Development of respiratory system

- Respiratory block

Objectives

At the end of the lecture the students should be able to

- Identify the development of the laryngeotracheal (respiratory) diverticulum.
- Identify the development of the larynx.
- Identify the development of the trachea.
- Identify the development of the bronchi and lung.
- Describe the periods of the maturation of the lung.
- Identify the most congenital anomaly.

Respiratory system

Respiratory system

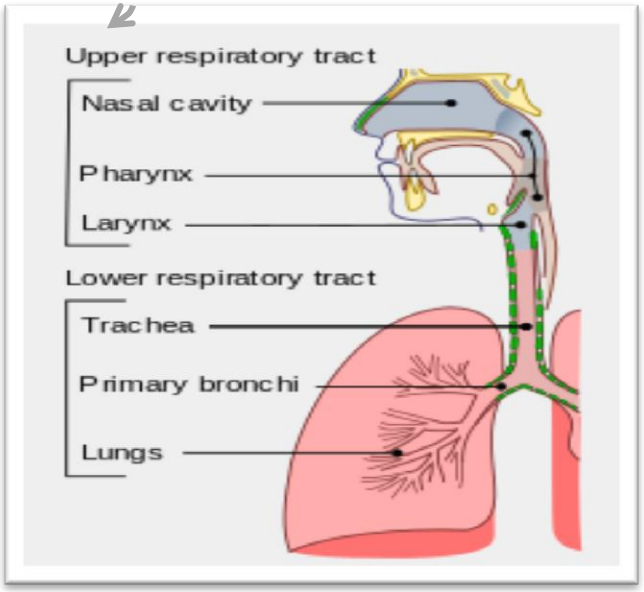
Upper respiratory tract

- Nose
- Nasal cavity and paranasal sinuses
- Pharynx

Lower respiratory tract

- Larynx
- Trachea
- Bronchi
- Lung

Note : In anatomy they consider , Larynx With upper respiratory system.



Development of the Lower Respiratory Tract

1

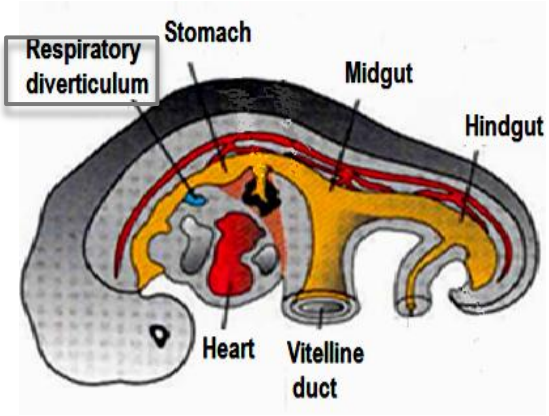
Begins to form during the **4th week** of development as a median outgrowth

From the caudal part of the ventral wall of the primitive"بدائي" pharynx

And this outgrowth called (laryngotracheal groove)

The groove Envaginates "يغلق" to form diverticulum

2



laryngotracheal (respiratory) diverticulum

يبدأ نمو الجهاز التنفسي السفلي أثناء الاسبوع الرابع بظهور نمو في الجزء السفلي من جدار البلعوم الأمامي يطلق عليه وصف تجويف أو شق groove ومن ثم يغلق هذا الشق فيصبح كالأنبوب له فوهة diverticulum

Development of the Lower Respiratory Tract

A longitudinal tracheo-esophageal septum (esophagotracheal ridge) develops and divides the diverticulum into a:

Ventral portion
primordium of "بداية"

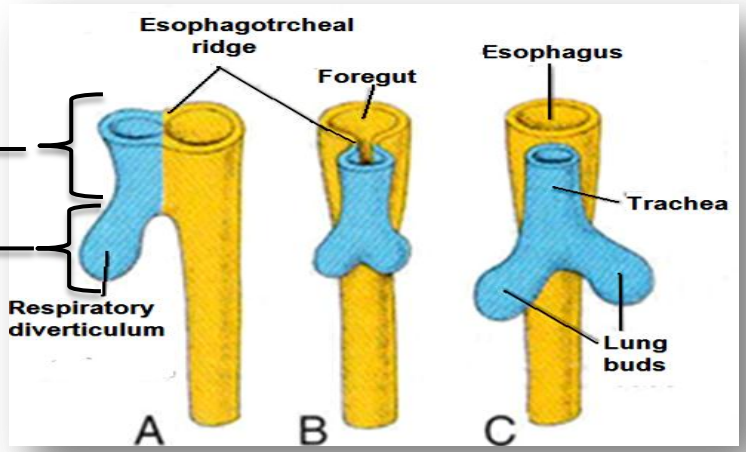
- bronchi
- lungs
- Larynx
- trachea

Dorsal portion
primordium of "بداية"

- oropharynx
- esophagus

The distal end of the diverticulum dilates to form **lung bud**, which divides to give rise to **2 lung buds (primary bronchial buds)**

The proximal part of the **respiratory diverticulum** remains tubular and forms **larynx** & **trachea**.



