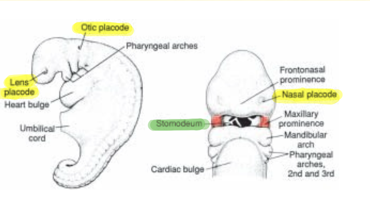
Embryo:- Development of RS :- (nose & palate)



* Placodes : organ بداية تكوين ال
  - Lens placode → eye
  - Otic placode → ear
  - Nasal placode → nose *

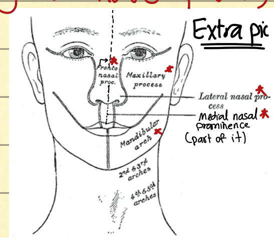
* prominences : development of an area
  ↳ (develops when the cells start to proliferate) ← Due to a received stimulus
  e.g. Fronto-nasal → from frontal bone to nose
  ↳ Forms the septum of the nose

* nose : two openings, ant & post (choana) + two cavities with a septum in between

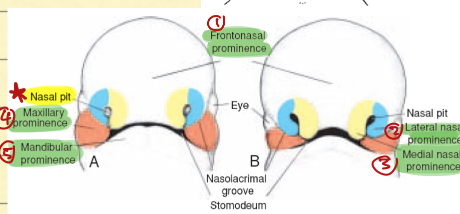
• Development of the nose :-

* starts from : the nasal placode → (beginning of the nasal openings)
  ↳ Nostrils → (beginning of the cavity of the nose) ⟹ then : the vestibule
* Frontonasal prominence → will form the septum of the nose (along with the medial nasal prominence)
  (one of the facial prominences) (الأكثر ال Fronto nasal هو الأساسي)

* The development of any organ usually starts at the 4th week of pregnancy / gestation
  ↳ Like the facial prominences (4th week) : are derived from neural crest → from mesenchymal layer
  ↳ (so the proliferation is in the mesenchymal cells)
* Stomodeum is the anterior part of the oral cavity → (separated from the nasal cavity by the palate) (mainly the hard palate)

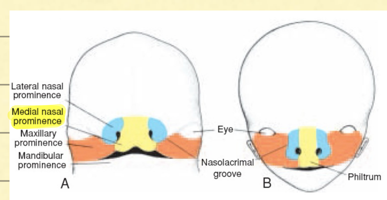


* During the 5th week : the nasal placode gives the nasal pits / anterior openings
  ↳ from the skin ⟹ so : ectodermal in origin
  ↳ then invaginates to give the vestibule (the dilatation)
  ⤳ so : vestibule lining epi is stratified squamous keratinized (skin)

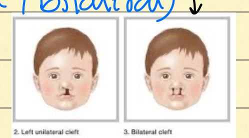


* Facial prominences : 1- fronto nasal → septum
  2- maxillary → to maxilla + upper lip + nose
  3- Mandibular → to lower jaw (mandible)
  4- Lateral nasal → lateral wall + alae of nose
  5- Medial nasal → crest + tip of the nose
  (4 & 5 : nasal prominences)
  (⊛ are mainly involved in the development of nose)

* Nasal prominences
1- Medial nasal (جوا) → on midline → will meet the maxillary prominance medially towards the midline
2- Lateral nasal (برا) → laterally (lateral wall of the nose + the alae of the nose)



* During the next 2 weeks (from the 5th week)
  ↳ The medial nasal prominence is the predominent one in the midline (in yellow) including the philtrum (meeting the frontonasal prominence & forming the septum)
  ↳ There's a cleft between the medial nasal prominence + maxillary prominence
  ↳ Fusion between these 2 should happen ⟹ No fusion ? Cleft lip (unilateral / bilateral) (with or without cleft palate)



(medial nasal + frontonasal (mainly this) = septum / medial nasal + maxillary = philtrum)

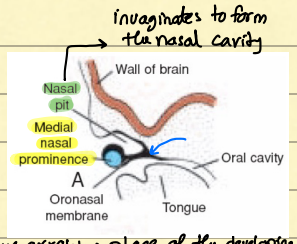
very imp. table :-

TABLE 15.2 Structures Contributing to Formation of the Face

Prominence	Structures Formed
Frontonasal[a]	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 + lateral wall of the nose
Mandibular	Lower lip + mandible

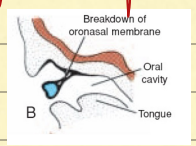
[a] The frontonasal prominence is a single unpaired structure; the other prominences are paired.

