Embryology

By: Dr. Ammar Ismail

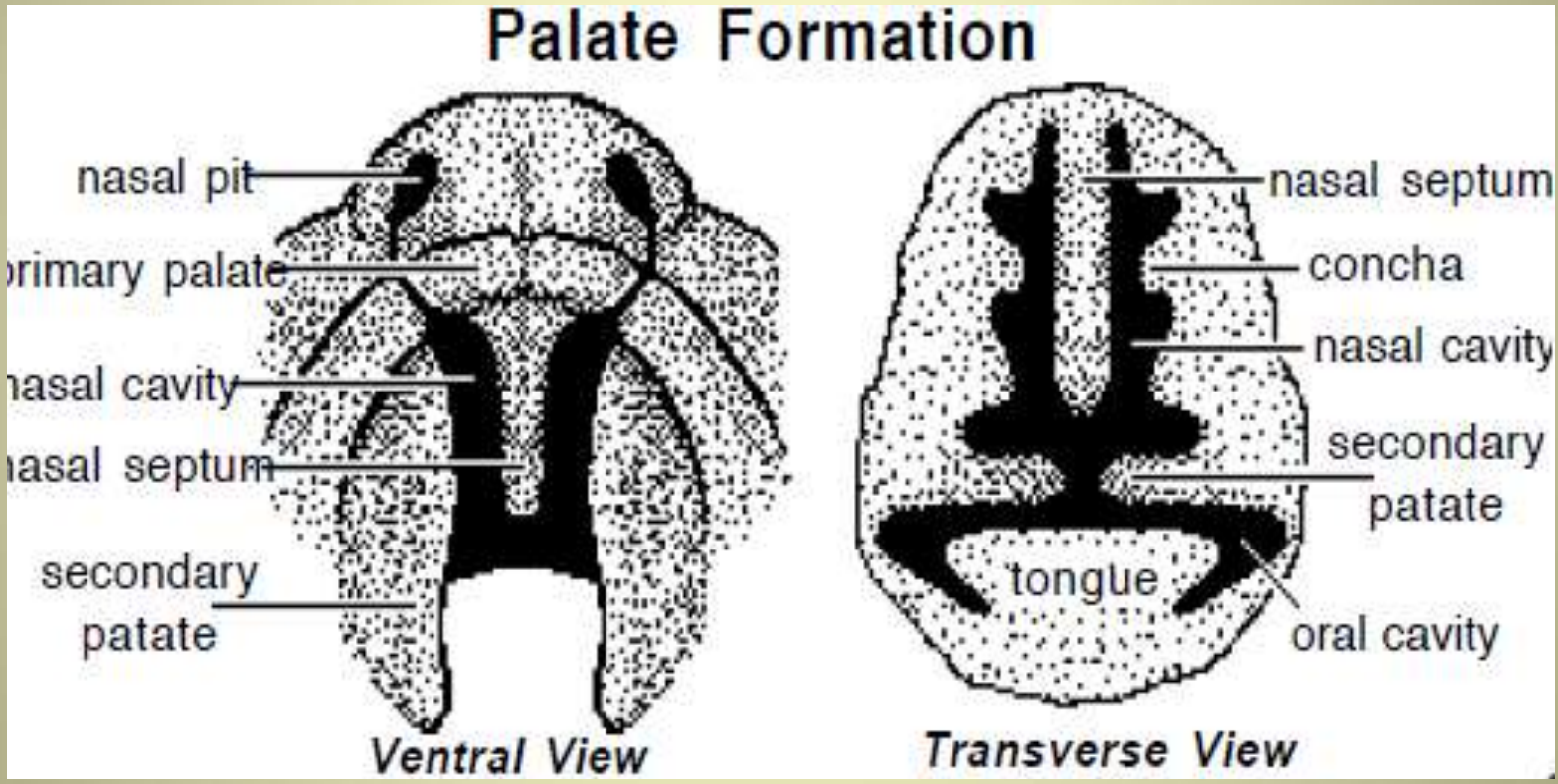
Respiratory system

- *The respiratory system consists of the nasal cavity, pharynx, larynx, trachea and lungs. The lining of the nasal cavity is derived from ectoderm; the lining of the rest of the respiratory system comes from endoderm.*

Summary of Nasal Cavity Development:

- *• (the placodes are ectodermal thickenings at the ventral tip of the frontonasal prominence).*
- *initially, bilateral nasal (olfactory) placodes appear.*
- *• placodes become nasal pits by outward growth of the surrounding medial and lateral nasal processes of the frontonasal prominence*
- *• continued outgrowth of medial & lateral nasal processes elongates the nasal pits and transforms them into a nasal cavity*
- *• right and left medial nasal processes fuse to form a primary palate (incisive bone & rostral upper lip) and a nasal septum; lateral nasal processes become nose cartilage and nasal & lacrimal bones*

- *• formation of the secondary palate divides a common naso-oral space into three separated cavities (right & left nasal cavities and the oral cavity); also, the secondary palate divides the pharynx into three compartments (nasopharynx, oropharynx, & laryngopharynx).*
- *• conchae (scrolls of thin bone covered by mucosa) arise as cartilaginous ridges from bones of the nasal cavity wall*
- *• paranasal sinuses (diverticula of the nasal cavity) develop postnatally.*