Laryngotracheal diverticulum

The endoderm
lining it
And gives rise to

- Epithelium
- gland

Of the respiratory tract

The splanchnic mesoderm
surrounding it
And gives rise to

- Smooth muscle
- Cartilage ‘except ‘ epiglottis.
- Connective tissue

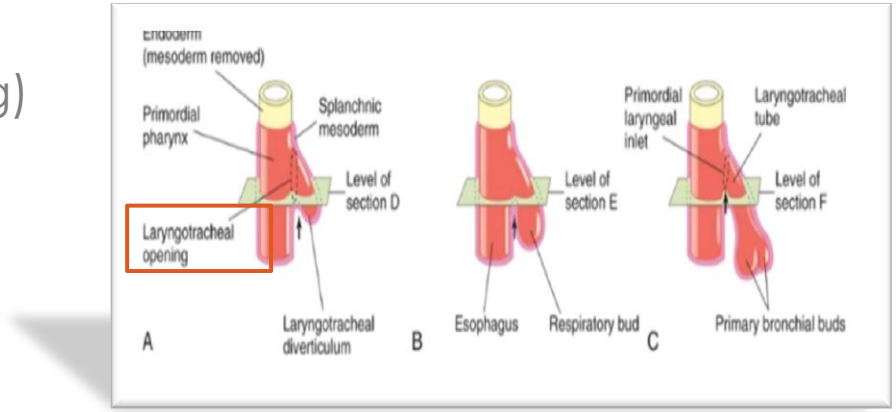
Of the respiratory tract

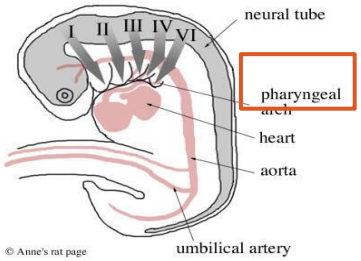
Development of the larynx

The opening of the laryngotracheal diverticulum into the primitive foregut (المعى الأمامي) becomes the laryngeal orifice(orifice: a hole or opening)

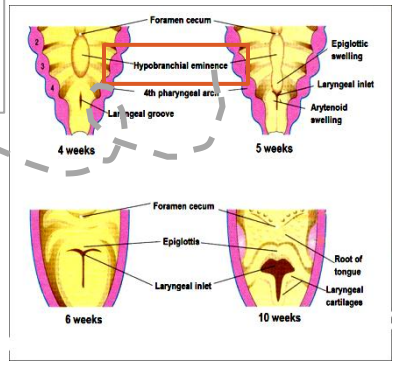
The epithelium & glands are derived from endoderm

Laryngeal muscles & the cartilages of the larynx except Epiglottis that develop from the mesoderm of **4th & 6th** pairs of pharyngeal arches





Note :
Hypobranchial eminence >> epiglottis

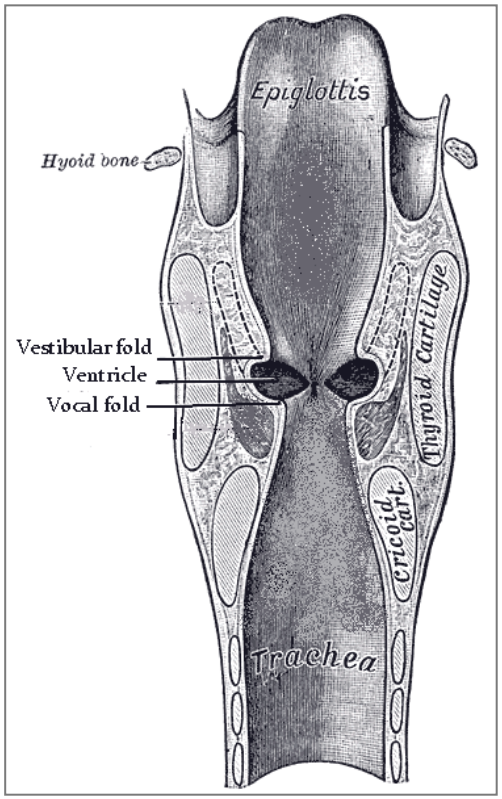


Recanalization of larynx

The laryngeal epithelium proliferates rapidly resulting in temporary occlusion(انسداد مؤقت) of the laryngeal lumen