* Nasal cavity : develops after invagination & proliferation of nasal prominences
  - Lateral wall → from lateral nasal prominence
  - septum or medial wall → from medial nasal + frontonasal prominences



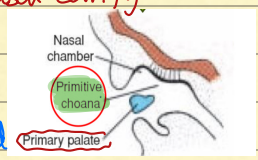
Blue arrow → place of the developing hard palate (to separate oral+nasal cavity)

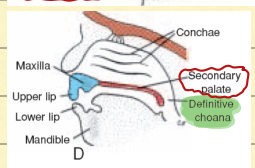
* Oro nasal membrane
  → Between the oral + nasal cavity
  then: Undergoes rupture → then returns to form a permanent membrane
  → Primary palate
  → Secondary palate



* The nasal pit invaginates through the mesenchyme to form the nasal cavity.

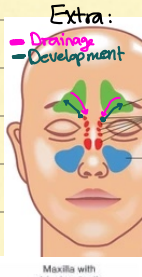
* Later on → primitive choanae is formed (post. nares) → ONLY develops when the membrane is formed & oral + nasal cavities are separated by the primary palate
  → then: definitive choanae → that opens into the nasopharynx (oral & nasal cavities are completely separated)



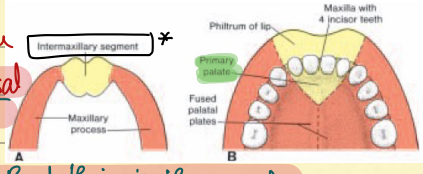


* Para-nasal sinuses → cavities in the skull bones → their ducts open & drain in the lateral wall of the nose
  → During development :-
  it's the opposite : Diverticula begins from the opening (from lateral wall of the nose) → invagination (backwards + upwards) → cavity → opens into the skull bones
  For e.g) - opening in the frontal bone → frontal air sinus
  → the sinuses become large in size with the development of the facial bones (as we grow)

Extra :
- Drainage
- Development



* Intermaxillary segment → When the 2 maxillary prominences in the 2 sides meet on the midline with the medial nasal prominence
  it forms :
  - Philtrum + the upper lip (labial component)
  - 4 incisors of the upper jaw (upper jaw component)
  - Primary palate (palatal component)
  → The frontonasal prominence descends downwards & forwards to form the septum & meet this segment at the 1° palate (for full separation of the 2 cavities of the nose)



But this is the main constituent of the segment

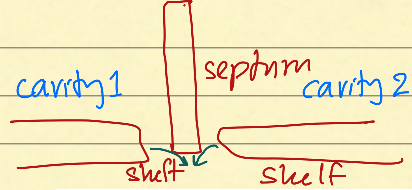
* Palate → Primary → from intermaxillary segment (when the 2 maxillary prominences meet at the midline with the medial nasal prominence)
  → Triangular in shape
  → Meets the frontonasal prominance
  → Secondary

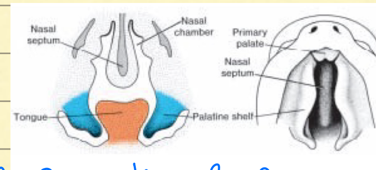
* Secondary palate (7th week) ← Fusion of lateral shelves

↳ starts from: palatine shelf (2 in #) ⟹ from the lateral sides of the maxilla

→ midline downwards to meet the primary palate

Forming: the hard palate



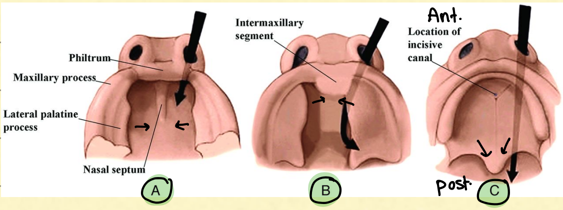


Between 1° + 2° palates → We have the incesive foramen (passage of a nerve + artery)

↳ also they fuse with the nasal septum ⟹ Which makes the 2 cavities of the nose

↳ They also grow posteriorly from the edge of palatine processes to form :-

1- Soft palate] → post. of the hard palate
2- Uvula



Extra pic

A - 2° palate will fuse with the septum

B - 2° palate will meet the 1° palate (of intermaxillary segment)

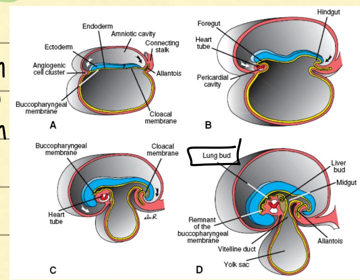
C - 2° palate fusion post. to form : soft palate + uvula

