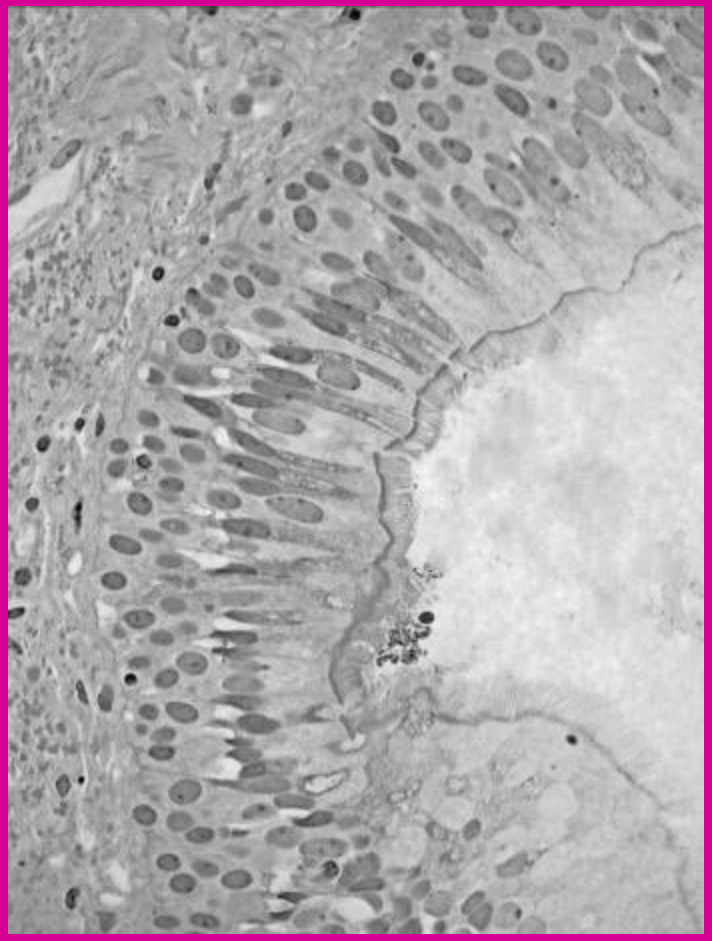
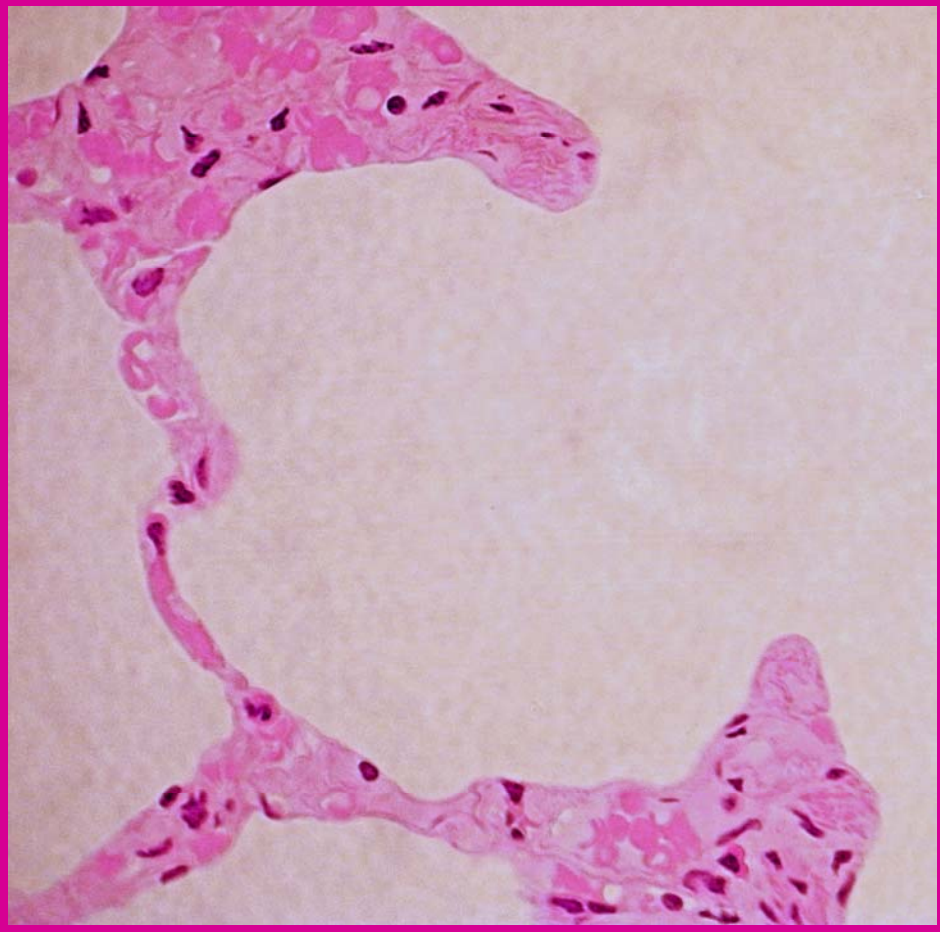
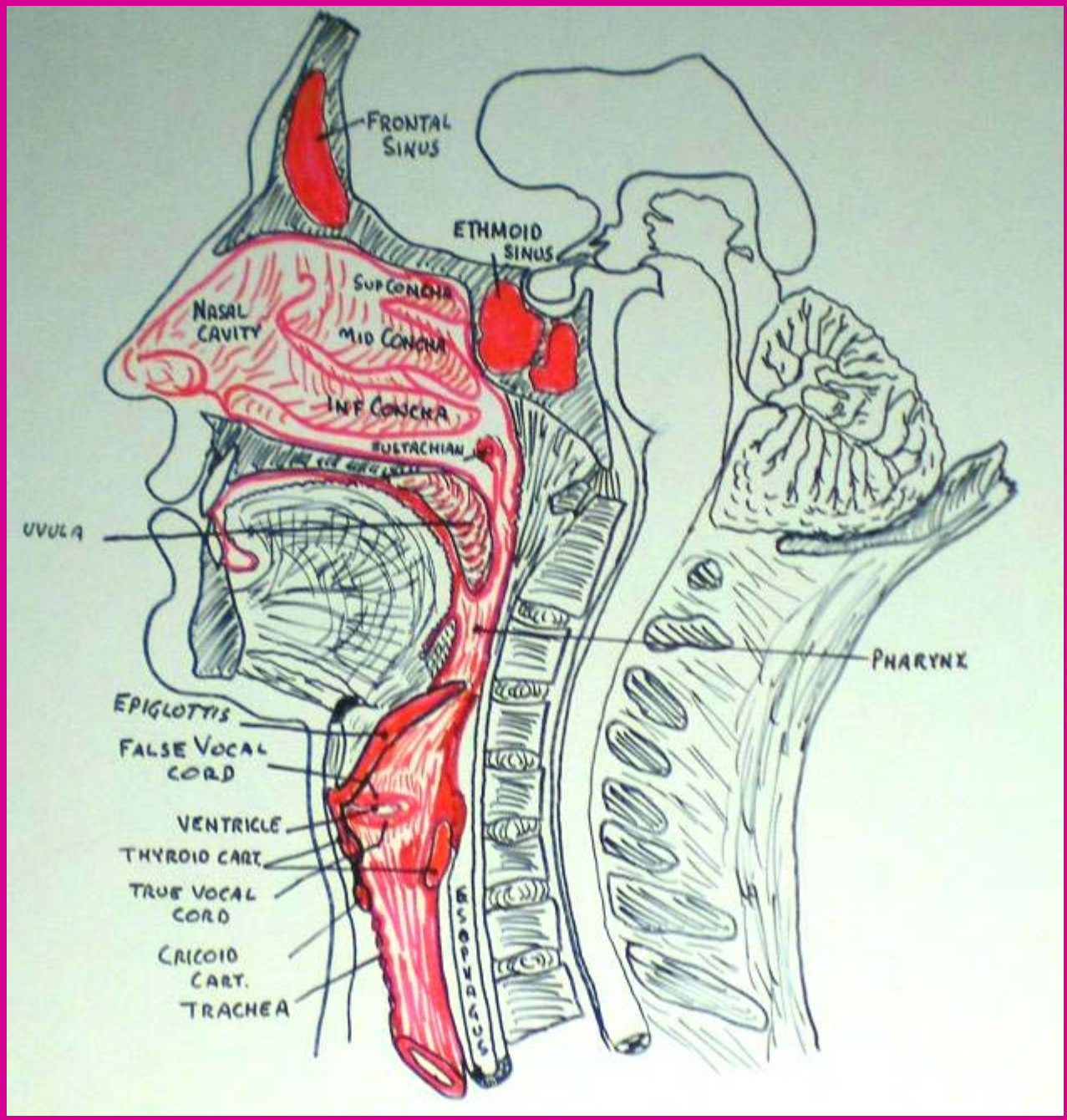
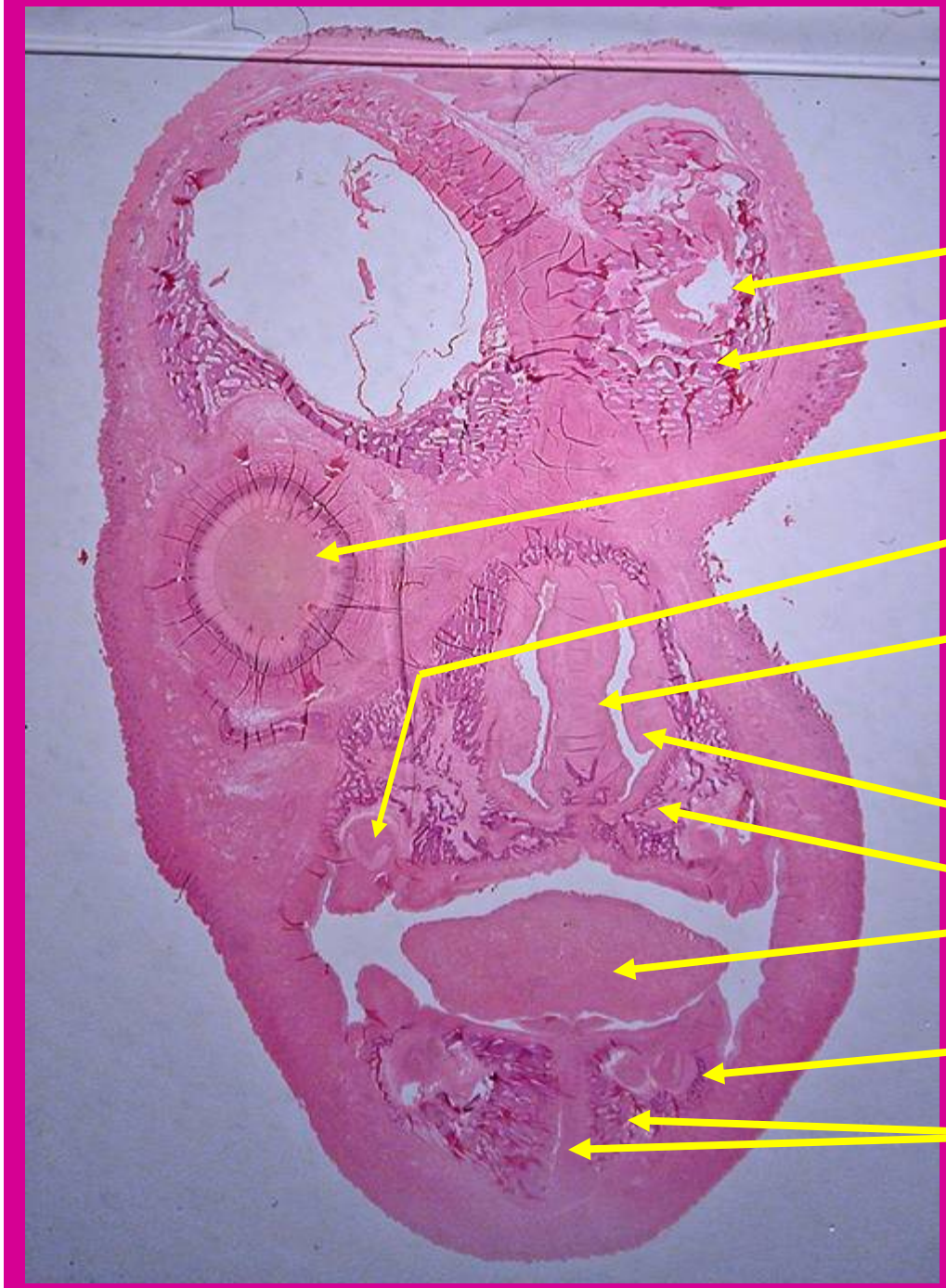
Anatomy & Histology of the Respiratory System





John E. B. Baker,
mikrogeo.com

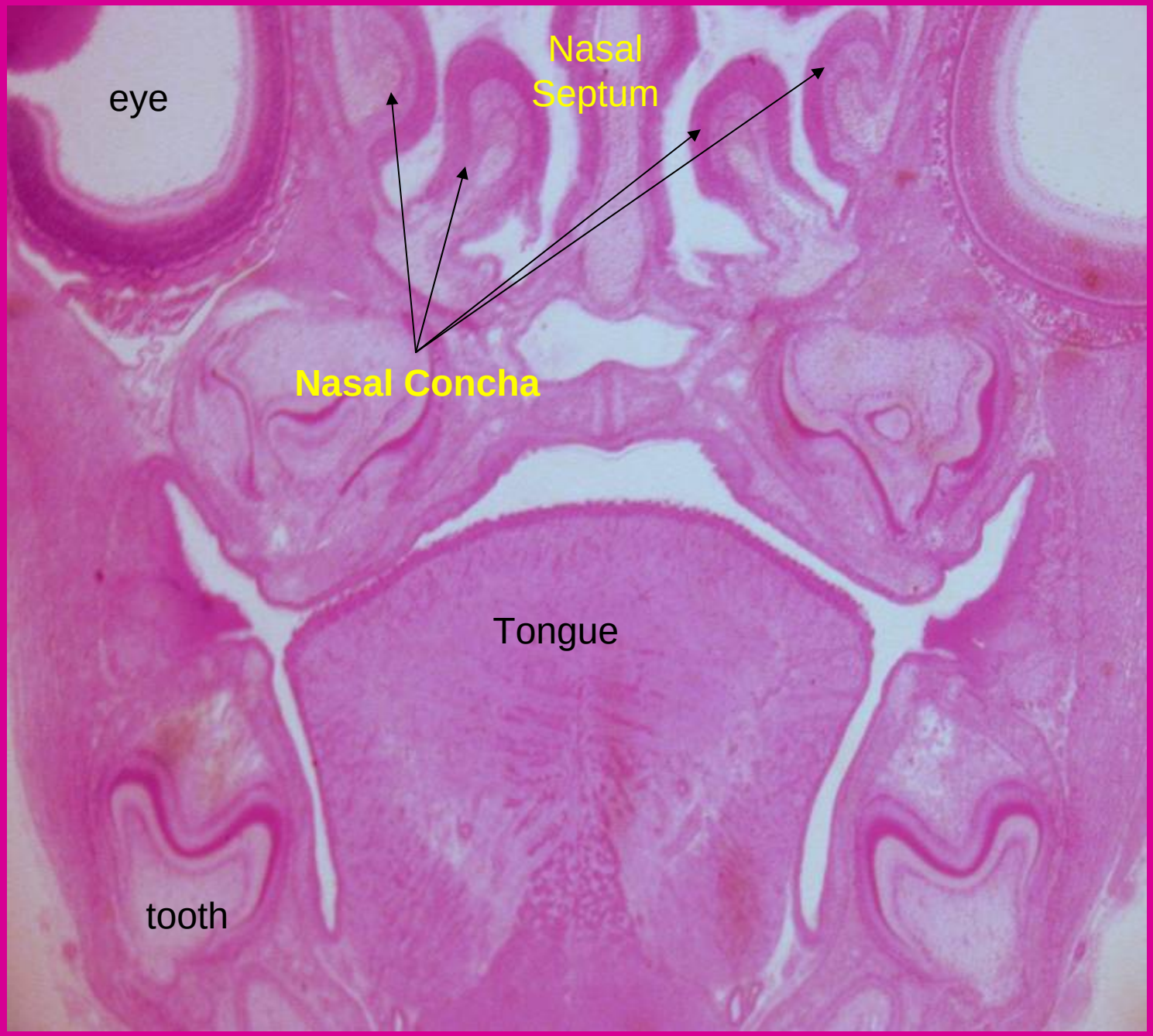

FRONTAL SINUS
ETHMOID SINUS
SUP CONCHA
NASAL CAVITY
MID CONCHA
INF CONCHA
EUSTACHIAN
UVULA
PHARYNX
EPIGLOTTIS
FALSE VOCAL CORD
VENTRICLE
THYROID CART.
TRUE VOCAL CORD
CRICOID CART.
TRACHEA
ESOPHAGUS



Human Face- 65 mm C-R, 12 Weeks

- Frontal Lobe- Left Cerebrum
- Frontal Bone
- Right Eye
- Milk Tooth
- Nasal Septum
- Nasal Concha
- Maxillary Bone
- Tongue
- Milk Tooth
- Mandible & Mental Symphysis