Recanalization of larynx normally occurs by the **10th week.**

Laryngeal ventricles, vocal folds and vestibular folds are formed during recanalization



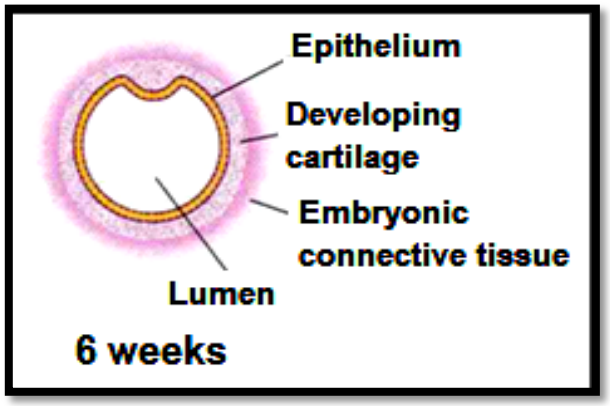
الغشاء السطحي للحنجره يتكاثر بسرعة وينتج عنه انسداد مؤقت في جوفها – في الأسبوع العاشر يحدث إعادة صنع للقنوات وينتج عنه التالي:

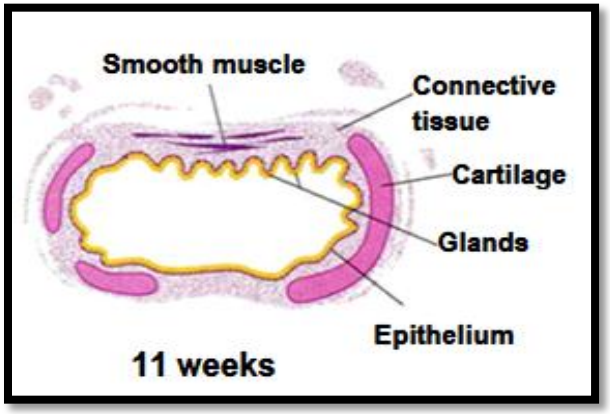
1- vocal cords
2- vestibular folds
3- laryngeal ventricles

Development of the trachea

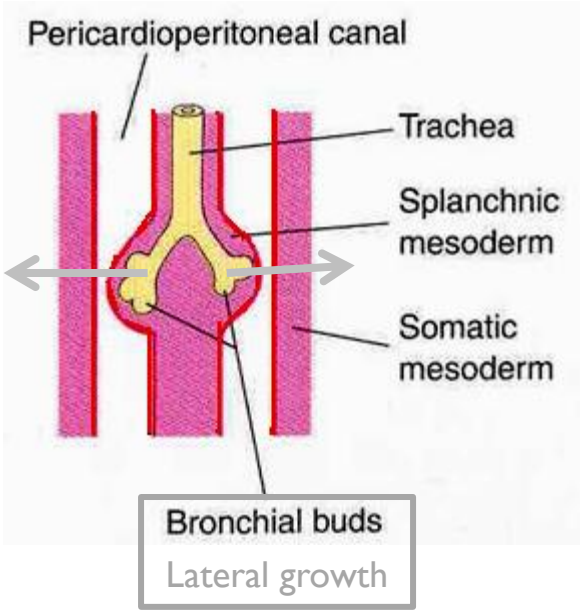
The **endodermal** lining of the laryngotracheal tube distal to the larynx differentiates into the epithelium and glands of the trachea and pulmonary epithelium

The cartilages, connective tissue, and muscles of the trachea are derived from the **mesoderm**.