* the fusion between the 2 folds of soft palate ⟹ 8th week

* Fusion between the 2 parts of the uvula (in midline) ⟹ 11th week

↳ no complete fusion? Cleft

Yellow: endoderm
Blue: ectoderm
Red: mesoderm



* Development of respiratory system

↳ also starts from the 4th week

↳ Respiratory bud + primitive gut ⟹ RS بداية تكوين الـ

↳ Gut is divided into 4 parts:

1- Pharyngeal gut (Ant part) → From oral cavity (its post. part) to pharynx ← From pharyngeal arches

2- Foregut → from lower part of esophagus → stomach to Half of duodenum (= 2nd part of duodenum = liver bud = outgrowth of liver)

3- Midgut → small intestine → large intestine to lateral 1/3rd of transverse colon (= medial 2/3rds of transverse colon)

4- Hindgut → lateral 1/3 rd of transverse colon → descending colon → sigmoid colon to anal canal

* Respiratory bud = respiratory diverticulum = Lung bud

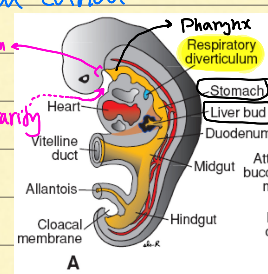
↳ Origin of the whole RT

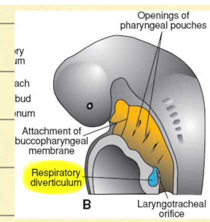
↳ During 4th week, appears as an outgrowth from the ventral wall of the foregut

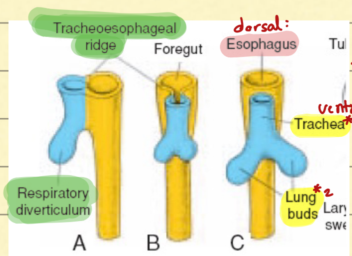
programmed stimulation in the 4th week to this bud → outgrowth of cells (خلايا)

↳ Lining epi : Endodermal

- while the cartilage + CT + muscles → mesodermal (mesenchymal cells)







→ Respiratory diverticulum is connected to the foregut

⇓

Separation is needed

How? Tracheoesophageal ridges on the 2 sides

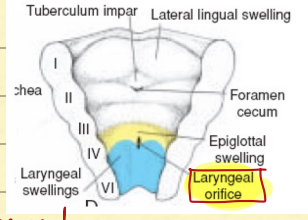
then: ⟹ they fuse to form a complete septum (complete separation ✓)

① Dorsal portion (esophagus) ② Ventral portion (trachea + lung buds)

* Is there a connection between RT & GIT ??

YES! The inlet of the larynx

→ First: it's a slit like opening (فتحة على شكل شق) → Laryngeal orifice



* Esophagus → descends downwards to the abdomen during development

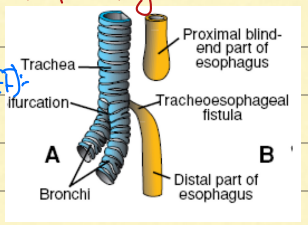
Due to: Development of the surrounding pericardium + heart + lung

→ The most common anomaly of tracheoesophageal fistulas (TEF)

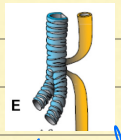
(Proximal esophageal atresia + distal tracheoesophageal fistula)

(Blind end of esophagus)

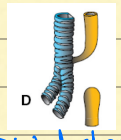
→ 90 % of cases → 1 /3000 birth



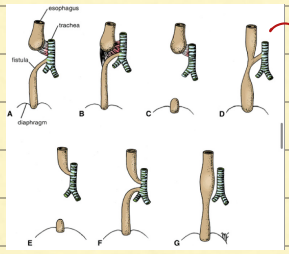
→ Other cases (Less common):



H-shaped



Distal atresia + proximal fistula



* All cases of TEF can cause the following complications :-

- If there's atresia → polyhydramnios (↑ amniotic fluid) (the opposite of oligohydramnios)

↳ WHY? Bcz we have atresia (closed end) → so the amniotic fluid returns back to the amniotic sac as it's being continuously secreted → ↑ amniotic fluid

- If we have a fistula → Pneumonitis

(inflammation in the lungs) → Due to: Fluids movement from GIT to RT

→ Bulge of the abdomen → Due to: Air movement from RT to GIT (abdomen)