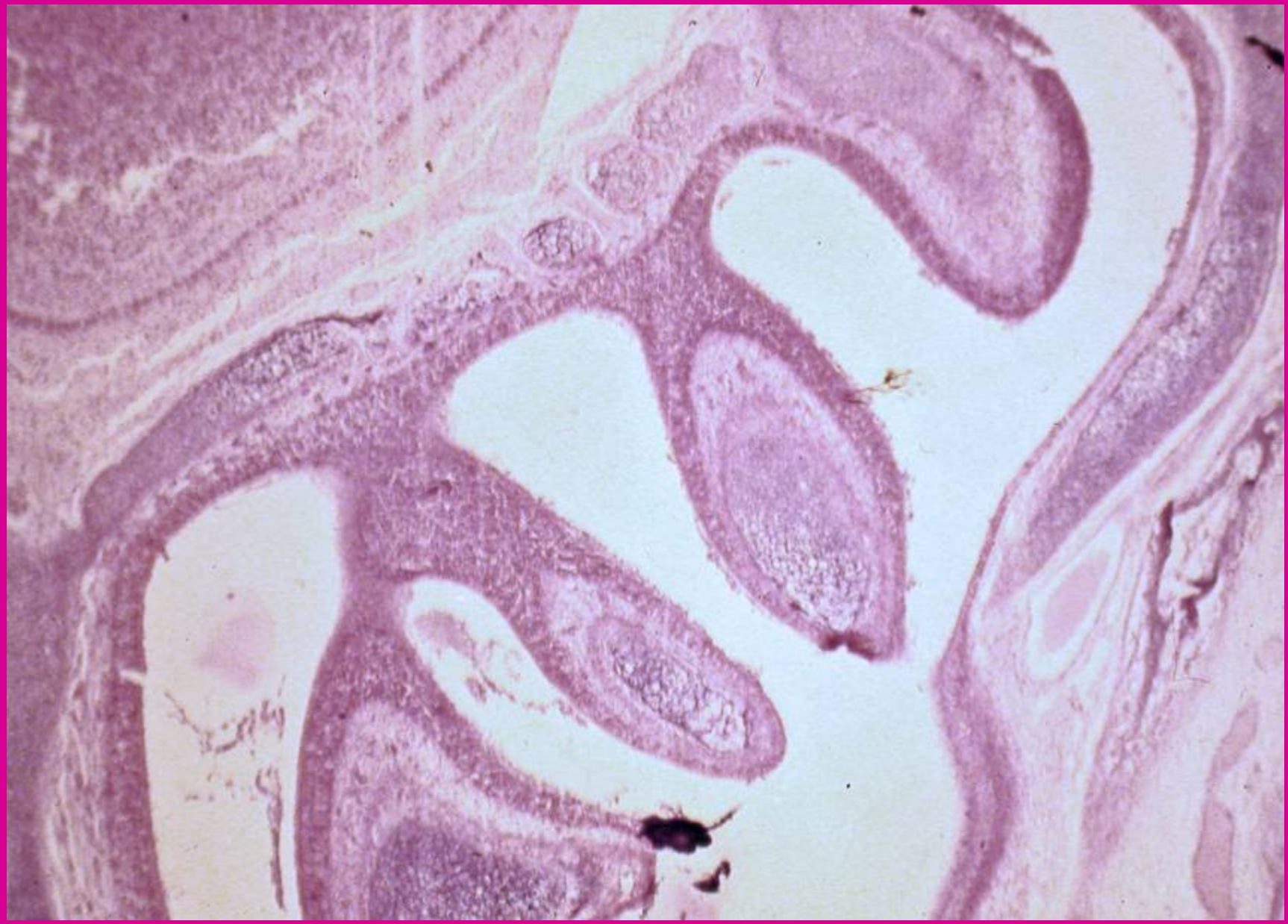
Newborn Rat Face- Compare to Human



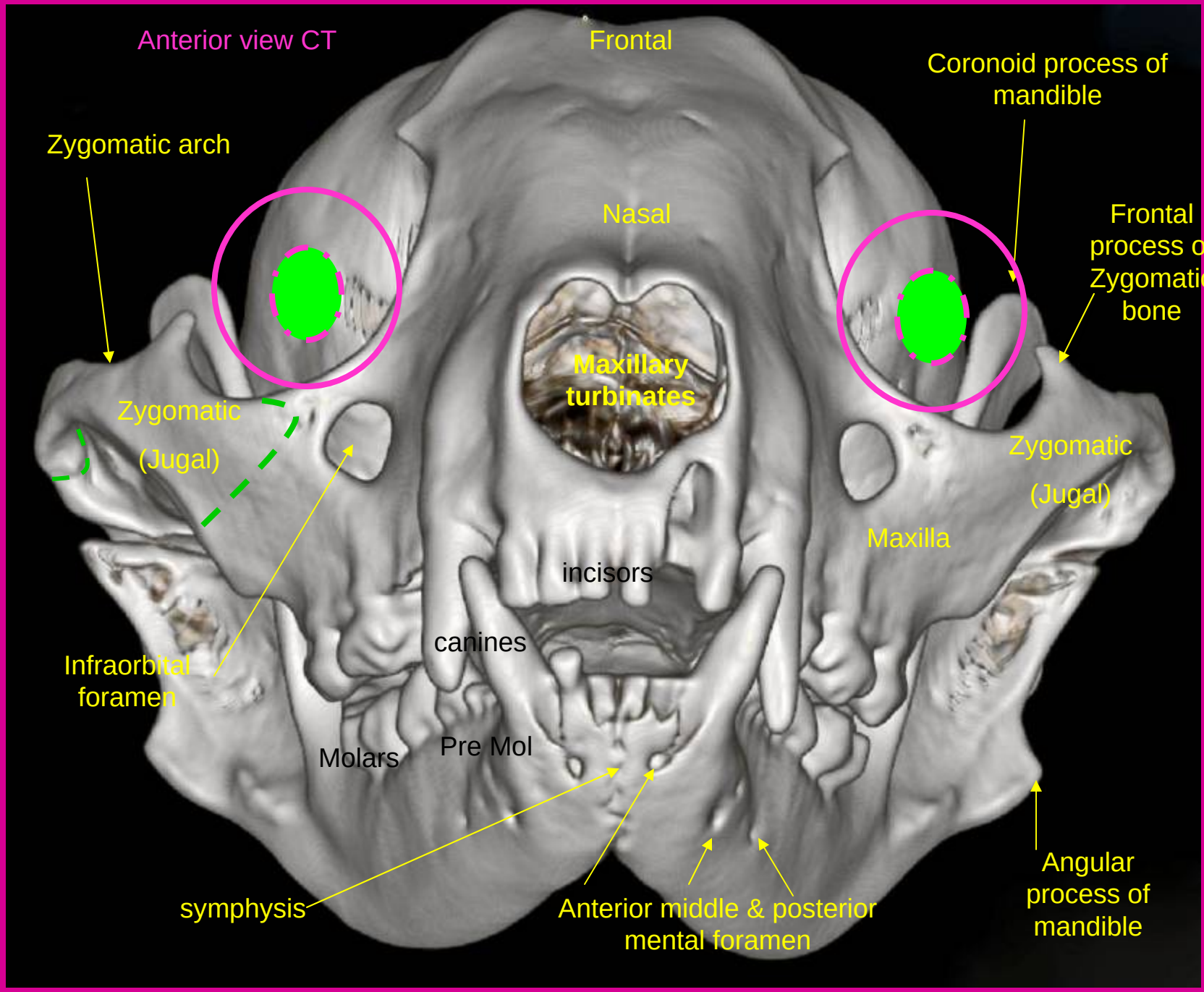

Nasal
Septum

Newborn Rat Face-

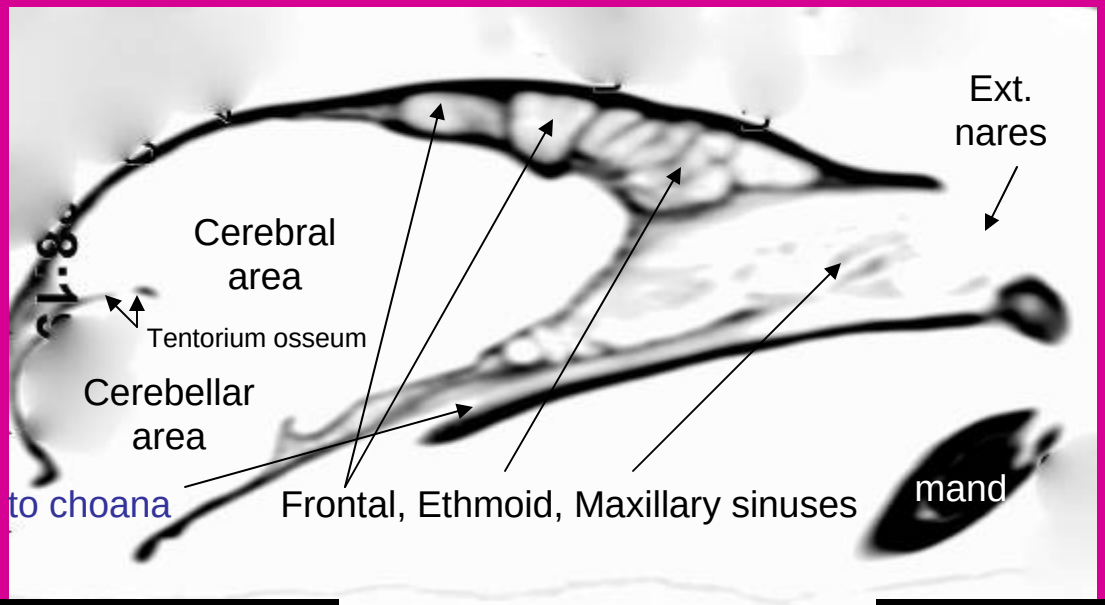
Nasal Passages of
Newborn Mouse:
see next slide

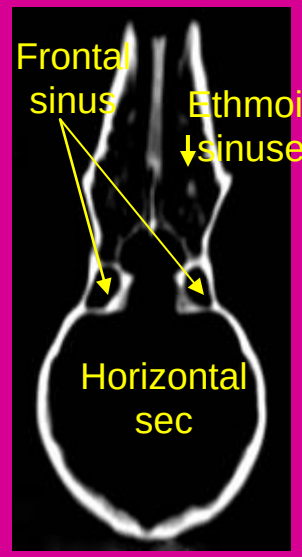



CONCHA or TURBINATES: bony nasal structures which are covered with nasal mucosa in life (cat): bones provide increased surface area

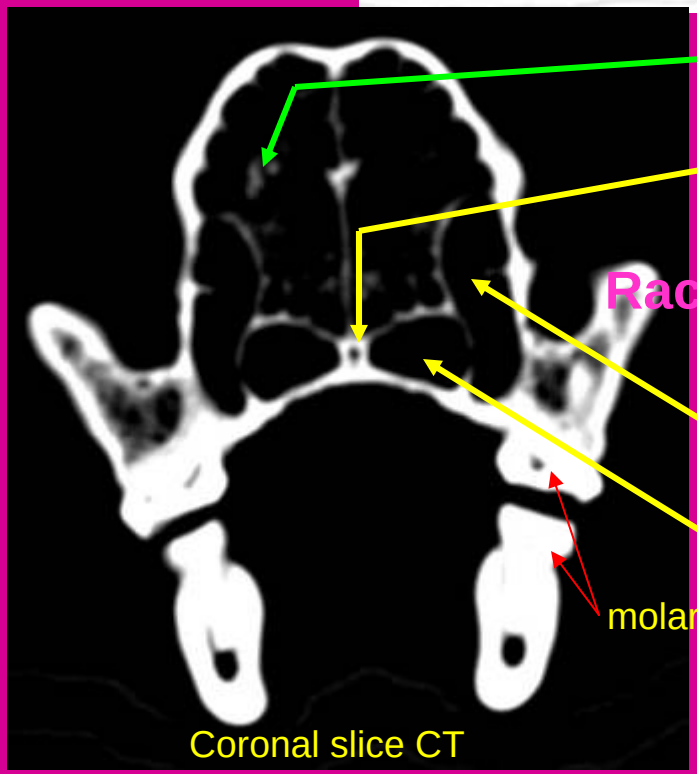

Anterior view CT
Frontal
Coronoid process of mandible
Zygomatic arch
Nasal
Frontal process of Zygomatic bone
Maxillary turbinates
Zygomatic (Jugal)
Zygomatic (Jugal)
Maxilla
incisors
canines
Infraorbital foramen
Molars
Pre Mol
symphysis
Anterior middle & posterior mental foramen
Angular process of mandible

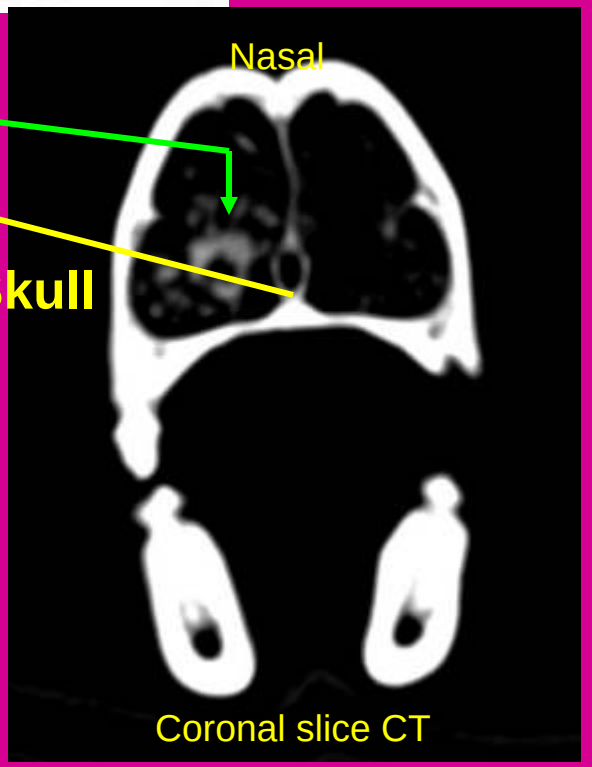
Near mid-sagital CT section



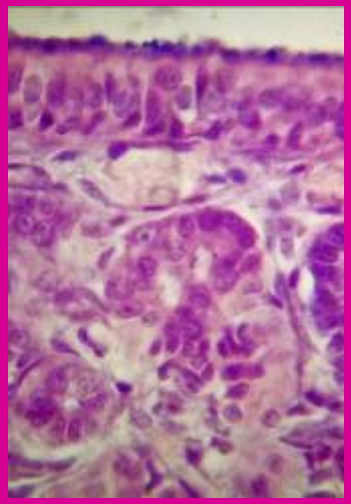


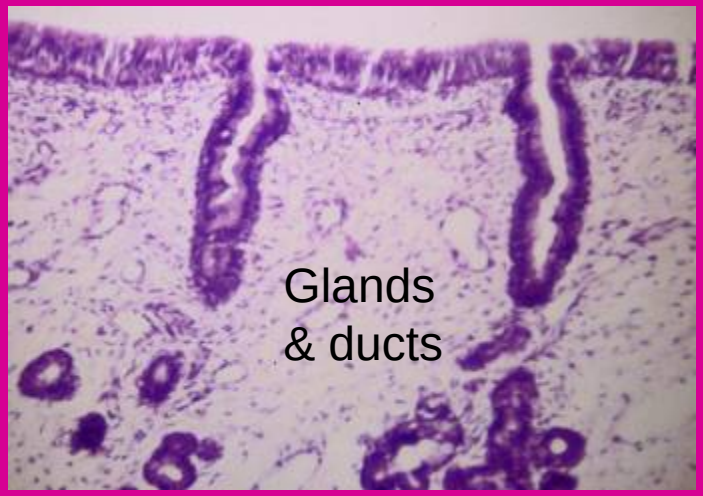
Raccoon (*Procyon sp*) Skull

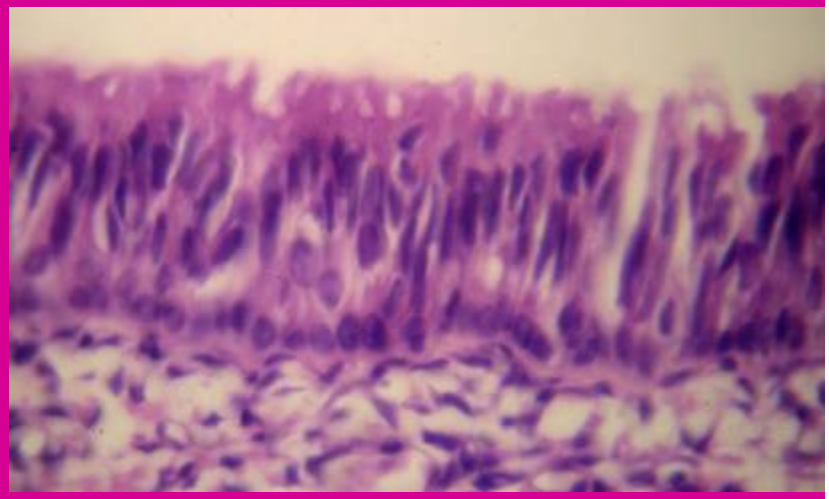




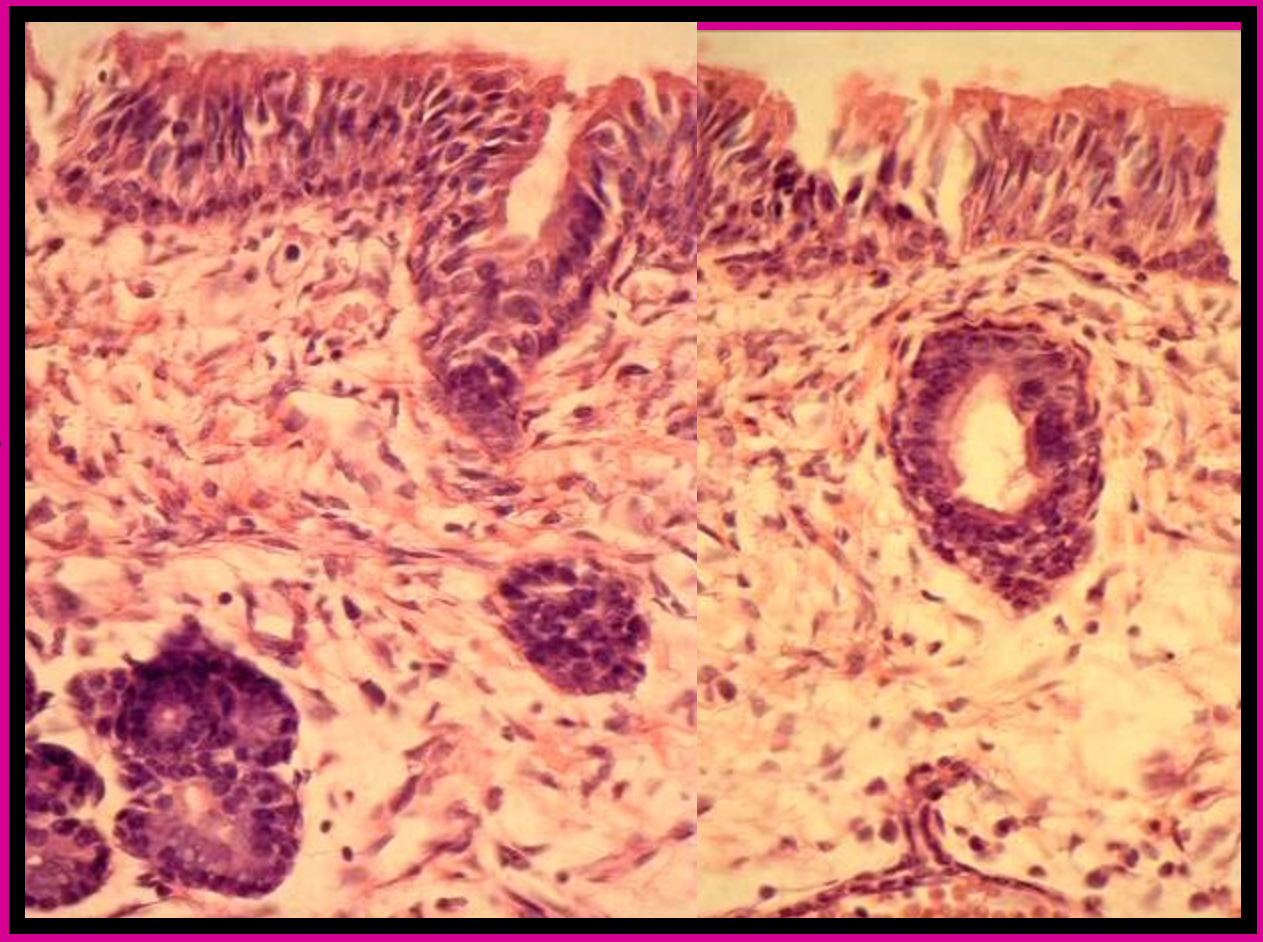
Nasal Concha covered with Olfactory Epithelium: Smell & mucous secretion

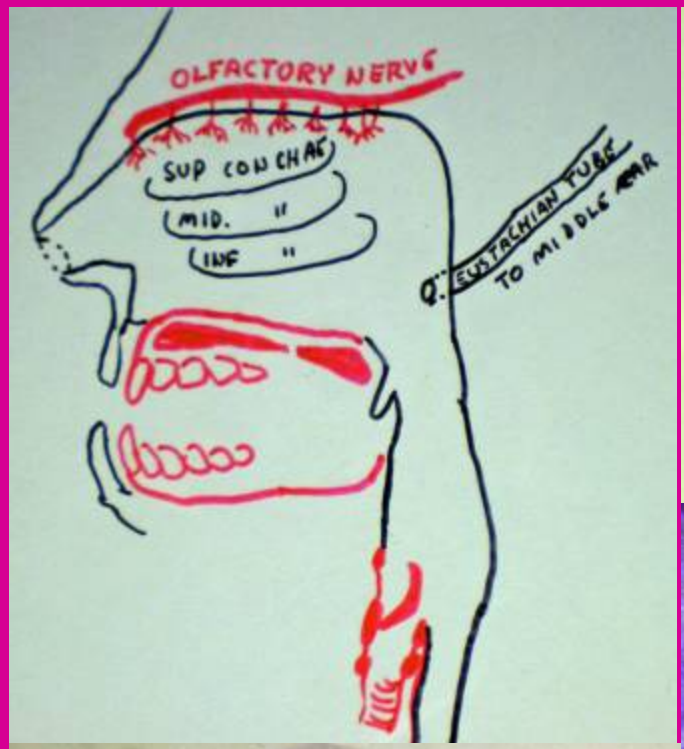


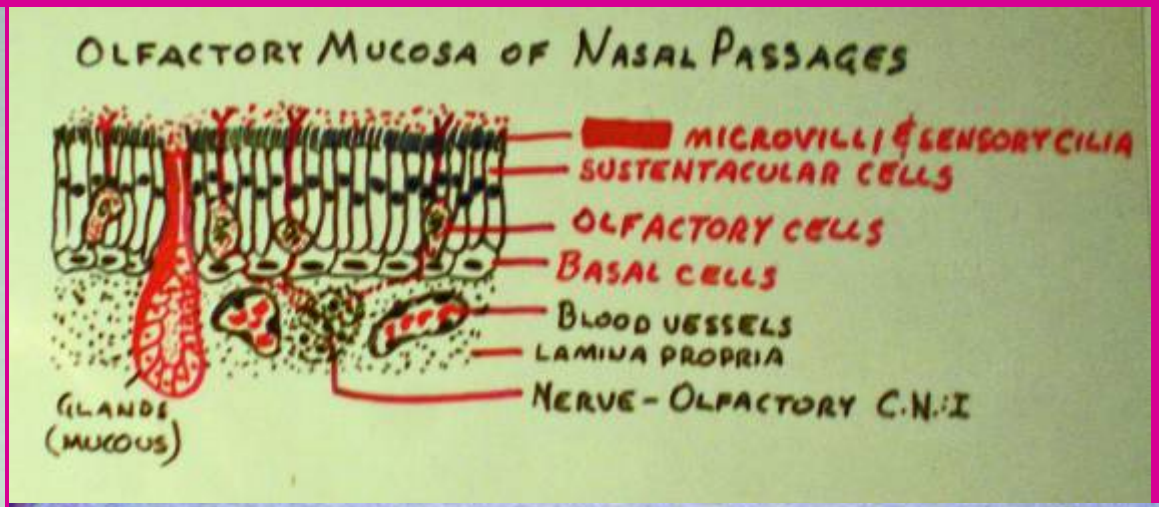


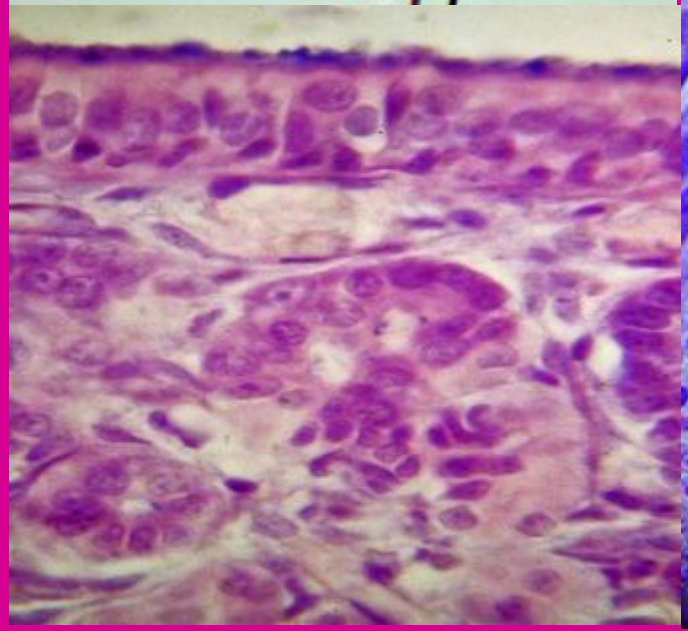


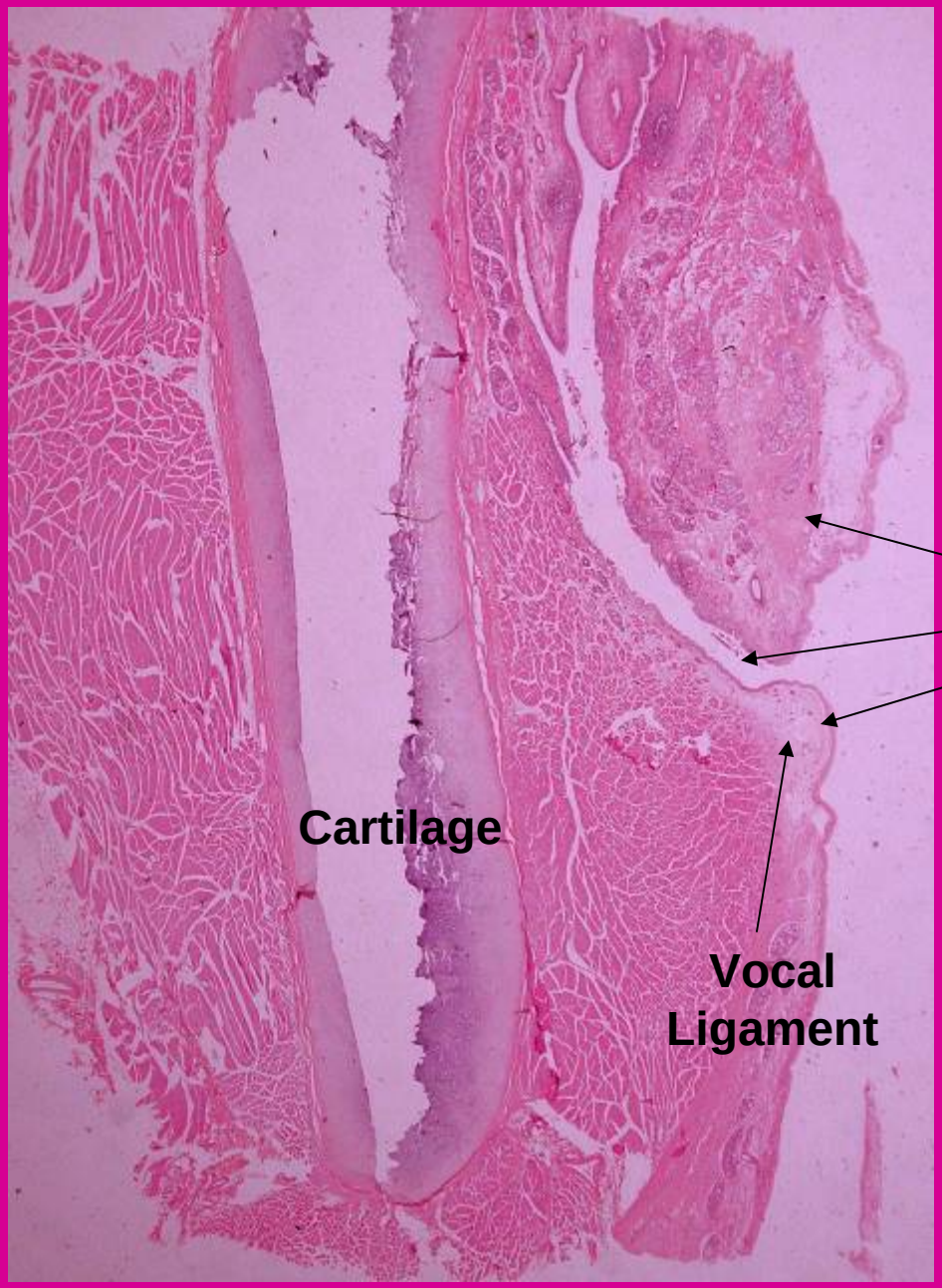
Nasal Respiratory Mucosa & Submucosal Mucous Glands

