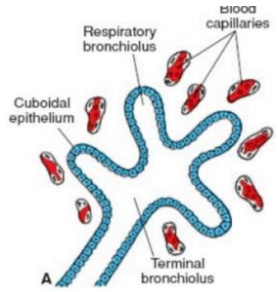
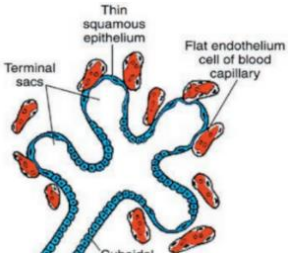
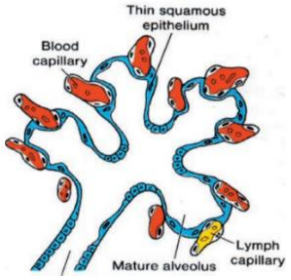
Maturation and development of the lungs

Pseudo-glandular period (stage 1): 1. Formation of conducting airways (terminal bronchioles) ONLY. 2. The epithelium is simple cuboidal epithelium.	**From weeks 5 to 16 of gestation** (Ending approximately halfway through the 4th month)
Canalicular period (Stage 2): 1. Each terminal bronchiole will divide to form about 2 respiratory bronchioles, and each of those will divide to form 3-6 alveolar ducts. 2. The epithelium becomes simple squamous epithelium. 3. Vascular supply increases steadily as alveolar capillaries (gas exchange may be possible at this stage).	**From weeks 16 to 26 of gestation** (Approximately up to 6th and a half months of gestation) 
Terminal Sac Period (stage 3): 1. Formation of immature alveoli, called terminal sacs or primitive alveoli. 2. Simple squamous epithelial cells are intimately associated (in contact) with numerous blood and lymph capillaries.	**From the 26th week of pregnancy until delivery** (Approximately 6.5-7th month) 
Alveolar Period (stage 4): 1. This period includes maturation of alveoli and an increase in their number. 2. Alveolar capillaries have established complete contact with the alveoli forming the respiratory membrane (blood-air barrier). 3. Type I alveolar cells become thinner to allow the alveolar capillaries to protrude into the alveolar sacs. 4. Lymphatic capillaries achieve close contact with the alveolar sacs.	**From the 8th month of pregnancy and continues through the first 10 years of life (childhood).** 

The development of type II alveolar cells (surfactant producing cells) reduces the surface tension at the liquid (water)air barrier in the alveolar sacs	Starts at the end of the 6th month of pregnancy or the beginning of the 7th month to the 8th month. The peak in surfactant production in the 9th month of pregnancy; specifically, when only 2 weeks are left for delivery.

Important notes
Many babies are born at the 7th month of pregnancy, which almost corresponds to the terminal sac stage of development, and they can survive.
Only one sixth of the total adult alveoli number is present at birth
What matters most for the growth of the lungs is the increase in the number of alveoli and bronchioles, not the increase in size.
Amniotic fluid is important in the stimulation of further lung development and conditioning of the respiratory muscles to make the baby ready for pulmonary ventilation after delivery.
At birth, when respiration begins, the fluid filling the lungs has to be resorbed. This happens by the help of blood and lymphatic capillaries.

Congenital Anomalies	
Respiratory Distress Syndrome (RDS)	▪ Missing surfactant at birth → during expiration, the newborn's alveoli will collapse due to loss of compliance and the need for high pressure to overcome the collapsing force of the lung and to keep the alveoli open. ▪ Accounting for 30% of neonatal diseases and 20% of deaths of newborns. ▪ Prematurity is one cause of RDS (insufficient amounts of surfactant) ▪ Treatment with glucocorticoids (like betamethasone) and thyroxine (stimulators for surfactant production). ▪ A common complication of RDS is intrauterine asphyxia, which can cause irreversible damage to type II cells → impossible for the newborn to survive. ▪ RDS can also be called hyaline membrane disease because of the high protein content and lamellar bodies that are probably derived from the surfactant layer.
Blind-ending trachea (atresia) with agenesis (absence or imperfect development) of one of the lungs	
Abnormal division of the bronchial tree	▪ More common than RDS. ▪ Result in supernumerary lobes, 3 or 4 lobes in the left lung instead of 2. ▪ Not functional significance but may cause difficulty during bronchoscopy.
Ectopic lung lobes	▪ lung lobes are developing somewhere outside the normal site. ▪ Probably arising from the trachea or esophagus. ▪ This happens by the formation of additional respiratory buds of the foregut.
Congenital cysts of the lung	▪ The most important clinically, lung with a honeycomb appearance on x-ray ▪ These occur due to the dilation of terminal or larger bronchi. ▪ One important complication is chronic infections because cystic structures of the lung drain poorly
Lung Hypoplasia	▪ Reduced lung volume… can be treated. ▪ Associated with Congenital Diaphragmatic Hernia (CDH). ▪ CDH is more common on the left side. ▪ Most infants due to pulmonary insufficiency as their lungs are too hypoplastic. This mainly depends on whether the other lung can compensate or not.
Oligohydramnios	▪ Reduced amount of amniotic fluid. ▪ Severe pulmonary hypoplasia will take place