- Other anomalies (esp. if there's atresia) → Cardiac anomalies (33%)

→ Vertebral anomalies

→ Anal anomalies

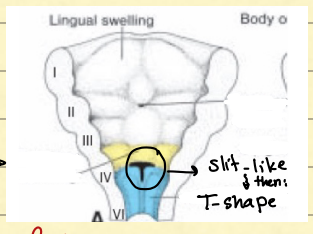
→ Renal anomalies

→ Limb anomalies

* Tracheal atresia & stenosis → Uncommon case

↳ usually causes partial airway obstruction

* Development of the Larynx



→ its cartilages + muscles → from mesoderm (mesenchymal in origin) of 4th + 6th pharyngeal arches

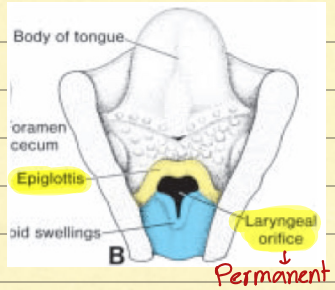
→ Laryngeal inlet → was a slit-like opening then → undergoes many changes

↓

Becomes a T-shaped opening

→ its lining → Endodermal in origin

* Larynx cartilages (thyroid + cricoid + arytenoid)
↳ When they develop ⟹ (Formation of:) a permanent laryngeal opening + epiglottis



↓ next stage in larynx development:

- Proliferation of cells → from endoderm + mesenchyme (inside the larynx)
  ↳ this causes a block in the larynx (lumen occlusion) (becomes filled with cells)

↓ Then:

- Canalization / vacuolization on the lateral sides

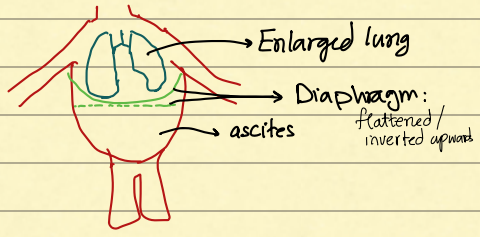
WHY do we need these 2 stages?
To form the ventricles + the saccule → on the lateral wall
↳ Above & below the ventricle ⟹ True + false vocal cords

* So: ventricle + saccule + true vocal cords + false vocal cords are formed from proliferation of cells → then canalization on lateral sides

* Nerve supply of the larynx
→ Mainly from: vagus nerve (Branches: Recurrent laryngeal; Sup. laryngeal → internal laryngeal, external laryngeal)
↳ Larynx: develops from 4th to 6th pharyngeal arches
↳ Cricothyroid muscle (From: 4th pharyngeal arch) → External laryngeal
↳ The rest of the muscles (From: 6th pharyngeal arch) → Recurrent laryngeal

* Anomalies of the larynx :-

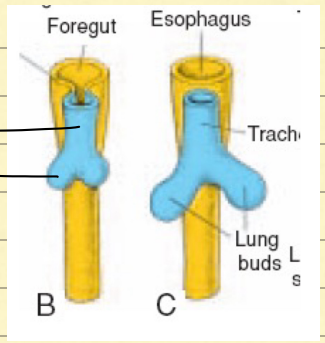
- Laryngeal atresia = congenital high airway obstruction syndrome (CHAOS)
↳ Rare!
↳ can lead to obstruction of the upper airway passage
↳ enlargement of the lung (not shrinkage) → to compensate for the obstruction from the atresia
↳ Diaphragm is flattened or inverted upwards
↳ Ascites (accumulation of serous fluid)
↳ Diagnosis: ultra-sonography



* Development of trachea + Bronchi + Lungs

↳ Are all from lung buds

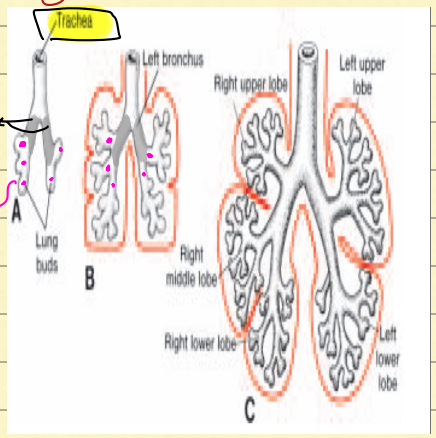
Starting from: • Trachea
• Bronchial buds → Rt / Lt main bronchi
∴



in blue: Lung buds

* A separation then happens between foregut + Lung bud

* In development (every main bronchus attains its shape)
- Rt main bronchus → vertical + wider + shorter
- Lt main bronchus → horizontal + narrower + longer