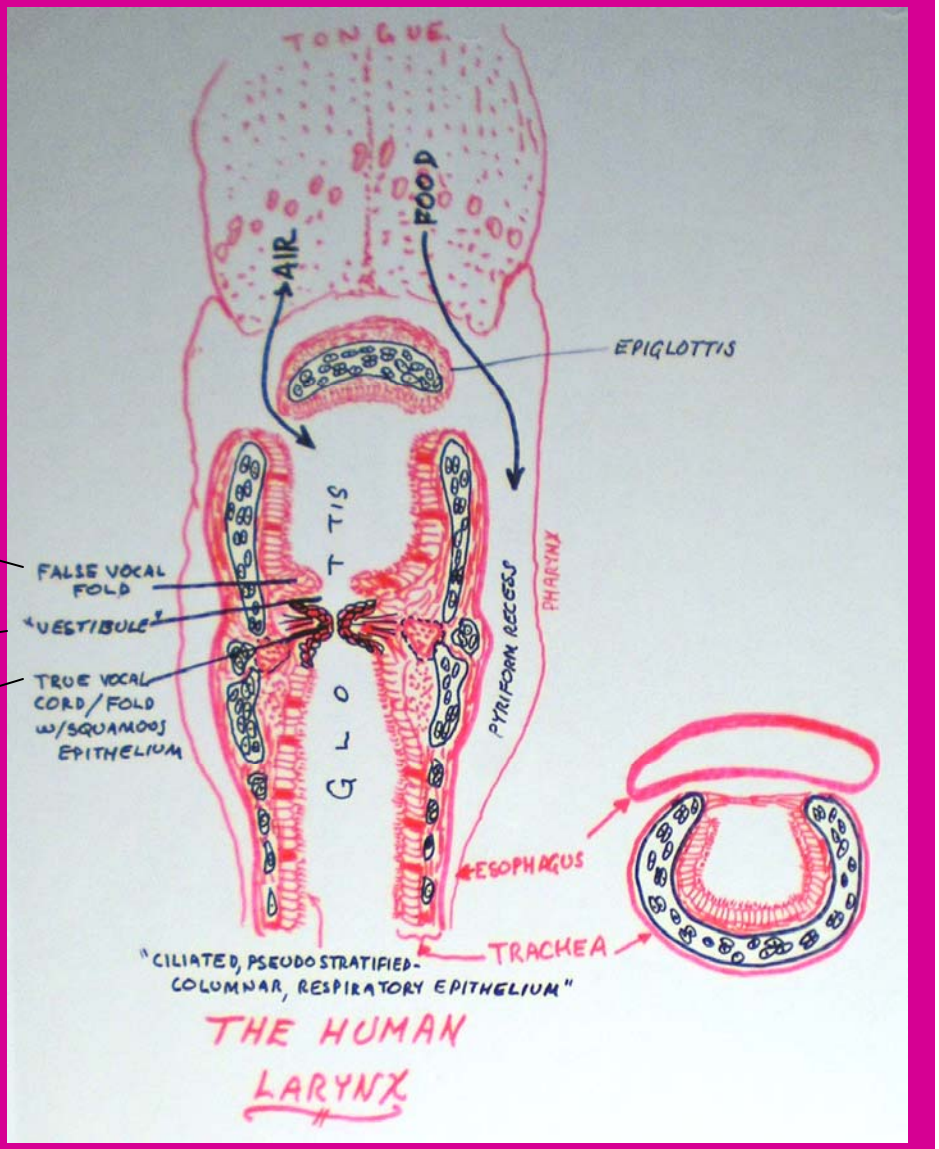


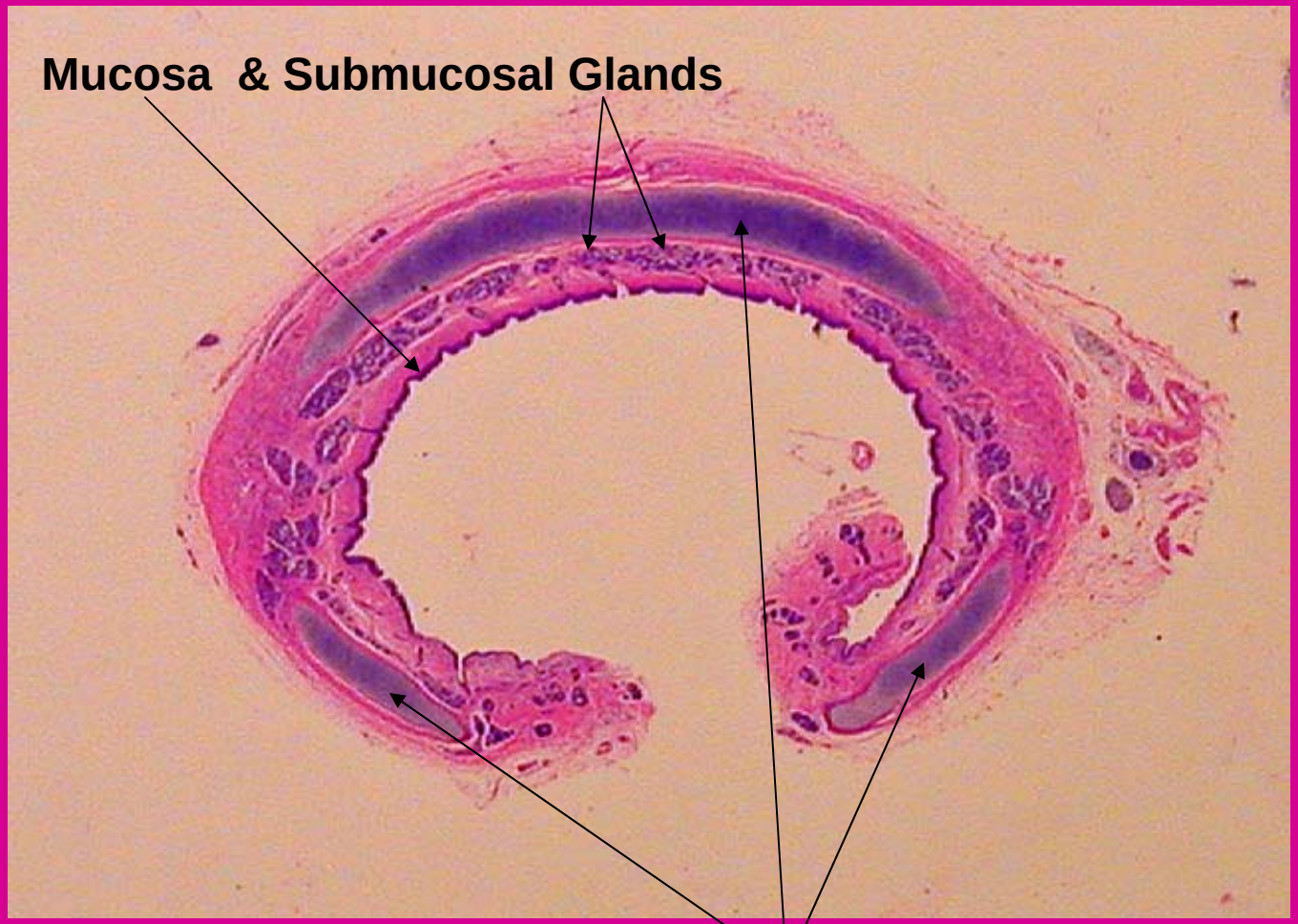

OLFACTORY NERVE
SUP CONCHAE
MID. "
INF "
EUSTACHIAN TUBE
TO MIDDLE EAR


OLFACTORY MUCOSA OF NASAL PASSAGES
MICROVILLI & SENSORY CILIA
SUSTENTACULAR CELLS
OLFACTORY CELLS
BASAL CELLS
BLOOD VESSELS
LAMINA PROPRIA
NERVE - OLFACTORY C.N. I
GLANDS (MUCOUS)

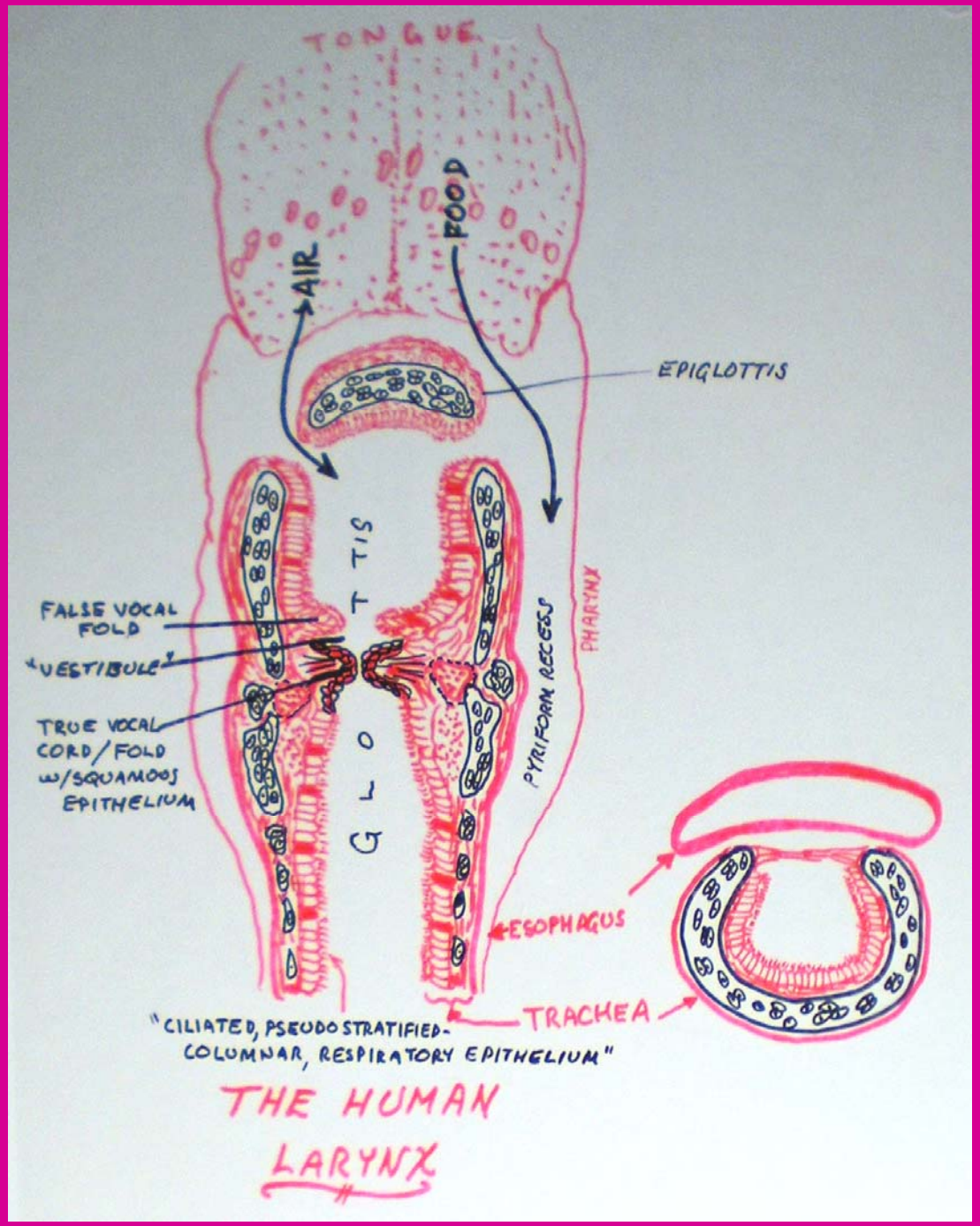


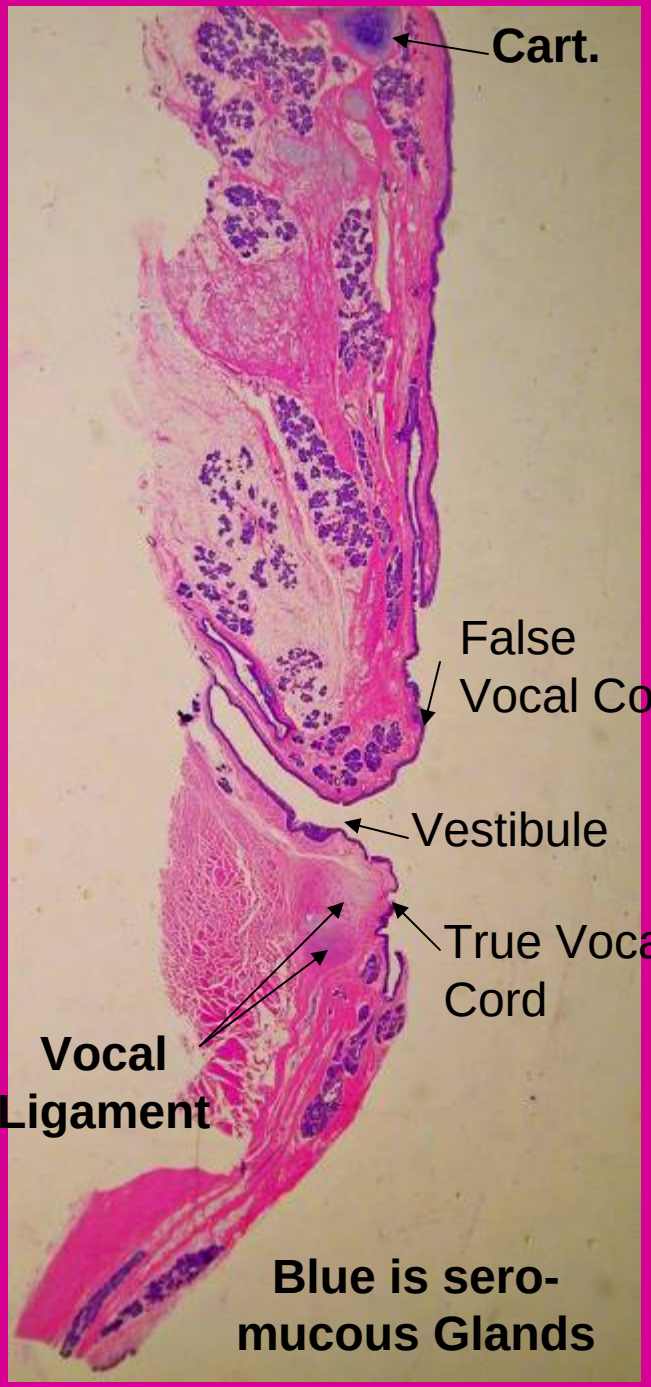

Cartilage
Vocal Ligament

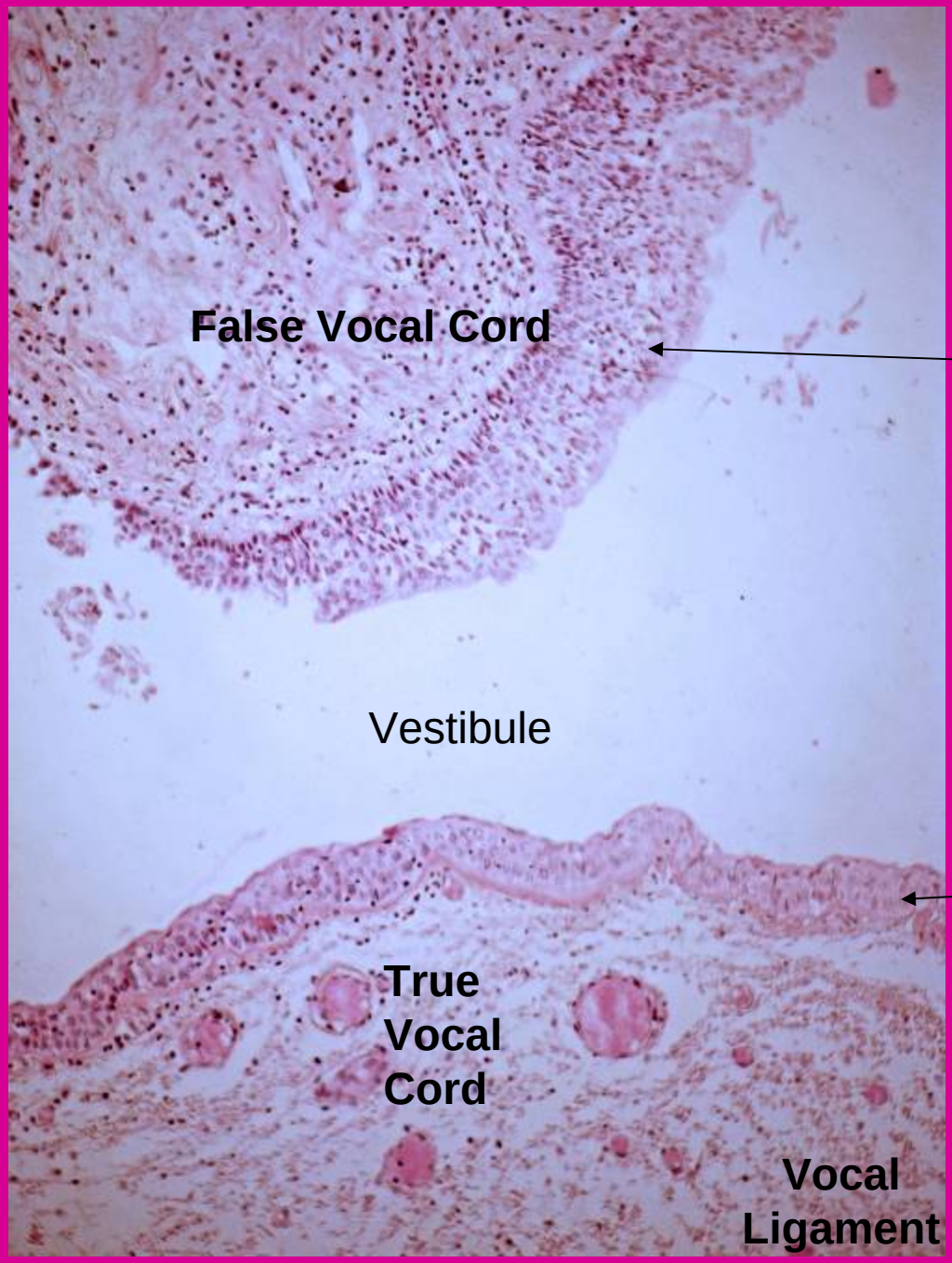

TONGUE
AIR
FOOD
EPIGLOTTIS
FALSE VOCAL FOLD
"VESTIBULE"
TRUE VOCAL CORD/FOLD W/SQUAMOUS EPITHELIUM
GLOTTIS
PYRIFORM RECESS
PHARYNX
ESOPHAGUS
TRACHEA
"CILIATED, PSEUDOSTRATIFIED-COLUMNAR, RESPIRATORY EPITHELIUM"
THE HUMAN LARYNX



C-shaped Cartilage Rings of TRACHEA

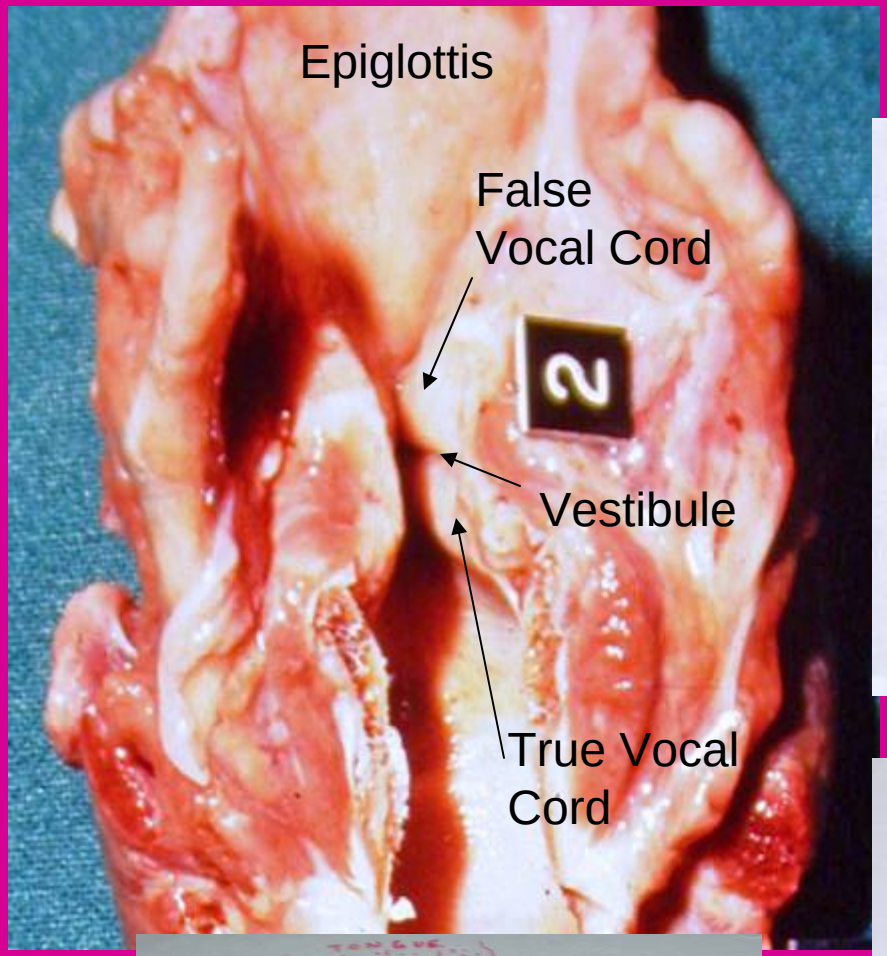

TONGUE
AIR
FOOD
EPIGLOTTIS
GLOTTIS
FALSE VOCAL FOLD
VESTIBULE
TRUE VOCAL CORD/FOLD W/SQUAMOUS EPITHELIUM
PYRIFORM RECESS
PHARYNX
ESOPHAGUS
TRACHEA
"CILIATED, PSEUDOSTRATIFIED-COLUMNAR, RESPIRATORY EPITHELIUM"
THE HUMAN LARYNX