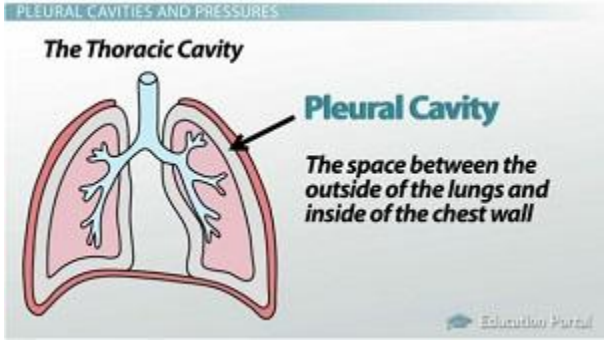


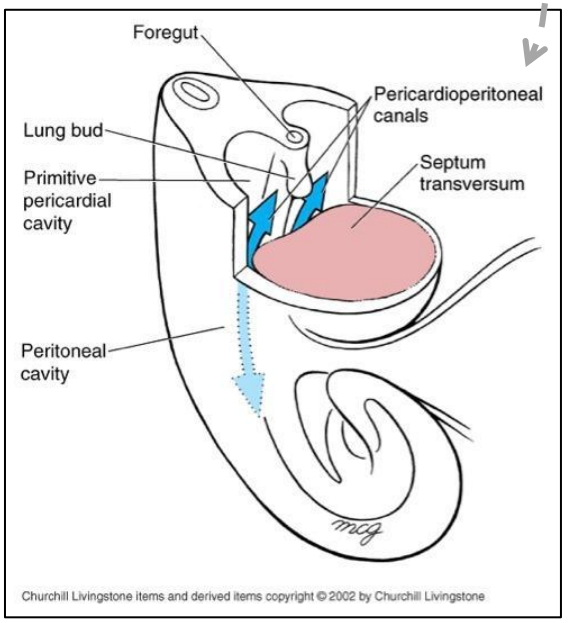


Development of the Bronchi & Lungs



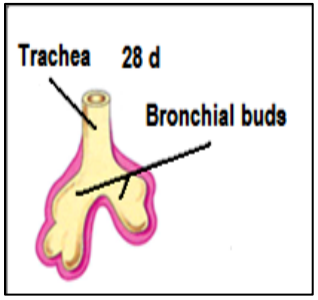
The 2 primary bronchial buds grow laterally into the **pericardio-peritoneal canals** (part of the intraembryonic celome), which is the **primordia** * of pleural cavities.





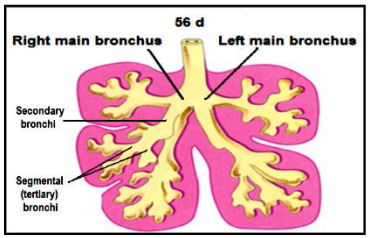
Primordia: the organ during the early stages of development أي بداية تكوين

Development of the Bronchi & Lungs



The right main bronchus is slightly **larger** (wider) than the left one and is oriented more vertically.

ليش؟ عشان **ثلثين** من قلب تكون في الجزء اليسار.
والربط مع الدرس الرابع في الأناتومي:
The anterior margin of the left pleura extends from the **4th** to the **6th** costal cartilage forming the **cardiac notch**.



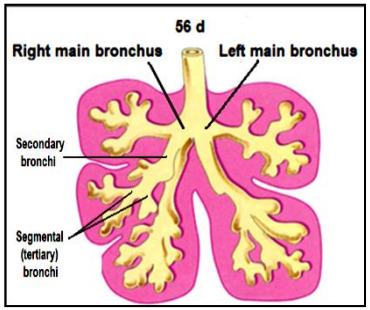
Bronchial buds divide and re-divide to give the bronchial tree.

The main bronchi subdivide into secondary and tertiary (segmental) bronchi which give rise to further branches.

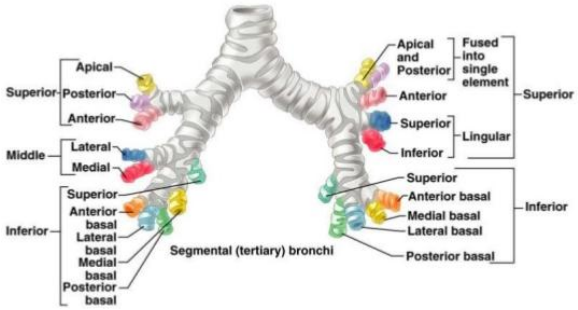
Right lung	Left lung
10 segmental bronchi	8 or 9 segmental bronchi
تذكير: اليمين تحتوي على bronchi أكثر لأنه أكبر حجماً	
This subdivision happens in **the 7th week.**	

