffer from respiratory distress due to surfactant deficiency but may survive if given intensive care.

#### 4-Alveolar Period (32 weeks - 8 years)

- At the beginning of the alveolar period, each respiratory bronchiole terminates in a cluster of thin-walled terminal saccules, separated from one another by loose connective tissue.
- These terminal saccules represent future alveolar sacs.

- The epithelial lining of the terminal sacs attenuates to an extremely thin squamous epithelial layer.
- Characteristic mature alveoli do not form until after birth. 95% of alveoli develop postnatally.
- About 50 million alveoli, one sixth of the adult number are present in the lungs of a full-term newborn infant.
- Most increase in the size of the lungs results from an increase in the number of respiratory bronchioles and primordial alveoli rather than from an increase in the size of the alveoli.
- From third to eight year or so, the number of immature alveoli continues to increase. Unlike mature alveoli, immature alveoli have the potential for forming additional primordial alveoli.
- By about the eighth year, the adult complement of 300 million alveoli is present.

### Breathing Movements:

- Occur before birth, are not continuous and increase as the time of delivery approaches.
- Help in conditioning the respiratory muscles.
- Stimulate lung development and are essential for normal lung development.

### Lungs at birth:

- The lungs are half filled with fluid derived from the amniotic fluid and from the lungs & tracheal glands.
- This fluid in the lungs is cleared at birth: by:
  - ❖ Pressure on the fetal thorax during delivery.
  - ❖ Absorption into the pulmonary capillaries and lymphatics.



## Lungs of a Newborn:

- **Fresh healthy** lung always contains some air (lungs float in water). **Diseased lung** may contain some fluid and may not float (may sink). Lungs of a **stillborn** infant are firm, contain fluid and may sink in water.

### Factors important for NORMAL lung development:

- Adequate thoracic space for lung growth
- Fetal breathing movements
- Adequate amniotic fluid volume

### Developmental Anomalies

- Laryngeal tresia
- **Tracheoesophageal fistula**
- Tracheal stenosis & atresia
- Congenital lung cysts
- Agenesis of lungs
- Lung hypoplasia
- Accessory lungs

### Tracheoesophageal Fistula:

- An abnormal passage between the trachea and esophagus
- Results from incomplete division of the cranial part of the foregut into respiratory and esophageal parts
- Occurs once in 3000 to 4500 live births
- Most affected infants are males
- In more than 85% of cases, the fistula is associated with esophageal atresia.