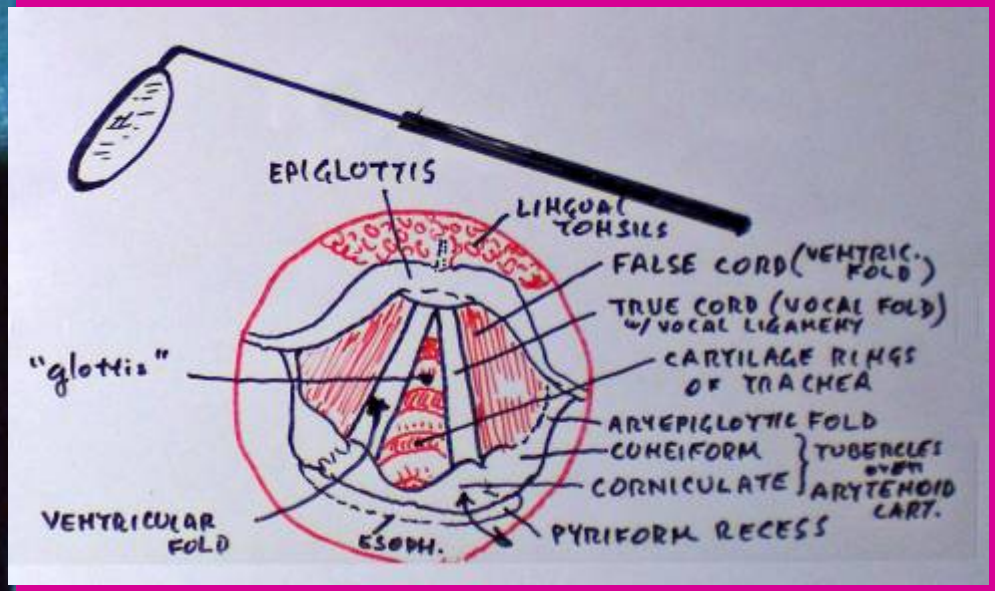

Cart.
False Vocal Cord
Vestibule
True Vocal Cord
Vocal Ligament
Blue is sero-mucous Glands

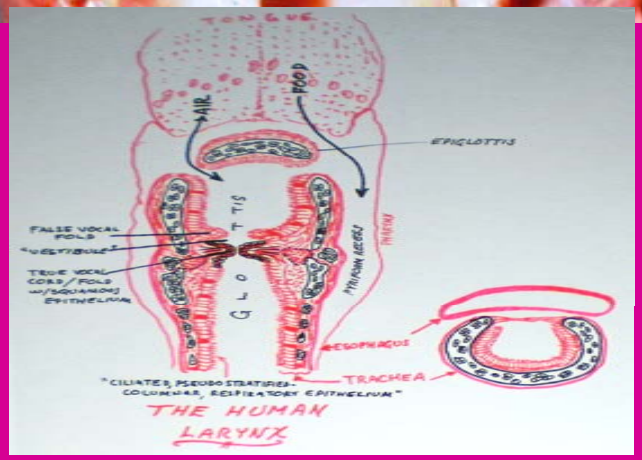


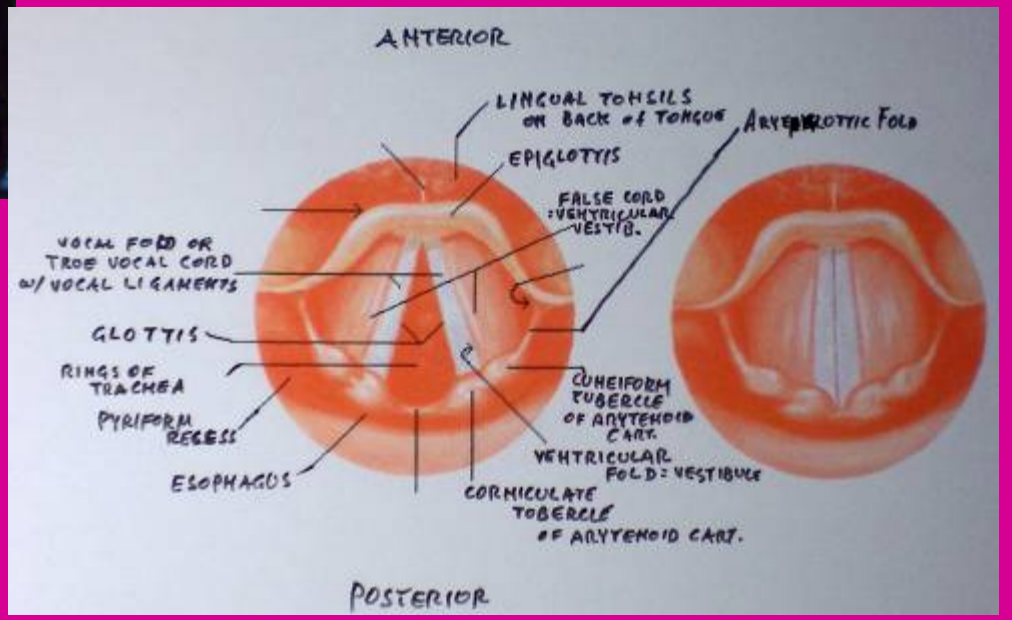
Respiratory Epithelium (Pseudostratified Columnar Ep.)

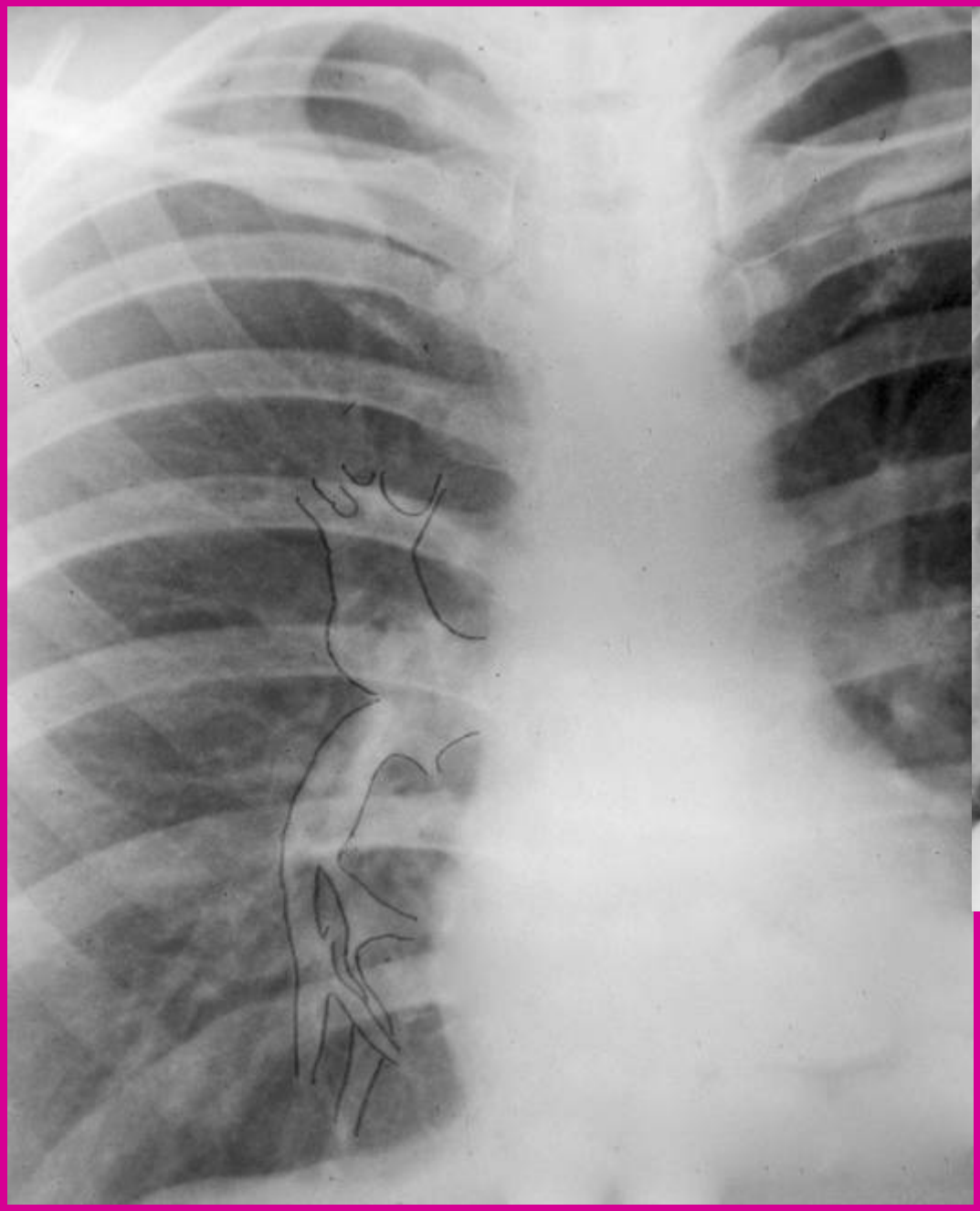
Srtatified Squamous Epithelium


Epiglottis
False
Vocal Cord
2
Vestibule
True Vocal
Cord

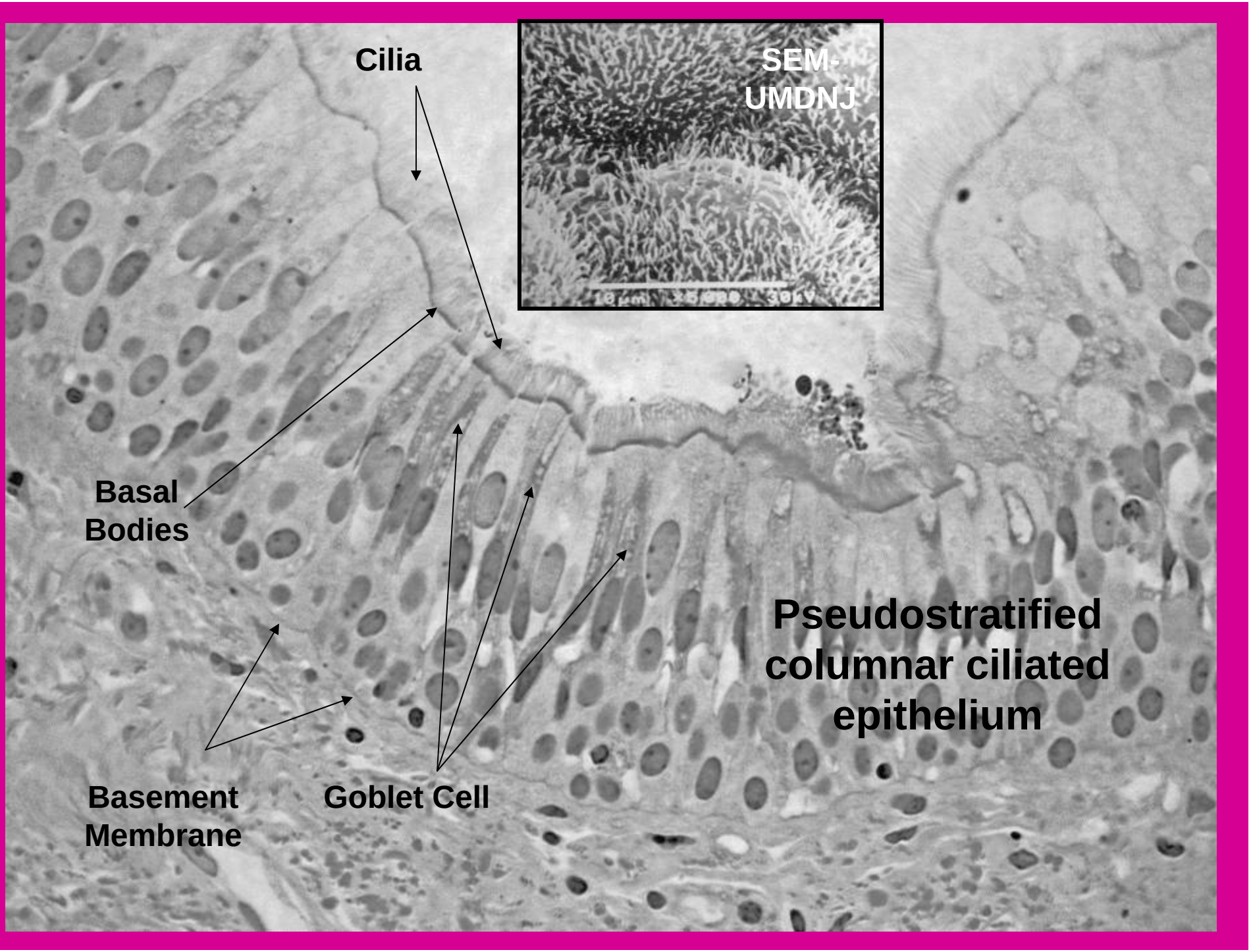

EPIGLOTTIS
LINGUAL TONSILS
FALSE CORD (VENTRIC. FOLD)
TRUE CORD (VOCAL FOLD) w/ VOCAL LIGAMENT
"glottis"
CARTILAGE RINGS OF TRACHEA
ARYEPIGLOTTIC FOLD
CUNEIFORM
CORNICULATE
TUBERCLES OF ARYTENOID CART.
VENTRICULAR FOLD
ESOPH.
PYRIFORM RECESS

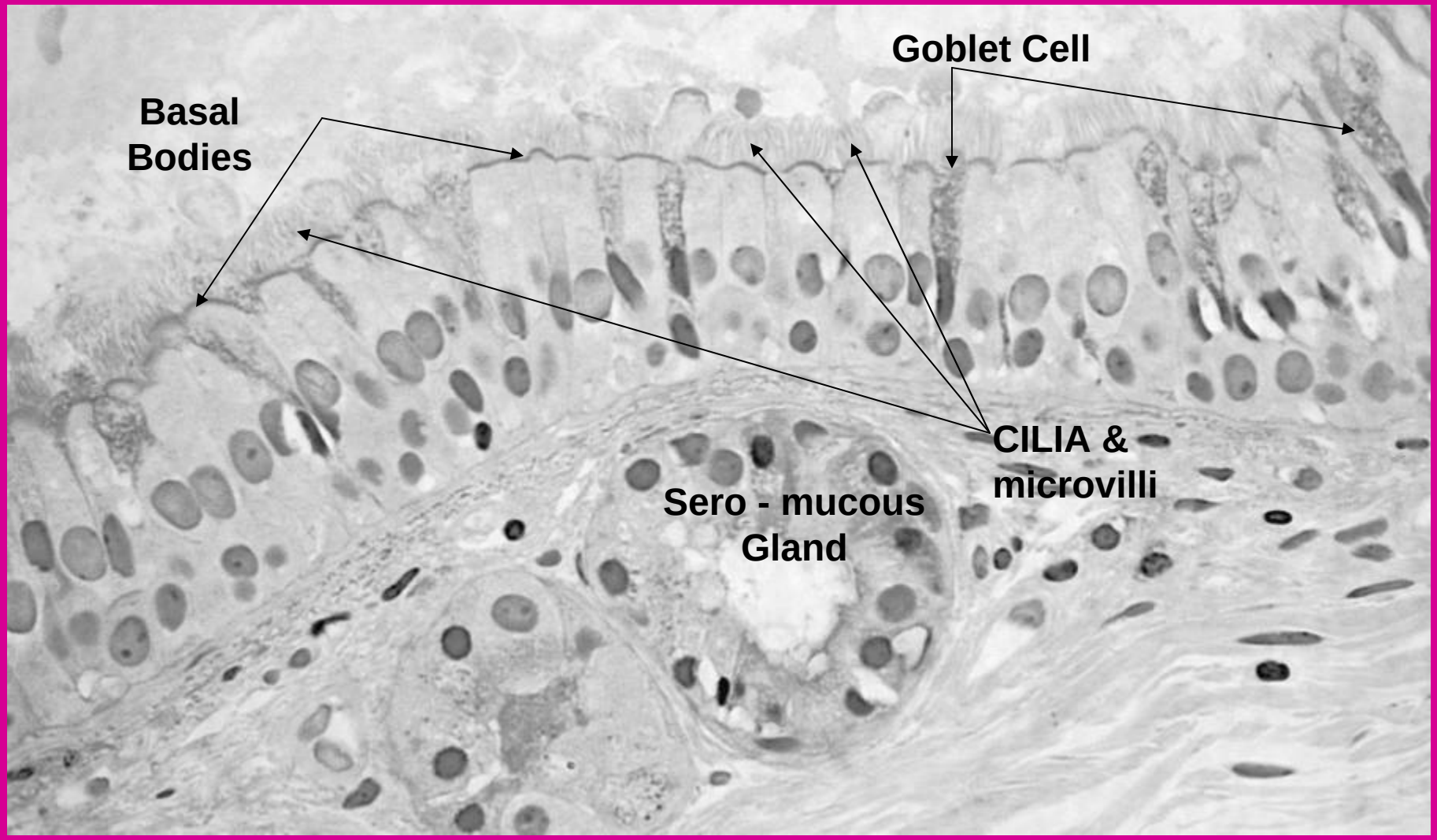

TONGUE
FOOD
AIR
EPIGLOTTIS
GLOTTIS
FALSE VOCAL FOLD
"VESTIBULE"
TRUE VOCAL CORD / FOLD w/ SQUAMOUS EPITHELIUM
PYRIFORM RECESS
ESOPHAGUS
TRACHEA
"CILIATED, PSEUDO STRATIFIED COLUMNAR, RESPIRATORY EPITHELIUM"
THE HUMAN LARYNX

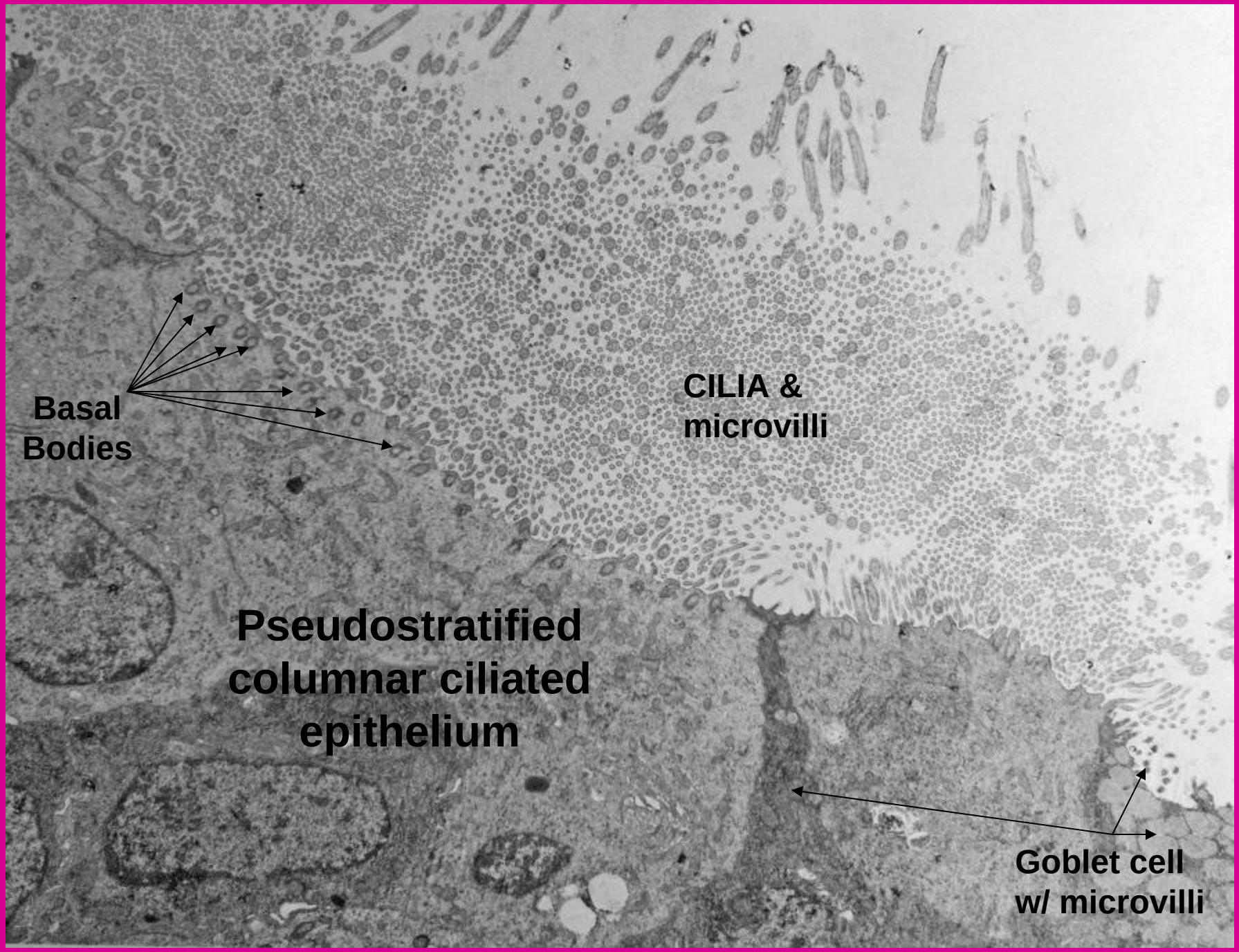

ANTERIOR
LINGUAL TONSILS ON BACK of TONGUE
ARYEPIGLOTTIC FOLD
EPIGLOTTIS
FALSE CORD: VENTRICULAR VESTIB.
VOCAL FOLD OR TRUE VOCAL CORD w/ VOCAL LIGAMENTS
GLOTTIS
RINGS OF TRACHEA
PYRIFORM RECESS
ESOPHAGUS
CUNEIFORM TUBERCLE OF ARYTENOID CART.
VENTRICULAR FOLD: VESTIBULE
CORNICULATE TUBERCLE OF ARYTENOID CART.
POSTERIOR