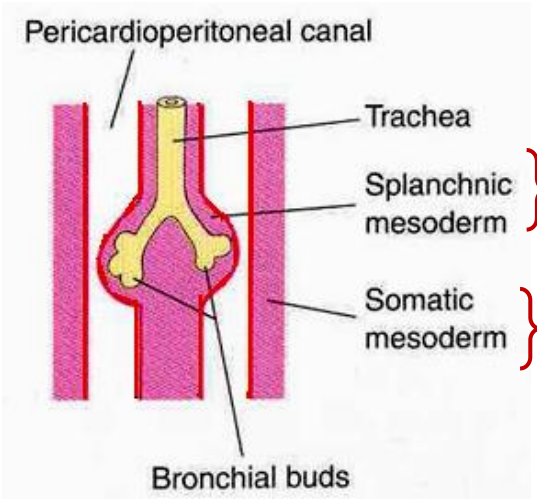
Development of the Bronchi & Lungs

The embryonic relationship persists in the adult.



The surrounding mesenchyme also divides. Each segmental bronchus with its surrounding mass of mesenchyme is the primordium of a bronchopulmonary segment.

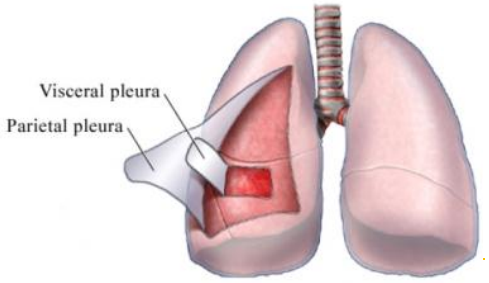




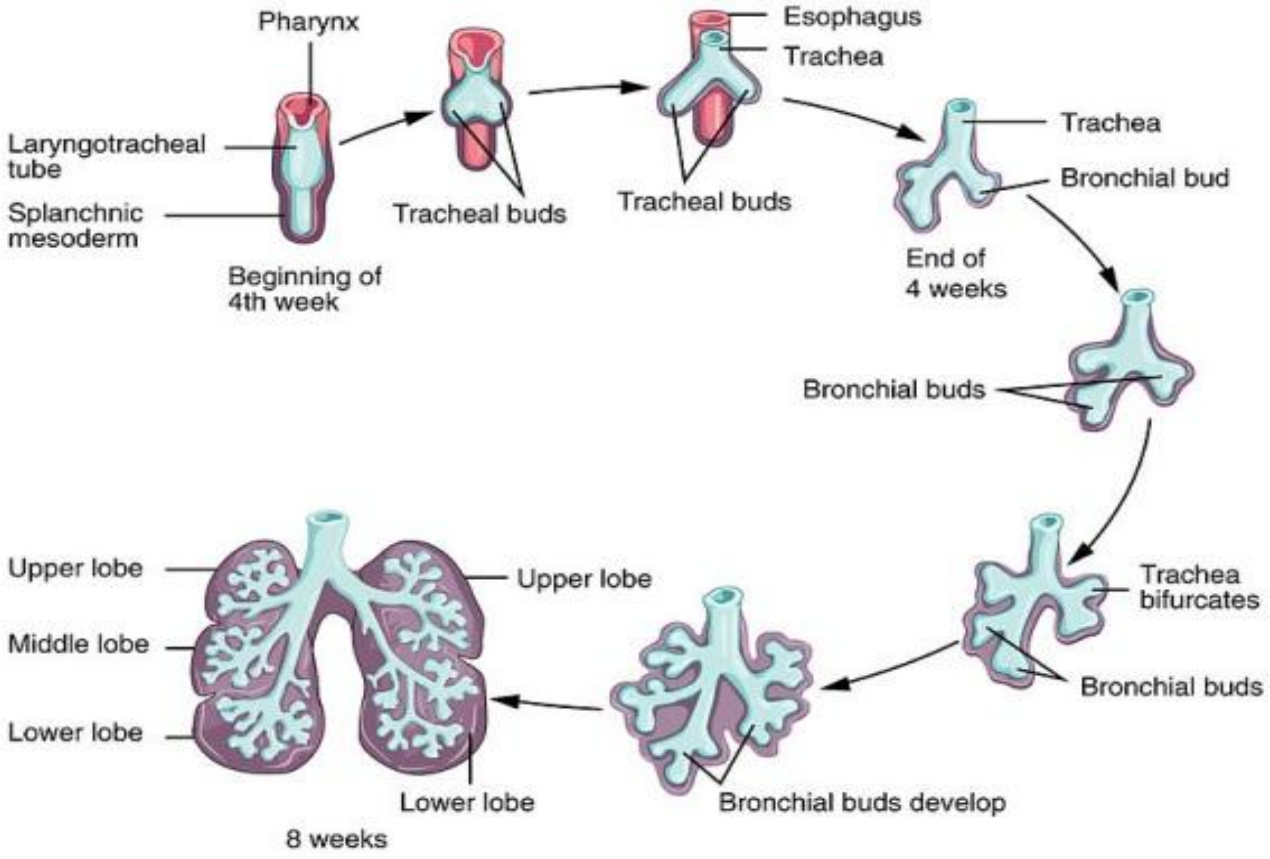
As the lungs develop, they acquire a layer of visceral pleura from the splanchnic mesenchyme.