* Secondary bronchi (lobar)
- 3 to the right
- 2 to the left
} they go to the lobes

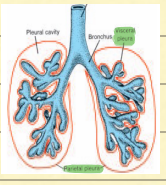
* Tertiary bronchi / bronchopulmonary segments
- Rt → 10 (Apical + Ant. + Post. / medial + lateral / 5 basal)
- Lt → 8 before birth (apico-post. + Ant. + sup lingual + inf. lingual / Antero-medial .....)
then: apical → post
Anterior → then: medial

↳ The segments undergo a dichotomous division 17 times ⟹ Giving 17 generations
⟹ after birth: We have 6 more divisions (postnatal) (so: a total of 23 divisions) → The bronchioles (then they give alveoli + sac...)

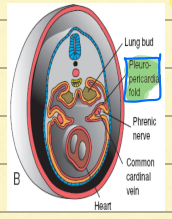
⇝ WHAT causes these divisions? Fibroblast growth factor (FGF)

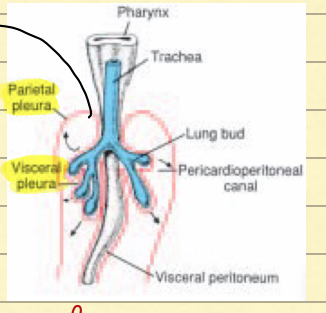
→ Then the lung + bronchial trea continue to grow, the lungs assume a more caudal position & the trachea assume its normal position (opposite the T4) → * Birth *

* The spaces for the lungs (where the lungs + bronchi grow)
↳ From: pericardioperitoneal canal
then: divides into:
Pericardial (surrounding the H) / Peritoneal (surrounding the abdomen)



Development of pleura





- And the pleuropericardial fold is upwards ⟹ Gives a space for the pleura
↳ the lungs develop here!, in the pleuropericardial space

* Visceral pleura → comes from the mesoderm that covers the lung from outside (covers the lung bud)

TABLE 12.1 Maturation of the Lungs (4 phases:)

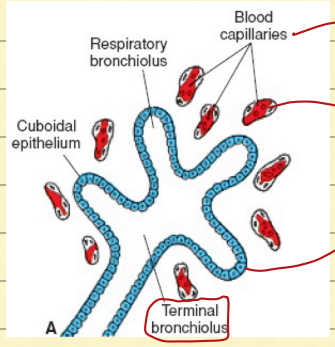
Pseudoglandular period	5–16 weeks	Branching has continued to form terminal bronchioles. No respiratory bronchioles or alveoli are present.
Canalicular period	16–26 weeks (≈ 6 months)	Each terminal bronchiole divides into 2 or more respiratory bronchioles, which in turn divide into 3–6 alveolar ducts.
Terminal sac period	26 weeks to birth	Terminal sacs (primitive alveoli) form, and capillaries establish close contact. to alveoli
Alveolar period	8 months to childhood	Mature alveoli have well-developed epithelial endothelial (capillary) contacts.

→ No respiration in this phase (only conducting bronchioles)

→ No respiration (still no respiratory membrane for gas exchange)

→ There's respiration ✔ (so: the baby born after 7 months can live!) (the respiratory membrane between capillaries & alveoli has developed)

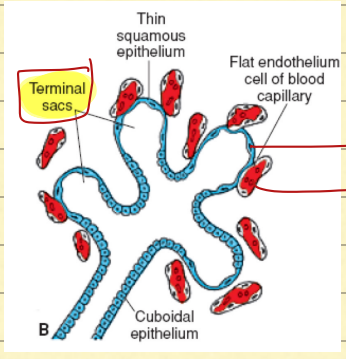
Well-developed resp. membrane



* canalicular phase :-

- capillaries are far away from the resp. bronchioles
- type of cells: cuboidal lining epi (still terminal bronchioles → not yet simple squamous)

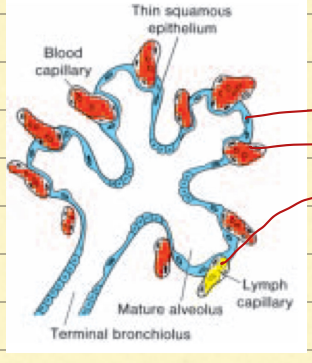
* Resp. bronchioles start to develop here