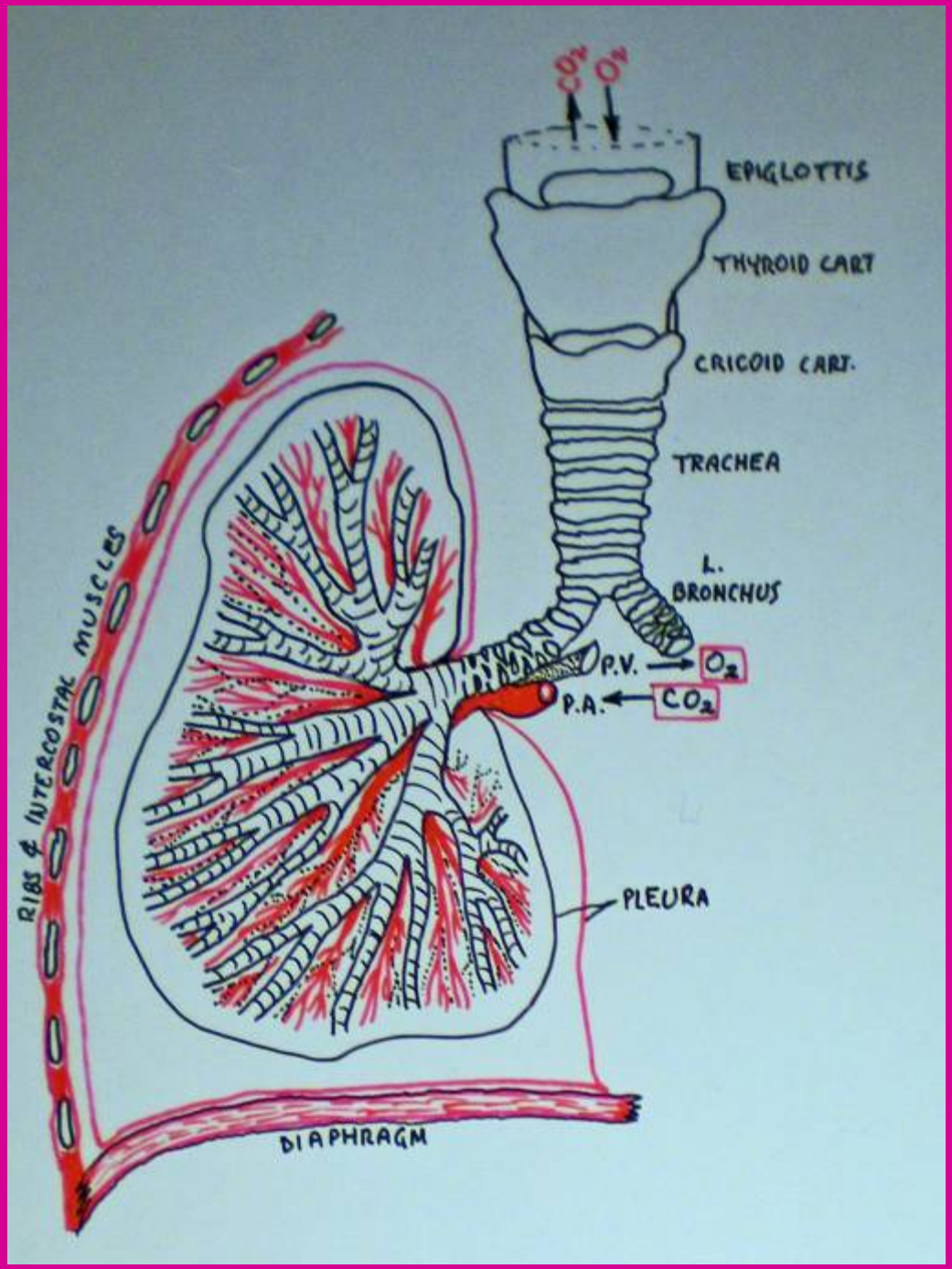


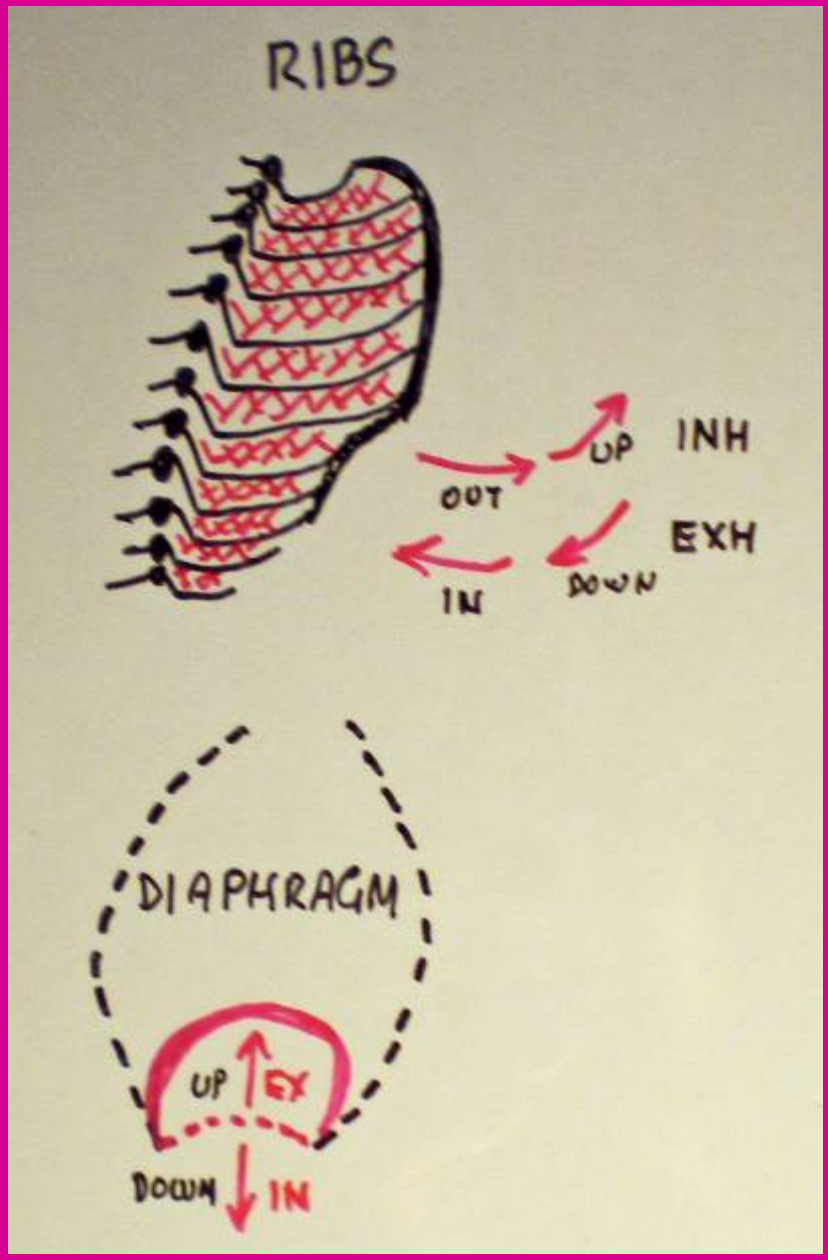
Radiographs
(X Rays)


Cilia
SEM-
UMDNJ
Basal
Bodies
Pseudostratified
columnar ciliated
epithelium
Basement
Membrane
Goblet Cell

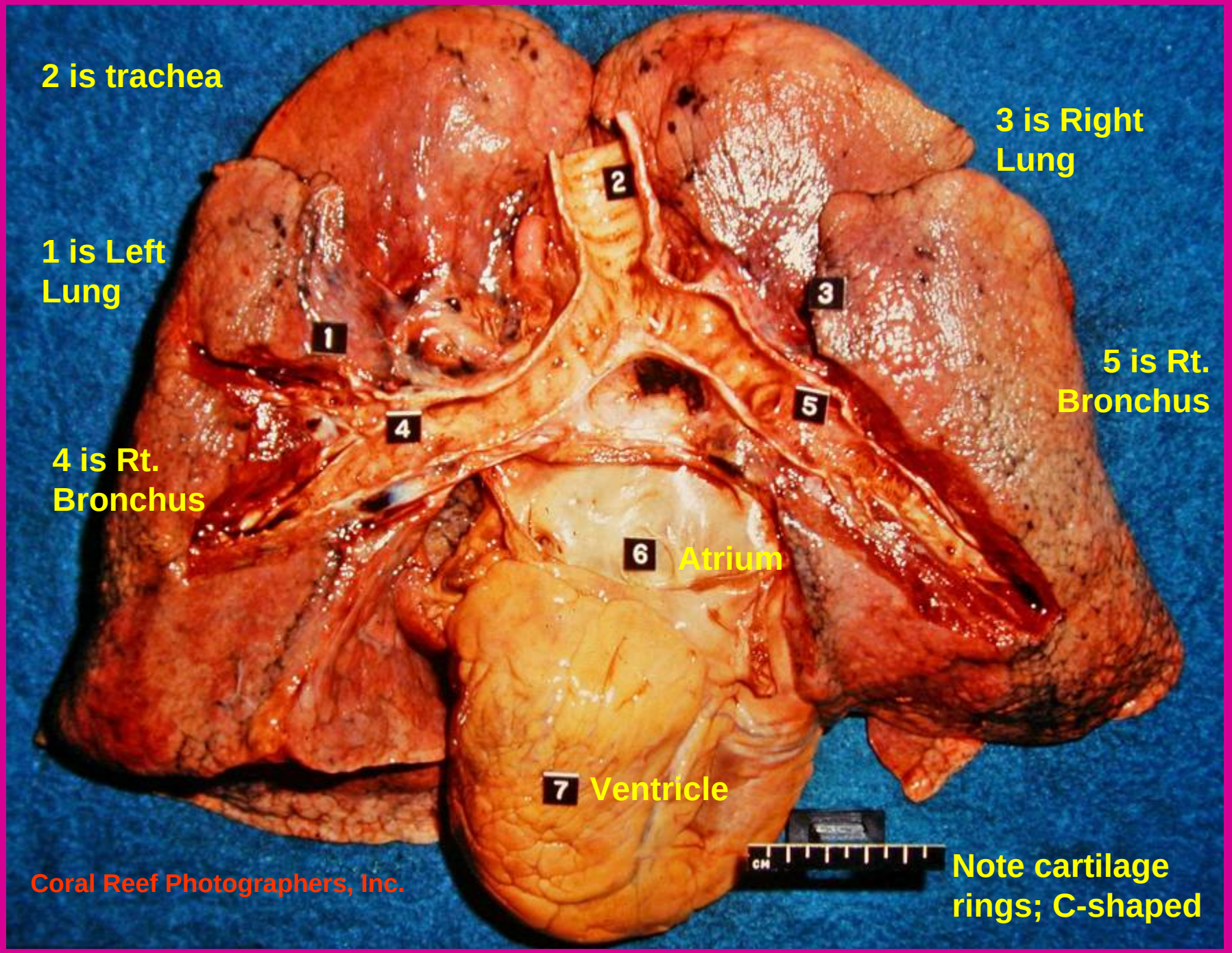

Goblet Cell
Basal Bodies
CILIA & microvilli
Sero - mucous Gland

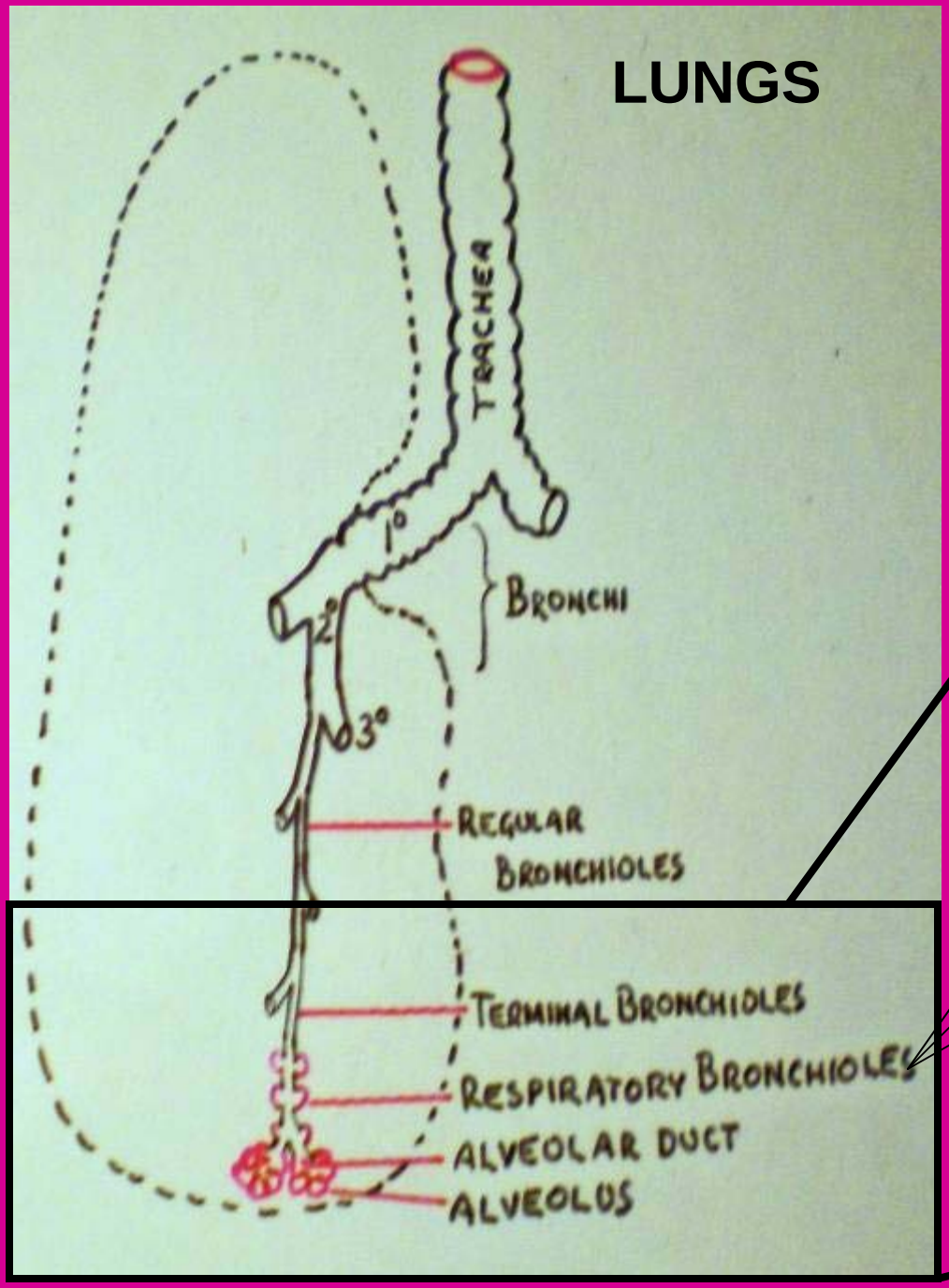

Basal Bodies
CILIA & microvilli
Pseudostratified columnar ciliated epithelium
Goblet cell w/ microvilli



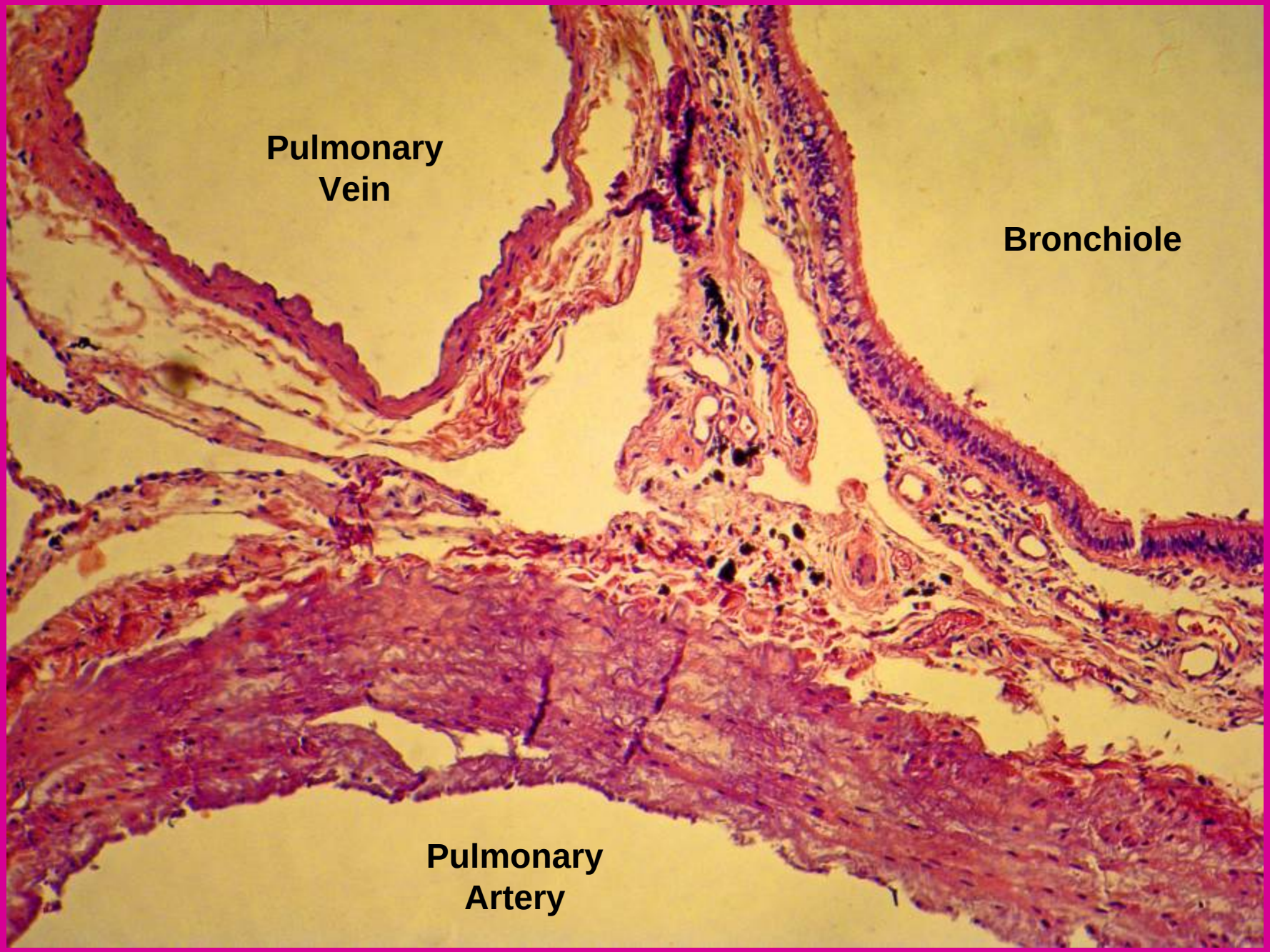


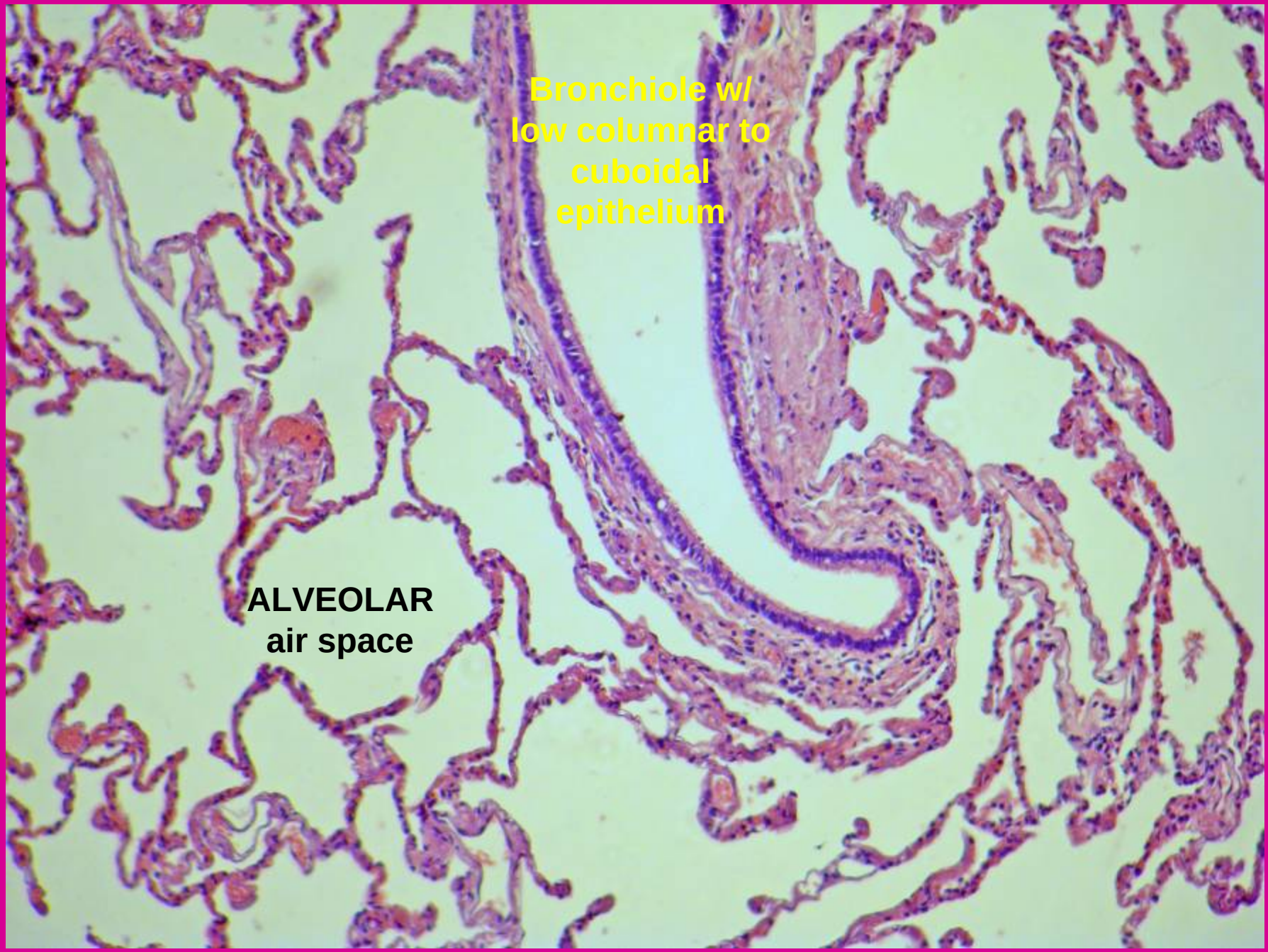
Lung expansion & contraction is passive to ribs and diaphragm

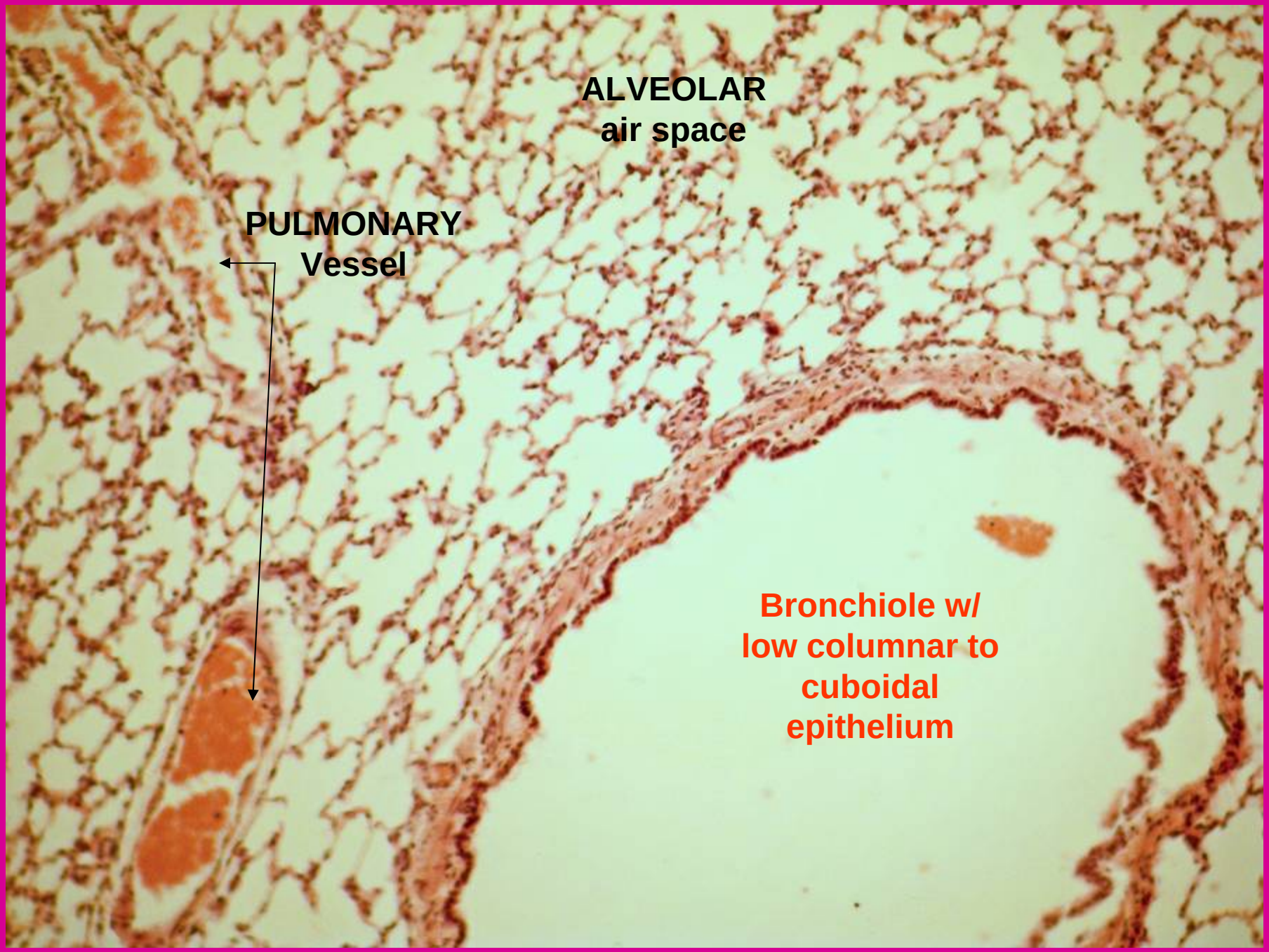

2 is trachea
3 is Right Lung
1 is Left Lung
5 is Rt. Bronchus
4 is Rt. Bronchus
6 Atrium
7 Ventricle
Note cartilage rings; C-shaped
Coral Reef Photographers, Inc.