The thoracic body wall becomes lined by a layer of parietal pleura from the somatic mesoderm.

هذولي الطبقتين يغطّون الرئة، وبينهم pleural space يحتوي على سائل للتقليل من الاحتكاك بينهم.



Development of the Bronchi & Lungs

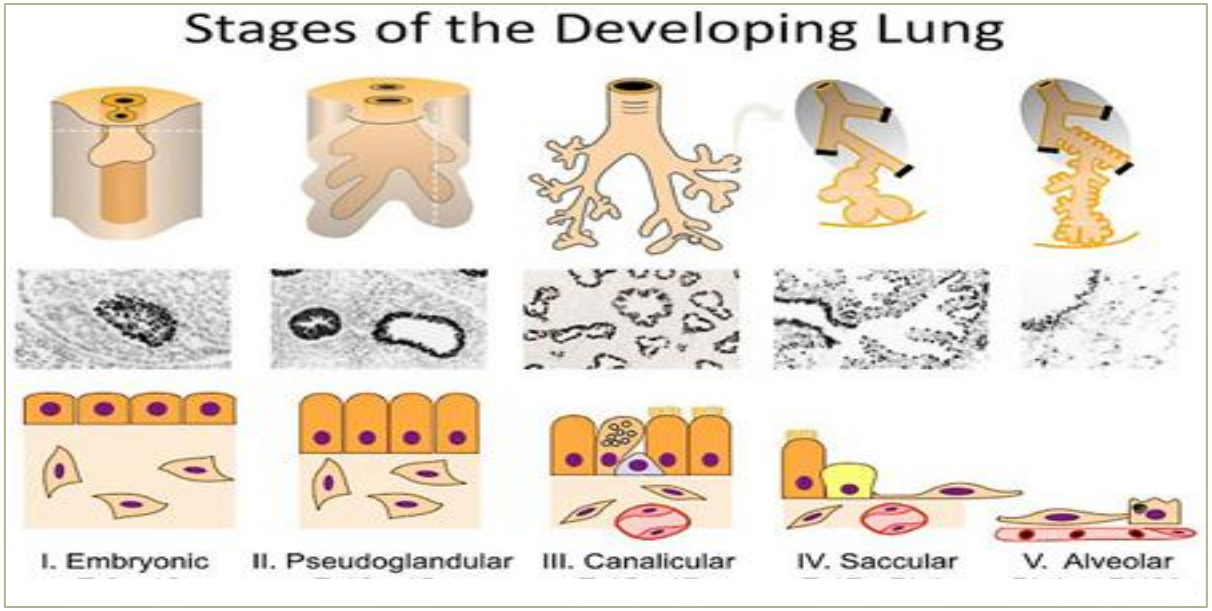


Maturation of the lungs:

Maturation of lungs is divided into 4 periods :

Pseudoglandular period : 5-17- weeks → Canalicular period: 16-25 weeks → Terminal sac: 24 weeks-birth → Alveolar: Late fetal period – childhood "8years"

These periods overlap each other" متداخلة ببعض بحيث قبل تنتهي المرحله الاولى تبدأ الثانية" because the cranial (superior) segments of the lungs mature faster than caudal (inferior) one.