* Terminal sac phase:-
(we have terminal sacs / primitive alveoli)

- the cells are simple squamous
- Capillaries are adherent to alveoli → to form: resp. membrane

✔ Gas exchange is possible (in preterm infants → Can live!) (7 months)



* Alveolar period:-

- all cells are simple squamous epi
- capillaries are more in-contact with alveoli
- Lymph capillaries develop
- The alveoli are developed (both → Type 1 alveolar cells, Type 2 alveolar cells (secrete surfactants))

↓
full alveolar maturation happens after birth

↓
Especially in last 2 weeks before birth

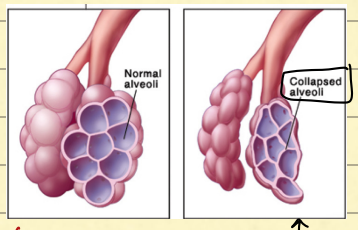
* The baby's respiratory tract directly after birth is filled with fluids: From cells / glands / surfactants

→ aspiration of fluids (عشان يقدر يتنفس) + (عشان يبدأ الـ respiration عشان ينزل بسرعة على ظهره اول ما يولد)

* Most imp. thing in respiration → is the surfactant membrane (the lining of type 1 alveolar cells)

If absent: Respiratory distress syndrome = Atelectasis during expiration = Hyaline membrane disease

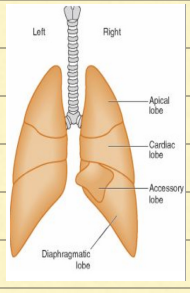
Decreases the surface tension (For lung expansion)



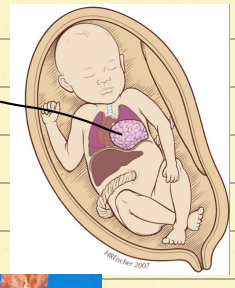
* Anomalies of the RT :-

- (RDS): respiratory distress syndrome → in premature infants
  - → Collapse of the lung during expiration
  - → Due to loss of surfactants
  - ⇓
  - But nowadays, surfactants can be given artificially or some drugs can be given to stimulate surfactants secretion → Thyroxine, Cortisone (like: Beta methasone)
  - → constitutes 20% of deaths among newborns

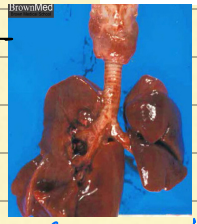
- Ectopic lung :-
  - → for e.g) 4 lobes in left lung instead of 2 lobes
  - ⇓
  - Caused by ↑ formation of lung buds (additional lung buds)



- Congenital cysts in the lungs — can be: single or multiple
  - → Most imp. side effect: Chronic infections in the lung



* Lung Hypoplasia (shrinkage of the lungs / ↓ in size)
  - → Usually develops with congenital diaphragmatic hernia.
    - → (common on left side)
    - → When a certain organ is pushed upwards → pressure on left lung ↓



When the lung is small → Can lead to asphyxia (neonatal) ⇐ ↓ Lung size

* Oligohydramnios → ↓ amount of amniotic fluid
  - Important for RT organs maturation
  - → if decreased ? Pulmonary hypoplasia

* Lungs of the newborn infants

→ if the baby is born already dead (still birth)
↳ when taking a lung tissue & putting it in water → will sink downwards

→ But if the baby was born normally but died after birth
↳ when taking a lung tissue & putting it in water → will float

- So: we can differentiate between these 2 cases by this simple lung test (bc in the 2nd case → could be the doctor's mistake & he's guilty !)

دعواتكم لأهلنا في غزة ...
للأسرى والشهداء والمكلومين ...

واذكروني في دعواتكم

بالتوفيق ...

* Weeks of development :-
- Facial prominences → 4th week
- Nasal pits (from nasal placode) → 5th week
- Fusion between medial nasal + maxillary prominences → 6th-7th week
- Fusion of lateral shelves of 2° palate → 7th week
- Fusion of the 2 folds of the soft palate → 8th week
- Fusion of the 2 parts of the uvula → 11th week
- Beginning of development of the RS → 4th week
- Resp. bud / lung bud / resp. diverticulum appearance → 4th week

development of lung:
- Pseudoglandular period → 5 - 16th weeks
- Canalicular period → 16 - 26th weeks
- Terminal sac period → 26th week to birth
- Alveolar period → 8th month - childhood