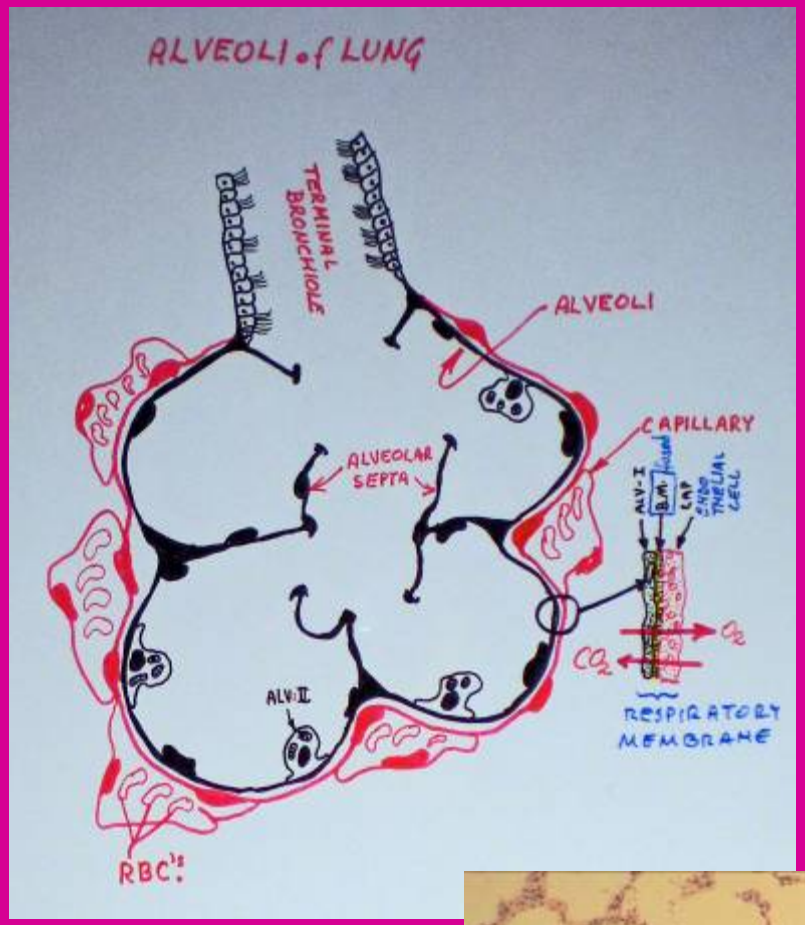

LUNGS
TRACHEA
1°
2°
3°
BRONCHI
REGULAR
BRONCHIOLES
TERMINAL BRONCHIOLES
RESPIRATORY BRONCHIOLES
ALVEOLAR DUCT
ALVEOLUS

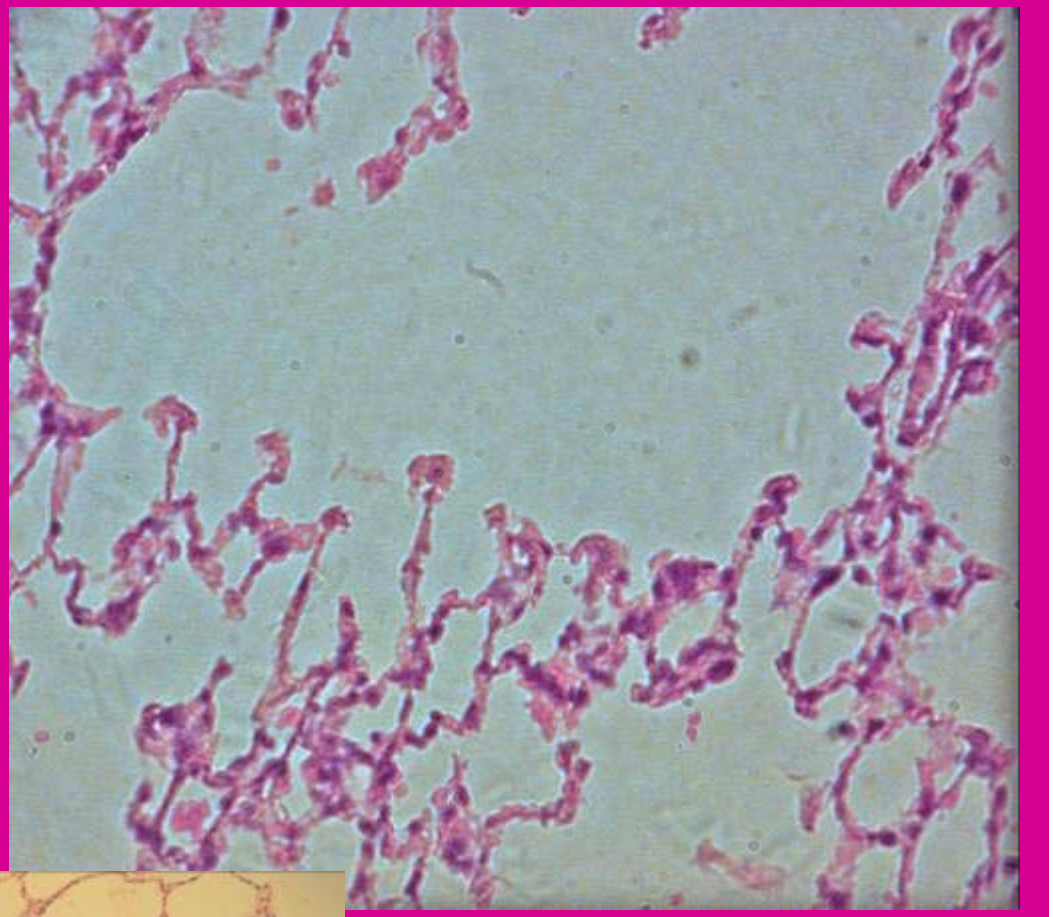

Smooth
muscle

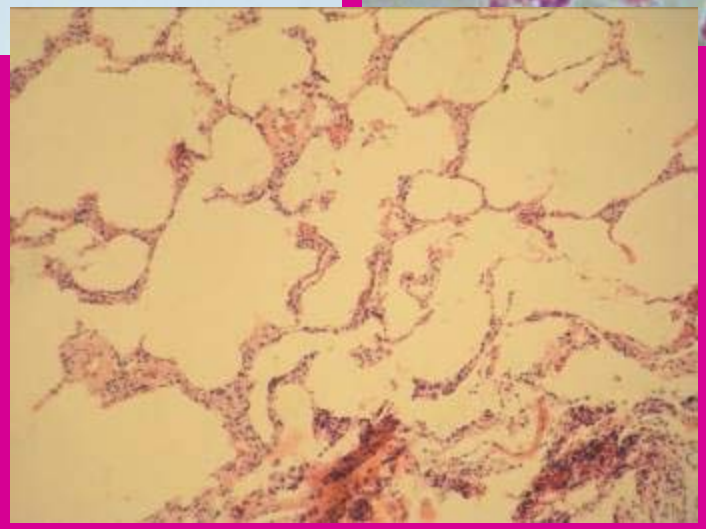

Pulmonary
Vein
Bronchiole
Pulmonary
Artery

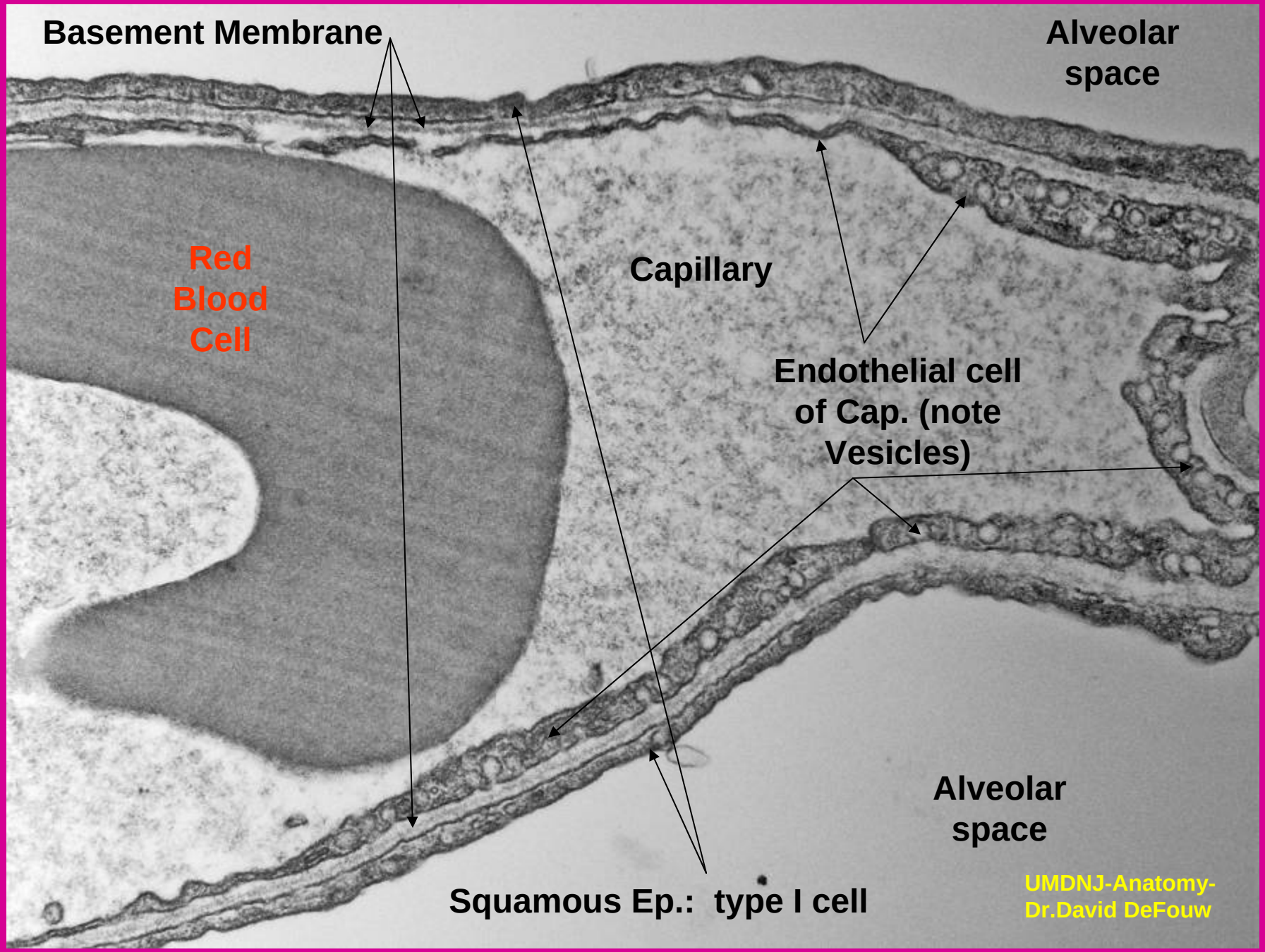

Bronchiole w/
low columnar to
cuboidal
epithelium
ALVEOLAR
air space

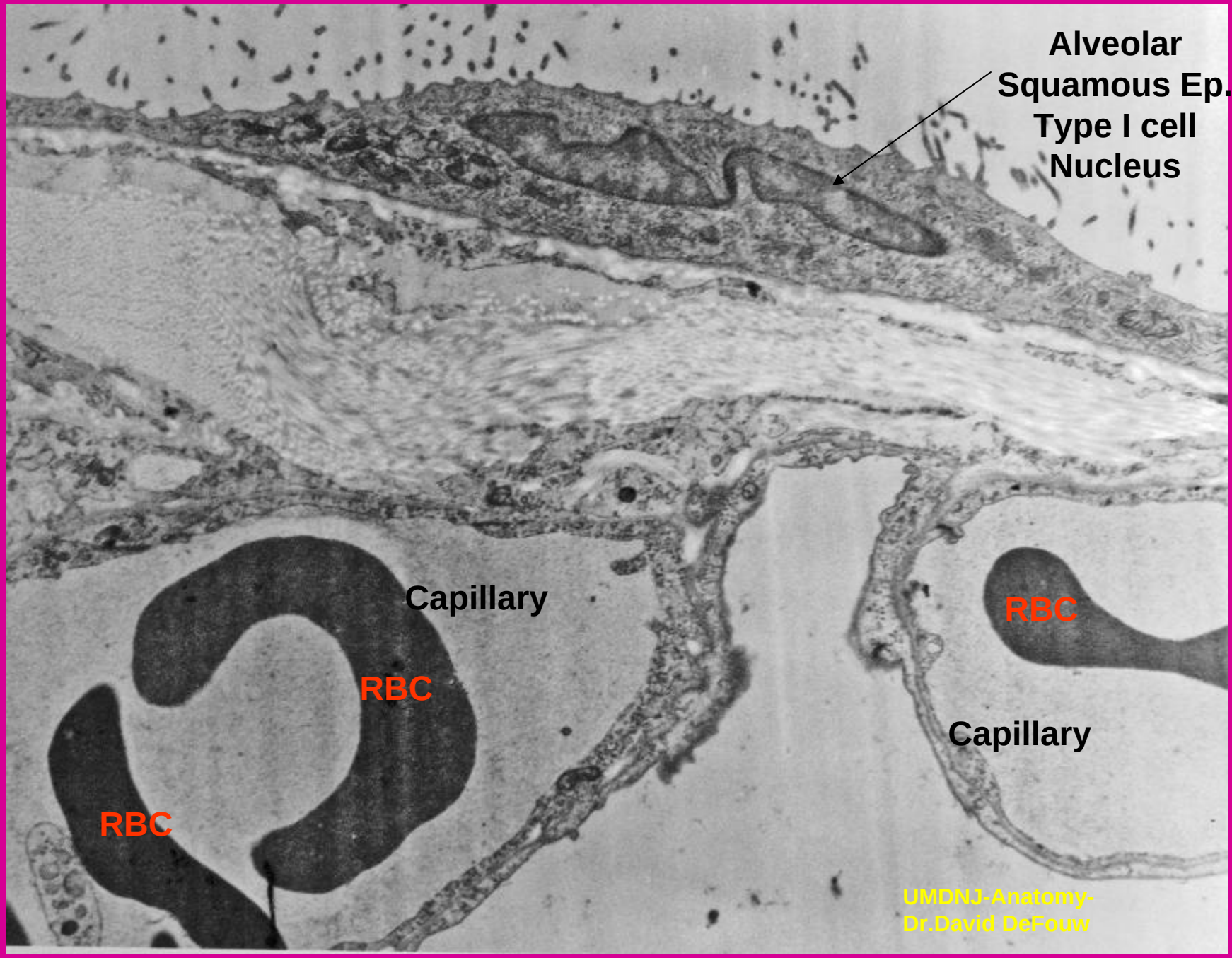

ALVEOLAR
air space
PULMONARY
Vessel
Bronchiole w/
low columnar to
cuboidal
epithelium


ALVEOLI of LUNG
TERMINAL BRONCHIOLE
ALVEOLI
CAPILLARY
ALVEOLAR SEPTA
ALV-I
B.M.
ENDOTHELIAL CELL
O_2
CO_2
ALV-II
RESPIRATORY MEMBRANE
RBC's

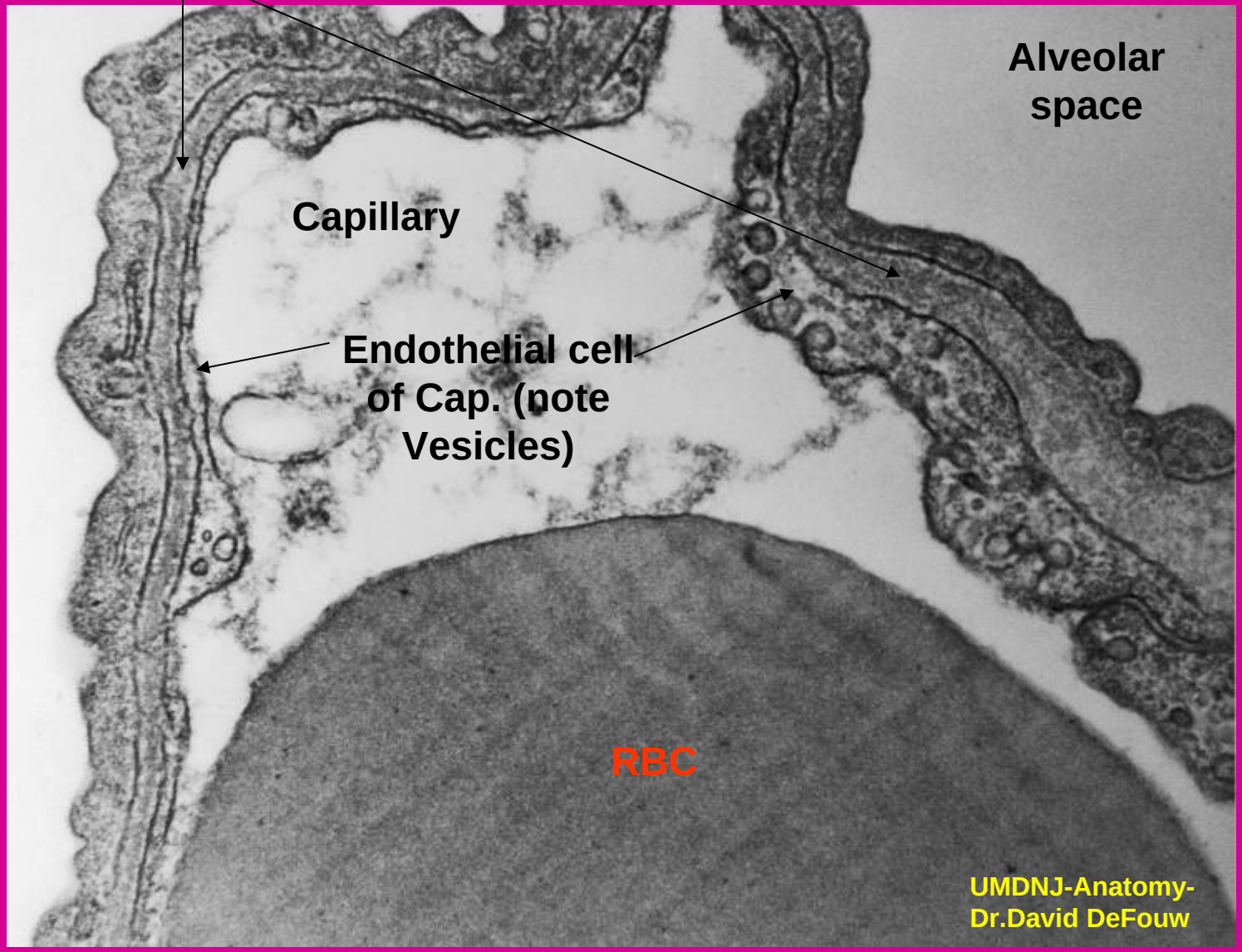


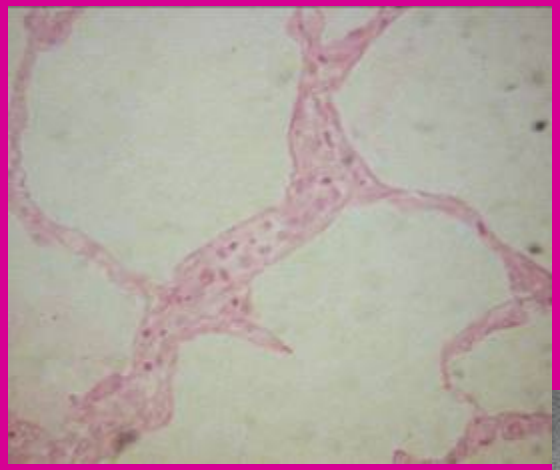



Basement Membrane
Alveolar space
Red Blood Cell
Capillary
Endothelial cell of Cap. (note Vesicles)
Alveolar space
Squamous Ep.: type I cell
UMDNJ-Anatomy-Dr.David DeFouw