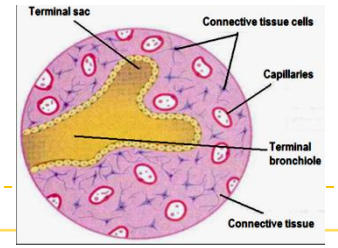
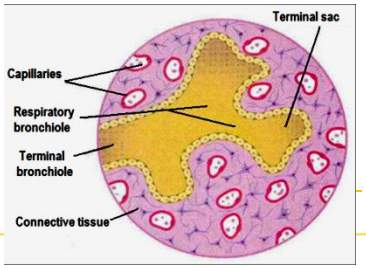
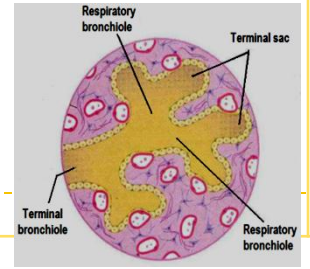
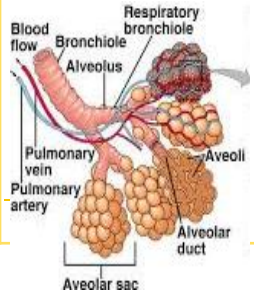
Maturation of the lungs:

Pseudoglandular Period:(5-17weeks)	- Developing lungs somewhat resembles an exocrine gland (e.g.: mammory, sweat & salivary glands) during this period. - By **17 weeks** all major elements of the lung have formed **except** those involved with gas exchange (**alveoli**)"responsible for gas exchange". - Respiration is **NOT** possible. - Fetuses born during this period are unable to survive.
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. "after the 6th week" - 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)

Maturation of the lungs:

Terminal 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"مانحتاج نحطه بحضانة" can occur which allows the prematurely born fetus to survive.
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**

Note: terminal bronchioles -> respiratory bronchioles -> alveolar ducts -> some terminal sac "alveolar sac contain may alveolar"

	Pseudoglandular Period	Canalicular Period	Terminal Period	Alveolar Period
Alveoli forming	No	Yes "**some**" : By 24 weeks terminal bronchiole has given rise to respiratory bronchioles.	Yes :developing of **many** alveoli	Yes
Respiratory	**No**	Yes at the end	Yes "Adequate"	Yes
survive	Unable to survive	May survive "usually die"	Yes	Yes
Capillaries begin to bulge	No	No	yes	-
Pictures				

Alveoli

- **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.
- From **3-8 year** or so, the number of alveoli continues to increase, forming additional primordial alveoli.
- By about the **eighth year**, the adult complement of **300** million alveoli is present.

Prenatal

NO mature alveoli

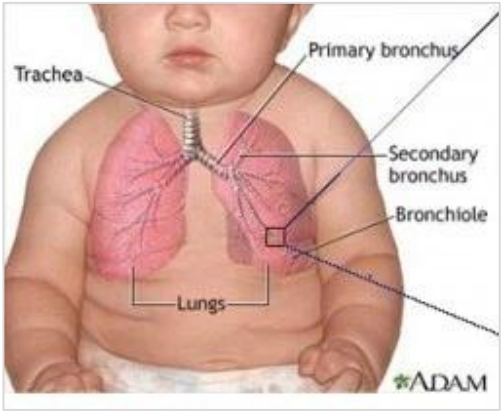
Postnatal

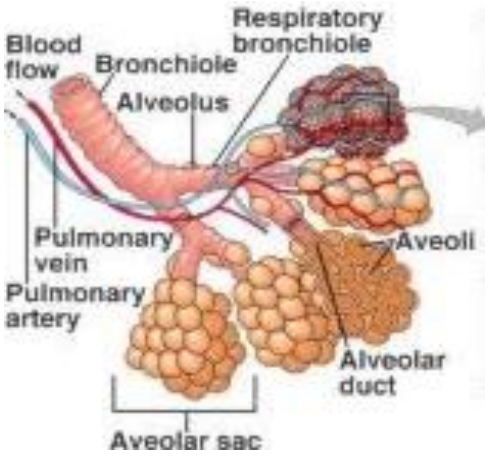
Alveoli **form** + **develop** (**50** million alveoli)

Childhood

From 3-8 year continues to **increase** in number = **300** million (**adult** number)

1/6





Breathing Movements & Lungs

Breathing Movements:

- Occur **before** birth, are **NOT continuous** and increase as the time of delivery approaches.

  هل يتنفس الجنين وهو داخل الرحم؟ نعم ، ويمكن سماعه بالسونار ويكون بشكل متقطع وغير متصل.
- Help in conditioning the respiratory muscles. تفيد عملية التنفس هذه في تحسين عضلات التنفس
- 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:
  1. Pressure on the fetal thorax during delivery.
  2. Absorption into the pulmonary capillaries and lymphatics.