Palate Formation
nasal pit
rimary palate
asal cavity
asal septum
secondary
patate
Ventral View
nasal septum
concha
nasal cavity
secondary
patate
tongue
oral cavity
Transverse View

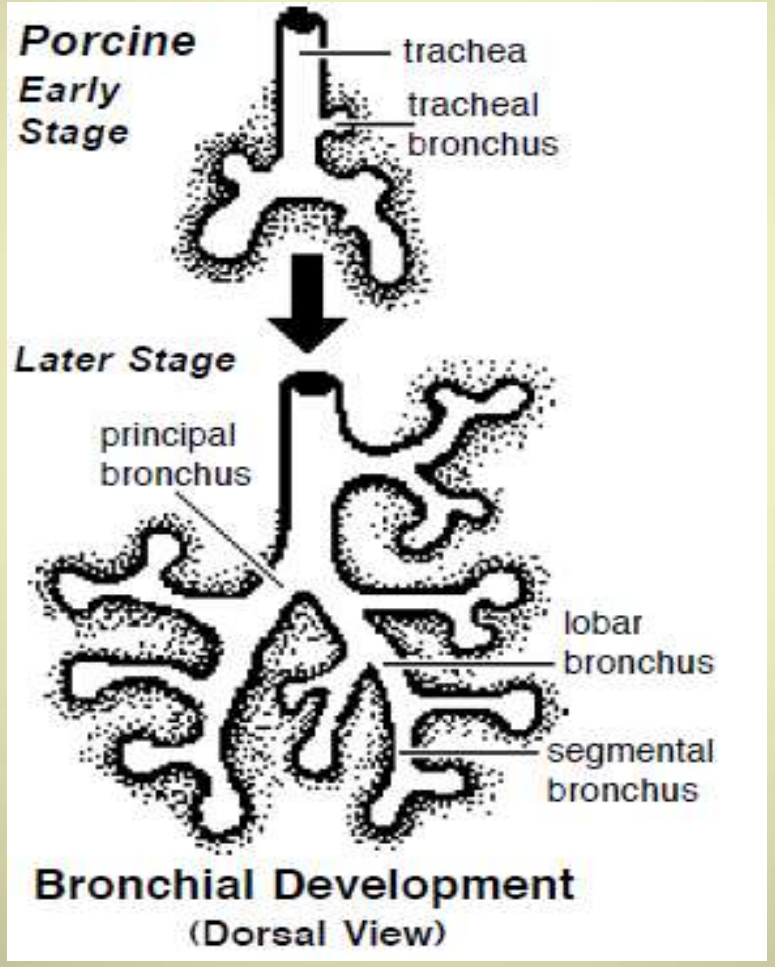
Larynx, Trachea and Lungs:

- *These respiratory structures originate as an evagination of endoderm along the floor of the pharynx. The evagination is designated the laryngotracheal groove.*
- *From lateral walls of the laryngotracheal groove, ridges grow medially, and fuse along the midline, establishing a tracheoesophageal septum. The septum separates a laryngotracheal tube (future trachea & lung buds) from the esophagus. The larynx develops rostrally, where the lumen of the groove retains communication with the pharynx.*

Trachea and bronchi:

- *The laryngotracheal tube grows caudally into splanchnic mesoderm located ventral to the pharynx. The mesoderm contributes cartilage and connective tissue and endoderm contributes respiratory epithelium to the developing trachea. Tracheal elongation shifts bronchi caudally into the thorax. The blind, caudal end of the tube develops bi-lobed bronchial buds which grows to form the future principal bronchi. Outgrowths of each principal bronchus form future lobar bronchi, each of which gives rise to outgrowths that become future segmental bronchi, each of which gives rise to more than a dozen additional bronchial branches. The smallest branches are bronchioles. They give rise to lung terminal sacs and alveoli. The bronchial branching continue to occur throughout the fetal period and into the postnatal period.*

- ***NOTE**: Generally in domestic mammals, the right principal bronchus divides into four lobar bronchi (cranial, middle, caudal & accessory lobes), while the left gives rise to two lobar bronchi (cranial & caudal lobes). There are right side exceptions: the horse lacks a middle lobe; (humans lack an accessory lobe) in ruminants and swine the right cranial lobe is supplied by a tracheal bronchus.*


Porcine
Early
Stage
trachea
tracheal
bronchus
Later Stage
principal
bronchus
lobar
bronchus
segmental
bronchus
Bronchial Development
(Dorsal View)

Lungs:

- *Continued branching of the bronchial tree results in lung tissue occupying more and more of the pleural cavity, coated by visceral pleura. The endoderm-lined bronchial tree grows into splanchnic mesoderm which forms the cartilage, fascia, smooth muscle, and vessels of the lung. Initially, bronchiole-lung branches are solid cores of cells that grow into splanchnic mesoderm*
- *(growth is like exocrine gland growth into mesoderm). Eventually, terminal branches become hollow, dilated, and sac-like with endoderm becomes a thin epithelium (terminal sacs). Alveoli are created by the formation of septae that partition the terminal sacs.*

Some endodermal alveolar cells become cuboidal rather than flat and produce a phospholipid surfactant that reduces surface tension and thus facilitates alveolar expansion (as opposed to alveolar collapse). Fetal lungs contain fluid that facilitates the breathing movements that take place in utero to prepare for postnatal respiration. At birth, lung fluid drains or is absorbed as air is breathed.

***NOTE**: Species differ in degree of lung maturity.*