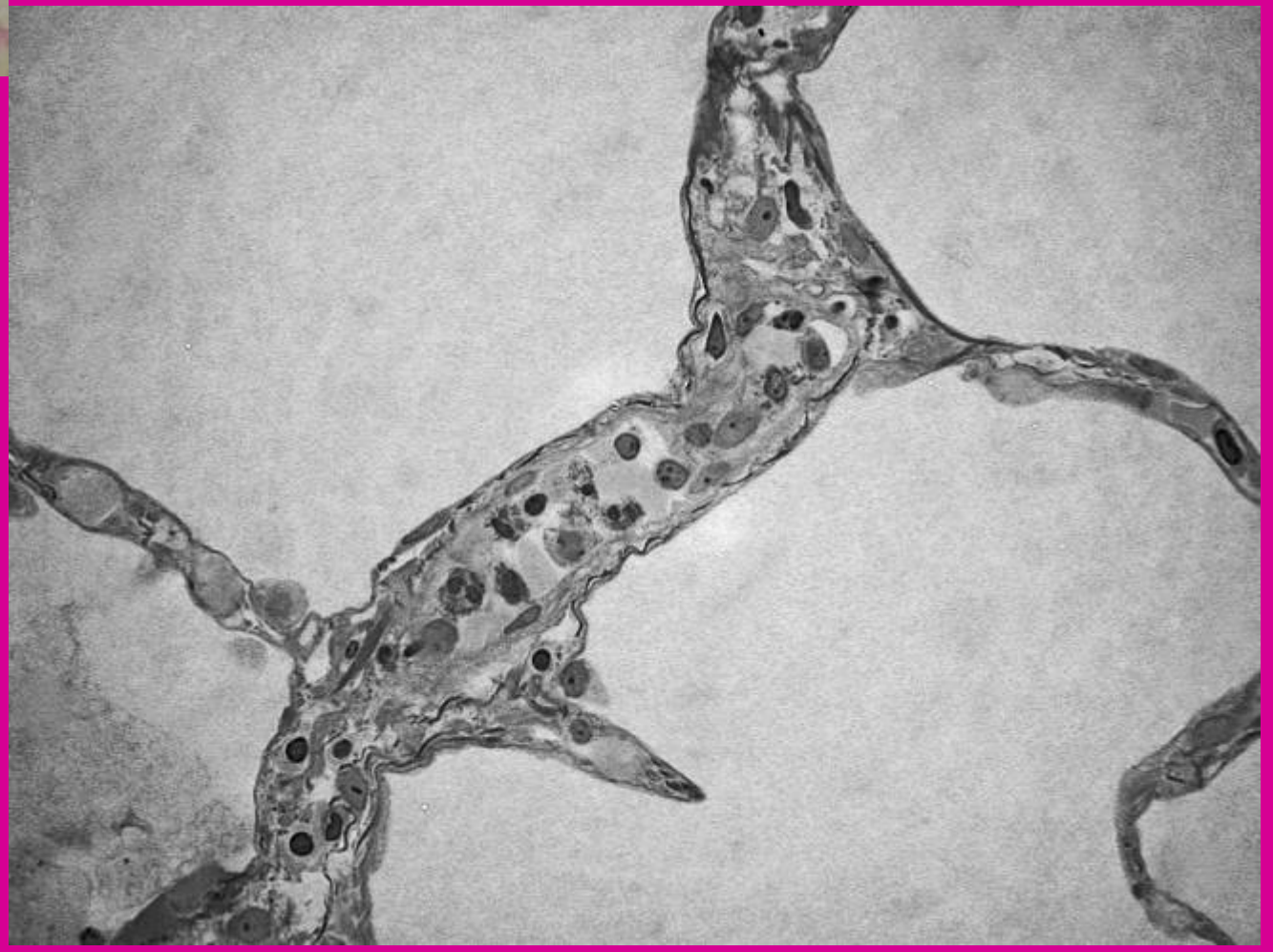

Alveolar
Squamous Ep.
Type I cell
Nucleus
Capillary
RBC
RBC
RBC
Capillary
UMDNJ-Anatomy-
Dr.David DeFouw

Basement Membrane





Alveolar space




Type II cell secreting *surfactant* in multilamellar bodies (a surface tension reducer)

Type II cells secretingsur factant in multilamellar bodies

Capillaries

RBC's

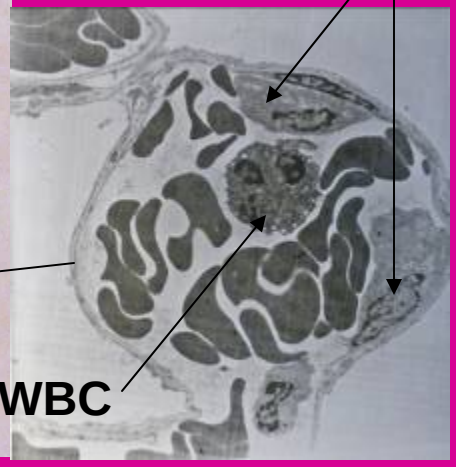
Alveolar Lumen

Nuclei of type I alveolar squamous cell

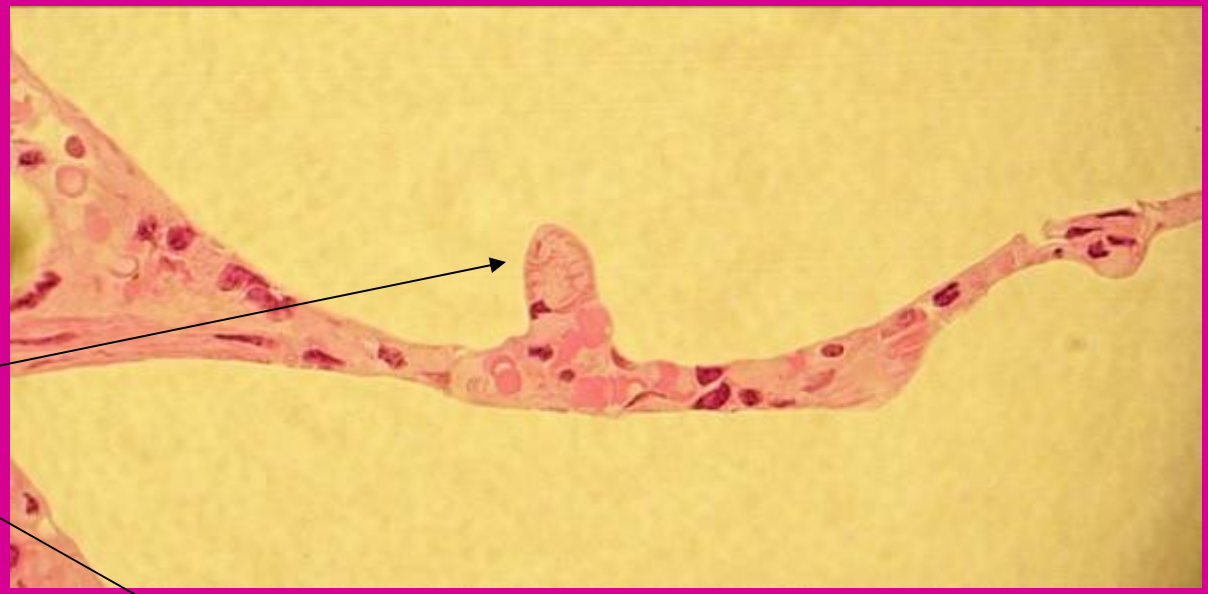
Alveolar details

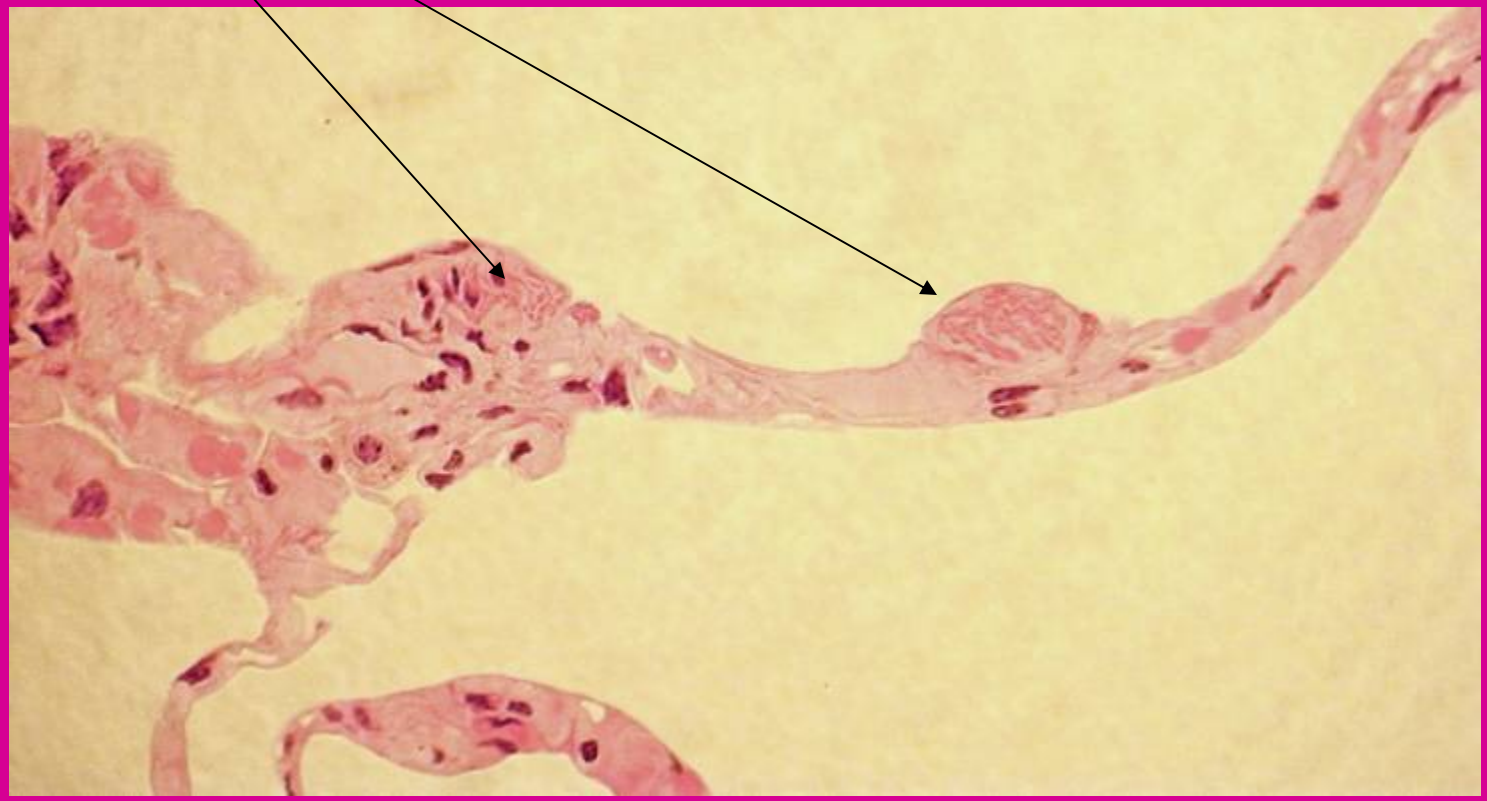
Endothelial cell of Cap.

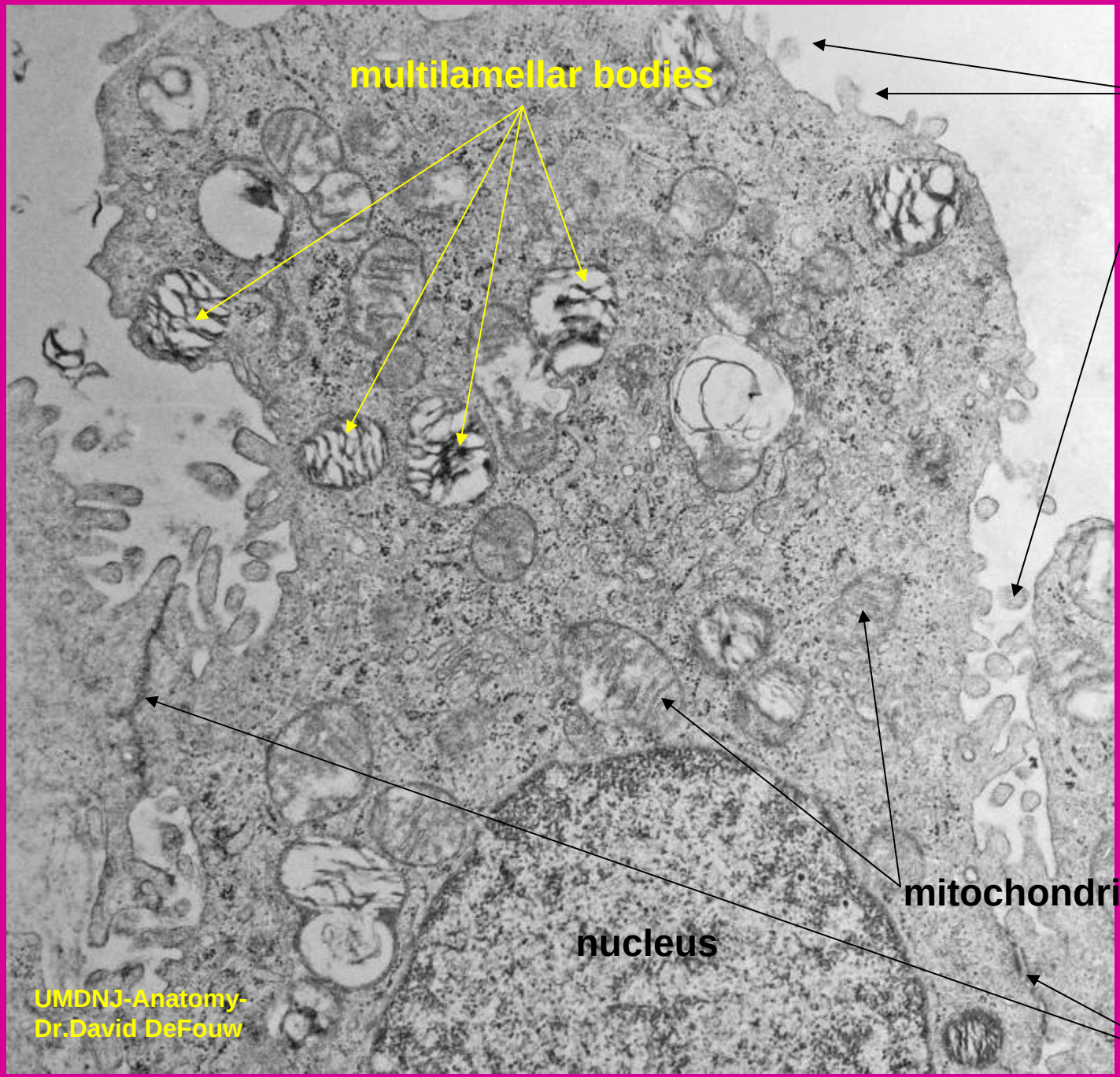
WBC

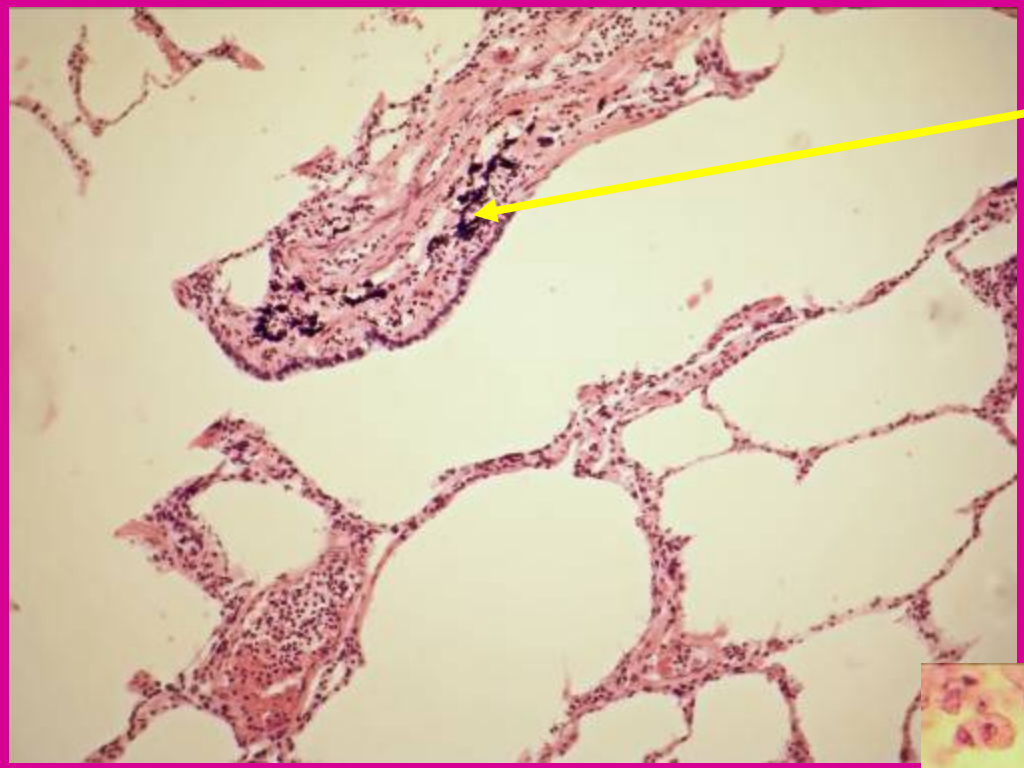


Type II cells secreting surfactant in multilamellar bodies



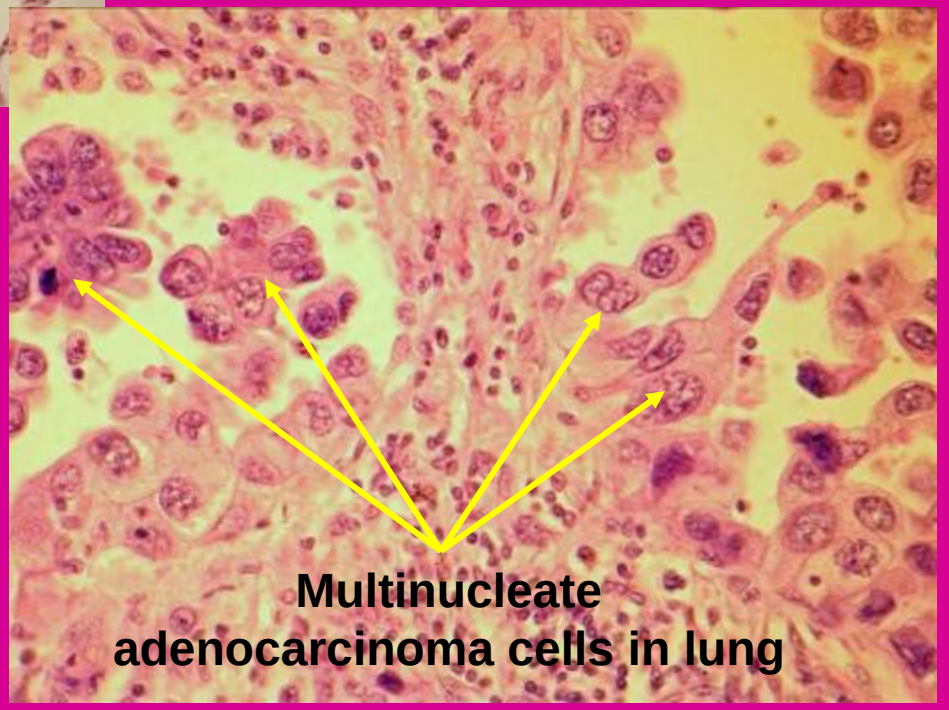



multilamellar bodies
Note short microvilli
Type II cell secreting *surfactant* in multilamellar bodies (a surface tension reducer)
mitochondria
nucleus
Junctional complex: occluding & desmosomal
UMDNJ-Anatomy-
Dr.David DeFouw