Factors important for normal lung development:

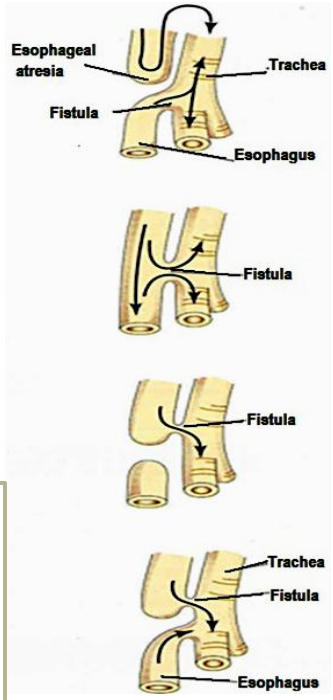
- Adequate thoracic space for lung growth.
- Fetal breathing movements.
- Adequate amniotic fluid volume.

Developmental Anomalies: Tracheoesophageal Fistula

Developmental Anomalies:

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

*We're only supposed to know one but memorize all of them.



- 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** (esophagus ends in a blind-ended pouch rather than connecting normally to the stomach).

Please watch the video it will help you understand it even more!
https://goo.gl/bVLfdY

Summary

4th weak	Begin to form lower respiratory tract
10th weak	Recanalization of the larynx
5-17 weak	Pseudoglandular
17 weak	All major elements of the lung formed except alveoli
16-25 weak	Canalicular
24 weak	Each terminal bronchiole has given rise to two or more respiratory bronchioles
24weak –birth	Terminal sac
Late fetal period 32 weaks – childhood 8 years	Alveolar
3-8 years	Immature alveoli increase forming additional primordial alveoli.
8 years	Adult complement of 300 million alveoli present

Summary

Maturation of the Lungs

Pseudoglandular	5 - 17 weeks	-The lungs resemble an exocrine gland. -All major elements of the lung have formed except the Alveoli. -Fetuses are unable to survive.
Canalicular	16 - 25 weeks	-Lung tissue becomes highly vascular. -By 24 weeks each terminal bronchiole has given rise to two or more respiratory bronchioles. -Alveolar ducts formed. -Fetus born at the end of this period may survive .
Terminal sac	24 weeks - birth	-Establish the blood-air barrier. -Gas exchange can occur.
Alveolar	32 weeks – 8 years	-Respiratory bronchiole terminates in terminal saccules. -Terminal saccules represent future alveolar sacs.

MSQ's

1- During which week does the lower respiratory tract start to develop ?	A-4th week	B-3rd week	C-5th week	D-6th week
2- Which portion of the divided diverticulum gives rise to the Larynx, Bronchi and Orophagus?	A-Dorsal portion	B-Ventral portion	C-Both of them A , B	D-None of them
3- Which of the fallowing does not form during recanalization of the Larynx?	A-Ventricles	B -vestibule	C -Vocal folds	D -Vestibular fold
4- During which week does the recanalization happen?	A-10th week	B-8th week	C-9th week	D-11th week
5- which of the fallowing does not derived from the mesoderm of the Laryngotracheal tube?	A-Connective tissue	B-Muscles of the trachea	C-Cartilages	D-Glands
6- How many segmental bronchi and when do they begin to form on the right lung?	A-10 segments 7th week	B-9-8 segments 7th week	C-10 segments 9th week	D-7 segments 10th week
7- What is the name of the period of lung maturation that start on the 16th and ends on the 25th week?	A-Pseudoglandular	B-Canalicular	C-Terminal sac	D-Alveolar

1-A
2-C
3-B
4-A
5-D
6-A
7-B

MSQ's

8- On which of the fallowing period does the respiratory bronchiole terminates in a cluster of thin walled terminal saccules separated from one another by loose connective tissue?	A-Pseudoglandular	B-Canalicular	C-Terminal sac	D-Alveolar
9- How much of the alveoli develop Postnatally ?	A-50%	B-90%	C-95%	D-85%
10-which lung is oriented more vertically	A-The left lung	B-The right lung	C-Both of them	D-None of them

10-B
9-C
8-D

Help full video of respiratory system

https://www.youtube.com/watch?v=Nvo8XGMSCwU

Girls team

Afnan Al-Malki

- Razan Alsabti
- Sarah AlMutawa
- Lamya Alsaghan
- Farrah Mendoza
- Lamees AL-Tamimi

boys team

Helmi M Alsweirki

- Nasser Almujaiwel
- Gassan Almeqbel
- Mohammed Alqarny
- Naif Alziyadi

Thank you for checking our work

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