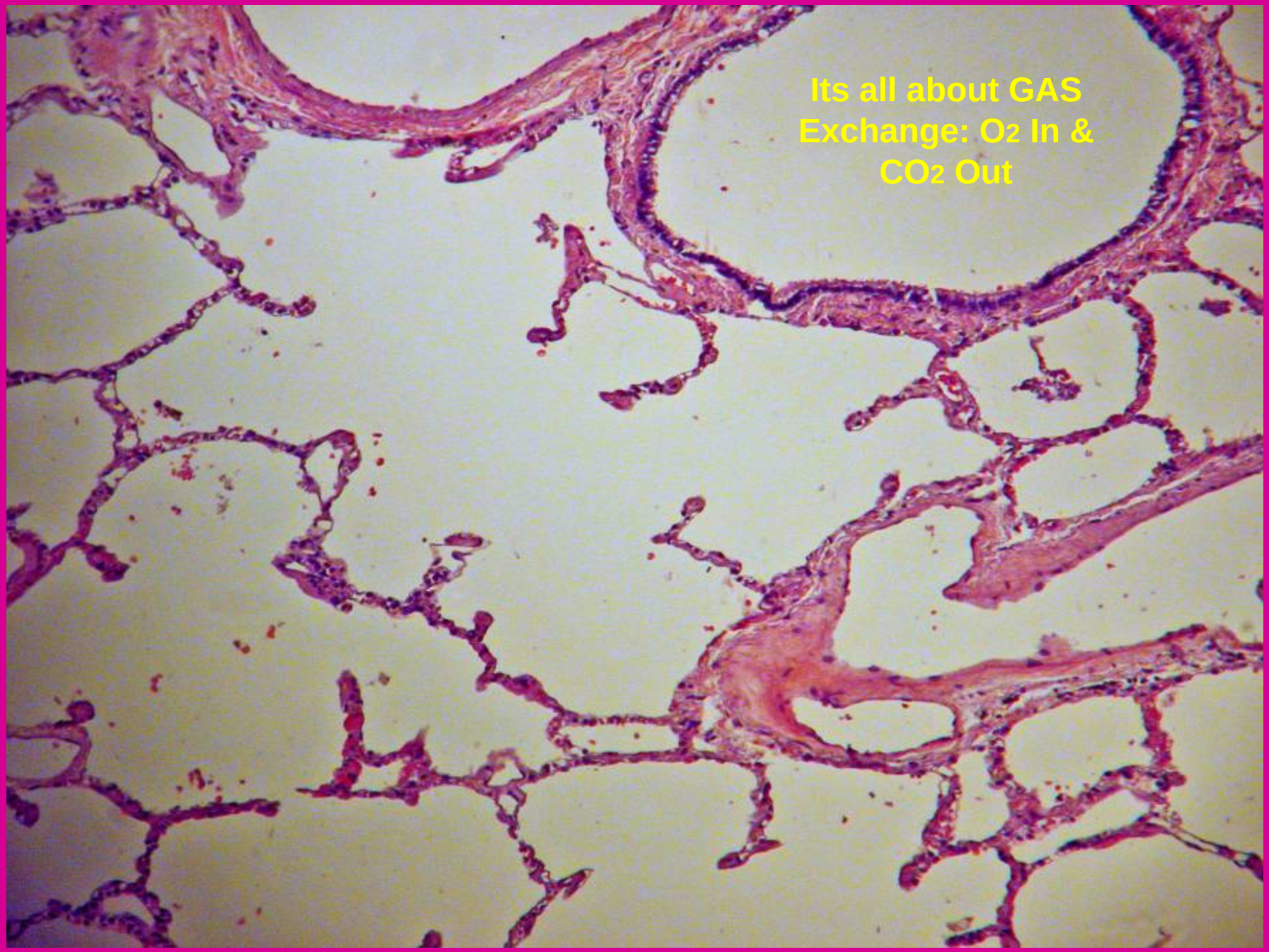


Black carbon particles in smoker's lung

Problems

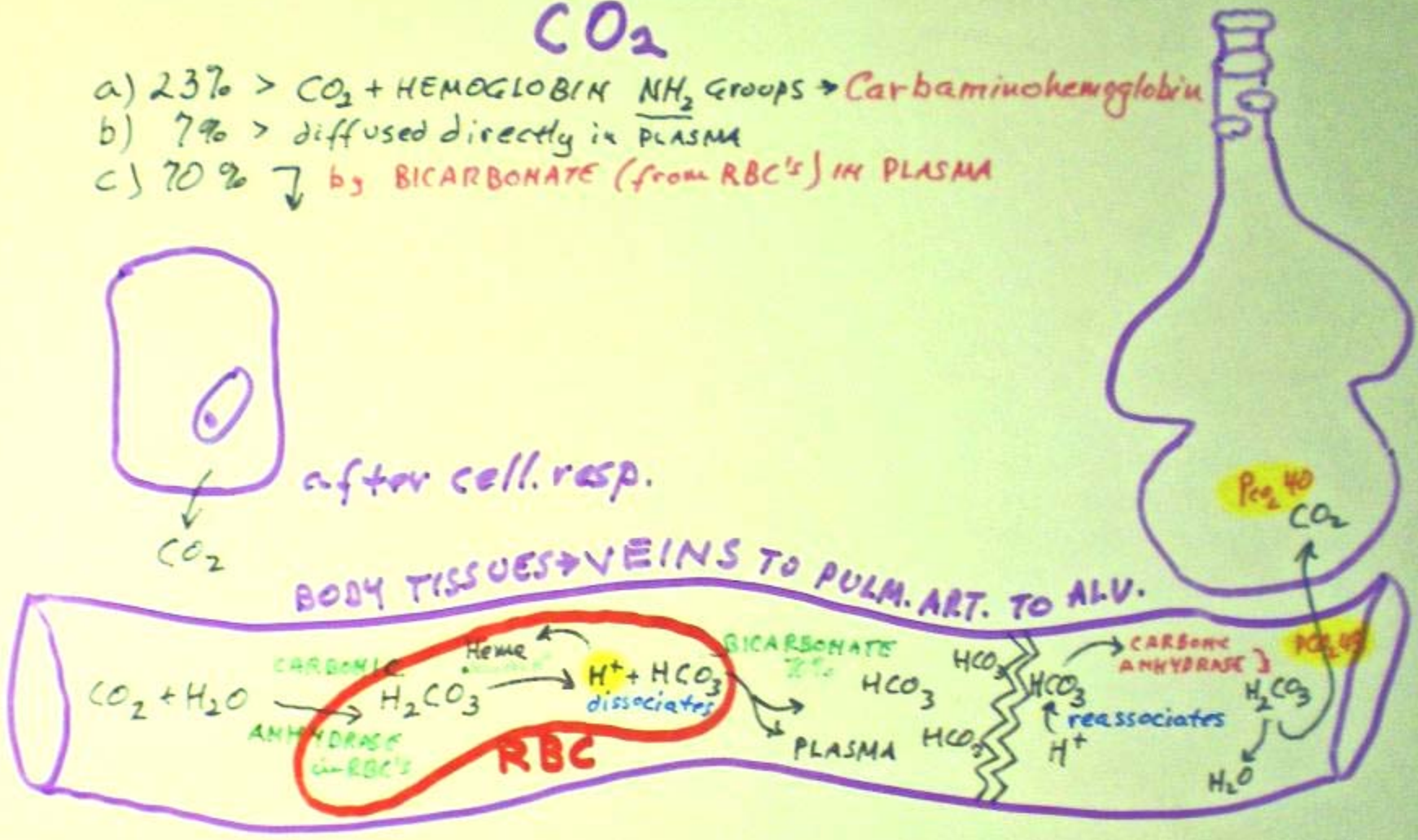


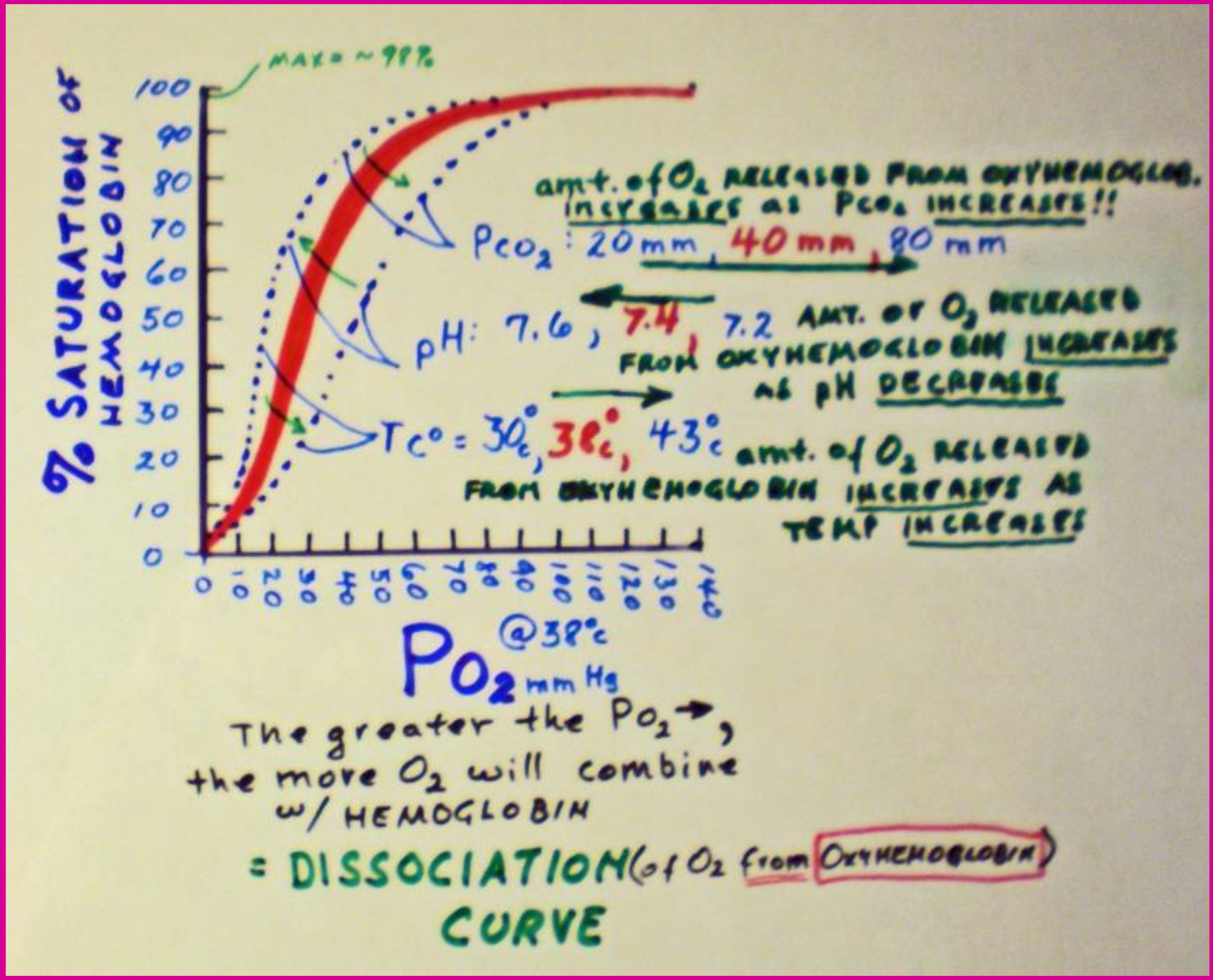
Multinucleate adenocarcinoma cells in lung

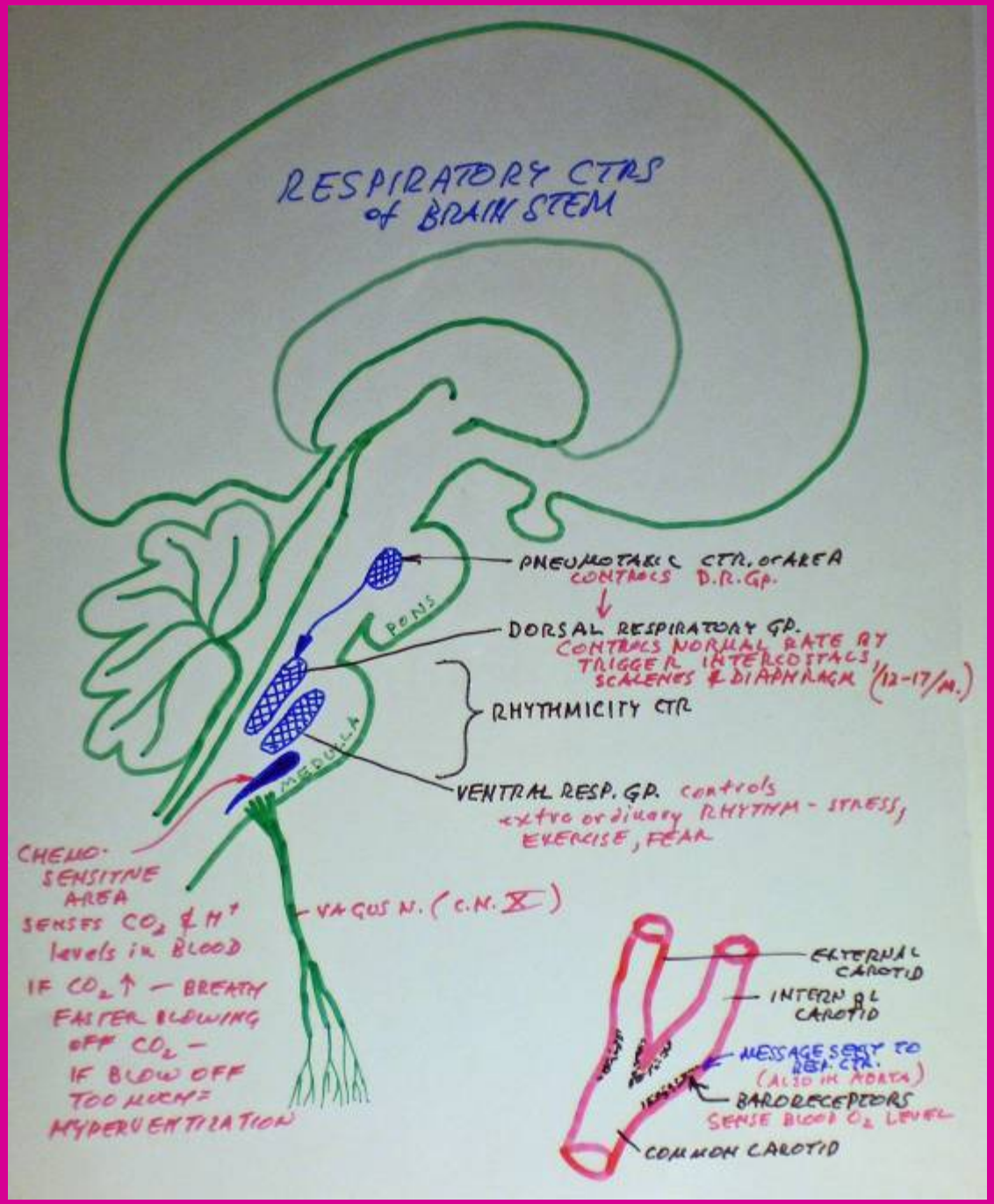

Its all about GAS Exchange: O_2 In & CO_2 Out

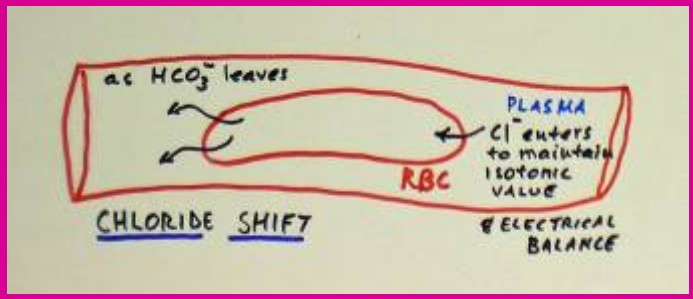
CO_2

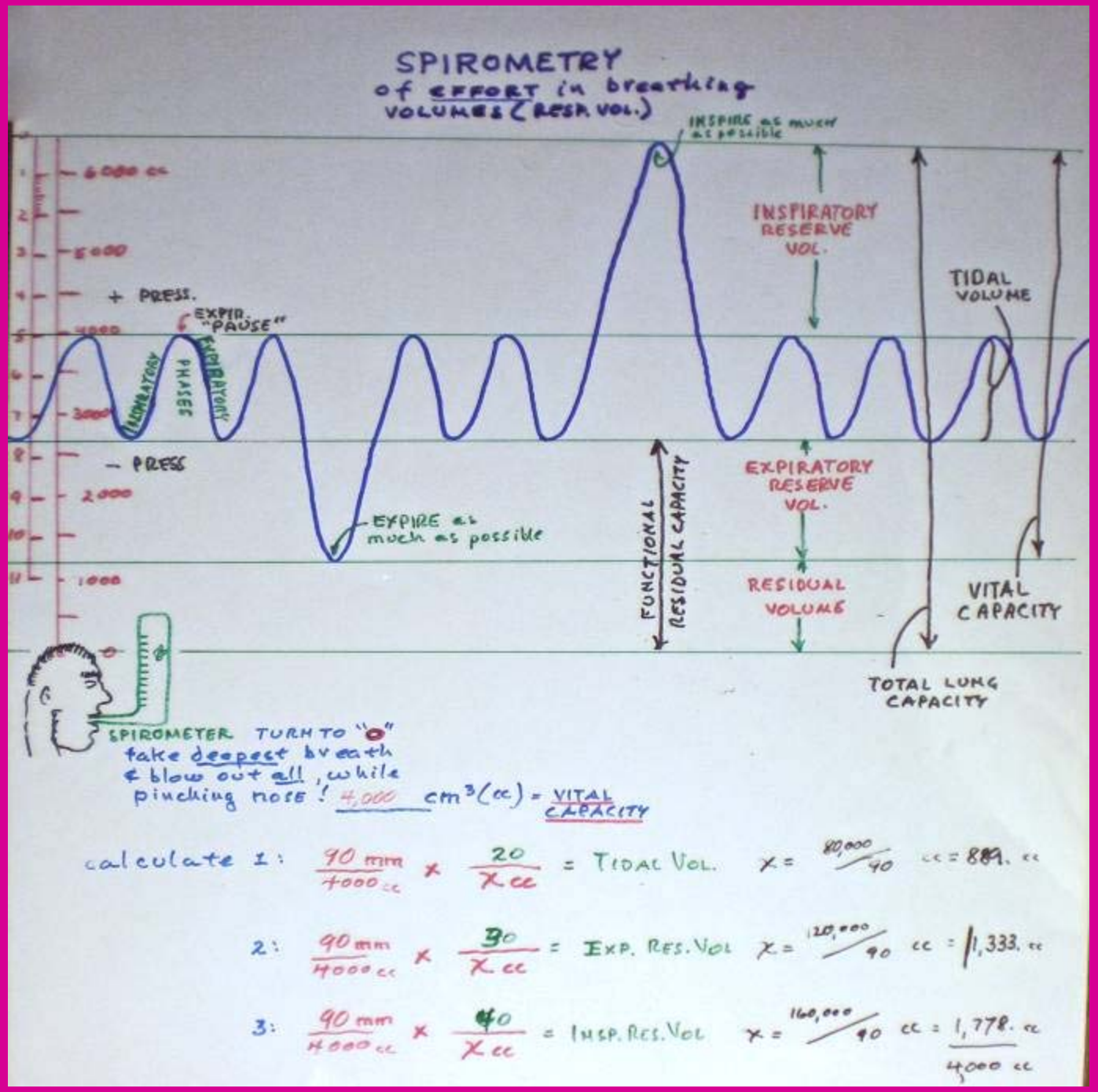
a) 23% > CO_2 + HEMOGLOBIN NH_2 Groups → Carbaminohemoglobin
b) 7% > diffused directly in PLASMA
c) 70% ↘ by BICARBONATE (from RBC's) IN PLASMA

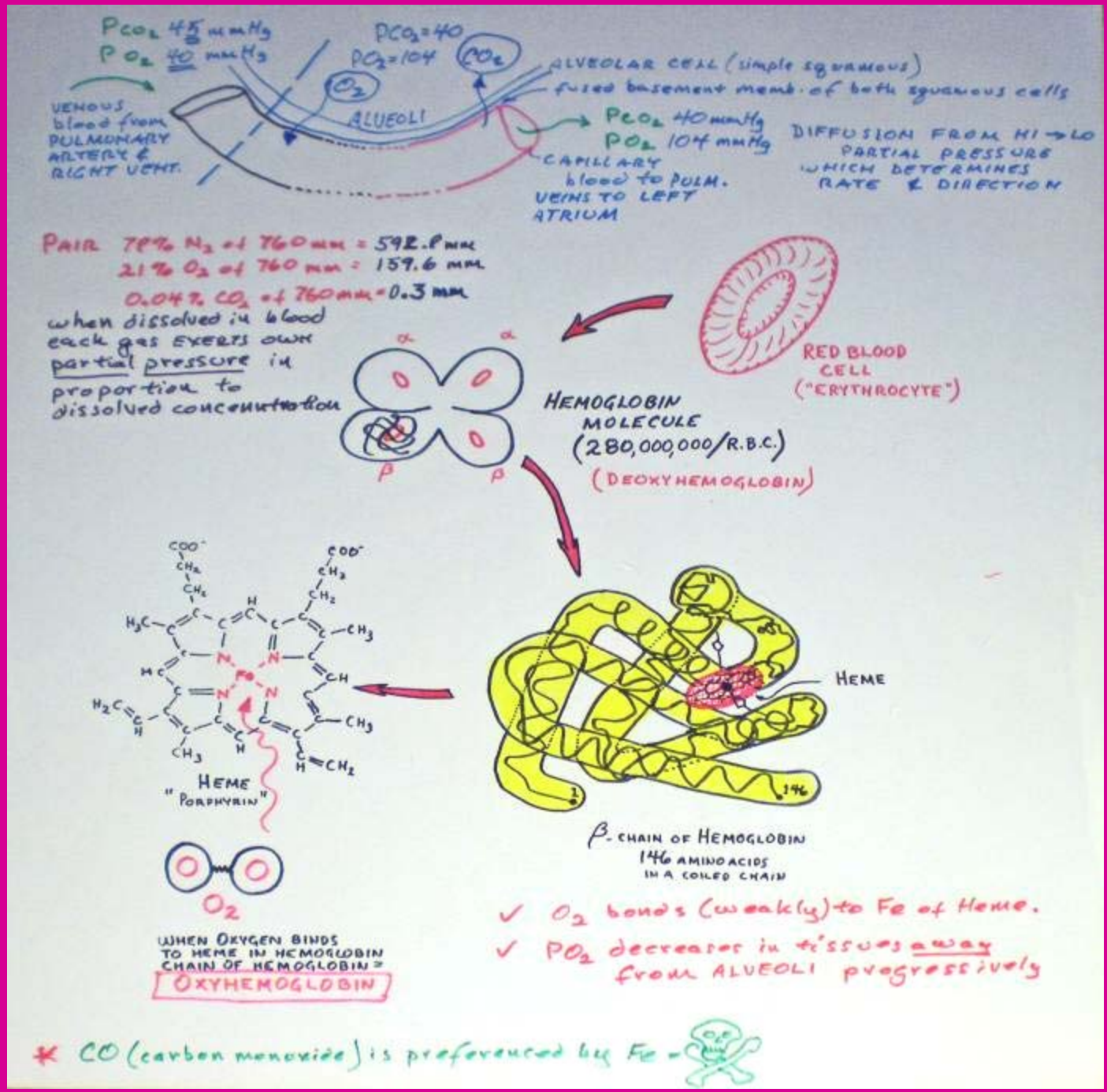



% SATURATION OF HEMOGLOBIN
MAX = ~ 99%
100
90
80
70
60
50
40
30
20
10
0
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140
@38°c
P_{O_2} mm Hg
P_{CO_2} : 20 mm, 40 mm, 80 mm
pH: 7.6, 7.4, 7.2
T C° = 30°c, 38°c, 43°c
amt. of O_2 RELEASED FROM OXYHEMOGLOB. INCREASES as P_{CO_2} INCREASES!!
AMT. OF O_2 RELEASED FROM OXYHEMOGLOBIN INCREASES AS pH DECREASES
amt. of O_2 RELEASED FROM OXYHEMOGLOBIN INCREASES AS TEMP INCREASES
The greater the P_{O_2} →, the more O_2 will combine w/ HEMOGLOBIN
= DISSOCIATION (of O_2 from OXYHEMOGLOBIN) CURVE


RESPIRATORY CTRS of BRAIN STEM
PONS
MEDULLA
PNEUMOTAXIC CTR. or AREA CONTROLS D.R.GP.
DORSAL RESPIRATORY GP. CONTROLS NORMAL RATE BY TRIGGER INTERCOSTALS SCALENES & DIAPHRAGM (12-17/M.)
RHYTHMICITY CTR
VENTRAL RESP. GP. controls extraordinary RHYTHM - STRESS, EXERCISE, FEAR
CHEMO-SENSITIVE AREA SENSES CO_2 & H^+ levels in BLOOD
IF CO_2 ↑ — BREATH FASTER BLOWING OFF CO_2 — IF BLOW OFF TOO MUCH = HYPERVENTILATION
VAGUS N. (C.N. X)
EXTERNAL CAROTID
INTERNAL CAROTID
MESSAGE SENT TO RES. CTR. (ALSO IN AORTA)
BARORECEPTORS SENSE BLOOD O_2 LEVEL
COMMON CAROTID


as HCO_3^- leaves
PLASMA
Cl^- enters to maintain isotonic value
RBC
CHLORIDE SHIFT
& ELECTRICAL BALANCE


SPIROMETRY
of EFFORT in breathing
VOLUMES (RESP. VOL.)
INSPIRE as much as possible
INSPIRATORY RESERVE VOL.
TIDAL VOLUME
+ PRESS.
EXPIR. "PAUSE"
INSPIRATORY PHASE
EXPIRATORY PHASE
- PRESS
EXPIRE as much as possible
FUNCTIONAL RESIDUAL CAPACITY
EXPIRATORY RESERVE VOL.
RESIDUAL VOLUME
VITAL CAPACITY
TOTAL LUNG CAPACITY
SPIROMETER TURN TO "0"
take deepest breath & blow out all, while pinching nose! 4,000 cm³(cc) = VITAL CAPACITY
calculate 1: 90 mm / 4000 cc × 20 / X cc = TIDAL VOL. X = 80,000 / 90 cc = 889. cc
2: 90 mm / 4000 cc × 30 / X cc = EXP. RES. VOL X = 120,000 / 90 cc = 1,333. cc
3: 90 mm / 4000 cc × 40 / X cc = INSP. RES. VOL X = 160,000 / 90 cc = 1,778. cc
4,000 cc


P_{CO_2} 45 mm Hg
P_{O_2} 40 mm Hg
P_{CO_2}=40
P_{O_2}=104
P_{O_2}
ALVEOLAR CELL (simple squamous)
fused basement memb. of both squamous cells
ALVEOLI
VENOUS blood from PULMONARY ARTERY & RIGHT VENT.
P_{CO_2} 40 mm Hg
P_{O_2} 104 mm Hg
CAPILLARY blood to PULM. VEINS TO LEFT ATRIUM
DIFFUSION FROM HI → LO PARTIAL PRESSURE WHICH DETERMINES RATE & DIRECTION
PAIR 78% N_2 of 760 mm = 592.8 mm
21% O_2 of 760 mm = 159.6 mm
0.04% CO_2 of 760 mm = 0.3 mm
when dissolved in blood each gas EXERTS own partial pressure in proportion to dissolved concentration
α α β β
RED BLOOD CELL ("ERYTHROCYTE")
HEMOGLOBIN MOLECULE (280,000,000/R.B.C.)
(DEOXYHEMOGLOBIN)
HEME
HEME "PORPHYRIN"
O_2
WHEN OXYGEN BINDS TO HEME IN HEMOGLOBIN CHAIN OF HEMOGLOBIN =
OXYHEMOGLOBIN
1
146
β-CHAIN OF HEMOGLOBIN 146 AMINOACIDS IN A COILED CHAIN
✓ O_2 bonds (weakly) to Fe of Heme.
✓ PO_2 decreases in tissues away from ALVEOLI progressively
* CO (carbon monoxide) is preferenced by Fe -